EVOLUTIONARY ETHICS: ITS ORIGINS AND CONTEMPORARY FACE

by Paul Thompson

Abstract. The development of modern evolutionary ethics began shortly after the publication of Charles Darwin's *On the Origin of Species by Natural Selection*. Early discussions were plagued by several problems. First, evolutionary ethical explanations were dependent on group-selection accounts of social behavior (especially the explanation of altruism). Second, they seem to violate the philosophical principle that "ought" statements cannot be derived from "is" statements alone (values cannot be derived from facts alone). Third, evolutionary ethics appeared to be biologically deterministic, deemed incompatible with the free will required for ethics to be possible. Fourth, social policies based on evolutionary theory (for example, eugenics in the early part of this century) seemed patently unethical. Sociobiology (which coalesced as a field of study with Edward O. Wilson's *Sociobiology: The New Synthesis*, 1975) addressed several of these problems and provided a rich framework and a new impetus for evolutionary ethics. The lingering problems were the philosophical is-ought barrier and biological determinism. After tracing the early and more recent development of evolutionary ethics, I argue that the remaining problems can be surmounted and an incipient evolutionary ethics can be defended. Thoroughgoing evolutionary ethics must await theoretical developments in neurobiology and cognitive science.

Keywords: biology of morality; ethics; evolution; evolutionary ethics; morality, naturalistic fallacy; sociobiology.

Paul Thompson is Professor of Biology and Philosophy at the University of Toronto at Scarborough, Scarborough, Ontario M1C 1A4, Canada. This paper was delivered at the Forty-fourth annual meeting of the Institute on Religion in an Age of Science, Star Island, New Hampshire, 26 July–2 August 1997.

[*Zygon*, vol. 34, no. 3 (September 1999).]

THE EARLY PERIOD

The modern conception of evolutionary ethics had its inception in the period immediately following the publication of *On the Origin of Species* by Charles Darwin in 1859. This landmark work in biological research and theorizing provided an entirely new framework within which to consider human origins, human behavior, and social policy. Much of the specific early work on human behavior and social policy had been rejected long before the present. Some aspects of it, for example eugenics, have been almost completely out of favor for the last fifty years (although no one should be under the illusion that eugenics does not still have champions and is no longer being implemented). The relevance of evolutionary theory to human behavior and to the understanding of social structures and the policies required to underpin them, however, still seems undeniable. The central questions are (1) What is the scope and nature of that relevance? (2) Is ethics in important respects independent of the evolutionary history of humans? and (3) What role does cognition play in ethics?

The Biological Thesis of the Origin of Species. In *On the Origin of Species*, Darwin resisted speculating on the implications of his evolutionary theory for human morality. His main focus was on the wealth of evidence he had amassed in favor of evolution and on his mechanism of evolution. Although his mechanism is frequently reduced by others to "natural selection," both in *On the Origin of Species* and in his later writings Darwin put forward a theory that was far richer than natural selection alone. Indeed, Darwin was well aware that evolution requires other key elements. For example, one of the key arguments of *On the Origin of Species* is that species are mutable. Darwin understood that the mutability of species is fundamental to evolution. As many creationists from Darwin's time to the present have pointed out, natural selection may act to favor one phenotype of a species over another, but unless species boundaries are able to be crossed, natural selection will not produce a new species. It will merely alter genotype frequencies *within a species.* Creationists, of course, claim that the species boundary is impermeable; hence, whatever change natural selection may be able to bring about *within a species*, it cannot create a new species.

Darwin meets this issue head on in *On the Origin of Species*. In the first three chapters, he argues at length that the concept of a species is artificial. For him, the organic world consists of an insensible series of organic lineages in which some varieties within a species differ more from each other than from the members of other species. In effect, Darwin argued that the term *species* is the same as terms like *seedling*, *sapling*, *infant*, *toddler*, and *teenager*. These are extremely useful terms for studying processes that are continuous from seed to tree, from zygote to adult, but they are imposed by humans on a seamless process in order to describe, explain, predict, and so on. If Darwin is correct that the concept of a species is a human artifact (albeit a very useful one), there is no species boundary to be crossed. Darwin considered the mutability of species as fundamental to evolutionary theory. Belief in it—rather than in natural selection—constitutes the "paradigm shift" (to use modern language) required in order for one to be an evolutionist.

However, accepting the mutability of species only clears the way for a mechanism by which species evolve that involves three elements: variation, natural selection (nonrandom differential reproduction), and heredity. These three conditions are jointly sufficient for the occurrence of evolution but are not individually or jointly necessary. That is, they do not preclude other mechanisms of evolution such as random drift. The important point to underscore is that this set of conditions is *jointly sufficient* to produce evolutionary change while natural selection alone is not sufficient. Without variation in a population, there would be nothing on which natural selection could act. Every selected organism would resemble every nonselected one. Without heredity, characteristics on the basis of which an organism was selected would not be represented (or not represented with the required faithfulness) in the next generation. As a result the effects of selection would not be preserved and accumulated.

Hence, the underlying theory that soon came to be viewed as having implications for morality has at least four elements among its "bare bones": the mutability of species, variability in populations, natural selection, and heredity. Darwin speculated about variability and heredity, and had evidence from animal breeding and familial resemblance that variation existed and that heredity occurred, but he did not have available to him any adequate theories. From our current vantage point his hypotheses appear simplistic and clearly flawed. It was not until the second quarter of the twentieth century that these elements of evolutionary theory began to have a sophisticated and well-grounded theoretical basis. Darwin was in the unfortunate position of knowing that a theory of heredity was essential to his theory of evolution and of having no theory available. Ironically, Gregor Mendel, unknown to most of the scientific world of his day, was developing just the theory Darwin needed. Mendel published the basis of his theory in 1865 in *Proceedings of the Natural History Society of Brünn,* a somewhat obscure publication that left his work unknown by the scientific community to which Darwin belonged.

The Implications of the Theory of Evolution for Ethics. As indicated, Darwin resisted speculating on the implications of his theory for morality in *On the Origin of Species*. He waited until 1871 to publicly disclose his views, which appeared in *The Descent of Man and Selection in Relation to Sex*. Darwin's moral theory is based on conscience. For him the evolution of morality *is* the evolution of conscience. Conscience is based on social instinct (an instinctive way of behaving for the benefit of the group to which one belongs). Although it is possible, using concepts within modern evolutionary theory, to provide an individual selection account of Darwin's social instinct, for him social instinct is the result of group selection (natural selection, which selects the characteristics of a group rather than an individual and, hence, increases the fitness of the group).

The transition from other organisms to humans is made through the development of intellect. Social instinct is a substrate—a propensity to seek an outcome that benefits the group. Intellect allows reasoning to choose the best route to achieve what social instinct dictates. Since both conscience and intellect are products of evolution, morality is thoroughly a product of evolution. According to this view, the fundamental propensities, which in humans are identified as conscience, are a direct legacy of evolution. As a result, the domain of human moral theorizing rests with the intellect: what are the best routes to achieving the impulses (resulting from evolution) of conscience.

The most influential view on ethics and evolution in the late nineteenth century was that of Herbert Spencer. Indeed, Spencer's view continues to be influential—notwithstanding the need to correct some of the science on which it is based and the very negative appraisal he has been given by numerous modern scholars. On this latter point perhaps the most negative impression of Spencer results from the identification of his view, by many, with twentieth-century eugenics—the historical and conceptual basis for which, it is claimed, can be found in Spencer's evolutionary ethics. As I shall argue, this charge reflects a misunderstanding of Spencer and his views.

Spencer's evolutionary ethics is rooted in the "greatest happiness" principle. His use of this principle needs to be clearly distinguished from the use made of it by utilitarians such as Jeremy Bentham and John Stuart Mill. For Bentham and Mill, "the greatest happiness for the greatest number" served as a principle for determining whether an action was right or wrong. For Spencer, greatest happiness is equated with justice and is a product of evolution, not a calculation used to determine the rightness of an action. It is also not an emotional state but a moral one. For a society to attain the greatest happiness for its individual citizens, social evolution must occur. Social evolution is analogous to physical evolution. Social evolution requires maximum freedom because only maximum freedom provides the variability upon which selection operates to maximize social fitness. This maximal freedom and the social struggle for survival results in altruism. Contrary to what one might expect, selection actually increases altruism within a society. This can be illustrated by two broad examples. Parents who are not altruistic to their children have fewer children survive to reproduce than those who are altruistic to their children. As a result, over time, those with the trait of altruism increase in number, and those without the trait decrease. Similarly, societies that are not altruistic to their citizens are less successful than those that are. Consequently, selection actually perfects societies and makes them more altruistic.

This is not the view of Spencer that is held by most late-twentieth-century philosophers. Far from promoting altruism, Spencer is regarded as the cruel advocate of "survival of the fittest," which justified the social abandonment of the poor and disabled (the unfit) and the introduction of programs to reduce their reproduction. Such programs included a rejection of welfare for the poor and disabled. This view of Spencer, however, is simplistic and inaccurate. I think the very best analysis of Spencer is that given by Robert Richards. After reading his book *Darwin and the Emergence of Evolutionary Theories of Mind and Behavior,* I reread a large number of Spencer's works and became completely convinced that Richards was correct and that Spencer had been dramatically misunderstood. Spencer actually did believe that social evolution would lead to a more altruistic and just society. As I indicated in the introduction to my book *Issues in Evolutionary Ethics* (1995), a correct reading of Spencer indicates that, on almost any issue, he was radical for his day. For example, as Richards makes clear, Spencer's rejection of the poor laws was not an antiwelfare position but a "pro-the-poor" position. His view was that the "poor laws," in fact, worked against the poor and absolved those in power of their responsibilities to them.

Both Darwin's and Spencer's views came under significant criticism, first early in this century and later in the late 1960s. The first challenge came from G. E. Moore (whose views I am now convinced originated in—some might say were plagiarized from—the works of H. Sidgwick: *Methods of Ethics*, and *Lectures on the Ethics of T. H. Green, Mr. Herbert Spencer, and J. Martineau*). Moore's challenge has been crystallized in the expression "naturalistic fallacy." For Moore, *good* as an ethical term was a nonnatural property that was primitive (that is, not reducible to any other natural or nonnatural property). Hence, unlike *green,* which was a natural property of an object and whose true attribution to an object was empirically determinable, *good* was a property of an object or action that was not empirically determinable.

Moore offered several arguments for this position, but the most famous is his "open question" argument. The argument is deceptively simple. For any natural property used to define *good*, the question whether it is good to have that property is left open. Hence, because whether the having of any natural property is good still has to be determined in every case, "good" cannot be identical to any natural property. Suppose for example that *good* is defined as "happiness." One can still ask whether it is good to be happy. Hence, *good* cannot really be identical with "happiness."

A similar point was made by David Hume in the mid-1700s. He claimed that "ought" statements (moral statements) cannot be derived from "is" statements (factual statements) alone. At least one “ought” statement has to be assumed in deriving an “ought” statement. Consider, for example, the claim, “one ought not to commit infanticide.” If an advocate of this claim were to support it by pointing out that (1) newborns have the potential to develop into adults, (2) newborns are unable to protect themselves, and (3) killing a newborn means taking a life, she or he would have failed to justify the initial claim. None of these factual claims by themselves or together entails that one ought not to commit infanticide. In addition, one needs statements such as (4) one *ought* not to deny a newborn the potential to develop into an adult, (5) one *ought* to protect those who are unable to protect themselves, and (6) one *ought* not to take a life. The advocate of the original claim may well believe one or all of the statements (4–6), but in order to justify the original claim, one or more of them must be advocated as well, and it is by no means clear that vigorous discussion would not occur about the truth of each of them in a free and open society.

The naturalistic fallacy in either form is widely accepted as the Achilles heel of evolutionary ethics, and Darwin and Spencer are both seen to have committed this fallacy.

A second objection to the evolutionary ethics of Darwin and Spencer is their reliance on group selection. Since George C. Williams published *Adaptation and Natural Selection* in 1966, group selection has had a rough ride. In spite of significant work by Lewontin, Wade, and Sloan-Wilson that revives in some measure group selection, the prevailing view is that group selection of the kind they have investigated constitutes special cases, and the overwhelming mode of selection is individual selection. The central argument for this position is that genes carry information and that individuals, not groups, carry genes. At levels of organization above chromosomes, in order for a gene to be selected, an individual has to be selected. Selection of a group, except in rare and unusual cases, can only take place through the cumulative selection of the individuals of the group. That is, a group is selected only because each of its members is selected.

This objection is important because, until the rise of sociobiology, it seemed to spell doom for evolutionary explanations of altruism because altruism seemed always to be contrary to individual interest. Altruistic behavior might benefit the group (society) or a third party, but the altruistic individual would decrease his or her own fitness by acting altruistically.

In addition to these intellectual objections to the evolutionary ethics of Darwin and Spencer, there were social and practical problems. First, Spencer’s struggle did not seem to lead to a more altruistic and just society. World War I cast considerable doubt on the truth of his views. Second, the disturbing development of eugenics and its assumed connection to social Darwinism (and hence to evolution as a basis for morality and social policy) caused a retreat from using evolution to understand ethics and social policy. Third, the specter of biological determinism that seemed to flow from the conjoining of organic evolution and evolutionary ethics caused a move to see freedom of action as an essential counterbalance to biological determinism and as an essential element in ethics. Ethics, therefore, must be more than what can be understood by biology.

SOCIOBIOLOGY AND THE SECOND WAVE

The foregoing intellectual, social, and practical problems seemed decisive reasons for rejecting evolutionary ethics. Their decisive force, however, was progressively and significantly weakened from about the mid-1960s onward. The first rumblings occurred both in biology and philosophy. In biology W. D. Hamilton introduced the transforming concept of *inclusive fitness*. In philosophy several philosophers began to challenge the naturalistic fallacy (see, for example, John Searle 1964). The entire issue exploded into public view in 1975 with the publication of *Sociobiology: The New Synthesis* by the Harvard entomologist Edward O. Wilson. Wilson drew together the threads of a large amount of biological and anthropological work into a synthesis using the most sophisticated version of evolutionary theory of the day.

Explaining Altruism Biologically. *Sociobiology: The New Synthesis* was thoroughly grounded in individual selection. Its most important concept was inclusive fitness, which allowed an evolutionary explanation of previously inexplicable phenomena such as altruism. Fitness is about genes and their transmission into the next generation. Inclusive fitness captures all of the physical and behavioral characteristics of genetically related individuals that result in the transmission of genes into the next generation. Inclusive fitness recognizes that if the behavior of one individual A assists in the transmission of the genes of a closely related individual B, then the behavior of A is actually part of the fitness of B. Further, if A and B share a large number of genes, A's behavior, which raises B's fitness, actually raises A's fitness as well. This concept allows an explanation of altruism based on individual selection.

Consider the dramatic case of hymenoptera (honey bees). This organism has a peculiar genetic structure that makes it an ideal example of inclusive fitness. Drones (males) are haploid (have only one set of chromosomes) whereas females are diploid (have two sets of paired chromosomes). In addition, except in very rare cases, the hive has only one reproducing female (the queen), who is fertilized once by a single drone. The queen can fertilize an egg or not at will. An unfertilized egg becomes a drone. A fertilized egg becomes a female worker (which is sterile unless, in the larvae, it is fed "royal jelly" —a protein substance—which results in its developing into a queen). As a result of this genetic structure, female workers are highly related genetically. The drone contributes the same set of chromosomes to each zygote (fertilized egg). Hence, all workers share the drone's contribution entirely. The queen's chromosomes segregate so that, on average, each zygote shares half of the queen's chromosomes. As a result, on average, workers share three-quarters of their genes in common. Hence, if a randomly chosen worker A makes it possible for the queen to continue to reproduce and for a new queen to be developed and in turn reproduce, that worker is putting at least 50 percent of her genes into the next generation and on average is contributing 75 percent.

The effect of this on altruistic behavior is straightforward. If there are two hives, α and β, and some of the bees in hive α have a gene for behaving altruistically (giving up their lives to save the hive) and none of the bees in hive β have it, hive α will survive an attack, and hive β will not. Inasmuch as the bees that gave up their lives are so highly genetically related to the bees that are saved by their action—including the queen—the gene for altruism will, with a very high probability, be passed to the next generation. Over time, only hives with bees that have the gene for altruism will survive, and the gene for altruism will propagate to all workers in all hives.

Altruism, on this account, is entirely consistent with individual selection and is entirely biological in its origins. In addition, the altruistic behavior is, in the word's normal sense, only superficially "altruistic," because the origin and maintenance of the behavior labeled "altruistic" is really selfishness (or, put more mechanistically and neutrally, is a behavior that is designed by biological evolution to raise the fitness of the individual engaged in the "altruistic" act). For a provocative exploration of the selfishness of genes in governing human physical structure and behavior, see Richard Dawkins's classic book *The Selfish Gene*. Also rewarding reading, and a counterbalance to Dawkins, is a paper on altruism by Elliot Sober (1988) in which he provides some useful clarity on this apparent twist of meaning of altruism. Sober suggests that altruism has a biological and an ethical sense.

Meeting the Challenges to a Sociobiological Approach to Morality. With the problem of altruism *apparently* resolved (or at least partially reconciled with individual selection) and the appeal to "group selection" banished, two problems remain unresolved by sociobiology: the naturalistic fallacy and the incompatibility of morality (requiring individual autonomy) with the kind of biological determinism that seems to underlie sociobiological explanations. I shall address each of these problems separately.

A standard move employed to get around the naturalistic fallacy is to deny that moral claims have a different status from factual claims. In effect, this denies the force of the is-ought distinction by claiming that an "ought" statement is simply a particular kind of "is" statement. This is the view taken by ethical naturalists. One way of capturing an "ought" in terms of an "is" statement is to reformulate "ought" claims as follows:

In order to achieve a stable social system, individuals in it ought (must) behave in way X.

One can then explore this claim empirically. If it is shown that behavior X does not lead to a stable social system, then the claim is empirically false.

A critic is certain to respond that this tack is still vulnerable to Moore's "open question." In this case, the question will be, Why is a stable social system good (why ought we to strive for it)? The critic will not be satisfied with the answer, Because it ensures the welfare of its members. She will plainly consider this evasive because this answer is also vulnerable to Moore's open question, Why is that good? And on and on it goes.

This, however, does not give victory to the advocate of Moore's naturalistic fallacy. All that the above demonstrates is that moral discourse admits of an infinite regress of questions and answers. If each one of the answers is capable of being given a naturalistic expression, this infinite regress is no different from the regress of questions and answers in the factual domain.

I: Why is that man wearing a blue coat and hat?
You: Because it is his work uniform.
I: Why is it his work uniform?
You: Because his employer made a decision about the kind of uniform the employees must wear.
I: Why did they make that decision?
You: Because they think it inspires public confidence in what they do.
I: Why do they think that?

And on and on go the "why" questions. That there is no ultimate answer does not mean that there is no contextually meaningful answer. Of course, one can continue to ask for justifications of justifications ad infinitum, but at a certain point the context of the initial question and its purpose suggest that further questioning is indulgent and unnecessary for the purposes at hand.

Hence, the crucial question is whether the regress of justifications is different in the two cases. Is the regress of justification of an "ought" statement fundamentally different than the regress of justification of an "is" statement? The only possible basis for an affirmative answer is the conviction that at the end of the regress of the "ought" statement must be an *ultimate* "ought" statement. However, if every "ought" statement in a regress can be reformulated as an empirical claim, it appears that acceptance that there is an ultimate "ought" statement (and that it is irreducibly nonempirical) is no more than an article of faith, and the open-question argument loses its force.

Turning now to determinism, classical determinism is best summarized in the claim "Same cause, same effect." Hence, the future follows necessarily from the sum of all present conditions. *Biological determinism*, as that term is most frequently used, is a species of classical determinism.

Recently, it has become apparent that although phenomena may be deterministic in the abstract, this is of little practical significance for three reasons.

First, fixing the initial conditions of a system with the required precision is impossible in practice. As work on chaos theory and nonlinear systems has made clear, initial conditions have to be specified with unachievable accuracy in order for any reliable prediction of future states to be made. To appreciate this, one need only consider two systems, each with identical starting conditions, with all parameters determined to the thousandth decimal point of measurement. Computer models verify that these two systems will, after a relatively small number of temporal sequences, diverge. The greater the time, the greater the divergence. This phenomenon is known as *sensitivity to initial conditions*: an extremely small difference in a variable at t_1 becomes a very large difference in the system's trajectory at t_n where n is usually small (say less than 20).

Second, nonlinear systems (which capture most biological systems) have their stable states described as behavior on a *strange attractor* (a fractal) in a state space. Very small perturbations cause such systems to move off the strange attractor and to assume a trajectory in the state space that is unstable; if the trajectory settles into a new stable state, it will do so on a different strange attractor. The trajectory may, however, be knocked forever out of a stable state.

Third, and most important for our purposes, "intelligent" systems create information loops. For example, a computer chess program works by having the computer *predict* the outcome of a large number of potential moves that it could make given a specific board configuration and potential responses by its opponent. Based on the assessment of "the future" as the computer calculates it, the computer makes a move in the present to achieve the predicted future. In a meaningful sense, the future (or at least the deterministically predicted future) affects action in the present. *Intelligent* in this context need mean no more than "can extrapolate with reasonable accuracy future probable outcomes." A classical deterministic system makes possible this information loop, and a system with a small number of variables and a denumerable and small number of potential futures (perhaps a million) is easily managed by a computer. As the number of variables or potential outcomes becomes larger, the level of computational "intelligence" must increase. Humans have phenomenal computational "intelligence" and, hence, engage in information looping on a constant basis.

Information loops result in the potential futures of a system determining a present action. Inasmuch as this is a phenomenon in which computers can be programmed to engage, there is nothing supernatural about the phenomenon. Of course, computers are able to do it *by design*. Humans write the requisite computer program. But humans are also "designed" by evolution, and those whose neurological capacities are "hardwired" for information looping have an advantage over those who have no such capacity. Moreover, those whose neurological system has the capacity and plasticity to be "programmed" by experience and culture to engage in massive information looping have a significant advantage over those organisms that have no plasticity. There is a clear evolutionary advantage to being able to assess the probable consequences of one's actions and to act on the basis of that knowledge.

The threads of all these arguments coalesce in a major conclusion: biological determinism does not entail the impossibility of choice. Cognition in humans allows a sophisticated process of extrapolation of potential futures and opens up choices of action based on the resulting knowledge. The process in humans is no more mystical than in computers. In both cases nothing more is required than the physical template (a neural structure or semiconductor circuit) and a mechanism for programming (hard or soft). The latter is provided by humans for computers and by evolution for humans. Sociobiology, far from being incompatible with the kind of choices required for human morality, explains the very existence of choice within a deterministic framework. Indeed, within a deterministic worldview (the one most commonly held), sociobiology provides a basis for asserting volition, free action, and (hence) responsibility for action.

Concluding Remarks

Evolutionary ethics seem alive and well in the late twentieth century, but there is clearly further work to be done. If ethics are to be rooted in evolutionary theory, a comprehensive reformulation of ethical theory will need to be undertaken in order to make it thoroughly evolutionary—that is, to bring it into the evolutionary family in the way that systematics, paleontology, biogeography, and similar fields have been brought in by people such as Ernst Mayr, George G. Simpson, David Lack, and others. The example of these areas of biological study makes it clear that membership in the family of evolutionary studies does not remove the need for autonomous development of knowledge within ethics. That knowledge, however, will be shaped by the overarching structure of evolutionary theory. Theodosius Dobzhansky once wrote that nothing in biology makes sense except in the light of evolution. Perhaps one can now say that nothing in ethics makes sense except in the light of evolution. Why be moral? What is the rational basis for constructing social morals regarding murder and incest, for example? In the late twentieth century, these seem appropriately answered by a thoroughgoing application of evolutionary theory.

All that is currently missing from a thoroughgoing evolutionary ethical theory is a theory of cognition and consciousness. Just as Darwin had no theory of heredity but knew from empirical evidence around him that heredity occurred, so too does an evolutionary ethicist know from the empirical evidence that cognition and consciousness have a certain structure and functional manifestation, and that both play an important role in evolutionary ethics, even though no accepted theory exists. *The final determination of the viability of evolutionary ethics does not rest with resolving the naturalistic fallacy or issues of determinism but with the results of theorizing in neurobiology and cognitive science.*

This conclusion will not strike everyone as inevitable or even sensible. For some, the conclusion will conflict with the sense of human freedom and perhaps with human dignity. The domain of ethics, for many, is the critical mark of humanness—that which makes us distinct within the vast array of living things. Without becoming sentimental, I would contend that my conclusion is faithful to our connectedness to this array of living things. We are indeed different but connected: our difference arises from our history and the cognitive capacities to which it has given rise and not from some discontinuity, some mystical saltation during the causal thread of evolutionary development.

REFERENCES

Bentham, Jeremy. 1823. *An Introduction to the Principles of Morals and Legislation.* Oxford: Oxford Univ. Press.

Darwin, Charles. 1859. *On the Origin of Species by Means of Natural Selection.* London: John Murray.

———. 1871. *The Descent of Man, and Selection in Relation to Sex.* London: John Murray.

Dawkins, Richard. 1976. *The Selfish Gene.* Oxford: Oxford Univ. Press.

Hamilton, W. D. 1964. "The Genetical Theory of Social Behavior," *Journal of Theoretical Biology* 6:1.

Hume, David. 1964. *Essays Moral, Political and Literary.* Vols. 3 and 4 of *Philosophical Works*, ed. T. H. Green and T. H. Grose. Aalen: Scientia Verlag. (These essays were published from 1750 to 1777.)

Kauffman, Stuart A. 1993. *The Origins of Order: Self-Organization and Selection in Evolution.* New York: Oxford Univ. Press.

Mendel, Johann (Gregor). 1865. "Versuche über Pflanzen-hybriden," *Verhandlungen des Naturforschenden Vereines in Brünn* 4:3–47.

Mill, John Stuart. 1861. "Utilitarianism." *Fraser's Magazine* (October, November, December).

Moore, G. E. 1903. *Principia Ethica.* Cambridge: Cambridge Univ. Press.

Richards, Robert. 1986. "A Defense of Evolutionary Ethics." *Biology and Philosophy* 1:265–92.

Searle, John. 1964. "How to Derive 'Ought' from 'Is.'" *Philosophical Review* 73:43–58.

Sidgwick, H. 1874. *Methods of Ethics.* London: Macmillan.

———. 1902. *Lectures on the Ethics of T. H. Green, Mr. Herbert Spencer, and J. Martineau.* London: Macmillan.

Sober, E. 1988. "What is Evolutionary Altruism?" *Canadian Journal of Philosophy* 14 (Supplementary): 75–99.

Spencer, Herbert. 1893. *Principles of Ethics.* London: Williams and Norgate.

Thompson, Paul, ed. 1995. *Issues in Evolutionary Ethics.* Albany: State Univ. of New York Press.

Williams, George C. 1966. *Adaptation and Natural Selection.* Princeton, N.J.: Princeton Univ. Press.

Wilson, Edward O. 1975. *Sociobiology: The New Synthesis.* Cambridge: Belknap Press, Harvard Univ.