Chapter 2
Human Sociobiology: The Essential E.O. Wilson

> *What is human nature? It is not the genes, which prescribe it, or culture, its ultimate product. Rather, human nature is something else for which we have only begun to find ready expression. It is the epigenetic rules, the hereditary regularities of mental development that bias cultural evolution in one direction as opposed to another, and thus connect the genes to culture.*
>
> *(E.O. Wilson, 1998)*

Paradigm shifts are refreshing new ways for humanity to understand the nature of their existence and their universe. Sadly, any challenge to the commonly held current order promises to introduce significant dissonance to most practitioners in a discipline. Those responses are no less dramatic in empirical practice than in the practice of literature, economics, politics, and the wide array of other disciplines. Thus, the more frequent response to the introduction of a new paradigm is disbelief, perceived threat, antagonism, and outright attack. This common occurrence was elegantly noted by Darwin in the conclusion of *The Origin of Species* (1859) when he acknowledged "... I by no means expect to convince experienced naturalists whose minds are stocked with a multitude of facts all viewed, during a long course of years, from a point of view directly opposite to mine". Surely, as we recognize the sesquicentennary year of Darwin's conception of biological evolution, we must acknowledge that it competes in most minds with all other creation myths (Durant, 1980).

Paradigm shifts can also be ideological threats as much as they are threats to a prevailing world view, causing irrational emotional responses couched as intellectual challenges. Such responses are based on tenaciously held personal ideologies that emerge over a lifetime of personal experience and emotional investment. Frequently, they are reinforced by the real-life need to sustain intellectual stature and professional influence. Most regrettable are those challenges roused by political or religious ideologies that have nothing at all to do with observations that are at hand, but have everything to do with the maintenance of a personal world view. Undeniably, true paradigm shifts are often challenged with such descriptors as controversial, untested, irresponsible, out of line with prevailing wisdom, or inconsistent with the evidence. Occasionally, the new paradigm and its proponents are publicly

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castigated with inflammatory rhetoric – such as blinded by bias, racist, or sexist. E.O. Wilson was not immune from such angst. Without a doubt, his 1971 naming and establishment of sociobiology as a discipline (*The Insect Societies*) both quickened the pace of humankind's anthropocentric demise and accelerated the perceived controversial nature of his work. Regardless of the manifestly important groundwork produced by scholars who articulated the foundations of sociobiology, it was Wilson himself who became the embodiment for its public persona.

For the first time, a comprehensive paradigm, a "new synthesis," was offered that no longer treated human social behavior and biology as separate subjects. Simply stated, sociobiology was defined by Wilson as "the systematic study of the biological basis of all forms of social behavior." By extension, the evolution of social behavior and culture is driven by the environmental contingencies of natural selection – just like any other behavioral repertoire or physical attribute. To be sure, *all* behavior should necessarily be viewed as an extension of the brain as a biological entity – including the repertoire of behavior typically described as human culture. The early 1970s witnessed a growing number of scholars ready to take on the rapidly accelerating sociobiology debate that was further animated by Wilson's *Sociobiology: The New Synthesis* (1975), and other publications such as *Animal Behavior: An Evolutionary Approach* (Alcock, 1975), *The Evolution of Behavior* (Brown, 1975), *Ethology: The Biology of Behavior* (Eibl-Eibesfeldt, 1975), and *The Selfish Gene* (Dawkins, 1976).

Predictably, this growing cadre of sociobiologists – Wilson in particular – was not immune to intellectual antagonism and verbal abuse related to sociobiology generally and human sociobiology in particular. Some of the most rancorous commentary was provoked by the so-called Sociobiology Study Group, the creation of scientist ideologues Stephen Jay Gould and Richard Lewontin. Their Marxist critique of Wilson went so far as to accuse sociobiology of being friendly to racism, misogyny, sexism, and genocide – inspiring verbal harassment of Wilson at public appearances and a well-known ice water dousing at the 1978 gathering of the American Association for the Advancement of Science. Readers interested in an authoritative discussion of the debate, its key players, and their work are encouraged to refer to Ullica Segerstråle's comprehensive and superbly crafted *Defenders of the Truth* (2000). To say the book is comprehensive somehow diminishes the magnitude of its accomplishment in meticulously capturing an essential moment in the history of science.

Wilson weathered the storm of criticism and attack with his characteristic kindness and dignity, personal attributes that have endeared him to the larger intellectual community during his long and productive career. Perhaps wisely, he retreated from the sociobiology debate during the decade of the 1980s, following the publication of *Genes, Mind and Culture* (1981) to focus more of his intellectual energy on his scientific passion for ants, environmental sustainability, and his newly developing concept of biophilia – all resulting in significant publications during that time. That passage of time dulled the edge of the ideological blade brandished at Wilson. Yet, the occasional distortion (both unintended and intended) and misrepresentation of his work persist to this day – not unlike the experience of other paradigm challenging

scholars that preceded him. Now, more than three decades after the initial publication of *The Insect Societies* and *Sociobiology: The New Synthesis*, Wilson's work is more widely accepted and is rightfully recognized as the essential foundation for the rapidly expanding field of evolutionary psychology.

Scholars have more recently offered Wilson a far more balanced and less biased reading, although the sociobiology conversation is far from over and its theoretical foundations far from commonly established among its scholars (Wilson and Wilson, 2007). Certainly, since 2004 (Wilson and Hölldobler), he has moved experts in genetic social theory of nonhuman animals to discuss (and perhaps rescue) group selection as a key element of sociobiology. Notwithstanding these important theoretical conversations that continue, he has rightfully earned a prominent place in the larger history of science and biology. Wilson deserves an open-minded readership for and balanced evaluation of his important ideas. Thus, the major portion of this chapter provides an overview of the essential conceptual framework of Wilson's sociobiology framed in the larger scientific and historical context of Darwinian evolutionary theory.

The HMS Beagle to the Modern Synthesis

Wilson's 1975 "new synthesis" challenge was clearly an innovative and effective means to enlarge the conversation regarding the fundamental biological elements of human nature and engage the social sciences in that larger intellectual conversation. Similar to any work of this intellectual magnitude, it did not come quickly or in isolation – many great minds set the stage. First and most notable among those great minds was Charles Darwin, on whose considerable shoulders Wilson stood in order to view the new horizon of sociobiology. Thus, a description of Darwin's theory of evolution by natural selection is the necessary starting point, followed by an account of other key contributors in the advancement of evolutionary theory in the early twentieth century, its more recent modern synthesis, and Wilson's new synthesis.

Darwin's predilection to keenly observe the natural world is mirrored in the early life of Wilson. Darwin was naturally drawn to beetles as a child, much like Wilson was drawn to ants. Innate and wide-ranging curiosity, the naturalist's penchant for keen observation, compulsively meticulous cataloging, and the precious ingredient of time were common elements in their early lives. Indeed, it is no irony to those familiar with their early lives and the scientific importance of their work as adults that Darwin and Wilson had so much in common. The trajectory of their intellectual lives was clearly established in their youth. A similar alignment is common to their adult lives, in that a keen focus on specific organisms at any given point in their career was complimented by enormous and unbounded appetite for all elements of the natural world. In Darwin's case, that appetite took him from barnacles to human morality – for Wilson, from ants to great apes and human culture.

Most biographers of Darwin identify his personal conflict in determining a professional direction for his early adult life. Medical practice and the ministry were both eliminated very quickly by Darwin as appropriate professional pursuits in favor of natural history and beetle collection. Instead, his lifelong curiosity for the natural world inspired his more active pursuit of botany and geology. His formal study of both disciplines was undertaken in a timely enough fashion for his achievement to gain notice as a prospect to serve as the unpaid naturalist for the voyage of the HMS Beagle in 1831. The 23-year old Darwin was offered that opportunity and he set sail on a 5-year voyage that originated to complete a detailed mapping of the South American coastline. The voyage included lengthy and plentiful stops along the way, enabling Darwin to build an enormous specimen collection. The voyage's circumnavigation of the globe before its return to England provided Darwin enormous time to carefully examine, describe, and catalog the specimens.

Darwin's interest in geology moved him to include a copy of Charles Lyell's recently published *Principles of Geology* (1830) on his Beagle journey. Lyell's book firmly established for Darwin two essential concepts to advance his thinking – the dynamic nature of the earth's physical history and its immense age. The trip provided ample additional evidence to support those concepts. While ashore on the west coast of South America, Darwin made particular note of the fossilized remains of a long extinct South American giant ground sloth and personally witnessed the dynamic earth at work when he experienced an earthquake. Additionally, the voyage provided enormous evidence for the diversity of life forms on the planet and very direct experiences with several human cultures that differed from those to which he was accustomed on the European continent. He surely achieved some of his most elegant writing as he deconstructed empty criticisms regarding perceived gaps in the fossil record. At the same time he provided example after example of observed fossilized extinct species and offered magnificent descriptions of transitional species in the time dependent process of evolution by natural selection (see *The Origin of Species*, Chapter 10). Darwin's genius for detailed analytical observation and his remarkable capacity to synthesize across those observations gave life to a new vision for the natural history of the planet.

The last spark of inspiration was provided by his fortuitous reading of a lengthy essay by Thomas Malthus, *An Essay on Population* (1798), two years after the return of the Beagle (Darwin, 1929). Malthus, an English economist, offered a theory to explain the occurrence of famine in populations. We now know his mathematical assumptions to be inaccurate; however, his theory that famine would inevitably result from the pressures of population growth was correct and an essential component in Darwin's thinking. Malthus conjectured that food resources tended to increase in only arithmetic progression, while populations competing for those resources increased in geometric progression. Overpopulation results in famine. Darwin pushed that thinking to suggest that the natural limitation of food resources might more logically result in individual competition for those resources rather than cause famine. Those organisms succeeding in that competition lived to achieve reproductive age and likely would pass to their offspring the physical and behavioral characteristics that resulted in their success.

> *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.*
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> *. . .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.*
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> *(Darwin, 1929)*

The serendipitous convergence of the voyage, well chosen books, and natural curiosity during the formative years of Darwin's scientific apprenticeship established the foundation for his life's work. The coincidental alignment of those factors during an era in which science and empirical practice were increasingly held in high regard provided fertile ground for the seeds of his revolutionary insights to grow. Observation and quantification, the hallmarks of empiricism, became the acknowledged essentials of scientific best practice – Darwin was obsessive about those basic empirical attributes. These elements combined to result in the most important biological statement of modern time – the 1859 publication of *The Origin of Species*, detailing Darwin's theory of "descent with modification through variation and natural selection."

His detailed observations made it apparent that individuals within a species have subtle differences in both physical and behavioral characteristics. It was also obvious to him that species have changed over an immensely long natural history of the earth. That gradual change was characterized by Darwin as evolution driven by the mechanism of natural selection. In sequential summary form, the following observations are commonly accepted to be those which led to Darwin's conceptualization:

(1) The age of the planet is immensely greater than previously accepted by theologians and academics. The magnitude of that time is on the order of millions of years during which the natural physical history of the earth has been fluid (Lyell).
(2) Population growth inevitably outstrips the resources necessary to sustain all individuals and results in famine (Malthus) or competition for survival (Darwin).
(3) Individual members within a species have observable physical and behavioral differences (Darwin).
(4) Individuals with differences that enable them to more successfully compete for limited resources will more likely survive to reproductive age. Consequently, it becomes likely they will pass on those characteristics to their offspring (Darwin).
(5) Darwin described this competition as natural selection – the process whereby small, but favorable, differences are passed on to the offspring and ultimately achieve common expression in future generations. The gradual accumulation of those differences can result in the emergence of new species and the extinction of an existing species.

A close reading of Darwin reveals his uncanny capacity to intersperse his lengthy and dense objective descriptions of the natural record with rich commentary that approaches the majesty of poetic achievement. Some of his best prose is accomplished in the book's concluding paragraphs in which he invites his readers to step back from the overwhelming detail of the book and view the magnificent simplicity of his theory.

> *It is interesting to contemplate a tangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us … Thus, from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of higher animals, directly follows. There is grandeur in this view of life.*
>
> *(Darwin, 1859)*

Darwin's theory in reality is not limited to just natural selection. Rather, it includes five related theories, each of which received varying levels of acceptance and challenge by late nineteenth and early twentieth century scholars. Simply stated, the five theories developed by Darwin include

(1) the ever-changing nature of species – nonconstancy made possible by genetic recombination of sexual reproduction and gene mutation,
(2) all organisms have common ancestry – organismal diversity "branches" by its nature,
(3) evolution is gradual – there are no biological discontinuities, only discontinuities in the fossil record that demonstrate gradual emergence of species,
(4) the slow but constant emergence of new species that lead to diversity and,
(5) natural selection.

The common pursuit of many scientists for many years following the publication of the book was to argue the reality and then the utility of these individual concepts, rather than to see them relating to each other by necessity. Still today, it is quite common that natural selection is exclusively identified by most as Darwin's chief contribution. Yet, Darwin was explicit from the outset in describing the essential interrelationship among all five of the concepts as the foundation of the origin of species. His critics tended to pull the concepts out of context from each other and thereby diminish Darwin's work by misrepresenting its internal consistency and, ultimately, the beauty of its simplicity.

Not until the 1920s, with the emergence of neo-Darwinism, did scholarly work begin to achieve a recognizable synthesis among the five theories with the newly developing field of population genetics. More significant theoretical foundations for accomplishing the synthesis were established in the 1930s, "When the publication of Ronald Fisher's *The Genetical Theory of Natural Selection* (1930), Sewall Wright's *Evolution in Mendelian Populations* (1931), and J.B.S. Haldane's *The Causes of Evolution* (1932)" demonstrated increasing acceptance among scientists – population geneticists in particular – for the interrelated nature of the five theories (Wilson,

1975). Ultimately, Theodosius Dobzhansky's *Genetics and the Origin of Species* (1937) became widely recognized as the fiber uniting Darwin's theory with modern genetics. Dobzhansky's synthesis had immense influence on a generation of biologists, and soon came to be recognized as the next major advancement in evolutionary theory – the so-called Modern Synthesis (Mayr, 1942). The fabric representing the modern era was then woven by Dobzhansky's contemporaries, including Julian Huxley (general theory), G. Evelyn Hutchinson (ecology), Ernst Mayr (systematics), G.G. Simpson (paleontology), G. Ledyard Stebbins (botany), and M.J.D. White (cytology). The full synthesis of their work in the larger context of Dobzhansky resolved the disconnection of various intellectual approaches to evolution and provided direction for modern evolutionary thought.

The Modern Synthesis made it apparent that the contemporary basis for understanding evolution would be described by the natural selection of variations caused by small genetic changes and that the more significant changes we observe in the fossil record can be explained by these same mechanisms continuing over enormous periods of time. Only in the very recent past (reviewed in Carroll, 2005 and Amundson, 2005) has a significantly new approach to evolutionary investigation emerged, albeit outside the framework of the modern synthesis. Evolutionary developmental biology (popularly known as evo devo) opened that fresh avenue of evolutionary investigation by describing mechanisms that go beyond natural selection and the gradual accumulation in populations of small genetic variations as the bases for evolution. Instead, evo devo explores the genetic and developmental mechanisms that guide how the actual form of organisms has evolved. Researchers are investigating how organismal morphology can be modified by evolutionary alterations in the ontogenetic process and how subtle changes in ontogeny produced by "toolkit genes" or "genetic switches" can alter individual development enough to initiate speciation.

Sociobiology and the New Synthesis

Wilson (1975) characterized the Modern Synthesis as "the elucidation, through excellent empirical research, of the nature of genetic variation within species and of the means by which species multiply." This synthesis was made possible when the newly emerging "branches of evolutionary biology – systematics, comparative morphology and physiology, paleontology, cytogenetics, and ethology were reformulated in the language of early population genetics." Stated simply, the Modern Synthesis weighs "each phenomenon for its adaptive significance and then relates it to the basic principles of population genetics." Sadly, until the recent emergence of evolutionary psychology and evolutionary developmental psychology, the social sciences made only slow and oftentimes contentious progress toward inclusion in the Modern Synthesis. Wilson's 1975 publication of *Sociobiology: The New Synthesis* intentionally set out to challenge this record by expanding the synthesis beyond the domain of biology to include the social sciences; thus, the basis of his subtitle –

The New Synthesis. Ultimately, Wilson aspired to "reformulate the foundations of the social sciences in a way that draws them into the Modern Synthesis," and he is meticulous in systematically developing the case that sociobiology completes the Modern Synthesis by drawing social science into evolutionary biology. His more recent *Consilience* (1998) is even more eloquent and expansive in describing that "new synthesis," while challenging scholars to advance the new synthesis to include the humanistic social sciences and humanities.

Scholars have slowly recognized that one of Wilson's most important and lasting intellectual contributions has been to make that Modern Synthesis real. Inspired by the central dogma of evolutionary biology that natural selection shapes ALL classes of traits in organisms, Wilson drew upon the work of ethologists, like Konrad Lorenz, to theorize that behavior and social structure should be studied as "'organs,' extensions of genes that exist because of their superior adaptive value." Thus, Wilson's essential definition of sociobiology describes it as "the systematic study of the biological basis of all forms of social behavior" (Wilson, 1975).

Wilson earned significant regard as a scientist early in his career. He established himself as one of the world's foremost experts on ants and their behavior in the 1950s, publishing extensively throughout that decade. His work on chemical communication among ants emerged in the late 1950s and guided the focus of his interest toward the biological basis for social structures among ants and beyond. One major result of that era in Wilson's intellectual life was his benchmark publication, *The Insect Societies* (1971). Among its many important conceptual contributions was to establish and name sociobiology as a discipline. To this day, the contents of the premier journal *Behavioral Ecology and Sociobiology* are built upon the original formulation that the discipline of sociobiology would be established on the foundation of population biology – a relatively new discipline in itself in the 1960s and 1970s. Thus, "sociobiology addresses not just the genetic origin of eusociality, but all of the key phenomena in communication, division of labor, and colony life cycles" (Wilson, 2007).

Wilson's early interests led him to consider the wider-ranging implications of social behavior, biology, and evolution. His greatest attention was on insect societies – the organization of their populations, caste structure, mechanisms for communication, and the underlying physiology of social adaptations. Yet, at the same time, he methodically pushed his conceptual framework to include all animal societies. Those more comprehensive considerations became the basis for his 1975 publication of *Sociobiology*, launching him into a much larger arena of attention and controversy. *Sociobiology* is most significantly dedicated to a comprehensive cataloging of the biological basis of social behavior across the great chain of being and succeeds in achieving a comparative view. Sparingly, he pushed the theoretical envelope to include primates and, finally, humankind in the final chapter. Yet, it is not by necessity of inclusion in that great chain that humankind appears in the new synthesis; it is by design. From the outset, Wilson intended for *Sociobiology* to have an ultimate focus on the social behavior of humankind. He does so by initiating his discussion of human sociobiology with an explication of the adaptive features of organization in small and isolated contemporary human societies. By extension,

we are all included. Yet, it is not until the 1981 publication of *Genes, Mind and Culture* that Wilson offers the mechanism for human sociobiology, gene-culture coevolution.

These initial comments are not intended to suggest that Wilson's work emerged in isolation or appeared as the only scholarly work advancing sociobiology. In fact, most scholars point to William Hamilton's publications of the early 1960s as the conceptual birth of sociobiology. Hamilton suggested that it was kin selection, rather than group selection, which explained the evolution of altruistic behavior. His early work on a genetic theory of social behavior and the evolution of altruistic behavior are commonly regarded as essential to the emergence of sociobiology. Indeed, Wilson credits Hamilton's theory of kin selection (1964) for providing him the key conceptual spark to invigorate his theoretical development of sociobiology. Yet, Hamilton's work also prompted the rejection of group selection as a mechanism driving the evolution of altruistic behavior. The rejection achieved such prominent stature within the community of evolutionary biologists that group selection was consistently avoided in evolutionary theory and sociobiology as a topic relevant to its theoretical foundations (reviewed in Williams, 1966). Additionally, scientifically naïve accusations regarding the determinism of group selection had significant enough political overtones to convince most scholars to maintain an assured clear distance from the concept.

Hamilton's work initiated more focused attention on a possible selfish gene mechanism operating in kin selection. Mathematically oriented theorists, such as George Williams, Robert Trivers, and John Maynard Smith (Evolutionarily Stable Strategy), all continued the march toward sociobiology in important ways. Most prominently, the early and continuing contributions of Richard Dawkins (*The Selfish Gene*, 1976; *The Extended Phenotype*, 1982; and *The Blind Watchmaker*, 1987) continue to be viewed by many as essential reading for a comprehensive understanding of the twentieth century sociobiology conversation. (Interested readers are also encouraged to read Grafen's and Ridley's book of collected essays, *Richard Dawkins: How a Scientist Changed the Way We Think*, for a more detailed analysis.) However, the long-lived impulse to avoid group selection in favor of kin selection and the selfish gene led to theoretical pursuit based solely on individual and genetic self-interest. This avoidance became so much a part of standard operating procedure in evolutionary biology that a generation of scholars was trained with no foundation in group selection as a component of multilevel selection (Wilson and Sober, 1994).

The most recent twenty-first century rethinking of the theoretical foundation of sociobiology holds the potential to correct the bearing of contemporary theory in sociobiology. E.O. Wilson now maintains that kin selection was an element, but not the principal founding idea, of sociobiology and that "kin selection theory in its original form has collapsed" (Wilson, 2007). Further, Wilson and Wilson (2007) suggest that current sociobiology is in "theoretical disarray," since the majority of scholars are still reluctant to revisit the 1960s rejection of group selection. Consequently, the development of alternative explanations for the evolution of cooperative and altruistic behavior continues to be sorely hampered. This current disarray has stirred a vigorous conversation among a growing number of sociobiologists and

has resulted in an important recapitulation of multilevel selection theory, including group selection, as the theoretical foundation for sociobiology in the future. "The importance of group selection in human evolution enables our groupish nature to be explained at face value. Thus, multilevel selection, not group selection alone, provides a comprehensive framework for understanding human evolution along with other major transitions." This "new" theoretical foundation of sociobiology takes us full circle to Darwin's suggestion that "natural selection takes place on more than one level of the biological hierarchy. Selfish individuals might outcompete altruists within groups, but altruistic groups outcompete selfish groups. This is the essential logic of what has become known as multiple selection theory" (Wilson and Wilson, 2007):

> *Like an exploded diagram of a machine, it (multilevel selection) allows one to identify the component parts of evolution in metapopulations and to see how they fit together. Natural selection within groups, variation among groups, and the way in which groups contribute to the formation of new groups are all fairly easy to understand as separate processes, after which they can be put together to determine what evolves.*
>
> *(D.S. Wilson, 1998)*

Human Sociobiology

> *The consideration of these various facts impresses the mind almost in the same manner as does the vain endeavor to grapple with the idea of eternity.*
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> *(Charles Darwin, 1859)*

The fossil record produced over millions of years reveals the slow march of natural selection in response to the ever-changing physical environment and supports as fact the five theories of Darwinian evolution. Even the most capable scientific minds in Darwin's era and after had enormous difficulty resolving the magnitude of time necessary for that slow march to proceed to no particular destination. Time and the suspension of perceived direction or progress as components of evolution were, and continue today as, significant obstacles to understanding evolution by natural selection. Additionally, humankind's common tendency toward anthropocentrism and need to view humanity as the crowning achievement of life on planet earth continue as barriers to better scientific understanding of evolution by natural selection. To this day, many prominent scientists deny the sociobiological essence of human culture and insist that promethean genes effectively liberate humankind from the remainder of human DNA and somehow free the mind from all antecedent biology. (Lumsden and Wilson, 1983)

Anthropocentrism achieves an even greater significance and potential for controversy when the evolution of human behavioral repertoires and constructs like culture are considered in light of evolutionary theory. This was the intellectual context in which E.O. Wilson's *Sociobiology: The New Synthesis* (1975) was published, little more than a century after the appearance of *The Origin of Species* (1859). Equal in its scientific rigor and comparable in its written elegance, *Sociobiology* initially

roused similar antagonism and received only limited acceptance. Its twentieth century Darwinism further challenges the place and importance of individual existence by suggesting, "... in evolutionary time, the individual organism counts for almost nothing ... Its primary function is not even to reproduce other organisms; it reproduces genes, and serves as their temporary carrier."

Human sociobiology brings about its most significant challenge to prevailing wisdom by suggesting that naturally selected genes provide the blueprint for the ENTIRE organism – including the brain, which carries predispositions for ALL behavioral repertoires. The leap from the natural selection of physical attributes to behavioral predisposition and expression of social behavior is the tension. Wilson advanced the concept that the emergence of culture is ultimately an expression of the natural selection of genes coding for those behavioral predispositions, natural selection being a "process whereby certain genes gain representation in the following generations superior to that of other genes located at the same chromosome positions." The environment and experience will then act to shape the trajectory of those genetic predispositions (Wilson, 1975).

Wilson went on to make human sociobiology more accessible in his Pulitzer Prize winning 1978 publication, *On Human Nature*. The question that has defined the most significant intellectual contributions of Wilson's long and prolific career is identified at the outset of *On Human Natur*e; "How does the mind work, and beyond that why does it work in such a way and not another, and from these two considerations together, what is man's ultimate nature?" Along with Charles Lumsden, Wilson also developed sophisticated mathematical modeling for gene culture coevolution in the 1981 book, *Genes, Mind and Culture* – a book that is infrequently referenced, but nonetheless essential to more completely understanding the evolution of human social behavior and culture. They also jointly authored a more accessible version of this 1981 publication, with *Promethean Fire* in 1983. In its own way, each subsequent publication reinforced human sociobiology's focus on mind and humankind's ultimate nature.

Wilson's final chapter of *Sociobiology* asserts his answer to the question of humankind's ultimate nature, "... the biological principles which now appear to be working reasonably well for animals in general can be extended profitably to the social sciences." His sociobiology, as the "new synthesis" of biology and the social sciences was conceptualized to achieve a new naturalism. "But to the extent that new naturalism is true, its pursuit seems certain to generate two great spiritual dilemmas" (Wilson, 1978). The two dilemmas are at the core of *human* sociobiology. Humankind's capacity to resolve the ideological and emotional conflict that results from acknowledging the two dilemmas, and to objectively describe their mechanisms will determine the prospects for the long-term success of our species.

Dilemma 1: "No species, ours included, possesses a purpose beyond the imperatives created by genetic history. Species may have vast potential for material and mental progress but they lack any immanent purpose ... the human mind is constructed in a way that locks it inside this fundamental constraint and forces it to make choices with a purely biological instrument. The human mind is a device for survival and reproduction, and reason is just one of its various techniques." The

implication of this dilemma is that transcendent and defining societal goals quickly diminish in their presumed moral equivalency of war. "In order to search for a new morality based upon a more truthful definition of man, it is necessary to look inward, to dissect the machinery of the mind and to retrace its evolutionary history." Therein lies the basis for the second dilemma.

Dilemma 2: "Innate censors and motivators exist in the brain that deeply and unconsciously affect our ethical premises; from these roots, morality evolved as instinct. Human emotional responses and the more general ethical practices based on them have been programmed to a substantial degree by natural selection over thousands of generations. . .Which of the censors and motivators should be obeyed and which ones might better be curtailed or sublimated? These guides are the very core of our humanity."

Reductionism is explicit in these dilemmas – a reductionism that is essential to the empirical process, yet which is frequently rejected by many academics when applied to humankind and our behavior. Even many of our most accomplished scientists have not resolved their emotional tension regarding the prospect that we are dehumanized by describing our behavior consistent with the laws of biology. "This perception, which equates the method of reduction with the philosophy of diminution, is entirely in error. The proper study of man is, for reasons that now transcend anthropocentrism, man" (Wilson, 1978). Thus, Wilson has advanced sociobiology as the systematic study of the biological basis of all forms of social behavior, in all kinds of organisms, including man. More specifically, sociobiology is ". . . a hybrid discipline derived from ethology, ecology, and genetics in order to derive general principles concerning the biological properties of entire societies" (Lumsden and Wilson, 1981). Sociobiology has accomplished this by reassembling the primary characteristics of social organization from ecology and genetics studied at the population level to show how social groups adapt to the environment by evolution. Ultimately, Wilson seeks application of sociobiology to better understand how we might shape human culture to increase altruism and cooperation in favor of our behavioral predispositions such as aggression and xenophobia. Such self-destructive behavior are relics of the primitive selection conditions that shaped behavior in our evolutionary past.

Wilson advanced a more complete conceptualization of the evolutionary basis for human sociobiology along with Charles Lumsden in the 1981 publication of *Genes, Mind and Culture*. The book offered an in-depth theoretical and mathematical framework for the mechanisms that "connect individual mental development to culture and culture to genetic evolution." With the support of Lumsden, a physicist who extended his research interests into theoretical biology, the book also provided explicit mathematical models for those mechanisms. They suggested that the overarching concept driving the genetic basis of social behavior and culture is *gene-culture coevolution*, a still largely underappreciated concept. They described it as a "complicated, fascinating interaction in which culture is generated and shaped by biological imperatives while biological traits are simultaneously altered by genetic evolution in response to cultural innovation." Sadly, few scholars have given much attention to gene-culture coevolution as a more comprehensive theory than Dawkins' selfish

genes and memes to explain human sociobiology (see Chapter 3 for a brief description of meme theory).

Gene-Culture Coevolution

The years since the appearance of *Genes, Mind and Culture* have been witness to an increasing capacity of social scientists to see beyond their initial rejection of biological causation and natural selection as the drivers of culture. Those years have seen the steady fruition and more widespread acceptance of evolutionary psychology. Lumsden and Wilson suggest that some initial reluctance among scientists might have been generally based on what some called the promethean gene hypothesis, which posits that a group of genes essentially freed the human mind from other genes by their function to provide for only the *capacity* to evolve by culture – not to provide for the kind of rich interactive feedback process described by gene-culture coevolution. *Promethean Fire* (1983) is their attempt to argue that the development of the human mind is not somehow freed from the biological imperatives of gene-culture coevolution. Instead, the seamless fabric of evolution is all-inclusive and needs no special stitching to hold the emergence of human nature and the human mind in place.

More recently, evolutionary psychology has established a more integrated direction for the social sciences toward alignment with the principles of biological evolution. Thus, human social behavior and culture are increasingly viewed by the social sciences as evolving and dynamic biological processes. David Buller (2005) offers a critical examination of evolutionary psychology and its chief contributors in *Adapting Minds*; readers are encouraged to seek out his appraisal of the discipline for a contemporary perspective. The field has generally gotten beyond the early criticisms of human sociobiology as prescriptive and deterministic – criticisms that were far more ideological than rational. Instead, there is a more sophisticated understanding that social behavior and culture are not explicitly prescribed in the genes; rather, they are implied by gene-culture coevolution. In other words, genes coevolve with culture to "prescribe a set of biological processes, called *epigenetic rules* that direct the assembly of the mind" (Lumsden and Wilson, 1981).

Epigenetic rules channel development of individual behavior according to the predispositions coded by the gene ensembles inherited by an organism. Ultimately genetically based, they are a set of biological processes that are both gene dependent and context dependent – context provided by information "derived from culture and physical environment." The human species is not immune to those epigenetic rules. We are as much a product of the coevolutionary processes as all primate species, "each adapted in idiosyncratic ways to particular environments." These paradigm challenging concepts require unfailing vigilance to allay the temptation by critics to irrationally attack their scientific basis. In Wilson's own words, "behavior is not explicit in the genes, and mind cannot be treated as a mere replica of behavioral traits." Rather, "genes prescribe a *set of biological processes* (epigenetic rules) that

direct the assembly of mind." Culture emerges as the collective behavior of many individuals aligning to create cultural patterns. Yet, the behavior of each individual still determines survival and prospects for reproduction – thus, their genetic fitness and the rate at which the gene ensembles dominate or decline within the population.

Epigenetic rules describe a mind as a system that tends to organize into certain forms in preference over others, while the combined action of many minds seems to lead to the emergence of patterns in culture that become statistically predictable. Culture, then, may be described as the mass pattern of mental activity, mental constructs, and behavior emitted by each organism as a result of expressed epigenetic rules. It is the process of social learning that enables the transmission of culture from one generation to another. Mind is the construct that expresses those cultural attributes within the individual organism. In the view of Lumsden and Wilson, genes are linked to culture and the individual construct of mind in a very subtle fashion. That gene-culture linkage achieves so consistent a path in its result across humankind that their biological foundation is a logical conclusion.

The biology of cultural transmission that achieves its ultimate result in the emergence of the human mind is driven by the behavioral attributes of learning and teaching. Lumsden and Wilson specify four capacities related to learning and teaching that appear in order of increasing sophistication: (1) learning – refers to classical conditioning; (2) imitation – defined by simple mimicking; (3) teaching – includes those operantly conditioned behaviors that are often initiated by cuing and (4) reification – the graphic or verbal symbolic representation of conceptual information. These four are the behavioral capacities organisms have evolved that are at the heart of cultural transmission. They can be combined in a variety of ways as means to structure stimuli, environments, and contingencies to channel behavioral response in organisms and, ultimately, to achieve symbolic conceptual representation in the human mind. Most typically, the attributes also appear in this increasing order in most lines of animal evolution. Lumsden and Wilson offer a simple combination of the components to describe five evolutionary grades that might parallel the emergence of cultural behavior. They propose that each species fits within one of the evolutionary grades and that the number of species falls rapidly at each subsequent grade. They suggest that humans alone occupy the final eucultural state defining true culture.

	Learning	*Imitation*	*Teaching*	*Reification*
Acultural I				
Acultural II	X			
Protocultural I	X	X		
Protocultural II	X	X	X	
Eucultural	X	X	X	X

Learning – Respondent conditioning
Imitation – Cue and mimic
Teaching – Cue/mimic and operantly shape
Reification – Symbolic representation what we desire to transmit intergenerationally (words, etc.)

(from: Lumsden and Wilson, 1981. p. 3)

Culture is intergenerationally transmitted by all four attributes. However, reification alone provides the clear separation of humankind from other organisms as it achieves the eucultural state. We achieve that capacity by means of highly structured learning environments (school) that promote specific stages of cognitive development ultimately resulting in the emergence of mental operations enabling sophisticated symbolic representation of abstract conceptual information – the stuff of Wilson's culturgens (memes). Reification (symbolization) assumes the capacity to produce those abstract concepts and continuously reclassify the world in the face of ever-increasing accumulated experiences and "creates order in a world otherwise overwhelmed in flux and detail" (Wilson, 1998).

The developmental nature of those mental operations was the basis of immense research over the last half of the twentieth century – most embodied in the life work of Jean Piaget. The scholarship of Piagetian developmental psychology was important in guiding our understanding that the mental operations required of abstract representation and reification come only after each child moves through a very specific sequence of cognitive development. Each child must first move through (1) a sensorimotor stage limited exclusively to here and now sensory experience, (2) a preoperational stage in which language is first used but significantly limited by both preconceptual and intuitive mistakes that result from inadequate experience and incomplete language, (3) a concrete operations stage in which language is increasingly utilized as a tool of mental representation and classification, but is also limited by concrete representation and category inflexibility, and (4) a formal operations stage that is characterized by reification and our adult capacities for abstract symbolic conceptual representation.

Reification enables the human mind to classify and represent sensory experience, it is a means to represent memories, it associates emotional context to memories and triggers emotional responses, and it is the means by which we transmit information and feeling to others. Lumsden and Wilson (1981) submitted that the attainment of euculture as a result of humankind's increasing capacity to reify was a unique event in the evolution of our species and the emergence of mind. "It was achieved through an acceleration of neuroanatomical and behavioral evolution unprecedented in the history of life. One can visualize the process in almost physical terms: the crossing of a eucultural threshold by the species, followed – perhaps inevitably – by a sustained autocatalytic reaction in which genetic and cultural evolution drove each other forward."

According to Lumsden and Wilson, the human mind as a construct of euculture is represented in *culturgens* – the array of transmissible behavior, mental constructs, and artifacts that denote the basic units of culture. The term *culturgen*, a concept not wholly dissimilar to Dawkins' *meme*, can be defined as generators of culture. The term is derived from *cultura* – Latin for culture and *gen* – Latin for produce. Terms coined by others to correspond to similar concepts include: mnemotype, idea, idene, meme, and sociogene, to name several. Years later, Wilson abdicated the term *culturgen* in favor of Dawkins' *meme*, which had achieved far more regular usage in the academic literature (Wilson, 1998). Regardless of the term presently utilized, Lumsden and Wilson encourage our usage to include within the definition "that

the unit of culture – meme – be the same as the node of semantic memory and its correlates in brain activity. The level of the node . . . determines the complexity of the idea, behavior, or artifact that it helps to sustain in the culture at large (Wilson, 1998).

The unique attributes of human culture that distance us from other species are the result of eucultural reification that enables symbolization of memes and their cross-generational transmission. Such reification is observed to occur only infrequently among other primate species. Hypothetically, culturgens may be passed from one generation to the next by means represented along a continuum defined by three possible worlds of behavioral etiology:

(1) *Pure genetic transmission* that would provide a world in which behavioral choices exist but only one will ever be preferred – a kind of innate determinism. Learning is certainly possible in this world as are other behavioral choices, but actual behavior is rigidly channeled by a mind prewired to respond in a stereotypical fashion.

(2) *Pure cultural transmission* that would produce a mind selecting behavior among equally attractive multiple choices – the ultimate blank slate. Individual behavior would be represented by behavioral choices that depend solely on the environment provided by the culture. Those choices would be easily learned, easily transmitted, and fully independent of biological influence.

(3) A mind produced by *gene-culture transmission* is the world we occupy where learning can make a wide range of behavior possible, but where biological predispositions of the brain make specific choices highly probable. This mind is where "genes and culture are held together by an elastic but unbreakable leash. Culture emerges and advances in development by means of innovation, and the introduction of new ideas and artifacts from the outside. However, it is constrained and directed to some extent by the genes. At the same time, the pressure exerted by cultural innovation affects the survival of the genes and ultimately alters the strength and torque of the genetic leash" (Lumsden and Wilson, 1981).

The coevolutionary "elastic leash" image is accurate in its symbolic representation of function, but is a rather unfortunate phrase choice, in that critics use the pejorative connotations of a leash as a means to suggest a kind of biological determinism and control. The emergence of mind as an outcome of gene-culture coevolution can better be represented by a less controlling image, like that of a rubber band in which the flexible rubber band represents genetic predisposition and the environment produces the stimulus forces that stretch the rubber band. The rubber band will always tend toward a particular position of equilibrium but is not as controlling as a leash. Regardless of descriptive image, mind is the operational construct of gene-culture coevolution – what Wilson calls epigenesis. Mind emerges as the sum of all interactions between genes and the culture that achieve expression in the work of neural mechanisms. That existing culture is the "accumulation of a particular history carried in the memories and archives of those who transmit it." We recognize the accumulation of those memes as culture, "a relatively homogeneous group of mental constructions or their products" (Lumsden and Wilson, 1983). At the same

time, it is the biological wetware of the mind that encodes the accumulated memes within a generation and prepares to represent (reify) them to the next generation.

Individual members within cultural populations contemplate competing memes in relation to any particular environmental circumstance or combination of circumstances in which they might find themselves. The mind arrives at a result among those competing memes and acts upon it. In reality, the process of coevolution suggests that the "choice" has been constrained by the rubber band of gene-culture transmission and, thereby, limited long ago by the dominant behavioral pattern. Out of the vast number of such "choices" across many categories of thought and behavior, culture grows, is reinforced, or slowly alters its form over time. Each "choice" among a vast array of memes that gives direction to behavioral repertoires combines in a rich interaction to produce the "whole" we observe to be culture. The problem of translating the mind directly to culture is similar to the challenge of determining the whole from the sum of individual parts – understanding the interaction of parts that combine to produce culture is far more complicated. Additionally, "minds do not develop independently of other minds; they are powerfully influenced by the decisions already taken by the rest of the society" (Lumsden and Wilson, 1983).

Additional Considerations

The conventional wisdom of most twentieth century social science is that the contemporary history of our species' behavior has been freed from the "constraints" of biology and is shaped solely by the environment. Wilson challenged that wisdom in a profound fashion. His conceptualization of gene-culture coevolution and its operative mechanism of epigenesis initiated a transformation of the behavioral sciences – a field we know today as evolutionary psychology. Unquestionably, his description of epigenesis as the "interaction between genes and the environment that ultimately result in the distinctive anatomical, physiological, cognitive, and behavioral traits of an organism," defines evolutionary psychology. "But in order to have a real evolutionary theory of mind and culture, one must begin with genes and the mechanisms that the genes actually prescribe. In human beings the genes do not specify social behavior." Genes generate the organic processes called epigenetic rules "that feed on culture to assemble the mind and channel its operation" (Lumsden and Wilson, 1981). Epigenetic rules are apparent as we observe the natural selection of variations in behavior that emerge from the interaction among: (1) the operant shaping provided by the imperatives of environmental consequences, (2) the developing contingencies of human social behavior and culture, and (3) the biological expression in neural information processing modules. The greater biological success of certain kinds of social behavior and culture causes the underlying epigenetic rules and their guiding genes to spread through the population. It is the ongoing coevolutionary interaction of those genes and the environment that drives all phenotypic expression of social behavior and culture. Wilson suggests that this rich gene-culture coevolution achieves its finest expression in the human mind – a continually

emerging accumulation of memes that are assimilated via continually emerging epigenetic rules.

The rapidly accumulating research in developmental biology, especially in the newly emerging field of evolutionary developmental biology (evo devo), may hold enormous potential for adding to our understanding of gene-culture coevolution. Evo devo is making rapid progress on explicating the so-called "tool kit" genes and genetic switches, thereby guiding our understanding of the ontogeny of phenotype and epigenetic alterations of gene regulation. The research suggests that expressed phenotypes are not uniquely determined by their genotypes. Rather, the generation of phenotype is dependent on environmental variables that interact with the emerging developmental expression of genotype (Carroll, 2005). Additionally, the extraordinarily extended neotenous condition of the human brain is a variable of notable importance impacting this rich interaction. The work to date has focused on specific observable physical manifestations of mainly fetal development. Future investigations will inevitably explore the emergent physical constituents of the brain that organize the development of behavioral repertoires as an organism moves from its fetal environment into its species-typical environment (Lickliter, 1996). Unquestionably, our better understanding of the evolution of human neural embryology and ontogeny may provide a more complete biological foundation for completing the modern synthesis that leads us to true consilience (Carroll, 2005).

Evo devo is likely to have its most significant influence on our better understanding of human nature by inspiring the advancement of research efforts and conceptual development in evolutionary developmental psychology. As a continuum of interrelated disciplines that emerged in the mid-1980s, the field ranges between cell biology and cultural anthropology, investigating behavioral development by intentionally integrating biological concepts with those from psychology. The clear focus in evolutionary developmental psychology "involves the expression of evolved, epigenetic programs in interaction with an individual's physical and social environment over the course of ontogeny. Central to evolutionary developmental psychology is the idea that there are different adaptive pressures at different times in ontogeny" (Bjorklund and Pellegrini, 2000). Thus, practitioners of evolutionary developmental psychology suggest that studying the discontinuities in the development of an organism's behavioral phenotype will provide insight regarding selection mechanisms that prevail during specific periods of ontogeny – periods that are not necessarily descriptive of behavioral maturation as a seamless continuum from infancy to adulthood.

> *Survival is a problem faced by any organism at any stage of its life span. Because threats to survival can take different forms for organisms of different ages, it is likely that organisms evolve multiple age-specific adaptations for survival during their life span. Therefore, the view that developing organisms may exhibit successive age-specific adaptations and that earlier adaptations may disappear and be replaced by new ones applies well to adaptations for survival.*
>
> *(Maestripieri and Roney, 2006)*

Additionally, a growing body of investigators is pursuing a comparative study focused on nonhuman primates to determine phylogenic relationships among

significantly related species. In reality, Darwin (1872) produced a significant body of work describing his observations of human facial expressions of emotions as potentially nonadaptive homologies of animal expressions. Contemporary comparative research is exploring a range of behavioral attributes that include infant's attachment to the caregiver and female interest during the juvenile period (Maestripieri and Roney, 2006).

Consilience

A congenital synthesizer, I held on to the dream of a unifying theory.

(Wilson, 1994)

Perhaps the most compelling and relevant question regarding any serious consideration of sociobiology and its place in the "modern" or "new" synthesis is one that went decades without being overtly discussed – that is, the appropriate resuscitation of group selection as a feature of multilevel selection. Sociobiology has begged the question regarding multilevel selection and group selection from its outset. And, aside from the notable persistence of David Sloan Wilson (1975, 1983, 2002, and 2008) and several others – Elliott Sober and E.O. Wilson (Sober and Wilson, 1998; Wilson and Wilson, 2007; and Wilson, 2008), the early ideological attacks on Wilson's sociobiology from the likes of Gould and Lewontin were replicated by similar ideological attacks on multilevel selection. Recent antipathy has been more precisely focused on group selection, most notably by Richard Dawkins (1976, 1982 and 1997).

Group selection and multilevel selection, by extension, are out of favor – not necessarily on scientific grounds, but on ideological grounds. Sober and Wilson (1998) have reinvigorated the conversation about multilevel and group selection, doggedly persisting in their pursuit of scientific truth and ideological neutrality. They have returned to the original conceptual framework of Darwin and accepted that group selection can explain both the behavior of social insects and virtuous human behavior. Inasmuch as group selection is still credible, so too is multilevel selection. "A growing number of scientists now find it both uncontroversial and highly insightful to think of natural selection as a process that operates on a nested hierarchy of units. Multilevel selection theory is being used to explore an extraordinary range of phenomena, from the origin of life to the nature of human societies" (Wilson and Sober, 1994 and Wilson and Wilson, 2007).

Multilevel selection theory views every level of the biological hierarchy through the same lens of natural selection. "Natural selection occurs when genes differentially survive and reproduce within single individuals, when individuals differentially survive and reproduce within single groups, and when groups differentially survive and reproduce within a global population" (Sober and Wilson, 1998). Indeed, Darwin (1859) originally first offered the concept of multilevel selection by suggesting that "natural selection takes place at more than one level of the biological hierarchy."

Selfish gene proponents criticize multilevel selection and group selection by stating that selfish behavior always prevails. Wilson (2007) resolved that commonly identified dilemma by suggesting that "selfish individuals might outcompete altruists within groups, but altruistic groups outcompete selfish groups." This is the essence of multilevel selection theory, of which group selection is a part. For its part, group selection favors characteristics that enhance the prospects for survival of a group relative to the other group. If group selection acts effectively, the group may evolve into an adaptive unit and be open to study in the same way individuals can be studied. In Darwin's words:

> *There can be no doubt that a tribe including many members who, from possessing in a high degree the spirit of patriotism, fidelity, obedience, courage and sympathy, were always ready to aid one another, and to sacrifice themselves for the common good would be victorious over most other tribes; and this would be natural selection.*
>
> *(Darwin, 1871)*

Wilson and Wilson (2007) go on to urge full re-evaluation of the 1960s rejection of group selection and the basic logic of multilevel selection theory. In fact, "Rethinking the Theoretical Foundations of Sociobiology" (Wilson and Wilson, 2007) argues that such a "back to basics" approach benefits everyone, "from the most advanced theorist to the student learning sociobiology for the first time." In closing, they submit that:

> *group selection is an important force in human evolution in part because cultural processes have a way of creating phenotypic variation among groups … If a new behavior arises by cultural mutation, it can quickly become the most common behavior within the group and provide the decisive edge in between-group competition … The importance of group selection in human evolution enables our groupish nature to be explained at face value … Thus, multilevel selection, not group selection alone provides a comprehensive framework for understanding human evolution along with other major transitions.*
>
> (*Wilson and Wilson, 2007)*

Certainly, "multilevel selection theory, including group selection, provides an elegant theoretical foundation for sociobiology in the future (Wilson and Wilson, 2007)." This most recent work by Wilson is critical to the continued vitality of sociobiology and clearly represents Wilson's expansive and synthetic intellectual style. It also represents an extremely useful conceptual and empirical pursuit at this point in his distinguished career – a pursuit that rejects the most naïve form of group selection that accepts that behavior evolves for the good of the group. Rather, "traits with public benefits and private costs do evolve by natural selection … the balance between levels of selection needs to be evaluated on a case-by-case basis" (Wilson and Wilson, 2008).

Contemporary sociobiology has much to gain by Wilson's twenty-first century contributions. Many scholars in the field had long anticipated additional seminal contributions from him after a long absence of his sociobiology voice. Following the publication of *Promethean Fire,* Wilson retreated from active publication regarding sociobiology in favor of more aggressive pursuit of his lifelong interest in biodiversity and his newly emerging concept of biophilia (1984). In fact, it is far more likely that recent generations of biologists are acquainted with Wilson for his work

in biodiversity than for his work in sociobiology. After nearly 15 years he exercised his sociobiology voice again; *Consilience*: *The Unity of Knowledge* (1998) was the result. By "unity of knowledge" he intended to challenge the entire intellectual community, including the humanities and fine arts, to become a part of a comprehensive intellectual synthesis that pushed beyond the "new synthesis" of his sociobiology. He proposed that this new "consilience" would achieve a complete knowledge of human nature as it aligned the collective wisdom from each discipline. Further, he proposed that the thread to stitch the fabric into one piece should be a deep understanding of gene-culture coevolution.

Wilson's consilient outcome would be a community of scholars steeped in the wisdom of their own discipline and well-informed about the biological basis of human nature. Such interdisciplinary and synthetic insight would enable the larger academic community to assume a more prominent role in educating humanity to achieve a sustainable future. Until this community of scholars is achieved, "we will continue to drown in information, while starving for wisdom. The world henceforth will be run by synthesizers" (Wilson, 1998). Consilience is a fascinating prospect and an admirable goal – the book is commendable for offering a lucid rationale to that end. Scholars have variously agreed and disagreed whether Wilson was successful in achieving his ambition for the book (Henriques, 2008).

A more pragmatic result accomplished by Wilson in *Consilience* was its contemporary recapitulation of sociobiology after a decade and a half of near silence. That passage of time enabled him to achieve a simple elegance in summarizing the essential principles of gene-culture coevolution for a new generation of readers. The two-time Pulitzer Prize winner is always best represented in his own words. Thus, the following passages are offered from *Consilience* to provide an appropriate summary and closing to this chapter.

> *Culture is created by the communal mind, and each mind in turn is the product of the genetically structured human brain. Genes and culture are therefore inseverably linked. But the linkage is flexible, to a degree still mostly unmeasured. The linkage is also tortuous: Genes prescribe epigenetic rules, which are the neural pathways and regularities in cognitive development by which the individual mind assembles itself. The mind grows from birth to death by absorbing parts of the existing culture available to it, with selections guided through epigenetic rules inherited by the individual brain.*
>
> *As part of gene-culture coevolution, culture is reconstructed each generation collectively in the minds of individuals. When oral tradition is supplemented by writing and art, culture can grow indefinitely large and it can even skip generations. But the fundamental biasing influence of the epigenetic rules, being genetic and ineradicable, stays constant.*
>
> *Some individuals inherit epigenetic rules enabling them to survive and reproduce better in the surrounding environment and culture than individuals who lack those rules, or at least possess them in weaker valence. By this means, over many generations, the more successful epigenetic rules have spread through the population along with the genes that prescribe the rules. As a consequence the human species has evolved genetically by natural selection in behavior, just as it has in the anatomy and physiology of the brain.*
>
> *The nature of the genetic leash and the role of culture can now be better understood as follows. Certain cultural norms also survive and reproduce better than competing norms, causing culture to evolve in a track parallel to and usually much faster than genetic*

> *evolution. The quicker the pace of cultural evolution, the looser the connection between genes and culture, although the connection is never completely broken. Culture allows a rapid adjustment to changes in the environment through finely tuned adaptations invented and transmitted without correspondingly precise genetic prescription. In this respect human beings differ fundamentally from all other animal species. (pp. 127–8)*

These steps can be summed up very briefly as follows:

> *Genes prescribe epigenetic rules, which are the regularities of sensory perception and mental development that animate and channel the acquisition of culture.*
>
> *Culture helps to determine which of the prescribing genes survive and multiply from one generation to the next.*
>
> *Successful new genes alter the epigenetic rules of populations.*
>
> *The altered epigenetic rules change the direction and effectiveness of the channels of cultural acquisition. (p. 157)*

In closing:

> *The brain constantly searches for meaning, for connections between objects and qualities that cross-cut the senses and provide information about external existence. We penetrate that world through the constraining portals of epigenetic rules . . . In order to grasp the human condition, both the genes and culture must be understood, not separately in the traditional manner of science and the humanities, but together, in recognition of the realities of human evolution." (p. 163)*

Resolving the origins of culture may go a long way to resolving the problem of mind. The prospect may exist that our best operational descriptors of mind exist at the intersection of paradigms advanced by Wilson and Skinner. In that context, mind is an emergent expression of the epigenetic process produced by the accumulation of memes that animate epigenesis *and* the feedback mechanism of environmental contingencies (operant shaping) of the behavioral choices considered by the individual. Our vocabulary is inadequate to provide accurate expression to this concept. We are reduced to utilize *mind*, with all its phenomenological and definitional baggage, and *choices*, with all its connotations of conscious action, freedom, and intent, in order to avoid the claims of reductionism and determinism.

With little doubt, mind is a word that represents a biological mechanism that emerges with the interaction of Skinner's three kinds of selection by consequences and their combined relatively proximate and relatively ultimate causal mechanisms. Darwin suggested the possibility that "natural selection has been the most important, but not the exclusive, means of modification." Those closing words from the introduction to *The Origin of Species* anticipated the prospect that so complex a phenomenon – the mind, might require the explanatory power of Skinner's operant selection by consequence, Wilson's gene-culture coevolution partly driven by that operant selection, and an inspired renewal of multilevel selection theory and group selection within the added context of Skinner's three kinds of selection by consequences.