

4. Darwin's challenges and the future of human society

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The challenge of Darwinism is to find out what our genes have been up to, and to make that knowledge widely available as a part of the environment in which each of us develops and lives so that we can decide for ourselves, quite deliberately, to what extent we wish to go along. (Alexander 1979: 136–137)

A hydrogen bomb is an example of mankind's enormous capacity for friendly cooperation. Its construction requires an intricate network of human teams, all working with single-minded devotion toward a common goal. Let us pause and savor the glow of self-congratulation we deserve for belonging to such an intelligent and sociable species. (Robert S. Bigelow 1969, *The Dawn Warriors*)

INTRODUCTION

The Extent of Wars and Genocides

“Human society” is a phrase used to refer to virtually everything about modern humans, presumably living in a civilized manner all over the Earth. But the truth is that we are a frighteningly long way from putting our global human house in order. Leaving aside all other problems, *National Geographic Magazine* (January 2006) reported that 50 million people were killed during the twentieth century in 48 instances of wars and genocides – averages of about 500 000 per year and 1400 per day. Not surprisingly, *National Geographic* labeled the twentieth century, the Killing Century. Other figures, however, indicate 2–3 times as many deaths from wars and genocides in the twentieth century: Scaruffi (2006) estimated 160 million (Sarkees and Wayman 2010; Wayman and Tago 2010).

After a long period of insistence that our pre-industrial ancestors were appropriately characterized as peaceful and gentle nomads, most anthropologists now accept that rates of killing were likely higher in pre-industrial societies than they are today, with 20–30 percent of men dying at the hands of others in their own species (e.g., Ember and Ember 1990). Nevertheless,

the number of deliberate killings in wars and genocides since the American Civil War may have resulted in the deaths of more “modern humans” than existed at any single time prior to what Diamond (1997) called humanity’s “Great Leap Forward,” about 50 000 years ago. It is difficult to believe that we will do better in the twenty-first century.

No one has yet found a way to measure satisfactorily the pain, misery, and suffering that also occur during such mass killings, including permanent physical maiming and disablement, and mental and emotional distress from the savageness of war and the wholesale destruction of fellow human beings (for the month of July 2010, ABC News reported that 32 US military personnel had committed suicide during the previous month, 21 of them while on active duty). Current wars may not be typical of pre-historical conflicts, but reports of their effects suggest that the numbers of people damaged significantly by war, though not killed, are many times higher than the numbers killed.

How many people seriously ponder why human groups persistently become involved in wars and genocides? Given our huge and complex brains, our cognitive abilities, and our capacity for fellowship – given our sympathy and empathy, our ability to be consciously thoughtful, and our confidence that, “deep down,” we are all basically kind and generous – how can we participate in or tolerate killings on such a scale? (“We” is not merely you and I, but every human being on Earth.) Why should the numbers of people killed and mutilated in wars and genocides continue, and even increase, rather than diminishing dramatically as what we call civilization continues to develop and “advance”? What other global issue is more appalling?

The Reciprocating Echoes of Intra-Group Amity and Inter-Group Enmity

Alone among all species, we have been designed by our evolutionary history to accept and routinely promote, within our own species, both intense inter-group competition and intense intra-group cooperation and benevolence. Is it possible that we continue this dual design, this uniquely destructive back-and-forth, not in spite of our tendencies to show affection, cooperativeness, patriotism, and loyalty to kin and friends within our own social groups, but because we use such tendencies to win – to engage and defeat other groups? Have we evolved to exploit the amity that helps us see ourselves as kind and benevolent at least partly because it generates and nurtures the enmity we also see as inevitable, and necessary for success in inter-group competition and war?

We overcome or dismiss distressing war experiences by adjusting our post-war minds and activities to peaceful and tranquil preoccupations.

We return to the harmony of our families and our local communities, and think of ourselves once again as “good people.” We seek gentle life situations, familiar places and people where we can live cooperatively, and where moral rules approach universality and are well understood, such that we can be confident and secure. But do the extremes of these respites actually take their form because they also prime and equip us for the next seemingly unavoidable competitive or violent episode?

Why are the temporary reliefs of being surrounded by local family and community sometimes contrary to caring on a wide or global scale, rather than a part of such caring? Can it be a heritage from our having become so dominant, ecologically, as a species that we were able to turn our attention to others among our own species as new – and enduring – hostile and competitive forces of nature? Is it that, for whatever reasons, we are inclined to justify our hostile acts as necessary – even inevitable – competitions for resources, for more resources, or more of the highest quality of resources: competitions that we typically glorify as reflecting the highest levels of morality, honor, and virtue because they serve our interests? Even if not all of these attitudes are entrenched, we are surely continuing to live with concepts of ourselves that include avarice, cruelty, and self-serving dismissiveness.

Can we deny that the intensity of cooperativeness and loyalty within mostly small and closely knit social groups not only enables them to be successful in competitions, but as well spawns tendencies to characterize members of other competitive and adversarial groups as inferior, sub-human, stupid, ignorant, misguided, wicked, depraved, and worse. Across much of the twentieth century, newspapers were liberally sprinkled with unmistakably ape-ish cartoons of our adversaries in World War II. Such tendencies have also led to acceptance of absolute authority in moral and religious matters, expressed both in the extreme cooperativeness of the members of groups and in the alienation between competitive groups that regards adversaries or enemies as negative and evil, and often applies vicious derogation to merely “different” groups. In these considerations, what is accepted as “right” or “good” is likely to be whatever best perpetuates the established moral influence and generates willingness to cooperate completely and sacrifice for the members of one’s own group (Alexander 1987).

Shouldn’t we all like to know a great deal more about how we got to be as we are now – why terribly destructive things keep on happening and are all too often treated as justifiable or inevitable? How did we acquire the consciousness that causes us to regard as essential the all-out inter-group competitions that plague our possibilities of living peacefully; the consciousness that also allows us, all too easily, to step back and dismiss or

tolerate the immediately previous ravages of inter-group hostility and war? Wouldn't knowledge of our history and the directions of our evolutionary background help us do something about the almost constant flow of these grotesque happenings?

The uniquely human tendency to engage almost continually in inter-group competitions and conflicts within our own species has spawned the set of evolutionary adaptations that more than any other has shaped the human species and accounts for virtually all of what might be called its major unique traits (Alexander 1990b, 2008). This tendency could not have become paramount until humans had achieved degrees of contentious dominance, involving sizable social groups, which enabled them to gain more by transferring investment in calories and risk-taking in within-species competitions than is apparently the case in any others among the tens of millions of living species.

Darwin (*Origin of Species*, 1936 [1859, 1871]) identified the hostile forces of nature responsible for natural selection, the principal guiding force of the evolutionary process, as predators, parasites, diseases, food shortages, climate, and weather (cf. Alexander 1979: 15–18). These threats primarily involve as worst enemies either other species or non-living forces. Darwin also included within-species conflicts such as sexual and social competition, and he was keenly aware of the importance of inter-group, within-species competition. But humans went a huge step further when they caused inter-group competition and conflict to become (uniquely) the main force of selection on the human species (Wrangham 1999; Alexander 1969, 2009, and references therein).

We have successfully marched our understanding and uses of rules and cooperation from family-like units to the levels of nations and alliances of nations. But we have not concomitantly alleviated the destructiveness of such grand affiliations. Nor have we successfully prevented or reduced the continuing development of ever more dreadful contrivances designed solely for deliberately destroying other humans.

I have emphasized wars and their effects, and brought up the unholy capability and willingness to turn closely knit groups into fighting machines. I believe that what we must seek to understand, and change, is by a large margin the most terrible puzzle of our world. Courts of law routinely settle disputes over careless or even inadvertent deaths or maimings of single individuals for millions of dollars. To say the least, we do not behave comparably toward slaughtered or damaged military personnel or their families, or toward civilians either deliberately or incidentally slain during war, unless we are willing to claim that merely honoring those killed and incapacitated by war is acceptable as appropriate compensation.

SOCIAL CHANGES AND BILATERAL KINSHIP SYSTEMS

Introduction

Bilateral kinship systems became possible when concealment of ovulation by females in multi-male bands of humans enabled recognition of both parents, hence both sets of family relationships, not merely those in the mother's family (Alexander and Noonan 1979; Alexander 1979, 1990a, 2008). Humans in multi-male groups became able to socially learn to recognize variations in genetic relatedness on both sides of the family, and eventually trace and remember the collective genealogies of their social groups. Everyone could thereby maximize the transgenerational persistence of their genes, not merely by producing and tending offspring, but as well through beneficence to both descendant and collateral (non-descendant) relatives (Hamilton 1964). Whether we like it or not, transgenerational persistence of some genes while others are disappearing is the main consequence of organic evolution. And it is what all whole organisms strive for, more or less exclusively, whether or not we humans are fully aware of the effects on ourselves or how they come about (Alexander 1990a). Even if organic evolution is a slow process, we need to consider the long history of cumulative changes that have made us what we are – at least until we learn how to override some of our less admirable tendencies.

Concealment of Ovulation: The Enabler of Within-Group Collaboration

Humans, chimpanzees, and bonobos all live in multi-male groups, but, among extant apes, only humans, in which females do not recognize or blatantly advertise ovulation, are able to discriminate nepotistically among a wide variety of genetic relatives. In most life situations, human males cannot or do not distinguish ovulating females from others that are not ovulating. In multi-male mammal social groups, only with sufficiently and appropriately concealed ovulation can there be high levels of confidence of paternity (recognition of fatherhood), hence strong and lasting parental and spousal bonds, and long-term biparental care. Only in humans with appropriately concealed ovulation have the bonds of parental care and differential nepotism provided the uniquely extensive bilateral systems of kinship that have functioned across history in tightly knit human social groups of up to several hundreds of individuals.

The evolution of durable spousal and parental bonds has enabled a flood of unique features characterizing the human species: the extreme altriciality and long juvenile life of human offspring, the expanded and

lengthened learning lives of juveniles, the cessation of production of offspring in mid-life in favor of extensive tending of diverse kin (in women, termed menopause), the uniquely extreme complexity of function and size of the human brain, and the doubling of the adult human lifetime compared to extant ape species (Alexander 1990a, 2008). The dramatically increased lifetime of humans necessarily occurred via slowing of senescence, owing to significant genetic reproduction caused by the rise of assistance to increasing numbers of genetic kin in later life. Increased reproduction, via nepotism in late life, alters evolutionary selection by favoring gene effects that would not have persisted without the significant late reproductive gains that facilitated the extensive kinship contributions and unity of the small groups that have continued to characterize modern humans (Williams 1957; Alexander 1987, 1990a, 2008).

Effects of Incomplete and Adaptively Concealed Consciousness

The elaborate consciousness of modern humans falls short of revealing to us that particular evolved reductions or cloakings of consciousness have enabled us to function more effectively in evolutionary or reproductive terms. But, along with our incredibly keen consciousness, we have evolved to ignore, dismiss, forget, or fail to recognize many life situations or consequences, and this is at least part of the reason for our difficulties in removing effects of our evolutionary background in the interest of solving problems such as war and its violent relatives.

Two categories of problems are involved in attempts to teach people how to understand biological events or phenomena that are not initially conscious. The first consists of items that merely have not been appropriately proximal to conscious-raising possibilities or explicitly alerted to individual consciousness (e.g., our historically inaccessible knowledge of the existence of genes and other microscopic physical and biological structures). This first category includes two possibilities: (1) items that can be easily and quickly taught and learned because such knowledge yields more or less obvious advantages that are often immediately understandable to the generally conscious learner (for example, the usefulness of language and arithmetic); and (2) items that are not learned easily because they are difficult to grasp, even without a history of evolutionary selection against specific conscious understanding (for example, the extent and nature of the physical universe). For such items we have been prone to fanciful and erroneous interpretations.

The second category includes items for which consciousness has been masked or disguised by evolutionary selection. Ovulation, for example,

does not have to be concealed consciously to yield bilateral kinship recognition in multi-male groups. No deliberate or conscious efforts to conceal ovulation, or even understanding of such concealment, are required – at least not in the current social environment. Nor should we expect complete inability of modern human females to know about or recognize their own ovulation. Modern women sometimes discover technological or incidental means of detecting ovulation reliably (e.g., thermometers, particular kinds and timing of discomfort or headaches, and other slight or barely noticeable changes). Modern men may sometimes detect ovulation, especially in closely bonded mates. Some reports, however, have indicated that in pre-technological or pre-industrial peoples, neither men nor women were aware of not only the significance of ovulation but also its actual existence and function. Nevertheless they obviously gained the ability to contrive mating opportunities facilitated by effective spousal and parental bonds that have provided accurate recognition of fatherhood (summarized from Alexander 1990a, 2008). It is likely that patterns of sexual behavior between parentally bonded spouses tend to acquire the function of social bonding and as a result assume patterns and frequencies in which ovulation results in pregnancy incidentally.

It is difficult for us to accept that evolutionarily adaptive concealing or cloaking of consciousness could improve our lives. It seems opposite to our sensitivity and pride, and this is perhaps a large part of the reason for our difficulties in finding ways to understand interactions between: (1) closely-knit local groups and their temporary national and international coalitions; and (2) inter-group competitions at all levels.

The astonishing complexity of detailed bilateral kinship patterns in pre-technological human societies studied by anthropologists supports the above arguments and promotes commonality of interests within small social groups (Alexander 1979, 1990a, 1990b, 1991, 2008). Coincidentally, complex features of kin recognition were surely instrumental in the evolution of the unique human intellect (Hamilton 1964; Humphrey 1976; Alexander 1987, 1989, 1990b, 1991). In turn, the bilateral kinship system and the expanding human intellect enabled late-life assistance of both descendant and collateral kin over the production of additional offspring, hence the doubling of human lifetimes, compared to the lifetimes of the 14 ape species that are the closest extant relatives of humans (Alexander 2008).

Consequences of Humans Evolving to be Their Own Principal Hostile Force of Nature

We really do not know what kind of predators, if any, might have been involved in the steady increase in man's brain size, and, as much as we may dislike the idea, I believe the possibility still exists that man is the only one that could have done the job. (Alexander 1969: 495)

In a 1967 lecture in an international University of Michigan systematics symposium, sponsored by the National Academy of Sciences, I suggested that humans have become their own principal hostile force of nature. So far as I am aware, no other species has done this. To reduce the continuing destructiveness of the human species we must understand what trends take place in the sociality of a group-living species when its groups have become the sources of war – the driving forces of evolutionary change for all the groups in our species. Multiple questions arise, concerning this situation. Will within-species interactions accelerate evolutionary change for unusual reasons; for example effects of inter-group interbreeding, resulting in new combinations of useful traits via winners co-parenting with winners? These are reasons that would not have the same effects in species that run the selective gauntlet against species other than their own. Have social groups, as a result, tended to become rapidly more aggressive, more powerful, more inclined to wage war, and more capable of it? Have there been tendencies for increasingly effective organization of adversarial groups? How can we best influence continuing changes in social organizing and leadership tendencies so as to disfavor persistent and increasingly devastating wars? What relationship is likely to unfold between the repeated waging of wars and the reciprocating returns to our small closely knit groups of kin and reciprocity investors? How many of the observable and not so observable trends of these topics tend to worsen rather than alleviate human destructiveness? How can we influence such trends? Will humans generate unpreventable “echo” systems of deadly warring in which local groups are expanded and increasingly organized by the social, legal, moral, and other behavior systems from families and local groups up to nations and alliances of nations? What relationships are likely to unfold between the repeated waging of wars and the repeated returns to small closely knit groups of relatives championing local and absolute systems of morality?

Large Groups and Global Problems

Inter-group competition has obviously led to ever-increasing group sizes, initially facilitated by parental bonds leading to the unity of bilateral kinship systems in multi-male groups. The continuing evolution of

intellect, and the correlated doubling of the human lifetime, compared to those of all our closest relatives among the extent apes, have contributed to the organizing and maintaining of progressively larger, more complex, more powerful groups capable of defending themselves against other such groups (Alexander 1987, 1990a, 2008).

Larger social groups become more difficult to maintain, and are benefited by competent leaders. Leaders in multi-male groups of intelligent humans tend to function as authoritative figures. In turn, morality becomes a prominent unifying theme, further emphasizing internal group harmony and cohesion as well as inter-group differences often leading to competitiveness and war.

Nowadays, apparently for the first time in history, we are acknowledging that we have generated global problems – involving at least war, overpopulation, environmental pollution, human-induced climatic warming, and resource depletion. These global problems can only be solved in ways that will be at least temporarily (and also variably) expensive to everyone; even though in the end far less expensive than if we do not confront and solve them. Reducing or eliminating the waging of war is the one change that potentially can massively reduce expense. The question is: can humans cooperate successfully on a global scale, particularly when different groups retain the tendency to compete; when everyone is likely to suffer temporary and sometimes unpredictable expense in acts of cooperation; and when everyone has strong probability of realizing all too consciously that the effort will be more costly for them than for some others?

There seems to be no evidence that humans have ever behaved as a single global cooperative population. The International Olympic Committee might be held up as a symbolic example. It is surely not trivial that the theme of the Olympics is athletic competition among nations. Most biologists view play as practice in low-cost, restricted situations (for example, a football, soccer, or basketball game) for full-cost situations involving all-out deadly competitions (for example, on a field of war). It is also no accident that, evidently alone among all species, humans play competitively, group against group, almost certainly as unknowing practice models for serious inter-group competition, or war (Alexander 1979, 1987, 1989, 1990a).

Some of us may live long enough to find out what can be accomplished that will lead to global cooperation. The answer, I believe, will be discovered among the biases – both conscious and unconscious – that differential reproduction, the principal and inexorable guiding force of evolution, has produced in us. It is probably more difficult than most people think, but surely not impossible, to go against a long history of adaptive change.

UNDERSTANDING EVOLUTION TO UNDERSTAND OURSELVES

Introduction

I have argued that the fastest and most reliable way to change ourselves in order to reduce the slaughter within our species, solve other growing global problems, and create a more secure, contented, and socially positive human population, is to maximize on a wide scale – in detail, accurately, and at long last – deep understanding of the evolutionary process that has constructed us. We need to know how evolution has affected us as singular, whole, functioning individuals, as social groups, and why evolution has prohibited us from knowing many things about the most important features of our species, and about ourselves as individuals. We seem to have two fruitful strategies: (1) use the components of our evolved within-group cooperativeness to diminish rather than enhance destructive between-group competition; and (2) work consciously against evolved tendencies that lead to global and other dire problems. Unfortunately, efforts with the first of these possibilities have mainly elevated the size and power of competitive groups that we call nations (and alliances of nations) with the result that the potential for destructiveness has become even more appalling.

It is likely that the vast majority of people in the world know little or nothing about organic evolution and the role of evolutionary adaptation in the makeup of their lives. Perhaps most know only the word “evolution,” and little else about it. Most of those still not included are almost certainly to one degree or another hostile to the concept of evolution, and either deny that the process exists, deny that it is important, or perhaps regard it as an instrument of some evil force adversarial to their religion, their ethics, or their local group’s way of thinking. Most of the tiny number left after all such exclusions, who may not be negative about evolution, are nevertheless unlikely to be experts regarding the evolutionary process and its significance to humans. Finally, even people who understand evolution profoundly often are reluctant to openly deliver honest, detailed, or complete descriptions of evolution and its past, even for the purpose of teaching humans how to get along, how to reduce or eliminate the worst things humans do; perhaps because if evolution operates as it seems to, we might think of ourselves as unable to change the situation. But we can accept that much of what evolution has done to us, and continues to do to us, can be reversed or altered as a result of our ability to use our evolved learning abilities to override our history of natural selection. It is an important aspect of this suggestion that we learn how to deal with what I have termed “cloaked consciousness.”

I think of current evolutionary understanding this way: if we could imagine a darkened map of the world, perhaps with different colored lights for different degrees of understanding, those who not only have a deep knowledge of evolution, but as well are willing and eager to consider seriously and openly how it relates to the nature and behavior of human beings, would be represented by an extremely thin scattering around the world of pinpoint lights so tiny that without extreme magnification we could not make the map large enough even to see them. I believe we desperately need to change this situation, so that we can decide how far to go along with, or resist, the results of our history of genetic changes.

Darwin's First Challenge

In the effort to realize the immediately previous considerations, I will go directly now to what I call Darwin's First Challenge, because it is the most general challenge in Darwin's 1859 book *On the Origin of Species*. I will briefly discuss some other challenges and statements, and proceed toward an explanation of the biases that the evolutionary process has generated in our makeup; for example, the specificities of our learning abilities and tendencies and the distribution of consciousness and its absence. Finally, I will attempt to generate an exhaustive list of the general classes of the positive social behaviors of humans, how they fit together to describe and define human sociality, and how the proximate mechanisms underlying social behaviors can help us in assessing the significance of social and benevolent behaviors. These are the relevant vehicles, or background, of our hopes to remake human society as a unified, harmonious world population.

1. If it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down. (Darwin 1936 [1859, 1871]: 189)

When Darwin set out the challenges for his theory of how all of life evolved, he was undertaking explanation of one of the greatest profusions of complexity humans have ever had opportunity to consider. In effect, he virtually formalized, or at least reinforced, a particular axis of opposites: on the one hand, science as open and continuing investigation of all cause-effect relations in the entire universe; and on the other hand, religion and patriotism as bastions of morality and authoritative absolutism, and social cooperativeness as essential, therefore sacred. These two routes to knowledge and cooperativeness have continued, and remain adversarial. To solve global problems, we need to explain why the repeated probing of

science and adamant adherence to authority-based rules exist in a kind of stalemate, and what we can do to make them compatible.

Darwin's various challenges were mostly in the form of hypotheses that if rejected would destroy his general theory. Hypotheses are surely the most important part of science. Grand and informed hypotheses, of the sort Darwin presented to us so long ago, are the ultimate intellectual stimulants to students of cause and effect in the world at large.

Darwin declared that, under certain conditions that he described, his general theory of life would absolutely break down. He did not say that if complex organs could be formed in ways other than as he indicates, his theory might break down, might have to be modified, or might be weakened or less useful, or any such thing. He did not rest until he had worked out a statement that, if true, would cause his theory, of how the entire world of life had come about, to absolutely break down. Such unequivocal falsification efforts best encourage the testing of scientific ideas. This 150-year-old example is an early such challenge, and surely one of the first clear and truly beautiful ones. Not surprisingly, his theory has never been successfully challenged, or falsified.

For at least three reasons falsification efforts are better than efforts to support a theory (Alexander 1988). First, when we are trying to support our own theory our bias is in the wrong direction. Whether or not we know it, we tend to see support everywhere, and to ignore possible falsifiers. Second, whatever supports our theory may, unknown to us, also be supporting one or several other theories. Third, however well we are able to support a particular theory, there may be another theory, totally unknown to us or not, that is better supported. Even successful falsifying of every theory of which we are aware, except our own, will not mean that the one theory remaining is the right one; unless we try with all our might, and in a continuing way, to falsify it. Even so, scientific or any other kind of investigation cannot absolutely demonstrate that a theory is entirely correct: to get things straight, scientific work must continue indefinitely. With his first challenge, however, Charles Darwin showed us – so very long ago – how best to set up a first-rate scientific investigation and carry it out.

The philosopher Karl Popper is generally given credit for introducing and explaining falsification in science (e.g., Popper 1963). He surely wrote more on the specific topic than anyone else, and explained its nature and importance well. Nevertheless, Darwin was presenting falsification challenges beautifully, with respect to actual, massively important, and ultimately difficult problems, long before 1902, when Popper was born. It is therefore ironic that until near the end of his life Karl Popper regarded evolution as metaphysical. I am not aware that he ever wrote explicitly of Darwin's challenges.

Seeking to falsify hypotheses and theories involves empirical work of various sorts, from merely thinking about already known facts until one or more of them either falsifies relevant propositions at hand or strengthens them by failure to falsify, to extensive and tedious gathering and statistical analysis of previously unexplored quantitative information that can become conclusive data. Nothing makes empirical work more effective than hypotheses of the sort Darwin proposed.

With regard to usefulness, what have by some been derogatorily called “adaptive stories” are potentially no less useful, or honorable, than what the Nobel Laureate Richard Feynman called the “guesses” that constitute the first steps in scientific procedures. As Feynman noted, hypotheses, or guesses, must be tested, and if they do not pass the tests, they must be discarded. The stream of worthwhile scientific discovery thus begins with the generation of grand hypotheses. As crucial as is reliable and thorough testing of hypotheses, it cannot rescue inferior or trivial hypotheses. Nothing is more frustrating and pointless than seeking to test a mediocre hypothesis. Mediocre hypotheses sometimes involve trivial topics, and sometimes have no possibility of being falsified, not because they might be wrong but because they are so constructed, or conceived, as to present only vague possibilities of showing how the premise involved could indeed be wrong.

Whenever we falsify a theory, that theory, or idea, is finished. We must seek another theory if we are to continue trying to explain the problem that stimulated the original theory. When we generate or locate a theory that we cannot falsify, especially about a massive and complicated problem such as the explanation of all life on earth – as Darwin apparently did repeatedly – then we are surely making scientific progress. When efforts at falsification fail consistently, scientists accept the theory, tentatively, and go on to new hypotheses and theories, dependent on the still not falsified theory. Science progresses through the generation and testing of sequences of interdependent theories, leading to increasing understanding of the phenomena being investigated. In a sense the entire body of science remains tentative, because absoluteness is not achievable at any stage. Because science is never absolute, scientists are forever returning to some earlier stage of their investigation, correcting a minor or major error, and proceeding once again. Despite the inescapable frustration of those who try to use results of science that are still in the process of refinement, there is no better way of establishing facts.

In my opinion there should be no quarrel with people who emphasize in their lives the importance of absolute faith. All of us depend now and then, and in some arenas virtually all the time, on information handed to us by others, in various forms and from various sources of authority, whether a holy book, a religious or other leader, a jural system, the constitution

and other documents of our organizations or our nation, or simply a commonly understood and accepted local pattern of social precedents. Faith, in this sense, is a necessary – though always tentative – aspect of life because none of us has the time or knowledge to figure out everything for ourselves. Moreover, in some arenas of human life the rules of human social behavior, in particular, are always more stringent than other facts about life; more nearly approaching absoluteness in the sense of universal agreement and universal approbation for missteps or violations. Morality is the parade example. This is true even though, undeniably and also paradoxically, part of the universality and insistence on absoluteness in any moral system stems from the interactions of different groups of people following different and sometimes incompatible sets of “absolute” moral rules (Alexander 1987, 1993). Such seeming arbitrariness can happen because the most important thing about morality often is judged, or accepted, not by the nature of the rules adhered to – not even by fairness or justice – but by the secure knowledge that the members of the group associated with a particular moral system are sufficiently patriotic (cooperative, trustworthy, dependable, willing, and loyal) as to further the interests of the component members and the future of the local and, unfortunately, exclusive group. This circumstance arises out of the dominating influences derived from the universal inter-group competitions alluded to earlier, and responsible for the negativism and horrific slaughter associated with warfare and genocide. Somewhere, sometime, a clever wag was perhaps more on target than he or she realized by saying that, “Justice really means Just-Us.”

It is one thing to practice faith in the ways and situations just described, but quite another to use authority to attempt to deny humans the right to discover, describe, and utilize facts about the natural world, or to attempt to restrict the areas in which such investigations of the natural world can proceed. All of us depend not only on faith – which nearly always derives from some kind of accepted or revered authority – but also on facts about the natural world that have been generated or demonstrated during extensive and careful open-minded study and testing. The most serious questions arise when moral authority and scientifically discovered facts seem to clash. Moral rules are preserved as absolutes because it is so important for all of us to know how and when to cooperate willingly, or completely. There is expectation that if any moral rule is broken, or changed, the entire social system of right and wrong might be damaged. Some of these clashes occur because the paradigms underlying our disciplines and beliefs – including both religion and early science – were established so long ago, and so solidly, that new discoveries and their effects are difficult to accept. After all, religion is hundreds or thousands of years old; although philosophy does go back two millenia, the supporting sciences are fairly young:

anthropology is only a century and a half old and other social sciences began to mature a century ago. And yet, not until George C. Williams (1966) wrote *Adaptation and Natural Selection* did we have clear – scattered but convincing – realizations of how natural selection actually works: how evolutionary adaptation comes about.

It is easy for those in power to declare or maintain that some aspect of human existence must be treated as factual, and also difficult for scientists to approach absoluteness in their searches for evidence, reliability, and truth. But everything about life is probabilistic. I admit to puzzlement in the presence of people who claim or believe that every aspect of their lives operates entirely on absolute faith rather than on a compatible mix of faith and personal exploration and investigation, subject to adjustment when new information demands it. I also admit that I am disappointed when people assert (as did at least three of the candidates who most recently sought to gain the presidency of the United States) that they do not “believe” in evolution, even though that process is simple to observe and understand in its basics, and is to all indications universal and ongoing continually among all forms of life. Evolution has been studied extensively and accepted since Darwin by many of the best and most careful minds ever engaged in exploration of the natural world. Denials of well-established realities – because of zeal to maintain adherence to beliefs that may be wildly unlikely, that have been solidly demonstrated to be false or to involve an entirely different topic or basis, or that are being avoided in an untruthful way to woo “voters” – are incompatible with reality. They lead to unnecessary and unresolvable conflicts, both within and between human groups (Alexander 1978). Perhaps we somehow sense that exposing ourselves as having evolved, bringing to light all the details of our evolved motivations and tendencies, laying bare every competitive strategy, would be like revealing all the dark corners in the basements of our personal lives, in the kind of autobiographical exposé Stanley Elkin (1993) declared is unlikely to become public (Elkin referred to “the nasty hoard” in the “secret cellar”). Yet, almost certainly, we must do something of this sort globally if we are interested in understanding ourselves well enough to solve the problems discussed in this chapter.

Returning to Darwin's first challenge, some of my students and fellow biologists have suggested that this challenge is impossible to test because, among all of life's forms, there are far too many complex organs to examine every one to see if each of them matches Darwin's proposition. As a result, these skeptics said, no one would ever try to demonstrate an exception to such a challenge. But Darwin was not suggesting that anyone should be required, or should try, to examine every single complex organ of every individual organism on earth. Instead he was inviting any or all of us to choose

just one organ – any complex organ – really, almost any structure or function of life that had to come about in the way that Darwin's first challenge specifies. He was telling us that we can select the one or ones we personally regard as most likely to meet his challenge. Moreover, the challenge continues, precisely the same today as it was when Darwin initially presented it. Barring falsification, it will stand forever. Any skeptic at any time can choose another complicated organ and try again, as many times as is desired or required.

I confess that when I first read this particular challenge of Darwin's, I thought it obscure and trivial. I wondered what was all the fuss about "numerous, successive, slight modifications." Eventually it dawned on me that Darwin was talking about the entire world of life: everything alive and everything that had ever lived. He was telling us one way to identify consequences of natural selection, across the billions of years that life has existed on earth.

It is worthwhile to consider for a moment the immensity of the phenomenon Darwin sought to encompass in his various challenges. Modern systematists estimate that there may be as many as 30–50 million species. Almost any one of these tens of millions of species can be composed of up to virtually countless individuals, each one of which is unique, even including monozygotic twins because of the innumerable internal and external, large and small environmental changes that vary across different lifetimes. Every one of these countless individuals may possess tens of thousands of genes and be made up of as many as tens of trillions of cells. Normally, every body cell carries a complete set of genes and, even though groups of cells are collectively specialized to function within complex arrays of organs and tissues, each cell is by itself a separate machine of incredible complexity, also going through a unique sequence of change as a result of a succession of internal and external environments. The human brain alone is incredibly complex, involving millions of neuronal changes that can occur within a split second, and that provide us with the ability to make uncountable numbers of behaviorally appropriate decisions across our entire lifetimes in an ever-changing and complicated world (consider the number of split seconds and the number of small and large, internal and external environmental variations in a single human lifetime). This staggering parade of innumerable and changing units, combinations, and variations, with – in most cases – each individual beginning from a single fertilized cell, is the foundation from which we must try to understand the immense complexity of life. And, in the end, we must understand the whole organism, not merely its parts, despite the obvious importance of modern reductionistic biology. It is clear that the persisting parts of the organism are designed and coordinated so as to cause every trait expression of the organism to serve its overall genetic reproduction.

Exactly what did Darwin mean by numerous, successive, slight modifications? How did he even come to speak of them? I do not think we can know what was in his mind, and I cannot say whether anyone else has actually taken up this question. Darwin often spoke of traits, and if that is what he meant he surely would have used that word in his discussion of this first challenge. He did not, however, use even the term “variations,” but rather “modifications,” suggesting that he was thinking of variations that arise somehow, thus becoming modifications. Whatever terms he used, he could not have referred directly to the genes and mutations that underlie traits because genes were not known until around the start of the twentieth century. There is apparently no evidence that Darwin ever knew about Mendel’s early work, at least sufficiently that he could have adopted Mendel’s term, “factors.” He is said to have had a copy of one of Mendel’s papers on his desk when he died, but it had never been unwrapped and read.

Anyone who considers traits of organisms that can be easily observed across several to many generations, such as in most domestic animals and plants, could have recognized that trait expressions can change in small increments. Perhaps this is what convinced Darwin to make his challenge regarding numerous, successive, slight modifications. He not only wrote scientifically about a wide array of different “wild” organisms, but also paid a good deal of attention to domestic animals and plants: for example, raising and breeding pigeons and discussing their traits, and their trait expressions and variations. He often used domestic animals and plants in his discussions of changes brought about by natural selection, as well as by “artificial” or human-mediated selection.

It would appear that, by numerous, successive, slight modifications, Darwin was describing how he thought natural selection, or differential reproduction, takes place. In effect, the challenge he issued meant that if complex organs, or whole organisms, have come about in any way other than by natural selection of small changes that persisted – for example, if they came about as a result of creation by “intelligent design” by a supernatural force or being – that process would have worked exactly as he understood natural selection to work. This conclusion, if correct, means that there is no reason for anyone to reject the scientific study of the evolution of life.

Albert Einstein, who spoke of mind pictures and hypothesis testing, completed the general theory of relativity in his brain and tested it there so thoroughly that he was confident that: ‘The result could not be otherwise than correct. I was only concerned with putting the answer into a lucid form. I did not for one second doubt that it would agree with observation’ (Clark 1971: 259).

Anonymous: *How did you discover the law of gravitation?*

Newton: *By thinking about it all the time.* (Frank 2001: 211)

The Components and Structure of the Evolutionary Process

Let us consider for a moment the nature of life and evolution, beginning with gene mutations. Gene mutations are the basic source of modifications of the size and prevalence that makes them the likely candidate for the vast majority of Darwin's numerous, successive, slight modifications (NSSM).

Today we know a great deal about how gene mutations relate to the structures and functions of organisms. Nevertheless, anyone can walk into a bookstore and find more than a few current books revealing that not even the most basic things about evolution are well understood by a good many of those making an effort to discuss the topic (cf. Parens et al. 2008). In 1979 I tried to outline the components and structure of the evolutionary process in *Darwinism and Human Affairs* (Alexander 1979: 15ff.). Whatever may be inadequate in my effort, I doubt that I can improve on that 35-year-old description. I will repeat most of it here because I think everyone who considers the topics in this chapter needs to know what natural selection is all about, and why it is regarded as the principal guiding force in the evolutionary process:

A theory is said to be a simple set of propositions that provides a large number of explanations. Einstein noted that 'a theory is the more impressive the greater is the simplicity of its premises, the more different are the kinds of things it relates and the more extended is its range of applicability.' Although he was not referring to evolutionary theory his statement could scarcely have applied more appropriately. For all that it purports to explain, evolutionary theory is based on a remarkably simple set of propositions. The process from which it stems derives from the interactions of five basic phenomena:

Inheritance: All living organisms (phenotypes) are products of the interaction of their genetic materials (genotypes) with their developmental (ontogenetic) environments; these genetic materials (genes, chromosomes) can be passed from generation to generation unchanged. Without inheritance there could not be cumulative change. [Learning of learned behaviors is cumulative in culture, paralleling cumulative change in the genetic materials.]

Mutation: The genetic materials do change occasionally, and these changes are in turn heritable. Without mutations there would be no continuing source of change (in forms lacking culture).

Selection: All genetic lines do not reproduce equally, and the causes of the variation may be consistent for long periods. Without selection there would be no direction to cumulative changes.

Isolation: Not all genetic lines are able, for various intrinsic and extrinsic reasons, to interbreed freely, and thus continually to re-amalgamate their differences. Thus, some populations cannot interbreed because they are spatially or temporally (extrinsically) separated; others are so genetically (intrinsically)

different as to preclude hybridization. Without isolation there would be but a single species.

Drift: Genetic materials are sometimes lost through accidents, which are by definition random or non-repetitive in their effects on populations. The main effect of genetic drift is to reduce the influence of selection, especially in very small populations; evolution could, of course, occur without drift.

These five phenomena have all been demonstrated repeatedly, and they can be demonstrated at will, as can some of their interactions. No living things have been demonstrated to lack any of them. Hence, they may be described as the *factual* basis of evolution.

The theory of evolution, then, is the proposition that the effects and interactions of these five phenomena, in the successions of environments in which organisms have lived, account for the traits and history of all forms of life. The challenge we face here is how to apply this simple proposition toward a better understanding of human sociality.

Of the five main components of the evolutionary process, natural selection, or the differential reproduction of genetic variants, is generally accepted as the principal guiding force. The reasons for this acceptance are not commonly discussed; it seems to me that there are at least three. First, altering the directions of selection apparently always alters the directions of change in organisms; this indicates that evolutionary change does not depend for its rate upon the appearance of mutations. Second, the causes of mutation and the causes of selection appear to be independent; and, third, only the causes of selection remain consistently directional for long periods, and, hence, could explain long-term directional changes.

Mutations are caused, at least chiefly in the past, by atmospheric radiation or, perhaps, by internal chemical events still poorly understood (Suzuki and Griffiths 1976). Selection, however, is caused by extrinsic phenomena that Darwin termed the "Hostile Forces of Nature": climate, weather, food shortages, predators, parasites, and diseases. This list implies competition for resources, such as food and shelter from the other hostile forces. Accordingly, for all sexual species, we must include competition for mates as a selective factor . . .

The competition involved in natural and sexual selection is not just for the greatest quantity of resources but also for the highest quality. Those organisms will out-reproduce that use the least energy and take the lowest risks in securing the highest quality and quantity of resources and converting them into their own genetic materials.

Because directions of mutation evidently are random with respect to directions of evolution, mutational changes as such are independent of adaptation, or the behavioral, physiological, and morphological fine tuning that organisms exhibit in response to their physical and biotic environments. The same is true of genetic drift, for by definition its causes are without cumulative directional effects on the genetic materials. This means, first, that as evolutionary adaptation proceeds, mutations must increasingly tend to become deleterious, so that their rates of occurrence have likely been selected severely downward. It also means that directional evolutionary change cannot result from either mutations or drift, but must be caused by directional selection . . . When one direction or force of selection is removed from the environment of a species, the necessary effect is to cause other previously opposing forces [of selection] to become more intense or powerful.

These are the reasons, then, for the common tendency to refer to the theory of evolution as the theory of natural selection; we derive them by applying logic to the set of facts known, from experiments and observations, about the phenomena that together make up the process of organic evolution.

So we are led to the next conclusion: *to understand ourselves better from our evolutionary background we must focus our attention on one particular part of the evolutionary process – on the causes and effects of differential reproduction or natural selection.*

Creation Research Scientists and Darwin's First Challenge

At least two approaches could have been made to try to meet Darwin's first challenge: (1) seek a complicated organ – or anything complicated about life, such as individual organisms – and try to demonstrate that it was not put together as a combining of numerous, successive, slight modifications; or (2) claim that a supernatural, all-powerful, everlasting force or being (often considered to be anthropomorphic) could have generated the underlying mechanics that have been demonstrated in natural selection and thereby produced the particular sort of small-step-by-small-step changes that Darwin regarded as universal. In effect, no such process of creation could ever be falsified because there would by definition be no limits on the nature or means of creation caused by an all-powerful and eternal supernatural force. The mere use of the term “supernatural” means that no natural restrictions can be claimed for the creative process. If supernatural creation is indeed the means by which life came about and took its present form, then it cannot be refuted or acclaimed via scientific challenges. All options, both imaginable and unimaginable, will always remain possible.

Some scientists – and others who favor or find acceptable a theory of creation – have continued to try to meet Darwin's first challenge. They have done it in at least three ways. First, the members of an organization prominent in the 1970s and 1980s, who referred to themselves as Creation Research Scientists, initially argued that evolution cannot be studied as a science because it takes so long that it cannot be observed directly. At some point, however, they withdrew this argument, realizing (as had been pointed out by biologists – for example, Alexander 1978) that evolution can indeed be observed directly, because many organisms have very short life cycles, and evolutionary change can be observed across one or a few generations. The Creation Research Scientists subsequently termed this portion of evolution, “micro-evolution,” and argued that “macro-evolution” – referring to a term used by biologists and paleontologists for what they see as effects deriving from long-term evolutionary changes – in particular the fragmentary and often disconnected remains of fossils, cannot be studied scientifically because the divergences resulting in such fragmentary remains really

do take too long for humans to observe them directly. Scientists and jurists, however, continue to make decisions of great importance on the basis of indirect observation (or circumstantial evidence), including accounting for the gaps in the fossil record that have been the items most questioned by creationists. One way to falsify the argument that the gaps are simply the result of only occasional individuals being fossilized, or of our efforts to locate the fossils that do exist being imperfect, is to show that no progress is being made in closing the gaps among fossils. As long as new fossils continue to be discovered that sometimes tend to reduce or close existing gaps among fossils – and particularly in the face of Darwin's first challenge – it is reasonable to proceed under the assumption that macro-evolution is no more than micro-evolution extended.

Creation Research Scientists failed again when they argued that the existence of different species is evidence of supernatural creation because species differences are too great, and of such a nature that they cannot be produced by numerous, successive, slight modifications. They used the arguments that species differences represent macro-evolution because such differences cannot be observed directly, and because no one has ever turned one species into another or caused one species to become two in the laboratory, or otherwise under direct observation. These arguments do not hold up because different species that live together, mixed individually, yet have never been found to hybridize in the field, can be caused to hybridize in the laboratory, sometimes simply by putting males of one species with females of another and vice versa. This fact has been well known for at least three-quarters of a century, for numerous species, including both vertebrates and insects. Moreover, sequences of controlled backcross hybridizations (crossing hybrids with members of either parent species) and hybridizing hybrids (creating successions of repeated hybridizations, yielding F1, F2, F3. . . generations) have shown many times over that the differences between species are indeed owing to Darwin's numerous, successive, slight modifications (cf. Alexander 1978, 1979: 8ff.). With regard to Darwin's first challenge, differences between members of different species are demonstrably – and likely invariably – of the same sort that occur among genetically different individuals within species. They give no evidence of requiring supernatural explanations. Species are simply populations that have diverged via NSSMs because they were separated in space, time, or both long enough that their differences in accumulated NSSMs prevented them from amalgamating again, either preventing all hybridization or rendering hybrids sufficiently non-reproductive that individuals avoiding hybridization were sufficiently favored by selection.

A second kind of effort to meet Darwin's challenge involved claiming to have discovered organs, or other traits in organisms, that cannot be

explained as comprising numerous, successive, slight modifications. Three arguments have been used to make this challenge: (1) noting that under certain circumstances complex organs occur in individuals whose parents show no indication of such organs; (2) claiming that the functions of many organs show that they could not have evolved by numerous, successive, slight modifications; and (3) choosing an organ that is so small, so symmetrical, and seemingly so “entire” in its structure as, on that basis alone, it appears to deny Darwin’s challenge.

Consider the first case. An example is cave-dwelling animals, such as fish. When animals continue to live in total darkness for long periods, after a long period of evolution in the light, selection changes direction. One change is that structural and functional losses to the complex organs that we call eyes will not be favored, so that other beneficial effects, having little or nothing to do with the eyes, can be saved at the expense of maintenance of functional eyes. Under this kind of selection, eyes tend to become imperfect, and sometimes may disappear entirely because of changes in one or a few genes that had become key to continuation of the eye. When an eye disappears, however, many or most of the genes formerly involved in its functioning may remain unchanged. Changes in only one or a few genes, among the many contributing in concert to produce a complex organ such as an eye, can eliminate most or all external evidence of the eye. In an entirely dark environment, any genetic event that canceled a useless but calorically and genetically expensive visual organ – especially when it did so as an aspect of improving some other sensory device – would be favored by natural selection. Again, hybridization experiments have demonstrated what has happened. Two parents showing little or no external evidence of eyes can produce offspring that have functional eyes. Even more important, they can produce offspring with eyes in various stages of imperfection, revealing that the complex organs called eyes do indeed evolve through Darwin’s numerous, successive, slight modifications. The “sudden” reappearance of an eye in offspring of two eyeless parents can come about because the particular gene mutations causing eyes to disappear may be different in the two parents, so that some offspring of those parents can possess all or nearly all of the original sets of genes responsible for eyes. Hybrids between eyeless cave creatures can end up with differing numbers of “eye” genes, and differences in the particular genes in their incomplete sets of eye genes; and, when they are hybridized, some of their offspring may accidentally wind up with complete sets.

In a second approach, creationists have argued that some complex organs, such as wings, could not have evolved via numerous, successive, slight modifications because they would have been non-functional in their early stages. This argument is falsified by knowledge that organs can begin

with one function and generate another function later. For example, wings of birds and mammals are clearly derived from forelimbs, and may have been gliding devices or courtship display devices before they were flying organs. Wings of insects have been postulated to have begun as swimming organs or as dorsal courtship display devices (or possibly both, in sequence) because there is ample evidence that early insects copulated with the female on the male's back. Either of the postulated early functions of mating insects could have involved means of moving their incipient wings prior to actual flying (Alexander and Brown 1963; Kukalova-Peck 1978, 1983).

The third case is different, but equally interesting. The option remains for hybridizing variants within species, or hybridizing different species, to bring out whether or not differences in organs are owing to numerous, slight, successive modifications. Sometimes, however, these options are not easily available because conditions enabling laboratory hybridization for the appropriate species have not yet been worked out. The question may also arise whether an organ results from many or relatively few genes. In the latter case, despite larger effects from individual gene changes, Darwin's challenge still holds, simply because the entire organism has relatively few genes. In such organisms, however, so-called "complex" organs are unlikely to be as complex as in organisms with tens of thousands of genes, yet still come about via numerous, slight, successive modifications.

Darwin was careful to state his challenge with the phrase, "If it could be demonstrated" This challenge does not leave the option of using one's intuition, or merely asserting that the overall appearance or structure of a complex organ can show that it is not owing to numerous, successive, slight modifications. Almost all complex organs, and, indeed, organisms themselves, are unitary in function, hence even if made up of large numbers of NSSMs they may give the impression of having been created entire (see Dobzhansky's statement below). Mere observation of populations of such organisms, across long periods, can however reveal effects of successive mutations in the form of slight changes.

Interestingly, the reverse of Darwin's first challenge is also true: if Darwin is right, then any complex structure or organ of a living creature is necessarily a product of natural selection. This fact becomes an underlying principle that every student of (for example) human behavior must take into account. Thus, if a trait such as net-cost social altruism is claimed to have been demonstrated – say, by experimentation – to be potentially adaptive, then unless that trait can be shown to be "complex," to be a result of numerous, successive, slight modifications, it is likely to be some kind of recent evolutionary accident or novelty; that is, a result of one mutation or a chance combination of a few mutations. If it is indeed a result of

numerous, slight, successive modifications, therefore necessarily evolved, then it is, or has been, reproductively functional.

If Darwin's first challenge is correct, then, we can feasibly use hybridization to test all apparently complex traits, believed to be independent of the evolutionary process or to have little or nothing to do with reproductive success (Alexander 2009).

Cooperation and Dobzhansky's Statement on Heredity and Development

To continue this kind of example, consider the statement below. It is not one of Darwin's observations but an explanatory effort by Theodosius Dobzhansky, a Russian who emigrated to the US and became one of the twentieth century's best-known and most important evolutionary geneticists. Fruit flies were his principal research subjects, but he also wrote extensively about human genetics. In the following statement he was participating in a discussion following a series of talks in a symposium in London on polymorphisms in insects:

Heredity is particulate, but development is unitary. Everything in the organism is the result of the interactions of all genes, subject to the environment to which they are exposed. What genes determine is not characters, but rather the ways in which the developing organism responds to the environment it encounters. (Dobzhansky 1961: 111)

From my first reading of this statement I regarded it as one of the most profoundly important biological observations I have encountered. Heredity is particulate, meaning that the genes mutate separately, they can be shuffled, and they are shuffled every generation in sexual organisms, which includes the vast majority of species. But development – the ontogeny of the individual – is unitary. What does this mean? It means that the genes in a genome have evolved, and are evolving, to cooperate completely (that is, even if they never achieve such completeness). This means that their interests are close to being identical, in the sense of a group with a common goal, while they are functioning within the genome. At some point, part of the reason for this direction of evolution became that genes in genomes could no longer change groups. Once the genome is formed, instances of genes changing groups – thus, in some cases, acting as if “selfishly” within the genome – are sufficiently unusual that they are singled out for special discussion. The major exception is the brief period of meiosis, sexual recombination, and zygote formation in sexual forms (e.g., Burt and Trivers 2006).

In October 2007, the evolutionary biologist Olivia Judson published a brief article in the *Atlantic Monthly* titled “The Selfless Gene.” She was, of

course, parodying Richard Dawkins's (1976) concept of *The Selfish Gene*. Nearly all of her paper was about cooperation, with the last part taking up what has come to be called "strong reciprocity." But cooperation, even though it involves within-group social beneficence, is not the opposite of selfishness. Cooperation refers to efforts of some kind of group to achieve a common goal. Cooperation is thus a way of competing at a higher level of social organization: competing against others at large by cooperating locally. It evolves because the genes, or organisms such as humans that cooperate, reproduce better in the overall population than those that do not cooperate, so that the genes of cooperators persist longer; and that is precisely why cooperators sometimes become prevalent. "Complete" cooperation is a theoretical extreme in which all of the group members come to have the same interests, either briefly or indefinitely. To the extent that development indeed is unitary, the ultimate situation approached is that every gene in a genome is favored for doing anything and everything that assists any and all of the other genes in enabling the genome (and themselves) to succeed; more accurately, and less anthropomorphically, alleles that do this are favored over others that do it less well. Again, the reason is that this is the way the cooperative genome becomes most successful, with the result that every gene that cooperates in furthering the genome gains maximally in the population at large (that is, is apt to persist longer). That this situation is approximated is indicated by cooperativeness within the genome having become so nearly complete that the genome has evolved, via the process of meiosis, to give every allele in the genome (or nearly every allele) approximately an equal chance to be inserted into the genome of each offspring that is produced during the organism's reproductive activities. This remarkable fact, the origin and elaboration of which apparently remains to be fully explained, is why the phrase "Mendelian ratios" can continue to be useful.

By using the hypothetical example of completely unitary development and (nearly) "complete cooperation" of the genes, I have painted the picture as somewhat simpler than it actually is, because there may always be instances of alleles outcompeting their counterparts, for example via what is called "meiotic drive" (see Burt and Trivers 2006 for a general discussion of cases). But such disruptors of genomes are often like cancer, in the sense that they at first seem to win, but then disappear in favor of cooperators. Unlike cancer, genes evolve to adhere to the developmental program of their organismal host to persist indefinitely. If it were not so, the incredible cooperativeness of the genome, hence the unitary nature of the whole organism, could not have evolved. The evolved and evolving function of the organism is to maximize the transgenerational transfer of its genes.

Cooperativeness thus does not constitute selflessness, even within genomes; its effect is to further the persistence of the cooperator (its genes) by furthering the persistence of the group that shares the cooperator's interests. Nor is modularity in ontogeny an exception to Dobzhansky's unity of development, any more than is the development of multiple separate organs, because typically the entire genome is contained in every cell of every part of the developing organism, so that the same rules of gene cooperation as are essential to the organism's reproductive success, and the indefinite intergenerational persistence of genes, necessarily apply. Although I have been discussing this fact with respect to genes in the genome, it is obviously central to understanding the behavioral cooperativeness within human organizations that structures our lives by the unique, continual, and often incredibly destructive inter-group competition within our species.

Unity of development explains why complex organs and complex organisms can form in ways that cause organs and organisms to have singular functions, no matter how complex they may be; no matter how many successive, slight modifications went into their evolution. In other words, organs and organisms develop – or form – in ways that cause them to look and act as though they were not formed by Darwin's numerous, successive, slight modifications. But every time anyone has studied a complex organ or organism carefully and thoroughly, it has seemed even more likely that Darwin's first challenge is never going to be met. In any case, as already noted, Darwin's first challenge cannot be met by intuition or mere observation, or an argument that the structure or function of an organ simply does not appear to be formed of NSSMs. Whenever any such organ or organism is watched through a few generations, or compared across its species, the evidence of NSSMs becomes apparent through the natural events of living and reproducing, even in the absence of investigations of either inter-specific hybridization or induced intra-specific hybridization. If Darwin was right, examining a population of any species across several generations will eventually demonstrate that it is being changed by NSSMs.

Mutations and Darwin's Numerous, Successive, Slight Modifications

Why, in selective terms, are NSSMs so numerous, successive, and slight? Returning to the causes of mutations and selection can remind us that Sir Ronald A. Fisher in the 1958 edition of his 1930 book, *The Genetical Theory of Natural Selection*, noted that if a change (for example, a mutation of a gene) is random with regard to its benefit or detriment for the organism, it is highly unlikely to be beneficial. To imagine otherwise would be the same as expecting that a random change in a complex machine

would be likely to improve the machine. Fisher went on to say as well that the larger the effect a mutation has on the structure or function of the organism – on the phenotype – the more likely it is to be deleterious, and to disappear quickly. A mutation that produces only a “slight” modification – that has only a small effect on the phenotype, especially if it has deleterious effects along with beneficial effects – is more likely to last at least a few generations because it is less likely to destroy the phenotype immediately. As a result it has a certain likelihood of lasting even longer, perhaps until the genome and the environment change sufficiently that its deleterious effect happens to become beneficial, or until the deleterious effect has been modified (as by changes in other genes) to essential neutrality (genes causing such modification would, because of that effect, become beneficial). Every genome carries many alleles that have been modified so as to make their deleterious effects become recessive, thereby not affecting the phenotype except when the gene is present in the homozygous condition. It may not be trivial that such alleles, and any others that appear to be non-functional (but may be functional, and in extremely important ways, even if only in rare but significant situations or environments), might be regarded as a kind of accidental or incidental reservoir of NSSMs that remain in a position to spread, and to be modified toward dominance, if their effects should for some reason – such as changes in the environment – become beneficial rather than deleterious.

The question of why Darwin's NSSMs should appear “successively” can also be related to the deleterious effects of most mutations, leading to down-selection of mutation rates. The appearance all at once of multiple or numerous mutations will have the effect of single mutations with large effects on the phenotype, hence “flocks of mutants” will be more likely to die out quickly because the harboring organism will be less likely to reproduce (the same effect is involved in hybridization of members of groups that have been apart long enough to have evolved numerous or large genetic differences). Darwin's use of “numerous” thus also refers to the fact that the effects of individual genes (Darwin's “modifications”) are nearly always small. As a consequence, every complex organ or organism is necessarily composed of numerous slight modifications that arrived successively in the organism's genome.

Several years ago, in a small assemblage of faculty from biology, medical genetics, and gerontology, I cited Dobzhansky's statement that heredity is particulate and development unitary, and that every gene likely affects the action of every other gene. Across the table a medical geneticist looked skeptical and finally said, “I don't understand Dobzhansky's statement. Every gene does but one thing, and we know what it is.” I replied, “But what if genes do their single ‘thing’ (meaning being turned on and turned

off) in more than a single environment?” Later I realized that environments are both internal and external, and the numbers of small and large, internal and external environmental variations that affect organisms are surely beyond estimating.

If humans have, say, 25 000 genes, and only variables resulting from an individual’s genes were considered, the extreme form of the medical geneticist’s view would mean that, taking into account all possible arrangements of genes being on or off, humans might result from the states of all genes being turned on or off, yielding two (on or off) to the 25 000 power.

As explained earlier, even this is but a minuscule fraction of the possibilities across a human lifetime (“It is now apparent that each gene may yield a large number of variants in trait expressions”; Silverman 2004). At least in part this figure almost certainly derives from cooperative effects between genes multiplying the potential number of trait expressions in different micro, macro, and internal and external changes in environments. When multiple alleles are present and many loci are heterozygous, the number of different things the organ or organism can do might be increased considerably more. But even these considerations do not give an adequate accounting if what we are told nowadays, for example about the complexity of the human brain, is accurate.

Taking into account the number of genes and their cooperative interactions in the human organism, and the multiplicity of both internal and external environments across the 80–90-year lifetimes of humans, the number of different actions possible in the individual human organism across its lifetime is so incredibly large as to be virtually immeasurable. In this sense, at least, Dobzhansky’s implication of evolution changing toward full cooperation of the genes while they are in the genome of the developing organism, makes considerable sense.

Evolution and Culture

There is every reason to expect a correlation between cultural change and inclusive-fitness-maximizing; if none had existed the capacity for culture could not have evolved by natural selection of genetic alternatives. (Alexander 1971: 106)

Everything said so far explains why evolution is generally a slow process. In particular, the randomness, resulting from the independence of the causes of change (mutations) and the causes of adaptiveness or maladaptiveness of NSSMs, results in change being relatively slow.

At this point an enlightening comparison can be made between the evolutionary process and the process of human cultural change, which I made in detail, originally in 1979, in *Darwinism and Human Affairs*,

under the heading “A Comparison of Organic and Cultural Evolution” (Alexander 1979: 73ff.). Unlike organisms in general, humans have evolved ways to complete the need–novelty connection (referring to the fact that environmental novelties lead us observers to identify what we see as adaptive “needs”). Humans are able to imagine novelties or improvements in their tools or activities, then build or practice them in ways that in effect replace Darwin’s NSSMs. Because of imagination and foresight – intent and purpose – which probably evolved largely in the context of social performance, humans are able to invent or “create,” and build, not only new structures and functions but also new kinds of domestic organisms (by deliberate breeding practices). They are able to do these things because they are able to visualize different situations or devices, create novelties that meet their current needs, and then implement them. They can imagine the effects of their efforts at new creations even before beginning to construct them. They are also able to generate cultural transmission of traits or practices through cumulative learning (including teaching). Their cultural “mutations” need not be only accidentally adaptive, because the process of selection among existing cultural alternatives can be carried out via imagination, foresight, intent, and purpose. Thus, a new kind of plow or computer can be conceived in the human brain and built for its expected usefulness; it can be rejected if it fails or adopted if it works, and it can also be improved repeatedly by the same processes of learning, imagination, and insight that initially enabled it to be conceived and constructed (Alexander 1979: 74). This is a main reason that cultural change can be much more rapid than evolutionary change (see also Flinn and Alexander 1982).

In other words, human imagination can lead to the creation of both inanimate and animate objects in the way that creationists have imagined that the physical and living universes and their contents have been produced. The intelligent designs evident in cultural items created by humans do not have to be produced via numerous, successive, slight modifications – just by the combining of imaginable changes. Additional insights may arise from continuing to compare the ways in which changes have taken place in living and non-living forms.

Even Darwin’s first and most basic challenge thus continues to provide insight into the nature of human society. The second of his five challenges is a summary statement about natural selection, followed by three challenges of great interest to students of human culture.

Darwin's Second Challenge

2. The only check to a continued augmentation of fertility in each organism seems to be either the expenditure of power and the greater risks run by parents that produce a more numerous progeny, or the contingency of very numerous eggs and young being produced of smaller size or less vigorous, or subsequently not so well nurtured. (Darwin 1871: Vol. 1, p. 319)

In this “seems to be” statement, Darwin is suggesting to us that each potentially parental organism has limitations in the production of offspring, limitations on available calories, and limitations on the likelihood that different degrees and kinds of risks will yield a net return. There is always a trade-off between producing many small offspring that will receive little or no parental care versus a few large offspring that can receive large amounts of parental care. Hence, birds that hide their nests or make them inaccessible to predators have been able to “win” by placing in such nests a few large eggs that are hatched by one or both parents incubating the eggs, with the offspring of some species entirely supplied with food brought to the nest by the parents. Humans, producing but one offspring at a time, are an even more extreme change in the same direction. At a different extreme are fish that produce thousands of tiny eggs and show little or no parental care. In each of these cases, whenever the population is remaining approximately stable in numbers, an average of two offspring per two-parent family survive and reproduce.

Humans are unique among all their primate relatives in producing small lifetime numbers of at first extremely helpless offspring and tending them for uniquely long periods; often, in some fashion, for the parents' entire lifetimes. “Helpless” or “altricial” offspring that have evolved to require enormous amounts of parental care gain by being able to devote high proportions of their calories to growth and development rather than to protecting themselves. Infant altriciality, lengthened juvenile life, and enormous amounts of parental care (and other kin help) thus facilitate early development of the huge social brain (cf. Alexander 1990a, 1990b) and provide opportunities for juveniles to learn how to be socially successful in ways that have enabled living in ever-larger social groups and caused lengthening of the human lifetime to approximately double those of our closest primate relatives (Alexander 2008).

The special message virtually hidden in Darwin's second challenge, however, is even more stark. It is that the phenotype – the organism itself, including its behavior and life pattern – is evolved solely in the context of reproductive success. Everything the organism is evolved to do is part of the reproductive process. As mentioned earlier, one of the biases apparently built into the human makeup is that we are not evolved to be

acutely conscious of facts central to our existence, such as the primacy of reproduction; both the production of offspring and the tending of both offspring and non-descendant or collateral relatives. Even more, we are apparently evolved to reject some such traits entirely. Sometimes, at least, the reason appears to be social. Reproduction is the most directly competitive activity of the individuals of any species, meaning partly that cooperation among individuals has not evolved to be nearly as complete – nor as consistent – as with genes in genomes. Individuals that possess a keenly and consistently conscious recognition of the primacy of reproduction in their lives – openly employing and demonstrating intent, foresight, and planning solely to maximize reproduction – will almost certainly either fail, or change so as to reduce consciousness on the issue of all-out reproduction, becoming deceptive about reproduction and their attitude toward it. If complete reproductive intent remained completely conscious, or obvious, it would surely be followed frequently by negative responses, detection of any deception, suspicion of unrestricted competitiveness (that is, evidence of a deficient morality), and, most likely, serious social rejection. Social rejection in our species, as well as many others, can lead to ostracism, and even murder or execution that could be considered justifiable by the social group. It is not that we cannot escape such strictures, but that, sometimes at least – and perhaps paradoxically – we are more capable of escaping them if we know about them and why they exist. In a social species made up of individuals capable of executing long-term plans, no individual is likely to gain by being too obviously conscious in planning to out-reproduce its associates. Reproductive competition across generations does not result in “winning” in the form of an eventually stable and final achievement; it is instead an endlessly continuous and open competition. The consequences, given our continuing sociality and our growing consciousness about precisely how we have evolved, are difficult to forecast.

As is discussed further below, evolution has produced several general biases in the social makeup of humans. These biases must be identified and taken into account during investigations of what humans do socially, and what they either do not do, or cannot do. Methods of judging whether acts are assumed to be adaptive can be generated by effects of hybridization and examination of proximate mechanisms of social behaviors (Alexander 1987: 13–20).

With the next three challenges Darwin moves us directly into the problems involved in the analysis and understanding of human sociality, in particular raising questions about what is typically referred to as altruism. How do we take up the topic of apparently selfless, beneficent behaviors toward others – not just between species but within species – and even, in a sense, “within” ourselves (in the sense of conscious motivation)? If, as

Darwin's second challenge (above) implies, the answer is to be couched in terms of every organism competing to secure the greatest amount of the highest possible quality resources, and then using them all for its own reproduction – sometimes via cooperative interactions within small groups that compete with other such groups – it will not be easy to understand all the details of human social behavior.

As suggested in the statement that introduces this chapter, the argument is not that we cannot do anything but what evolution has primed us to do, but rather how we can identify and then deal with the biases evolution has installed in us, some of which are poorly understood, while others tend to remain outside our consciousness for either accidental or evolutionary reasons.

Three Additional Darwinian Challenges

3. If it could be proved that any part of the structure of any one species had been formed for the exclusive good of another species, it would annihilate my theory, for such could not have been produced through natural selection. (Darwin 1936 [1859, 1871]: 201)

4. Natural selection will never produce in a being anything injurious to itself . . . no organ will be formed . . . for the purpose of causing pain or doing an injury to its possessor. (Darwin 1936 [1859, 1871]: 201)

5. . . . some naturalists believe that many structures have been created for the sake of beauty, to delight man or the Creator . . . or for the sake of mere variety . . . Such doctrines, if true, would be absolutely fatal to my theory. (Darwin 1936 [1859, 1871]: 146)

These three challenges require careful analysis. It is easy to misinterpret what Darwin must have meant, and to conclude (erroneously) that he was wrong.

A main point to be understood for all three of these challenges is Darwin's use of the term "for the exclusive good of another species." The meaning is that such a tendency would not serve the interests of the individual possessing the structure. In statement (4), Darwin is not referring to acts that have beneficial effects even though they cause pain as a side-effect. He is not saying that organisms will evolve to do nothing at all likely to cause pain. He is rather saying that organisms will not evolve to cause themselves pain, or hurt, in the absence of any available or possible countering effects. The same is true of his statement (5) about beauty. He is surely not discussing instances in which a viewer chooses the beautiful individual or the beautiful tool because of the usefulness associated with the perception of its beauty; because of what is meant by the old adage,

“Beauty is as beauty does.” Instead Darwin is referring to beauty that has no practical application whatever. We can evolve to see as beautiful something that is useful, even if only because seeing it as beautiful inspires us in one way or another. But natural selection cannot cause objects to change to meet our standards of beauty solely because we like them, even though humans can change features such as those regarded as beautiful, using human-generated or so-called “artificial” selection. Beauty does not evolve because it causes us to admire it for no functional reason, and we do not evolve to see beauty when it has no relationship to our own evolved functions.

Similarly, when Darwin says that an organism cannot evolve to do anything injurious to itself, he apparently meant doing anything that solely hurts itself; something that has no other function. Thus he could even have meant, by “hurt,” the reduction of reproductive success.

Pain, too, evolves when it is useful. Pain that is suffered because some part of one’s body has been damaged is generally (but not always) functional. When we are injured or wounded, pain at the appropriate location guides us to tend and protect the injury, thus hastening its healing, as well as reminding us to avoid the same pain later. That such pain is evolved seems obvious from the fact that parts of our body that have no history of repeated healing (such as the interior of the brain, injuries to which, in pre-technological, pre-medical times, would tend always to be fatal), have not evolved significant pain sensors.

Without the pain that relates to healing we would surely be in trouble a good deal of the time, even from minor wounds. That horses, for example, do not easily heal injured or broken legs is related to the fact that horses are prey animals that rely heavily upon quick speed to escape dangers and are likely to “run over” anything in their paths. When predation is consistently intense, slower or obviously crippled individuals are sought out and eliminated, thereby reducing or removing the possibility of evolving the ability to recover. This is at least in part why, in a recent example, the broken leg of the valuable racehorse Barbaro in the US resulted in the horse being euthanized, despite a remarkable investment of time, effort, and modern veterinarian expertise.

Consider the pain of childbirth. It is reasonable to assume that this pain is caused by the severe displacement of bones and tissues in the mother’s pelvic region. Two possibilities exist, and each may be real in particular instances. Childbirth pain may occur because the infant is sufficiently large – in humans, especially the infant’s head (its brain) – to cause pain by disrupting tissues or straining bone structure in the region of the emergence of the newborn. But this pain did not evolve because of that problem; the predictability of its eventual appearance was in place before

childbirth became as difficult as it is in many or most modern women. For natural selection to remove the pain of childbirth, yet retain the large head and brain, would presumably require such serious alterations of the pelvic region that reproductive success would in some way be reduced. Natural selection has taken women to extremes in birthing large infants (and infants with large heads) because of benefit to the infant itself, and for that reason benefit to the reproduction of the mother (Alexander 1990a). Similarly, if admiring a prospective mate as beautiful means admiring features that are likely to make a prospective mate the best possible match for the admirer, then features predicting reproductive success have evolved to be seen as beautiful rather than the perception of beauty evolving independently of any indication of reproductive success.

Regarding beauty, Darwin (1936 [1859, 1871]: 147) wrote as follows:

If beautiful objects had been created solely for man's gratification, it ought to be shown that before man appeared, there was less beauty on the face of the earth than since he came on the stage. Were the beautiful volute and cone shells of the Eocene epoch, and the gracefully sculptured ammonites of the Secondary period, created that man might ages afterward admire them in his cabinet? Few objects are more beautiful than the minute siliceous cases of the diatomaceae: were these created that they might be examined and admired under the high powers of the microscope?

Evolution-Based Biases in the Social Actions of Humans

Now we can consider whether social acts evolve to be selfless, partly by taking into account biases we can expect to find in the social behavior of humans, biases planted in us by the process of evolution. Then I will discuss what I see as an exhaustive list of the general kinds of social behaviors evolved in the human species. I will also discuss the use of proximate mechanisms of social behavior in humans to help identify the likely consequences of different human social acts, particularly in deciding whether net-cost altruism is prevalent or evolved. I would argue that all social scientists will be better equipped to conduct experimental studies of social acts – and to develop the deep understanding of humans that surely will be required to solve the massive and global problems of humanity – if they contemplate lists such as are presented below and adjust their approaches to take into account the manners in which evolution has constructed our human characteristics.

Following are four evolution-based biases in human social acts, from Darwin's challenges. Again, I am not arguing that we cannot escape these biases. Instead I am suggesting we will be better able to escape them if we know about them and understand their basis and significance:

1. Evolved human interests are expected to be solely reproductive; natural selection is differential reproduction, meaning adding to the intergenerational persistence of genes in whatever combinations they regularly assume.
2. All evolved acts are presumably constructed by natural selection so as to serve the actor's interests (that is, can be termed self-interested), whether "self" refers to genes only, genes that give rise to competing individuals, genes that give rise to integrated (and competing) groups of individuals, or any combination of the three possibilities.
3. Not all acts or efforts will have evolved to be either conscious or completely understood. Failures of acts to be conscious may have come about: (a) incidentally because there is no benefit to their being conscious; or (b) by selection because there is a net detriment arising from their being conscious. For either alternative we humans have an enormously difficult task in working out how to deal with our inability to distinguish truly selfless acts from acts that we and others may erroneously term selfless. Much of learning and teaching (training, education) consists of bringing into our consciousness phenomena that for one or the other of the two above reasons have not been conscious.

Acts that do not serve the actor's reproductive interests are presumably not evolved, rather are evolutionary accidents or mistakes. Such acts, for example, can take place in evolutionarily novel environments. Included are deliberate deviations from evolved acts, because conscious knowledge brought about by scientific understanding constitutes a novel environment. Evolutionary accidents and mistakes are not necessarily likely to come about because of numerous, slight, successive modifications, and when they do it is likely because some aspect of the environment has changed in a way that makes a previously expressed adaptation useless or negative.

4. The intense and pervasive role of within-species inter-group competition in human evolution has uniquely shaped human social behavior at both individual and group levels, yielding not only sympathy and empathy, but the corresponding potential for extreme inter-group competitions, including tendencies of local pride and fellowship that facilitate extreme patriotism and xenophobic tendencies.

BUILDING BLOCKS OF HUMAN SOCIETY

The following list of possible positive social actions by humans is an effort to be complete, meaning that, regardless how many different kinds of individual actions can be discovered, each should fit into one or another

of the general categories represented by the list that follows. The purpose of making this list is to show that the number of classes of positive social interactions is not indefinitely large, and that not all are entirely obvious; collectively, however, they are the explanations of our evolutionary background. As a result, human society is not easily understood except by taking into accurate account the particular biases caused by our background in differential reproduction. All but three of the possible social actions listed below are consistent with a history of cumulative differential reproduction. The second social action has become equivocal, hence less useful, because of the different ways humans have regarded it. The fifth and thirteenth are inconsistent with a history of cumulative differential reproduction. It is not that these three actions (*asterisked below) cannot be carried out; we are free to use them, appropriate to our own considerations.

1. Ecological Mutualism

Ecological mutualism is a reciprocal, low-risk, shared interaction that often arises between co-resident species and becomes profitable to each party. Such interactions can begin either with the extraction of benefits by one species via parasitism, or by no-cost one-way benefits (commensalism) utilized by one species via benefits from the other. Mutualism exists when each partner becomes a valuable and reliable resource to the other. Mutual benefits can become elaborate because the risk of withdrawal is low as a result of consistent co-residence of potential mutualists, and is weighed against benefits returned from the partner. In mutualism neither partner suffers a net loss by providing benefits to the other, and the low risk from the outset tends to cause the traits involved in the mutualism to become phenotypically obligate. Mutualism can thus flourish without requiring foresight or risk assessment of the sort involved in human social reciprocity.

An example of interspecific ecological mutualism involving humans could be their interaction with dogs, if the interaction actually came about in approximately the following way (the example is valid, as given, even if the dog-human interaction actually came about in a different sequence). Suppose that dogs gained by beginning to approach human groups and feed upon the leavings from meals made up of animals hunted and partly consumed by the humans. At first, humans may have neither gained nor lost from this interaction. Apparently, dogs eventually began to stay around human settlements, became accustomed to humans, and started to respond aggressively (territorially) to predators such as big cats or other animals dangerous to themselves – and ultimately to

humans. These behaviors, beneficial to the dogs, would also tend to benefit humans, at the least warning them of danger. At some point humans began to promote the benefits of their association with dogs by deliberately providing food and other rewards to keep the dogs around. Dogs would gain from becoming increasingly tolerant of humans, and increasingly familiar with, or beholden to, particular individuals or families, the latter leading to within-group competition of both humans and dogs. At some point dogs must have begun to follow humans on their hunts, and to interact in other ways that immediately favored humans, or that humans could adjust or manipulate to their own benefit. The association, as I have just described it, would have taken place at first by accident, serving only one of the two participants but also not particularly costly to the other. Gradually both participants became contributors to the interaction, and each benefited from it. Obviously, additional kinds of beneficent acts, such as are typical of deliberately modified different breeds of dogs today, were added to the dog-human mutualism (via mainly Darwin's "numerous, successive, slight modifications" in dogs and almost certainly via mainly considerable learning or "cultural changes" in humans). The dog-human mutualism is not obligate, but thousands of other mutualisms have become so.

2. Altruism*

"Unselfish concern for the welfare of others" (*Webster's Unabridged Dictionary*). Because of the implication of assumed or intended selflessness, with insufficient attention to possible return benefits (as occur in mutualism, cooperation, nepotism, and direct and indirect social reciprocity – see below), and because of the possibility of evolved misconception and self-deception regarding motive, altruism has become an ambiguous and misleading term, not easy to use in efforts to analyze social behavior (see cooperation, below). Dictionary definitions of selfishness and altruism do not necessarily take into account that: (a) humans did not evolve to be keenly conscious of the probability of compensatory returns from all social investments; and (b) consciousness can be adaptively cloaked or concealed.

3. Social Beneficence

Acts costly to benefactors and likely to benefit recipients, with or without returns to self or self's relatives (directly or indirectly). Social beneficence can be a positive benefit to the benefactor, or it can be accidentally altruistic (see #4 and #5 below).

4. Net-Gain Social Beneficence

Social beneficence that involves overcompensating returns via mutualism, cooperation, nepotism, or direct or indirect social reciprocity.

5. Net-Cost (or Net-Loss) Social Beneficence (Net-Cost Altruism)*

Social beneficence without overcompensating returns. Such acts may occur, either by mistake or accident, or deliberately, despite even conscious knowledge that they cannot lead to gains, in terms of differential reproduction. But the tendency to carry them out, or elaborate them (except as practice, especially by juveniles and “beginners”), cannot evolve via Darwin’s numerous, successive, slight modifications. Note the relationship to altruism (#2 and #3 above), which by its usual definition, also cannot evolve.

6. Social Investment (or Investment Beneficence)

Social beneficence treated, or regarded, as likely to yield (later, or eventually) overcompensating returns, regardless whether the beneficent individual or the cooperative gene is “aware” of the reliability of compensating return.

7. Nepotism

Social beneficence passed directly or indirectly to accurately (but not necessarily consciously) identified genetic relatives. The return is via reproduction of genes identical to those of the benefactor by immediate descent in the helped individual. Genes are likely to persist only if they are reproduced (multiplied).

It is essential to realize that even quite large bilateral kinship systems (or kin groups) can be comprised entirely of socially recognizable genetic relatives, including in-laws (Alexander 1990a, 1990b), which in large kin groups typically reproduce with relatives. Spousal and parental bonds arise (or are coerced) within such groups, most often with cross-cousins, either first or more distant cousins. In such cases all members of the kin group can eventually evolve to be prepared continually to assist any individual within the kin group because there will be genetic returns from aiding the reproduction of relatives (or in-laws) when individuals living in kin groups are competitive with other less closely related groups. The universality of relatedness in such groups, generated genealogically, establishes an equivalent to Hamilton’s “genes identical by immediate descent.” This social

situation, which for numerous reasons is unlikely to be so precise throughout the kin group as to follow Hamilton's Rule (see #8) in all respects, might be misinterpreted as pure altruism or net-cost social beneficence, and perhaps regarded as proof of either willing cooperativeness or "goodness" (altruism*). In-laws, even if unrelated to their marriage partners, can be included in this evolved beneficence within kin groups, without changing what has just been said, because, as noted, they are linked to the large group of relatives via the reproductive effort that connects them genetically with members of the kin group. Here, as elsewhere (for example, in direct and indirect reciprocity in social groups that have evolved to utilize the benefits of social reciprocity), there is no reason to believe that, for evolved adaptiveness to be involved, genetic returns must be consciously anticipated or consciously calculated, by beneficent individuals, or even perceived by observers.

8. Hamilton's Rule

All else being equal, organisms are expected to evolve to treat genetic relatives according to their degrees of relationship in genes identical by immediate descent (Hamilton 1964).

Social proximity, and patterns of social interaction consistent with genealogies, rather than recognition of trait variations reflecting genetic differences, are what (at least typically) allows the evolution of ability to learn (consciously or not: Alexander 1979, 1990a, 1991) to classify different relatives accurately according to genes; hence the engagement of differential nepotism, as in all human societies, and the rise of the complex kinship systems of all studied human groups. I have argued that differential nepotism to multiple relatives of differing degrees – in the manner according with Hamilton's Rule – can come about (in any organisms) only via evolved patterns (including effects of evolved opportunities) and biases of learning abilities and tendencies. The success of some ants in carrying off larvae from other colonies, or species, to be "willing (non-reproductive) slaves" in their own colony, is a demonstration of such learning or tolerance. So far, complex patterns of differential nepotism that would accord precisely with a full-blown version of Hamilton's Rule (for example, including virtually all available relatives, even distant cousins) are approached only in humans, although other primates have probably not been investigated sufficiently to make adequate comparisons. There are multiple categories of imperfect social learning that may appear to be differential nepotism but are not evolved as such, and do not require social learning of different relatives (Alexander 1990b, 1991).

Hamilton's Rule can be extended to account for sterility in the workers

and soldiers of eusocial forms. The example is worth citing here because it demonstrates the extremes to which nepotistic beneficence can be extended. Thus: if the trait of sterility can be carried without being expressed, then if those who express it help sufficiently those who carry it without expressing it, the trait itself can be advanced by natural selection (Darwin's idea; Darwin 1936 [1859, 1871]: 238; Alexander et al. 1991).

9. Direct Reciprocity

Direct reciprocity occurs when benefits are returned from recipients of the initial beneficence. In all forms of social reciprocity, whether or not conscious and deliberate, the beneficence involved is appropriately termed social investment, investment beneficence, or temporary altruism (meaning that overcompensating returns are expected; again, not necessarily consciously). Unlike in mutualism, there tends always to be a risk of failure to return social beneficence, because return beneficence can be optional and may occur only after significant delays, which may result in changes in the social situation.

10. Indirect Reciprocity

Indirect reciprocity occurs when benefits are returned from parties other than recipients of the initial beneficence (for example, groups promoting beneficent or heroic acts; observers seeking reciprocal interactions). Returns from a single act of social beneficence can involve both direct and indirect reciprocity. Indirect reciprocity can occur in extremely diverse and complex, subtle and unexpected interlacing of interactions (Alexander 2005, 2006; see below). Reputation is one of the important ways in which knowledge of a potentially good partner in reciprocity can be identified and engaged, but it need not be a necessary element in indirect reciprocity.

11. Cooperation

Group action to bring about a common goal – any of the above social acts except net-cost beneficence, which cannot evolve via Darwin's “numerous, successive, slight modifications” – and some forms of what is called altruism. Cooperative acts thus evolve as self-interested competition by individuals via levels of organization higher than the individual. They pay off to the participants when the interests of cooperative individuals become sufficiently similar as to more than compensate, within the population at large, for whatever inter-individual competition occurs within the group.

As with other species, humans can evolve to provide social benefits that

will result in net benefits to the donor without conscious perception of the complete interaction by either (any) party. An example is selflessness (in cooperation) within groups from which no individual can emigrate, meaning that the interests of all group members have become identical and anyone who fails to contribute to the success of the group – regardless whether all other individuals behave similarly – increases the likelihood that all will perish. This situation can occur with genes in genomes and with groups of humans, including humans when they are in dire situations such as war.

12. Self-Interested Behaviors

In evolutionary terms, any acts that serve the reproductive interests of the actor (that is, the transgenerational persistence of the actor's genes), including all of the above social acts except net-cost social beneficence and some forms of what is called altruism.

13. Alternatives to Self-Interest*

Evolutionary mistakes (including deliberate deviations); any net-cost social beneficence; any efforts at self-interested acts that fail to increase the actor's reproductive success (including via returns to genetic relatives). Self-interest includes: (a) return benefits to self's phenotype; and (b) benefits to self's genes, whether to genes residing in self, or genes residing in genetic relatives of self.

Recognition of the differences among acts of social beneficence with differing prospects of returns has probably evolved, and adjusted the relative frequencies of the different acts in human sociality. Such recognition need not be conscious to potential social investors, or to any involved parties.

Complete cooperation, approached for example by genes within the genome, is self-interested if the reproductive fate of the group (such as the genome) is identical to that of every cooperator; hence, of every member of the group (such as different genes in the same genome or the different individuals in a military squad on a dangerous mission). Complete cooperation may never be achieved, except as visualized end-results of directions of evolutionary change; it is the continuing direction of evolutionary change that should be our focus. Whenever group members consistently cannot change groups, as when genes are functioning within genomes, selection will tend to favor complete cooperation, in which every individual's fate can become inseparable from that of the genome (because more effectively cooperative mutants will successively prevail over less cooperative mutants). Compare genomes in which the genes are always evolved to cooperate

(asexual forms), or shuffled each generation (sexual forms), with the contrasts of dramatically fluctuating intensities of patriotism (that is, cooperation approaching completeness) in humans in separate, adversarial groups: such cooperativeness is extreme (as extensions of within-group amity) when kin groups, clans, or nations are at war; mild when inter-group conflict is minimal and, correspondingly, when intra-group conflict is most intense.

14. So-Called “Strong Reciprocity”: Is It Real?

recent experimental research has revealed forms of human behavior involving interaction among unrelated individuals that cannot be explained in terms of self-interest. One such trait, which we call strong reciprocity . . . is a predisposition to cooperate with others and to punish those who violate the norms of cooperation, at personal cost, even when it is implausible to expect that these costs will be repaid either by others or at a later date.

We show that under conditions plausibly characteristic of the early stages of human evolution, a small number of strong reciprocators could invade a population of self-regarding types, and strong reciprocity is an evolutionary stable strategy. (Gintis et al. 2003: 154)

A sizable group of students of social behavior has recently generated a significant literature regarding social experiments, the results of which they believe require a new term, “strong reciprocity” (e.g., Gintis 2000; Fehr and Henrich 2003; Bowles and Gintis 2003; Gintis et al. 2003; and references cited in Hammerstein 2003): “Strong reciprocity means that people willingly repay gifts and punish the violation of cooperation and fairness norms [when the act of punishment is costly to the punisher] even in anonymous one-shot encounters with genetically unrelated strangers” (Fehr and Heinrich 2003). Fehr and Heinrich (2003) add that, “This chapter provides ethnographic and experimental evidence suggesting that ultimate theories of kin selection, reciprocal altruism, costly signaling, and indirect reciprocity do not provide satisfactory evolutionary explanations of strong reciprocity.” They argue that these theories “can rationalize strong reciprocity only if it is viewed as maladaptive behavior, whereas the evidence suggests that it is an adaptive trait.”

I have suggested (Alexander 2005) that there are multiple possible solutions to the so-called “strong reciprocity” phenomenon, as derived by the experiments of the above authors, that must be explored before we are required to accept the tendencies they regard as unexplainable via the “ultimate theories of kin selection, reciprocal altruism, and the risks of costly signaling and indirect reciprocity” (Fehr and Heinrich 2003; see also Burnham and Johnson 1992). The proponents of “strong reciprocity” as an independent form of social activity need to be certain that the phrase “at risk” is not more accurate than “at personal cost.” It is all too easy to

assume wrongly that there is no possibility of return benefits in interactions that take the often subtle and sometimes disguised or concealed expressions of indirect reciprocity.

The comment that “interaction among unrelated individuals . . . cannot be explained in terms of self-interest” (Gintis et al. 2003) needs explanation. It is not the saving of self that drives evolution, but the saving of genes – the transmission of genes (of self or identical to those of self) – to the next generation. In some situations the greatest number of genes is saved by assisting genes carried by distant relatives, or by assisting non-relatives in high-risk indirect reciprocity (Alexander 1979, 1987, 1990b, 1993, 2005, 2008).

The apparent claim that strong reciprocity involves personal cost, or net-cost altruism, suggests violation of Darwin's first challenge (see above) either: (1) because strong reciprocity does not fit the criteria of an evolved complex organ of sociality; or (2) because it is after all formed by numerous, successive, slight modifications and does not fit the claim of voluntary personal cost, as when it is regarded as implausible to expect that these costs will be repaid either by others or at a later date.

Reviewing Indirect Reciprocity

Indirect reciprocity is surely the most difficult of all human social interactions because of: (1) the diversity, complexity, and indirectness of sources of returns; especially among non-relatives (because there is less predictability in the patterning of responses to reciprocal as opposed to nepotistic social actions); and (2) the effects of adaptively cloaked or muted consciousness.

Indirect reciprocity is often subtle and deceptive, both consciously and non-consciously. Almost no positive or punishing social act can remain entirely free of social consequences; essentially all of our social rules – and the perceptions of observers – reinforce this reality. As a result, a thorough understanding of indirect reciprocity will require a detailed science of its own. Such a science requires painstaking attention to all possibilities of unexpected positive and negative responses to every positive or punishing social act.

Returns from indirect reciprocity may take at least three major forms (Alexander 1987: 94): (1) the beneficent individual may later be engaged in profitable reciprocal interactions by individuals who have observed their behavior in directly reciprocal interactions, or by others informed by the observing individual or by the actual beneficent individual (the ‘reputation’ or ‘status’ of the investor is enhanced, to their ultimate benefit); (2) the beneficent individual may be rewarded with direct compensation from

all or part of the group (such as with money, or a medal, or social elevation as a hero); and (3) the beneficent individual may be rewarded by simply having the success of the group within which they behaved beneficently contribute to the success of their own descendants and collateral relatives. For example, when the canoe is headed for a deadly waterfall everyone in the canoe is likely to gain by paddling as hard as possible, which can cause every individual in the canoe to be rewarded by their behavior; selflessness, or net-cost altruism, need not be involved. Unlike genes in genomes, humans, in particular, are not expected to remain in tightly knit social groups for the entire lives of all participating individuals; when the canoe has been beached successfully, everyone may go their own way and perhaps pursue similar jeopardies with different groups of individuals.

Leaving aside maladaptive accidents or errors, I can think of at least three other possible adaptive (indirect reciprocity) explanations for what some authors in this volume call “one-shot” social investments: (4) the return may be to the beneficent individual’s relatives or friends, and the nature of social information spread as a result may be such as to make this kind of return consistent with reciprocity being self-serving; (5) the investment may serve the individual practicing how to engage in reciprocity adaptively, as with individuals who practice while alone for success in, say, being humorous, or in developing a useful conscience, or any other social behavior (that is, as a way of learning how to invest socially in a more rewarding – more profitable – way). This is not reciprocity per se, nor is it evidence of net-cost beneficence; rather, it is investment that can improve the individual’s later engagement in social reciprocity. In my experience we do this kind of thing all the time, and I regard it as an essential part of knowing how to behave socially in one’s own interests. For several decades I consistently practiced my biology lectures while driving to the university. An alien, or a member of another species, observing my behavior, might believe that I was displaying net-cost frivolous behavior, or revealing some kind of mental disturbance, lacking in any beneficent return. Because of such possibilities, special care must be taken in interpreting social investment, especially by rapid and resolute learning of career-oriented pre-adults (such as were employed by those occupied with “strong reciprocity”). Juvenile individuals, “practicing” moral behavior, may carry out learning propositions that occur much less often in adults. Who can say how frequently an exceedingly polite student may respond with what appears to be a net-cost act of politeness, with no available responder, or on the other hand deliberately use knowledge of how a question was asked to amuse fellow students and show his or her evidence of superiority?

An example of social behavior, relevant to this discussion, can be illustrated by a true story. A distinguished entomology professor and close

friend was for years my best discussant (and critic) of propositions regarding human social behavior. On one occasion, he told me that on his walk to the Museum of Zoology that morning he had noticed a butterfly larva (caterpillar) moving across the sidewalk. Believing that the caterpillar had fallen from its host plant, and that it was moving in the wrong direction, the professor said he picked up the caterpillar and carefully placed it back on its host plant. At the end of the story he said to me, "Now, Dick, wouldn't you agree that was an act of pure altruism?" I replied, "It might have been – until you told me about it." He and I eventually agreed that the caterpillar may not have been helped at all. Because of the season, and its observed size, it was almost surely full-grown, therefore likely seeking a suitable location for pupation rather than having fallen off the host plant from which it was departing.

It is not necessary for an individual who carries out an act of the above sort to tell anyone at all about it – except himself – to keep it from being an act of "pure altruism." Anyone who thinks about their own beneficent behavior with respect to others can be expected to "practice" doing the kinds of things that will yield returns in social rewards, including (but not solely) reputational effects. As practice, an act of net-cost altruism can even yield a pleasurable response in the actor, especially if they regard the practice as likely to contribute positively, and even much later, to their own ability to perform socially. Of course we practice – often alone and sometimes in the presence of others unlikely to respond appropriately – at such things as music, humor, politeness, honesty, upcoming performances, and many other kinds of social efforts.

Fehr and Henrich (2003), citing Gintis (2000), argue that, when groups face such extinction threats as "wars, famines, and environmental catastrophes," then "neither reciprocal altruism nor indirect reciprocity can sustain the necessary cooperation that helps the group survive the situation because the shadow of the future is too weak." This argument seems to be cast in terms of the overall situation; for example, the war as a whole. But wars are fought not by entire armies as masses of unorganized individuals, and not as independent individuals. Armies tend to function as absolute dictatorships and, particularly on the battlefield, individuals are constrained in ways that do not provide opportunities to behave according to personal inclinations. During my brief military experience (basic training as an infantry rifleman followed by service as an entomologist, 1951–53), my training company was informed publicly, via loudspeaker and while arrayed in ranks on the parade ground, that anyone who disobeyed a command on the battlefield could be summarily shot dead, either from the front or from behind. There is little room for personal concern about "the shadow of the future" in such a situation.

In situations in which the interests of group members are identical, or nearly so, individuals (as with genes) can act (function) appropriately without the ability – or even tendency – to remember the relevant past or predict the relevant future. Genes accomplish this because genes functioning in genomes have had a long and consistent history of identical interests, or near-identical interests; the reason for Dobzhansky (1961) to argue that development is unitary (cf. Alexander 1993).

I suggest that: (a) humans learn a very great deal about the adaptive way to behave in virtually every social situation; (b) humans possess great ability to change back and forth quickly between significant within-group competition and extreme patriotism, or within-group cooperation (see also Lahti and Weinstein 2005); and (c) close and constant social interaction and the vigilance of moral systems enforces such quick and decisive changes. Humans are too flexible, and too capable of policing, and of enforcing moral behavior, to be explained solely, or even primarily, in terms of proportions of purely selfish and strongly reciprocating individuals.

Finally, (6), social investment may be part of an individual's effort explicitly (either consciously or unconsciously) to elevate the general level of reciprocity in society. Thus, generous donations to people affected by a disaster, or efforts to enlist in the armed forces at the onset of war, can have snowballing effects on donations or rates of enlistment that raise the level of social investment generally, and may benefit the individual by various indirectly reciprocal returns. Whenever the general level of social investment is raised, all persons had better pay attention and act wisely, or they may lose by being viewed as laggards, or as self-serving and stingy. It is not necessary, however, that the reputation of an individual contributing to the rise in social investment in indirect reciprocity be involved. Such donations can be entirely anonymous and without conscious anticipation of returns, and the donor can still gain, individually, as whenever their interests are sufficiently close to those of the entire group.

General changes in levels of beneficence, or risk-taking with acts of beneficence within a society, if they are adaptive, are adjustments of systems of indirect reciprocity (or nepotism). Anyone who carries out acts that raise the level of beneficence within a society can be investing in indirect reciprocity. There may often be significant risks – and frequent losses – involved in individual attempts to change society toward a greater level of beneficence. But, obviously, there can also be huge benefits, in the form of rewards directly to the social beneficence pioneer, or to the anonymous pioneer in the particular form of a generally more beneficent society which may: (a) increase the likelihood of a healthy persistence of the society harboring the pioneer's circle of kin; and/or (b) yield an outright bias of benefits to the kin of the social pioneer.

It seems to me undeniable that selection has favored flexibilities in individual humans via the patterning of learning skills and biases, flexibilities that have allowed individuals to perform appropriately along all of the axes in the kinds of experiments being described to test for strong reciprocity. Individual humans have been influenced differently by personal social (learning) histories, affecting both whether they return kindnesses in one-shot anonymous encounters and whether they punish violations of cooperativeness and fairness. I regard it as undeniable that individual humans can possess both of these tendencies and capabilities, and can act on them in rapid alternation or virtually simultaneously. I also suggest that most individual humans are capable of changing their behavior between “strong” and “not-so-strong” reciprocity (social beneficence) as they pass through different life situations affecting whether those alternative behaviors are adaptive. Acceptance of this possibility can be inferred from Fehr and Heinrich’s (2003) sentence, “This logic applies to genes, cultural traits, or both in an interactive process.” At least it does so if the statement includes that individuals can change between the different situations, treat different individuals differently in the same situation, and assume these stances along a more or less continuous axis. I would also argue that the importance of these kinds of skills and flexibility, and their potential for opposite behaviors evolving in the different situations just described, are the most likely explanations for the general nature and extremeness of the human brain and the overall complexity of human sociality. Should these things be true, it seems fairly clear that (risky) investments in ordinary direct and indirect social reciprocity are being described. This conclusion does not preclude using the phrase “strong reciprocity” as the authors have used it, but it does suggest that direct and indirect reciprocity, and nepotism – as originally known to most evolutionary biologists – are all together capable of explaining what is being discussed, so long as we include, when appropriate, that for various reasons in each of the situations just described, individuals showing so-called “strong reciprocity” may simply be behaving maladaptively.

Probably, no one doubts that what appears to be net-cost beneficence can evolve when the beneficence is channeled to entities with interests common to those of the original benefactor, or to entities whose interests incidentally or accidentally cause them to benefit the original benefactor because of the beneficence. The question seems to be whether or not net-cost beneficence can evolve in the absence of returns, or is only an incidental or accidental effect of evolved (hence, in some sense, even if unconscious, calculated) social investment when no return occurs or is likely. If the action is adaptive, then there will be returns to the beneficent

individual's genes. Otherwise, we have to be puzzled by use of the word "reciprocity" in the term "strong reciprocity."

In the absence of the extremely careful, meticulous, and time-consuming analyses obviously required to test the experiments said to demonstrate social behaviors regarded as both adaptive and contrary to self-interest, I can only suggest that if so-called strong reciprocity is truly reciprocity, and therefore potentially adaptive, it is almost certainly an aspect of indirect reciprocity, and as such it can be explained using existing social theory (Alexander 1987, 1993, 2005).

USING PROXIMATE MECHANISMS TO INTERPRET RESULTS OF EXPERIMENTS WITH HUMAN SOCIAL BEHAVIOR

Natural selection cannot produce pleasurable responses to acts that consistently cause net expense to an organism, because pleasure leads to efforts to seek out and repeat acts. Pleasure signifies benefit, therefore attraction and repetition. Displeasure or pain signifies detriment, therefore avoidance. (Alexander 1987: 26ff., 110–114).

Pleasure and displeasure (or pain) are proximate mechanisms affecting, respectively, positive and negative responses to life experiences. Natural selection favors pleasurable responses to acts with positive effects (net-gain social beneficence), causing such acts to be sought out and repeated. Net-cost social beneficence, as with other investment mistakes or deviations from evolutionarily appropriate actions, yields displeasure or pain, including efforts to avoid and escape repetitions. These proximate responses may be useful in facilitating current studies of social beneficence by assessment of expectations of experimental subjects. Their use, however, will require careful analysis that takes into account participants' skill or competence in different circumstances to assess both the risk of no returns and the possibility of unexpected or particularly generous return benefits (that is, those worthy of serious risk-taking), in particular via indirect reciprocity.

If a participant in a social experiment demonstrates a pleasurable response following an act regarded by the investigator as net-cost beneficence, the investigator must somehow reconcile this response with his own interpretation. We should not expect that net-cost beneficence will yield a pleasurable response.

Thorough understanding of social beneficence will likely require the development of a detailed science of indirect reciprocity, because of an evolved inadequacy of conscious acceptance of the rewards of indirect reciprocity, as well as evolved resistance to the suggestion that social

beneficence is only accidentally or incidentally expressed (meaning not evolved), except in situations involving reliable returns. This suggestion does not mean that net-cost beneficence (or any other behavior) cannot become prevalent as a deliberate deviation from evolved tendencies. It does mean that, whatever evolved tendencies might enable such deviations, they did not evolve as a favoring of net-cost beneficence, or as a response to evolutionarily novel situations. Such tendencies could have evolved, however, as a willingness to risk almost certain net-cost beneficence in desperate situations.

There is much yet to be worked out in the convolutions of indirect reciprocity and cooperativeness, and how they are reflected in our conscious and non-conscious motivations; perhaps there is no more difficult proposition in understanding ourselves socially. For these reasons it will not always be a simple matter to measure proximate mechanisms and assess their direction of expression as a test of alternative motivations in game theory and other social beneficence experiments. Nevertheless, these are potentially useful methods, and perhaps essential, in efforts to understand the meaning of results in such experiments.

CONCLUDING REFLECTIONS ON GLOBAL COOPERATION

Consider the two above propositions, in relation to combined effects of global problems such as war, environmental pollution, resource depletion, and overpopulation, and how or whether humans will ever be able to cooperate on any universal project, especially if they necessarily yield varyingly uncertain levels of at least temporary net expense to every participant. All humans, whether individuals or groups, are evolved to compete, even as cooperators at multiple sub-global levels. Perhaps this problem cannot be resolved without a sufficient number of the participants recognizing consciously that a special kind of cooperativeness – or at least enormous risk – must be engaged. Some participants must expect to lose permanently, compared to others, in order to produce universal benefits that will prevent catastrophic results to the entire world population of individuals and genes. There may be no precedent for this kind of “global” (in essence, one cooperative group) behavior across the entire history of the human species. The conditions of cooperation, or willing risk-taking or self-destruction that take place in military combat or with so-called suicide bombers, are not precisely parallel. There, decisions often must be made instantly, and there is as well a rich background of both urging and coercion to heroism. Included are potential rewards to family

– or self when death can be avoided – and manipulation to further patriotism. The imposing of authoritarianism in military situations includes the threat of being executed summarily when an order is refused, or of ignominious imprisonment, with potentially disastrous consequences for the offending individual’s family or clan. These possibilities are real, because when the chips are down, even in democracies the military deliberately takes a form approaching that of an absolute hierarchy and morality. Moreover, the relevant question is whether it has been adaptive to accept willingly the edicts of authoritarian figures, particularly in times of inter-group conflict. If it has, then we can explain as indirect reciprocity, or coercion to complete cooperation, what Bowles and Gintis (2003) referred to as “common behaviors in warfare as in everyday life [that] are not easily explained by the expectation of future reciprocity.” The lure of possible social returns via indirect reciprocity, sometimes involving promised rewards from supernatural forces after death, sometimes involving moral consequences to families (e.g., Alexander 1989: 464), also attests to the potential adaptive value of risky social investment. The “future reciprocity” need not accrue to the beneficent individual to be evolutionarily adaptive. In general, only genes and learning accumulate changes and persist across generations, and the learning only because of the presence and functioning of the genes.

As the quote at the start of this chapter indicates, whatever degrees or kinds of cooperative behavior we are able to accomplish in the future need not accord with every detail of our evolutionary history, even though we are unlikely to be able to change ourselves fully, or well, in directions contrary to our evolutionary backgrounds unless and until we are fully understanding of those evolutionary backgrounds. It is a most important example that we will surely be required, in some sense or to some extent, to view the members of our entire species as we view today’s surrogate kin groups, local communities, and nations of patriots. The question is: in the presence of even potential conspecific adversaries, will such a global attitude ever become anything other than too much to ask?

As long as there are sovereign nations possessing great power, war is inevitable.
(Albert Einstein)

Kindness and generosity arise spontaneously when the otherness of others goes away. (Barry R. McKay, August 3, 2007: Letter to the *Ann Arbor News*, Ann Arbor, Michigan)

If only we could devise an effective way to tackle the question – and generate the solution – of how to make “otherness” go away!

ACKNOWLEDGMENTS

This chapter is expanded not only from the University of Michigan symposium initiating this volume, but also from a lecture inaugurating the Bowling Green State University, USA, November 2007 Symposium on Darwin's Heirs: Evolution and Human Society, organized and sponsored by the BGSU Social Philosophy and Policy Center, and the 2007 keynote lecture before the Evolution and Human Behavior Society in Kyoto, Japan (Alexander 2008). I have benefited from discussions with many people, including the editors of this volume, but especially from extensive email conversations with Billy E. Frye, John Cooley's help in locating and interpreting Darwin's challenges, David Marshall's assistance in determining the range of possible differences resulting from variations in a human genome, and Mark Flinn's critique of this chapter.

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Published by
Edward Elgar Publishing Limited
The Lypiatts
15 Lansdown Road
Cheltenham
Glos GL50 2JA
UK

Edward Elgar Publishing, Inc.
William Pratt House
9 Dewey Court
Northampton
Massachusetts 01060
USA

A catalogue record for this book
is available from the British Library

Library of Congress Control Number: 2014932605

This book is available electronically in the ElgarOnline.com
Social and Political Science Subject Collection, E-ISBN 978 1 78347 187 4



ISBN 978 1 78347 186 7

Typeset by Servis Filmsetting Ltd, Stockport, Cheshire
Printed and bound in Great Britain by T.J. International Ltd, Padstow