

## Chapter 7: Nothing about Culture Makes Sense except in the Light of Evolution

Nothing in biology makes sense except in the light of evolution

—Theodosius Dobzhansky, 1973

When Dobzhansky penned our epigraph in the 1970's, relatively few biologists devoted themselves to the study of evolution, and today evolutionary biologists are vastly outnumbered by molecular biologists, physiologists, developmental biologists, ecologists, and all the rest. Nonetheless evolution plays a central role in biology, because it provides answers to *why* questions. Why do humans have big brains? Why do horses walk on the tips of their toes? Why do female spotted hyenas dominate males? The answers to these questions draw on all parts of biology. To explain why horses walk on their toes, we need to connect the ecology of Miocene grasslands, the developmental biology of the vertebrate limb, the genetics of quantitative characters, the molecular biology and biophysics of keratin, and much more. Because evolution provides the ultimate explanation for why organisms are the way they are, it is the center of a web of biological explanation that links the work of all the other areas of biology into a single, satisfying, explanatory framework. As Dobzhansky put it, without the light of evolution, biology “becomes a pile of sundry facts, some of them interesting or curious but making no meaningful picture as a whole.”<sup>1</sup>

We believe that evolution can play the same role in explaining human culture. The ultimate explanation for cultural phenomena lies in understanding the genetic *and* cultural

evolutionary processes that generate them. Genetic evolution is important because culture is deeply intertwined with other parts of human biology. The ways we think, the ways we learn, and the ways we feel shape culture, affecting which cultural variants are learned, remembered, and taught, and thus which variants persist and spread. Parents love their own children more than those of siblings or friends, and this must be part of the explanation for why marriage systems persist. But *why* do people value their own children more than others? Obviously, an important part of the answer is that such feelings were favored by natural selection in our evolutionary past.

Cultural evolution is also important for understanding the nature of culture. Because culture is transmitted, it is subject to natural selection. Some cultural variants persist and spread because they cause their bearers to be more likely to survive and be imitated. The answer to why mothers and fathers send their sons off to war is probably that social groups having such norms that encourage such behavior outcompete groups that do not have such norms.

Finally, genetic and cultural evolution interact in complex ways. We saw that social psychologists and experimental economists, working from very different research traditions, have produced compelling evidence that people have prosocial predispositions that cause us to act altruistically. But *why* do we have such predispositions in the first place? Evolutionary theory and the lack of large-scale cooperation in other primates suggest that selection directly on genes is unlikely to produce such predispositions. So, why did they evolve? We think cultural evolutionary processes constructed a social environment that caused ordinary natural selection to favor empathetic altruism. Our specific explanation may be in error; you seldom get it straight on the first try. The important point is that evolving culture, certainly in theory and probably in fact, has a fundamentally important role in shaping our species.

## Is dual inheritance theory the proper theory of cultural evolution?

Of course, to agree that evolutionary theory is a valuable tool in the human sciences is not necessarily to agree that the approach we propose is the right one. Karl Popper, the famous philosopher of science, said that science trades only in conjectures not (yet) refuted. But some issues cease to be debated because the evidence becomes so overwhelming. In our lifetimes, the propositions that genes are DNA and that seafloor spreading causes continental drift have passed from doubtful speculations to textbook conventions. Will the Darwinian theory of cultural evolution be one of those currently controversial ideas that become standard textbook fare in the early twenty-first century? In this chapter, we gather the threads of the case we have laid out in this book to allow readers to answer this question for themselves. We are, of course, partisans of this endeavor, but we hope that the fair-minded skeptic will find the evidence strong and the issues worth pursuing.

Evolutionary biologist E. O. Wilson recently revived notion of “consilience,”<sup>2</sup> introduced by the nineteenth-century polymath, William Whewell. The idea, which was a favorite of Darwin’s, holds that seemingly disparate phenomena in the world are in fact connected. For instance, nuclear physics is “remote” scientifically from the social sciences, yet nuclear reactions in the sun are the most important source of energy on earth; nuclear decay in the earth’s interior drives seafloor spreading, which in turn shapes terrestrial ecology; and nuclear weapons profoundly altered the shape of international politics. Nematologists will remind you that if the rest of the biosphere suddenly disappeared, nematodes would trace out a ghostly outline of it all. Nothing, then, is in principle irrelevant to the study of the human species. Since this is so, scientific theories are vulnerable to disproof in all the realms of phenomena where they apply.

Evolutionary theories apply to highly consilient phenomena. You will have noticed that our examples have sprawled across a considerable territory. Let us remap the territory in terms of five sorts of investigations where evolutionary theory is vulnerable: logical coherence, investigations of proximate mechanisms, microevolutionary studies, macroevolutionary studies, and patterns of adaptation and maladaptation. This is just a taxonomy of convenience, but most evolutionary investigations fall into one category or another. It is a useful device for depicting the wide-ranging consilience of evolutionary phenomena. Any given evolutionary hypothesis can usually fail in several if not all of these domains.

### ***Logical consistency***

We have devoted a lot of effort to making mathematical models of cultural processes. Although we have spared you the details here, the models play a very important role in our story, because they ensure that our arguments are deductively sound.<sup>3</sup> Critics of mathematical models often recoil at their simplicity, yet simple models are an effective prosthesis for a mind that is poor at following intricate, quantitative causal pathways— tools to help us think a little more clearly about complex problems. Without such models we would be forced to rely entirely upon verbal arguments and intuitions whose logical consistency is difficult to check.

Mathematical models stand behind all our explanations of cultural evolution and gene-culture coevolution. In chapter 3, we argued that a style of modeling borrowed from population biology, with suitable modification to reflect the very real differences between culture and genes, can be used to test the logical cogency of cultural evolutionary hypotheses. In chapter 4, we described several models that investigate the basic adaptive properties of cultural transmission, leading to the hypothesis that culture was initially an adaptation to variable environments. In

chapter 5, we sketched the results of models that show how adaptive cultural mechanisms systematically lead to the spread of maladaptive cultural variants. Finally, in chapter 6, we outlined models of cultural group selection, a process that might explain our quite unusual and phenomenally successful social systems. These models may be wrong, but they are (probably) deductively sound.

### ***Proximate mechanisms***

In chapter 4, we described evidence comparing social learning in humans and other animals. While many animals have rudimentary capacities for social learning, these are uniquely hypertrophied in humans. In late infancy, a suite of behaviors emerges in humans that make us very efficient imitators compared to any other animal. These capacities might underlie language, though the dominant school of linguists insists that language learning is a special-purpose capacity. Regardless of these controversial details, humans are clearly capable of transmitting vast quantities of information by imitation, instruction, and verbal communication. Humans have the capacity to form a large cultural repertoire, and the evidence surveyed in chapter 2 shows that much of the extraordinary behavioral variation stems from differences in cultural traditions. Human populations are characterized by durable traditions that result in different behaviors even in the same environments.

Two other plausible mechanisms explain variation in human behavior among groups: genetic differences and individual adaptation to environmental differences. Genetic differences cannot be very important, as borne out in the most direct data bearing on this issue, the results of cross-cultural adoptions. The evidence indicates that children raised by parents of another culture behave like the members of their adoptive culture, not their natal culture, in all important

respects. Until a few thousand years ago, all humans lived in quite simple societies. Since then, most of us have come to live in much more complex ones, albeit some of us much more recently than others. Human behavior, under the influence of evolving cultural traditions, can change enormously without any appreciable genetic evolution. Whatever average innate differences might exist between human populations, they must be small compared to cultural differences.<sup>4</sup>

The importance of individual behavioral versus cultural adaptation to local environments is a more difficult issue. Humans are adaptable and inventive creatures, no doubt. However, if individual behavioral adaptation to local conditions is the primary force generating behavioral differences between groups, then people living in the same environment should all behave in more or less the same way, but we know they often don't. Farmers with Lutheran German, Anabaptist German, and Yankee roots living side by side in the American Midwest behave quite differently, confirming that cultural tradition often has a powerful impact on behavior.

### ***Microevolution***

In chapter 3, we built a case for culture being an evolutionary phenomenon susceptible to analysis using Darwinian tools. The heart of Darwinism is the close study of evolutionary processes on the generation-to-generation timescale that allows precise observation and controlled experiment. Such microevolutionary studies contrast with macroevolutionary investigations of the grand results of evolution on time scales of tens of generations and longer. Macroevolutionists normally have to work without the benefit of direct observation and experiment and must rely upon the scrappy fossil record and comparative study of extant forms. Most cultural change is relatively gradual, and is apparently the result of modest innovations spreading by diffusion from their point of origin to other places. Such patterns were well

documented by anthropologists in the nineteenth century. In the twentieth century, “diffusionism” fell into disrepute for being atheoretical and merely descriptive.

A Darwinian theory provides the tools needed to analyze the process of invention and diffusion in a rigorous way. Cultural evolution is a population phenomenon. Individuals invent, and they observe the behavior of others. Imitation by discriminating observers selectively retains and spreads innovations which in turn accumulate and eventually yield complex technology and social organization. Darwin described such patterns of change as “descent with modification.” The theoretical and empirical tools designed by evolutionary biologists to study genes are well suited to describing cultural evolution *given suitable modification*. The examples we use to illustrate most points about cultural evolutionary processes are microevolutionary. For example, in chapter 5 we reviewed evidence that several different processes, operating against the background of the expanding influence of nonparental relative to parental transmission of culture, have successively come to influence attitudes toward family size and family-planning technology.

### ***Macroevolution***

Understanding what regulates the rate of evolution in different times and places is one of the main tasks of macroevolutionary studies and one that is none-too-well advanced, even in biology. The large-scale and comparative evidence suggest that cultural evolution has an important role to play in understanding the major events in human evolution. In chapter 4, we reviewed the basic adaptive properties of the cultural system of information transmission. The theoretical models tell us that a system of social learning is likely to have been favored initially as an adaptation to variable environments. Paleoclimatologists tell us that the environments of

the last couple of million years have become highly variable on timescales that our models suggest ought to strongly favor a cultural animal. We can even make a stab at guessing why only humans have this adaptation. In chapter 6, we proposed a hypothesis, based on models of cultural group selection, to explain the highly unusual form of human social organization. We explained how the coevolution of genes and culture could create innate psychological dispositions that could never evolve by genes alone.

The macroevolutionary record is a stern test of explanatory hypotheses because the explanation has to get the timescale right. For example, the emergence of complex societies over the last five thousand years can't have been the result of genetic change, because it happened too fast. On the other hand, it happened far too slowly to be explained by purely individual adaptation, be it by rational choice or any other individual-level psychological process. Some factor that has just the right amount of historical inertia is required to explain the moderately rapid growth of social complexity over the last five thousand years. Cultural traditions change on the appropriate timescale, adding credence to the theory. The next question is, can we ferret out what kinds of traditions are the rate-limiting step in such progressive sequences? Many scholars argue that the rate of evolution of social institutions is the rate-limiting step due to the difficulty of observing with foreign social institutions and the difficulty of experimenting with any novel institution.<sup>5</sup>

### ***Patterns of adaptation and maladaptation***

Humans adapt quickly and efficiently to variable environments using technology, and they evolve variable, often complex, social institutions producing unusual amounts of cooperation, coordination, and division of labor. Much of the diversity of human behavior in time and space



results from adaptive microevolutionary processes shaping complexes of technology and social organization that suit us to live in most of the terrestrial and littoral habitats on earth. Other organisms must speciate in order to occupy novel environments, whereas humans rely mostly upon culture. Modern humans apparently have spread out of Africa to the rest of the world in the last one hundred thousand years, relying on their ability to generate complex cultural adaptations suited to virtually every habitat on earth.<sup>6</sup>

Cultural maladaptations are a more pointed test of our approach. The same is true of Darwinian theory generally. Although divine creation accounted for *adaptation*, Darwin's theory has the edge in that it also accounts for vestigial organs and other maladaptations. Maladaptations are plausible byproducts of a messy natural process of descent with modification, but are an embarrassment to the work of an omniscient Creator. Contemporary population geneticists have discovered interesting organic maladaptations that resulted from the peculiarities of the genetic inheritance system.

Darwinian models of cultural evolution make specific predictions about classes of maladaptations that we should observe with fair frequency. In chapter 5, we presented the case that selfish cultural variants should be reasonably common. The existence of many adaptive cultural traits and the costs of evaluating the utility of different ideas put the sophisticated social learner on the horns of a dilemma. Impressionable observers risk imitating poorly adapted cultural variants, while conservative observers may miss out on valuable new techniques and social arrangements. The human cultural psychology seems adapted to balance these costs and opportunities. We have various forms of "fast and frugal" transmission biases that give us a good chance of sweeping up good ideas and rejecting bad ones. The chance that such biases will find a better variant to favor goes up with the number of models surveyed. But the tendency for selfish

cultural variants to be favored by natural selection increases as the influence of nonparental models increases. A certain frequency of maladaptation inevitably results from design tradeoffs confronting an advanced cultural creature.

We presented evidence in chapter 5 that some very common features of human societies, such as the modern transition to low fertility, are examples of selfish cultural variants. Modern societies, by vastly enlarging the scope for nonparental transmission, have also magnified the chance of choosing maladaptive memes. On the one hand, modern technology and social organizations produce a cornucopia of adaptations. On the other, we face a barrage of well-advertised innovations that have the net effect of causing birthrates to plummet in modern societies, thereby reversing the normal correlation of economic and reproductive success. Anabaptist societies show how relentlessly discriminating a culture must be to adopt modern innovations that increase economic efficiency but still retain traditional cultural values that maintain birthrates at fitness-maximizing levels.

In chapter 6, we discussed cultural group selection, another engine for generating maladaptations from the narrow genes'-eye point of view. Human societies are crude superorganisms. One of the human species' main social *adaptations* is the ability to organize cooperation, coordination, and a division of labor on a much larger scale than the typical primate kin group. Yet cultural group selection remains in conflict with selection on genes that continue to favor only small-scale, family-oriented, and reciprocal cooperation. The dilemma of cooperation exists at the evolutionary level as well as the personal. Selection on genes can't favor large-scale cooperation even if every individual is on average are better off if they cooperate. Even taking into account coevolutionary selection pressures for more-docile genes, selection on genes still tends to favor people who look out for themselves, their families, and

their partners in significant measure. Human social institutions, particularly those of the really large-scale societies of the past five thousand years, have developed work-arounds to resolve the inevitable conflicts built into our social psychology.

The debate over whether culture is adaptive, maladaptive, or just neutral has gone on for a century. The theory outlined here predicts what the empirical evidence tells us—culture is sometimes adaptive, sometimes maladaptive, and sometimes neutral. It adds the nuance that what is maladaptive from the gene's-eye point of view may result from selection acting on cultural variation. Then, genes adapt secondarily to a world with culturally evolved institutions, so that genes come to support cultural adaptations. In a broader sense, human genes have also on average benefited from cultural adaptations even though natural selection directly on genes never favored large-scale cooperation! The soap opera messiness of human life accords well with the idea that multilevel selection has built conflict into our instincts and our institutions.

The Darwinian theory of cultural evolution and gene-culture coevolution does not fail in any of the five domains, while theories that invoke only genes and individual decision-making have problems with every one. The tracks of culture are all over human behavior, no matter how we view the case?

## We need a synthetic theory of human behavior

Consider for a moment how biology is taught to undergraduates. Although students know that biology is composed of many subdisciplines—ecology, molecular biology, genetics, and so forth—it is taught as an integrated subject up through the first course in college. Good instructors take care to present the unifying themes of biology—genetics, basic metabolic principles, and

evolutionary processes. They do not do this because they value a general education for its own sake. Rather, they know that all of these levels of organization are linked in a causal web.

Biology has many subdisciplines, yet the boundaries between them, and between biology and the other natural sciences, are porous. Some of the most creative scientific work is done by harnessing findings or methods in one field to problems posed in others. The classic example is the importation of chemistry into biology to create a succession of new disciplines—physiology, biochemistry, and molecular biology. Moreover, many of the early molecular biologists were actually trained in physics.<sup>7</sup> Later, Richard Lewontin's pioneering application of biochemists' methods for studying molecular variation almost at the level of the gene<sup>8</sup> led to his discovery that a surprising number of gene loci are polymorphic. This finding attracted a generation of students to the problems of evolution at the level of genes and launched the still-vibrant field of molecular evolution.

When we first began exploring the social sciences, we were struck by how isolated they are from one another, as well as from the natural sciences. The problem begins with educational traditions. Psychology, sociology, economics, linguistics, history, and political science all teach proprietary first-year introductory courses. Students are encouraged to think that the study of humans can be divided into isolated chunks corresponding to these historical disciplines. Why is there no *Homo sapiens* 1 course based on the model of Bio 1, a complete introduction to the whole problem of understanding human behavior? Even in anthropology, where students in traditional programs typically take introductory courses in biological, sociocultural, archaeological and linguistics subfields, efforts to link the subfields are limited (and have become more unfashionable in recent decades).<sup>9</sup>

One reason, perhaps, is that the key integrative fields have not yet developed in the social

sciences. If so, a proper evolutionary theory of culture should make a major contribution to the unification of the social sciences. Not only does it allow a smooth integration of the human sciences with rest of biology; it also provides a framework for linking the human sciences to one another. Much of human psychology is concerned with acquiring and managing culturally acquired information, and the variation in psychology among different groups of people is mainly a cultural phenomenon. The rational-choice disciplines of economics and game theory need theories of constraints and preferences, many of which are cultural in origin. Anthropology, sociology, political science, linguistics, and history have long relied on cultural explanations to account for changes in human behavior and to explain diversity. In this book, we have drawn upon empirical work from all of these disciplines to understand the nature of cultural evolution. We have advanced cultural evolutionary hypotheses to explain interesting phenomena that social scientists have documented, such as the surprising reversal of the correlation between wealth and reproductive success that has gradually spread from society to society over the last two centuries. We don't expect all of these hypotheses to stand the test of time; perhaps none will. Our use of this immense and valuable body of data, we hope, illustrates the relevance of the social sciences to evolutionary questions.

We also hope we have demonstrated to your satisfaction how cultural-evolutionary analyses integrate data from disparate disciplines and schools within the human sciences. Several questions that have excited enormous controversy in the social sciences seem to us to have natural resolutions in the evolutionary framework.

### ***Methodological individualism versus methodological collectivism***

The social sciences have long been bedeviled by the “micro-macro problem.”<sup>10</sup> If, like

economists, you start with a theory based on individual behavior, how can you ever get to a proper account of society-scale phenomena like social institutions? If you start with collective institutions, like many sociologists and anthropologists do, how do you make room for individuals? A distinguished sociologist once astounded us with the claim that it had been *proved* that you had to pick one or the other and that it was a logical certainty that the two approaches could never be unified.

Actually, Darwinian concepts provide a neat account of the relations between individual and collective phenomena. The Darwinian tools were *invented* to integrate levels. The basic biological theory includes genes, individuals, and populations. In these models, what happens to *individuals* (for example, natural selection) affects the *population's* properties (for example, the frequencies of genes), even as individuals are the prisoners of the gene pool they draw upon. Many other links between individuals and the populations they live in are possible, and the addition of culture creates still more. We have considered examples such as conformist transmission, where the frequency of a cultural variant, a *population* property, affects its probability of being imitated by *individuals*. Darwinian tools help us build linkages between phenomena at different levels as given problems require. Individuals seem to be hapless prisoners of their institutions because, in the short run, individual decisions don't have much effect on institutions. But, in the long run, accumulated over many decisions, individual decisions have a profound effect on institutions. Evolutionary theory gets right the basic structure of the relationship between individuals and the collective properties of their societies.

### ***History versus science***

Historians and historically minded social scientists sometimes argue that the actual evolution of

social institutions and the like is produced by a myriad of concrete events peculiar to a particular place and time. Generalizations or hypotheses derived from general models like those used in economics or psychology add nothing to the history of these concrete events, and are often positively misleading because they focus attention on a-priori concerns to the detriment of understanding the actual events of the case at hand.

Historical contingency is as important in the biology of other organisms as it is in our own species. Every species is unique, after all, and derives from the highly contingent events of its evolutionary history. The convergences of plants and animals on similar adaptations in similar but isolated environments are often striking, but equally striking differences remain. The Darwinian theoretical tool box furnishes bits of canned logical analysis applicable to such phenomena. Our empirical methods are similarly tuned in the first instance to the accurate depiction of concrete historical trajectories and the local causal processes that drive them. Students of a particular case should sort through the tool box to select the apt tools for the problem at hand in the event that some models do prove to apply to many cases, and empirical generalizations sometimes have great power. Hamilton's theory of inclusive fitness turns out to apply very broadly; cooperation in animal societies is almost always organized along family lines, although the diversity within that generalization is certainly considerable. Inclusive fitness theory itself accounts for much but by no means all of this diversity.<sup>11</sup> Humans are a partial exception to Hamilton's generalizations, and we showed how a theory of cultural group selection might explain our exceptional level of cooperation. The cultural group selection model is in the same spirit as Hamilton's, with a sharp tweak to fit our unique case. We thus submit that our model building and the kinds of empirical studies we champion are acutely sensitive to the details of the human case. Everything from evolutionary biology has to be rethought in the light

of the massive importance of culture in our species, leading to a tool box specifically tailored for the unique features of human evolution.

Models of modestly general applicability and empirical generalizations of modest scope are extremely valuable for two reasons. First, individuals are quite stupid compared to the complexity of the problems we aspire to solve. Well-studied models and well-tested empirical generalizations embody the collective wisdom of one's fellow scientists. An isolated individual thinker has no chance against a problem of any complexity. As teachers we know, for example, that even the simplest population-level process, exponential growth, flummoxes the untutored. Second, most concrete cases are so complex that no one investigator can hope to study in detail every dimension of the problem. In actual historical investigations, many important processes and events will not enter the record at all, and the problem is necessarily simplified, often drastically, by the investigator. Empirical generalizations and theories help to make this inevitable simplification transparent. Sensible evolutionists know they have left out much and know that any conclusions they reach are vulnerable as a consequence. All anyone can hope to do is to make canny simplifications that do minimum damage to understanding.

Ironically, the evolutionary tool box helps explain why historical contingency plays the large role that it does. For example, evolutionary game theory shows how easily multiple, evolutionarily stable strategies arise even in rather simple games. For example, in the standard model of reciprocity, the iterated prisoner's dilemma, *any* behavior from never cooperate to always cooperate and everything in between is favored by selection once it becomes common enough. Historians have everything to gain and nothing to lose by using appropriate evolutionary tools for their job.



## <B>Functional versus symbolic elements of culture</B>

The relationship between the functional and symbolic elements of culture is a bit intricate, but by no means intractable. Human scientists interested in the symbolic aspects of culture sometimes claim that symbolic considerations rule out functional interpretations of culture.<sup>12</sup> Some evolutionary functionalists claim that a strict separation exists between stylistic elements, like the decorations on a pot, that evolve by random processes and functional elements, like its size and shape, that evolve by selection.<sup>13</sup> Evolutionary analyses confirm<sup>14</sup> what some social scientists have claimed for a long time:<sup>15</sup> stylistic differences have functions even when the precise form of a style has no function. The pot's decoration may serve to advertise its maker's group membership or status within the group.<sup>16</sup> Evolutionary theory and some good data suggest that symbols are used as badges of group membership, as badges of roles within groups, and as the means to assert personal status. Stylistic displays often convey useful information to potential imitators.<sup>17</sup> On the other hand, the evolution of style by the runaway process can generate maladaptive exaggeration of style. We considered how status-motivated consumption races may play a role in the demographic transition.

### ***Function and dysfunction***

The sources of human happiness and human misery are evolutionary. Take social institutions as an example. Some simple societies lack effective systems of dispute resolution, whereas others have quite effective ones.<sup>18</sup> Levels of trust, happiness, and satisfaction with life differ greatly within western European countries, quite independently of per-capita wealth.<sup>19</sup> People evidently find some sets of social institutions more congenial than others. Since individual decision-making and collective decision-making institutions act as forces in cultural evolution, we may be

said to affect our own evolution. However, we are also the prisoners of the culture and genes we inherit.

Aggregating individual decisions to make collective ones is a formidable problem in theory and in practice.<sup>20</sup> In our discussion of the work-arounds that make complex societies possible, we took pains to point out that each functional work-around has its evil twin; emphasizing one element at the expense of the other is a recipe for error. Utopians meet defeat after defeat in attempts to persuade people to slip their chains, and attempts at revolution often fall victim to a combination of impossible dreams and cabals of the selfish, vicious, and power hungry. On the other hand, corrupt regimes must be repressive because they always face resistance from altruistically motivated moralists advocating reform. Societies that are unwilling or unable to change subject their people to much the same vices as failed revolutions. Low-trust societies controlled by authoritarian political institutions look much the same no matter their origins. The modern evolution of technology shows that the rate of evolution can be enormously accelerated, in largely desirable directions, if things such as property-rights institutions are favorable.<sup>21</sup> The evolution of social institutions is the tougher nut to crack **As opposed to genetic evolution?**, but the capacity of open political systems to build the interpersonal trust that in turn serves as the basis for desirable innovations in social arrangements is fairly impressive. No doubt, if we understood the nature of social evolution better, we could improve the process.

If our general argument is correct, the reason that these classic problems led to intractable debates rather than scientific progress is simply that Darwinian concepts and methods are appropriate to the problems of organic and cultural evolution. Without these tools, you just cannot think straight about problems involving cultural evolution, and problems of cultural

evolution are fundamental to understanding human behavior.

## The theory is an engine for generating new questions

From the scientist's point of view, the most important function of a scientific theory is productivity. Does it point research in a useful direction? Does it create more new and interesting problems than it solves? A sociologist once remarked to us that Darwinian theories of cultural evolution looked to him like conventional social science done with a different slant. That we have been able to use much of conventional social science to make a case for the theory lends weight to this critique. But cultural evolutionists advocate adding new evolutionary tools, not carrying on as always.

Many cultural scientists of our acquaintance are infected with a certain ennui. They seem to feel that the late "Great Men" of their fields, Marx, Weber, Durkheim, Parsons, and so on, said most of what can be said about the human condition. Contemporary scholars can mine thin ore that the Great Men passed over; they can slice, dice, and recombine old arguments to get interesting but not very novel new variants; or they can abandon science entirely for personalized accounts of human behavior in the humanistic vein. We believe that social scientists should not be discouraged. We really know very little about how cultural evolution works. Some of you may have concluded that this is because cultural evolution is beyond scientific understanding, at least of the sort we advocate. But we believe that thinking about culture using Darwinian tools opens many new avenues for investigation.

Our knowledge of the basic patterns of cultural variation is grossly incomplete, and understanding patterns is often the key to understanding process. While we have argued that

many patterns of variation in human behavior are inconsistent with genetic and environmental explanations and quite consistent with cultural ones, high-quality, systematic studies are very few. Most descriptions of cultural variation are qualitative rather than quantitative. While the ethnographic record is a splendid body of knowledge, the study of the processes of cultural evolution needs more-precise description. Some studies based on qualitative data are rather sophisticated,<sup>22</sup> but many opportunities to do better work exist. We need to characterize cultural variation in the same quantitative detail as genetic variation. Recent work in cross-cultural psychology<sup>23</sup> and in the use of economic games to investigate norms of fairness cross-culturally<sup>24</sup> will open a new era of quantitative ethnography that will revolutionize our understanding of human behavioral variation.

Cultural variation in time is also poorly quantified. Archaeologists and historians have very clearly documented cultural change in the long run. However, their impulse is usually to attempt to reconstruct the societies that lived in the past. An inherently simpler task is to use the best parts of the sketchy records available to estimate rates of change. Often, inferences about evolutionary processes imply quite different rates of evolution, and the archaeological and historical records are the best places to test these inferences. For example, the rise of literacy should allow increased rates of evolution by creating a form of memory less limited and less prone to error than that in human brains.<sup>25</sup> Impressionistically, over the last five thousand years, evolutionary rates do seem to accelerate with the development and expansion of literacy. Would such a hypothesis withstand quantitative test? Do other processes or variables have a comparable impact?

The evolutionary processes that operate on culture are poorly understood. In this book, we have used a taxonomy of evolutionary forces acting on cultural variation that was developed

in our previous book.<sup>26</sup> We are partial to this taxonomy, but it is surely incomplete. The trend in evolutionary biology has been to subdivide general categories of evolutionary processes into many distinctive subtypes, usually because the dynamic behavior of populations under their influence is distinctive. In chapter 4, we introduced the concept of imitating the successful and one of its subtypes, the imitation of those with prestige. But prestige is itself a complex social construction. Some prestige derives from personal charisma, some from institutionalized office. Some kinds of prestige may be recognized by nearly everyone in a society, whereas other forms may be highly local. We have no idea how many distinct varieties of prestige-based selective imitation there might be. We have little doubt that cultural evolution a complex and diverse set of phenomena, though we can only dimly imagine complexity from our present vantage point.

The quantitative roles of the various forces in concrete cases of evolution are scarcely known. In selecting studies to include in this book to illustrate the processes of cultural evolution, we have usually been reduced to examples where a single process, such as natural selection or one of the decision-making forces, is arguably dominant. In general, several forces are liable to simultaneously affect the evolution of any given bit of culture we choose to focus on. For example, innate, learned, and culturally acquired dispositions, often acting in different directions, are liable to simultaneously affect whether certain religious beliefs or innovations increase or decrease in frequency. Much of evolutionary science can be boiled down to estimating the strength of various effects on the trajectory of evolution in a sufficiently large number of cases to obtain some empirical generalizations. The gold-standard study of organic evolution is one in which the investigator estimates the strength of natural selection and other forces in an evolving population.<sup>27</sup> In the case of culture, such studies are still very few.<sup>28</sup>

## Conclusion: Nothing about culture makes sense except in the light of evolution

In 1982, the pioneering evolutionary economists Richard Nelson and Sidney Winter remarked that among the interesting intellectual challenges in their discipline, “certainly none is more worthy of attention than that of understanding the great complex of cumulative change in technology and economic organization that has transformed the human situation in the last few centuries.”<sup>29</sup> Historians and sociologists would nominate the rise of complex societies beginning five millennia ago and their subsequent development as another paramount question.

Anthropologists would nominate the origins of agriculture eleven millennia ago and paleoanthropologists the origins of modern humans that culminated with the first complex cultural systems some one hundred or more millennia ago. At the other end of the spectrum, political scientists would nominate the emergence of new political institutions and public policies, and how these rule systems affect political and economic development on the timescale of a few election cycles. What contemporary humans *are* is a product of such past and ongoing evolutionary events.

Evolutionary processes are thus at the crux of the most interesting questions about our species. How do we find ourselves in the early twenty-first century in the particular state we are in? The cultural evolutionary events of the centuries that came before have everything to do with that. Why do we have the social predispositions that we do? The coevolution of genes and culture over a million or more years has much to do with that. Can we influence the current evolution of human societies in desirable directions? As humans, we are unusually active agents in our own evolution, because we each choose which cultural variants to adopt and which to neglect.<sup>30</sup> Moreover, we organize institutions ranging from a simple tribal council to highly

complex modern ones, such as the research university and the political party, that are designed to direct the course of cultural evolution.<sup>31</sup> Yet, cultural evolution is a very big dog on the end of our leash. Even cultural heroes leading great political movements typically have modest effects. Gandhi could not prevent the Muslims from leaving India, nor could he persuade Hindus to reform the caste system. Only by attending properly to the population-level processes can we arrive at a proper picture of cultural evolution. With a reasonable picture of cultural evolution in hand, we could begin to understand how we might humanize processes that often exact savage costs in the currency of human misery.

In this book, we have made the case for using Darwinian methods to understand cultural evolution. Culture is stored in populations, so understanding human brains and how populations change requires population thinking. Darwinian accounts are one part bookkeeping—a quantitative description of cultural variation and its change through time. In addition, they are one part quantitative budget analysis—a systematic attribution of changes to causal processes. If you are going to study cultural evolution in a serious way, you are going to be driven to Darwinian methods of analysis. You have to be able to describe change and you have to be able to account for change. Several research programs in social sciences have independently converged on the Darwinian methods. The sociolinguists' microevolutionary studies of dialect evolution are a particularly sophisticated example; elsewhere we note others.<sup>32</sup>

Our own particular analyses may be maladroit. Borrowing tools from biology and remodeling them for culture has the attraction of capitalizing on the sophistication of evolutionary biology, but it may well introduce distortions. What is more, we have just argued that the Darwinian work to date is at best seriously incomplete. We make no apology for this. Science is an error prone, one-step-at-a-time procedure, and the story shall remain incomplete for

a long time if not forever.<sup>33</sup> The only thing about the project that we care to assert with utter conviction is that the Darwinian approach is *worth pursuing*.<sup>34</sup> Those who engage in the pursuit will take proper delight in remedying our generation's errors and omissions!

Much of the objection to applying Darwinian tools to the human case seems to come from a visceral dislike of picturing us as just “another unique species.”<sup>35</sup> From the evolutionist's point of view, human exceptionalism is a major problem. As long as humans stand outside the Darwinian synthesis, as long as human culture is said to be superorganic, the whole Darwinian project has a potentially fatal gap. Darwin feared that attacks on the *Descent of Man* would be used as a platform for attacks on the whole edifice of his theory. In this he was not disappointed. As the *Quarterly Review*'s commentator, probably the long hostile and devoutly Catholic St. George Mivart, gloated, the *Descent* “offers a good opportunity for reviewing his whole position” (and rejecting it).<sup>36</sup> The modern secular Science Wars critics evolved from the superorganic version of human exceptionalism that we critiqued in chapter 1, and their objection to science being applied to humans has generally come to be accompanied by a hostility toward science in general. Of course, the religious version persists, too, in fundamentalist circles. Doc Watson sings, “Man came from monkey, so some folks say, but the Good Book don't quite tell it that way. If you believe the monkey business, some people do, then I'd rather be that monkey's brother than you.”<sup>37</sup> If humans are outside the bounds of science, then no doubt other things are, too. Science is *bound by its charter* to pursue explanations of human evolution!

Darwinians generally feel more bemused than beleaguered by their critics. Scientists very commonly have humanistic interests. They paint, read novels, write history. So many older scientists try their hand at philosophy that it can practically be regarded as a normal sign of aging. Many are politically active. On the religious side, most scientists will admit to a belief in a



god if a sufficiently broad definition is used.<sup>38</sup> Far from feeling a conflict between their science, their religion, and their humanistic impulses, most scientists find their science suffused with the beautiful and the sublime.<sup>39</sup> Darwin ended *On the Origin of Species* with a lyrical paragraph reading in part as follows:

It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other in so complex a manner, have all been produced by laws acting around us. . . . There is grandeur in this view of life, with its several powers, having originally breathed into a few forms or into one; and that, whilst this planet has gone on cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.

Scientific methods are a lot like Zen meditation—arduous and exacting practices that allow the practitioner to win some lovely, if fragile and fallible, truths, eyeball to eyeball with the great mystery. Scratch many a scientist, and a nature mystic bleeds. We feel so about our subject. Peoples and their cultures are wondrous and diverse. The study of human diversity highlights how much humanity we share with the most exotic of our fellows. Darwin believed that anyone whose heart had not been hardened by some specious ideology would feel sympathy for the sufferings of any other human. His description of his feelings about slavery, aroused by his experience of Brazil's treatment of slaves, is the most passionate passage he ever wrote.<sup>40</sup> On the other hand, cultural differences are profound and profoundly interesting. We don't subscribe to an extreme form of cultural relativism (Nazism, after all, was not quaint German folklore). However, the anthropologists' practice of refusing the easy pleasures of ethnocentrism in favor of reserving judgment about other societies—at least until you understand them well—has much to recommend it. Stubbornly anachronistic peoples such as the Anabaptists and the Nuer command respect—even admiration. Though few of us would care to join such societies, we can

understand why those brought up in them are proud and successful human beings.

Mathematical models are, as we have said, deliberately shorn of all the rich detail that makes people themselves so interesting. Foolish indeed are the mathematical modelers who confuse their abstractions with reality. But when used properly, mathematics schools our intuition in ways that no other technique can. It is a form of meditation upon nature without peer. We are constantly struck by the way our naive intuitions are confounded and then rebuilt along new lines by the results of models. Bit by bit, models can be used to dissect the logic of complex systems. The sharp contrast between the difficulty of making good models and their manifest simplicity compared to the phenomena they seek to understand is a humbling, even spiritual, experience. We followed the development of adding social learning to individual learning in simple evolutionary models in chapter 4. We saw that Alan Rogers's very simple model in which social learning evolved without being adaptive led to some real insights into exactly what properties are needed for culture to be adaptive. Good models produce diamond-clear deductive insights into the logic of evolutionary processes. The aesthetic dimension of models is something their critics, unfortunately, never experience. Modelers love a well-designed, well-analyzed representation, as with other artifacts whose beauty lies in their elegant minimalist functionality. We experience when teaching how taking up a nice, old model after a length of time brings on a nice, warm feeling. When it comes to subject areas like evolution, you cannot think straight without them, just like you can't hike for long over rough ground without a good pair of boots. You don't have to *be* a modeler to appreciate models. Much like in any other art form, educated connoisseurs can get a lot out of them.

A good set of data also is a beautiful thing to behold. Foolish, of course, is the empiricist who thinks that even the most beautiful set of data captures any complex phenomenon

completely, especially one who thinks that the data from his own case applies without exception to a diverse system such as human culture.<sup>41</sup> However, data are the ultimate arbiter. More than just testing hypotheses, data often start us thinking in the first place. The great pioneer of mathematical population genetics, J. B. S. Haldane, said, “the world is not only queerer than we suppose, but queerer than we can suppose.”<sup>42</sup> In chapter 2, we reviewed beautiful studies documenting the existence of cultural variation. Many scholars poke fun at cultural explanations for their supposed lack of sophistication, and argue cogently that innate information, rational calculation, and ecological variation are quite plausible alternatives to cultural explanations. In any given case, perhaps such alternatives are correct, but as general arguments against culture, the empirical data are clear enough. Cultural scientists have developed a considerable body of elegantly compelling, even if largely qualitative, data. The importance of cultural variation in the human species is hardly more dubious than role of gravity in the motions of the planets. As with models, the empirical picture gets built bit by bit, gradually constraining the range of plausible explanations with ever better data.

Some data are so sublime they completely transform our picture of the world in a most surprising way. Data from ice and ocean cores collected over the last decade document the extreme variability of climate during the last ice age, giving us a stunningly surprising picture of the sort of world in which our cultural system arose. We barely dared to imagine that such data would come to light, even though our models suggested that such variability is a plausible engine driving the evolution of our capacities for culture. More surprises in both past and future climates are virtually a certainty.<sup>43</sup> The world is so complex that without sound empirical data the theorists are blind. Those who claim to study unquantifiable complexity are being unreasonable, for quantifying is precisely what we do when things get complicated.

With that thought, we rest our case.

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1. Dobzhansky 1973, 129
2. Wilson 1998.
3. For an elementary treatment of cultural evolutionary models, see Richerson and Boyd 1992. For advanced treatments see Cavalli-Sforza and Feldman 1981 and Boyd and Richerson 1985.
4. Human geneticists also tell us that total human genetic variation is modest; that most of it is expressed within, not between, populations; and that Africans are altogether more variable than the rest of our species (Harpending and Rogers 2000).
5. North and Thomas 1973; Bettinger and Baumhoff 1982.
6. Klein 1999, chap. 7. We of course do not deny that biological adaptations like skin color, body form, and disease resistance alleles are important in human adaptation to new environments.
7. Weiner 1999.
8. Lewontin and Hubby 1966.
9. Donald Campbell's 1969, 1979, 1985 cheerleading for interdisciplinary studies more than a generation ago shows that recognition of the problem goes back a long ways.
10. Alexander 1987.
11. For instance, Keller 1995 and Keller and Ross 1993 describe some fascinating social systems in ants. Both our personal kitchen ants here in California are Argentine ants, a recent invader that lacks genetic diversity for colony odor and violates inclusive fitness expectations even more massively than humans. The species forms giant supercolonies that have about a two-fold advantage over its ancestors in Argentina: because colonies cannot recognize strangers, they do not fight. (Genetic relatedness within subcolonies is practically zero.) For the same reason, it has driven most competing ant species out of the habitats that are suitable to it (Holway, Suarez, and Case 1998).
12. Sahlins 1976a
13. Dunnell 1978.
14. Bettinger, Boyd, and Richerson 1996.
15. Cohen 1974.
16. Bettinger, Boyd, and Richerson 1996.
17. Henrich and Gil-White 2001.
18. Edgerton 1992; Knauff 1985a.
19. Inglehart and Rabier 1986.
20. Arrow 1963.
21. North and Thomas 1973.
22. E.g., Jorgensen 1980.
23. Nisbett 2003, McElreath in press.
24. Henrich et al. 2001.
25. Donald 1991.
26. Boyd and Richerson 1985.
27. Endler (1986) utilizes many such studies of natural selection in the wild in his meta-analysis of the strength of natural selection.
28. For an experimental example see Insko et al. 1983; for an observational approach see Cavalli-Sforza et al. 1982 and McElreath in press.

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29. Nelson and Winter 1982, 3.
  30. Other organisms are also active in their own evolution through “niche construction”; culture is just a particularly efficient mechanism for doing so. For a more general theory, see Odling-Smee et al. 2003.
  31. Richerson and Boyd 2000.
  32. Labov 2001; Weingart et al. 1997, 292–97.
  33. Recall Vannevar Bush’s 1945 characterization of science as the endless frontier. If the frontier truly is endless, the story will never be complete.
  34. As the philosopher of science John Beatty 1987 notes, that is about the best you can say for any research program.
  35. Thanks to Robert Foley for this phrase.
  36. Anonymous [St. George Mivart] 1871. Ironically, Mivart later ran afoul of Catholic orthodoxy and was excommunicated (<http://www.newadvent.org/cathen/10407b.htm>).
  37. The song is “That’s All” from the CD *Elementary Doc Watson*, Collectables, 1997.
  38. Easterbrook 1997.
  39. Kiestler’s 1996/7 essay on the aesthetics of biodiversity is interesting in this regard.
  40. Darwin 1902. His paean against slavery begins (561–63):

On the 19th of August, we finally left the shores of Brazil. I thank God I shall never again visit a slave country. To this day, if I hear a distant scream, it recalls with vivid painfulness my feelings when, passing a house near Pernambuco I heard the most pitiable moans, and could not but suspect that some poor slave was being tortured, yet knew that I was as powerless as a child even to remonstrate.
  - And ends:

It makes one’s blood boil, yet heart tremble, to think that Englishmen and our American descendants with their boastful cry of liberty, have been and are so guilty: but it is a consolation to reflect that we have made a greater sacrifice than ever made by any nation to expiate our sin. [Britain freed the slaves in all her colonies in 1838.]
  41. PJR is a sometime limnologist, a student of lakes. Limnologists have a saying that is inevitably truer than it should be: “Everyone sees the world from the shores of their own lake.”
  42. Haldane 1927, 286.
  43. A recent National Academy of Sciences committee entitles their report *Abrupt Climate Change: Inevitable Surprises* (National Research Council 2002).