2 Cultural Evolution

The concept of cultural evolution—the idea that culture evolves and that useful parallels can be drawn between biological and cultural change—has had a long and often controversial history in the social sciences. Ever since the publication of *The Origin of Species* in 1859, scholars have attempted to use ideas from biology to understand cultural change. Evolutionary approaches to culture have, at different times over the past century and a half, been both the dominant paradigm for understanding cultural change and also deeply unpopular and virtually taboo. There have also been several different theories of "cultural evolution," from nineteenth-century progressive theories of cultural evolution to more recent fads such as memetics. Not all of these bear much resemblance to evolution as either Darwin, or modern biologists, would recognize it. So it is crucial to specify exactly what is meant by a theory of cultural evolution and also to show that this theory is empirically supported.

While biology has undoubtedly changed in the 150 years since its publication, *The Origin* remains one of the most compelling descriptions of biological evolution ever written, and the basics of Darwin's argument have not considerably changed.[1] A clearer picture of a theory of cultural evolution can, I think, be achieved by going back to this original source.[2] Darwin famously described

The Origin as "one long argument." This argument can be seen as comprising three elements, or preconditions: variation, competition, and inheritance.[3] First, individuals within a species *vary* in their characteristics. For example, finches might vary in the size of their beaks, with some finches having larger beaks than other finches. Second, there is *competition* between individuals. This competition may be over food, nesting space, mates, or any other limited resource. As a result, not all individuals will have an equal chance of surviving and reproducing. Moreover, an individual's characteristics affect its success in this competition to survive and reproduce. For example, finches with larger-than-average beaks might be able to open a wider range of seeds than finches with smaller-than-average beaks. These large-beaked finches will get more food, thus increasing their chances of survival to reproductive age and of successfully raising offspring compared to small-beaked finches. We can say here that larger-beaked finches have higher fitness than smaller-beaked finches, where fitness refers to the success of an entity in reproducing. Finally, offspring *inherit* characteristics from their parents. For example, large-beaked finches will, on average, give birth to similarly large-beaked offspring. Over time, this variation-competition-inheritance cycle results in evolutionary change, defined as a change in the frequency of a trait in a population over time. Finches with larger beaks obtain more food and so have more offspring on average than finches with small beaks. Because those offspring inherit large beaks from their parents, the next generation will, on average, have slightly larger beaks than the parental generation. The same happens in the subsequent generation: larger-beaked finches will have more offspring than smaller-beaked finches, and the third generation will have slightly larger beaks again. Over successive generations, beak size gradually increases. Indeed, this very process of finch beak evolution was observed in the 1970s on the Galápagos Islands, when a drought drastically reduced the number of seeds in the environment. Large-beaked finches were able to open a wider range of seeds than small-beaked finches, were more likely to survive and reproduce, and so average beak size in the population increased.[4]

So this was Darwin's basic idea—that all biological change can be described in terms of just three basic preconditions: variation, competition, and inheritance. If any of these cannot be demonstrated, then evolution simply does not happen (indeed, this is an important and often underappreciated point: that the theory of evolution is falsifiable). Since *The Origin*, biologists have established without a shadow of a doubt that Darwin's theory is correct as applied to biological change.

Does Cultural Change Exhibit Darwin's Three Preconditions?

But what about cultural change? Can we also show that culture exhibits these three key preconditions specified by Darwin? If so, then this would provide justification for describing cultural change as a Darwinian evolutionary process. Let's take each in turn.

Precondition One: Variation. Darwin documented, in often excruciating detail, the variation between individuals of several species, especially pigeons:

> The proportional width of the gape of mouth, the proportional length of the eyelids, of the orifice of the nostrils, of the tongue (not always in strict correlation with the length of beak), the size of the crop and of the upper part of the oesophagus; the development and abortion of the oil-gland; the number of the primary wing and caudal feathers; the relative length of wing and tail to each other and to the body; the relative length of leg and of the feet; the number of scutellae on the toes, the development of skin between the toes, are all points of structure which are variable.[5]

And this goes on for several pages. But Darwin had good reason to go into such painstaking detail. If every individual were identical, then there would be nothing for natural selection to select, and no meaningful change could take place. As Darwin noted, "These individual differences are highly important for us, as they afford materials for natural selection to accumulate."[6]

Since *The Origin*, biologists have confirmed and quantified the extent to which biological organisms vary. There are, for example, an estimated 1.8 million extant biological species, while in terms of within-species variation, humans and mice have around 20,000–25,000 protein-coding genes, *Drosophila* have 13,000, and rice has 46,000.[7] Biologists have also determined exactly how variation is generated, in the form of genetic mutation and recombination, and established that novel variation is blind with respect to fitness (i.e., beneficial mutations are no more likely to arise when they are needed than when they are not needed). The equivalent processes that are responsible for variation in cultural evolution and the issue of blind variation will be discussed later in this chapter. For now, let us stick with the direct comparison with *The Origin* and, like Darwin, simply try to demonstrate that culture varies and remain temporarily ignorant of the causes of this variation. Indeed, this echoes the position of Darwin, who admitted that "our ignorance of the laws of variation is profound."[8]

That culture also varies is patently obvious. People vary in their religious beliefs, in their political views, in their scientific knowledge, in their skills, and so on. The manifestation or expression of these mental aspects of culture also, as a result, varies, such as variation in buildings and tools. But following Darwin's lead, can we go beyond informal observation and give documented examples of this variation? And furthermore, can we in any way quantify this variation? Technology provides a good source of data regarding cultural variation. Historian Henry Petroski documents the variation found in forks of the late 1800s, each designed for a slightly different function, listing "oyster fork-spoon, oyster forks (four styles), berry forks (four styles), terrapin, lettuce and ramekin fork . . . large salad, small salad, child's, lobster, oyster, oyster-cocktail, fruit, terrapin, lobster, fish, and oyster-cocktail fork . . . mango, berry, ice-cream, terrapin, lobster, oyster, pastry, salad, fish, pie, dessert, and dinner fork."[9] These vary in the number of tines, the dimensions (length, width, thickness), the shape of the tines, the shape of the handle, the material used, and so on, reminiscent of the minute variation documented by Darwin for pigeons.

The patent record provides a good way of measuring technological variation on a grosser scale. A staggering 7.7 million patents were issued in the United States alone between 1790 and 2006.[10] Because a successfully patented invention must, by law, be demonstrably different to all existing patents, each of these 7.7 million patents describes unique variation. Other databases do the same for other aspects of culture. Take religious beliefs: the *World Christian Encyclopedia* estimates that there are over 10,000 distinct religions worldwide.[11] Within each of these 10,000 religions there is further variation: Christianity can be divided into 33,830 denominations, for example. Languages also vary: there are an estimated 6,800 languages currently spoken worldwide.[12] Again, within each language there is further variation: the *Oxford English Dictionary* contains over 615,000 different words, with the average person using 16,000 words every day.[13] And just as dictionaries contain a record of linguistic variation, encyclopedias contain a record of general knowledge. In August 2009, the English-language Wikipedia added its three-millionth page (it was about Beate Eriksen, a Norwegian soap opera actor). The combined number of Wikipedia entries across all languages is, at the time of writing, 9.25 million, while even this is just a fraction of the more than 25 billion website pages on the internet.[14]

There are, of course, caveats to these figures. Some might quibble with the methods of data collection, or how the different units (words, religions, technologies, web pages) are defined. It also presupposes that this variation is discrete and can be counted, rather than being continuous, in which case there would be no discrete units (e.g., words, patents) to count. Another important issue is the distinction between variation of the same type of cultural trait (e.g., different types of fork), analogous to within-species variation, versus variation between different types of cultural trait (e.g., forks and tractors), analogous to between-species variation. This is important because competition will be most extreme in the former case, between similar traits that serve the same purpose and so are competing for the same cultural "niche." These are all important issues, and no doubt methods for quantification can be improved. But it is reasonable to conclude that there is huge variation in human culture, on the order of millions to billions of variants, and that this variation can be documented and quantified. We can therefore state with some certainty that the first of Darwin's preconditions—variation—is present in culture.[15]

Precondition Two: Competition. Darwin talked about competition in terms of a "struggle for existence," asking rhetorically, "can we doubt (remembering that many more individuals are born than can possibly survive) that individuals having any advantage, however slight, over others, would have the best chance of surviving and of procreating their kind?"[16]

Inspired by the ideas of the economist and demographer Thomas Malthus, Darwin argued that this struggle for existence results from the fact that populations tend to increase in size exponentially, generating inevitable shortages of finite resources such as food, living space, and mates. There will therefore be competition for these limited resources, with only a subset of the population likely to survive and reproduce. This competition between individuals might be direct and physical, such as when jackals fight over a fresh carcass or when stags lock antlers in order to impress onlooking females. However, Darwin also stressed that competition need not be literal or direct. A single individual can also be said to struggle for existence in the face of the physical environment, such as when "a plant at the edge of a desert is said to struggle for life against the drought."[17] Here, competition between different plants is indirect, with the plants best able to deal with dry conditions more likely to survive and reproduce than less able plants. This indirect competition is not what most people think of as "competition," and to avoid this confusion modern biologists tend to use the phrase "differential fitness" instead of "competition."[18] I will continue to use the word "competition" because it is less cumbersome and maintains the link with Darwin's terminology in *The Origin*. But really "competition" is shorthand for "differential fitness," which simply says that some individuals are more likely to survive and reproduce than other individuals, and these differences in survival and reproduction are linked in some way to their characteristics.

Intuitively, there must be some form of competition in culture given the extent of the variation observed even in such things as forks, let alone religions and languages. It is surely impossible for any single person to possess the knowledge and skills to manufacture 7.7 million distinct inventions, or to learn every one of the 6,800 languages in existence. And even if some linguistic genius *could* learn 6,800 languages, they could only ever speak one language at any one time. This highlights the finite resources that are acting upon culturally acquired information: there are limitations on memory capacity and on the time it takes to learn and express knowledge.

Evidence supports this intuitive reasoning. That technology and language are subject to competition due to finite resources is highlighted by the phenomenon of extinction, just as extinction of species is the product of biological competition. The extinction of various forms of technology has been documented by historians and anthropologists, such as the loss of various technologies and practices from the islands of Oceania (e.g., the canoe, pottery, the bow and arrow, and circumcision) and the loss of artifacts such as bone tools and skills such as fishing in prehistoric Tasmania following isolation from mainland Australia.[19] There is also an extremely high extinction rate of languages at present, much higher than the extinction rate of any biological species.[20] And within languages, it has been shown that numerous irregular verbs have, throughout history, gradually been whittled down to just a handful, based on how often those verbs are used.[21] Irregular verbs that are used often, such as "to go" with its irregular past tense of "went," are easier to remember, less likely to be regularized, and so more likely to survive in the vocabulary. Indeed, this process in which easily remembered words are more likely to survive was presaged by Darwin himself:

> A struggle for life is constantly going on amongst the words and grammatical forms in each language. The better, the shorter, the easier forms are constantly gaining the upper hand.[22]

Archaeologists, too, have documented many examples in which one type of artifact or technology has increased in frequency over a specific time period, while a different type of artifact or technology shows a corresponding decrease over the same time period. This is consistent with the former replacing the latter as a result of competition between the types. Examples include painted pottery replacing corrugated pottery in New Mexico or the replacement of spear-throwing technology with bow-and-arrow technology in North America.[23]

At a more proximate level, evidence from experimental psychology provides details of how different ideas compete for memory space. Classic experiments have demonstrated the existence of "interference effects" in memory.[24] In these experiments, subjects are asked to read and recall lists of words. Subjects show significantly worse recall of the words when they have to read another list of words while they are trying to remember the first list. This suggests that the second list is interfering with recall of the first. And if one cannot recall a word, one cannot pass it on to another person, and the word declines in frequency in the population as a whole. Interestingly, this interference is greater when the distractor words are similar in meaning to the target words, suggesting that, as Darwin noted, competition is greatest between similar kinds, because they are competing for the same cultural niche:

> [I]t is the most closely allied forms—varieties of the same species and species of the same genus or of related genera—which, from having nearly the same structure, constitution, and habits, generally come into the severest competition with each other.[25]

We therefore see competition in culture both at the psychological level, in the form of competition for space in memory, and also the effects of that competition, in the form of the extinction of various cultural practices and forms. Cultural traits, like biological organisms, take part in an endless struggle for existence.

Precondition Three: Inheritance. The third of Darwin's preconditions for evolution was inheritance, and he was direct about its importance:

"Any variation which is not inherited is unimportant for us."[26] Darwin noted that individuals that are more likely to survive and reproduce during the struggle for existence will often pass on their traits or characteristics to their offspring. If those characteristics were at least partially responsible for the parents' increased chances of survival and reproduction, then there will be a gradual increase in fitness and adaptation to the local environment. Inheritance therefore allows beneficial traits to be preserved in successive generations. Without inheritance, beneficial traits are not preserved, and evolution cannot occur.

Although inheritance was necessary for Darwin's argument, for him "the laws governing inheritance are quite unknown"[27] beyond the basic observation that offspring resemble parents more than a randomly chosen member of the species. It was not until the rediscovery of Gregor Mendel's pea-plant experiments, and further experiments in the early twentieth century, that the details of genetic inheritance were worked out. So for the moment let's ignore the details of cultural inheritance and simply ask whether cultural information can be successfully reproduced, or transmitted, from one person to another.

As discussed in chapter 1, there is voluminous evidence from cross-cultural comparisons that people acquire beliefs, attitudes, skills, and knowledge from other people via cultural transmission. Early immigrants to the United States have passed values related to civic duty down successive generations via cultural transmission, people in small-scale societies transmit norms relating to fairness as evidenced by cultural variation in the ultimatum game, and holistic and analytic thinking styles have been transmitted from generation to generation in East Asia and the West, respectively. Evidence from studies of contemporary immigrants confirms that this inheritance is cultural rather than genetic, given that in only one or two generations the children of immigrants are indistinguishable from long-term residents, rather than their more immediate genetic ancestors.

Such cross-cultural studies are complemented by more direct experimental studies that demonstrate person-to-person cultural transmission of behavior, attitudes, and opinions. Classic experiments conducted by social psychologist Albert Bandura in the 1960s showed that children will readily imitate the behavior of adult demonstrators.[28] Children who saw an adult acting aggressively toward a large inflatable "Bobo" doll themselves later showed more aggressive actions toward the doll than children who did not see any aggressive actions, or who saw an adult behaving nonaggressively. Other classic experiments conducted by social psychologist Solomon Asch show how adults readily adopt the opinion of others in simple tasks, such as matching a line to one of a set of other lines of varying length, even when the other people's answers (actually stooges of the experimenter) are patently false.[29] These experimental studies are complemented by questionnaire studies showing strong parent-offspring correlations in traits that are unlikely to be entirely genetic, such as religious beliefs and hobbies, as well as similarly high correlations between unrelated peers in such traits, which cannot be genetic.[30]

In a sense, however, mere person-to-person transmission of information is not enough for a fully Darwinian cultural evolution. Darwin famously described biological evolution as "descent with modification." By this he meant that for biological evolution to work, minor modifications must not merely be inherited from parent to offspring in a one-to-one fashion, inheritance must be faithful enough such that the modifications are preserved over several successive generations and potentially combined with other beneficial traits. Only then can we explain the complex adaptations involving several functionally interrelated parts, such as eyes or wings, that are the result of the accumulation of numerous separate modifications over countless generations.

We can similarly demonstrate the gradual accumulation of modifications in culture. Historians have repeatedly shown how technological artifacts rarely, if ever, spring from nothing. Instead, successful innovations are always slight modifications of what went before, or the combination of previously separate innovations. Historian George Basalla gives the example of the steam engine.[31] Rather than suddenly emerging fully formed from James Watt's inventive mind, as suggested by some popular accounts, Watt's steam engine was actually a modified version of the preexisting Newcomen steam engine, with which Watt had had extensive experience, and which in turn was a modification of a previous model, and so on back through history. Bodies of knowledge also accumulate gradually in the same way that technological artifacts do. Mathematics, for example, has evolved through the accumulation of successive innovations by different individuals in different societies over vast periods of time, with each new innovation paving the way for the next. Even the basic base-10 decimal system took over 4,000 years to emerge. Only after the Sumerians began to use written symbols to represent numbers in around 2400 BC could the Babylonians invent the place value system, in which the position of a digit with respect to the decimal place determines its value. This then allowed the Hindus and Mayans to invent a written symbol for zero, which in turn made calculations easier. This accumulation of directly related successive inventions proceeded for centuries, with major additions from the Greeks (e.g., geometry), Arabs (e.g., algebra), and Europeans (e.g., calculus), through to present-day mathematics.[32]

Human culture therefore also exhibits the last of Darwin's three preconditions for evolution, inheritance. Cultural variants can be passed faithfully from one individual to another, just as genes are passed from parent to offspring in biological evolution. Moreover, this cultural inheritance is of sufficiently high fidelity that it can successfully support the gradual accumulation of modifications, just as Darwin observed for lineages of biological organisms.

Further Parallels

As well as demonstrating the existence of these three key characteristics of Darwinian evolution—variation, competition, and inheritance—Darwin also showed that these characteristics can explain the hitherto mysterious biological phenomena that had puzzled naturalists for centuries. Three such phenomena are adaptation, maladaptation, and convergence. So if culture is Darwinian, then we should expect to see these emergent phenomena in culture also.

Adaptation. One of Darwin's greatest achievements was to provide a scientific explanation for the often striking fit between organisms and their environments, in the form of adaptations:

> We see these beautiful co-adaptations . . . in the structure of the beetle which dives through the water; in the plumed seed which is wafted by the gentlest breeze; in short, we see beautiful adaptations everywhere and in every part of the organic world.[33]

Natural selection provides a scientific explanation for this organism-environment fit. Over successive generations, individuals that are better at interacting with and gaining resources from their environments—individuals that are faster or more efficient at swimming through water, for example—are more likely to survive and reproduce than less effective individuals. We see the outcome of this gradual selection process in the form of, for example, streamlined body shapes that make swimming faster and more efficient. More complex adaptations, such as the eye, may have multiple working parts all interacting with one another in a precise manner. These can equally be shown to be the product of gradual natural selection through the accumulation of successive beneficial modifications, from concave pits of photosensitive cells to adjustable lenses, each of which improved an organism's ability to sense light and movement in their environments.

We can also observe cultural adaptations that are exquisitely designed for a particular purpose or for use in a particular environment but that are the result of cultural rather than biological evolution. An example might be the bow and arrow, which features multiple working parts all interacting with one another in a precise manner. For example, the San people of Botswana have 1-meter-long bows with strings made of animal tendons, arrow shafts made of reeds, arrowheads of ostrich bone (or more recently, barbed wire) that are poisoned using beetle larva, and quivers made of tree roots.[34] These components together form a "beautiful co-adaptation" that is highly suited to its function and features many functionally interrelated parts. The examples of cumulative cultural evolution given above, such as modern mathematics or the steam engine, also constitute cultural adaptations. Indeed, these examples highlight the power of cultural processes in generating adaptations that single individuals could never have come up with on their own.

Maladaptation. While it was important for Darwin to demonstrate that his theory could explain adaptations, it was equally important to demonstrate that species are not perfectly adapted to their environments. Perfect adaptation would, after all, be consistent with the action of an omniscient creator designing every species to a perfect standard. To counter this view, Darwin gave examples of maladaptation, where a species is ill fitted to its environment. This might occur when the environment in which a species lives changes in some way, or when a species moves into a new environment. Although drastic mismatches between the species and the new environment are likely to lead to extinction, when the mismatch is not so drastic then minor remnants of adaptations to the previous environment may often persist despite no longer serving any purpose. Examples include the small and functionless skeletal hind limbs of whales and snakes that have been preserved from their quadrupedal ancestors but which no longer serve any function. Vestigial organs such as these provide evidence for descent, and therefore for Darwinian evolution.

Aspects of culture can also be described as vestigial, where once-adaptive cultural adaptations become maladaptive when environments change. A familiar example is the QWERTY keyboard, which comprises a configuration of keys designed to make typing as slow and awkward as possible. In the context in which it emerged, the QWERTY keyboard was highly functional because fast typing caused early typewriter keyboards to jam. Modern keyboards no longer have this limitation, yet the suboptimal QWERTY keyboard configuration remains.[35] Vestigial features are also common in technological artifacts, especially when new raw materials become available. Indeed, George Basalla notes that such cases are common enough to merit their own label, namely, a "skeuomorph," which is defined as an "element of design or structure that serves little or no purpose in the artifact fashioned from the new material but [which] was essential to the object made from the original material."[36] Stone columns, for example, often retain the masonry joints of their wooden precursors, despite no longer serving a function.

Convergence. Finally, Darwin observed that isolated species could evolve similar traits due to convergent evolution to similar environments. He himself drew a cultural analogy here:

> [I]n nearly the same way as two men have sometimes independently hit on the very same invention, so natural selection . . . has sometimes modified in very nearly the same manner two parts in two organic beings, which owe but little of their structure in common to inheritance from the same ancestor.[37]

Familiar examples of convergence in biological evolution include the independent evolution of wings in bats, birds, and insects, or streamlined body forms in fish and cetaceans. Indeed, convergence is now considered to be one of the strongest forms of evidence for natural selection, given the unlikelihood that similar forms would evolve independently in unrelated lineages unless they are adaptations to similar environments.

In culture, Darwin famously confirmed the first part of his observation above when both he and Alfred Russel Wallace came up with the theory of natural selection at the same time. Other examples of parallel inventions or discoveries in culture include writing, which was invented independently by the Sumerians around 3000 BC, the Chinese around 1300 BC, and the Mexican Indians around 600 BC.[38] Convergent cultural evolution may also produce artifacts that perform the same function but do so in different ways, such as knives and forks in Europe and chopsticks in China, both used to handle hot food.[39]

Darwinian versus Spencerian Theories of Cultural Evolution

Given the many parallels outlined above between biological and cultural change, including several parallels pointed out by Darwin himself, it is not surprising that theories of cultural evolution began to appear not long after the publication of *The Origin of Species*. Many of these were proposed by influential early anthropologists such as Edward Burnett Tylor in Britain and Lewis Henry Morgan in the United States.[40] Unfortunately, the evolutionary theory that they applied to culture bore little resemblance to Darwin's theory and more closely resembled the rather un-Darwinian "progressive" evolutionary ideas of Darwin's contemporary, Herbert Spencer.[41] Spencer saw evolution as embodying a process of inevitable progress along a ladder of increasing complexity, from simple microorganisms, to more complex plants and animals, and ultimately to humans. Following Spencer, Tylor and Morgan saw cultural evolution as also embodying some form of inevitable progress. For them, cultural change could be described as the movement of societies along fixed stages of ever-increasing complexity. For example, Morgan presented seven stages through which every human society supposedly has passed or will pass in the future: lower, middle, and upper savagery, then lower, middle, and upper barbarism, and finally civilization. According to Morgan, each of these periods "has a distinct culture and exhibits a mode of life more or less special and peculiar to itself."[42] For example, "lower barbarism" begins with the appearance of speech and ends with the invention of fire, while "middle barbarism" begins with the domestication of animals and ends with the appearance of iron smelting. (For computer game enthusiasts, it's a lot like the fixed stages of technological advancement seen in Sid Meier's Civilization games.) Morgan then goes on to classify contemporary societies as each having advanced to one of these levels. Australian aborigines, for example, he classified as having achieved "middle savagery," while Central American "Village Indians" were placed at "middle barbarism." European societies, and their recent colonial offshoots such as the United States, were placed at the top of this cultural ladder, and non-European societies were explicitly compared with ancestral stages of European societies. For example, contemporary (to Morgan) Central American "Village Indians" had reached the same stage as ancient Britons, and had not yet achieved the stage attained by "Italian tribes shortly before the founding of Rome."[43]

There are many problems with these early "progress" theories of cultural evolution. First, they are rather tainted by the racist and colonialist social views of the Victorian societies in which they emerged. The idea that non-Western societies were "less evolved" than contemporary Britain or America provided an attractive "scientific" justification for what today are considered to be rather distasteful social and political attitudes. Beyond their political implications, however, it is crucial to recognize that these progress theories bear little resemblance to the evolutionary theory that Darwin proposed in *The Origin*, nor to what modern-day biologists understand by evolution, and nor, indeed, to the theory of cultural evolution presented in this book. As the biologist Stephen Jay Gould has repeatedly argued, biological evolution is explicitly nonprogressive.[44] Species do not progress along fixed stages from simple microorganisms to more complex plants and animals. Humans are not at the top of the evolutionary ladder, because there is no ladder of which to be at the top. There is only local adaptation to local environments, which does not necessarily translate into global increases in fitness, and does not result in inevitable and entirely predictable evolutionary change along a prespecified course.

Similarly, as argued in the 1920s by anthropologists such as Franz Boas and his followers, there is little historical or ethnographic evidence that different societies pass through exactly the same stages in the same order, and contemporary non-Western societies cannot be meaningfully equated with ancient European societies.[45] More fundamentally, societies do not constitute self-contained wholes in the form of distinct stages. Ideas, technologies, and people can move from one society to another, such that different societies may share some aspects of culture and differ in others. Finally, progressive theories are inadequate because they do not specify the processes that are responsible for this supposed cultural progression. It seems that societies somehow magically jump from one stage to the next once they have accumulated the necessary inventions (e.g., the use of fire or pottery).[46]

Unfortunately, while progress theories of biological evolution were quickly purged from biology, progress theories of cultural evolution persisted well into the twentieth century.[47] To this day, many anthropologists and sociologists are wary of modern theories of cultural evolution because of their (unfounded) association with politically motivated and scientifically dubious nineteenth-century progress theories of cultural evolution. It is crucial to recognize, therefore, that

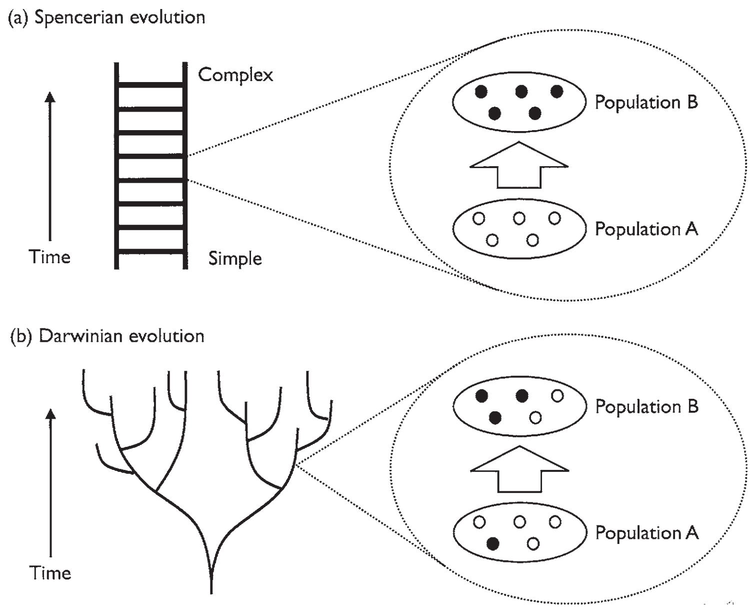

FIGURE 2.1 The conceptual differences between Spencerian and Darwinian evolution. (*a*) Spencerian evolution involves movement up a ladder of increasing complexity, from simple to more complex stages. The inset shows how populations (e.g., species or societies) are considered to be homogenous types. (*b*) Darwinian evolution is treelike rather than ladderlike. There is no inevitable increase in complexity, and many branches go extinct. The inset shows how variation within populations (e.g., species or societies) gradually changes over time.

the progressive Spencerian theory of evolution is fundamentally different to Darwin's population-based theory of evolution. This difference is illustrated in figure 2.1. Spencer's theory views species as a group of homogenous individuals that all share the same essential qualities. Evolutionary change occurs when one species abruptly steps up to the next rung of the evolutionary ladder to become a new, more "complex" species. The same was true of Spencerian theories of cultural evolution, except instead of species there are societies that move up a stagelike ladder. Darwin's theory, on the other hand, focuses instead on the variation *within* populations (e.g., in beak size) and how this variation gradually changes over time. Given enough time, a population might change enough to warrant being called a new species, but this change is internally driven by selection and other processes acting on the individuals within the population, rather than propelled by an externally triggered shift. This change in thinking, from essentialist, ladderlike thinking to variation-focused, Darwinian "population" thinking, has been described as one of Darwin's major contributions to science.[48] Furthermore, Darwinian evolution does not require that species increase in complexity over time. Traits may be lost, and species frequently go extinct (the dead-end branches in figure 2.1b). This makes Darwinian evolution more treelike than ladderlike, as lineages branch off from one another in a haphazard, nonlinear manner. The theory of cultural evolution discussed in this book is Darwinian, not Spencerian.

Darwinian versus Neo-Darwinian Theories of Cultural Evolution

Another important distinction to make is between Darwinian theories of cultural evolution and *neo-Darwinian* theories of cultural evolution. The evidence reviewed above demonstrates that cultural change is Darwinian in that it exhibits those properties of variation, competition, and inheritance that Darwin outlined in *The Origin*. Yet Darwin often had little idea—and in some cases was dead wrong—about exactly how these processes worked at a microlevel: where new variation comes from and how it is generated, the precise forms of competition that act to sort different variants, and the mechanisms by which traits are inherited from parent to offspring. In the decades following publication of *The Origin*, a group of biologists known as experimental geneticists conducted a series of ingenious breeding experiments in order to work out these "microevolutionary" details. *Microevolution* describes those small-scale, individual-level processes that act to change trait frequencies within a single population, and can be contrasted with *macroevolution*, which describes large-scale patterns and trends above the species level, such as the emergence and diversification of new species due to adaptation.

The microevolutionary details worked out by experimental geneticists include the findings that genetic inheritance is *particulate* (it involves the transmission of discrete units of information in an all-or-nothing manner) and *non-Lamarckian* (changes to an organism during its lifetime, such as the loss of a limb or the overuse of a muscle, are not directly transmitted to offspring), and that genetic mutation is blind with respect to selection (genetic mutations are no more likely to arise when they are needed than when they are not needed). Adding these microevolutionary details to the basic theory of Darwinian evolution gave rise to what became known as the neo-Darwinian theory of evolution.

Several researchers have subsequently argued that these neo-Darwinian details also apply to cultural evolution: that cultural transmission is particulate, cultural evolution is strictly non-Lamarckian, and cultural mutation is blind with respect to selection. However, many social scientists have argued that these neo-Darwinian details do not apply to cultural change. In many cases these criticisms appear to be valid, or at least potentially valid. The following sections examine in more detail these three neo-Darwinian principles first as applied to biological evolution and then whether they also apply to cultural evolution.

Is Cultural Transmission Particulate? A common observation by animal and plant breeders of Darwin's day was that traits appear to blend when they are inherited: a large pigeon and a small pigeon would have intermediately sized offspring, for example. This suggested to many early biologists, Darwin included, that biological inheritance is a process of blending, where offspring take an intermediate form between their two parents. However, Austrian monk Gregor Mendel showed through breeding experiments with pea plants that this blending is just superficial, and at a microlevel biological inheritance is in fact particulate not blending. In other words, biological inheritance involves the transmission of discrete units of inheritance (called genes) that are transmitted in an all-or-nothing fashion. We either inherit one version (or allele) of a gene or another version, and these discrete units do not blend together to produce an intermediate allele halfway between our two parents' alleles. Eye color is the classic example, where the child of a brown-eyed parent and a blue-eyed parent will have either brown or blue eyes, not a mixture of brown and blue. While other traits such as height or skin color do appear to blend and take on any value on a continuum, such cases are now known to be caused by lots of discrete underlying alleles jointly determining such characters. For example, in 2009 a team of researchers showed that the striking variation in the coats of different dog breeds, from shaggy-coated bearded collies to smooth-coated Chihuahuas, is controlled by just three discrete genes.[49]

Does cultural inheritance similarly involve the particulate, all-or-nothing transmission of discrete units of cultural information? This is a central assumption of the neo-Darwinian theory of cultural evolution called *memetics*. Memetics originated in the final chapter of Richard Dawkins's hugely influential book *The Selfish Gene*, where he coined the term "meme" to describe a discrete unit of cultural inheritance, or cultural replicator, that operates within human culture.[50] He described this as the cultural equivalent of the biological replicator, the gene, such that the differential selection and transmission of these memes would make cultural change an evolutionary process. Although Dawkins primarily intended the meme concept to be a way of highlighting how his replicator-centered theory of evolution was not limited to just genes, others such as philosopher Dan Dennett and psychologist Susan Blackmore have developed the meme concept into a full theory of memetics.[51] Memetics makes the neo-Darwinian assumption that culture can be divided into discrete units that are inherited in a particulate fashion, like genes. It also assumes that memes are transmitted with high fidelity, this being one of the defining characteristics of a replicator according to Dawkins.

However, whereas genetic inheritance is particulate, cultural inheritance in many cases appears to be nonparticulate. As anthropologist Maurice Bloch puts it, "culture simply does not normally divide up into naturally discernable bits."[52] Think of political beliefs, which vary on a continuum from extreme left-wing to extreme right-wing, or archaeological artifacts such as arrowheads, which vary continuously in their length and width. There is also evidence that cultural traits blend when transmitted. During language acquisition, children appear to blend the speech sounds of their parents and their peers, resulting in a shift toward the average pronunciation of several people.[53] Social psychologists have similarly found that people adopt the blended average of other people's judgments of ambiguous stimuli, such as the extent to which a small point of light appears to be moving in a pitch-black room.[54]

Now, a limitation of such studies is that they might be at entirely the wrong level of analysis: artifacts, speech sounds, and stated beliefs are the outward behavioral expressions of information stored in the brain and as such are the cultural equivalents of phenotypic traits such as height or skin color. As we saw for the biological case, even though phenotypic traits such as height may vary continuously and appear to blend in offspring, they are nevertheless determined by discrete underlying units of inheritance (genes). In the same way, it may be that continuous, blending cultural traits such as speech sounds and expressed political values are determined at the neural level by discrete cultural units of transmission. This is ultimately an issue for neuroscientists studying how information is represented in the brain and how it is transmitted from one brain to another. Given our current lack of understanding of such issues, it is impossible to say with certainty whether cultural transmission, at the neural level, is particulate or nonparticulate. Without this evidence, a cautious working assumption should be that cultural variation may, in some cases, be continuous, and that cultural transmission may, in some cases, be blending.[55]

Is Cultural Evolution Lamarckian? Another common belief of early biologists, including Darwin, was that changes that occurred to an organism in its lifetime were directly (i.e., genetically) transmitted to its offspring. This inheritance of acquired characteristics is often called "Lamarckian" after the eighteenth-century French biologist Jean-Baptiste Lamarck.[56] The textbook example of Lamarckian inheritance involves giraffes: a Lamarckian explanation of long giraffe necks is that giraffes in one generation stretch to get leaves on high tree branches; their neck muscles stretch and lengthen slightly as a result of this stretching, and their offspring directly inherit these elongated neck muscles. Successive generations of stretching resulted in the long necks we see today. The alternative to this Lamarckian explanation instead invokes selection: some giraffes happen to have been born with long necks, some with short necks; those with longer necks can reach higher branches, get more food, and have more offspring; those offspring inherit the long necks of their parents, and so long-neck genes gradually spread in the population.

Careful experiments conducted by geneticists such as August Weismann in the 1890s showed that the former Lamarckian mechanism does not operate in biological evolution. Weismann and others showed, for example, that rats who had their tails cut off gave birth to offspring with fully intact tails, indicating that acquired changes are not transmitted genetically. This led to a distinction between the *genotype*, the genetic information inherited by offspring, and the *phenotype*, the expression of the genotype in the form of anatomical and physiological structures. Changes to the phenotype are not directly transmitted to the genotype; they cannot pass what became known as "Weismann's barrier." In neo-Darwinian evolutionary theory, therefore, selection is the main process that causes biological change, and Lamarckian inheritance is strictly absent.[57]

Is cultural evolution Lamarckian? Obviously it is not literally Lamarckian in the sense that the knowledge and skills we learn during our lifetimes, such as how to play the violin or do differential calculus, are not transmitted genetically to our offspring. But several researchers have argued that cultural evolution is Lamarckian in the sense that the knowledge and skills that we learn can be directly transmitted to others culturally, rather than genetically. As Stephen Jay Gould put it, "cultural evolution is direct and Lamarckian in form: The achievements of one generation are passed by education and publication directly to descendants."[58] Others, such as economists Geoffrey Hodgson and Thorbjørn Knudsen, maintain that cultural evolution, like biological evolution, is strictly non-Lamarckian even in this sense. Still others, such as philosopher David Hull, have argued that the term "Larmarckian" cannot be meaningfully applied to cultural evolution.[59] Clearly much disagreement exists over this issue.

Whether cultural evolution can properly be described as Lamarckian depends on how one defines the equivalent of the genotype-phenotype distinction in culture. The ideational definition of culture given in chapter 1 implies that the cultural equivalent of the genotype is the information stored in people's brains that represents their beliefs, attitudes, values, skills, knowledge, and so on. The cultural equivalent of the phenotype is the expression of that information in the form of behavior, speech, and artifacts. It is the latter—the phenotype equivalent—that is copied during cultural transmission: we do not directly acquire neural patterns of activation in people's brains; we copy people's behavior, we listen to what they say, and we read what they write. If we then modify the acquired beliefs, knowledge, and skills in some way before transmitting them to someone else, we can be said to be engaging in Lamarckian cultural inheritance.

The history books are full of apparent examples of the inheritance of acquired cultural change, where single inventors have individually modified an existing technology that has then spread to other members of society. For example, in the 1760s James Watt dismantled and tinkered with the workings of the preexisting Newcomen steam engine.[60] The Newcomen engine uses the condensation of steam to create a vacuum underneath a piston. The greater pressure acting from above then forces the piston down. Over the next two decades Watt made several modifications to this preexisting design, such as having a separate compartment for condensing the steam, which allowed the piston chamber to remain hot continuously. Watt's improved steam engine, which first appeared in 1784, diffused across the world and dominated engine design for the next fifty years. So here we have one individual (Watt) acquiring information from another (Newcomen, via his engine), modifying it in some way, and transmitting the modified information to others, in a manner that can be described as Lamarckian. So given the assumptions made earlier, we can say that cultural evolution can be described as Lamarckian, and the neo-Darwinian requirement that inheritance is strictly non-Lamarckian does not apply to cultural evolution.

Is Cultural Evolution Blind? A third neo-Darwinian assumption is that mutation is blind or undirected, such that novel genetic mutations are no more likely to arise when they are needed (i.e., when they will confer a fitness benefit on their bearer) than when they are not needed. This was demonstrated definitively in the 1940s in experiments conducted by Salvador Luria and Max Delbrück.[61] In these experiments, different colonies of initially genetically identical bacteria were exposed to a virus. Luria and Delbrück reasoned that if mutations that conferred resistance to the virus occurred randomly, then different colonies would vary in their level of resistance, as only some colonies would happen to have these beneficial mutations. If, on the other hand, mutations conferring resistance appeared nonrandomly and were triggered by the presence of the virus, then all colonies should have the same level of resistance. The former was found, indicating that beneficial mutations occur randomly and not in response to a particular adaptive problem. This finding that genetic mutation is blind with respect to fitness reinforces the notion that biological evolution is undirected or unguided by any kind of foresight.

A neo-Darwinian theory of cultural evolution that incorporates the principle of blind variation is psychologist Donald T. Campbell's "blind-variation-and-selective-retention" (BVSR) theory.[62] Campbell argued that blindly generated cultural variants are subject to consistent selection criteria, and the positively selected variants are preserved. One of the key assumptions of BVSR theory, as its name suggests, is that new cultural variation arises blindly, with no foresight directing the course of cultural evolution. This resembles the neo-Darwinian assumption of blind, or nonadaptive, mutation as established by Luria and Delbrück for genetic variation. Consequently, BVSR theorists such as psychologist Dean Keith Simonton have conducted extensive historical studies of creativity and discovery in order to test this blind variation hypothesis.[63]

Is cultural evolution blind? On the face of it, no: cultural evolution appears to be guided by the intentional actions of people who possess at least some degree of foresight, potentially increasing the likelihood of adaptive cultural mutations. Inventors and scientists strive to solve a particular problem, military commanders plot the course of a coming engagement, and advertisers plan marketing campaigns, for example. This is a point frequently made by social scientists. Sociologist Ted Benton remarks that "Darwin's mechanism of natural selection assumes that mutations are random with respect to the selective pressures which affect their chances of replication. In the case of the activities which lead to social change . . . human agents act intentionally to produce anticipated outcomes: they are not 'blind watchmakers.'"[64] On the other hand, historical analyses of scientific and technological change suggest that cultural change is not quite so directed, and foresight not quite as accurate, as commonly assumed.[65] Historical figures often claim retrospectively to have guided cultural change in particular directions, yet such claims may have the benefit of hindsight and be self-servingly exaggerated.[66] However, there is a general lack of systematic evidence regarding this issue, at least compared to the careful experiments conducted by Luria and Delbrück in biology. We should therefore be prepared to accept that cultural evolution may, at least in some instances, be directed rather than blind and that there is a valid difference here between cultural and biological evolution.

Cultural Evolution Is Darwinian, But Not Neo-Darwinian. This lack of correspondence between neo-Darwinian evolutionary theory and cultural change has often led to the wholesale rejection of any kind of evolutionary theory of culture. Stephen Jay Gould, for example, argued on the basis of the aforementioned differences that "biological evolution is a bad analogue for cultural change,"[67] while John Maynard Smith, one of the most highly regarded biologists of the twentieth century, argued that the

> explanatory power of evolutionary theory rests largely on three assumptions: that mutation is nonadaptive, that acquired characters are not inherited, and that inheritance is Mendelian—that is, it is atomic, and we inherit atoms, or genes, equally from our two parents, and from no one else. In the cultural analogy, none of these things is true. This must severely limit the ability of a theory of cultural inheritance to say what can happen and, most importantly, what cannot happen.[68]

This wholesale rejection of the application of evolutionary theory to culture is unfounded once we make a distinction between Darwinian and neo-Darwinian evolution. Whereas cultural evolution does not appear to resemble neo-Darwinian evolution, with its strict assumptions of blind mutation and particulate, non-Lamarckian inheritance, cultural evolution can still be described as Darwinian, given the evidence reviewed above that it exhibits the basic Darwinian properties of variation, competition, and inheritance.[69] Variation that is nonrandom is still variation, and inheritance that is Lamarckian and nonparticulate is still inheritance. Indeed, it is an interesting historical point that Darwin himself held distinctly non-neo-Darwinian beliefs concerning biological evolution, such as in blending and Lamarckian inheritance.

What is needed is a theory of Darwinian cultural evolution that explicitly incorporates non-neo-Darwinian microevolutionary processes such as blending inheritance, Lamarckian inheritance of acquired characteristics, and nonrandom variation, as well as other processes that may have no parallel whatsoever in biological microevolution. Such a theory is presented in chapter 3. However, further examination of the history of biology suggests that simply having the correct microevolutionary processes in place was not enough to make every biologist agree on a single, unifying theoretical framework. It is instructive for the social sciences to examine why not.

Bridging the Micro-Macro Divide

The Micro-Macro Problem in Early Biology. Even after experimental geneticists such as Mendel and Weismann had established the neo-Darwinian microevolutionary principles of particulate, non-Lamarckian inheritance and random variation, these microevolutionary principles were not readily accepted by other biologists studying macroevolution, such as naturalists documenting spatial macroevolutionary patterns by comparing the species found in different regions and paleontologists documenting temporal macroevolutionary trends in the fossil record. As biologist Ernst Mayr notes:

> Through the first third of the twentieth century the gap between the experimental geneticists and the naturalists seemed so deep and wide that it looked as if nothing would be able to bridge it . . . The members of the two camps continued to talk different languages, to ask different questions, to adhere to different conceptions.[70]

One particularly fierce argument raged over Lamarckian inheritance and the strength of selection.[71] Naturalists had by this time documented immense diversity in living species as a result of expeditions such as Darwin's own voyage on the *Beagle*, as well as equally diverse forms found in the fossil record, such as the many dinosaur species uncovered in the late nineteenth century. The only process that is strong enough to generate such diversity, the naturalists reasoned, was Lamarckian inheritance. After all, if an organism could directly transmit beneficial changes to its offspring, then meaningful change could occur in just a single generation and myriad diverse forms could rapidly emerge. The non-Lamarckian alternative, natural selection, seemed to the naturalists to be far too weak to generate the diversity that they had documented. Selection, they thought, was severely limited because it relied on the chance occurrence of beneficial mutations. And even when a beneficial mutation did happen to arise, it must spread gradually over the course of several generations as those individuals that possessed the beneficial mutation had more offspring than those that didn't possess the beneficial trait. This advocacy of Lamarckian inheritance over selection put the naturalists in direct conflict with experimental geneticists such as Weismann who, as we saw above, had shown experimentally that inheritance is strictly non-Lamarckian.

A second division between the experimental geneticists and the naturalists concerned particulate inheritance and gradualism.[72] Experimental geneticists such as Mendel had shown that biological inheritance involves the all-or-nothing transmission of discrete units (genes), with evolutionary change occurring when one of these discrete units mutates into a different version. Several experimental geneticists, most notably Richard Goldschmidt, saw this as inconsistent with Darwin's assertion in *The Origin* that biological change is gradual. Goldschmidt and others instead advanced a saltationist theory of evolution, in which major evolutionary change, such as the appearance of new species, occurs in a sudden, single-generation leap, equivalent to a massive mutation. While most of these mutants will be maladaptive, or nonviable, a rare mutant (a "hopeful monster" as Goldschmidt put it) might happen to be adaptive, and thus an entirely new species is born. Naturalists and paleontologists, on the other hand, saw saltationist theories of evolution as entirely inconsistent with their observations of macroevolution. The fossil record, rather than showing sudden jumps, generally records gradual change in species over time. Rather than birds evolving from dinosaurs in a single dramatic mutation, paleontologists were finding transitionary forms such as *Archaeopteryx* that indicated gradual, incremental evolutionary change. The same applied to geographical variation in species, which tended to be gradual rather than abrupt. The finch species found by Darwin on the Galápagos, for example, while being measurably different in beak size and shape, were nevertheless all minor variations on the same design (i.e., the common ancestor).

The Evolutionary Synthesis in Biology: The Benefits of Formal Models. These disagreements between the experimentalists and the naturalists were caused largely by flawed, informal reasoning on both sides regarding the relationship between micro- and macroevolution: the naturalists' informal intuition that selection (a microevolutionary process) is too weak to generate the rich species diversity they had observed (a macroevolutionary pattern), and the experimentalists' intuition that particulate inheritance (a microevolutionary process) was incompatible with gradual change (a macroevolutionary trend). What was needed was a way to more precisely test these intuitions regarding the macroevolutionary consequences of different microevolutionary processes. In the 1920s and 1930s a group of mathematically inclined biologists, primarily R. A. Fisher and J. B. S. Haldane in the United Kingdom and Sewell Wright in the United States, developed a set of mathematical tools, known as population genetic models, that allowed these informal intuitions to be tested far more precisely than is possible with informal, verbal arguments and thought experiments.[73] These population genetic models can be seen as methods of evolutionary "bookkeeping." Just as a bookkeeper compiles a record of all of the financial transactions that act to change a company's stock levels or profit margin, so a population geneticist compiles a record of all of the natural processes that act to change gene frequencies in a population over time. The modeler specifies a set of alternative genes (or alternative versions of a gene, known as alleles) in a population. Then they specify a set of processes (e.g., mutation or different kinds of selection) that change the variation in genes in the population in a single generation. Mathematical modeling techniques are then used to predict the long-term changes in genetic variation over time, identifying, for example, whether one allele will entirely replace another allele, or whether the two alleles will coexist at some stable equilibrium.[74]

In the 1920s and 1930s, Fisher, Haldane, Wright, and others used population genetic models to resolve the disagreements that separated the naturalists and experimentalists. They showed mathematically that selection, far from being the weak, insignificant force assumed by the naturalists, was in fact an extremely potent force.[75] Their models showed, for example, that a gene that conferred an advantage of just 1 percent (i.e., its bearers were 1 percent more likely to reproduce than individuals without the gene) could spread to half of a population in just 100 generations. Although quite long in terms of human generations, for most species 100 generations is quite short. And compared to the complete history of life on earth, it is but the blink of an eye. Fisher and Haldane therefore showed that the naturalists' assumption that selection was too weak to effect meaningful biological change was incorrect and that recourse to Lamarckian inheritance was unnecessary. Once the naturalists accepted this, reconciliation with the anti-Lamarckian experimentalists soon followed. Fisher also showed mathematically that continuous phenotypic variation, like that seen in height or skin color, could arise from the combined action of multiple discrete genetic characters, each of which has a small individual effect. This reinforced Mendel's experimental demonstration that biological inheritance is particulate. He then showed that gradual phenotypic change could occur as mutations appear in just a subset of the underlying discrete characters. Because each discrete character has a small individual effect, this does not result in the massive phenotypic mutations envisioned by the experimental geneticists who advocated saltationism. Thus the experimental geneticists' informal intuition that particulate inheritance inevitably leads to abrupt, discontinuous change became untenable; they abandoned saltationism and accepted the gradualism of the naturalists.

Once the population geneticists had used formal models to resolve these disagreements, the two previously separate camps—experimental geneticists studying microevolution and naturalists studying macroevolution—came together during a short ten-year period from 1937 to 1947 in what is known as the evolutionary (or modern) synthesis to form what we now recognize as evolutionary biology.[76] Essentially this synthesis represented a bridging of the micro-macro divide: macroevolutionary patterns documented by naturalists, such as gradual change and species diversity, were shown to be consistent with the microevolutionary processes that had been demonstrated experimentally by the geneticists, such as particulate and non-Lamarckian inheritance. As Mayr put it:

> The proponents of the synthetic theory maintain that all evolution is due to the accumulation of small genetic changes, guided by natural selection, and that transspecific evolution is nothing but an extrapolation and magnification of the events that take place within populations and species . . . it is misleading to make a distinction between the causes of micro- and macroevolution.[77]

Although this synthesis was by no means comprehensive and complete (a major omission, for example, was development), the bridging of the micro-macro divide within a common neo-Darwinian theoretical framework set the stage for huge advances in the study of biological evolution.

The Micro-Macro Divide in the Social Sciences. The micro-macro divide that afflicted the biological sciences in the early twentieth century has a striking parallel in the social sciences today. The divide in the social sciences is between the microlevel, that is, those small-scale, individual-level processes that act to change the frequency of culturally transmitted traits within a single population, and the macrolevel, that is, large-scale patterns and trends at or above the level of entire societies, such as cross-cultural differences in civic duty or cognition, or long-term historical trends such as the rise and fall of the Roman empire or the diversification of Indo-European languages. Just like the geneticist-naturalist divide in presynthetic biology, these two levels are often studied entirely separately, by different scholars in different disciplines, and with little attempt to ensure that the findings at one level are consistent with the other, or to use the findings of one to explain observations at the other. Psychologists, for example, study the behavior of single individuals (as in cognitive psychology), or at most the behavior of individuals interacting within small groups (as in social psychology), under controlled conditions in the laboratory. Cultural anthropologists, meanwhile, often focus on macrolevel, societywide cultural variation in customs and practices, and archaeologists deal with macrolevel cultural change over time, such as the spread of a particular arrowhead design over several centuries. Other disciplines exhibit an internal micro-macro split. Economics is partitioned into microeconomics, the study of individual-level processes such as how the decisions of individual buyers and sellers affect supply and demand for goods, and macroeconomics, the study of population-level variables such as GDP and unemployment rates. Similarly, microsociology is concerned with the analysis of individual behavior (or "agency"), while macrosociology deals with population-level phenomena such as social structure. Linguistics has microlevel branches such as psycholinguistics, concerned with how individuals acquire and use language, and macrolevel branches such as historical linguistics, concerned with how entire languages change over hundreds or thousands of years.

This micro-macro divide is problematic for two reasons. First, macrolevel researchers are often unwilling to explain macrolevel patterns and trends that they document in terms of underlying individual-level processes. This reluctance has its origin in the ideas of many influential early social scientists. For example, cultural anthropologist Alfred Kroeber saw culture as a "superorganic" phenomenon that cannot be reduced to individual-level psychological ("mental") processes:

> Mental activity . . . proves nothing whatever as to social events. Mentality relates to the individual. The social or cultural, on the other hand, is in its very essence non-individual. Civilization, as such, begins only where the individual ends.[78]

Similarly, one of the founders of sociology, Emile Durkheim, argued that:

> In no case can sociology simply borrow from psychology any one of its principles in order to apply it, as such, to social facts. Collective thought, in its form as in its matter, must be studied in its entirety, in and for itself, with an understanding of its peculiar nature.[79]

This unwillingness to reduce cultural phenomena down to individual behavior persists to this day. While macrolevel disciplines such as cultural anthropology, historical linguistics, history, and macrosociology have documented patterns of cultural change, such as the rise and fall of the Roman empire or the diversification of Indo-European languages, and patterns of cross-cultural variation in, for example, supernatural and religious beliefs, marriage systems, or agricultural methods, they have generally failed to explain these patterns of change and variation in terms of the behavior and psychological processes of the people who are responsible for those patterns. This reluctance to reduce cultural phenomena to individual psychological processes may have its roots in the mind-body dualism inherent in many of the nonscientific approaches to culture such as social constructionism that were discussed in chapter 1.[80] Yet reductionism is a key tool of the scientific method and is responsible for huge advances in the physical and natural sciences, whether it is the reduction of matter to atoms and subatomic particles in physics or, as we have seen in biology, the reduction of macroevolutionary patterns such as adaptation and speciation to microevolutionary processes such as natural selection and particulate inheritance.

The second problem is the opposite of the first: micro-level disciplines such as psychology have failed to acknowledge the extent to which macrolevel cultural processes shape individual behavior.[81] Psychologists, for example, tend to focus on single individuals and their behavior in nonsocial experimental situations in the lab, or at most interactions within small groups. Similarly, economists typically assume that people make economic decisions in isolation from other people by rationally assessing the costs and benefits of different options. Yet as reviewed in chapter 1, recent findings from cultural psychology have demonstrated that culture shapes numerous aspects of human behavior to a degree not hitherto suspected, from cooperative tendencies to basic processes of attention and perception. Although these are significant findings, they are rather recent and have yet to permeate most of psychology. A similar situation pertains to economics, in which the lack of consideration of cultural processes such as conformity (sometimes called "herd behavior") has limited economists' understanding of macroevolutionary phenomena such as market bubbles and crashes.[82] As economist Herbert Gintis notes:

> Sociology and anthropology recognize the importance of conformist transmission but the notion is virtually absent from economic theory. For instance, in economic theory consumers maximize utility and firms maximize profits by considering only market prices and their own preference and production functions. In fact, in the face of incomplete information and the high cost of information-gathering, both consumers and firms in the first instance may simply imitate what appear to be the successful practices of others.[83]

Microlevel disciplines such as psychology and microeconomics remain largely divorced from the real-world patterns of cultural change and variation documented by macrolevel disciplines such as cultural anthropology, and archaeology. Without such links, the validity of microlevel experiments and theories concerning human behavior remain in doubt.

Conclusion: A Darwinian Theory of Culture Can Synthesize the Social Sciences

Given that cultural change, like biological change, is Darwinian, perhaps a similar evolutionary synthesis to that which occurred in the biological sciences in the 1940s might be possible for the social sciences. Just as the evolutionary synthesis in biology solved the micro-macro problem by showing, through the use of formal, quantitative models, how microevolutionary processes are consistent with, and indeed explain, macroevolutionary patterns, an equivalent evolutionary synthesis in the social sciences would use similar models to show how cultural macroevolution, as studied by macroeconomists, macrosociologists, historical linguists, historians, cultural anthropologists and archaeologists, is consistent with, and indeed explicable from, microevolutionary processes studied by microeconomists, microsociologists, psycholinguists, neuroscientists, and psychologists. Yet it is crucial that the differences between biological and cultural evolution are incorporated into these models, given that cultural evolution does not exhibit the same neo-Darwinian microevolutionary processes as does biological evolution. The following chapter outlines the pioneering work of a handful of scholars who in the 1970s and 1980s attempted to construct a formal theory of Darwinian cultural evolution taking these differences into account.