

of vocabulary. It serves as a prototype for future research aimed at bridging science and the humanities.

Some epigenetic rules, including color vision, are primate traits tens of millions of years old. Others, such as the neural mechanisms of language, are uniquely human and possibly date back no more than several hundred thousand years. The search for human nature can be viewed as the archaeology of the epigenetic rules. It is destined to be a vital part of future interdisciplinary research.

In gene-culture coevolution as now conceived by biologists and social scientists, causal events ripple out from the genes to the cells to tissues and thence to brain and behavior. By interaction with the physical environment and preexisting culture, they bias further evolution of the culture. But this sequence—composing what the genes do to culture by way of epigenesis—is only half the circle. The other half is what culture does to the genes. The question posed by the second half of the coevolutionary circle is how culture helps to select the mutating and recombining genes that underlie human nature.

By expressing gene-culture coevolution in such a simple manner, I have no wish either to overwork the metaphor of the selfish gene or to minimize the creative powers of the mind. After all, the genes prescribing the epigenetic rules of brain and behavior are only segments of giant molecules. They feel nothing, care for nothing, intend nothing. Their role is simply to trigger the sequences of chemical reactions within the highly structured fertilized cell that orchestrate epigenesis. They writ extends to the levels of molecule, cell, and organ. This early stage of epigenesis, consisting of a series of sequential physicochemical reactions, culminates in the self-assembly of the sensory system and brain. Only then, when the organism is completed, does mental activity appear as an emergent process. The brain is a product of the very highest levels of biological order, which are constrained by epigenetic rules implicit in the organism's anatomy and physiology. Working in a chaotic flood of environmental stimuli, it sees and listens, learns, plans its own future. By that means the brain determines the fate of the genes that prescribed it. Across evolutionary time, the aggregate choices of many brains determine the Darwinian fate of everything human—the genes, the epigenetic rules, the communicating minds, and the culture.

Brains that choose wisely possess superior Darwinian fitness, meaning that statistically they survive longer and leave more offspring

CHAPTER 8

THE FITNESS OF HUMAN NATURE

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

Human nature is still an elusive concept because our understanding of the epigenetic rules composing it is rudimentary. The rules I have used as examples in previous chapters are no more than fragments cut from the vast mental landscape. Yet, coming from so many behavioral categories, they offer persuasive testimony of the existence of a genetically based human nature. Consider the variety of examples so far reviewed: the hallucinatory properties of dreams, the mesmerizing fear of snakes, phoneme construction, elementary preferences in the sense of taste, details of mother-infant bonding, the basic facial expressions, the reification of concepts, the personalization of inanimate objects, and the tendency to split continuously varying objects and processes into two discrete classes. One more rule in particular, the breaking of light into the colors of the rainbow, has been placed within a causal sequence running all the way from the genes to the invention

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than brains that choose badly. That generalization by itself, commonly telescoped into the phrase "survival of the fittest," sounds like a tautology—the fit survive and those who survive are fit—yet it expresses a powerful generative process well documented in nature. During hundreds of millennia of Paleolithic history, the genes prescribing certain human epigenetic rules increased and spread at the expense of others through the species by means of natural selection. By that laborious process human nature assembled itself.

What is truly unique about human evolution, as opposed say to chimpanzee or wolf evolution, is that a large part of the environment shaping it has been cultural. Therefore, construction of a special environment is what culture does to the behavioral genes. Members of past generations who used their culture to best advantage, like foragers gleaning food from a surrounding forest, enjoyed the greatest Darwinian advantage. During prehistory their genes multiplied, changing brain circuitry and behavior traits bit by bit to construct human nature as it exists today. Historical accident played a role in the assembly, and there were many particular expressions of the epigenetic rules that proved self-destructive. But by and large, natural selection, sustained and averaged over long periods of time, was the driving force of human evolution. Human nature is adaptive, or at least was at the time of its genetic origin.

Gene-culture coevolution may seem to create a paradox: At the same time that culture arises from human action, human action arises from culture. The contradiction evaporates, however, if we compare the human condition with the simpler form of reciprocity between environment and behavior widespread in the animal kingdom. African elephants, while consuming the vegetation of large numbers of trees and shrubs, create the open woodlands in which they thrive. Termites, swarming at their feet, consume leftover dead vegetation and build tightly sealed nests from soil and their own excrement, creating moist, high-carbon-dioxide microclimates to which—no surprise—their physiology is closely adapted. To view human beings evolving among elephants and termites in the same habitat during the Pleistocene Epoch, we need only replace environment in part with culture. While it is true that culture, strictly defined as complex socially learned behavior, is evidently limited to humans, and as a consequence the reciprocity between genes and culture-as-environment is also unique, the underlying principle is the same. There is nothing

contradictory in saying that culture arises from human action while human action arises from culture.

The general biological imagery of the origin of human nature has repelled some writers, including a few of the most discerning scholars in the social sciences and humanities. They are, I am sure, mistaken. They misunderstand gene-culture coevolution, confusing it with rigid genetic determinism, the discredited idea that genes dictate particular forms of culture. I believe reasonable concerns can be dispelled by the following argument. Genes do not specify elaborate conventions such as totemism, elder councils, and religious ceremonies. To the best of my knowledge no serious scientist or humanities scholar has ever suggested such a thing. Instead, complexes of gene-based epigenetic rules predispose people to invent and adopt such conventions. If the epigenetic rules are powerful enough, they cause the behaviors they affect to evolve convergently across a great many societies. The conventions—evolved by culture, biased by epigenetic rules—are then spoken of as the cultural universals. Rare cultural forms are also possible under the same scenario. The whole matter can be expressed another way by reverting to the imagery of developmental genetics. The norm of reacting to the underwriting genes is greatly narrowed in the case of a cultural universal; in other words, there are few if any environments available to human beings in which the cultural conventions does not arise. In contrast, genes that spawn many rare conventions in response to changing environments, thus expanding cultural diversity, are those with broader norms of reaction.

Genetic evolution might have gone the other way by eliminating epigenetic bias altogether, expanding the norm of reaction of the prescribing genes to indefinite degree, and thus causing cultural diversity to explode. That is a theoretical possibility, but the existence of such a phenomenon does not imply that culture can be cut loose from the human genome. It means only that the prescriptive genes can design the brain to learn and respond with equal alacrity to any experience. Bias-free learning, if it exists, is not an erasure of gene-culture coevolution but an extremely specialized product of it, based on a very peculiar kind of epigenetic rule. For the time being, however, the argument is moot, because no example of bias-free mental development has yet been discovered. Some degree of epigenetic bias has been demonstrated in every one of the small number of cultural categories thus far tested for the presence or absence of such bias.

The swiftness of cultural evolution in historical times may by itself seem to imply that humanity has slipped its genetic instructions, or somehow suppressed them. But that is an illusion. The ancient genes and the epigenetic rules of behavior they ordain remain comfortably in place. For most of the evolutionary history of *Homo sapiens* and its antecedent species *Homo habilis*, *Homo erectus*, and *Homo ergaster*, cultural evolution was slow enough to remain tightly coupled to genetic evolution. Both culture and the genes underlying human nature were probably genetically fit throughout that time. For tens of thousands of years during the Pleistocene Epoch the evolution of artifacts remained nearly static, and presumably so did the basic social organization of the hunter-gatherer bands using them. There was time enough, as one millennium passed into another, for the genes and epigenetic rules to evolve in concert with culture. By Upper Paleolithic times, however, from about 40,000 to 10,000 years before the present, the tempo of cultural evolution quickened. During the ensuing Neolithic-agricultural advance, the pace accelerated dramatically. According to the theory of population genetics, most of the change was far too fast to be tracked closely by genetic evolution. But there is no evidence that the Paleolithic genes simply disappeared during this "creative revolution." They stayed in place and continued to prescribe the foundational rules of human nature. If they could not keep up with culture, neither could culture expunge them. For better or worse they carried human nature into the chaos of modern history.

TO TAKE behavioral genes into account therefore seems a prudent step when assessing human behavior. Sociobiology (or Darwinian anthropology, or evolutionary psychology, or whatever more politically acceptable term one chooses to call it) offers a key link in the attempt to explain the biological foundation of human nature. By asking questions framed in evolutionary theory, it has already steered research in anthropology and psychology in new directions. Its major research strategy in human studies has been to work from the first principles of population genetics and reproductive biology to predict the forms of social behavior that confer the greatest Darwinian fitness. The predictions are then tested with data taken from ethnographic archives and historical records, as well as from fresh field studies explicitly designed

for the purpose. Some of the tests are conducted on preliterate and other traditional societies, whose conservative social practices are likely to resemble most closely those of Paleolithic ancestors. A very few societies in Australia, New Guinea, and South America in fact still have stone-age cultures, which is why anthropologists find them especially interesting. Other tests are conducted with data from modern societies, where fast-evolving cultural norms may no longer be optimally fit. In all these studies a full array of analytic techniques is brought to bear. They include multiple competing hypotheses, mathematical models, statistical analysis, and even the reconstruction of the histories of memes and cultural conventions by the same quantitative procedures used to trace the evolution of genes and species.

In the past quarter-century, human sociobiology has grown into a large and technically complex subject. Nevertheless, it is possible to reduce its primary evolutionary principles to some basic categories, which I will now briefly summarize.

Kin selection is the natural selection of genes based on their effects on individuals carrying them plus the effects the presence of the genes has on all the genetic relatives of the individuals, including parents, children, siblings, cousins, and others who still live and are capable either of reproducing or of affecting the reproduction of blood relatives. Kin selection is especially important in the origin of altruistic behavior. Consider two sisters, who share half their genes by virtue of having the same father and mother. One sacrifices her life, or at least remains childless, in order to help her sister. As a result the sister raises more than twice as many children as she would have otherwise. Since half of her genes are identical to those of her generous sister, the loss in genetic fitness is more than made up by the altruistic nature of the sacrifice. If such actions are predisposed by genes and occur commonly, the genes can spread through the population, even though they induce individuals to surrender personal advantage.

From this simple premise and elaborations of it have come a wealth of predictions about patterns of altruism, patriotism, ethnicity, inheritance rules, adoption practices, and infanticide. Many are novel, and most have held up well under testing.

Parental investment is behavior toward offspring that increases the fitness of the latter at the cost of the parent's ability to invest in other offspring. The different patterns of investment have consequences for

the fitness of the genes that predispose individuals to select the partners. Choose one, and you leave more offspring; choose another, and you leave fewer offspring. The idea has given rise to a biologically based "family theory," spinning off new insights on sex ratios, marriage contracts, parent-offspring conflict, grief at the loss of a child, child abuse, and infanticide. I will take up family theory again in the next chapter, in order to illustrate more fully the relevance of evolutionary reasoning for the social sciences.

Mating strategy is influenced by the cardinal fact that women have more at stake in sexual activity than men, because of the limited age span in which they can reproduce and the heavy investment required of them with each child conceived. One egg, to put the matter in elemental terms, is hugely more valuable than a single sperm, which must compete with millions of other sperm for the egg. The achievement of pregnancy closes off further breeding opportunity of the mother for a substantial fraction of her remaining reproductive life, whereas the father has the physical capacity to inseminate another woman almost immediately. With considerable success, the nuances of this concept have been used by scientists to predict patterns of mate choice and courtship, relative degrees of sexual permissiveness, paternity anxiety, treatment of women as resources, and polygyny (multiple wives, which in the past at least has been an accepted arrangement in three-quarters of societies around the world). The optimum sexual instinct of men, to put the matter in the now familiar formula of popular literature, is to be assertive and ruttish, while that of women is to be coy and selective. Men are expected to be more drawn than women to pornography and prostitution. And in courtship, men are predicted to stress exclusive sexual access and guarantees of paternity, while women consistently emphasize commitment of resources and material security.

Status is central to all complex mammal societies, humanity included. To say that people generally seek status, whether by rank, class, or wealth, is to sum up a large part of the catalogue of human social behavior. In traditional societies genetic fitness of individuals is generally but not universally correlated with status. In chiefdoms and despotic states especially, dominant males have easy access to multiple women and produce more children, often in spectacular disproportion. Throughout history, despots (absolute rulers with arbitrary power

ers of life and death over their subjects) commanded access to hundreds or even thousands of women. Some states used explicit rules of distribution, as in Inca Peru, where by law petty chiefs were given seven women, governors of a hundred people eight, leaders of a thousand people fifteen, and lords and kings no fewer than seven hundred. Commoners took what was left over. The fathering of children was commensurately lopsided. In modern industrial states, the relationship between status and genetic fitness is more ambiguous. The data show that high male status is correlated with greater longevity and copulation with more women, but not necessarily the fathering of more children.

Territorial expansion and defense by tribes and their modern equivalents the nation states is a cultural universal. The contribution to survival and future reproductive potential, especially of tribal leaders, is overwhelming, and so is the warlike imperative of tribal defense. "Our country!" declared Commodore Stephen Decatur, hard-fighting hero of the War of 1812, "may she always be right; but our country, right or wrong." (Personal aggressiveness has its Darwinian limits, however; Decatur was killed in a duel in 1820.)

Biologists have determined that territoriality is not unavoidable during social evolution. It is apparently entirely absent in many animal species. The territorial instinct arises during evolution when some vital resource serves as a "density-dependent factor." That is, the growth of population density is slowed incrementally by an increasing shortage of food, water, nest sites, or the entire local terrain available to individuals searching for these resources. Death rates increase or birth rates decrease, or both, until the two rates come more or less into balance and population density levels off. Under such circumstances animal species tend to evolve territorial behavior. The theoretical explanation is that individuals hereditarily predisposed to defend private resources for themselves and their social group pass more genes on to the next generation.

In contrast, the growth of other species is not leveled off by limiting resources but by rising amounts of emigration, disease, or predation. When such alternative density-dependent factors are paramount, and resource control is therefore not required, territorial defense usually does not evolve as a hereditary response.

Humanity is decidedly a territorial species. Since the control of

limiting resources has been a matter of life and death through millennia of evolutionary time, territorial aggression is widespread and reaction to it often murderous. It is comforting to say that war, being cultural in origin, can be avoided. Unfortunately, that bit of conventional wisdom is only a half truth. It is more nearly correct—and far more prudent—to say that war arises from both genes and culture and can best be avoided by a thorough understanding of the manner in which these two modes of heredity interact within different historical contexts.

Contractual agreement so thoroughly pervades human social behavior, virtually like the air we breathe, that it attracts no special notice—until it goes bad. Yet it deserves focused scientific research for the following reason. All mammals, including humans, form societies based on a conjunction of selfish interests. Unlike the worker castes of ants and other social insects, they resist committing their bodies and services to the common good. Rather, they devote their energies to their own welfare and that of close kin. For mammals, social life is a contrivance to enhance personal survival and reproductive success. As a consequence, societies of nonhuman mammalian species are far less organized than the insect societies. They depend on a combination of dominance hierarchies, rapidly shifting alliances, and blood ties. Human beings have loosened this constraint and improved social organization by extending kinshiplike ties to others through long-term contracts.

Contract formation is more than a cultural universal. It is a human trait as characteristic of our species as language and abstract thought, having been constructed from both instinct and high intelligence. Thanks to ground-breaking experiments by the psychologists Leda Cosmides and John Tooby at the University of California at Santa Barbara, we know that contract formation is not simply the product of a single rational faculty that operates equally across all agreements made among bargaining parties. Instead, one capacity, the detection of cheating, is developed to exceptional levels of sharpness and rapid calculation. Cheater detection stands out in acuity from mere error detection and the assessment of altruistic intent on the part of others. It is furthermore triggered as a computation procedure only when the cost and benefits of a social contract are specified. More than error, more than good deeds, and more even than the margin of profit, the pos-

sibility of cheating by others attracts attention. It excites emotion and serves as the principal source of hostile gossip and moralistic aggression by which the integrity of the political economy is maintained.

THE GENETIC FITNESS hypothesis—that the most widely distributed traits of culture confer Darwinian advantage on the genes that predispose them—has been reasonably well borne out by the evidence. Widely distributed traits are usually adaptive, and their existence accords with the first principles of evolution by natural selection. It is further true that by and large people behave in their daily lives as though somehow guided, whether consciously or unconsciously, by these first principles. The value of the genetic fitness hypothesis lies in the insights concerning human nature it provides and the productive new directions in scholarly research it has stimulated.

There are nonetheless many weaknesses in the genetic fitness hypothesis. For the most part the flaws are due not to contradictory evidence but to a scarcity of relevant information. Because human behavioral genetics is still in its infancy, there is a near-absence of direct links between particular genes and behavior underlying the universal culture traits. The observed fit between theory and fact is based mostly on statistical correlation. One of the rare exceptions, described in the previous chapter, is the connection successfully made between the genetics and vocabulary of color vision.

The epigenetic rules that guide behavioral development are also largely unexplored, and as a result the exact nature of gene-culture co-evolution can in most cases only be guessed. It makes all the difference in the world whether epigenetic rules are rigid, specialized functions of the brain, and thus resemble animal instinct, or whether they are more generalized rational algorithms that function across a wide range of behavioral categories. The evidence to date shows that both kinds of epigenetic rules, narrow and broad, exist. For example, the use of the smile is narrowly channeled by one set of rules, while territorial response is broadly channeled by another. But until such rules are better documented and disentangled, along with the manner in which they guide mental development, it will be difficult to account for the wide cultural variation that occurs in a majority of behavioral categories.

These shortcomings in behavioral genetics and development are

conceptual, technical, and deep. But they are ultimately solvable. Urless new evidence commands otherwise, trust is wisely placed in the natural conscience of the disciplines now addressing the connection between heredity and culture, even if support for it is accumulating slowly and in bits and pieces. The resolution of the difficulties awaits the further expansion of biology and its coalescence with psychology and anthropology.

THE CATEGORY OF human behavior that provides the fullest test of the genetic fitness hypothesis to date is incest avoidance. A large amount of information concerning the phenomenon has become available at different levels of biology and culture. The behavior itself is universal, or nearly so. It is also relatively clear-cut in expression. Sexual activity in all societies is relatively uncommon between siblings and between parents and their offspring; children produced by such activity are rare; and long-term unions made with the consensual purpose of having such children are almost nonexistent.

The current explanation of incest avoidance, which combines genetic and cultural evolution, is a straightforward sociobiological exercise. Inbreeding at the level of siblings and parents and children yields a high percentage of offspring with genetic defects. Humans tend to avoid this risk by unconscious obedience to the following epigenetic rule: If a boy and girl are brought together before one or the other is thirty months of age and then raised in close domestic proximity—use the same potty, so to speak—they are devoid of later sexual interest in each other, and the very thought of it arouses an acute aversion. This emotional incapacity, fortified in many societies by a rational understanding of the consequence of inbreeding, has led to the cultural incest taboos, which prohibit incest by custom and law.

The risk of defective children from incest—inbreeding depression as it is called by geneticists—is now well understood. On average, each person carries somewhere on his twenty-three pairs of chromosomes two sites that contain recessive lethal genes. The sites can be almost anywhere on the chromosomes. They also differ in exact number and location from one person to the next. Only one of the two homologous chromosomes in the affected pair carries lethals at the site; the other homologous chromosome carries a normal gene, which overrides the effects of the lethal gene. The reason is the lethality itself. When both

chromosomes carry a lethal gene at a particular site, the fetus is aborted or the child dies in infancy.

Consider a woman with a lethal gene at one such site. If she is impregnated by her brother, and if their parents themselves are unrelated, her child has one chance in eight of dying as a fetus or as an infant. If she has lethal genes at two such sites, her child has about one chance in four of dying. There exist in addition a horde of other recessive genes that cause crippling anatomical and mental defects. The total effect is that early mortality of children born of incest is about twice that of outbred children, and among those that survive, genetic defects such as dwarfism, heart deformities, severe mental retardation, deaf-mutism, enlargement of the colon, and urinary tract abnormalities are ten times more common.

The destructive consequence of incest is a general phenomenon not just in humans but also in plants and animals. Almost all species vulnerable to moderate or severe inbreeding depression use some biologically programmed method to avoid incest. Among the apes, monkeys, and other nonhuman primates the method is two-layered. First, among all nineteen social species whose mating patterns have been studied, young individuals tend to practice the equivalent of human exogamy: Before reaching full adult size they leave the group in which they were born and join another. In the lemurs of Madagascar and in the majority of monkey species from both the Old and New Worlds, it is the males who emigrate. In red colobus monkeys, hamadryas baboons, gorillas, and chimpanzees of Africa, the females leave. In howler monkeys of Central and South America, both sexes depart. The restless young of these diverse primate species are not driven out of the group by aggressive adults. Their departure appears to be entirely voluntary.

Whatever its ultimate evolutionary origin, and however else it affects reproductive success, the emigration of young primates prior to reaching full sexual maturity greatly reduces the potential for inbreeding. But the barrier against inbreeding is reinforced by a second line of resistance. This is the avoidance of sexual activity by even those individuals who remain with their natal group. In all the social nonhuman primate species whose sexual development has been carefully studied, including marmosets and tamarins of South America, Asian macaques, baboons, and chimpanzees, both adult males and females display the "Westermarck effect": They spurn individuals with whom

they were closely associated in early life. Mothers and sons almost never copulate, and brothers and sisters kept together mate much less frequently than do more distantly related individuals.

This elemental response was discovered, not in monkeys and apes, but in human beings, by the Finnish anthropologist Edward A. Westermarck and first reported in his 1891 masterwork *The History of Human Marriage*. The existence of the phenomenon has gained increasing support from many sources in the intervening years. None is more persuasive than the study of "minor marriages" in Taiwan by Arthur P. Wolf of Stanford University. Minor marriages, formerly widespread in southern China, are those in which unrelated infant girls are adopted by families, raised with the biological sons in an ordinary brother-sister relationship, and later married to the sons. The motivation for the practice appears to be to insure partners for sons when an unbalanced sex ratio and economic prosperity combine to create a highly competitive marriage market.

Across four decades, from 1957 to 1995, Wolf studied the histories of 14,200 Taiwanese women contracted for minor marriage during the late nineteenth and early twentieth centuries. The statistics were supplemented by personal interviews with many of these "little daughters-in-law," or *sim-pua*, as they are known in the Hokkien language, as well as with their friends and relatives.

What Wolf had hit upon was a controlled—if unintended—experiment in the psychological origins of a major piece of human social behavior. The *sim-pua* and their husbands were not biologically related, thus taking away all of the conceivable factors due to close genetic similarity. Yet they were raised in a proximity as intimate as that experienced by brothers and sisters in Taiwanese households.

The results unequivocally favor the Westermarck hypothesis. When the future wife was adopted before thirty months of age, she usually resisted later marriage with her *de facto* brother. The parents often had to coerce the couple to consummate the marriage, in some cases by threat of physical punishment. The marriages ended in divorce three times more often than "major marriages" in the same communities. They produced nearly 40 percent fewer children, and a third of the women were reported to have committed adultery, as opposed to about 10 percent of wives in major marriages.

In a meticulous series of cross-analyses, Wolf identified the key inhibiting factor as close coexistence during the first thirty months of life

of either or both of the partners. The longer and closer the association during this critical period, the stronger the later effect. Wolf's data allow the reduction or elimination of other imaginable factors that might have played a role, including the experience of adoption, financial status of the host family, health, age at marriage, sibling rivalry, and the natural aversion to incest that could have arisen from confusing the pair with true, genetic siblings.

A parallel unintended experiment has been performed in Israeli kibbutzim, where children are raised in crèches as closely as brothers and sisters in conventional families. The anthropologist Joseph Shepher and his co-workers reported in 1971 that among 2,769 marriages of young adults reared in this environment, none was between members of the same kibbutz peer group who had lived together since birth. There was not even a single known case of heterosexual activity, despite the fact that the kibbutz adults were not especially opposed to it.

From these examples, and a great deal of additional anecdotal evidence gleaned from other societies, it is evident that the human brain is programmed to follow a simple rule of thumb: *Have no sexual interest in those whom you knew intimately during the earliest years of your life.*

The Westermarck effect is also consistent with the principle of graded effect in psychology. The evidence from across many societies shows that the more intimate the association during the critical period of early childhood, the less likely is it that heterosexual activity will occur. Hence mother-son incest, which is inhibited by the intense bonding during the infancy of the son, is by far the rarest kind. Next in scarcity is sibling incest, then sexual abuse of girls by their biological fathers (I say abuse because consent is seldom given freely by the daughters), and finally sexual abuse of girls by their stepfathers.

Yet, while the evidence makes a tidy and persuasive picture, we are still far from a full explanation of incest avoidance. There is no conclusive proof that the Westermarck effect originated from genetic evolution by natural selection. Certainly all the signs point that way. Incest avoidance diminishes inbreeding and thereby increases the production of healthy offspring. Given even a small amount of genetic variability in sexual responsiveness to childhood associates, the differences in fitness based on it would have been strong enough, in population genetics theory at least, to spread the Westermarck effect throughout

the population from a very low incidence to widespread occurrence in as few as ten generations. Further evidence is the occurrence of the effect in other primates, including our closest living relatives the chimpanzees, where it is unquestionably genetic, not cultural, in origin. Still, no attempt has been made to measure heritability in the human response or to discover the genes underwriting it.

A second shortcoming on the research front is that we do not know the exact psychological source of the Westermarck effect. The stimuli from childmates that trigger the inhibition have not been pinpointed. It is not known whether they occur during play, eating together, unavoidable aggressive exchanges, or other events more subtle and perhaps only subliminally sensed. The critical stimuli could be anything, large or small, visual, auditory, or olfactory, and not necessarily understood in any ordinary adult sense. The essence of instinct as interpreted by biologists is that it is evoked by simple cues that need only be associated in real life with the object to which it is directed. A scent or a single touch at a critical moment can unleash complex behavior, or inhibit it.

A further complication in the story of human incest avoidance is the existence of a third barrier, incest taboos, the culturally transmitted sets of rules that prohibit sexual activity among very close relatives. Many societies permit or even encourage marriages between first cousins, especially when the bonding serves group cohesion and consolidates wealth, but forbid it between siblings and half siblings.

The taboos, being conscious inventions and not simple instinctive responses, vary enormously in detail from one society to the next. In many cultures they are interwoven with the strictures of kinship classification and exogamous marriage contracts. In preliterate societies incest is commonly thought to be connected with cannibalism, vampirism, and malign witchcraft, each of which is punishable on its own account. Modern societies enact laws to discourage incest. During the Commonwealth and Protectorate period of England, from 1650 to the Restoration a decade later, it was punishable by death. In Scotland until 1887, it was nominally a capital offense, although transgressions seldom drew more than life imprisonment. In the United States incest has been generally treated as a felony punishable by fine, imprisonment, or both. The sexual abuse of children is considered all the more abhorrent when it is in addition incestuous.

History, as ever true for human mores generally, records exceptions. Societies with some degree of permissiveness have included the Incas, Hawaiians, Thais, ancient Egyptians, Nkole (Uganda), Bunyoro (Uganda), Ganda (Uganda), Zande (Sudan), and Dahomeyans of West Africa. In each case the practice is (or in most instances was, having been discontinued) surrounded by ritual and limited to royalty or other groups of high status. In all the incestuous arrangements the male also consorted with other women, fathering outbred children in addition to "pure" progeny. The ruling families are or were patrilineal. The strategy yielding maximum genetic fitness for a high-ranking male is to mate with his own sister, producing children who share with him 75 percent of their genes by common descent, instead of the usual 50 percent, and also to mate with women who are genetically unrelated and more likely to give birth to normal children. Less easily explained are the common and well-documented cases of brother-sister marriages among commoners in Roman Egypt, from about 30 B.C. to A.D. 324. Papyrus texts from the period reveal beyond reasonable doubt that at least some of the siblings engaged in full and unabashed sexual relations.

Incest taboos have led us, once again, to the borderland between the natural and social sciences. The question they raise is as follows: What is the relation between the Westermarck effect, which is biological, and the incest taboos, which are cultural?

The issue can be drawn more sharply by distinguishing the two principal hypotheses that compete for the explanation of human incest avoidance. The first is Westermarck's, which I will now summarize in updated language: People avoid incest because of a hereditary epigenetic rule of human nature that they have translated into taboos. The opposing hypothesis is that of Sigmund Freud. There is no Westermarck effect, the great theoretician insisted when he learned of it. Just the opposite: Heterosexual lust among members of the same family is primal and compelling, and not forestalled by any instinctive inhibition. In order to prevent such incest, and the consequent disastrous ripping apart of family bonds, societies invent taboos. One result, which Freud developed as part of his grand scheme for psychology, is the Oedipus complex, the unresolved desire of a son for sexual gratification with his mother and his simultaneous hatred for the father, who is seen as a rival. "The first choice of object in mankind," he wrote in

1917, "is regularly an incestuous one, directed to the mother and sister of men, and the most stringent prohibitions are required to prevent this sustained infantile tendency from being carried into effect."

Labeling the idea of the Westermarck effect "preposterous," Freud carried the day from the very start. The findings of psychoanalysis, he asserted, make the phenomenon untenable. He also drew heavily on a rebuttal by James Frazer, the British anthropologist, classicist, and author of *The Golden Bough*. If the Westermarck effect really existed, Frazer reasoned, no taboos would be required. "It is not easy to see why any deep human instinct should need to be reinforced by law." That logic prevailed in textbooks and scholarly reviews for most of the rest of the twentieth century.

Westermarck's response to Frazer was simple, equally logical, and supported by growing amounts of evidence, but ignored in the triumphant onrush of psychoanalytic theory. Individual humans, Westermarck said, reason as follows: *I am sexually indifferent to my parents and siblings. Yet occasionally I wonder what it would be like to have sex with them. The thought is repugnant! Incest is forced and unnatural. It would alter or break other bonds I have formed with them and must maintain on a day-to-day basis for my own welfare. Incest by others is by extension also repugnant to my mind, and evidently to that of others too, and so the rare cases in which it occurs should be condemned as immoral.*

Reasonable as that explanation may be, and supported by evidence, it is nevertheless easy to see why Freud and a host of other influential social theorists reacted so vehemently to the Westermarck effect. It imperiled a foundation piece of modernist thought, calling into question what had come to be regarded as a major intellectual advance of the era. Wolf has expressed the difficulty with precision: "Freud saw all too clearly that if Westermarck was right, *he* was wrong. The possibility that early childhood association suppressed sexual attraction had to be denied lest the basis of the Oedipus complex crumble and with it his conception of personality dynamics, his explanation of neuroses, and his grand view of the origins of law, art, and civilization."

The Westermarck effect rocks other boats as well. There is the matter of whether social regulation in general exists to repress human nature or to express it. And from that comes the not so trivial question of

what incest taboos imply about the origins of morality. Orthodox social theory holds that morality is largely a convention of obligation and duty constructed from mode and custom. The alternative view, favored by Westermarck in his writings on ethics, is that moral concepts are derived from innate emotions.

In the clash of ethical theory at least, the matter of incest avoidance can be settled empirically. Either Westermarck or Freud was factually right. The evidence now leans strongly to Westermarck. Yet there is more to incest taboos than the mere grafting of cultural conventions onto personal preference. It is also possible for people to observe the effects of inbreeding directly. They are capable of recognizing in at least a vague way that deformed children are a frequent product of incestuous unions. William H. Durham, a colleague of Arthur Wolf's at Stanford University, searched the ethnographic records of sixty societies chosen at random from around the world for references to any form of understanding of the consequences of incest. He found that twenty showed some degree of such awareness. The Tlingit Amerindians of the Pacific Northwest, for example, grasped in a straightforward manner that defective children are often produced from matings of very close kin. Other societies not only knew that much, but also developed folk theories to explain it. The Lapps of Scandinavia spoke of "bad blood" created by incest. The Tikopian Polynesians thought that *marā*, the doom generated by partners in incest, is transmitted to their young. The Kapauku of New Guinea, in a similar theory, believed that the act of incest causes a deterioration of the vital substances of the transgressors, which is then passed on to their children. The Toradja of Sulawesi, Indonesia, were more cosmic in their interpretation. They said that whenever people mate who have certain conflicting characteristics, as between close kin, nature is thrown into confusion.

Curiously, while fifty-six of Durham's sixty societies had incest motifs in one or more of their myths, only five contained accounts of evil effects. A somewhat larger number ascribed beneficial results, in particular the creation of giants and heroes. But even here incest was viewed as something special if not abnormal.

In summary, the factual picture emerging from research on human incest avoidance is one of multiple, successive barriers. Up front is the Westermarck effect, the ancient sexual desensitization found in all other primates thus far, and thus likely to be universal in

humans. Next there is the dispersal of the young at sexual maturity, also a universal primate trait, manifested in humans by adolescent restlessness and the formal practices of exogamous marriage. The deeper psychological motivations of the dispersal behaviors and the epigenetic rules composing them remain unknown. Finally, there are the cultural incest taboos, which enhance the Westermarck effect and dispersal. The taboos seem likely to have arisen from the Westermarck effect but also, in a minority of societies, from a direct perception of the destructive effects of inbreeding.

By translating the Westermarck effect into incest taboos, humans appear to pass from pure instinct to pure rational choice. But do they really? What is rational choice anyway? I suggest that rational choice is the casting about among alternative mental scenarios to hit upon the ones which, in a given context, satisfy the strongest epigenetic rules. It is these rules and this hierarchy of their relative strengths by which human beings have successfully survived and reproduced for hundreds of millennia. The incest avoidance case may illustrate the manner in which the coevolution of genes and culture has woven not just part but all of the rich fabric of human social behavior.

CHAPTER 9

THE SOCIAL SCIENCES

PEOPLE EXPECT from the social sciences—anthropology, sociology, economics, and political science—the knowledge to understand their lives and control their future. They want the power to predict, not the preordained unfolding of events, which does not exist, but what will happen if society selects one course of action over another.

Political life and the economy are already pivoted upon the presumed existence of such a predictive capacity. The social sciences are striving to achieve it, and to do so largely without linkage to the natural sciences. How well are they doing on their own? Not very well, considering their track record in comparison with the resources placed at their command.

The current status of the social sciences can be put in perspective by comparing them with the medical sciences. Both have been entrusted with big, urgent problems. Medical scientists are paid, for example, to cure cancer, correct genetic birth defects, and repair severed nerve cords. Social scientists are expected to tell us how to moderate ethnic conflict, convert developing countries into prosperous democracies, and optimize world trade. In both spheres the problems have been intractably complex, partly because the root causes are poorly understood.

The medical sciences are nevertheless progressing dramatically. Breakthroughs have been achieved in basic research and others are