

**Wade, Nicholas. *Before the Dawn: Recovering the Lost History of Our Ancestors*. New York: Penguin Books, 2006.**

Nicholas Wade reports on science and political topics for the *New York Times*. He previously wrote for scientific journals.

1. **Genetics & Genesis.** The record of human culture fades to nothing at 15,000 years in the past. At 50,000 years in the past, all humans dwelt in Africa. What happened to humankind in those 35,000 years before the cultural record commences in the first human settlements? The human genome, in its various representations on the planet, fills in parts of this missing story of humanity. For example, genetic materials give clues about when humans first fashioned clothing. Lice live less than twenty-four hours without a human host. The body louse evolved when humans lost their body hair, which event necessitated clothing. Some lice found a new niche in human garments. The body louse, according to research by Stoneking, first evolved around 72,000 years ago.

Seven disciplines examine the human past: paleoanthropology, archaeology, population genetics, historical linguistics, primatology, social anthropology, and evolutionary psychology. Evolutionary biology also makes a contribution, as the human genome continues to adapt. Characteristics of adaptive genes allow their emergence to be broadly dated. Some genetic materials are passed unchanged, except by random mutation, from one generation to the next. These DNA bits permit genealogies to be constructed.

Wade states some conclusions that the scientific community has proposed. 1) The human world is contiguous with the chimpanzee world of five million years ago. Our territorial, violent, sexual hierarchy, breeding, and other patterns adapt the chimp norm. 2) Human society drives human evolution. It is the primary environmental factor to which the genome is responsive. The human brain evolved to deal with the complexities of human social interactions. 3) Human physical form became common first (around 100,000 years ago), then the behavioral components (first in evidence around 50,000 years ago). 4) The last ice age (Pleistocene) affected human development, since most of human evolution occurred during it. 5) War, religion, and trade evolved by 50,000 years ago. 6) The initial human population was too violent to live in settled villages. They survived nomadically, plagued by constant intertribal warfare. Humans evolved into a less aggressive, more delicate creature (a gracile form), and settled around 15,000 years ago. 7) Human evolution has continued to the present, and its major changes have affected all human populations as they adapted to similar problems. 8) The small African pre-diaspora population probably spoke one language from which all others derive. Language genealogies reflect human movements and settlements. Some linguists work to reconstruct language trees back to the original tongue. 9) The genome provides another source of information independent from the historical or archeological record, and supplementary to them.

2. **Metamorphosis.** 50,000 years ago, the Ice Age had desertified Africa, which was greatly depopulated. The human population had dwindled to 5,000, all hunkering in the northeast portion of the continent. A group of modern humans, possibly as small as 150 individuals, left Africa across the diminished Red Sea. Human predecessors (*Homo neanderthalensis* and *Homo erectus*) occupied the lands into which the modern humans migrated. These humans succeeded in their migration, when other modern humans had likely failed, because, in the interim, language evolved.

The human genetic line departed from the chimpanzees some five million years ago, during a period of intense glaciation. The cold dried Africa, causing its forests to thin or disappear. Bipedalism adapted the human line to savannah survival, first in the australopithecines about 4.4 million years ago. At 2.5 million years ago, australopithecines branched into leaf-eaters and carnivores. This latter species is known as *Homo habilis*, its brain larger and tool-making capacity (Olduwan) increasing. Wade speculates that the cause of increasing brain size was the need to cope with increasing social complexity. Around 1.7 million years ago, *Homo ergaster*, probably descended from *Homo habilis*, improved tools (Acheulean). Its chest and arms had modern human form. Its diet consisted in meat and possibly tubers. Males and females came closer in size, which may indicate a change in their social relations. The female pelvis was

smaller, indicating that infant brains developed after birth. This made mothers vulnerable, and may have necessitated paternal interest in the mother and infant. Probably, in *Homo ergaster* the human line first lost most of its body hair, due to the need to sweat (to cool the big brain in hot climates), and due to sexual selection (mates preferring less hairy partners). The skin darkened under the intense African sun, from its original light color (like that of chimpanzees). The skin darkening gene spread through the African human population around 1.2 million years ago. The remaining human hair also underwent change. It grows without limit, necessitating cutting, which fact has spawned a wealth of social communication manipulations. This change occurred around 200,000 years ago.

*Homo ergaster's* descendant, *Homo erectus*, departed Africa, perhaps as long ago as 1.7 million years ago. A second diaspora took *Homo heidelbergensis* from Africa, which primate evolved into *Homo neanderthalensis* in European colds. Each *homo* gene pool, now separated, evolved independently. In the African *homo* population, brain size reached the human norm 200,000 years ago. Despite the change in brain size, the tool kit of these peoples did not change. Anatomically modern humans were hemmed into northeast Africa by *Homo erectus* and *neanderthalensis*. Their tools remained the same until around 100,000 years ago. Modern humans left Africa around 125,000 years ago, migrating into Palestine, but Neanderthals drove them back onto the African continent. Though modern in appearance, these anatomically modern humans did not behave like modern humans and had no competitive advantage with respect to Neanderthals and *Homo erectus*.

Behaviorally modern humans emerged around 50,000 years ago. The genetic change accounting for the behavioral change is language. These views, proposed by Klein, are challenged by some experts.

3. **First Words.** Evolution has no goal. It works by selecting among available mutations for their survival benefit. How has the massively complex organization we call language arisen? Other primates have communicational gestures and calls, but all lack syntax. Thought is not language. Language creates spoken or written words from thoughts, using a system styled a “combinatorial syntax.” A genetic program underlies language acquisition in children. Noam Chomsky exercised a large influence over linguistics of the last century, and he avoided evolutionary analysis. Pidgins (small vocabulary languages bridging to others whose speakers have no translator) evolve into creoles (pidgins with grammar). Pidgins and creoles may be half-way steps between language and non-language. Gestures were certainly part of primordial language, and may have, at its inception, been the only component. Speech may have waited evolutionary changes to the larynx and brain.

What evolutionary pressure made language advantageous? Robin Dunbar theorizes that language was an efficient social grooming alternative, allowing proto-humans to bond into groups three times the size of monkey troops. Geoffrey Miller argues that sexual selection created language; one wants to know one’s sexual partner(s), and language facilitates that learning like no other trait. Stephen Pinker argues that language evolved because humans’ moved into a survival niche that put a premium on knowledge: social relations, types of food and its harvest, and tools. The date for fully articulate human language is hotly debated.

The FOXP2 gene bears on human language, though the gene itself is ancient and highly conserved (70 million years with only one change). FOXP2’s language affect was discovered by researching a London family with significant language deficiencies. FOXP2 evolved rapidly in humans, due to the utility of language for survival, sometime in the last 200,000 years.

4. **Eden.** All humans derive from an ancestral population of modern humans around 5,000 in number living in east Africa. The Y chromosome and mitochondrial DNA do not shuffle genes in reproductive recombination. [Note the nice summary of human sexual genetics on page 53.] For this reason, all men have the same Y chromosome and all people have the same mitochondrial DNA. Mutations on the Y chromosome cumulate at a fairly regular interval. Because humans tend to stay and breed where they were born, one can follow the mutations in local populations. Mitochondrial DNA can be typed similarly. The mitochondrial DNA indicates an effective population (inferred from DNA variation) of around 2,000 breeding members and an overall population of around 5,000.

Khoisan click languages may echo the language of the ancestral population, which could be useful in locating the original human population. The !Kung and Hadzabe speak click languages, and genetic data show them to be two of the earliest separated populations of humans. Clicks may be a remnant from the ancestral tongue. The original range of the San people (of whom the !Kung are part, was east Africa. Based on genetic analysis, Ethiopia is the most likely location for the human population that dispersed from Africa, which event occurred around 50,000 years ago.

What were the ancestral people like? Heavier skeletons indicated more aggression. Donald Brown cumulates trans-cultural behaviors into a picture of the Universal People: families, marriage (recognized sexual access), territory, men in politics, submissive women, kinship organization, reciprocity and trade, sanctions for errant conduct, supernatural beliefs, divination, fashion, dance, song, shelter, and tools. Wade speculates that the !Kung San's way of life may resemble the ancestral population's approach to survival. They forage widely, two-thirds of their food is plant matter, and one-third meat from hunting. They are impressive trackers and use poison arrows to increase kill rates. !Kung women carry their young until they reach weaning at age four. All food and land are owned collectively. Groups aggregate in winter, but have difficulty growing because strict egalitarianism prevents hierarchy. !Kung resolve most conflicts by leaving the tribe. They have a high violence rate.

It is unlikely that the ancestral humans were exactly like the !Kung. The brain has continued to evolve, and some of the !Kung tools were unknown to the first humans. But the ancestral population would have had dark skin, spoken a language (possibly with clicks), lived in small egalitarian groups, divided when groups quarreled, practiced religion, had a sense of justice, and engaged constant warfare.

5. **Exodus.** A single small group (around 150) from among the ancestral humans crossed the Gate of Grief (south end of the Red Sea) about 50,000 years ago, a time when sea levels were 230 feet below their current levels, and the bottleneck was dotted with stepping-stone islands. Not all experts concur in this picture. The globe-spanning migrations of humans were not one long journey, but rather a series of small steps, generation by generation. Wade speculates that Neanderthals and *Homo erectus* populations prevented pre-linguistic humans from exiting Africa.

Humans, because they are territorial, stay where they land. Only those who are deemed too-numerous move to new sites. The mitochondrial DNA and Y chromosome studies support this hypothesis. The small size of the population departing Africa made its limited genetic diversity more subject to genetic drift. Mutation creates genetic diversity; drift ejects novelty from the genome.

The first splitting occurred in India; some continued toward Australia, others spread north through the Middle East into Europe. Humans reached Australia around 46,000 years ago; large fauna were decimated. The spread of humans to its Tasmanian terminus, then, lasted around 4,000 years. Wade considers the extreme warfare of the New Guinean Dani people. Relict populations dot the path from East Africa.

Adaman Islanders' (120 miles off Myanmar in the Bay of Bengal) DNA reflects their part early in the outward migration of humans. Their physical isolation and extreme violence deterred intruders. They speak an isolate language. A linguist said languages can be divided into two groups: Adamanese and everything else.

From Indonesia, humans spread north into China, following coastlines, rivers, and game. This brought modern humans into direct contact with *Homo erectus* and Neanderthals. Only the moderns survived these encounters. Body louse DNA proves the connection between the archaics and moderns. Wade recounts the *Homo erectus* of Flores Island, downsized *Homo erectus* with surprisingly advanced tool skills. The Neanderthals of Europe were stocky, sported brow ridges, had many broken bones, tended their ill, and practiced at least occasional cannibalism. Their brains in some cases exceed modern capacity. Behaviorally, Neanderthals remained archaic, clinging to their ancient Mousterian tool kit. They may have lacked language altogether. The human genome shows no trace of Neanderthal contribution, and Neanderthal mitochondrial DNA differs substantially from human sources. The territorial conflict between Neanderthal and modern humans lasted 15,000 years, with the last of the Neanderthals disappearing some 30,000 years ago in Spain.

The archaic-free world left modern humans without competitors. Isolated populations began to diverge in skin coloration and art. The Australian exodus settled into innovation stagnation; the European groups consistently innovated. Why is there a difference? In addition to cultural oddities, genetic drift and adaptation must also have played a role. The human diaspora created a genetic laboratory for fashioning diverse forms of human adaptation.

6. **Stasis.** To abandon hunting and gathering, tribes needed to learn to tolerate strangers, give up flight as a way to deal with objectionable neighbors, and accept hierarchical social relations. Learning these skills took not less than 25,000 years. Climate warming, with a warming period in the Pleistocene ice age from 10,000 years ago to the present, assisted agriculture.

The *Aurignacian* culture of Europe (45,000 to 28,000 years ago) is defined for us by its tool set and cave painting. The Aurignacians were replaced by the *Gravettian* culture (28,000 to 21,000 years ago), employing different stone tools and shaping Venus figurines. Near the end of this culture, the peoples invented the bow and arrow. The successor culture was the *Solutrean* (21,000 to 16,500 years ago), which hunted different animals, and lived more closely with other groups. The *Magdalenian* culture (18,000 to 11,000 years ago) spread through France and Germany.

Genetic analysis has been adding information to the picture of this period of a sort unavailable to archeologists. Most European are descended from Aurignacian people, who arrived at the inception of European occupation. The Neolithic middle easterners who brought agriculture presented a life change that the existing population adopted. Those who study ancient cultures hope for a grand synthesis in which archeological, genetic, and linguistic studies link together to form a consistent picture of the course of occupation of Europe by *Homo sapiens*.

In Siberia, humans domesticated dogs and discovered the Americas. Dogs may have been used in hunting and as an early warning of imminent attack. Dogs' need for one master may have become a first example of individual ownership, a departure from egalitarian communism. Archeological evidence of domesticated dogs is 14,000 years old. Dogs were selected for tolerance for human presence and ability to read human body language. Dogs may have domesticated themselves. Dogs scavenge; human sites were good food sources. American dogs all descend from Old World wolves, not American wolves.

The course of occupation of North and South America is hotly disputed. Greenberg hypothesized three separate waves of immigration beginning around 12,000 years ago. Mitochondrial genetic samples support a considerably earlier date, around 30,000 years ago. Y chromosome studies support a date of 15,000 to 18,000 years ago. Amerind mitochondrial DNA may have offered special cold-adaptation to humans bearing those lines. They may have been, therefore, better able to tolerate cold climate near the glacial edges, and to endure crossing Beringia into the New World. The mongoloid skull type first emerged around 10,000 years ago, as did all of the racial differentiations among humans.

7. **Settlement.** As the glaciers retreated, mankind experimented in settling. Several changes were needed to facilitate this adjustment to a different way of life: abandoning egalitarianism, creating villages large enough to fend off raiders, agriculture so a group does not strip its locale of foodstuffs, and new social orders. Settled peoples domesticated plants several thousand years after adopting sedentism. The Natufians (15,000 to 11,500 years ago) created settled villages in the Near East, harvesting (but not domesticating) grains. The dead were buried near familial houses. Settling emphasized skills of little use to hunter-gatherers. Wade notes the puzzling issue: why did it take 45,000 years for the first great civilizations to emerge after behaviorally-modern humans evolved? Renfrew calls this the "sapient paradox." Wade argues that evolutionary changes were required, pointing to reductions in aggressiveness and the gracilization of the human skull planetwide. Settlement permitted increases in productivity by specialization, which then undergirded trade. Einkorn wheat was first domesticated 10,500 years ago, though cultivated earlier. Sheep and goats and cattle were domesticated around 10,000 years ago, and horses around 6,000 years ago.

Human genes responded to the new agrarian sedentism. Wade speculates that the breeding advantage of hunters would have diminished in favor of those adept at settlement skills. Cattle breeding elicited lactose tolerance in humans. Lactose tolerance proves three propositions:

1) human evolution is ongoing, 2) separated populations develop similar genetic adaptations (convergent evolution), and 3) genes respond to cultural changes as they do to changes in the physical environment. Human genes have changed substantially, though not fundamentally, in the last 50,000 years.

8. **Sociality.** In the primitive Yanomamo tribe of Brazil, thirty percent of adult male deaths are caused by homicide and violence. The Yanomamo culture shares all the features of other human cultures. There is also cohesion and cooperation in the midst of violence. Is there a genetic template for human social relations? Is the human experience rooted in a chimp template modified for heightened violence and cooperation? Males dominate chimp society by their aggression. Females dominate bonobo society by their social smoothing. Human society is dominated by family units, with males and females cooperating, rather than the independent sexual hierarchies of chimp societies. Human and chimp societies are patrilocal, with young women leaving the troop to find mates. Both human and chimp societies war. Studies show that expanding territory causes female chimpanzees to bear more frequently. Further, high status males sire more young. Low ranking females' infants suffer higher mortality. Chimp societies create reproductive advantage for high ranking males and females. All chimp societies use tools, but tool use differs among societies. No bonobo societies employ tools.

Bonobo females dominate by female alliances. No infanticide troubles bonobos, and sex is used for social smoothing as well as reproduction. Bonobo ovulation is unannounced, making paternity muddled. Bonobo groups intermingle without violence. Females feed together, and their diet is broader. Wade concludes that humans developed heightened versions of both bonobo and chimpanzee society: aggressive territoriality and cooperative conciliation.

A benefit of human warfare is that, like chimps, killing one's own kind removes them as a threat permanently. Humans and chimps prefer the raid, which includes a ratio of three to one, raider to victim. From among ten million terrestrial species, only humans and chimps employ territorial aggression with raiding into enemy territory to kill vulnerable individuals. Prestige associated with killing enemies raises one's breeding opportunities. Due to this violent penchant in humans and chimps, for males, the individual likelihood of dying violently is thirty percent. Warfare among primitive societies was incessant and merciless. The usual goal was extermination of the opponent population. Sixty-five percent were at war continually, and eighty-seven percent suffered war more than once yearly. One-half of one percent of tribal members died annually due to violence. If that rate pertained in the twentieth century, two billion people would have died in the wars. War was a constant in pre-state societies, and its impact devastating. Historians have under-reported the carnage. War is one of the most typical of human behaviors, extending into its pre-human past.

It is highly possible that proto-humans were more violent than behaviorally-modern humans. Cannibalism was broadly practiced. Human prion disease resistance in the Fore population derives from the death due to prion disease of most of their women, who consumed opponent brains. The genetic signature of the Fore is present globally, and existed before the human diaspora from Africa. This signature is a remnant of a global cannibal past. Warfare is not criminal violence; individual assaulters are usually punished or killed. War spans a society, and was a universal feature of primitive societies. Modern states have remarkably stunted war behaviors.

Over against human war-making propensity, humans cooperate with strangers. Shifts in human culture and genetics have tipped the balance toward cooperation. Nuclear families give all a chance to reproduce, and hence to participate in societal nurture and defense. Fairness waxed, though a primitive impulse. Language linked people. Religion bound them. In the end, it appears that, despite being violent, humans find cooperation advantageous as compared with war.

*Inclusive fitness*, the theory that helping others promotes one's genes as represented in kin rather than in one's own genetic complement, explains how some social behavior could evolve. *Reciprocal altruism*, the theory that some helping anticipates being helped in the future by the one now helped, may explain other instances of altruism. We have developed strong detection ability for persons who free ride, and distrust them when identified. Social reciprocity undergirds *trade*, in which persons rely on non-family members to create goods essential to well-being. Humans exhibit an innate trust of strangers. Neurologically, oxytocin increases trust among

individuals. Freeloaders take advantage, but are ferreted out by religion. Religious practices and sentiment are difficult to feign. The human predilection to religion is emotive and innate. Pair bonding also promotes sociality. With sexual opportunity for all males, inter-male rivalry is reduced as sex is privatized. This arrangement has significant risks for males, who may be cuckolded into raising other men's children. Women prefer tall wealthy older men. Men prefer younger, fecund women. Sexual selection tends to proliferate the traits that the other sex prefers. Physical beauty meshes together various aspects of breeding fitness.

Growing human departure from violence shows up in the gracilization, which is thinning, of the human skull in the upper Paleolithic period. Gracilization may be a domestication artifact. Human random and sexual selection pressures may be favoring a less-violent human, and so we are becoming more peaceful. Though evolution as a process has no goal, when human choices enter the picture, the evolution of humans and their companion species may well develop a direction. Humans have been becoming more peaceful and cooperative since the first settlements. Two basic human features, aggression and reciprocity, drove the creation of larger and more cohesive social organizations. Human communities needed to protect themselves (defense) and supply themselves (trade).

9. **Race.** The African diaspora created several human populations from the one ancestral population. The independent evolutionary development of each resulted in human races. Despite the ugly history of race theory in human life, human race should be studied for its historical value, and for the medical implications of race. Some diseases are race-specific. Some drugs are race-effective. Some physicians argue that race should not be considered. Risch has taken them to task, arguing that race is continental: African, Caucasian, Asian, Pacific Islanders, and native Americans. Skin color differs among these groups, and so is unhelpful for purposes of categorization. There remain social barriers to interracial marriage, and so the gene pool mixing is surprisingly slow. Evolutionary change can be identified in Icelandic populations, though the island has been occupied for only 1,000 years. Three evolutionary forces drive racial differentiation: genetic drift, natural selection, and sexual selection. The commonplace notion of race has been genetically confirmed; race is continental. Computer programs that correlate genetic results can identify the race(s) of an individual based on 30-377 markers.

Some social scientists, based on work by Lewontin, believe that race is a social category, not a meaningful differentiation among humans. Wade disagrees, arguing that the dismissal of race as a meaningful subject of genetic study is a political, not scientific, opinion. The degree of differentiation between human races would, in other animals, identify subspecies. The underlying unity of humanity remains, with all humans able to interbreed and function within one another's cultures. The phenotypes of races differ in physical appearance, disease vulnerability, drug efficacy, intelligence scores, and physical acumen and ability. Jared Diamond argues that geography, resistance to domesticated animal diseases, and natural resources, but not race, explain why the Eurasian cultures dominated technology. Yet Diamond relies on genetic change to explain New Guinean intelligence. His account is conflicted. Race emerged because of genetic influences as the human population was divided into separated continental groups. So, too language.

10. **Language.** All extant languages derive from a single ancestral language. A genealogical tree of language is theoretically possible. If linked to genetic discoveries and archeological records, our picture of human history might grow considerably more reliable than at present. Distribution of earth's 6,000 languages is odd. Wade relates the multiplicity of languages to the human need for communal defense. Dialects befuddle strangers, and serve as a reliable badge of belonging. Where politics are stable, great linguistic balkanization arises (mosaic zones), as in New Guinea. Where there are large scale dislocations or conquests or climate disasters or the adoption of agriculture, spread zones emerge in which a single language predominates. Experts dispute the relative importance of these factors, and the genetic evidence is equivocal in this regard. Dating languages might help settle the issue, but its techniques remain exploratory. Glottochronology compares cognates deemed stable over time. Linguistic paleontology matches word sets to archeological objects. Both approaches have possibly fatal flaws. A phylogenetic tree method, called maximum likelihood analysis, calculates what shape a language tree must have to conform

to the evidence that exists. Gray-Atkinson analysis uses maximum likelihood trees anchored in time to known dates to create a statistically likely language tree. Greenberg created a typology of all human language, arguing that all fit into fourteen superfamilies. There was strong resistance to Greenberg's conclusions, and deep criticism of his errors and methods. Wade recounts Greenberg's classifications of African, Amerind, and European/Asian languages. Many linguists despair of tracing human language back to its ancestral African unity.

11. **History.** Wade explores genetic insights into historical times. *Khans.* The large prevalence of a single set of Y chromosomes in the peoples of the one-time Mongol Empire is attributed to the sexual appetite of Genghis Khan and his line (Khan had forty sons). Wade also considers Giocangga of the Manchu royal house and Niall of the Nine Hostages, an Irish ruler, for similar Y chromosome effects of fecund sexual activity. *Sykeses.* Wade tells the story of scientist Brian Sykes, who sought out other Sykeses and genetically tested them. All come, except those who are of other fathers, from a single Sikes in West Yorkshire. *Icelanders.* Celts, defeated politically, nevertheless continued their genetic line throughout England and Ireland. Iceland's careful medical records and good ancient records make investigation of its genetic heritage especially fruitful. Iceland also suffered population decimations in plague (1402), smallpox (1708), and famine due to volcanic eruption (1784), stressing the population and sending it down its own genetic path. The resulting patterns show that most family lines go extinct over time, leaving most Icelanders derived from a small percentage of ancestors. *Ashkenazim.* Wade speculates that employment discrimination against Ashkenazi Jews winnowed their numbers for high intelligence. Genetic evidence points toward the idea that Jewish diaspora males took wives in their host communities at the commencement of the ex-patriot communities. Y chromosome studies support the historical myth that all cohanic priests descend from one man. The genetic studies of levitical priests show much less uniformity. Survivors of population disasters spread their genes widely in a population; this is the founder effect. Ashkenazi genetic diseases may derive from founder effects in sphingolipid diseases. Some researchers relate these diseases to heightened Ashkenazi intelligence. *Jefferson.* Genetic studies show that Jefferson fathered a family with his slave, Sally Hemings. Jefferson scholars denied this story, but some changed their minds when historical evidence was re-evaluated and bolstered by (admittedly fragmented) evidence from genetic testing.

12. **Evolution.** Humans evolved from other species. Accounts that differ are insupportable. Humans evolved from proto-apes. At 1.7 million years ago, permanent bonds between males and females evolved. 50,000 years ago, language evolved. That event enabled new types of social bonds, including war, trade, religion, and conscientious altruism. This view disquiets many. E. O. Wilson said that the human brain is evolved to believe in religion, not biology. The appearance that mankind is evolved for special purpose derives from our extermination of our hominin cousins: *Homo erectus*, *Homo neanderthalensis*, and *Homo floresiensis*. In social creatures, a significant part of their environment is the socially created ethos. So, social creatures influence their own evolution. The following are evidence of recent human evolution: a) disease defenses, such as sickle cell adaptations responding to malaria, and b) genetic changes responding to cultural changes, such as loss of olfactory adroitness, genes that detoxify plant poisons, lactose tolerance, and heightened intelligence.

These examples indicate that evolution continues to affect the human population. History overlays evolution, a second layer of story about mankind. Historians neglect the unspoken force of sexual selection in their accounts. Yet there are the wide-ranging appetites of Genghis Khan, Mao, and Clinton. The genome can change rapidly. And it responds to cultural changes. Future people will differ from today's. Wade notes Fisher's work that argued since intelligent people have fewer children, selection weighs against increasing intelligence. Yet, just such increase in intelligence is occurring. Genetic drift weakens in large populations, and so the pruning of drift culls fewer mutations. Human speciation may result, making some populations infertile with respect to others. We can direct human genome developments, or leave them to the natural forces. Wade leans in the direction of eugenic interventions.