At first glance, these two statements appear to correspond perfectly:

a) A person (or animal, or plant) uses genes to create another person (or animal, or plant).
b) Genes use a person (or animal, or plant) to create more genes.

But although the statements are similar in form, there is an important substantive difference between them. When genes replicate, their "children" are identical to the original genes. But although human beings *reproduce*, they never *replicate*: human children are *not* copies of their parents. Genes make copies of themselves; human beings do not, nor do members of any other sexually reproducing species.

The biologist Richard Dawkins wrote a celebrated book, *The Selfish Gene*, in which he emphasized the "gene's-eye view" of reproduction. Of course, a gene is just a molecule, with no consciousness or purpose at all, selfish or otherwise. However, the result of natural selection is much the same as if the genes actually were selfish, and you will rarely reach a wrong conclusion by viewing them as such. (Of course, a conclusion reached in this fashion should be checked against the true test: differential replication rates.)

It is interesting to consider what the function of a human being is from the standpoint of his genes. Genes are just molecules, and they can easily be destroyed by heat, by radiation, or by dangerous chemicals in the outside world. To protect themselves, the genes construct a container around themselves to keep out harmful chemicals and radiation, a "house" with a thermostat that keeps the temperature nearly constant. If the "house" (i.e., the human being or animal produced by the genes) is well designed, then the genes can survive and replicate; if the house has serious defects, the genes inside it will die.[6] (Note the contrast: for a human being, the genes inside its sperm or egg cells are merely a means of reproduction; they do nothing to help the individual survive.)

Section 5 – Present status of the theory of evolution

The theory of evolution was introduced by Charles Darwin in 1859 in his great work, *The Origin of Species*. In the century and a half since then, there have been several important modifications of his original theory. For example, Darwin did not discuss genetic drift, rarely mentioned mutations, and knew nothing about genes. Furthermore, it seems likely that there will be additional refinements to Darwin's theory in the future. Still, virtually all modern scientists agree that Darwin's central insight — evolution by means of natural selection — was correct.

Nevertheless, lots of people have never really accepted the theory of evolution. The most obvious of these are religious fundamentalists, many of whom openly dispute the theory. A more important group, however, consists of the numerous persons who say (and think) that they accept the theory of evolution, but who in fact shrink from accepting the implications of that theory. Among those unwelcome implications are:

1) Human beings are animals: very unusual animals, to be sure, but nevertheless animals. In origin, we are not fallen angels, but apes arisen.

CHAPTER 3

INTELLIGENCE

Section 1 – What is intelligence?

We all recognize that some persons are "smarter" than others. They reason more quickly and accurately (particularly about abstract questions), and usually learn more readily and retain information longer than other persons do. We say that such persons possess the attribute of "intelligence." Unfortunately, like many commonly used words, the word *intelligence* is hard to define precisely. In this book, I shall use as a working definition of intelligence: "general reasoning ability, and in particular the ability to carry out and understand abstract reasoning."

Not everyone, however, uses the word in that fashion. Howard Gardner, for example, in his theory of multiple intelligences, lists at least seven different types of intelligence,[1] including *musical intelligence* (as exemplified by the composer Igor Stravinsky) and *bodily-kinesthetic intelligence* (as exemplified by the dancer Martha Graham). While it is clear that Stravinsky and Graham possessed exceptional talents, referring to those talents as "intelligences" merely serves to obfuscate discussions of *intellectual* ability.[2]

The reader, of course, is free to use whatever terminology he or she prefers. In this book, however, the term "intelligence" will be used only in the sense of the word stated in the first paragraph. The advantages of this definition are:

- It accords fairly well with common usage.
- It is very close to such common dictionary definitions as "the ability to acquire and retain knowledge" and "use of the faculty of reason in solving problems." (It also resembles the dictionary definition of intellect as "the ability to think abstractly or profoundly.")
- It seems to describe the faculty that is actually measured in standard intelligence tests.

In any event, intelligence is not the same thing as *knowledge*. Memorizing a page from a telephone book increases your store of knowledge, but it does not make you any smarter. (Since a more intelligent person has a greater ability to acquire and retain

"mean kinetic energy per molecule" — or sometimes, even more abstractly, as "the partial derivative of internal energy with respect to entropy." Should we dismiss the concept of temperature as "just a mathematical construct?" In some sense, it is; nevertheless, if you touch a hot stove, you will burn your finger!

The point is that although, in order to render the notion precise, we have defined temperature in abstract mathematical terminology, the term describes a phenomenon that exists in the real world. In like fashion, the "*g* factor" describes a phenomenon — an individual's general intelligence — that we had already noticed, and which has real, observable consequences.

We might still ask, of course, whether the *g* factor is a unitary talent or is instead a composite of several more basic abilities. At present, we are not sure; however, since the answer would not affect any of the other conclusions in this book, I will not dwell on that question.

One more point of terminology: Some intelligence tests correlate more strongly with an individual's *g* factor than others do. We say that such tests are "strongly *g*-loaded."

Section 3 – Variation of intelligence with age

A newborn child has very little reasoning ability, and his intelligence is therefore very low. However, a child's reasoning ability gradually increases as he matures. A rough approximation is that intelligence increases linearly with age, typically reaching a maximum at about age fourteen or fifteen. (Of course, at that age a person has much less knowledge and experience than he will have when he is older.)

The intelligence of an adult typically remains nearly constant for many years, and then gradually diminishes with age. None of us is as smart at age seventy as we were at twenty; however, in the absence of serious disease or injury, we are a lot smarter than we were at age seven.

Section 4 – IQ

As the average person's intelligence varies so little between ages twenty and fifty-five, we can almost regard his adult intelligence as a constant. However, we cannot do this for children, since a child's intelligence increases markedly as he matures. The notion of IQ — an abbreviation for "intelligence quotient" — was designed to estimate the (nearly constant) intelligence that a child is likely to have when he becomes an adult.

This is done by first determining a child's "mental age" (defined as the age of typical children who do as well as he does on a standard intelligence test) and then comparing it with his chronological age. His IQ is then defined as: IQ = (mental age/chronological age) × 100. A child of average intelligence for his age will therefore have an IQ of 100.

Empirically, we find that a child's IQ (as defined above) varies far less with age than do his raw scores on intelligence tests. IQ tests given after a child reaches the age of seven usually provide fairly good estimates of his adult intelligence.

heritability of IQ is about 60% or higher, rising to 70% or more in some age groups.[22]

I have spent so much time on this topic because in the past many persons have supported hypotheses (a) or (b) — which we can now see are plainly refuted by the scientific data — or have taken the position that we have no idea what the answer to question (2) is. The empirical data, however, makes it very clear that we do know the answer. *Both genetic and environmental factors affect a person's intelligence, with the influence of heredity being somewhat larger than that of his upbringing and environment, perhaps considerably larger.*

Section 9 – Summary

The essential points of this chapter can be summarized rather easily. Basically, many of the old common-sense views about intelligence that used to be widely accepted (and would probably be readily accepted today if racial concerns did not make us self-conscious) are compatible with recent scientific studies. Among these common-sense views are:

1) Some people are smarter than others, and all gradations of intelligence exist.

2) There are different aspects of intelligence, and typically an individual is not equally gifted in all those aspects. A person's overall mental ability is a combination of his or her general intelligence (which is usually the dominant factor) and various special intellectual strengths and weaknesses.

3) Those persons who are considered to be "very smart" typically have a high general intelligence, and their general intelligence can be applied to a wide variety of practical tasks.

4) There are many other important talents and character traits besides intelligence; and high intelligence, by itself, rarely results in success.

5) However, there are tasks that do require high intelligence, and high intelligence tends to enhance a person's other capabilities, sometimes quite markedly. Therefore, other factors being equal, a person of high intelligence will be able to perform a great variety of tasks better than someone of lower intelligence.

6) Modern intelligence tests, although certainly not perfect, are reasonably accurate; and a person's IQ provides a fair approximation to his general intelligence.

7) Individual differences in intelligence are caused in part by genetic factors, and in part by differences in upbringing and environment. However, in adult life the genetic factors are typically more important.

8) Although brain size does not rigidly determine a person's intelligence, there is a marked positive correlation between brain size and IQ.

FOOTNOTES – CHAPTER 2

1) For example:
   (a) A statement drafted by several well-known scholars and issued by UNESCO in 1950 said: "For all practical social purposes 'race' is not so much a biological phenomenon as a social myth." See Montagu, Ashley (1972), p. 10.
   (b) According to James Schreeve, "Surveys of physical anthropologists have found that almost half no longer believe that biological races exist." (See the November, 1994 issue of *Discover*, p. 60.)
   (c) In the same issue of *Discover*, on p. 83, the well-known scholar Jared Diamond said, "The reality of human races is another commonsense 'truth' destined to follow the flat Earth into oblivion."
   (d) In Cavalli-Sforza, et al. (1994), the heading of section 1.6 (on p. 19) is "Scientific Failure of the Concept of Human Races."

2) (a) As a famous geneticist put it: "… members of the same species who inhabit different parts of the world are often visibly and genetically different. This, in the simplest terms possible, is what race is as a biological phenomenon." (Dobzhansky, T. [1970], p. 269.)
   (b) See also Whitney, Glayde (1999), and Wilson, Edward O. (2000), pp. 9-10.

3) (a) "A breed of dog is a construct zoologically and genetically equivalent to a race of man." (Freedman, Daniel G. [1979], p. 144.)
   (b) See also chapter 7 of *The Descent of Man* (1871), where Darwin discusses at length the question of whether the various races should be considered different species. He concludes that, although the human races are not separate species, "… it seems that the term 'sub-species' might here be used with propriety. But from long habit the term 'race' will perhaps always be employed."

4) (a) *Encyclopaedia Britannica*, 15th edition (1986). See article on "Heterosis" on p. 903 of volume 5.
   (b) Villee, Claude A. (1972), pp. 658-659.
   (c) Cavalli-Sforza, L.L. (2000), p. 47.

5) Here are two other counterexamples:
   (a) As there are at least 3 billion human beings with heights between 4'6" and 6'6", if one lined up everyone alive today in size place, the typical person would differ in height from the one adjacent to him by less than a hundred-millionth of an inch. Nevertheless, we have no trouble saying that those persons with heights greater than six feet are *tall* and that those with heights of less than five feet are *short*.
   (b) If you held hands with your mother, and she with her mother, and so on until the chain included 250,000 generations, those at the modern end of the chain would be obviously and indisputably human, while those at the early end of the chain (about five million years ago) would look like and be categorized as apes. Yet each individual on the chain would appear to be of the same species as her neighbor.

6) As Andrew Hacker put it: "In the United States, what people mean by 'race' is usually straightforward and clear, given the principal division into black and white." (Hacker, 1992, p. 5.) Indeed, the entire set of regulations involving racial preferences and/or "affirmative action" would be impossible to apply if the word "race" was meaningless.

7) Dawkins, Richard (2004), p. 399.

8) Descriptions of the physical appearance of Australian aborigines can be found in:
   (a) *Colliers Encyclopedia* (1963 edition). See article on "Australia, Primitive Tribes of" on page 275 of volume 3.

FOOTNOTES – CHAPTER 1

1) These ideas were first presented by Charles Darwin in *The Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (1859). Other restatements of his ideas can be found in most modern college textbooks on biology, for example: Wallace, R.A. (1992), chapters 1 and 10.

2) Sexual selection was discussed at length by Darwin in his second major book, *The Descent of Man, and Selection in Relation to Sex* (1871).

3) Most of the material in this section can be found in many introductory college textbooks, for example: Wallace, R.A. (1992), chapter 7.

4) Except in very technical writing, it is common to refer to alleles as "genes" when no confusion will result, and I shall often do so in this book.

5) Genetic drift is mentioned in standard college texts such as Wallace, R.A. (1992), chapter 10. More detailed discussions can be found in many places, including:

   (a) Kimura, M. (1983);
   (b) Cavalli-Sforza, et al. (1994), especially section 1.4, pp. 13-15; and
   (c) Wilson, Edward O. (2000), pp. 64-66.

6) Dawkins, Richard (1989), especially chapters 2 and 3.

7) See Pinker, Steven (2002), *The Blank Slate*, pp. 45-50 and 373-377.

(b) *Encyclopaedia Brittanica* (15th edition, 1986). See article on "Human Evolution" (especially p. 975) in volume 18. Also see photograph on p. 971.
(c) Baker, John R. (1974), chapter 16, especially pp. 278-291. Also see photos on p. 274.

9) See Cavalli-Sforza, et al. (1994), Tables 2.3.1A and 2.3.1B on pp. 75-76.

10) The Bushmen and Hottentots refer to themselves as *San* and *Khoikhoi*, respectively.

11) See Cavalli-Sforza, et al. (1994), especially:
(a) Figure 2.3.2.B, on p. 78.
(b) Table 3.7.1, on p. 175, where he also says, "The San differ from other sub-Saharan Africans … more than any other sub-Saharan group differs from any other."

12) For estimates of the average amount of Caucasoid parentage in the gene pool of American blacks see Reed, T. (1969); or Levin, M. (1997), p. 20.

FOOTNOTES – CHAPTER 3

1) Gardner, H. (1983). *Frames of Mind: The Theory of Multiple Intelligences.* New York: Basic Books.

2) Gardner's theory has also been criticized on other grounds, for example that he does not supply any quantitative evidence to support it. See pp. 18-19 of *The Bell Curve* (Herrnstein & Murray, 1994), or pp. 128-130 of *The g Factor* (Jensen, 1998) for a fuller discussion.

3) This is well established. See, for example:

   (a) Detterman, D.K. & M.H. Daniel (1989) who state on p. 349: "Positive manifold among mental tests is one of the most reliable, replicable, and important empirical discoveries about human ability yet found."
   (b) Herrnstein & Murray (1994), p.3.
   (c) Jencks, C. (1998). See pp. 59-60 in chapter 2 of *The Black-White Test Score Gap.*

4) Spearman, Charles (1904).

5) For a full discussion see *Bias in Mental Testing* (Jensen, 1980). For a briefer discussion see pp. 280-282 of Herrnstein & Murray (1994).

6) For a more detailed description of the reaction time experiments discussed here see Jensen, Arthur (1998), pp. 210-216.

7) Morris, R.D. & W.D. Hopkins (1995).

8) Jensen, Arthur (1998), pp. 212-214.

9) Jensen, Arthur (1987). Also see Deary, I.J. (2003), pp. 55, 61, and 62.

10) (a) Frearson, W.M. & H.J. Eysenck (1986).
    (b) Jensen, Arthur (1992).
    (c) Jensen, Arthur (1993).
    (d) Jensen, Arthur & P.A. Whang (1993).

11) Jensen, Arthur (1998), p. 221; see also note 22 on p. 263.

12) For a fuller discussion of this point, and some examples, see chapter 3 of Herrnstein & Murray (1994), particularly pp. 70-80.

13) The heritability of a trait is defined as the proportion of the total variance of that trait that is genetically explained. (The variance of a trait within a population is defined as the square of the standard deviation of that trait in the population.) Note that the standard deviation, and therefore the variance, is not a property of any individual, but is inherently a group property. It follows that the heritability of a trait is also a property of the group, and is not defined for individuals.

14) (a) Willerman, et al. (1991).
    (b) Andreasen, et al. (1993).
    (c) Egan, et al. (1994).
    (d) Wickett, Vernon, & Lee (1994).
    (e) Anderson, Britt (2003), especially pp. 30-35.
    (f) McDaniel, Michael A. (2005).

In the second place, high intelligence enhances most other abilities. Even when a job or task can be performed adequately by someone of average intelligence, it can usually be performed better by a person of higher intelligence.[12] This holds for such varied tasks as planting crops, composing music, or waiting on tables. It is even true for many menial tasks.

Finally, high intelligence plays a crucial role in inventions. Every aspect of our modern world and its technology had to be invented, and virtually none of those innovations were obvious. It seems highly probable that throughout history (and prehistory) all the important inventions and innovations were made by persons who were far above average intelligence.

Section 8 – What causes differences in intelligence?

Since individuals differ greatly in intelligence, we may ask:

1) What are the direct biological factors responsible for those differences?
2) What are the underlying factors? In particular, are individual differences in intelligence caused primarily by genetic factors or by differences in upbringing and environment? (In technical language, what is the heritability[13] of intelligence?)

As for question (1), at least three biological factors affect the intelligence of a human being:

- The size of his brain.
- The microstructure of his brain. (For example, the surfaces of the cerebral cortex are extremely convoluted, and the extent of those convolutions — which is much greater in human beings than in any other animal — may be connected with intelligence.)
- The details of his brain chemistry, such as the abundance of various neurotransmitters.

It is plain that brain size is not the only factor. There are many persons whose high intelligence is undisputed but who have smaller than average brains, and vice versa. However, on average, persons with larger brains are more intelligent.

This is what we would intuitively expect. After all, larger hearts can pump more blood, and larger muscles can lift greater weights. We would therefore expect that larger brains can, on average, process more information. Furthermore, there is a high correlation between intelligence and brain size across animal species. Finally, since brains are very expensive organs metabolically, it seems unlikely that natural selection would have permitted the evolution of large brains unless they resulted in greater intelligence.

However, there is no need to rely upon intuition in this matter. There are several scientific studies that show a positive correlation between individual brain size and intelligence in human beings.[14] Estimates of the correlation vary, but cluster around $r = 0.35$.

CHAPTER 2

HUMAN RACES

Section 1 – Introduction

The entire topic of human races is a contentious issue, beset by ideological passions. Indeed, so intense are these passions that some people speak as if race is nothing but skin color, others assert that the notion of race is just a "social construct," and others claim that there is no such thing as race or races.[1]

Such a claim is ridiculous. Even a child can detect the obvious physical differences between members of different races. If the proverbial "man from Mars" were to visit Earth he would readily see that human beings come in different varieties. If he went to northern China, he would notice that most of the people living there have a yellowish tinge to their skins, straight black hair, very little body hair, and a configuration of their eyelids that give them a slightly "slant-eyed" appearance.

If he visited central or southern Africa, he would see that the great majority of the persons living there have very broad, flat noses (relative to Europeans and Chinese), with the nostrils flaring out. He would also see that most of them have brown skins, very curly hair, very little body hair, and thick, everted lips.

Finally, if he were to visit northwest Europe, he would notice that most people there have pale, "pinkish" skins, much more body hair than Chinese or black Africans, and relatively protruding noses. He would also notice that the number of people with blond or red hair is much greater than in China or Africa, as is the number with blue or green eyes.

In other words, he would readily detect the existence of the three large races (often called the Mongoloid, Negro, and Caucasoid races). Nor would he have any trouble in discovering that the above traits are inherited. Whenever two typical-looking north Chinese mate and produce a child, the child shares the attributes mentioned above, and the same is true for Europeans and Africans. Of course, he would also notice that there are many human beings who do not readily fit into any of the three categories just described.

The existence of races is not unique to the human species. Many animal species consist of more than one type, although in the case of animals these are usually called

to disease). This might be called "survival selection." However, in sexually reproducing species, an individual cannot pass on its genes unless it mates with a member of the opposite sex. Consequently, traits that make an individual a more attractive mate will also be selected for, whether or not they aid in survival. This is called "sexual selection," and is an important evolutionary mechanism.[2]

Section 2 – Genes

Heritable traits are transmitted from parent to child by microscopically small particles called genes. All cells contain genes, but it is only the genes contained in the sperm and egg cells that are responsible for heredity. Normally, an individual receives two copies of each gene, one from each parent. However, he will pass only one copy of each gene on to his offspring.[3]

It is common for there to be two or more slightly different forms of a given gene. These variants are called *alleles*. If, for some gene, an individual receives identical alleles from his two parents he is said to be *homozygous* at that gene site. If instead he receives different alleles from his two parents at that gene site he is *heterozygous* for that gene. In the latter case, the individual often exhibits the trait corresponding to just one of those alleles (the "dominant" one), and the other allele (the "recessive" one) will have no effect. However, the recessive allele is not destroyed, and is just as likely as the dominant one to be passed on to the person's offspring.

A gene is a fragment of a large molecule called DNA. However, for most purposes, one can consider an individual gene to be an independent molecule, a molecule which consists of a long string of simpler units called *nucleotides*. There are four types of nucleotide; and the various genes (and alleles of the same gene) can differ from each other by containing either:

1) Different numbers of nucleotides; or
2) The same total number of nucleotides, but not the same number of each type; or
3) The same number of each type of nucleotide, but arranged in a different order.

Mutations occur when a gene in a sperm or egg cell is altered, most commonly by some random natural occurrence such as:

- cosmic rays
- gamma rays emitted from radioactive materials in the Earth's crust
- solar radiation (particularly ultraviolet radiation)
- certain chemicals ("mutagenic" chemicals)
- ordinary thermal agitation.

(Human activities can also produce gamma rays, ultraviolet rays, X-rays, and mutagenic chemicals; but so far these have had almost no impact on our gene pool.)

Initially, genes were thought of as simply the physical particles responsible for our inherited characteristics. Today, we know that the genes do far more than code for our

If we use "commonly interbreed in the wild" as our criterion, then *HSS* should be considered a separate species. Human beings who possessed syntactic language would surely have considered hominids without speech to be "subhuman," which explains why they rarely interbred with them. With rare exceptions, human females adamantly refuse to copulate with anything subhuman; and although young males will sometimes *copulate* with anything vaguely female, they will *marry* a female only if they consider her fully human.

Definitions, of course, are arbitrary and adopted merely for convenience. How we choose to define a word will not change any physical or biological facts. Therefore, you need not consider *HSS* to be a separate species if you don't want to. However, in the rest of this book I will use the terms "human," "human race," "human species," "human beings," and "humanity" to refer to *Homo sapiens sapiens*, and to them alone. When I wish to include other hominids, I shall use the terms, "*Homo*," "*Homo sapiens*," or "hominid."

FOOTNOTES – CHAPTER 4

1) Sarich, Vincent & Allan C. Wilson, (1967).

2) Typically, the brain of an adult human accounts for only about 2 percent of his weight, but it uses about 20 percent of his resting energy.

3) Most of the data in this section comes from either Fagan, Brian M. (2001), chapters 2 and 3; or Cavalli-Sforza, et al. (1994), chapter 2.

4) This date is very uncertain:

   (a) Clark, J. Desmond (1989) suggests more than 400 kya. (See figure 29.2 on p. 567.)
   (b) Bräuer, Günter (1989), suggests 450 kya. (See his figure 8.1 on p. 124.)
   (c) Caralli-Sforza, et al. (1994) says "at least 300 kya." (See p. 61.)
   (d) Fagan, Brian M. (2001) says 200-400 kya. (See p. 107.)

5) Brooks, Alison & Bernard Wood (1990).

6) See Cavalli-Sforza, et al. (1994), figure 2.1.2; or Fagan, Brian M. (2001), figure 3.16.

7) Mellars, P.A. (1993), pp. 202-203.

8) (a) Stringer, C.B. (1989), p. 241.
   (b) Klein, Richard G. (1989), pp. 334-343.
   (c) Diamond, Jared (1992), p. 53.
   (d) Diamond, Jared (1999), pp. 40-41.
   (e) Zubrow, Ezra (1989), p. 212.

9) The date is uncertain. My figure is based on:
   (a) Rightmire, G.P. (1989), p. 120.
   (b) Deacon, H.J. (1989), p. 561.
   (c) Bräuer, Günter (1989), p. 123.
   (d) Clark, J. Desmond (1993), p. 148.

10) A sophisticated presentation of this view is given by Wolpoff, M.H. (1989).

The above definition of IQ applies only to children. It is usual to measure an adult's intelligence simply by his score on a normalized standard IQ test. ("Normalized" means that each person's raw score on the test is modified in a standard fashion so that the average score of the entire population is 100.)

Section 5 – Intelligence tests, and possible bias in testing

Throughout most of history, estimates of the intelligence of an individual were entirely subjective. The first attempts to construct objective tests of intelligence were made by Francis Galton in the last half of the 19th century. Although the tests he constructed did not turn out to be accurate measures of intelligence, Galton's writings stimulated work in the field. By 1905, Alfred Binet had developed a test that, although crude by modern standards, still did a fairly good job of measuring a person's intelligence.

Since Binets's day, intelligence tests have been steadily improved. Modern tests are statistically good predictors of both academic success and adult income. They correlate highly with each other, and with subjective assessments of an individual's intelligence. They also correlate with various physical attributes, such as brain size, and with the results of reaction time experiments (described in the next section).

It has often been asserted that intelligence tests are so culturally biased as to be worthless, or at least unreliable. As an example of such bias, proponents of this view often point to an analogy question that once appeared in an SAT (a test widely used in the United States for college admissions), to which the correct answer was:

RUNNER : MARATHON *as* OARSMAN : REGATTA.

Obviously this was a very poor question, heavily biased against persons whose upbringing and circumstances had not brought them into any contact with boating or regattas. However, it was only one question in an examination that consisted of more than one hundred, and therefore — while it may have detracted slightly from the accuracy of that test — it could not have drastically affected anyone's score.

Although this example is still widely quoted, it is taken from an examination given several decades ago, and such tests have been greatly improved in the intervening time. Test writers have become very sensitive to the question of test bias and now take great care to minimize it. Questions like the "regatta" item are unlikely to appear on an SAT test today.

It might seem that the extent of bias in an intelligence test is completely subjective. Actually, there are several established techniques for measuring it. For example, *internal* tests of bias begin by ranking the test's questions in order of difficulty (as measured by what fraction of all test takers answer them correctly), and then check whether the rank order of the questions varies greatly between different groups of test takers. If so, it implies that some questions are highly biased against a group. There are also *external* tests of test bias. Intelligence tests are often used for predictive purposes: for example, to predict the academic success of college students. If a particular test is

Section 2 – Archaic *Homo sapiens*

The prevailing view among anthropologists is that *Homo sapiens* originated in Africa about 350 kya.[4] (Note: "kya" is an abbreviation for "kiloyears ago," and since 1 kiloyear = 1000 years, 350 kya means 350,000 years ago.) The new species spread widely and eventually replaced *Homo erectus* everywhere. *Homo sapiens* reached China at least as early as 210 kya, and possibly as early as 300 kya.[5] They probably reached Europe and Central Asia earlier than China, and the Middle East earlier still.

From their fossil remains, we can tell that those early humans looked somewhat different from us, so — even though their brains were roughly as large as ours — we often refer to them as "archaic *Homo sapiens*" (or *AHS*). Their possession of human-sized brains does not prove they had the same mental skills as we do, and it is doubtful that they did. However, their displacement of *Homo erectus* is consistent with the view that the larger brains of *AHS* gave them a clear advantage over the earlier species.

Since *AHS* was widely scattered throughout Asia, Africa, and Europe, and since inhabitants of each region had very little opportunity to mate with inhabitants of other regions, we would expect regional variations of *AHS* to arise. This indeed occurred. The variant that evolved in Western Europe was particularly distinctive and is often called "Neanderthal Man" or *Homo sapiens neanderthalensis.*

The Neanderthals were a successful subspecies, and specimens have been found in Eastern Europe, Southwest Asia, and as far east as Uzbekistan, in Central Asia.[6] They were a bit shorter than modern human beings, and more heavily built, which was an advantage in the cold climate they originated in. In addition, they probably evolved various physiological adaptations to protect them from the cold. Unfortunately, such adaptations are hard to detect from skeletal remains, so their exact nature is unknown.

The most obvious behavioral difference between *AHS* and *Homo erectus* lies in the markedly superior tools produced by *AHS.* In particular, the Neanderthals developed a set of tools — often called the Mousterian toolkit, after the French cave where the first samples were found — which were plainly more sophisticated than Acheulian tools.

For tens of thousands of years, the Neanderthals were the only hominids living in Europe. However, anatomically modern humans entered Eastern Europe about 46 kya,[7] and by 30 kya, only a few pockets of Neanderthals survived. They appear to have contributed very little to the gene pool of modern human beings.[8]

Section 3 – The advent of *Homo sapiens sapiens*

Besides the Neanderthals, there were several other regional variants of *Homo sapiens*. About 100 kya a new variant — *Homo sapiens sapiens* (or "*HSS*") — arose in sub-Saharan Africa.[9] This new variant is important because it eventually spread throughout the entire world, displacing all other variants (apparently with rather little interbreeding), and as a result all humans living today are members of that subspecies.

Some scholars dispute the claim that *HSS* originated only in Africa, and instead espouse the "multiregional model," according to which *HSS* evolved more or less

original structure. A complete set of our genes is present in every one of our cells, and throughout our lives they direct the operation of those cells.

The genes in a person's body cells were produced by copying the genes present in the fertilized egg from which that individual started. Since an adult human being contains about a quadrillion (a thousand trillion, or 10^{15}) cells, each of the genes present in that egg must have been copied about a quadrillion times. To appreciate the magnitude of the task involved, we should take into account that the human genome — i.e., the complete set of genes present in a *single* cell — consists of tens of thousands of genes, totaling about one hundred million nucleotides!

The biological process by which genes are copied (or "replicated") is usually very accurate. However, it is not absolutely perfect, and many of our cells contain one or more incorrect nucleotides. Usually, the presence of a few incorrect nucleotides does not greatly affect the functioning of the cell, but sometimes it does. Indeed, there are instances in which a single incorrect nucleotide will cause a cell to malfunction and die. It is only because the copying process for genes is normally so marvelously precise that we are able to survive.

Section 3 – Genetic drift

Suppose that two alleles of a given gene are equally advantageous. Call the two alleles P and Q. One might think that the law of averages ensures that the percentage of the population holding allele P will not vary from generation to generation. However, chance variations from the law of averages occur quite frequently, and as a result the percentage of the population with allele P will vary. Indeed, such chance variations can even result in the complete elimination of an allele from the gene pool.

Changes in gene frequencies (strictly speaking, allele frequencies[4]) that result purely from chance are called "genetic drift," and are an additional cause of evolution.[5] If a species has a very large population, then genetic drift is usually a slow and relatively unimportant process. However, if the population size is small then genetic drift can be a significant factor. There are occasions when the population of a species is drastically reduced by a plague, famine, or other catastrophe, and genetic drift can be of great importance when such a "population bottleneck" occurs.

If different alleles of the same gene are not equally advantageous to an organism, the effects of natural selection will normally swamp the effects of genetic drift. Drift is therefore most likely to occur in those sections of the DNA that have no known genetic effect. (Such sections — which are surprisingly common — are often referred to as "junk DNA.")

Section 4 – Chickens and eggs

A wit once said, "A chicken is just an egg's way of making another egg." For a long time, that was considered to be just a clever quip; but we now realize that the alternative way it suggests of viewing reproduction provides valuable insights.

knowledge, he will probably have accumulated a greater store of knowledge than a less intelligent person of the same age; the two concepts, however, are quite distinct.)

Section 2 – Correlations and the "*g* factor"

We all know individuals who have high verbal skills but who seem to have trouble with mathematics. Conversely, there are persons who are good at math, but whose verbal skills are weak. Nevertheless, if a large number of people are each given two tests, one measuring their verbal skills and the other measuring their mathematical abilities, we find that *on average* those persons who do well on one test also do well on the other one, and those who do poorly on one test also do poorly on the other. We can summarize this by saying that verbal abilities and mathematical abilities are *positively correlated* with each other.

The degree to which high values of one quantity are, on average, associated with high values of another quantity can be expressed precisely by a number that statisticians call the *correlation coefficient*. That coefficient, which is often designated by the letter r, is defined in such a way that it cannot be greater than 1.0 nor less than –1.0. A correlation of 1.0 would indicate that the connection between the two quantities is not merely statistical but is exact and invariable. A value of $r = 0.95$ would indicate that the two quantities are very closely correlated, whereas $r = 0.05$ would indicate only a very small statistical relation between the two quantities. A value of $r = 0$ would indicate that there is no statistical correlation between the two quantities. If, on average, those persons who did well on the math test did *poorly* on the verbal test (and vice versa) we would then say that mathematical and verbal abilities were *negatively correlated*, and such a result would be described by a value of r that was less than zero. (Although such a result is possible in theory, test results show that in fact mathematical and verbal abilities are positively correlated.)

Indeed, if we give a large group of people *any* two standard intelligence tests — even if the two tests seem to measure quite different aspects of intelligence — we almost always find a positive correlation between the results of the two tests,[3] and usually a rather high correlation. The simplest explanation of those results is that an individual's score on any well-designed intelligence test is strongly influenced by some underlying factor which we call his *general intelligence*, but is also affected (although to a lesser degree) by various special talents. The underlying factor is usually referred to as the "*g* factor."

The first person to define the *g* factor precisely was the British psychologist Charles Spearman,[4] although the general notion had been expressed many times before. Spearman also invented a mathematical technique ("factor analysis") by means of which an individual's *g* factor can be calculated from his scores on an assortment of standardized intelligence tests.

Some people have objected to the whole notion of the *g* factor, on the grounds that it is "just a mathematical construct." That objection, however, is without merit. After all, physicists seeking to give a precise meaning to the word *temperature* define it as

CHAPTER 4

THE ORIGIN OF *HOMO SAPIENS*

Section 1 – Predecessors of *Homo sapiens*

Zoologists classify our species as part of the genus *Homo*, which in turn is part of the hominid family. The hominid family once included another genus (now extinct) called *Australopithecus*. One species within that genus was *Australopithecus afarensis*, which lived in East Africa about 3.5 million years ago, and from which the entire genus *Homo* is believed to be descended.

We are the only surviving species in genus *Homo* (indeed, in the entire hominid family), and our closest living relatives are the chimpanzees. Chimpanzees are not hominids, but belong to another family, the pongids (or great apes). The last common ancestor of chimpanzees and human beings probably lived about 5 million years ago.[1] (For information about how prehistoric dates are determined, see Appendix 2.)

Two major differences between hominids and pongids are: (1) We are fully adapted to bipedal locomotion; and (2) we have much larger brains. The purpose of our large brain size is clear enough: it enables us to have high intelligence. Otherwise, our large brains — which are metabolically very expensive[2] — would never have evolved.

Among the extinct species within our genus are *Homo habilis* and *Homo erectus*. (The official name of a species consists of two words, the first being the genus to which it belongs.) The exact evolutionary sequence leading to *Homo sapiens* is still disputed, but a common view is that we derive from *Homo erectus*, which derived from *Homo habilis*, which in turn derived from *Australopithecus afarensis*.

Adult members of *Australopithecus afarensis* were considerably smaller than we are. Their average height was about 3'6" (1.1 meters), and their average weight about 110 pounds (50 kg). They walked erect, but their brains were much smaller than ours, typically only about 450 cc (cubic centimeters). This is about the same size as that of an average chimpanzee, but only one-third that of a modern human. However, as they were considerably smaller than chimpanzees, their encephalization (i.e., the ratio of brain weight to body weight) was much higher, and they were probably a good deal smarter.

simultaneously in several parts of the Old World.[10] However, the majority of anthropologists now reject that hypothesis[11] and accept the "out-of-Africa" model because:

(a) Early examples of *HSS* in Africa (at Border Cave and at Klasies River, both in southern Africa) are much older than the earliest examples of *HSS* in China, India, or Europe.

(b) Only in Africa do we find a convincing sequence of forms leading from archaic *Homo sapiens* (such as those at Broken Hill and at Eliye Springs), through transitional forms (such as those at Florisbad, Omo, and Laetoli) to early *HSS* (such as those at Border Cave and Klasies River).

(c) Studies of mitochondrial DNA from humans living in widely separated parts of the world show that they all have as one of their ancestors a particular woman (the so-called "African Eve"), and that she lived about 200 kya, not 1000 kya as the multiregional model suggests.[12]

The worldwide triumph of *HSS* over its rivals makes it plain that it was "superior" (in the Darwinian sense of the word) to those rivals. However, examination of the fossil remains reveals only small differences between the skeletal structure of *HSS* and the other subspecies, seemingly far too small to explain its rapid triumph over the others. The members of *HSS* did not have larger brains than their rivals; nor is there any sign that they were generally bigger, stronger, or faster than the other variants of *Homo sapiens*.

It has frequently been suggested that the superiority of *HSS* resided in their greater *linguistic* skills. Early humans certainly had some sort of primitive speech; but it has been suggested that *HSS* were the first humans capable of fully-developed language.[13]

Our brains appear to be "hard-wired" in such a way as to enable children to master language, and to do so long before they can master various other tasks that are far less complicated.[14] It is well established, for example, that there are sections of our brain — Broca's area, for example, and Wernicke's area — that are highly specialized for the production and understanding of human speech. If *HSS* (but not any other variant of *Homo sapiens*) possessed these built-in language capacities, its triumph over the other variants would be easily explicable — indeed, virtually inevitable.

Note that if, in earlier variants of *Homo sapiens*, Broca's area and Wernicke's area were less specialized for the production and understanding of language — or if they were smaller, or less developed, or even completely absent in those variants — we could not observe the difference just by examining the skeletal remains. The hypothesis that the superiority of *HSS* lay in their linguistic skills is therefore unproven, and may never be conclusively demonstrated. However, the hypothesis appears to be consistent with the available data; and since no better explanation for the triumph of *HSS* is known, I shall adopt it in this book.

biased against a group of persons, then their scores on that test will underestimate how well those persons do in college.

A large amount of data has been accumulated on such matters, and the subject of bias in intelligence tests has been analyzed in great detail, using both the internal and external evidence. These analyses show that the amount of bias in most modern intelligence tests is very small.[5]

Section 6 – Reaction time experiments

Two types of tests that almost everyone agrees are free of serious cultural bias are *reaction time tests* and *digit span tests.*

There are several types of reaction time experiments.[6] In the "choice reaction time" (CRT) experiment, the person being tested sits in front of a console on which there are eight translucent push buttons arranged in a semicircle, plus one more button — the "home button" — at the center. The subject starts with his finger holding down the home button. He is told that in a few seconds one of the translucent buttons will light up, and that he should then push that button down, as quickly as he can, using the finger that he had on the home button. Instruction is given in the subject's native language, and the task is so simple that everyone (with the exception of severely retarded or brain damaged persons) can do it with 100% accuracy. In fact, the task can be performed by chimpanzees, and they do about as well as normal eight-year-old children.[7]

The time it takes to push the button down after it lights up can be divided into two parts, which can be timed separately and automatically:

a) The reaction time is defined as the interval between the instant the light goes on and the time the subject's finger leaves the home button.

b) The movement time is defined as the time it then takes for the subject's finger to depress the target button.

Movement times are typically about a quarter of a second, and are not significantly correlated with intelligence. Reaction times *are* usually a bit longer and are significantly correlated with IQ.[8] The correlation is negative, which means that persons with higher IQs tend to have *shorter* reaction times.[9]

The "odd-man-out" experiments are quite similar to CRTs, except that:

a) Three buttons light up instead of one, with two of the buttons being closer to each other than either is to the third button.

b) The subject is instructed not to push either of the buttons that are close to each other, but to push only the lit button that is furthest from the other two.

These instructions, too, can be carried out accurately by virtually everyone. Movement times are typically about the same as in the CRT experiments; but reaction times are a good deal longer. The correlation between IQ and reaction times is much greater in the odd-man-out experiments than in the CRT experiments — about twice as large, in fact.[10] This is such a high correlation that the odd-man-out reaction time test can be

CHAPTER 1

THE THEORY OF EVOLUTION

Section 1 – Natural selection

The theory of evolution is the central, unifying principle of modern biology. Although entire books have been devoted to explaining the theory in detail, its fundamental ideas can be summarized briefly.

1) The individual members of any given species vary considerably from each other, and some of that variation is due to genetic factors. Furthermore, new heritable traits are constantly arising because of random mutations.

2) Since, in each species, there are more offspring than the environment can support, many individuals die without reproducing.

3) Those members of the species who have inherited traits that make them less likely to survive will, on average, have fewer offspring. Hence, in the next generation, there will be fewer individuals with those traits.

4) The result is the selective elimination of less useful traits and, in comparison, the *natural selection* of more useful traits.

5) This leads to a series of small changes within a species; and the gradual accumulation of many such small changes eventually results in the formation of a new species, related to the original one.[1]

Note that two separate processes are involved: (a) random mutations (which occur entirely by chance); and (b) selection of the more useful traits (a process that is far from random). The notion that evolution is governed entirely by chance is therefore false.

At no stage in either process have the resulting organisms been deliberately designed. However, since natural selection results in organisms that are very well adapted to their environments, they usually give the *appearance* of having been designed.

Most frequently, selection is for traits that make it more likely that the individual organism will survive (such as greater size, speed, strength, intelligence, or resistance

The two objections just mentioned are typical forms of sophistry. People who make objections of this sort are ignoring the fact that similar objections would apply to their own reasoning on most other topics.

Despite the attempts of some writers to pretend that the word "race" is meaningless, I suspect that most readers of this book do not doubt that it refers to something real. (He may find it hard to give a precise definition of the word, but when he hears or reads it he know what is being talked about.[6]) As a well-known biologist put it, "It requires an almost superhuman feat of political zeal to overlook the conspicuous differences between our own local populations or races."[7]

Section 2 – The Australoids

Australian aborigines resemble Negroes in having brown skins and broad noses, but in many other respects they differ greatly from Negroes. For example:

- Their lips, although thick, are not everted.
- A significant number of them have blond hair.
- Their hair is typically wavy, unlike the very curly hair of Negroes.
- They have a substantial amount of body hair.
- Compared to most humans, they are prognathous (i.e., their jaws protrude forward).
- They have prominent brow ridges above their eyes (somewhat like the now-extinct Neanderthals), which are very rare among Negroes.[8]

It is therefore generally agreed that they should not be classified as Negroes, and DNA tests (see chapter 10) confirm that the two groups are not closely related.[9] Since they are so different from the three groups described at the beginning of this chapter, they are usually considered to belong to a fourth race, the *Australoids*.

Section 3 – Some sub-races

Although various other racial groups have been identified, most of them appear to be subgroups of the races already described. For example, because of their small stature, the Pygmies living in central Africa (the *Congoid Pygmies*) can easily be distinguished from the nearby Negro tribes. However, their resemblance to the Negroes — who constitute most of the population of sub-Saharan Africa — is obvious, so I think it reasonable to classify both groups as branches (or sub-races) of a larger racial group, which I shall call Negrids.

In southern Africa, there are two small groups — commonly called the Bushmen and the Hottentots[10] — which together comprise another distinctive racial group. Scientists call this group the Sanids, or Khoisan. Since the Sanids resemble the Negrids in many ways, it seems best to classify both of them as sub-races of a still larger group, the Negroids.[11] (See Table 2-1.)

Question (2) has aroused a great deal of controversy. Five possible hypotheses are:

(a) The differences are caused almost entirely by environmental factors.

(b) They are caused by a combination of factors, with the environmental factors normally being more important.

(c) Environmental and genetic factors are about equally important.

(d) They are caused by a combination of factors, with the genetic factors normally being more important.

(e) The differences are due almost entirely to genetic factors.

Offhand, (a) and (e) sound like extreme views, and the others therefore seem more likely. However, we need not rely on intuition alone, since there is a good deal of scientific data that bears on the question.

Perhaps the most straightforward way of measuring the heritability of IQ is by comparing the IQs of identical twins who were reared separately. Although such pairs (called "monozygotic apart" or "MZA" in the literature) are quite rare, because of their theoretical importance they have been sought out and carefully studied. Every study shows a high correlation between the IQs of MZAs, with the correlations ranging from 0.69 to 0.78.[15] These results strongly support hypothesis (d). (MZAs also show high correlations on a variety of personality traits and social attitudes.[16])

These results should be compared with the correlation between the IQs of ordinary siblings reared *together* which is only 0.49.[17] (Such pairs share half of their genes in addition to having been reared in very similar environments.) Even in the case of fraternal twins reared together, the correlation of the IQs is only about 0.60.[18] That is a high figure, but still a good deal lower than for identical twins reared apart, which suggests that genetic factors are more powerful than environmental ones in shaping a person's IQ.

Another approach is to compare the correlation between the adult IQs of ordinary siblings who have been reared apart (which is about 0.47) with the correlation between the IQs of unrelated adults who were reared together (which is nearly zero).[19]

A slightly different approach is to compare the IQs of adopted children who have never known their biological parents with: (i) the IQs of their biological parents; and (ii) the IQs of their adoptive parents. Careful studies show that the first correlation is greater than the second.[20] This strongly contradicts the predictions of hypotheses (a) and (b), but is consistent with hypothesis (d).

Although all studies show that the heritability of intelligence is non-zero — and indeed quite significant — its numerical value is still in dispute. The heritablility depends in part upon how old the subjects are (because the effect of the shared home environment is greatest during childhood and becomes less important as a person ages.) Plomin, after using several different approaches to the question, estimated the heritability of IQ to be about 50%.[21] Other scholars have concluded that, for adults, the

subspecies or *varieties* or *breeds*.[2]

A race (or subspecies, or variety, or breed) might be defined as a large group of individuals — all of them members of the same species — who have formed a partially or completely isolated breeding population for a significant period of time, and who consequently differ statistically from the rest of the species in various heritable traits by which they can be recognized.[3]

It is possible for one subspecies to be included in another, larger subspecies. (In other words, every member of the smaller group is also a member of the larger group.) In such cases, we call the smaller group a *sub-subspecies* (or *sub-variety*, or *sub-race*, or *sub-breed*). When this occurs, however, the differences between sub-subspecies may be quite small, so disputes as to classification often arise.

In most cases, it is geographic separation that has caused the group to be an isolated breeding population; however, there can be other causes. For example, social taboos against marrying someone of a different religion, social class, or ethnic group can be the cause; and the mating choices of domesticated animals are often restricted by their human owners, sometimes for the explicit purpose of creating a new breed.

If two breeding populations are separated from each other for a long time, the result will be an accumulation of genetic differences between them, either by natural selection or by genetic drift. If the separation continues long enough, they can diverge into separate species. However, as long as the two groups will usually mate (if given the opportunity) and produce fertile offspring, they are generally considered to be varieties of the same species.

Perhaps the best known example of a species that includes various breeds or subspecies is the domestic dog, *Canis familiaris*. If a zoologist who had never seen a dog before was shown a group of Irish setters, he would readily notice the large number of similar traits that they share. He would also observe that they freely mated with each other, and that their offspring shared the obvious physical traits of the prior generation. (In other words, they "breed true.") He would therefore classify them as a species, and — noticing their resemblance to wolves (*Canis lupus*) — might call them *Canis irishsetter.*

In like fashion, if the same zoologist was then shown a group of dachshunds, he would notice their resemblance to each other, and that they bred true, and he would probably decide that dachshunds constitute another species, which he might call *Canis dachshund*.

However, if he then permitted the Irish setters and the dachshunds to intermingle, he would soon find that they mated with each other freely and produced fertile offspring. He would conclude that rather than being two distinct species, Irish setters and dachshunds were merely different varieties or breeds of a single species. Despite their rather different appearance, he would realize that the two breeds must share many genes, including the ones responsible for mating and reproduction. He would reach the same conclusion, of course, for the dozens of other breeds of dogs.

thought of as almost an IQ test in itself. It is, of course, cruder and less comprehensive that ordinary IQ tests; but it has the advantage of being completely independent of any prior knowledge, and therefore free from any cultural bias.

In a digit span test, the subject is read a set of digits (at a standard rate of one per second) and asked to repeat them in the order given. The longest set of digits he can repeat without error is his *forward digit span* (FDS). In a variant of this test, the subject must repeat the digits, but in the reverse order. The longest set of digits he can repeat backwards is his *backward digit span* (BDS). Like reaction times, digit spans are independent of prior knowledge and free of cultural bias.

We might expect that an individual's FDS is greater than his BDS, and experimentally this is almost always the case. Both forward digit span and backward digit span increase during childhood. For adults of normal intelligence, FDS averages about seven while BDS averages about five. Both are correlated with general intelligence, but the correlation is about twice as high for BDS as it is for FDS.[11] Because of these correlations, digit span tests are often used as a component of more comprehensive intelligence tests.

Section 7 – How important is intelligence?

It is clear that high intelligence does not, by itself, ensure an individual's success. Indeed, persons of obviously high intelligence who have nevertheless failed to accomplish anything significant are so common that we have a special word for them: underachievers. Even a very smart person is unlikely to accomplish much if he lacks sufficient energy, dedication, and determination; and he might also be held back by a lack of social skills, or by poor health, or by lack of opportunity.

Nor is high intelligence — or even average intelligence — necessary for an individual to function capably in everyday life. Many people have the notion that a person with an IQ of 70 is an incompetent who needs to be institutionalized; but that notion is incorrect. Such persons can not only wash, dress, and feed themselves, but can also make and retain friends, marry, rear children, and support themselves economically. They can learn a wide range of skills by direct, hands-on instruction, or by simply watching more experienced persons. As long as their job or occupation does not require a high degree of abstract reasoning, such persons are able to perform their duties in an adequate manner.

Not only is this true today, but it was even more true in past ages, including the Paleolithic Era, during which most human evolution occurred. It did not require high intelligence for a parent to demonstrate to his child how to make a hand ax by chipping a piece of stone, or to show him which plants were edible and which should be avoided. The same is true for the typical skills needed by subsistence farmers.

However, although high intelligence is neither necessary for functioning in ordinary circumstances, nor sufficient by itself for marked success, it is not unimportant. In the first place, there are certain tasks for which high intelligence is an absolute requisite. For example, one can hardly imagine a person of average intelligence teaching a course in quantum mechanics.

2) Evolution is a completely amoral process.

3) A person's physical capabilities and limitations are strongly influenced by his genes.

4) A person's mental attributes (i.e., his individual abilities and proclivities) are also influenced by his genes — not rigidly determined, but strongly influenced. The notion that we are entirely products of our environments is therefore false.[7]

5) The observed behavioral differences between the sexes are strongly influenced by our genes — again, not rigidly determined, but strongly influenced.

Even less welcome, perhaps, are these other implications of the theory:

6) Whenever two populations within a species are reproductively isolated, they will diverge from each other genetically. If they are in different environments, this will occur by natural selection; but it will occur by genetic drift even if the environments are the same.

7) The process of evolution did not stop with the emergence of *Homo sapiens*, nor with the emergence of *Homo sapiens sapiens* (the branch of that species to which all living humans belong). Rather, evolution has continued and has produced visible differences between human groups whose ancestors evolved in different regions.

8) There is no reason to suppose that the visible differences we see between the regional variations of human beings are the only differences that exist between them. On the contrary, it would be very surprising if that were the case.

These conclusions may be unpalatable, but they are amply confirmed by our knowledge of biology. Of course, the *extent* of the differences can only be determined by observation and experiment.

TABLE 2-1

PRINCIPAL HUMAN RACES, AND SOME SUB-RACES

Races	Sub-races
Negroids	A) Negrids 1) Negroes 2) Congoid Pygmies B) Sanids (= Khoisan)
Caucasoids	
Mongoloids	A) Amerids (=American Indians) B) Mongolids (=Asian Mongoloids)
Australoids	

Similarly, since the American Indians have so many traits in common with the Mongoloids living in East Asia, I think it best to consider the two groups as comprising subgroups of a larger race. I shall call the Asian branch of this race the *Mongolids*, the American branch the *Amerids*, and the combined group the *Mongoloid* race.

(Note: A wide variety of nomenclatures have been used by various scholars when discussing human racial groups; the one used in Table 2-1 may be easier to use than most.)

Not all human beings are members of discrete racial groups. Many of us are of mixed parentage; such persons may be referred to as "hybrids." There are regions where hybrids are particularly common, and other regions (for example, the North China Plain) where they are comparatively rare. In some countries, there are important groups that contain a high percentage of hybrids. For example, most "blacks" living in the United States today are hybrids.[12] (The infamous *one drop rule* — "If you're one percent black, you're all black" — is a *social* rule that has no basis in biology.)

Among the important questions concerning human races which will be discussed in later chapters are:

1) Where and when were the various races formed?

2) Do the races differ in other ways, besides the physical traits mentioned?

3) Have the differences between the races had any significant historical consequences?

The offspring of a dachshund and an Irish setter — or of any two dogs belonging to different breeds — is not a member of either breed. We call such dogs *mongrels*. (The term used for most other species is *hybrids*.) A mongrel, of course, is just as much a member of the species *Canis familiaris* as any purebred dog, and he possesses all the traits that are common to that species; he is just not a member of any of the special breeds.

The reader might ask whether we should consider mongrels to constitute a separate breed of dog. There are two reasons why we do not. In the first place, mongrels (unlike Irish setters) share no set of physical traits, except those common to all dogs. In the second place, mongrels (unlike Irish setters) do not "breed true."

Are mongrels better or worse than purebred dogs? That is a subjective question, since it depends upon what traits you value in dogs. If you value *speed*, for example, then greyhounds are better than mongrels. If you value the Irish setter's lovely reddish-brown coat, you are not likely to find a mongrel (or any other dog) that is quite that beautiful. But by most criteria, mongrels are neither better nor worse than purebred dogs.

However, in one important aspect, mongels tend to be slightly superior to purebred dogs. Like hybrids of most species, they often have fewer genetic defects than purebreds, and therefore (if equally well cared for) will on average be healthier. This effect — called *hybrid vigor* — is the exact complement of the tendency for offspring of incestuous matings to have a higher than average number of genetic defects, and it has the same cause.[4] The majority of deleterious alleles are recessive, so the more closely related two individuals are, the more likely it is that their offspring will be harmed by inheriting the same recessive allele from both of them.

Some people have objected to the entire concept of human races. One common objection is: "There are all degrees of gradations between the so-called 'races' of mankind, and many individuals do not fit into any single racial group. The concept of 'race' is therefore meaningless, or at least pointless."

Although that argument is often presented, it is fallacious, as can be seen by considering a few counterexamples: (a) It is useful and meaningful to employ the terms *blue* and *green* even though there are an infinite number of gradations between the two colors; (b) Similarly, although there are all gradations between rich and poor, it is nevertheless plain that John D. Rockefeller was rich, while at the same time large numbers of peasants in China and India were poor; (c) Likewise, the terms fat and skinny are widely used, as are the terms hard and soft. In all these examples, the extreme cases are obvious; and even though many intermediate cases are hard to classify, the terms are meaningful and widely used.[5]

Another common objection is that the word "race" is difficult to define, and dictionaries give varying definitions of it (most of which contain some ambiguities). That argument is also fallacious. Virtually all common terms are hard to define (except in mathematics and, to a lesser extent, in the hard sciences). Insistence on precise definitions for every term used would render *all* serious discussion (except in mathematics) virtually impossible.

15) Levin, Michael (1997), pp. 97-98. Also see:

(a) Newman, Freeman, & Holzinger (1937), see Table 96 on p. 347.
(b) Bouchard, et al. (1990).
(c) Pedersen, et al. (1992).

16) Bouchard, et al. (1990).

17) (a) Paul, S.M. (1980), whose study was based on over 27,000 sibling pairs.
(b) Bouchard & McGue (1981). This review discusses the results for many other kinship relationships. It is based on over 100 studies which, together, include over 40,000 kinship pairs. For the 68 studies involving siblings reared together, they obtain a weighted average of 0.47, very similar to Paul's result.

18) Bouchard & McGue (1981), see figure 1, p. 1056.

19) Jensen, Arthur (1998), p. 178.

20) Scarr, Sandra & Richard A. Weinberg (1983), p. 262. Also see Jensen, Arthur (1998), p. 177.

21) Plomin, R. (1990). See also Chipuer, Rovine, & Plomin (1990).

22) (a) Bouchard, et al. (1990).
(b) Pederson, et al. (1992).

Our genus, *Homo*, originated about 2.5 million years ago, and its earliest known species was *Homo habilis*. As all species of *Australopithecus* lived in Africa, *Homo habilis* must have originated there; and indeed, fossil remains of *Homo habilis* have been found only in East Africa.

Although there were several anatomical differences between *Homo habilis* and *Australopithecus*, the most important one involved brain size. The brains of *Homo habilis* averaged about 650 cc in size — roughly fifty percent larger than those of *Australopithecus*, although only about half the size of ours. The increase in brain size was accompanied by a significant behavioral change: They developed techniques for making stone tools. Although the tools they produced were very crude, it was an important advance. (That early type of tools is called *Oldowan*, after Olduvai gorge in modern Tanzania, where many of the remains of *Homo habilis* have been found.)

About 1.8 million years ago a new species, *Homo erectus*, arose in East Africa. The brains of *Homo erectus* were much larger than those of *Homo habilis*, and for adults averaged about 1000 cc. Indeed, the largest *Homo erectus* brains lie within the range of our own species, although far below the human average.

Once again, the increased brain power of the new species was accompanied by behavioral changes, at least three of which are noteworthy. To begin with, *Homo erectus* was the first hominid to spread out of Africa into Asia and Europe. They reached Central Asia at least 1.5 million years ago, and must have entered the Middle East even earlier. Remains of *Homo erectus* have been found in northern China (in the cave at Zhoukoudian, near Beijing), and as far east as Java. Indeed, the first *Homo erectus* skull ever discovered was found in central Java in 1891; and for a while, the species was called "Java Man" or *Pithecanthropus erectus*. That skull might be about a million years old, and it therefore predates the earliest specimens of *Homo erectus* found in Europe.

In the second place, *Homo erectus* was the first of our ancestors to use and maintain fires. This advance was made at least 1.6 million years ago. Most primates lack the anatomical and physiological features necessary to survive cold winters, and — with the exception of those in genus *Homo* — they are only found in tropical regions. It seems likely, therefore, that it was only due to its mastery of fire that *Homo erectus* was able to move into such regions as Central Asia, northern China, and Europe.

Thirdly, *Homo erectus* created a new set of tools, better and more varied than any produced by *Homo habilis*. This improved toolkit is often called *Acheulian*, after the site in France where samples of it were first found. (For a list of some major prehistoric stone toolkits, see Table A2-1 in Appendix 2.)

Because of the higher intelligence of the new species, and the advances resulting from it, *Homo erectus* eventually supplanted all earlier hominid species, and by one million BC those earlier species had become extinct. A similar fate was to befall *Homo erectus* after *Homo sapiens* arose.[3]

Section 4 – Syntactic language and the human species

In the previous section, I mentioned that there was an important difference between "primitive speech" and "fully-developed language" without specifying the differences between the two categories. In primitive speech (such as many animals possess):

- The vocabulary is small.
- Each sentence consists of a single word.
- There are no grammatical rules.

On the other hand, in a fully-developed language (or "syntactic language"):

- There is a large vocabulary.
- Multi-word sentences (sometimes quite lengthy ones) are common.
- There are rules for expressing:
  a) Negatives.
  b) Conditional or hypothetical statements.
  c) The distinction between the subject and the object of a verb.
  d) A full range of tenses, including past, present, future, future perfect, pluperfect, and so forth.

In the period when the transition from more primitive language to fully syntactic language took place there must have been languages that did not fall clearly into either category. However, no such languages survive. All existing animal languages are primitive, and all existing human languages are syntactic. As the difference between primitive and syntactic languages is so enormous, I shall hereafter use the word *speech* to refer only to the latter.

In the course of human history and prehistory there have been many inventions of great importance, including agriculture, metalworking, printing, firearms, antibiotics, and computers. But none of those was nearly as important as the invention of speech. It is speech — syntactic language — that truly separates us from all other animals.

Taxonomists list *HSS* as a mere subspecies of *Homo sapiens*, and there is little doubt that matings between *HSS* and archaic *Homo sapiens* would have produced fertile offspring. But although the visible anatomical differences separating us from *AHS* are minor, behaviorally we are worlds apart. Behaviorally, any hominid without speech is closer to *Australopithecus* than it is to us.

It is sometimes said that two organisms or populations should be included in the same species if they produce fertile offspring. However, this method of classifying species is not always followed by biologists. Taxonomists consider lions (*Panthera leo*) and tigers (*Panthera tigris*) separate species, even though they have been crossbred in zoos and the offspring are fertile, because lions and tigers do not interbreed in the wild.[15] In like fashion, dogs and wolves are considered separate species. This is because — even though wolves are physically capable of mating with dogs and producing fertile offspring — in the wild they more commonly kill and eat them.