A Question of Origins

Created or Evolved?

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Preface: What Are Truth and Facts?

What are facts? What is truth? It is surprising to see that many people have trouble defining these words clearly. Webster's Online Dictionary defines fact as "something that truly exists or happens, the quality of being actual, a true piece of information." The dictionary defines truth in much the same way. According to Webster, truth is " the real facts about something, the body of real things, events, and facts, being in accord with fact or reality." These definitions indicate that truth and facts are closely related. In fact, they seem to be almost interchangeable.

Why, then, do many people have problems recognizing facts and going where the facts lead them? Perhaps they have separated these two words from each other because of the way they look at the facts—their worldview. For example, some people consider facts as absolutes while truth is how we interpret those facts. For them, truth is pliable, and there are no absolutes.

Yet truth and facts are inextricably tied to each other and to reality. Those who fail to understand this often find themselves confused and easily persuaded to believe things that are simply without factual basis and thus untrue. Witness the many college students who blindly accept what they have been told about origins because someone in a position of authority said so, without taking the time to check the facts for themselves. When asked why they believe evolution is true, they often have no ready answer. It is important that no creationist be in this predicament.

Rightly examining the facts and interpreting them begins with a logical and correct viewpoint. If a witness at a court trial was asked why he was giving testimony about something that happened in the past, and he replied, "Everyone I know says it is true," his testimony would be summarily dismissed. If he testified that he knew it to be true because someone close to him had said so, this testimony would also be given little weight. However, if he stated that he had in his hands a full, written confession of the person who did the act, his testimony should have great credence. The juror's judgment must be focused on the *facts*, not on others' opinions of the facts. He or she must have the right starting point. Young-earth Bible creationists have such a starting point in God's Word. They have His own testimony: "In the beginning, God created the heavens and the earth" (Genesis 1:1).

Evolutionists have no such starting point; they have no witness from which to start. They believe that all living things evolved from a single cell, which somehow was formed from inorganic material, and this gain of massive amounts of

information occurred through random, mechanistic processes—in other words, by chance. Yet observable, scientific *facts* show this statement to be without basis in reality.

Scientifically establishing the truth of a past event can be difficult. No human was there to see or record it. The event cannot be repeated. Observation and experimentation can only be done in the present. However, the creationist has God's Word as a starting point. He can now use normal, logical, rational thought to study verifiable, scientific facts and go where they lead, without fearing where they may lead him.

An examination of the study of origins exemplifies this. Is it a true statement that change occurs? Yes, we know this because we have factual scientific proof of change occurring. On the other hand, is it a true statement that molecules-to-man evolution occurs? No, because the facts show that only limited changes occur and only if directed by *existing* information (DNA). There is no process of change which adds information—the kind of addition that is needed to change molecules into men.

So why do many scientists continue to treat molecules-to-man evolution as truth? Their own bias often leads them to ignore facts that disprove their beliefs or fail to support them. They have separated truth from facts. Evolutionist Professor Richard Lewontin makes this clear in "Billions and Billions of Demons," published in *The New York Review* (January 9, 1997, p. 31). "We take the side of science in spite of the patent absurdity of some of its constructs,… in spite of the tolerance of the scientific community for unsubstantiated, just-so stories, because we have a prior commitment, a commitment to materialism…. **Moreover, that materialism is absolute, for we cannot allow a Divine Foot in the door."** (Emphasis added by author.) The evolutionist's bias obviously leads him to regard his faith in materialism as more important than the scientific facts.

Yet, isn't science supposed to be about truth—about reality, about the *facts*? And if the facts point in a different direction from the "constructs" and "just-so stories," aren't scientists obligated to follow the facts, regardless to where that leads them? Aren't they supposed to be unbiased observers forming theories based on facts rather than allowing their pre-conceptions to control their theories, regardless of the facts?

Creationists look at the same facts as evolutionists, but from the worldview that a creator formed this earth and its inhabitants, as truthfully recorded in His Word. Thus, both groups can be said to be biased and to express faith. However, the question is, which position is correct or true because it is most accurately supported by the scientific *facts*? The purpose of this book is to present some of the evidence and let the reader decide.

Critical Thinking

Before beginning, it would be well to do a short study on critical thinking. After all, the evolutionist and the creationist examine the same evidence. What is different is the worldview from which they begin. While emotion has a place in science, commitment to a certain viewpoint does not make that viewpoint true. To examine any evidence and interpret it correctly demands a willingness to make objective judgments based on facts and reasons, not merely on emotions or a philosophy. Critical thinking is the ability to do this instead of relying on emotion and prior belief.

One of the first important steps to take is to **define terms carefully**. Vague or poorly defined terms can be misleading and cause confusion. For example, evolutionists often define evolution as "change over time." Since change *does* occur, the creationist would seem to have no reason to argue with this. However, this definition is too broad and vague. It does not explain how this change occurs—is it due to a loss or to a gain of genetic information? Or is it a combination of both? Also, how extensive is the change? Is it referring to change within genus or species? Or does the change extend further to the phylum level and beyond? These are the issues that divide evolutionists and creationists. Therefore, in making any study of origins, it is important to see how a term is defined and if the definition changes from time to time to suit the needs of a particular writer. If it does, the writer is committing the error of logic called **equivocation**, a fallacy based on the use of the same term in different ways. It is important to make sure that a scientist and/or author is defining his terms precisely and consistently.

Drawing by A. Margetic.

Another important step to take is to examine the evidence carefully and come to a conclusion **based on the facts**. It is very poor science, indeed, to study a group of facts that point to a logical conclusion, and then attempt to explain away those facts because of a pre-existing bias. For example, if an anthropologist finds an obviously human fossil such as a human arm or leg bone in rock he believes is very old, it would be illogical for him to assume it is not human simply because it does not fit his preconception of where human bones should be found. If he does, this individual is basing his interpretation of the evidence on his preconceptions rather than on the facts.

Perhaps, based on this new evidence, he should change his preconceptions and look for other explanations. Evolutionists find this extremely difficult to do because they might then "allow a Diving Foot in the door." This would not only remove the basis for their beliefs but force them to acknowledge a greather power than themselves. Individuals who habitually ignore evidence that points to a different conclusion are **suppressing evidence**, another logical fallacy.

A third step in critical thinking is to avoid circular reasoning. **Circular reasoning** is using two ideas to validate each other: making the assumption that idea A is true because of idea B and that idea B is true because of idea A, without validating either idea through an independent source. For example, if an individual remarks that he is reading a good book and is asked why it is good, he might reply, "I just like it." He may later remark that he likes the book he is reading because it is a good one. If he does, he is guilty of circular reasoning. He has not established any independent facts about the book that merit it being called "good." It is simply good because he likes it, and he likes it because it is good. (To be completely accurate, he would also have to be careful to define precisely what he means by "good" and "like.")

It is also important to avoid **over generalization**. Simply because a fact holds true in a specific circumstance does not mean that it is true on a broader scale. For example, even if several redheaded girls and boys have fiery tempers, this does not mean that all redheads do, or even that a bad temper is a common trait among redheads. Similarly, even though there is ample evidence to show that change occurs at the genus and species level, there is no reason to believe that it extends all the way to the kingdom level, unless there is widespread, clear proof that it does.

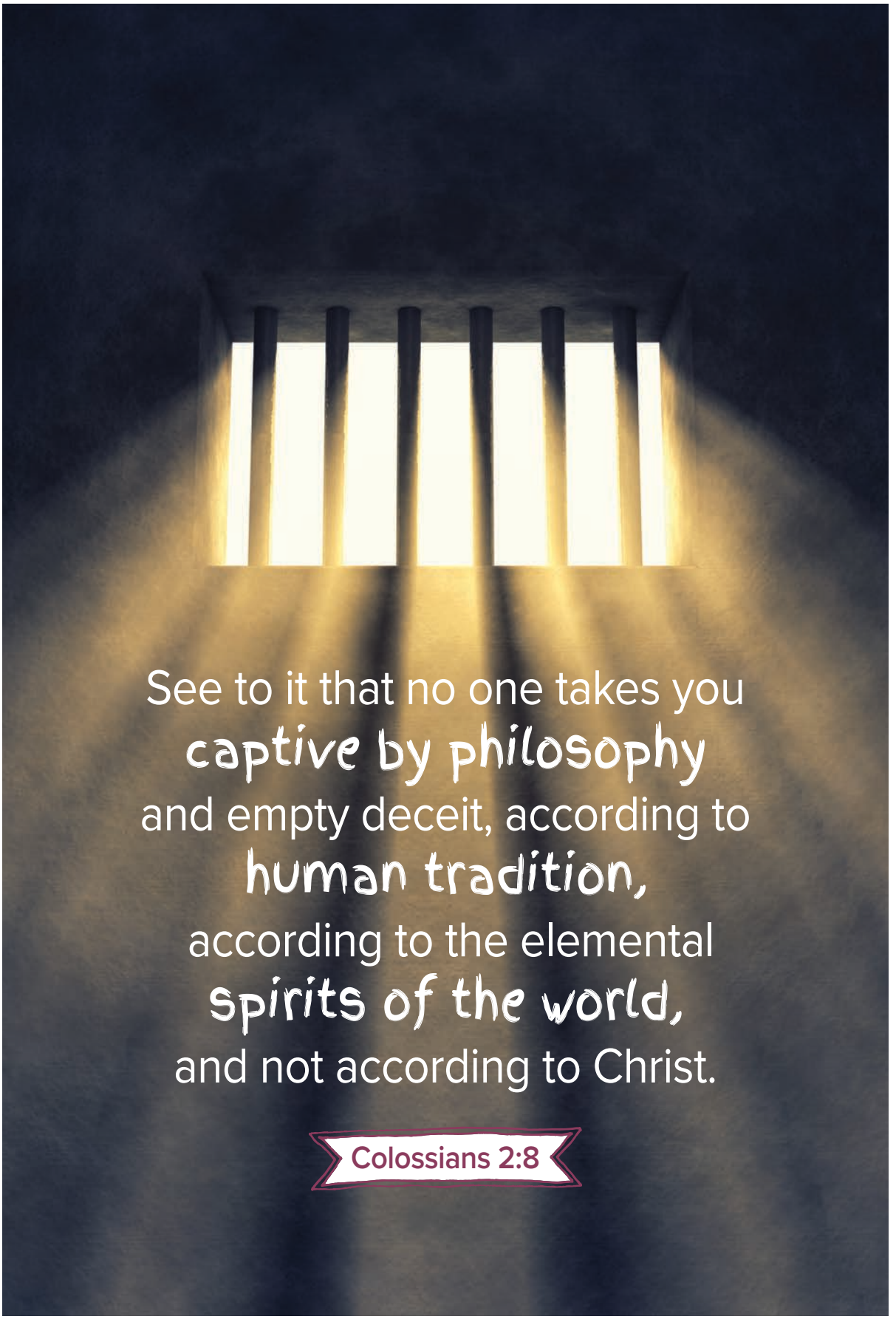
A fifth step in critical thinking is **being willing to test and analyze your own assumptions and those held by others**. This is not easy for either evolutionists or creationists who have a blinkered view of the evidence. It is also important to state the assumption in a way that can be either proved or disproved by the evidence, if it exists. Scientists call this the **principle of falsifiability,** and it is a critical step in the application of the Scientific Method. Again, as in defining terms, preciseness is crucial. In forming a hypothesis, the scientist must predict not only what will happen but also what will not happen. For example, evolutionists generally believe that every living thing on Earth evolved from a single-celled organism that arose by spontaneous generation from inorganic materials in the Earth's atmosphere or oceans. From this "primitive" cell came, first of all, simple organisms such as anaerobic bacteria and yeasts, etc. Later insects, fish, amphibians, reptiles, mammals, and finally man evolved. If this theory were true, the evolutionist would predict that the insects and simple plants should show up in very old rock formations. Then fish, amphibians, reptiles, etc. should show up in successively younger rock. A creationist, on the other hand, would predict that representatives of most of the phyla should show up in very early rock, since he believes they were created at relatively the same time. Obviously, the structure of

the fossil record—the same evidence for both groups—should support or refute one or both of these hypotheses.

It is also important to recognize an error of logic called **"Straw Man."** Individuals who commit this error distort their opponent's argument and then attack the distorted argument. For example, an individual might comment that it is important to remove able-bodied men and women from the welfare roles. If another person replies that welfare is necessary to support the old, the young, and the sick, he has distorted his opponent's argument, since his opponent did not mention taking *these* people from the welfare roles. In a sense, Straw Man is one of the main sources of confusion in the creation-evolution controversy. Evolutionists are often heard stating that creation is religion while evolution is science, and therefore creationism should be prohibited from the public schools because of the separation of church and state mandated in the constitution. In reality, creation deals with scientific facts, even more so than evolution does, as will be demonstrated in the following chapters.

Finally, it is important to keep in mind that even if a reasoning process is entirely correct, **if the assumptions upon which it rests are incorrect, the conclusions will also be incorrect**. Thus, it is important to carefully examine the assumptions behind both the evolution and creation theories.

* This is by no means a comprehensive explanation of critical thinking. For additional details, you may check with your local public library or creation.com, which also deals with this subject.


See to it that no one takes you
captive by philosophy
and empty deceit, according to
human tradition,
according to the elemental
spirits of the world,
and not according to Christ.
Colossians 2:8

Chapter 1

History of Evolutionary Theory

Introduction

Studying the evidence about origins is like sitting on a jury. To do his job correctly, a juror is required to check the evidence presented by both sides, examine the facts carefully, and based on that information, reach a conclusion. Individuals representing each side will present the case as they feel it should be considered, and they will interpret the facts accordingly. A good juror realizes this. He focuses on the *facts* in deciding which side has reached the most logical conclusion.

There are two contrasting views of origins. Evolutionists believe that the first cell formed randomly from inorganic substances and that all living things evolved from that cell. Who were the people who developed evolution as a model of origins? What information did they study in developing their beliefs? What supporting evidence do they have? This book's first three chapters will present the case for evolution. In the following chapters creationists

will present scientific evidence for their position. As a good juror, focus on the *facts* and see where they lead you.

Section 1: Types of Rock

Vocabulary words to know: igneous rock, sedimentary rock, and metamorphic rock

Figure 1-1a: Igneous rock from a volcanic eruption.

In studying origins, one piece of evidence scientists examine is rock layers. There are three basic types of rocks. These are igneous, sedimentary, and metamorphic. Igneous rocks form when processes within the earth melt existing rock. While underground, this molten rock is called magma. As the rock reaches the surface, it often erupts with an explosive force, spewing molten material onto the surface and forming volcanoes or volcanic plateaus. On the Earth's surface the molten material is called lava. As the magma and lava cool and harden, they form igneous rock.

Any type of rock that is exposed to the wind, sun, and rain will erode, forming rock particles. Water can then deposit these particles in layers. As the water in these layers is gradually removed, chemicals that were in the water are left behind and help to turn the layers into a rock resembling concrete. This is **sedimentary rock**.

Figure 1-1b: Shale, a sedimentary rock—note the layering.

Both igneous and sedimentary rock later can be subjected to further pressure by upper rock layers and form magma. However, at times this pressure and heat may not be intense enough to melt them. Instead, they undergo physical and chemical changes while remaining solid. This process forms another type of rock which is called **metamorphic**. (Because the Earth is a dynamic planet, the forces that shape these rocks are continuous, and each type of rock can be changed into another in a continuous rock cycle.) Of these three types of rock, the sedimentary rock is generally the most important to evolutionary scientists studying origins because it contains the fossils which they use in an attempt to understand how life on Earth began. Creation scientists view the same fossils as evidence of Noah's flood and use them to study life as it existed on Earth prior to the flood.

Figure 1-1c: Metamorphic rock—a piece of marble, changed by heat and pressure from limestone.

Questions for Review:

1. What are igneous, sedimentary, and metamorphic rocks? How do they differ?

Section 2: The Geologic Column

People and words to know: William Smith, Charles Lyell, geologic column, and correlating rocks

Scientists began serious study of these different types of rocks in the late eighteenth century. By studying how sedimentary rocks came together and comparing their relative positions in several places, **William Smith** (1769–1839) managed to put together the first **geologic map**. Smith was an English surveyor who had the opportunity to study layers of sedimentary rock that had been exposed in the digging of an industrial canal in the British Isles. He began to make diagrams of the rock sequences and of the fossils he found in them. He then combined this data with information he gathered from several other places including mines, stone quarries, and road cuts.

Using this data he made a chart of the rocks in his region, designating the bottom layers as the oldest and the top layers as the youngest. Smith sent copies of his work to many other geologists. When they saw how effective the list was for arranging information, they began to produce geologic columns for their regions also.

Although many men worked on the development of individual geologic columns, the man most responsible for the one we use today is a Scotsman named **Charles Lyell** (1797–1875). Lyell was a lawyer, but he was fascinated by geology. He traveled widely, observing rock formations in many locations. He also spent much of his time gathering and organizing information from other scientists.

By the late nineteenth century, Lyell had developed a geologic column that is very similar to the one used today. He examined rocks in different locations and determined through the character of the rocks and the fossils that they held that they were of the same age. This is referred to as **correlating the rocks**. Lyell also used local geologic maps from around the world to help in his formation of one large column. He gave the same names to rocks of the same apparent age from all parts of the world. Using the principle of uniformity (explained in section 3), he also assigned ages to these rocks that were much older than scientists in the past had believed them to be. Thus, the geologic column was born and became the sole method of dating rocks and fossils until the twentieth century. It is still the primary method used today.

Questions for Review:

1. Who started the first geologic column? How did he put it together?
2. How did Lyell contribute to this work? (See Figure 1-2)
3. Define the principle of "correlating the rocks."

EVOLUTIONARY GEOLOGIC TIME SCALE

ERA	PERIOD	EPOCH	Beginning (millions of years ago)	Ending (Millions of years ago)
Cenozoic	Quaternary	Holocene	0.0117	Present
	Neogene	Pleistocene	2.58	0.0117
		Pliocene	5.33	2.58
		Miocene	23.0	5.33
	Paleogene	Oligocene	33.9	23.0
		Eocene	56.0	33.9
		Paleocene	66.0	56.0
Mesozoic	Cretaceous		145.5	66.0
	Jurassic		200.0	145.5
	Triassic		251.0	200.0
Paleozoic	Permian		299.0	251.0
	Carboniferous	Pennsylvanian	323.2	299.0
		Mississippian	359.0	323.2
	Devonian		419.2	359.0
	Silurian		443.8	419.2
	Ordovician		485.4	443.8
	Cambrian		541.0	485.4

Figure 1-2: Geologic Time Scale. This chart is based on information gleaned from several evolutionary sources and is a fair representation of the evolutionary view of the age of the Earth. The Precambrian period is reputed to have begun over 4.5 billion years ago.

Section 3: Developers of Evolutionary Model of Origins

Vocabulary words and concepts to know: principle of uniformity, use and disuse of organs, inheritance of acquired traits, vestigial, natural selection, and adaptation

Although different concepts of evolution have existed for thousands of years, only in the past two hundred years have scientists made a concerted effort to develop a workable one. During this time, several individuals made contributions to these studies.

Charles Lyell

Charles Lyell's work helped make the model of evolution possible. Lyell published a book called *Principles of Geology* in 1830. In it he postulated the **principle of uniformity**. This stated that "the present is the key to the past." In other words, **the processes that shape the world today are the same processes that shaped the world in the past. Lyell believed these processes had operated at the same rate in the past as they do in the present.** He made no allowance for the possibility of a major catastrophic occurrence, such as a worldwide flood, helping to form the rock strata and the fossil record. Thus, Lyell believed the Earth had to be very old so there would be enough time for the formation of the deep layers of existing sedimentary rock. Since a great deal of time is necessary for evolution to occur, an old Earth was absolutely necessary for the model of origins.

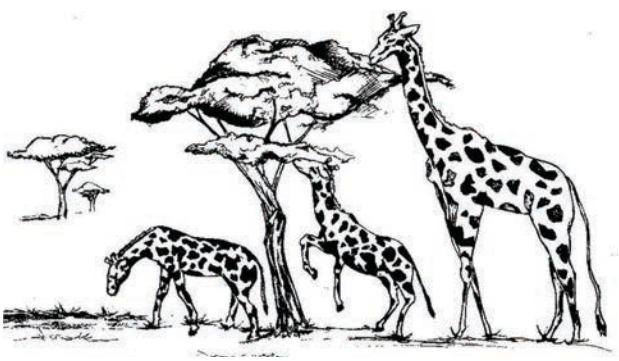
Public domain

Figure 1-3: Lamarck

Jean Baptiste de Lamarck

Another individual who made a contribution to the model of evolution was Jean Baptiste de Lamarck (1744–1829). He published two books, *Philosophie Zoologique* and *Animaux sans Vertebres*. In them he explained his model of evolution. Lamarck's model was based on his belief in two biological processes—the **use and disuse of organs** and the **inheritance of acquired characteristics**. Lamarck believed that organisms adapted to their environment by changing their existing organs or developing new ones. This change in use of an existing organ or development of a new one he called an **acquired trait**.

If an environmental change led to the disuse of an organ, it gradually would disappear because it was no longer needed. On the other hand, if an organ was gradually used more heavily, it would become more prominent in succeeding generations. Lamarck also believed that such traits could be passed on to the organism's offspring. This he called the **inheritance of acquired characteristics**. Thus, each generation could benefit from the useful structures produced by earlier generations, and evolution could proceed.



Drawing by Amber St. Arno

Figure 1-4: An illustration of Lamarck's hypothesis on how the giraffe developed its long neck.

Lamarck illustrated his model by explaining how giraffes got their long necks. He imagined that early giraffes might have had much shorter necks because they ate mainly grass. However, if grass became scarce due to a drought, the giraffes might have had to stretch their necks to reach the leaves on the trees. He believed the more they stretched, the longer their necks became. The giraffes then passed the trait of "long neckedness" on to their offspring. In this way organisms

Chapter 2

Evolution—What is it?

Introduction

In Chapter One we looked at a brief history of evolutionary thought, but to have a real understanding of it, we must study it more thoroughly. First of all, many scientists define evolution as change over time. However, is all change truly evolution? A more accurate definition of evolution was proposed by evolutionary biologist Dr. G.A. Kerkut in 1960. He stated that **evolution** is **"the theory that all the living forms in the world have arisen from a single source which itself came from an inorganic form."**[1] This is the definition with which creationists disagree. Creationists agree that change occurs, but how much change and how it is brought about is the issue.

Section 1: The Agents of Evolution

Vocabulary words and concepts to know: evolution, devolution, speciation, meiosis, genetic isolation, genetic drift, geographic isolation, natural selection, and migration

From an evolutionary standpoint, evolution can be divided into two categories—that which occurs chiefly because of a loss and that which would be attributed to a gain of information. (Some change involves neither a gain nor a loss of information.) Change due to a loss of information could better be called **devolution**, since it involves the *deterioration* of pre-existing information. However, huge *gains* of information are needed to turn microscopic organisms into human beings. One example of change is **speciation**, referring to the creation of new species. A common definition of speciation is "the formation of new species as a result of geographic, physiological, anatomical, or behavioral factors that prevent previously interbreeding populations from breeding with each other."[2] In many instances, this definition is amended to state that different species are no longer *able* to mate and produce fertile offspring. Yet groups that can still mate successfully are often referred to as different species. Obviously, since the definition of speciation is man-made, it is somewhat flexible.

Courtesy of Tracie Thompson and Tarla Gernert

Figure 2-1: Sheltie and Collie

One good example of speciation that both creationists and evolutionists can accept is the changes in the genus *Canis* which have occurred over the past few thousand years. Although members of this genus can interbreed, they are categorized in different species. Today, all dogs are classified as gray wolves, according to genetics. All the species of dogs we have today thus descended from gray wolves. However, as members of this original dog "type" interbred, a different combination of genes were distributed in their offspring (in much the same way that you have a different gene combination than your brothers and sisters). Different groups also became isolated from one another and rarely interbreed. Since different genetic combinations result in the expression of different traits, in a very short period of time there could be a wide variety of characteristics displayed within the canine population. These different characteristics could result from geographic and thus genetic isolation and **meiosis**, the "reshuffling" of *pre-existing* genes that occurs each generation.

Genetic isolation

Man has also effected change in domestic dogs by providing the genetic isolation necessary for it to occur rapidly. **Genetic isolation** is the separation of members of a population into two or more groups so that they no longer can interbreed freely. From time to time, a particular trait that humans consider beneficial might show up in two or more dogs. Humans then breed those dogs primarily to one another in order to increase the chances that that trait will become common among their offspring.

For instance, breeders in the nineteenth century decided that a smaller version of the Collie would be beneficial. So they took Collies that were smaller than the average and began to breed them together. They then took the smallest of those offspring and interbred them. They also added some new genes through breeding the smaller Collies

to Spaniels and Pomeranians. Over a period of time, these Collies became progressively smaller, and began to look a little different. It is important to note that the smaller Collies could not be permitted to breed with bigger ones, or Collies of many different sizes would be produced. Humans provided the artificial "genetic isolation" necessary for a new breed to emerge, the Shetland Sheep Dog (commonly called the Sheltie).

Genetic drift

Genetic drift refers to random changes in the frequencies of genes in the gene pool of a population. Again, when dog breeders wanted to produce a smaller Collie, they created their own "genetic drift." They looked for small Collies to breed to other small Collies. They knew that many of the genes for tallness were missing from these dogs. Each time they bred the offspring of these dogs, they selected only the smaller ones to breed. Thus, by not allowing larger Collies to add their genes for tallness, breeders gradually eliminated these genes, and a population of dogs was produced whose small size was due to a loss of genetic information.

Genetic isolation and genetic drift also occur in nature. For example, a particular gene may be present in only a few members of a population. If they die before they have a chance to breed, the genes that only they carry will be completely eliminated from the population just as breeders often eliminate certain genes by selective breeding.

An illustration of "extreme" genetic drift is the founder effect. The Amish of eastern Pennsylvania have descended from a small group of Germans. Because they do not generally marry outside their group, they suffer from a higher number of certain diseases caused by genetic mutations than does the general population. The recessive, mutated genes of the founders have become more common in the Amish than in the general population due to intermarriage. Genetic drift can also occur if a small portion of a population unexpectedly survives and the rest die. Finally, genetic drift can be affected by mutation.

Geographic isolation

Geographic isolation occurs any time a natural barrier such as a river or a mountain range comes between members of the same population and prevents them from freely interbreeding. This, of course, causes genetic isolation in much the same way the activity of dog breeders does. Gradually, as different members of the two wild populations die before

Pexels.com.

Figure 2-2: The great depth and width of the Grand Canyon causes geographic isolation, which can lead to genetic isolation and the development of new species.

they produce offspring, genetic drift occurs. As common genes are lost, the populations get progressively less alike. This can lead even to the production of two distinct species.

On the north and south rims of the Grand Canyon live two different species of squirrels. Scientists believe that these squirrels were once of the same species. However, the Grand Canyon prevented them from interbreeding. Geographic isolation then led to genetic isolation and genetic drift, helping to form two distinct species of squirrels.

Migration

Migration can also bring about changes in a population's genetic makeup. Migration is the movement of individuals into or out of a population. In creating the Shelties, man prevented the smaller Collies from breeding with larger ones, while at the same time permitting them to mix with Spaniels and Pomeranians. This affected the genetic make-up of the Collie population by adding some genes while removing others. Similarly, if an animal leaves its group before it breeds, it will remove any genes only it possesses. Conversely, if an animal enters a new population and interbreeds with its members, it adds its genes to the new population's gene pool.

Scientists are now seeing what many call a new species formed as a result of the interbreeding of wolves, coyotes, and large domestic dogs. In this case, the migration of coyotes into the Eastern United States and Canada, combined with the destruction of much of the Eastern wolves' habitat has brought about increased interbreeding of these three species. The result, what scientists call the coywolf, is now commonly seen in these areas. **Note: in each of these situations no new information was added, only the isolation, loss, or reintroduction of pre-existing information.**

Natural selection

Charles Darwin popularized natural selection, another factor in change, in his famous book, *Origin of Species*. As was discussed in Chapter One, **natural selection** refers to the action of "nature" in influencing which organisms will survive and which will not. **Those organisms best adapted to their environment generally survive and reproduce more often than those that are not well adapted.** For example, a swift gazelle is much less apt to be caught and eaten by a predator than a slow one. Its speed makes it more likely to survive and reproduce. An insect whose coloring matches its environment is difficult to see and is less likely to be eaten. Natural selection helps change populations by selecting against certain organisms that are poorly adapted and thus against the genes they carry.

Mutation

There is one last factor that affects the gene pool. A **mutation** is a spontaneous change in a gene or chromosome. Mutations do occur, but not all of their causes are known. Ultraviolet, gamma, X rays, and certain chemicals are known to produce them. Whatever their origin, they do bring about change, but in the vast majority of cases, these changes are not beneficial; they are harmful. However, evolutionists still believe that over millions of years minute changes caused by countless beneficial genetic mutations, combined with natural selection and the other factors mentioned above, have brought about evolution.

Both evolutionists and creationists generally believe that meiosis, genetic isolation, natural selection, migration, mutation, and genetic drift work together to cause change. However, it is the *extent* of the change about which they disagree. Creationists contend

CHAPTER 3

Evolution of Man

Introduction

Perhaps the most controversial issue in evolution is the development of man. Some people accept evolution on a limited scale but believe that man is a special exception. However, if evolution is true, it follows that all organisms on the face of the earth must be a product of this process. This is what most evolutionists believe.

Section 1: Important Evolutionary Terms

Vocabulary words to know: primates, paleontologists, physical anthropologists, paleoanthropologists, geologists, bipedalism, regional-continuity model, out of Africa model, and hominid

Before discussing human evolution, it is important to know what types of scientists work in this area. Several different types of scientists look for evidence of evolution. For example, **paleontologists study fossils** of all kinds. **Physical anthropologists** (also known as **paleoanthropologists**) concentrate on human fossils. **Geologists** use fossils (and other methods) to help determine the history of the Earth.

Paleoanthropologists classify humans as **primates**. This means that they, along with approximately 200 other species such as apes, chimpanzees, and orangutans, belong to the same order. They believe that primates began to evolve about 70 million years ago, and as their evolution progressed, led to the ancestors of modern man within the last 3 to 6.5 million years. Initially, evolutionists believed that the human brain was the first characteristic to evolve in the human lineage. However, they later hypothesized that **bipedalism** (the ability to walk on two legs), together with changes in the face and teeth, came first. The brain does not fully fill the skull, and since paleontologists are working solely with the bones, they can only estimate the skull size or **cranial capacity**.

Figure 3-1: Bipedalism—humans' primary mode of transportation

There are two different views that evolutionists hold concerning the evolution of man. One is called the **"regional-continuity"** or **"multi-regional"** model. Proponents of this view state that groups of *Homo erectus* dispersed from Africa into many areas of the old world; then each group fathered a line that gave rise to modern humans. There would have been some intermixing of these groups that would have maintained their basic "human" similarities.

The second model, called the **"out of Africa"** or **"single origin"** model, states that modern humans evolved in Africa and then came out of the continent and replaced other,

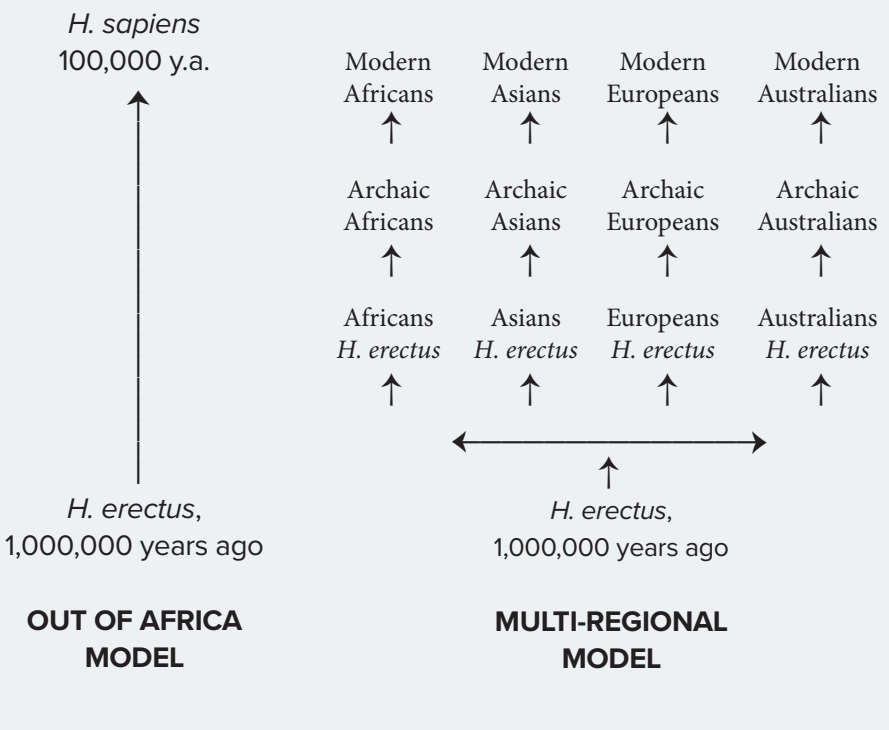


Figure 3-2: Evolutionists' models of origins of man

less-evolved hominids that had left Africa at an earlier time. Since the possibility of several lines of humans evolving simultaneously is the minority view among evolutionists, this chapter will deal primarily with the out of Africa model.

Equally important is understanding exactly what is meant by the word **hominid**, since its definition has been changed by some paleoanthropologists. Until recently, the term hominid referred only to those creatures that were thought to be in the line of man. However, some anthropologists are beginning to classify gorilla, chimpanzee and orangutan ancestors as hominids also. In this chapter, the term *hominid* will refer only to those fossils believed by evolutionists to be in the line of humans.

It is also important to note that not all evolutionists agree about which hominids belong in the human evolutionary line. For example, *Paranthropus robustus (formerly Australopithecus robustus)* will not be covered here, as most anthropologists consider this genus and species to be in the line of modern apes and not of humans. Several other hominids are also not covered for similar reasons.

Scientists are hampered in the field of human evolution by the lack of evidence. First of all, there are only a few hundred fossils and some related information such as the Lake Laetoli footprints of East Africa. Often, only a few pieces of a given fossil are found. Thus, evolutionists must work from limited records and are often changing their interpretations as new fossils are uncovered. The following specimens are by no means all of the ones that have been found. However, they represent what many evolutionists accept as being in the line of man.

Questions for Review:

1. Name and define the specialties of the following scientists: paleontologists, paleoanthropologists, geologists.
2. What are different names for paleoanthropologists, out of Africa model, and regional continuity model?
3. Explain the difference between the out of Africa model and the regional continuity model.
4. Define the following terms: primates, bipedalism, hominid, cranial capacity.

Section 2: Early Hominids

Ardipithecus ramidus and *Ardipithecus kadabba*

Estimated cranial capacity: 350–400 cubic centimeters.

In 1992 in the Afar Depression of Ethiopia, paleoanthropologist Timothy White discovered the bones of an animal he thinks is bipedal. He dated the fossil at 4.4 million years old. Although he at first thought it to be an australopithecine, he later decided it was more primitive and created a new genus and species for it—*Ardipithecus ramidus*. (The word

Ardipithecus was formed from an African word for "ground floor" and a Greek word for "ape"; ramidus comes from an African word for "root.")

White and his researchers found some teeth, a mandible, some arm bones, and pieces of a skull. In 1994 additional bones were found that were believed to be of the same species. These bones, together with those found earlier, comprised about 45 per cent of a skeleton, including most of the hands, feet, pelvis and skull. Nicknamed "Ardi," the fossil is believed to be that of a 110 pound female.

Later, researchers from Indiana University discovered fragmented remains from nine separate fossils believed to belong to the same species. They were found on the western edge of the Afar Depression and were also dated to be 4.4 million years old.

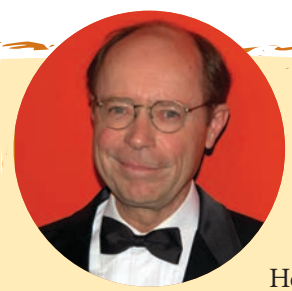
The brain size of this hominid was small—between 300 and 350 cubic centimeters. This is less than 25 percent of that of a modern human. Ardi was believed to be bipedal on the ground but to go on all fours when climbing trees, just as modern humans do. However, she also had a big toe that could grasp branches, as members of the ape family do. *Ardipithecus ramidus* lived in a woodland habitat.

T. Michael Keesey, Wikimedia Commons CC BY-SA 2.0

Figure 3-3: *Ardipithecus ramidus* skull, reassembled from fragments

From examination of the dental remains, researchers have concluded that *Ardipithecus ramidus* was omnivorous. Since its teeth show characteristics of both apes and a later hominid, *A. afarensis,* many evolutionary paleontologists believe it to be a common ancestor of both apes and humans.

In 1997 members of an international team of paleoanthropologists discovered a jawbone fragment, a mandible, some teeth, a collarbone, and some fragments of hand, foot, and arm bones. Altogether, the team found 11 specimens from at least 5 different individuals. These



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Dr. Tim White

BIOGRAPHY—Dr. Tim White

Tim White was born in Los Angeles county, California, on August 24, 1950, but he grew up near Lake Arrowhead, close to the San Bernadino National forest. As a child he roamed the mountains, collecting an assortment of relics. He also developed an interest in fossils that was to stay with him as he grew older. He attended the University of California, Riverside, where he majored in biology and anthropology. White then earned his doctorate in physical anthropology at the University of Michigan. After receiving his doctorate, White joined the faculty at the University of California, Berkeley, where he has held several positions. He is currently professor of integrative biology at the university. Dr. White has also spent much of his life doing field work. He has worked with members of the Leakey family, as well as with Donald Johanson on several fossil finds. In 1994 White's own team, while working in the Afar Depression in Ethiopia, found the fossil he later named *Ardipithecus ramidus*.

were located in several sites. The remains at first were considered a variety of *A. ramidus* but later classified as a new sub-species, *Ardipithecus ramidus kadabba*. Dr. White is now proposing that this creature was so different it should be classified as a separate species, *Ardipithecus kadabba*. Using argon-argon and another dating method, members of the team have decided that "most of the fossils are between 5.6 million and 5.8 million years old, although one toe bone is a few hundred thousand years younger."[1] *A. kadabba* is believed to have walked upright and to have been an ancestor of *A. ramidus*.

Questions for Review:

1. When, where, and by whom was *Ardipithecus ramidus* found?
2. Give three characteristics of *A. ramidus*.
3. To whom is *Ardipithecus kadabba* assumed to be related?

Section 3: Early Australopithecines

Australopithecus anamensis

Estimated cranial capacity: 350–400 cubic centimeters.

One recent discovery by Meave Leakey, wife of the well-known paleoanthropologist, Richard Leakey, has many scientists debating whether she has found the oldest australopithecine. In 1994 Dr. Leakey and her coworkers found a mandible with an upper jaw nearby. In another location workers found the upper and lower parts of a tibia, the main bone of the lower leg. In the same general vicinity, several other skeletal fragments have been found. There are volcanic ash layers, a form of igneous rock, in the Turkana Basin. Since radiometric dating is used to date igneous rock, Dr. Leakey employed this method to assign a date of 4.1 million years to her specimen. She states that the tibia fragments prove her specimen walked upright. However, the mandible shows the creature is "chinless," an apelike characteristic. She also feels the roots of the canine teeth in the upper jaw are more vertical in their placement than they are in chimpanzees—a human characteristic. Dr. Leakey has named her specimen *Australopithecus anamensis*. "Anamensis" is based on a

Pierre-Selim, Wikimedia Commons CC BY-SA 2.0.

Meave Leakey

BIOGRAPHY—Meave Leakey

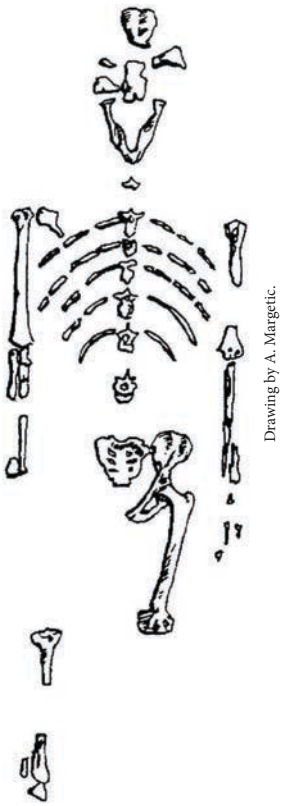
Dr. Meave Leakey, a zoologist and paleontologist, was born Meave Epps in London in 1942. In 1965 she went to work for British anthropologist Louis Leakey. Under his leadership she studied primates in Kenya. In 1969 she was invited to join a fossil-hunting expedition led by the Leakeys' son Richard. Two years later she and Richard married, and she became part of the famous fossil-hunting family.

Kenyan tribal word for "lake," since Dr. Leakey's specimen was found near Lake Turkana, Kenya.

Australopithecus afarensis

Estimated cranial capacity: 400 cubic centimeters.

Another specimen that was for many years generally considered as being the oldest known hominid is *Australopithecus afarensis* (named for the Afar region of Ethiopia). Individuals working for an anthropologist named Donald Johanson found *A. afarensis* in 1974 in Africa's Great Rift Valley. Johanson dated the fossil, using the geologic time scale, and estimated its age to be approximately 3.6 million years old. Later radiometric dating efforts have put its age at 3.18 million years old. About 40% of the skeleton was found, including a few parts of a skull. The bones were found with many other fossils representing at least 35 different individuals. The skeleton was believed to be that of a female that had been a little over 3 feet tall and probably weighed less than 50 pounds. Johanson nicknamed the specimen Lucy after a Beatles song that was popular at the time. The arms appear to be long and chimp-like. However, many scientists believe that Lucy's skeleton is human-like in many respects and that she definitely was bipedal.



Drawing by A. Margetic.

Figure 3-4: An illustration of the bones of *Australopithecus afarensis* (Lucy) that were found in one location. Note: the skull parts are only fragmentary.

Eighteen years later, in 1992, Johanson returned to Africa, hoping to find a complete afarensis skull. He and his associates returned to the general area where Lucy was found and discovered a skull that they believe belongs to the *afarensis* species. However, the skull is much larger than Lucy's head would have been, and is considered an afarensis male. Johanson has classified *A. afarensis* as an early australopithecine and an early ancestor of humans.

Map by NASA. Public domain.

Figure 3-5: The red line denotes the Great Rift Valley of Africa where so many fossils have been found.

However, not all scientists agree. Because no tools were found with Lucy, some scientists believe *A. afarensis* to be an ancestor of apes rather than of humans. In fact, Louis Leakey's wife, Mary and their son Richard, who have also made many discoveries relating to man's ancestry, feel that *A. afarensis* was simply an australopithecine whose line became extinct.

Since Johanson's discovery, several other specimens have been found and classified as *A. afarensis*. However, Lucy is the most complete individual specimen found to date.

Questions for Review:

1. When, where, and by whom was *A. anamensis* found?
2. How much of the fossil was found? Were all the parts found in the same location?
3. By what method was it dated, and how old is it believed to be?
4. What features of *A. anamensis* appear to be ape-like, and what features are believed to resemble humans?
5. When, where and by whom was *A. afarensis* found?
6. How much of the fossil was found? Were all the parts found at the same time and together?
7. Name two characteristics that Johanson believes *A. afarensis* (Lucy) possessed.

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Donald Johanson

BIOGRAPHY—Donald Johanson

The discoverer of *Australopithecus afarensis*, Donald Johanson, was born in Chicago, Illinois, in 1943. When his father died two years later, Johanson's mother moved with her son to Hartford, Connecticut, where she worked as a domestic and her son attended school and developed an interest in anthropology. His interest was encouraged by a neighbor who taught anthropology and who became a surrogate father to him. Planning on a career in chemistry, Johanson entered the University of Illinois, but he switched majors and graduated with a degree in anthropology instead.

Johanson later received his master's degree from the University of Chicago and completed work for his doctorate four years later. In 1972 Johanson decided to mount an expedition to the Hadar Valley in northeastern Ethiopia, the home of the Afar people. There two years later in the fall of 1974 members of the expedition discovered Lucy, which became known as *Australopithecus afarensis*. The term australopithecus means 'southern ape,' while afarensis refers to the Afar region where Lucy was found.

Section 4: Later Australopithecines

Kenyanthropus platyops

Estimated cranial capacity: 350–400 cubic centimeters.

One of the most controversial proposed ancestors of man is *Kenyanthropus platyops*. The single specimen of this genus was found in 1999 near Lake Turkana, Kenya by Justus