

HUMAN ORIGINS

WHAT BONES AND GENOMES TELL US ABOUT OURSELVES

Rob DeSalle & Ian Tattersall

Texas A & M University Press

College Station

A PETER N. NÉVRAUMONT BOOK

CHAPTER ONE

THINKING ABOUT OUR ORIGINS

10 HUMAN ORIGINS

WHEN WE BEGAN OUR CAREERS AS SCIENTISTS, WE NEVER REALIZED THAT PHILOSOPHY WOULD BE SUCH A HUGE PART OF OUR EVERYDAY WORK.

But understanding the role of philosophy in what we do as anthropologists, systematists, and evolutionary biologists is critical not only to how we do our science but also to what our science might mean in the greater scheme of things. This has become even more evident to us during the preparation of the Anne and Bernard Spitzer Hall of Human Origins at the American Museum of Natural History, to which this book is intended to serve as a companion—or as a substitute, in the case of those who are unable to make it to New York.

The major question we approach in this chapter is why we would want to understand our evolutionary past in the first place. In this context, we will discuss the outward uniqueness of our species *Homo sapiens*, as well as our obvious similarities to other organisms on this planet. And we will place both these similarities and uniquenesses in a more general context, philosophical, if you will. For our epistemology (a fancy name for how humans explain knowledge) of human origins depends on the rules we devise for establishing the validity of how we know and perceive those origins.

The “philosophical” approach of this chapter will also allow us to look at this inherently fascinating subject from a historical perspective, starting with ancient—even prehistoric—views and continuing with the many different ways in which the origins both of humans and of the universe that contains them have been explained over the last five or so millennia. We will attempt to make this excursion into the history of attitudes to human origins both temporally and spatially complete, meaning that we will not only examine the changes in how humans have approached their origins through the ages, but also give a multi-cultural perspective by detailing the attitudes toward human origins of a representative selection of cultures across the globe.

The establishment of the historical background will be followed by a closer look at the scientific context of human origins. We strongly believe that by clearly explaining the scientific process, it will become evident which approaches to understanding our origins are scientific and which are not. This subject is an extremely important one in the current intellectual climate, and is an essential one for this book. The last part of this introductory chapter will introduce the human origins “toolbox.” By discussing what information we have, and need, to understand the science of human origins, we can introduce the three major components of the human origins toolbox: paleoanthropology, genomics, and evolutionary process.

Human Origins and Sophistication

What is it about our human nature that makes us wonder about where we come from? We need only to look upward at the sky or downward to the ground to be puzzled, amazed, and inquisitive about our and their existence. But how did we achieve the ability to wonder about our place in nature and in the universe? One way to understand this important question is to delve into the attitudes of ancient peoples. Some ancient peoples have left written or oral traditions concerning their existence and their place in nature, and some have left more indirect traces. For even if we can't ask humans who lived 25,000 years ago what they might have thought about their existence, we can try to infer this from the material evidence they left behind of their lives. And it turns out that people who lived that long ago were probably very sophisticated in their perception of the world around them and their place in it.

The recently discovered cave paintings at Chauvet, France, and the more famous but younger ones of Lascaux in France and Altamira and El Castillo in Spain, are but a few examples of amazing and extremely beautiful depictions of animals from the period between about 34,000 and 10,000 years ago. [Figure 1] At first glance, these paintings might seem to be straightforward renditions of what their creators saw on the landscape around them. But the selection of animals depicted, the juxtaposition of species, and the almost invariable presence along with them of mysterious signs and symbols make it clear that there was a lot more to these images than simple representation. At one time, for instance, it was thought that these paintings might have been related to the hunt: that the artists believed that the ritual slaying of animals on cave walls—for many animal images appear to be pierced by weapons—would by some sympathetic magic lead to success in hunting them.

But scientists who analyze the diets and lifestyles of these ancient people through examination of food remains at their living sites have determined that they were not regularly eating the animals most frequently seen in the paintings. The cave art is more than a mere menu, and is much more likely the result of sophisticated minds attempting to grapple in a larger sense with their surroundings, perhaps even with their very existence. In an even more immediate sense, we recognize that the art was the product of minds that 21st century humans can relate to. There can be little question that the people who quested in this way 30,000 years ago were able to think not only about a plethora of practical subjects, but about abstract concepts, such as their existence on this planet and their place in nature. In this fundamental sense, these people were modern people.

What is not clear is what their exact thoughts were. Resurrecting entire systems of belief from such indirect evidence is an impossible task. But such exactness is much less of a problem when we come to the written and oral traditions that are recorded for several ancient civilizations. It is amazing that, of the many civilizations that have left or are continuing to leave records of their thought processes, almost all have bequeathed us evidence of their interest in their own origins. Tax records aside, perhaps the most prominent of their concerns seems to have been with what, for lack of a better word, we would call "creation." The almost universal need shown by most civilizations, religions, and philosophical movements of the last five millennia to address this problem of origin extends not only to people, but to Earth itself. The various creation stories and their philosophical



FIGURE 1. Animal images from the "Hall of Bulls" at the cave of Lascaux, in southwestern France. Accompanied by a profusion of inscrutable symbolic signs, these 17,000 year-old images have never been exceeded in their power and expressiveness. Courtesy of Norbert Aujoulat, Centre National de Préhistoire, Ministère de Culture, France.

ramifications are deeply affected by the underlying thought processes. Even a brief examination of the philosophical issues associated with creation myths will make it clear that the fundamental structures of the creation stories used to explain the natural world around us are very different from the structures of scientific accounts. Of course, both religious and scientific approaches to human and planetary origins involve protagonists and events. But scientific approaches have a unique philosophical framework all to themselves, and an understanding of this framework is critical to how we, as scientists, approach our own origins and the origins of the natural world around us.

Creation Myths and the Philosophy of Existence

Creation myths from different cultures are unique in their details, but the thought process that lies behind them is pretty universal, and is based on an apparently innate desire among people to know their roots and heritages and places in nature. [Figure 2] This is why the same general ideas in creation myths are repeated over and over in very different cultures.

While it is difficult to categorize these myths, there are some commonalities among them. For instance, the Hmong, Maya, Navajo, and Norse all suggest that man arose from some plant matter (pumpkins, maize dough, white and yellow corn, and logs

respectively). But man can also come from other substances, such as clay (Greek and Judeo Christian accounts), dirt (Inkan accounts), and eggs (Egyptian and Surat Shabda Yoga accounts). In other recountings, individual gods split in two to form Earth and water, as in ancient Babylonian mythology and various ancient Chinese accounts of creation. And in still others, humans are the offspring or creation of the gods (Maori myths, Zoroastrianism, ancient Greek, Inca, Christianity, Islam, and others). Some approaches

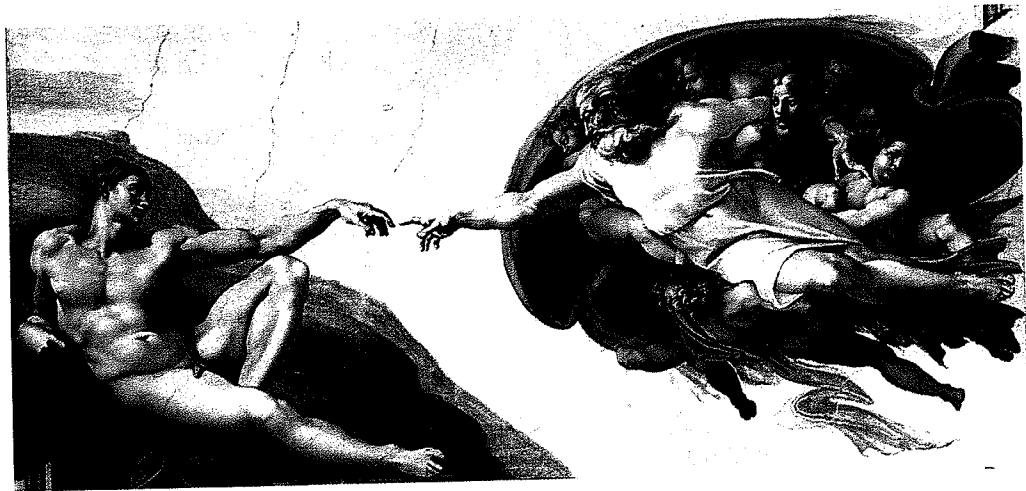


FIGURE 2. Two creation myths. Below: The creation of the cosmos and the separation of heaven and Earth are shown on the painted sarcophagus of Butehamun, scribe, in the necropolis of Thebes. The star-covered body of the sky-goddess is being lifted up by the air-god. 21st Dynasty. Turin, Museo Egizio. Above: Detail from the Sistine Chapel ceiling by Michelangelo.

to creation, such as those of conservative Christianity, Judaism, and Islam, have emphatic ideas embedded in their written records (the Bible and the Quran) that implicate a creator in the origin both of man and the universe.

Even refinements of these strongly phrased and rigidly posed accounts, such as intelligent design is to conservative Christianity, implicate a creator as the ultimate cause of the origin of complex things. Other accounts of creation skirt the issue altogether—such as those of Buddhism and Taoism. Buddhism suggests that questions about creation are not connected with the goal of life, so that ideas about creation are not a part of “holy life.” Taoism suggests that because we don’t know the real nature of creation “we can only call it the Way.” Oral accounts of human origins, such as those of some native American groups (e.g., Iroquois, Inuit, and Huron) involve women, while others, such as those of the Yoruba in western Africa, leave women out completely.

While the conservative Christian account of creation is often claimed to be at odds with more natural explanations for the existence of the universe in general and humans in particular, many other accounts from other religions are not in conflict at all—and almost all of them work at the level of metaphor. We have already mentioned Buddhism and Taoism as religions that avoid the issue of creation and hence have no conflict with ideas of evolution; but Hinduism, Zen, Japanese mythology, and many specific branches of Christianity also see no conflict between their doctrines and natural explanations for the origin of universe and man. For instance, the Catholic Church made the following statement on Oct. 23, 1996: “Fresh knowledge leads to recognition of the theory of evolution as more than just a hypothesis.” The statement clarified a longstanding attitude of the Catholic Church that a natural explanation of the universe, such as evolutionary theory, does not conflict with Catholic doctrine. The rider to this statement, however, makes it plain that accounts of evolution are only okay as long as the ultimate creator of the human soul is God. And it appears that as leaders change in religions, so might attitudes toward science. This notion is exemplified in a recent *New York Times* editorial by Christoph Schönborn, the Roman Catholic cardinal archbishop of Vienna. In this editorial, Schönborn shifts the attitude toward evolution from one of non-competition to one of direct confrontation:

Evolution in the sense of common ancestry might be true, but evolution in the neo-Darwinian sense—an unguided, unplanned process of random variation and natural selection—is not. Any system of thought that denies or seeks to explain away the overwhelming evidence for design in biology is ideology, not science.

The critical word in the quote above is “design” about which we will have more to say later in this chapter.

The breadth of these accounts of the beginning of the universe and the origin of man illustrates the importance to the human mind of understanding the origin of the natural world around us and our own place in it. But there are different approaches to doing this. The religious and mythical accounts are united by one basic approach—faith. In order for these accounts to mean anything with respect to the natural world, one must have faith in the accounts, faith in a creator, or faith in an initial cause for the creation of the universe. No amount of evidence (short of the physical appearance of a creator) can help to evaluate the accuracy of such explanations of the origins of the universe, Earth, and humans.

Animal Parts and Sailing Beagles

While all creation myths and stories have traditionally satisfied humans' need for explanation of their surroundings, more precise descriptions of nature have been developed since the birth of modern science. Over the past two centuries or so, a completely new way of thinking about nature has emerged; but ancient science is another matter, and it makes an interesting halfway house in ways of looking at the world. Aristotle was the first writer to detail the various organisms in nature and to try to make some sense of the lavish diversity of the natural world. In his *Parts of Animals*, he described some 500 different organisms, with great precision and some speculation. Imagine being the first person in the history of humans to realize and write the following:

Of animals, some resemble one another in all their parts, while others have parts wherein they differ. Sometimes the parts are identical in form or species, as, for instance, one man's nose or eye resembles another man's nose or eye, flesh flesh, and bone bone; and in like manner with a horse, and with all other animals which we reckon to be of one and the same species. *Parts of Animals* Book I; Section 1.

This passage demonstrates an acute realization of the form and substance of animals and the suggestion that parts of one animal will resemble parts of other animals. But Aristotle could not quite get away from considering animals as fixed creations, and indeed today his ideas about the generation of animals seem quite bizarre to us:

Of these insects the flea is generated out of the slightest amount of putrefying matter; for wherever there is any dry excrement, a flea is sure to be found. Bugs are generated from the moisture of living animals, as it dries up outside their bodies. Lice are generated out of the flesh of animals. *Parts of Animals* Book V; Section 31.

In Aristotle's view animals remained fixed, unchanging entities in nature. They were generated, not evolved. His approach was to describe the type of organisms, to extract the average characteristics of organisms. This forced him to think in a very narrow sense about nature, and his great contribution to our understanding of it lay in his acute observational and descriptive abilities. But at the same time, this meant that Aristotle was unable to recognize the importance of biological variation. While in Books VIII and IX of the *Parts of Animals* he did recognize that variation existed—as is evident in his detailed descriptions of varieties between and within species—he simply subdivided this variation further, and described the resulting varieties as types.

The Christian tradition of observing the universe retained the creation myth as its basis and reaffirmed Aristotle's type-based thinking, which thus directly influenced the way nature was viewed for nearly two millennia. Other societies, cultures, and religions also imported a semblance of the creation myth into their observations of the natural world; and indeed, an element of storytelling is implicit in almost any description of nature. Many folk descriptions of nature in general and of organisms in particular are derived from creation myths. But the main common thread of Aristotelian and Christian views was the idea

that species were fixed. The idea that species were unchanging entities fits very nicely with the Christian creationist account of the origin of life and of humans, in which, the Creator had made all of the species on the planet just as they exist today.

In this brief discussion of evolutionary thinking we have succumbed to the temptation to jump immediately to Charles Darwin and the influence of the observations he made during the voyage of the *Beagle*. [Figure 3] For aside from some wonderful developments in early Islamic Arabian science, the rumblings of a great leap forward in science during the Renaissance, the opening of the mind to studies of nature, and the rise of anatomical studies in Europe just prior to Darwin's work, the period in between Aristotle and Darwin (over 2,000 years) is remarkably barren of any new thinking about origins. The Dark Ages were truly dark with respect to the human desire to understand the place of humans in Nature; and the Renaissance focused mostly on the physical sciences, as did Arabian science. Most of the anatomical studies of the late 1700s and the early 1800s were shackled by religious beliefs about the origins of life, species and man. It took an immense stride in thinking to break away from the two millennia-old view of our origins.

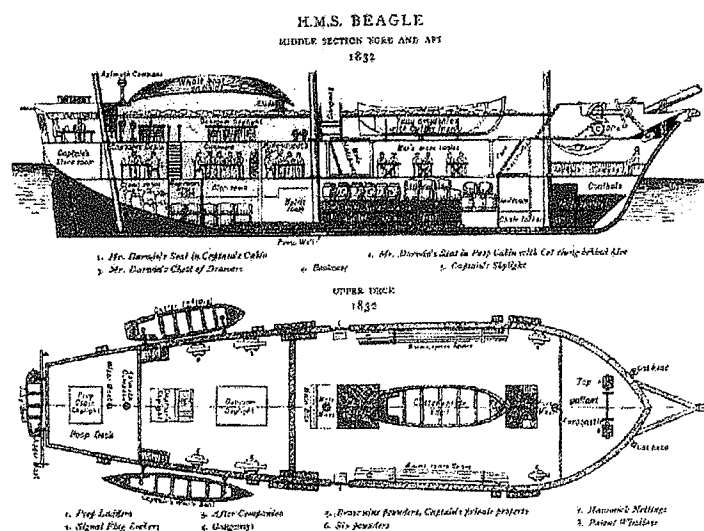


FIGURE 3. Cross sectional diagram of the HMS *Beagle*, the ship that Darwin sailed on to South America and the Galapagos.

Darwin's contribution to our modern scientific perspective was his articulation and defense of the idea that evolutionary processes, and particularly natural selection, have molded the malleable natural world around us. His ideas about nature began to form when he was a young unpaid naturalist on the global circumnavigation of the HMS *Beagle* from 1831 to 1836; and they had, indeed, matured considerably by the time he left the vessel. But then, for two agonizing decades, he kept his ideas to himself. He was forced to make them public, and to display the reasoning that had formed them, by the emergence of similar thinking from his younger contemporary Alfred Russel Wallace and in 1859 Darwin published his world-changing perspective in his great work *On the Origin of Species by Means of Natural Selection*.

This massive volume is rightly regarded as among the most seminal works in the entire history of science. What did Darwin do right to merit his amazingly important place in human thought? Of the many things he achieved in the *Origin of Species*, three stand out. The first is his presentation of overwhelming evidence in favor of the process of evolution as the explanation for the pattern evident in the natural world. Darwin called his treatise "one long argument" and his friend and supporter Thomas Huxley called it "a long chain of arguments," for the existence of evolution. His second major achievement was to present a possible mechanism for evolution. This he called "natural selection," and we will have much more to say about it later. His third achievement was to add a completely new approach to observing things in nature. Remember that Aristotle looked to the mean, or the average, type when he wanted to describe things. If variation existed, he either melded it into an average or type description, or he called the variation a new thing entirely.

In contrast, Darwin turned this way of thinking upside down and began to believe that the variation he saw in nature was real, while the mean or type was an abstraction. What this allowed Darwin to do was to begin thinking about how nature dealt with variation, and to recognize that species were *not* fixed. Once he had recognized this, the floodgates opened, and his revolutionary perspective became the pervasive and persuasive way of explaining nature. In particular, Darwin saw that natural selection acted upon the variation he observed in natural populations, and that he could use this in explaining how evolution happened. It was because he thought in this new way that he could see that species were not fixed. In fact, the only figure in *On the Origin of Species* is a genealogy, or tree, that shows the lack of fixity of species and the fluidity of transitions of forms from generation to generation. We will have much to say in subsequent chapters about evolutionary trees.

While totally committed to evolution as an explanation of natural diversity, Darwin personally found the results of his novel thought processes excruciating. Later, he admitted that when it dawned on him that evolution was indeed a possible way of explaining nature, that species were not fixed, and that natural selection was a possible mechanism to explain that fact, it felt like "confessing a murder." For the past 150 years, scientists have taken Darwin's astonishing insights to heart, and by dint of a lot of hard work and reasoning, have molded them into a diverse but coherent branch of biology.

Eureka! The Philosophy of Science

What exactly can we say is real or true in the universe? Is knowing something different from explaining something? How do we learn things about our biological past? These are all questions that affect our philosophical approaches to our origins, and that bear directly on our ability to assess our scientific approaches to understanding our universe and our origins. The postmodern notion of the natural world, for example, suggests that knowing things for certain is not possible. What this means in a scientific context is that when we study history, especially natural history, there is no assurance that we will discover the truth – or even that there is any need to try. The truth simply is unknowable with respect to natural history, where we lack the ability to go back in time and observe the events anew. Some philosophers of science have even extended this notion of unknowable truth to laboratory sciences, such as chemistry and physics. But if truth in

the sciences is not attainable, what, then, is it that scientists do, especially in the historical sciences, those most relevant to understanding our origins?

This question is directly relevant to one of those just asked: Is knowing something different from explaining something? The answer to this question is yes, definitely; and since the postmodern view of the world tells us that we cannot know things for certain, then we are left with explaining things. Explaining is our substitute for knowing, and science is about finding the best explanations for natural phenomena.

One of the best-known philosophers of science in the 20th century was Karl Popper, who was preoccupied with how science worked. His conclusions are highly relevant to the study of the origins of the universe and of humans. Popper proposed that there is very little that we can know for sure. He suggested that the best explanations for things in the natural world come from very severe criticism, or testing, of ideas or hypotheses. Popper also recognized that because we cannot know the truth, the next best thing is to be able to show that certain ideas or hypotheses are false—for verification, the search for proof, is a shaky basis for science.

The classical example of this situation is the white swan statement. We can make the statement that “all swans are white.” We can superficially confirm or verify this hypothesis by finding a few white swans and then just quit looking. But to prove or confirm the statement completely, we would need to find all the swans on the planet and verify that they are all white, an impossible task. When one adds the dimension of time to the problem (if you say “all swans,” then that should also include swans in the past and the future, shouldn’t it?), the verification of the statement becomes impossible, unless one has a time machine.

What is possible, though, is to falsify, or reject, the statement that “all swans are white.” The mechanism of falsifying this statement exists simply in finding a swan that is not white. [Figure 4] Such do indeed exist, in the form of *Cygnus atratus*, the Australian black version of swans. The existence of the Australian black swan then negates or rejects the initial statement that “all swans are white.” The point here is that while you can often

verify statements on a superficial level, you can never do it universally; but when a statement is falsified once, it drops out of contention. There is a huge difference, then, between verifying a statement and testing it to attempt to falsify it.

In Popper’s perspective, then, statements that are constructed so as to be verified are unscientific. Only statements that are framed so that they can be tested or falsified are scientific; and any statement that cannot be refuted is not scientific. Science is not an authoritarian system, and contrary to popular belief, irrefutability is not a desirable characteristic of scientific theory. Indeed, the only advances we make in science come at the expense of refuting statements that have been made. Every day in science, perfectly good



FIGURE 4. *Cygnus atratus*, the Australian swan that falsifies the assertion that “all swans are white.” Courtesy Wikipedia.

statements or hypotheses are put to the test, and refuted. And it is through the falsification of such hypotheses that we refine our knowledge of the natural world around us.

Through knowing what does not exist or what is not real (and those things or statements that are falsified help us to decide this), we are able to describe the natural world more accurately. In fact, this approach of falsifying things allows us to come up with the best available explanations for the things we see around us. We won't know if our explanations are true, but we can be assured that they are the best we can do, at least for the moment, to explain the natural phenomena around us. What this also means is that many ideas in science are highly provisional and prone to rejection by the process that Popper described.

Why make such a big deal out of falsifiability and testability? Because, unlike the creation myths described in the previous section of this book, the basics of evolutionary theory are testable. Even the hard-to-please Popper, after much thought, came to the conclusion that evolutionary theory offered "a possible framework for testing scientific hypotheses." In other words, evolutionary questions can be posed in the form of statements that are susceptible to falsification. And indeed, over the past century, thousands of hypotheses relating to the evolutionary process have been tested, and many rejected. This process, of testing and rejecting hypotheses about the patterns of relationship among the organisms on this planet has led to the recognition of common ancestries as the best explanation for the pattern of life we see around us (sets within sets).

Actually, it turns out that evolution is the *only* approach to explaining our natural world that predicts the pattern we actually find out there. The other possible alternative currently proposed to explain what we see around us is special creation (or, in its most recent disguise, "intelligent design"). [Figure 5] Creation by a supernatural being would imply only that the world is the way it is because that supernatural being decided to make it that way. It makes no predictions about the pattern we actually see—whereas evolution does. The result is that the creationist explanation for our natural world is untestable. To accept creation as an explanation requires faith. And although faith is quite legitimately untestable, it isn't science.

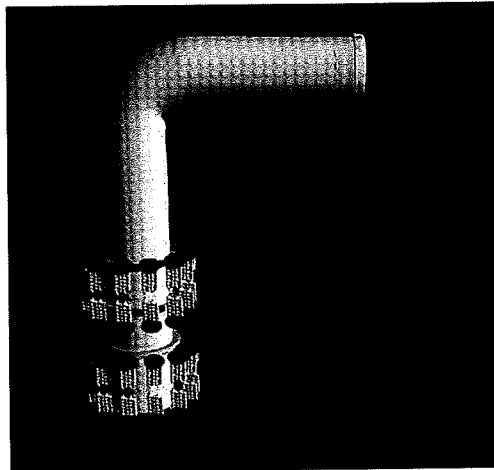


FIGURE 5. A flagellum—the symbol of ID. according to Intelligent Design proponents, this structure is supposed to be irreducibly complex.

In an amusing critique of the "science" in intelligent design the writers at the humor newspaper *The Onion* offered this headline: "Evangelical Scientists Refute Gravity With New 'Intelligent Falling' Theory." [Figure 6] This cleverly written satire points out the problems with "faith-based science." The fictional conservative "intelligent falling" scientist quoted in the article makes the following statement: "Things fall not because they are acted upon by some gravitational force, but because a higher intelligence, 'God' if you will, is pushing them down." An interesting statement, but entirely untestable.

In the context of "intelligent falling," no one in his right mind would suggest that the concept of gravity is not a natural force,

because of the many scientific hypotheses that have been tested and falsified about gravity since Newton's time. The series of testing experiments on this question over the past several centuries has accumulated to the point that the only available explanation for gravity is a natural one. Note that over the past centuries several ideas about, and formulations of, gravity were in vogue before ultimately being rejected after scientists tested them and found them wanting. The provisional nature of the current formulation of gravity has at no time in its development jeopardized its natural explanation. "Intelligent falling," or any other faith-based explanation for gravity would, we know, be untestable and hence unscientific. Likewise for the faith-based explanations for the origin of the natural world around us, and for the origin of our species in particular.

Evangelical Scientists Refute Gravity With New 'Intelligent Falling' Theory

August 17, 2005 | ISSUE 41 • 33

KANSAS CITY, KS—As the debate over the teaching of evolution in public schools continues, a new controversy over the science curriculum arose Monday in this embattled Midwestern state. Scientists from the Evangelical Center For Faith-Based Reasoning are now asserting that the long-held "theory of gravity" is flawed, and they have responded to it with a new theory of Intelligent Falling.

ENLARGE IMAGE



Rev. Gabriel Burdett explains Intelligent Falling.

"Things fall not because they are acted upon by some gravitational force, but because a higher intelligence, 'God' if you will, is pushing them down," said Gabriel Burdett, who holds degrees in education, applied Scripture, and physics from Oral Roberts University.

FIGURE 6. Intelligent Falling: A fictional headline and news story from the humor newspaper *The Onion*.

A Toolbox for Human Origins

Throughout this book we will delve into the scientific discoveries, experiments, hypothesis tests, and theories about human origins. As with any project, we need tools to explain these subjects well—a toolbox, so to speak, for human origins. The toolbox for human origins 40 years ago consisted of three major tools—paleoanthropology, genetics, and evolutionary theory. The big difference in the toolbox of today is that all three of these tools that already existed in the 1960s and 1970s have been greatly refined and expanded, rather as the toolboxes our fathers used around the house look very primitive, compared with the ones we use now around ours. The old screwdriver is present in a power version, the handsaw is replaced by an electric programmable round saw, and the spirit level has been evicted by a laser-based leveling device.