Evolution

Evolution is both a theory and a fact. We know that groups of organisms change over time. This is an established historical fact that has been overwhelmingly determined by the fossil evidence, the details of anatomy, molecular biology and the astonishing depth of new genetic information. Very substantial changes in organisms have been shown in recorded history with the breeding of pets, farm animals, crops and decorative flowers. There is the rapid evolution of bacteria that are resistant to antibiotics. We have seen the evolution of dark colored moths that are highly camouflaged in dirty urban environments. We know that organisms change. This is the fact of evolution.

The theory of evolution is the scientific description of the process by which organisms change. The term "theory" can be used colloquially to indicate an unconfirmed speculation. In science "theory" has a different meaning. Theory is used to indicate fully confirmed scientific laws such as in the "theory of gravity" and Einstein's "theory of relativity." A theory in science must make statements about the world that can be proven or disconfirmed by experimentation or objective observation. Scientific theory is confirmed by that evidence as evaluated by the preponderance of scientists.

What does the theory of evolution say and how has it been confirmed? Darwin described evolution as descent through generations with modifications that are then selectively enhanced in the population if those modifications contribute to the organism's ability to survive and reproduce. This is still an excellent one sentence summary of evolution. In Darwin's time this could be deduced from the externally obvious characteristics of organisms.

Darwin sailed to the Galapagos Islands in 1835. Islands start as rocks with almost no life. This means that when life appears there is often little competition for the available sources of food. The few organisms that arrive on the island or island system often have numerous choices concerning the type of food that they might prefer. If those that have similar preferences mate with each other they will over time form a different species from the others of their type. The ones that are best physically suited for the food choice made (ecological niche) will better survive and reproduce. This creation of multiple species from one starting species is called adaptive radiation. It happened with the finches on the Galapagos Islands, now named after Darwin..

There are at least thirteen species of Darwin's finches on the Galapagos Islands. They are highly related to each other with a major difference being the shape of the bill and whether they are tree or ground dwellers. Some specialize in eating insects, others eat seeds or fruit. Darwin noted, "One might really fancy that, from an original paucity of birds in this archipelago, one species had been taken and modified for different ends."(1) Darwin recognized that all of these species were unique to the Galapagos but similar to a mainland genus. These finches provided major evidence for common evolutionary descent with modification.

There were once fifteen species of Giant Tortoise on the fifteen Galapagos Islands, another example of adaptive radiation. Darwin noted, "The inhabitants...state that they can distinguish the tortoise from different islands; and that they differ not only in size, but in other characters. Captain Porter has described those from Charles and from the nearest island to it, namely Hood Island, as having their shells in front thick and turned up like a Spanish saddle, whilst the tortoises from James Island are rounder, blacker, and have a better taste when cooked."(2) The length of the neck and the shape of the shell varies depending upon the need to reach higher to obtain food on a given island. They evolved from a small number (perhaps a single pregnant female) of a much smaller turtle species from the mainland. The large size came from the fact that there were no other large herbivores competing for that ecological niche.

These Galapagos examples are strongly suggestive of common descent given their extreme similarity. The theory of evolution generalizes this principle and says that all of life shares a common ancestry. This has been well documented with fossil and genetic evidence.

There is no intrinsic contradiction between religion and science unless a given religious believer asserts something about the physical world that a competent scientist can show to be untrue. Some people do assert for religious reasons that common descent does not occur. They are especially concerned about including humans among those that share a common descent with all other living creatures. They feel that if evolution accomplished the creation of human life then the role of God has been repudiated. They are quite correct that the findings of science do contradict all such religious conceptions of the origin of the species. Religious people who think that God used evolution to establish all life will have no problem with the evidence for evolution.

Mammals, including humans, evolved from reptiles. The transition from reptiles to mammals is extraordinarily well documented with the gradual transition of reptilian jaw bones to the three inner ear bones in man. At first glance such an idea seems quite preposterous. However, reptiles did sense sound through their jaws and the gradual steps of evolutionary development made sense at every point in the transition. The recent (2001) discovery of the Hadrocodium wui, a mammal like creature the size of a paper clip, adds to the intermediate steps demonstrated in this process.(3)

Man's closest living relative is the chimpanzee with which we share about 98 percent of our genetic information. We had a common ancestor with the chimpanzee between 5 and 8 million years ago. The African continent was a lush tropical forest at that time with many species related to modern apes and humans. We have many fossils of hominids that were either direct ancestors or near relatives of those that were ancestors.(4) They elegantly illustrate the increasingly human qualities with the changes in brain size and upright walking stance. In more recent times Africa become much drier and the forests gave way to a savanna that required upright walking rather than the grasping big toes that were an appropriate adaptation for dwelling in trees.

We know that evolution works through a now well understood structure of DNA in a double helix configuration. We have been able to read these sequences and compare them between individuals and between species. We have isolated many particular genes as the ones that are responsible for specifying particular functions and their failure has been linked to specific genetic diseases. The genes in an organism are a recipe for encoding proteins that are used to create all tissues and structures in the body.

The theory of common descent is supported by the substantial similarity in the genes of organisms that are closely related. Not only are 98 percent of human genes the same as chimpanzee genes, in many cases they share the same flaws. The nonfunctional gene to make vitamin C has been isolated in humans and

related ape species. The differences are exactly as would be predicted given the time since each pair of species had a common ancestor. The location of these genes are in precisely the same DNA double helix location in each species.

Retroviruses are a class of virus that inserts its own DNA into the host's genes. Occasionally, these retroviruses leave evidence of an infection in the egg or sperm cells that are passed on to following generations. When organisms have the same genetic sequence from the same ancient infection in exactly the same location this is an additional proof that genes have been shared through an identical common ancestor.(5)

There have been over 100 cases of humans born with tails. In some cases this anomaly has been passed on to additional children. Several human tails have been found with up to five well-developed, articulating vertebrae. True human tails can be moved with voluntary muscles as with monkey species.(6)(7) This should not be surprising to any student of the human embryo. It is often said that ontogeny recapitulates phylogeny. This means that the growth of the embryo (ontogeny) expresses the sequence of evolutionary organisms from which we have evolved (phyogeny). At four weeks the human embryo will have four gill slits pouches and a tail. These features will appear in the embryos of all vertebrate species and reflect the evolutionary history of vertebrate species.(8)

These examples are only a tiny sampling of the evidence for common descent of all living organisms, including humans. The basic unit of energy storage, the adenosine triphosphate molecule (ATP), is the same in all species that have been studied. In all but very simple bacteria, the same ten step process is used to create usable biological energy from ATP and those steps are executed in exactly the same sequence. This is one of a great many commonalties that humans have with any common flower.

What does this mean for religion? The human brain has evolved as the other organs have evolved, like the heart, the kidney, or the skin. The functions of the brain well explain all of human consciousness. The theory of evolution is consistent with the human brain being a purely physical organ. When the brain dies, all of the physical functions that produce consciousness cease. A physical understanding of consciousness would imply that there is no consciousness or personal life after death. This prediction, that logically derives from evolution, is one of the underlying reasons behind the hysterical attacks on evolution from fundamentalists.

Creationists (religious belief in direct creation by God) or "Intelligent Design" advocates will bring out a small number of people with some scientific training who will question evolution. The number of such people is very small and they have no credibility whatsoever in the broad professional scientific community. In order to underscore the absurdity of this small group being given any credibility, the National Center for Science Education created Project Steve. They allowed scientists named Steve (or cognates such a Stephan, Stefan and Stephanie) to sign a statement in support of evolution. That statement starts:

"Evolution is a vital, well-supported, unifying principle of the biological sciences, and the scientific evidence is overwhelmingly in favor of the idea that all living things share a common ancestry."

As of April 22, 2005, 563 scientists named Steve (or cognates) have signed this statement.(9) This is up from 513 on November 8, 2004. About two thirds of these are biologists. If roughly one percent of the population of scientists are Steves by the NCSE standard, this implies that over 56,000 scientists explicitly support evolution compared to the minuscule number who question evolution.(10) As we noted in the

beginning, scientific theory is confirmed by evidence as evaluated by the preponderance of scientists. We have very solid knowledge concerning the evaluation made by those scientists.

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