MOLECULAR BIOLOGY: A CHECKMATE TO CREATIONISM

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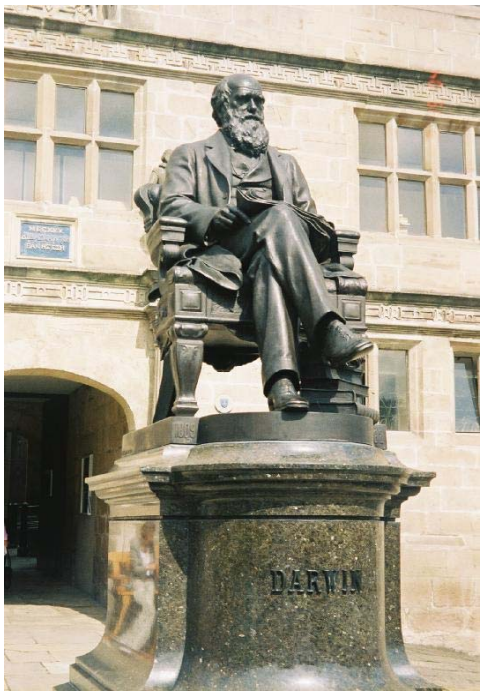
In the study of evolution it is fundamental to note that Darwin made three very separate contributions to this concept. In other words, there are three different aspects of his works that spanned over several decades of his life from 1809-1882. As we talk about him it is very important to focus on his three works separately.



His main achievement was that he convinced the scientific world that evolution had occurred and the different animals are closely related to each other and to their distant cousins the plants. This article pertains to this aspect of his work.

The Second work of Darwin was that he proposed how evolution happened. He proposed that "natural selection" was the main mechanism behind evolution over billions of years. However, there may be additional mechanisms at play such as intracellular or genetic mechanisms. Thirdly, Darwin or at least the neo-Darwinists, suggest absence of any living will that controlled the evolutionary processes and their outcome. It is suggested that it is a totally blind process determined by chance alone and survival of the fittest. This article covers the first aspect of Darwin's work where we completely agree with him. This is a hot topic as even in this day and age 45% of USA population believes in young earth or creationism.[1] [2]

The field of molecular biology provides the most detailed and convincing evidence available for biological evolution. In its unveiling of the nature of DNA and the workings of organisms at the level of enzymes and other protein molecules, it has shown that these molecules hold information about every organism's ancestry. This has made it possible to reconstruct evolutionary events that were previously unknown and to confirm and adjust the view of events already known. The precision, with which ancestries can be traced, like the paternity in a lawsuit, is one reason the evidence from molecular biology is so compelling.

ANALOGY OF A TREE

In a notebook, amid many tentative and frantic drawings, Darwin made a simple sketch that was to capture at a stroke the conceptual sweep of the theory slowly forming in his mind. The drawing was of an "irregularly branched" tree, intended to convey the genealogical history of plants and animals: a tree of life. As a metaphor it was brilliant, conveying the essential notion that life originated in the dim and distant past with a unique, spontaneous event. From this single common ancestor-the trunk of the tree life diversified over time by successive branching, with new species splitting away from old. The ends of the branches represent extinctions like dinosaurs. Quoting his exact words, "The affinities of all the beings of the same class have sometimes been represented by a great tree. I believe this simile largely speaks the truth. The green and budding twigs may represent existing species; and those produced during former years may represent the long succession of extinct species."[3] In other words he visualized a tree with one trunk; that would be in line with the concept of God of the Jews, the Unitarian Christians and Muslims. He did not propose three trees and not a tree with three trunks each showing creation of God the Father, Jesus Christ and the Holy Ghost, in line with the Trinitarian concept of God!

The existence of a solitary trunk was a guess. Darwin disliked what he called the "excessively complicated" notion of life constantly emerging, creating a jumbled forest of life in place of a lone tree. Today, biologists insist that Darwin's guess was basically correct: life on Earth has descended from a single common ancestor.

What makes them so sure? There are several excellent reasons to believe in a universal ancestor. For a start, every known organism shares a common physical

and chemical system. The metabolic pathways of the cell-how it grows, which molecules do what and when, how energy gets stored and liberated, where proteins get made and what they do---are basically the same throughout. The way in which a cell records genetic information and reproduces it is also common to all life. Perhaps the most convincing evidence for a common origin is that genetic instructions are implemented using a universal code. It is too much to believe that all these complex and highly specific features arose independently many times. More likely, they reflect properties already present in a universal ancestor cell, and inherited by its descendants.

THE COMMON DNA AMONG APES

The human DNA can be thought of as a very long string of letters — about 3 billion of them — that sometimes form words (genes). The Human Genome Project has given us ever increasing understanding of the blue print of humans and its relation with other apes like chimpanzees and Gorillas.

Baby human and baby chimpanzee skeleton

Matt Ridley writes in his book *Genome:*

“If you select at random any 'paragraph' in the chimp genome and compare it with the comparable 'paragraph' in the human genome, you will find very few 'letters' are different: on average, less than two in every hundred. We are, to a ninety-eight per cent approximation, chimpanzees, and they are, with ninety-eight per cent confidence limits, human beings. If that does not dent your self-esteem, consider that chimpanzees are only ninety-seven per cent gorillas; and humans are also ninety-seven per cent gorillas. In other words we are more chimpanzee-like than gorillas are."[4]

A remarkable uniformity exists in the molecular components of organisms—in the nature of the components as well as in the ways in which they are assembled and used. In all bacteria, plants, animals, and humans, the DNA comprises a different sequence of the same four component nucleotides, and all the various proteins are synthesized from different combinations and sequences of the same

20 amino acids, although several hundred other amino acids do exist. The genetic code by which the information contained in the DNA of the cell nucleus is passed on to proteins is virtually the same everywhere. Similar metabolic pathways—sequences of biochemical reactions (see metabolism)—are used by the most diverse organisms to produce energy and to make up the cell components.

In the words of Encyclopedia Britannica online:
"Each of the thousands of genes and thousands of proteins contained in an organism provides an independent test of that organism's evolutionary history. Not all possible tests have been performed, but many hundreds have been done, and not one has given evidence contrary to evolution. There is probably no other notion in any field of science that has been as extensively tested and as thoroughly corroborated as the evolutionary origin of living organisms."[5] In short, "molecular evolution has shown all living organisms, from bacteria to humans, to be related by descent from common ancestors." [6]

OUR MISSING VITAMIN C

Vitamin C or ascorbic acid, is a co-enzyme that is synthesized by all plants and animals, except for humans, apes and monkeys. Most mammals can make their own vitamin C. Primates are a group that includes humans, apes, monkeys and lemurs. Primates that are more distantly related to apes or humans that is the lemurs have fully functional genes to make vitamin C. It seems that ability was lost some where during the transition from lemurs to monkeys. Making of Vitamin C has many steps and requires many enzymes for the needed chemical reactions. These enzymes reside in the liver. One of these enzymes that is lacking in humans, apes and some primates is the called gulonolactone oxidase (GLO).

In the words of Prof. Kenneth Miller in his recent book:

"Unless there was a plan to pump up sales of citrus fruits, why were we designed without a gene that could have made our dietary lives so much simpler? The

people who believe our genome was indeed designed have heard these questions before, and they have a ready answer: Something can truly be designed and still be far from perfect, like a bad car or a very slow computer. Design, therefore, does not imply perfection, and a bad design is still a design. There's no reason to think that a designer had to make us metabolically perfect. Fair enough.
But the interesting part of the story is that we aren't exactly missing the GLO gene. In fact, it's right there on chromosome 8, in pretty much the same relative position in our genome where it is found in other mammals. The problem is that our copy of the GLO gene has accumulated so many mutations, in the form of changes in the DNA base sequence that it no longer works. We've got to include vitamin C in our diets because we carry a defective version of our GLO gene. In effect, we all suffer from a genetic disease, which we can correct only by including vitamin C in our diets. What follows, of course, is a very logical question. If the designer wanted us to be dependent on vitamin C, why didn't he just leave out the GLO gene from the plan for our genome? Why is its corpse still there?"[7]

As all humans and apes today carry this broken gene, the conclusion is inescapable that humans, apes and primates are related to each other.
This means that the common ancestor in which the capacity to make vitamin C was originally lost wasn't a human, but a primate, an ancestor that according to the advocates of creationism, we're not supposed to have. And that is an epiphany moment!

This unity reveals the genetic continuity and common ancestry of all organisms. There is no other rational way to account for their molecular uniformity when numerous alternative structures are equally likely. The genetic code serves as an example. Each particular sequence of three nucleotides in the nuclear DNA acts as a pattern for the production of exactly the same amino acid in all organisms. This is no more necessary than it is for a language to use a particular combination of letters to represent a particular object. If it is found that certain sequences of letters—planet, tree, woman—are used with identical meanings in a number of different books, one can be sure that the languages used in those books are of common origin.

OUR CHROMOSOME NUMBER TWO

In the words of Prof. Kenneth Miller in his book *Only a Theory: Evolution and the battle for America's soul*,

"Our forty-six chromosomes are actually twenty-three pairs of chromosomes (since we inherit two complete sets, one from Mom and one from Dad), which means that the great apes have twenty-four pairs. So, if we share common ancestry with these organisms, we humans must be missing a single pair of chromosomes. Could that chromosome pair have been lost in the line that gave rise to us? Not a chance. We know enough about primate genetics to understand

that the loss of a complete chromosome pair (and all the genes they contain) would be fatal-to a human or a chimpanzee.
There is, in fact, just one way to explain the apparent absence of a pair of chromosomes in our species. In the line that led to us, two primate chromosomes must have been accidentally fused to form a single human chromosome. The beauty of this hypothesis is that it is testable. If one of our chromosomes was indeed produced this way, we ought to be able to scan the human genome and identify a chromosome with two halves, literally pasted together, from its primate ancestors. If we don't find such a chromosome, then the common evolutionary ancestry postulated for our species might be wrong. If, on the other hand, we do find such a chromosome, then we have once again found evidence that confirms evolution. Now all we need is a way to recognize that fusion and solve 'the case of the missing chromosome.'"[8]

The central portion of the chromosome is called the centromere and the ending is called telomere. Human chromosome 2 does indeed contain telomere DNA at its middle, at the fusion point, and it carries two centromere sequences that correspond to the centromeres from chimpanzee chromosomes 12 and 13. Furthermore the genes on human chromosome 2 are arranged in an almost exact match for the patterns of corresponding genes on the two chimp chromosomes. So clear is the match, in fact, that scientists working on the chimpanzee genome have now changed the numbering of chimp chromosomes 12 and 13 to chromosomes 2A and 2B, to match the human chromosome to which they correspond. The forensic case of the missing chromosome is settled beyond any doubt.

Matt Ridley writes in his book *Genome* where he has dedicated a chapter to each pair of 23 human chromosomes pairs, he says about the second chromosome: "It is actually rather surprising that human beings do not have twenty-four pairs of chromosomes. Chimpanzees have twenty-four pairs of chromosomes; so do gorillas and orangutans. Among the apes we are the exception. Under the microscope, the most striking and obvious difference between ourselves and all the other great apes is that we have one pair less. The reason, it immediately becomes apparent, is not that a pair of ape chromosomes has gone missing in us, but that two ape chromosomes have fused together in us. Chromosome 2, the second biggest of the human chromosomes, is in fact formed from the fusion of two medium-sized ape chromosomes, as can be seen from the pattern of black bands on the respective chromosomes."[9] A little further in the chapter he has to say, "Apart from the fusion of chromosome 2, visible differences between chimp and human chromosomes are few and tiny."[10]

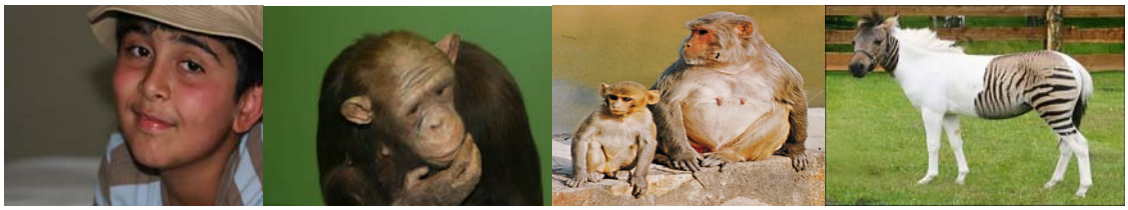
GENES AND PROTEINS

In the words of Encyclopedia Britannica online:
"Genes and proteins are long molecules that contain information in the sequence of their components in much the same way as sentences of the English language contain information in the sequence of their letters and words. The sequences

that make up the genes are passed on from parents to offspring and are identical except for occasional changes introduced by mutations. As an illustration, one may assume that two books are being compared. Both books are 200 pages long and contain the same number of chapters. Closer examination reveals that the two books are identical page for page and word for word, except that an occasional word—say, one in 100—is different. The two books cannot have been written independently; either one has been copied from the other, or both have been copied, directly or indirectly, from the same original book. Similarly, if each component nucleotide of DNA is represented by one letter, the complete sequence of nucleotides in the DNA of a higher organism would require several hundred books of hundreds of pages, with several thousand letters on each page. When the "pages" (or sequences of nucleotides) in these "books" (organisms) are examined one by one, the correspondence in the "letters" (nucleotides) gives unmistakable evidence of common origin." [11]

CYTOCHROME C

Different organisms have a large proportion of their genes in common, particularly those that code for proteins at the central core of the chemical machinery of the cell. For example, most organisms have a gene coding for the energy-producing protein cytochrome C, and furthermore, this gene has a very similar nucleotide sequence in all organisms (that is, the sequence is conserved). However, the sequences of cytochrome C in different organisms do show differences, and the key to phylogeny is that the differences are proportionately fewer between organisms that are closely related. The argument, concerning similarity in the sequence of nucleotides in the DNA (and thus the sequence of amino acids in the proteins), says that books with very similar texts cannot be of independent origin.



The evidence of evolution revealed by molecular biology goes even farther. The degree of similarity in the sequence of nucleotides or of amino acids can be precisely quantified. At the cellular level of enzymes there are numerous interesting stories. One illuminating example is that of protein cytochrome c that is involved in cell respiration. The sequence of amino acids in this protein is known for many organisms, from bacteria and yeast to insects and humans; in animals, cytochrome c consists of 104 amino acids. In humans and chimpanzees, the protein molecule called cytochrome c, which serves a vital function in respiration within cells, consists of the same 104 amino acids in exactly the same order. When the amino-acid sequences of humans and rhesus monkeys are compared, they are found to be different at position 66 (isoleucine in humans, threonine in rhesus monkeys), but identical at the other 103 positions.

When humans are compared with horses, 12 amino-acid differences are found; but when horses are compared with rhesus monkeys there are only 11 amino-acid differences. Even without knowing anything else about the evolutionary history of mammals, one would conclude that the lineages of humans and rhesus monkeys diverged from each other much more recently than they diverged from the horse lineage. The degree of similarity reflects the recency of common ancestry. Thus, the inferences from comparative anatomy and other disciplines concerning evolutionary history can be tested in molecular studies of DNA and proteins by examining their sequences of nucleotides and amino acids.

CONCLUSION

In the words of Francis S Collins, head of the human genome project:
"No serious biologist today doubts the theory of evolution to explain the marvelous complexity and diversity of life. In fact, the relatedness of all species through the mechanism of evolution is such a profound foundation for the understanding of all biology that it is difficult to imagine how one would study life without it. Yet what area of scientific inquiry has generated more friction with religious perspectives than Darwin's revolutionary insight? From the circus like Scopes "monkey trial" in 1925 right through to today's debates in the United States about the teaching of evolution in the schools, this battle shows no signs of ending."[12]

The circus like Scopes trial can be watched in a black and white movie *Inherit the Wind*. Those who liked this movie, showing Scopes or Monkey trial in 1925, about creationism, may be ready for its sequel. There was a recent legal battle fought by Intelligent Design, in the town of Dover, Pennsylvania, in 2005. A wonderful and detailed PBS movie about this trial can be seen online.[13] The federal court in this case ruled that Intelligent Design was not clearly distinct from 'creationism' and therefore should be excluded from the curriculum in Public schools on the basis of earlier decisions.[14] Intelligent Design, seeks to fundamentally redefine science to accept supernatural explanations.[15]

Darwin himself was deeply concerned about the effect of his theory on religious belief, though in The Origin of Species he took pains to point out a possible harmonious interpretation: "I see no good reason why the views given in this volume should shock the religious feelings of anyone. …. A celebrated author and divine has written to me that he 'has gradually learned to see that it is just as noble a conception of the deity to believe that he created a few original forms capable of self development into other and needful forms, as to believe that he required a fresh act of creation to supply the voids caused by the action of his laws.'"[16]

Darwin's own personal beliefs remain ambiguous and seemed to vary throughout the last years of his life. At one time he said, "Agnostic would be the most correct description of my state of mind." At another time he wrote that he was greatly challenged by "the extreme difficulty, or rather the impossibility, of conceiving this

immense and wonderful universe, including man with his capacity for looking far backwards and far into futurity, as the result of blind chance or necessity. When thus reflecting I feel compelled to look to a First Cause having an intelligent mind in some degree analogous to that of man; and I deserve to be called a Theist."[17]

Darwin even concludes The Origin of Species with the following sentence: "There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning, endless forms most beautiful and most wonderful have been, and are being evolved."[18]

In the words of Francis S Collins, head of the human genome project:

"Many people who have considered all the scientific and spiritual evidence still see God's creative and guiding hand at work. For a believer, there is not a shred of disappointment or disillusionment in these discoveries about the nature of life-quite the contrary! How marvelous and intricate life turns out to be! How deeply satisfying is the digital elegance of DNA! How aesthetically appealing and artistically sublime are the components of living things, from the ribosome that translates RNA into protein, to the metamorphosis of the caterpillar into the butterfly, to the fabulous plumage of the peacock attracting his mate! Evolution, as a mechanism, can be and must be true. But that says nothing about the nature of its author. For those who believe in God, there are reasons now to be more in awe, not less."[19]

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[1] Ian G Barbour. When science meets religion. Haper Collins Publisher, 2000. Page 1.
[2] US data from Gallup poll, Nov, 1991, see US News and World Report, 23 Dec, 1991, p 59.
[3] Charles Darwin, *On the Origin of Species,* 1909. Page 143.
[4] Matt Ridley. Genome: The autobiography of a species in 23 chapters. Harper – Perennial, 2006. Page 28.
[5] "**evolution**." Encyclopædia Britannica. 2008. Encyclopædia Britannica Online. 03 Sep. 2008 <http://www.britannica.com/EBchecked/topic/197367/evolution>.
[6] "**evolution**." Encyclopædia Britannica. 2008. Encyclopædia Britannica Online. 03 Sep. 2008 <http://www.britannica.com/EBchecked/topic/197367/evolution>.
[7] Prof. Kenneth Miller. Only a Theory: Evolution and the battle for America's soul. Viking Penguin, 2008. Pages 97-98.
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[9] Matt Ridley. Genome: The autobiography of a species in 23 chapters. Harper – Perennial, 2006. Page 24.
[10] Matt Ridley. Genome: The autobiography of a species in 23 chapters. Harper – Perennial, 2006. Page 28.
[11] "**evolution**." Encyclopædia Britannica. 2008. Encyclopædia Britannica Online. 03 Sep. 2008 <http://www.britannica.com/EBchecked/topic/197367/evolution>.
[12] Francis S Collins. The language of God. Free Press 2006. Page 99.
[13] http://www.pbs.org/wgbh/nova/programs/
[14] http://www.britannica.com/eb/article-9432671/intelligent-design.
[15] http://en.wikipedia.org/wiki/Intelligent_design.
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[17] Charles Darwin. On the Origin of Species by Means of Natural Selection – Edited by Joseph Carroll - Science - 2003. Page 433.
[18] Charles Darwin. On origin of species. Harvard Classics edition., edited by Charles W Elliot. Full view available in Google books. Page 528-529.
[19] Francis S Collins. The language of God. Free Press 2006. Page 106-107.