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| Pseudogenes: A result of common ancestry or common designer? |
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**Pseudogenes: A result of common ancestry or common designer?**

Our knowledge of the genome and its structure and function, is rapidly advancing as technology continues to progress. One of the biggest milestones in researching the genome was The Human Genome project of 2003 in being able to sequence and map the entire human genome. This allowed researchers to identify all of 20000- 25000 genes in human DNA and determine the sequences of 3 billion base pairs. (Human Genome Project, 2008) This research is significant in increasing our understanding of the potential functionality of genes as well as the nonfunctionality. Researchers in this field of genomics are currently working with this data to compare the structures, functions and maybe even evolutionary relationships of the organisms of the world. They are able to see the similarities and differences of organisms by looking at the basic building blocks of their DNA. Research has shown that organisms have remarkable similarities, especially humans and chimpanzees, which are 98% identical in their genetic makeup. (Goodman et al, 1990) Another more recent study sequenced the chimpanzee genome and found that the sequence differences between humans and chimpanzees were only 1.23% (Wood, 2006). Interestingly this similarity has been found not only in the functioning genes but also the dysfunctioning genes, termed ”pseudogenes,” of the genome. These pseudogenes have been found to be located in identical places between different species and are used as tracers to determine the possible evolutionary relationships between organisms. As the mystery of the genome is beginning to unfold it causes us to question why it is that the human genome looks so similar to the chimpanzee genome. Evolutionists would say that it’s because of a common ancestor and that pseudogenes are evidence for this. The pseudogenes are thought to be genetic fossils that are remnants of a functioning gene from an earlier ancestor. In comparing common pseudogenes between organisms, evolutionists have been able to depict evolutionary trees to portray their effective evolutionary relationships. (Max, 2003) Creationists on the other hand say that each species was created independently but designed with similar features in order to have comparable functions. (Woodmorappe, 2004) Although there is a strong similarity between genomes, careful research shows that there is not enough information or research done to assert the claim of pseudogenes being a proof of evolution.

Evolution is an extremely controversial subject that is often shied away from by Christians ever since Charles Darwin came out with the Origin of Species in 1859. Darwin rocked the world of science and religion by introducing the idea that populations of living organisms change over time which has resulted in today’s present biodiversity. This idea was based on two ideas, one that there is heritable variation within populations and that this variation experiences reproductive success through natural selection by struggling for existence. This seemingly simple idea had huge implications. It was immediately latched onto by atheists as their explanation for how the world was created without a creator. As Richard Dawkins put it, “Although atheism might have been logically tenable before Darwin, Darwin made it possible to be an intellectually fulfilled atheist.” (Miller,2000) Technology has advanced since then and molecular biology and biochemistry have seemed to verify evolution as a means of change, especially in the case of pseudogenes. The definition that will be used throughout this paper to explain evolution is “a process that results in heritable changes in a population spread over many generations.” (Moran, 1993)

Many Christian scientists do not know how to react to information that strongly points to evolution. Is science attempting to “dethrone God” or is there a way to reconcile the two points of view? As Christians it is important that we explore the world that God has created and seek to find the truth. That does not mean ignoring theories such as evolution which may seem controversial, but it means digging deeper and attempting to find a “perspective of faith that does not ignore facts or compromise scientific integrity.” (Wilcox, 2004)

Recent genome sequencing results have shown that >90% of the DNA of vertebrates does not code for a product (Walkup, 2000). The human chromosome 22 was recently sequenced by Dunham et al identifying 134 pseudogenes within 545 genes in the region which is about 1.1% of the human genome. Using this data it was extrapolated that there are about 15000 pseudogenes in the human genome. (Max, 2003) Pseudogenes are normally located near a functional gene but have been inactivated in some way. Inactivation occurs through a number of different processes including insertion, deletion or premature stop codons. A certain type of pseudogene known as a “processed pseudogene” is thought to have arisen from mRNA and has been reinserted back into the DNA. It lacks introns and has a poly A tail which are specific characteristics of an RNA transcript. (Walkup, 2000) Recent studies show many identical pseudogenes between humans and other primates. One example is *Alu* elements which are a 16 nucleotide SINE insertion into DNA, have been found to be shared between humans and other primates. (Finlay, 2002) Also the human Urate oxidase pseudogene which is apparently functionless in being able to produce uric acid has the same three mutations as the chimpanzee and orangutan. (Woodmorappe, 2004) And yet another example is the galactosyltransferase pseudogene which is present in the human genome as well as apes and Old world monkeys. (Galili and Swanson, 1991) Other shared pseudogenes between humans and primates include the enolase pseudogene, hemoglobin pseudogene, sulfatase pseudogene and the steroid 21- hydroxylase pseudogene. This steroid 21- hydroxylase pseudogene is an 8- nucleotide deletion that has been found to be identical in humans and chimpanzees that causes the gene function to be deactivated. (Moore, 2001) These pseudogenes are just a few of the many examples that have been discovered between humans and animals of complementary dysfunctional genes.

The pseudogene is thought of as a vestigial structure that was once necessary but over time has lost its function due to natural selection. An example of a pseudogene is the GLO pseudogene. The GLO gene is used to synthesize ascorbic acid which is vitamin C and is found in most animals. Humans and Guinea pigs lack this functional GLO gene because they get enough vitamin C supplemented in their diet. According to the evolutionary hypothesis the GLO gene in human and guinea pig lineages has been inactivated because it is no longer necessary. The pseudogene is a remnant of a functional gene from a common ancestor who needed to synthesize ascorbic acid for survival. (Max, 2003) Another example of an apparent vestigial structure are the Odorant receptor genes (OR genes). They are located in the cell membrane of olfactory sensory neurons of the nasal epithelium and play a role in odorant binding. (Lightner, 2008) There is a great range in ability to smell between animals. Some primates are thought to have a lower functioning of OR genes than other animals because they don’t need a keen sense of smell. It’s hypothesized that primates have progressively accumulated pseudogenes in the OR gene through evolution. Their theory states that primates have a reduced sense of smell due to the generation of OR pseudogenes. (Rouquier et al., 1999) There are other cases such as these that evolutionists use as fuel to say that pseudogenes might have had a function in an earlier ancestor which has been inactivated due to redundancy.

They would say it is unlikely that we have these genetic errors that match other organism’s genomes by independent creation but instead they must come from copying an earlier organism. The idea of copyright law can be used as an analogy that explains this theory of copying involves two cases of plagiarism:

In 1941 the author of a chemistry textbook brought suit charging that portions of his textbook had been plagiarized by the author of a competing textbook. In 1946 the publisher of a trade directory for the construction industry made similar charges against a competing directory publisher. In both cases, mere similarity between the contents of the alleged copies and the originals was not considered compelling evidence of copying. After all, both chemistry textbooks were describing the same body of chemical knowledge (the books were designed to "function similarly") and both directories listed members of the same industry, so substantial resemblance would be expected even if no copying had occurred. However, in both cases errors present in the "originals" appeared in the alleged copies. The courts judged that it was inconceivable that the same errors could have been made independently by each plaintiff and defendant, and ruled in both cases that copying had occurred. The principle that duplicated errors imply copying is now well established in copyright law. (Max, 2006)

This analogy explains why it is thought that the homology between pseudogenes in genomes points to copying from a common ancestor. The evolutionist’s arguments for pseudogenes pointing to common ancestry can be summarized into three main points. The first is that pseudogenes have originated from a “genetic accident,” they maintain that pseudogene formation is a highly random process. If these mutations that cause dysfunction are random processes it would seem doubtful that they would just happen to occur in the same location in two different species. Secondly, they state that pseudogenes serve no function or benefit to the host organism. If they truly are functionless, then what purpose do they serve in our genome besides being remnants of an earlier functional gene? And thirdly evolutionists assert that it is implausible that pseudogenes would have been designed. (Woodmorappe, 2004) They ask, why would God have designed functionless genes into our genome?

The evidence for evolution being the means by which pseudogenes have generated throughout different species genomes seems very strong. How do we as Christians react to this? Evolution has always been a very controversial subject among Christians as it seems to discredit the Genesis account of creation. Although it is important for Christians to hold to their core beliefs and values of God being the creator of our earth, it is also important that Christians do not appear ignorant of scientific evidence. It’s crucial that we as Christians dive into the studies and really search out the truth so that we show that we are credible in our beliefs. In looking deeper into this issue of pseudogenes and whether or not they are a fingerprint of an earlier common ancestor, it can be found that there is much more to the story. For instance the OR pseudogenes previously mentioned have been found in recent studies to not be as directly correlated with olfactory function as originally thought. Evolutionists ascertain that the OR pseudogenes becoming progressively more frequent as you go up the evolutionary tree reaching a maximum at hominoids, giving them a reduced sense of smell. (Rouquier et al., 1999) Basically it’s believed that since humans have a lesser sense of smell than other animals and a larger number of OR pseudogenes they have accumulated these pseudogenes because natural selection would not have had the need to remove them as would be the case in animals with a strong sense of smell. (Woodmorappe, 2004) But recently it has been found in a study done by Whinnett and Mundy in 2003 that there is a background rate of OR pseudogenes in all lineages of animals which does not affect the function. As if this doesn’t contradict the evolutionary theory enough the study took a look at the marmoset genome, which is an animal known for its keen sense of smell, and found that it contained many OR pseudogenes. Clearly the OR pseudogenes are not a result of loss of the olfactory function from an earlier ancestor. Also the GLO pseudogene found in humans and primates is often used as a scientific proof that pseudogenes are remnants of earlier functioning genes in a common ancestor. Interestingly, it has been found that the GLO pseudogenes that most closely parallel each other are between humans and guinea pigs. Guinea pigs and simians are not sister groups according to theory of evolution. It seems strange that this pseudogene is not identical in the many animals that should come between these two groups according to the evolutionary hierarchy. This disproves the theory that the analogous GLO pseudogene found in humans and guinea pigs point to a common ancestor. This also breaks down the nested hierarchy idea of the evolutionary tree in that pseudogenes of distant relatives resemble each other more than closely related relatives. By taking a closer look, we see the gaps in the seemingly airtight proof that pseudogenes are shared errors based from a common ancestor.

The theory of evolution is largely based on the idea of chance in that it allows for variation and adaptation. The first main argument for pseudogenes being a proof of evolution from a common ancestor, mentioned earlier, was that pseudogenes have been derived by a “genetic accident.” This is not necessarily true and highly unlikely. The probability that identical substitutions occur at random in the exact same location in both humans and primates have been calculated to be extremely low being 1.84 x 10 -12. (Inai et al., 2003) So why are these identical mutations occurring? There are areas of the genome called “hotspots” which are sections that have a higher probability of mutations to occur due to different endogenous and exogenous factors. Sequences as far as 10 nucleotides away can influence the mutational rate of a hotspot. (Woodmorappe, 2004) This is a possible reason as to why humans and other primates have pseudogenes occurring in the same location. The copyright analogy referred to earlier breaks down in that textbooks are consistent and predictable and so common errors would point to copying from an earlier source, but in the case of the genome there is a degree of unpredictability that needs to be accounted for, which shows that copying is not necessarily the cause. Based on this information it is fairer to say that these pseudogenes are a result of parallel mutations rather than common evolutionary ancestry.

The next point maintained by evolutionists to advocate for pseudogenes pointing to common ancestry, is that pseudogenes have no function in the genome since they do not produce a protein. “DNA not known to be coding for proteins or functional RNAs, especially pseudogenes, are now at times referred to in publications simply as nonfunctional DNA, as though their nonfunctionality were an established fact.” (Zuckerkandl, Latter and Jurka, 1989) According to evolutionists, these dysfunctional genes are the perfect raw material for the production of new genes by mutations that can be selected for in evolution. (Max, 2003) The study of the entire genome is a very recent event and the more the genome is being studied the more they are surprisingly finding that pseudogenes actually do have functions. “Pseudogenes may lose some specific functions but retain others, and even acquire new ones, which may not be simply recognizable.” (Balakireve and Ayala, 2003) The case of functionality being found in pseudogenes is just like other seemingly functionless aspects of DNA including introns once thought to be vestigial sequences. It has now been determined that they have important biological functions including regulation and structural roles. Introns have been found to affect mRNA encoding, frame shifting, base hopping and control sequences. One example is a study produced by Ron James of Pharmaceutical Proteins ltd. In which he and his team injected mouse eggs with an alpha-1 antitrypsin gene that included the introns into transgenic sheep. He found that higher yields resulted with the addition of introns showing that introns clearly played a facilitator role. (Bergman, 2001) These studies show that genes are more involved than was once thought and the more we learn about the genome the more we discover about the functionality of genes. This is exactly the case of pseudogenes; research is showing that they play a role in affecting gene regulation and activity by binding to transcriptional factors. (Walkup, 2000) They have been shown to exhibit functional roles such as gene expression, gene regulation and be involved in recombination of functional genes. (**Evgeniy S. Balakirev and Francisco J. Ayala, 2003) Makorin 1 is an expressed pseudogene that has been found to regulate the messenger- RNA stability of a related coding gene. (**[Hirotsune S](http://www.ncbi.nlm.nih.gov/sites/entrez?Db=pubmed&Cmd=Search&Term=%22Hirotsune%20S%22%5BAuthor%5D&itool=EntrezSystem2.PEntrez.Pubmed.Pubmed_ResultsPanel.Pubmed_DiscoveryPanel.Pubmed_RVAbstractPlus), et al. 2003) Also the Alu gene, previously mentioned, has recently been studied and found to work as a gene regulator and help with the assembly of new genes. (Woodmorappe, 2000) These studies are the beginning of a wave of scientific data coming in demonstrating that pseudogenes do have specific regulatory roles and have functional significance even if they do not code for a protein. Also we need to remember that it is energetically very costly for the cell to create DNA, in saying this if pseudogenes really were non-functional they should have been eliminated by natural selection a long time ago according to the evolutionary theory. The fact that they are conserved demonstrates that functionality is yet to be discovered and that more investigation needs to be undergone. We do not have enough current information about pseudogenes to confidently assert that they have no function which challenges the evolutionary theory of pseudogenes pointing to common ancestry.

The third point made by evolutionists is that pseudogenes cannot be reasonably interpreted as having been designed. This is a huge statement to make and is reflective of the tension between Christianity and science. As scientists we need to be careful not to undermine the authority and creativity of God. He works in ways that we do not always understand and it is completely within his power to incorporate pseudogenes within our genomes. Science on the other hand is flawed and not always factual as it is subject to our biases, interpretations and human error. We like to think of science as “cold, hard facts” but history has shown us that it can be proven wrong, for instance scientists once advocated that the world was flat. This homology between species is visually and genetically obvious, but it doesn’t necessarily point to a common ancestor. The commonality could also be a significant indicator of a common designer who designed humans and animals similarly so that they would function similarly.

The question is still open as to why God would design us with seemingly functionless genes in our genomes and in the genomes of animals. A possible reason is because of the fall, in Genesis 3 sin enters the world; plants bear thorns and thistles, the soil is difficult to work and animals and humans bear the effects of sin. Sin is underlying all parts of our world and the effects of evil are evident. It is very possible that it has also corrupted our DNA. When the Lord cursed Adam and Eve out of the Garden of Eden after the fall, the curse reached all life and may have introduced errors into the DNA. (Plaisted, 2003) Although we cannot understand it, it is a certainty that God has a purpose for all things and his purpose is to bring us closer to him.

Christianity and Science constantly seem to be in conflict which has caused a great division in the church. Christian scientists do not know how to resolve the two opposing points of view and the endless debate only serves to distract the church from what truly matters. At some point it is important to realise that we are merely humans and we do not know exactly what happened at the beginning of time. Instead of arguing about such inconsequential details it is important that the church concentrates on what it is called to do and that is to proclaim the good news of salvation in Jesus Christ. This is the great commission:

And Jesus came and spoke to them, saying, "All authority has been given to Me in heaven and on earth. Go therefore and make disciples of all the nations, baptizing them in the name of the Father and of the Son and of the Holy Spirit, teaching them to observe all things that I have commanded you; and lo, I am with you always, even to the end of the age." Amen. (Matthew 28:18-20)

These artifacts of distant past in the form of pseudogenes are not straightforward enough answers to satisfy our scepticism as Christians trying to address this issue. Evolutionists are using “evidence” that is not well enough understood to be conclusive. Through careful research it is evident that pseudogenes are not clear and decisive pointers of evolutionary ancestry caused by evolution. As Christians we know that God truly is the creator of the Earth. We do not completely understand how it was created or if evolution was a means by which He created it because there is clearly not enough information to give us that answer. Instead we should concentrate on what we do know; we know that man was created in God’s image. The bible emphasizes this point in Genesis and James:

“Then God said, "Let us make man in our image, in our likeness, and let them rule over the fish of the sea and the birds of the air, over the livestock, over all the earth, [a] and over all the creatures that move along the ground.“ (Genesis 1:26-27)

“With the tongue we praise our Lord and Father, and with it we curse men, who have been made in God's likeness” (James 3:9)

In being created in his image, there is assurance that humans were created with an identity and special role above animals. He has distinguished humans from animals in that they can have a personal relationship with Him. Although they may have similar genomes, humans have been created specifically by God to have a relationship with Him. Jeeves wrote, “The meaning of the “image of God” is thus to be found in the human vocation, given and enabled by God, to relate to God as God’s partner in covenant, to join in companionship with the human family and in relation to the whole cosmos in ways that reflect the covenant love of God.” (Jeeves, 249) God has made it clear in his word what man’s purpose is in life even if the human origins are unclear.

As Christians grappling with difficult issues such as evolution we need to be intentionally seeking the truth and making sure we or not ignorant on the matter. Malcolm Jeeves has a great perspective on the issue of finding truth as a Christian, he writes, “Believing that all truth comes from God, whether through scripture or through science, we recognize our need to keep an open mind but not an empty mind on whatever of reality God has yet to show us about ourselves. We need to continue to work together “as workers who have no need to be ashamed” (2 Tim 2:15) employing the varied talents he has given us to discover more of how we are, indeed, “fearfully and wonderfully made” (ps 139:14)” (Jeeves, 249) It is our duty as Christians to earnestly study and learn about the world around us to the best of our abilities and in this learn more about our Creator. We now know that pseudogenes do actually have functions and could not have been created by chance giving us a reasonable interpretation that they are a result of a designer. The more we learn about the genome, the more complex we see that it is; reminding us of how little our knowledge is and how amazing the work of God is. Although discovering new things such as pseudogenes about the genome does give us more information to consider, when examined closely it does not cause us to doubt our basic and most fundamental beliefs in God. Instead we honour God for the complexity and intricacy of the world He created.

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