WHY IT IS IMPORTANT TO STUDY AND UNDERSTAND HUMAN ORIGINS FROM AN ENVIRONMENTAL, BIOLOGICAL AND CULTURAL PERSPECTIVE

'Given the recent paleontological discoveries in South Africa, why is it important for us to study and understand human origins?'

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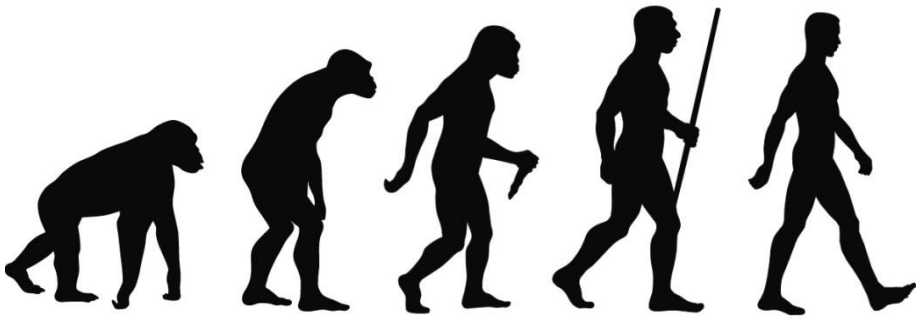

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ABSTRACT

The study of human origins has often been criticised for its uselessness in today's time. This, however, is challenged by the researchers who prove that studying the past does benefit us today in terms of medical knowledge about the development of cancers and genetic disorders through the study of the environment and mitochondrial DNA. It was found that not only does the past give us a window into the world during its cyclical change but that by studying this, scientists may be able to predict the adaptability of humans in the future. Neuroscience and psychology have also made some strides in figuring out what makes humans different from chimpanzees, apes and other primates. From these points, it is shown that studying the past does not mean that the research cannot be applied to life in the present.

Introduction

T.S Elliot once said, "The historical sense involves a perception, not only of the pastness of the past, but of its presence." While this was not said in the context of human origins and its usefulness today, it does carry the basic argument of those who study the subject – one can learn much about the future by looking at the past. Anthropogeny or the study of human origins is beneficial to a variety of fields, not just palaeontology and archaeology. It is particularly useful in the medical field where the information gained from studying hominins provides information that could assist in disease and mutation research. The evolution of hominins during the Earth's cyclical patterns of temperature, oxygen levels and humidity can yield valuable information on the survival of *Homo sapiens* as the world's temperature increases. What's more, the development of DNA analysis of hominid species, primate relatives (such as the bonobo) and humans today allow advances in neuroscience, bringing scientists closer to the answer of what makes humans different to our closest evolutionary relatives.

Earth's Environmental Changes

Hominin remains from different periods of the Earth's environmental cycles show how natural selection led to the rise and decline of different hominin species. An example of this is the skull cast of a hominin living during the ice age. The sinus cavities of the hominin had extra pockets for air to be humidified and warmed. Rick Potts, the head of the Human Origins Programme at the Smithsonian Nation Museum of Natural History, has described this as "…having a warm pocket of air close to the brain to keep away the chill of the ice age." The fossils of hominins show a record of species from the ape-like *Australopithecus afarensis* to the first hominins to build rafts for sea travel, *Homo erectus,* to the species we are today through the various environmental changes of the Earth (Howell, F, *Early Man*, Time Life Books, 1974).

One way organisms learn to adapt to the changes in environment is through genetic adaptation (Marchi,E, Kanapin, A , Belshaw, R. , *2012, Neanderthal and Denisovan Retrovirus in Modern Humans*). This is when many alleles are found in a population in different amounts. As the environment changes, natural selection favours one allele over others. Phenotypic plasticity, the changing of the structure and appearance of an organism based on the conditions it lives in, is also helpful for an organism to have as it assists it in adapting to fluctuating environmental conditions (Potts, R , 2012, *Human biology and the Origins of Homo)*

Studying past changes in the relationship between hominins and their environment could provide clues about evolutionary adaptations in the future as humans face anthropogenic global warming. This would help researchers determine whether or not humans will evolve to endure the changes or die out like its predecessors. The current era of geological change has been called the Anthropocene (Marshall, K , Boes, T, 2014, w*riting the Anthropocene*), a period in geologic time when human development and interference has had an impact on the Earth's climate and ecosystems. Potts thinks that by studying and comparing the climate changes from the past to those of the present, researchers will be able to find humans' sources of and extent of adaptability in the face of these changes.

Medical Field

Another area anthropogeny and evolutionary principles are affecting is the medical field. Studying human origins helps researchers understand genetic variation and how the diversifying genes impacts modern humans' immune systems. In order to keep up with pathogenic diseases to develop effective treatments, researchers have to understand the evolutionary patterns of the pathogenic organisms and humans. In addition to this, studying the evolution of genes that are likely to cause illness may benefit those suffering from hereditary diseases (University of Berkeley: Understanding Evolution, *Huntington's Chorea: Evolution and Genetic Disease*).

Mitochondrial DNA

Interest in Darwinism in the medical field decreased during the second half of the century due to the rise of molecular biological approaches to disease. Evolutionary medicine is based on the principles that evolutionary history does not cause diseases, as natural selection acts on fitness rather than health, but affects a person's risk of developing the disease. It also takes into account that we are no longer living in the same environment from the one we evolved in (Mayr, E. , 1970, Population, *Species and Evolution*) Doctors often look at the activities the patient has done in their lives to attempt to find the source of the disease (mechanistic approach) without considering evolutionary reasons. The finding that mtDNA (mitochondrial DNA) can be traced back to our earliest ancestor reveals what researchers call the "mitochondrial Eve" (Berkeley, 2015, *Making Sense of Ancient Hominin DNA).*
mtDNA is only passed on down the maternal line which means that by analysing the mtDNA of two people, researchers can tell if the two are related and the years between their existences . It also explains the inheritance of mitochondrial mutations that affect the nervous system. About every thousand years a point mutation occurs. This mutation then gets passed on to offspring. Should a male inherit this gene that causes disease, he will not pass it on to his child as mtDNA can only be inherited from the mother (Cree, L.M , Samuels, D.C , Chinnery, P.F, 2009*)*. Further research into mtDNA diseases and its inheritance could greatly benefit people suffering from mitochondrial disorders. This creates the need for a way of preventing the transfer as genetic counselling can help to prevent the spread of the disorder by analysing the mtDNA of the embryo but it brings up other moral complications should the embryo test positive for the disorder.
Evolutionary concepts used in evolutionary psychology were thought to have been too watered-down which led to the discrediting of Darwinism in medicine (Nesse,R ,2001, University of Michigan Department of Psychiatry and Institute for Social Research*).*

Evolutionary concepts such as natural selection results in a population that is better suited to living in a certain environment. This concept developed through the research of Darwin and Wallace is conclusively accepted by researchers (Futuyma D. , *Evolution, Science and Society*, 2001*)*. Natural selection is not perfect, however, and through environmental factors such as radiation and certain toxins, mutations can occur. Other factors, such as disease, can wipe out a certain population with a beneficial mutation and inbreeding decreases the gene pool and influences the distribution of phenotypes and characteristics passed on.

Two main branches of evolutionary medicine are phylogeny and adaptation. Niklaas Tinbergen helped biologists understand that every organism present needs to have

explanations of how it works (proximate) as well as explanations for their origins (evolutionary). A complete biological explanation, answers Tinbergen's four questions: What is the organism? How did it develop? Does it have an advantage over predecessors? What is its phylogeny? (Simons, E . , 1963, *Some Fallacies in the Study of Hominid Phylogeny*) Two of these questions can only be answered using evolutionary concepts.

An example where anthropogeny has already answered questions relating to medicine deals with pain and fever experienced with certain infections. It has been accepted that this is the body's way of attempting to fight the pathogen. This has led to physicians being more cautionary when prescribing medicines. Researchers worked out that the same viruses and bacteria were present millions of years ago (Marchi,E, Kanapin, A , Belshaw, R. , *2012, Neanderthal and Denisovan Retrovirus in Modern Humans*) . This study also found that about eight percent of human DNA is made of virus DNA. This would greatly impact the amount of treatment-resistant diseases around as the body's natural way of healing does not depend on finishing a course of medicines where a misuse could result in mutated pathogens.

Mutations and Cancers

Further research into anthropogeny and genetics has lead to the development of a method of getting an accurate measurement of mutation growth and finding the source of cancer. This could possibly assist researchers in answering old questions about mutation and the accumulation of mutated cells and its treatment (Muller, HJ, *Our Load of Mutations, 1950*). This is closely linked to cancers and their treatments. There are many other hypotheses that are being tested using genetic and anthropogenic knowledge.

Through the study of a Neanderthal's bones, a tumour was found. The bone as found in Croatia and its possessor is thought to have lived one hundred and twenty thousand years ago (Stromberg,J, 2013 *Evidence for the Oldest Ever Bone Tumour was Just Found in a Neanderthal Fossil*). The left rib had spongy tissue in it which is indicative of a tumour caused by the disease, fibrous dysplasia. This was noteworthy as tumours in fossils are extremely rare. This is because tumours in any other part of the body would not be preserved and that cancers are generally more likely to affect older people and the Neanderthals often did not live past thirty years. This fact makes the discovery significant as despite his/her age, the fossil had a tumour. Tumours are usually thought to be linked to the environmental conditions present. This showed researchers that the development of bone cancer does not have many links to environmental conditions as the world the Neanderthals lived in was clean, without many pollutants (Stromberg,J, 2013 *Evidence for the Oldest Ever Bone Tumour was Just Found in a Neanderthal Fossil*). Another case arose when Louis Leakey discovered a bone tumour in the jaw of a fossil (Johnson,G,2013, *Cancer has Afflicted People Since Prehistoric Times*). Little research has gone into this tumour, however. More research into this could possibly benefit those with cancer today but few tumours are ever found in order for researchers to find out more.

Neuroscience

Neuroscience has used anthropogenic research to find that humans have a larger, more complex brain than hominids. Humans show a larger amount of white matter in the prefrontal cortex than chimpanzees. The larger volume of white matter results in more connections between nerve cells (Bartholomew, M, Pearson, 2012,*Fundementals of Anatomy and Physiology*). This means that humans have a greater ability to process information as the prefrontal cortex is the part of the brain responsible for thinking. The complexity of human brains leads to the rise of an increased dexterity, the development of languages (Hockett,C. 1960, *The Origin of Speech*) and the ability to alter their environment. This brings researchers a step forward in finding what makes humans different to their closest primate relative

Psychology

Psychologists have worked with anthropologists to attempt to determine the source of feelings such as aggression, stress and fear. This was done by investigating the effects of adrenalin on the human body. It was found that the adrenalin allowed energy to be released faster and increased the bloodflow to the vital organs. Cannon hypothesised that this was beneficial for sudden fast movements and fast decision making- the basis for fight or flight reaction (Lavoie, S, no date, *Walter Cannon: Stress&Fight or Flight Theories*). This hypothesis is supported by Richard Lee's research on Bushmen that found that a spike in adrenalin aided hunting or escaping predators.

Society and Culture

By studying the hominin's and learning more about their lives, we can learn that they were "culturally simplified versions of ourselves" A good example of this is the invention of the primitive needle. By discovering this tool it can be assumed that *Cro-Magnon* hunters stitched animal hides to make clothes (Howell, F, *Early Man*, Time Life Books, 1974). This discovery however does not shed light on aspects such as gender roles, different type of dress of men and women. This begs the question as to when and why the distinction between men and women as seen today began. The needle itself presents another question- who developed it and who used it? This links to gender roles as a man would have been thought to have invented it while a woman would have used it. This has never been confirmed which allows one to assume that by studying the past, the source of present stereotypical gender roles can be found.

Conclusion

Understanding and continuing to research human origins have importance in solving modern medical problems, providing clues as to what the Earth will look like in the future and how humans will react to the change based on the past cycles of the Earth. People need to understand **W**here humans come from in order to learn from the mistakes and triumphs of our predecessors as there is nothing that says humans cannot be **W**iped out like hominins. The knowledge of the past gives us an idea of the evolution of culture and society – how we came to be so diverse from fairly primitive beings.

GLOSSARY

Hominin: Refers to human and their closest extinct predecessors whereas the term hominid includes other primates such as chimpanzee, gorilla and orangutan.

Anthropogeny: The study of humans in the past and in the present. Anthropogeny draws information from other fields such as physical sciences.

Mechanistic approach to cause and diagnosis of disease: The idea that one can remove damaged or faulty parts of the body without affecting other parts of the body.

Point mutation: Only one nucleotide is affected in a genetic sequence

Phylogenetics:The study of evolutionary history of a group of people. The analysis of heritable traits creates a phylogeny or phylogenetic tree.

Allele: A varying form of a gene at the same locus. One allele is inherited from each parent.

Phenotypic plasticity: The ability for an organism to change its phenotype or physical characteristics in response to environmental changes

Pathogenic: Disease causing organisms

Darwinism:The theory based on the evolution of a species. This is brought about by natural selection.

Fibrous dysplasia: An uncommon bone disorder that causes bones to become spongy and weak making fractures likely.

Mitochondrial DNA: DNA located in the mitochondria. The DNA is only passed on from mothers to their children which creates a direct line back to the first ancestor, the “Evolutionary Eve”.

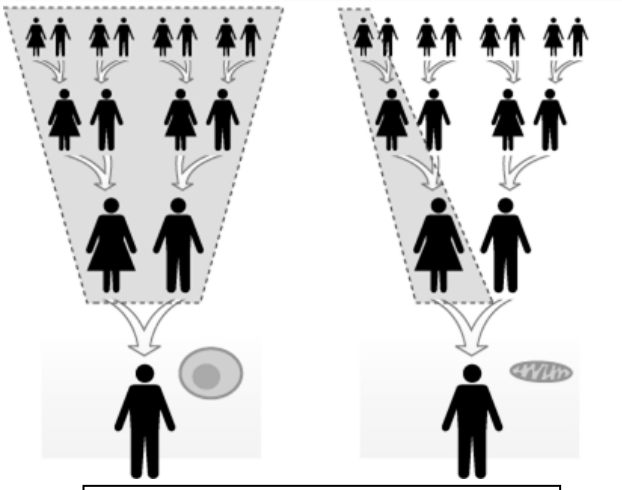

Diagram showing inheritance of nuclear and mitochondrial DNA

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