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# Images of human evolution in South African life sciences textbooks

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# Images of human evolution in South African Life Sciences textbooks

**Martin Nyagwaya**

**A research report submitted to the Faculty of Science, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements of the degree of Masters of Science**

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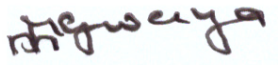
**Abstract**

Images in human evolution play a pivotal role in helping learners understand the nature and characteristics of early humans which are central to understanding human ancestry and identity. These images, like any sign systems, were created from a particular perspective and are prone to have multiple interpretations depending on the ideological and cultural disposition of both the creator and the reader. Therefore, there is a potential that unintended meanings and associations with the representations could propagate misconceptions about human evolution. This study aims to investigate how Grade 12 Life Sciences textbooks portray human evolution through the use of a semiotic analysis based on Barthes' (1977) semiotic theory. Through conducting my analysis, I found out that multiple modes of representation were used to portray human evolution. I also found that the degree of accuracy varied with graphs being the most accurate in comparison to other modes of representations. Furthermore, some images latently communicate race and gender related biases as well as the idea that apes are ancestors of human beings.

The implications of this study are that there is need to make Life Sciences teachers more aware of the multiple meanings associated with images of human evolution so that they can articulate the multiple meanings of these images. Furthermore, there is a need for further study regarding how teachers and learners interpret the meanings associated with human evolution images with an aim of revising them if need be so as to enhance learning of the relevant concepts about the broader concept of human evolution.

**Declaration**

I, Nyagwaya Martin declare that this research report is my own unaided work. It is submitted for the degree of Master of Science at the University of the Witwatersrand, Johannesburg. It has not been submitted before any degree or examination in any other university.



Nyagwaya Martin

**Dedication**

To my wife Florence, daughter Primrose, Sons Pardon and Prosper and my grandmother

Gertrude Nyamugunduru

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# Chapter 1

# An introduction to the problem

## 1.1 Introduction

The concept of human evolution is a crucial one as it enables learners not only to understand fundamental biological concepts such as ecology, genetics and diversity but also to appreciate their ancestry as well as their identity. However, in negotiating its terrain learners encounter communicative signs in form of textual, verbal and or images. Such signs might enhance or hinder the acquisition of relevant scientific knowledge, particularly with respect to images which observers may interpret from varied ideological positions and socio-cultural contexts.

Scott (2007), while referring to museum visitors, postulates that observers reinterpret human evolution images from their own social positions. She envisaged two basic mutually inclusive interpretive positions, which comprise of either popular views or marginalised cultural perspectives. The former portrays a dominant interpretation which has a strong influence from Western ideology and culture, while the later reveals a negotiated or resistant interpretation based on politicisation or a feeling of alienation emanating from politics of oppression and persecution (Scott, 2007). These two imagined dialogical positions are believed to have been acquired by visitors prior to visiting the museum but are reinforced in the museum. Similarly, readers interacting with human evolution images in Life Sciences textbooks might also have different interpretive positions. The dominant interpretive position can be viewed as the intended scientific position, since scientific knowledge is western in origin, while the marginalised interpretative position could be that of a reader who views scientific culture as foreign masculine knowledge (Scott, 2007).

The existence of potentially varied interpretations of human evolution images is problematic as it potentially hinders learners' acquisition of relevant and appropriate scientific knowledge central to ancestry and identity concepts as well as the overall acquisition of key biological concepts such as genetics, ecology and diversity. Therefore, this study will analyse representations of human evolution in order to decode the images and elicit debate and further studies on how to best represent the concept of human evolution so as to enhance teaching and learner acquisition of the intended scientific knowledge.

**1.2 Background to the study**

The Inter Academy Panel (IAP), representing the world's national Science Academies from sixty-eight countries that included South Africa, United Kingdom, Australia and Germany among others published a joint statement on in the 21st of June 2006 on the teaching of evolution:

> "We, the undersigned Academies of Sciences, have learned that in various parts of the world, within science courses taught in certain public systems of education, scientific evidence, data, and testable theories about the origins and evolution of life on Earth are being concealed, denied or confused with theories not testable by science. We urge decision makers, teachers, and parents to educate all children about the methods and discoveries of science and to foster an understanding of the science of nature. Knowledge of the natural world in which they live empowers people to meet human needs and protect the planet" (IAP, 2006: p.1).

Although such a declaration demonstrates the importance of teaching all science concepts, it particularly emphasises the teaching and learning of human evolution which is fraught

with controversy. It is important to highlight at this juncture that in this study the controversy associated with human evolution is not a question about whether it occurred but rather on its visual representations in the form of images which may be prone to multiple interpretations.

Scholars such as Scott (2007), Pillay (2010), Quessada, Clement, Oerke & Valente (2008), Quessada & Clement (2009 and 2014) have studied the subject of images representing human evolution. Scott (2007) has studied images that represent human evolution in different museums, including the National Museum of Kenya in Nairobi, the American Museum of Natural History in New York and the Natural History Museum in London. Among her findings, she observed that human evolution images were imbued with racial connotations. Pillay (2010), in the footsteps of Scott (2007), studied the representation of human evolution in the museums of the Cradle of Humankind World Heritage Site in South Africa. Among other findings, Pillay (2010) noted that hominin evolution images were entrenched with gender and racial stereotypes. Quessada, Clement, Oerke & Valente (2008) and Quessada & Clement (2009 and 2014) researched on human evolution images in classroom textbooks of different countries which included Cyprus, Italy, France, and Senegal. They discovered among others that *Homo sapiens* were always represented by a White man who was either naked or dressed in modern western clothing. Furthermore, Quessada & Clement (2014) observed that scientific representations with tree-like (non-linear) evolution schemes were rare in 2004 textbooks and before. This seems to suggest that the "*March of Progress"* images, which are discussed in detail in the following chapters, were dominant during that era.

### 1.3 Rationale for the study

As alluded to in prior paragraphs, analysis of human evolution images in Museums was done by Scott (2007), while those in textbooks from countries such as Cyprus, Senegal and France was done by Quessada & Clement (2009 and 2014). They generally found that human evolution images also convey unintended meanings such as racism in addition the dominant science concepts. From the above discussions it has be revealed that the study of how human evolution is represented by images in school textbooks is lacking in South African context, since most studies focus on representations in museums. This has prompted me to carry out such research whose outcome can be a valuable starting point for public engagement and for further studies on the subject of representation of human evolution. Furthermore, public discourse on human evolution images as presented to school learners might open windows through which their effectiveness in representation can be evaluated with a view of possibly minimising the occurrences of misconceptions among both learners and educators.

Media such as textbooks include visual images which make use of linguistic conventions to communicate their messages. Since an image can be revealed to be linguistic in its inner workings (Mitchell, 1986), it implies that one has to able to read an image in order to interpret it. As such, these images are like a language that can be analysed through semiotics. As a discipline, semiotics has been defined by Cobley and Jansz (1997:4) as "…the analysis of signs or the study of the functioning of the sign system." This seems to imply that semiotics is a study of interpretation of the code embedded in a sign. Thus the essence of this study is to identify the intended meanings and the connoted meanings communicated by images of human evolution in Grade 12 textbooks in order to understand

how these signs communicate meaning in a South African context. The findings of this study could be of value to the curriculum developers, text book publishers and teachers as they influence the selection of what is used to mediate learning of scientific concepts. Since images and texts work together to convey meanings, it implies that the meaning portrayed by an image should aid that of the text so as to enhance learner conceptualisation of a scientific concept. Furthermore, images and written text work together in presenting science concepts. That is to say images complement and sometimes override written texts as they present ideas that cannot be economically reduced to written texts. Thus, knowledge of how text book images portray human evolution can be of critical importance to a practicing teacher as well as textbook publishers, as textbooks influence learning through selection and presentation of information.

In South Africa, semiotic analysis of human evolution images in textbooks is notably absent. Therefore, this study can provide a window through which a public discourse about representation of human evolution in particular and science concepts in general. Furthermore, since Lelliott (2016) in his survey of the visitors of the Cradle of Humankind and Sanders & Ngxolo (2009) in their article about addressing teachers' concerns about teaching evolution have noted prevalent misconceptions with respect to human evolution among general public and teachers respectively, this study might help in identifying sources of some of the misconceptions.

### 1.4 Aim of the study

The aim of this study is to investigate what images of human evolution in Grade 12 Life Sciences textbooks denote and connote, and then to explore the ways in which the interpretation of such images might influence what is learnt about human evolution. The

concepts of denotation and connotation are explained in more detail in chapter two that follows.

### 1.5 Research questions

In order to investigate the significance of images of human evolution in Grade 12 Life sciences textbooks, in this study the following questions have been addressed:

1. How do Grade 12 Life Sciences textbooks portray human evolution?
2. How accurate are human evolution images portrayed in Grade 12 Life Sciences textbooks?
3. What attitudes and ideas are promoted by human evolution images in Grade 12 Life Sciences textbooks?

### 1.6 How the research was conducted

Seven current Grade 12 Life Sciences textbooks were purposefully sampled. Images portraying human evolution were identified, selected and each was then analysed used the semiotic instrument I constructed using Barthes's (1977) Semiotic theory.

### 1.7 Delineation of the study

I employed a semiotic analytic instrument, constructed drawing from the ideas of semioticians such as Roland Barthes (1977) and Rose (2010) because it allows for the interpretation of denoted as well as the associated meaning. Furthermore, the study was limited to Grade 12 textbooks because this is where the content of human evolution constitutes about 28 % of the Life Sciences curriculum.

## 1.8 Organisation of the research report

This research report is composed of six chapters. Chapter one provides an introduction and background to the study. Chapter two discusses related literature as well as the theoretical framework. It should be noted that some related literature review is introduced in chapter five where it was felt that it could buttress the argument being raised. Chapter three discusses research methodology. Chapter four deals with an overview of the concept of human evolution. A discussion on the analysis of human evolution images is done in chapter five. Last but not least, chapter six includes the summary and conclusion of this semiotic study and covers aspects such as its implications and limitations.

## 1.9 Summary

This chapter discussed the problem and outlined the background of the study. Furthermore, the rationale and the aims of the study were given. The research questions and a brief organisation of the research were also discussed. The next chapter presents the related literature review and the theoretical framework that informed this study.

# Chapter 2

# Literature review

## 2.1 Introduction

This section covers related literature. This helps to position this study in relation to other studies in the similar field. Furthermore, it also helps to avoid unnecessary duplication and be informed of findings and challenges encountered by prior researchers. Discussions in this chapter have been limited to curriculum issues about human evolution, challenges involved in teaching and learning about evolution and on theories on reading of images. It is important to note that further literature has been reviewed in other chapters such as five as the study evolved so as to add more substance to image analysis process as it unfolded.

## 2.2 Curriculum issues on human evolution

Studies on the teaching and learning of human evolution across the globe have revealed that the concept of evolution is not taught uniformly and has not been given the central role that it is believed to play in biology. An analysis of the Zimbabwe School Examination Council (ZIMSEC) biology 5008 and biology 9190 syllabi has revealed that human evolution has been excluded. A similar observation was done by Quessada & Clement (2014) when they analysed the biology syllabi of Algeria, Tunisia, Morocco, Portugal and Burkina Faso among others. However, not all countries excluded human evolution from the curriculum, as Quessada & Clement (2014) discovered countries such as Italy, Senegal, Estonia, France and Hungary to name but a few had human evolution as one of the curriculum concept to learned.

Even though human evolution was a concept in the curriculum, Skoog (2005) reported that in the United States of America (USA), it was given very little attention in biology textbooks prior to 1960, and the situation worsened two decades later as information about evolution was minimal. However, he observed that an improvement occurred after the 1990s as access to information, teaching and learning of human evolution became unrestricted. Studies by Quessada & Clement (2007) reveal that in France human evolution was taught up to beginning of the 20$^{th}$ century, suppressed for the next 50 years and then regularly taught from 1950s. In Greece, Lakka & Vassilopoula (2004) observed that human evolution was not always taught although it was supposed to be (according to official curricular documents). Further studies by Prinou, Halka & Skordulaulis (2007), cited by Quessada et al. (2008) revealed that from 1983 up until 2000 human evolution was only taught to a small percentage of learners who were aspiring medical students in Greece. This seems to suggest teaching and learning of human evolution is a contentious issue as it did not enjoy the same stability perceived to be prevalent in other biology topics such as cell biology, genetics, reproduction and ecology, among others. The contentious nature of human evolution can be thought of stemming from its sharp contrast to a creationist perspective as well how it is represented in popular media and textbooks. Furthermore, one can also infer that South Africa specifically was not really lagging behind in the teaching and learning of human evolution as the concept was contentious almost everywhere.

In South Africa, prior to 1994, human evolution was not taught in schools. This can be attributed to the political ideology of the day which promoted *Christian National Education* (CNE). The ideology of Apartheid utilised Christian rhetoric to promote the idea that White, (male) Afrikaners were the superior race, chosen by God to legitimise their racist policies. To

achieve this Christian religious instruction was made a compulsory part of the curriculum (Christie, 1991). Furthermore, CNE discouraged Black students from pursuing science subjects, thereby limiting science knowledge that they could possibly get as they were being channelled to become labourers. Even though White students were privileged to do science during the Apartheid era, CNE did not expose them to evolution discourses. This appears to agree with Lelliott (2016), when he argued that even the name of Charles Darwin was notably absent in school curricula by the 1960s, resulting in generations of South Africans being denied access to this overarching biological theory across the racial divide, despite major discoveries of hominin fossils being made in the country. It was a sad reality as most South African general public could not play a critical role in advancing the history and science of palaeontology, even though frontiers in this regard were being shifted emanating from discoveries from their immediate environs.

The emergence of the new democratic dispensation in 1994 resulted in curriculum revisions which culminated in the ushering in of the concept of human evolution as part of the Life Sciences curriculum in 2008 (Abrie, 2010). An analysis of the current Curriculum and Assessment Policy Statement (CAPS) has revealed that for the Grade 12, human evolution has a weight of 28 % of the teaching time, second only to genetics. The reason behind the considerable increase in the content on human evolution could be the introduction of a new ideological dispensation (from Apartheid to a more inclusive and democratic political dispensation), which brings with it a belief that arming school leavers with relevant scientific knowledge could spur rapid social, economic and political development, thereby uplifting the lives of the majority of the people. Furthermore, South Africa has a World Heritage Site known as the Cradle of Humankind with a rich record of human evolution which is still being

retrieved. Thus knowledge of human evolution might enable learners to have the opportunity to directly access sites of scientific significance (such as the Cradle of Humankind) and become engaged with or becomes makers of scholarship related to human origins located locally but having a global significance. This could lead, in my opinion, to increasing the pride of the nation by its inhabitants, appreciation of the rich history and heritage of the country in addition to boosting the tourism industry.

**2.3 Challenges in the teaching and learning of human evolution**

The teaching and learning of human evolution is littered with many challenges. The most important challenges are the manner in which human evolution is represented in textbooks, and how the social-cultural context of the reader affects interpretation of the images. In the South African context, since generations were denied access to evolution discourses by CNE there is also the challenge of evolution content adequacy among the majority of teachers. Research by Sanders & Ngxolo (2010) appeared to have confirmed this perspective when they reported that most of teachers lacked both content and the pedagogy needed to effectively implement the evolution concept in the classroom. In addition, human evolution may be construed as a suspicious concept that is counter to Christian ideas by those teachers and learners who might have a heavy leaning on Christian religious beliefs. These ideas are confirmed in Clement & Quessada (2007) who posited that social issues such as degree of belief in God and in religious practice, economic status of the country and teachers' level of training correlates strongly with teachers' conceptions of and acceptance of evolution. In their further studies in 14 countries, which included Cyprus, Hungary, Morocco and Tunisia on the textbooks and teacher conceptions on evolution, Quessada & Clement (2014), reported that teacher acceptance of evolution is directly proportional to

the time the teacher spent training at the university. They also attributed some of the problematic issues to the manner images in school textbooks depicted human evolution. Sexism, racism, finalism and occidentalism are among some of the problematic issues that were associated with how images portrayed human evolution.

It is important to highlight the meaning being accorded to the terms: sexism, racism, finalism and occidentalism in this study. According to Schneider, Grumman & Coutts (2005), sexism can be viewed as subordination of one sex (in most circumstances the female) based on the assumed superiority of the other (usually the male). This can be portrayed if the male category dominates the other among the images. Delgado & Stefancic (2012) define racism as prejudice directed someone of a different race based on the belief that one's own race is superior. With respect to images, racism can be portrayed if one race category is seen as inferior, which may also include associated negative perceptions. Gould (1989) viewed finalism as the presentation which appears to be directed toward a specific end (goal directed). This is particularly noticeable when hominins are arranged in a line as if they are marching from the least (inferior) evolved to the most (superior) evolved being (as in the "*March of Progress"* discussed later). The term, "occident", according to Delgado & Stefancic (2012), mean the West. This seems to imply that occidentalism is the presentation of an image in such a manner that it portrays a western culture, such as wearing linen clothing. The problematic nature of occidentalism is that it belongs to cultural evolution, different from biological evolution. Therefore, if it is used in the explanation of biological evolution it tends to signify non-western races as inferior in evolutionary terms.

Kyriacou, de Beer & Ramnarain (2015) concur with Clement & Quessada (2014), in their suggestion that longer learning interventions are needed to uproot essentialist reasoning

prevalent in both pre-service and in-service teachers in South Africa. Essentialism is the idea that members of a particular species have an inherent character that determines their phenotype and behaviour (Shtulman & Schulz (2008). That is to say essentialism in evolution does not believe that there is intraspecific variation. This belief (essentialism) may overshadow the critical component for understanding the theory of evolution through natural selection, as intra-specific variation, that is differences within the species provides a fertile ground for natural selection to process to act with the end result being micro and then macro evolution process. The process of natural selection act upon variations within the species by creating a selection pressure that favours survival of the fittest. The organisms that survive and breed the next generations are those that have characteristics that best suit the environmental.

Textbooks are indispensable educational resources that have been used over ages in the act of teaching and learning. This appears to be supported by Heyneman (2006) when he views textbooks as the most effective of all the educational technologies invented so far. Therefore, it would be naïve and ignorant to believe that any modern education system would efficiently deliver its constitutional and moral mandate without textbooks.

Although textbooks are designed to help teachers in bringing knowledge to the learners, there might be an interpretation problem that hinders effective communication of the intended ideas. This problem of interpretation can emanate from misunderstanding meaning of words. Although science words pose a challenge to learners, it is everyday words that change meaning when used in a science context that pose a serious challenge (Oyoo, 2007), since many teachers take them for granted and do not explain them to learners. Besides the difficulty posed by science words, images, representing science ideas,

such as human evolution (which is the focus of this study) can also be misunderstood. According to, Barthes (1977) problem of image representation emanate from multiplicity of meanings. This appears to agree with Scott (2007), when she argued that that museum visitors interpret human evolution representations from two perspectives which are the dominant (scientific position) and the marginalised perspectives (negotiated and resistance position). The dominant perspective is a position that resonates with the Western scientific perspective, while the marginalised may emanate from the community that had suffered or still suffering from economic, political and cultural oppression. Therefore, there is a need for these multiple meanings to be ascertained so that learners are scaffolded and reinforced to towards the acceptable and intended understanding.

**2.4 The importance of images of human evolution**

The concept of human evolution is presented in both textual (non-visual) and image (visual) format in the Grade 12 textbooks. These textual and visual representations complement each other, for instance, images communicate ideas that cannot be presented efficiently in textual format. This is because images present ideas in one frame and make use of a different set of conventions such as line, scale, shape and repetition among others. The immediacy of the image and that we see the whole text at once may make the image easier to understand and hence a more efficient way of communicating complex ideas such as human evolution. According to Mitchell (1986), an image is like a transparent window through which reality can be viewed for it to be understood. However, it is not as simple as that as the skill of visual literacy is needed for one to be able to read and interrogate visual images, which is often a more complicated process. Therefore, images do need to be decoded to be understood since they convey a message in a coded form. Although the focus

of this research is on images of human evolution, textual messages in the form of captions that often accompany the diagrams to communicate the intended meaning will also be considered as part of the meaning making process, since iconic and textual messages complement each other in effectively communicating ideas. The caption is intended to focus the readers of an image to a particular meaning as images have multiple meanings embedded. Therefore, this study will explore the captions that accompany the images as part of the meaning producing structure of the visual texts. When considering human evolution, images are used to help learners visualize evolution, which is a difficult concept to understand, especially since it is at variance with other social and religious beliefs. It's also important to note that even though images are often presented as powerful scientific documents, they may be laden with latent meanings that may negatively affect evolution discourses.

Visual images of human evolution are more than just images as they are often densely packaged with ideas of what it means to be human (Scott,2007). However, it is important to note that images may fail to portray what they are intended to portray. This is because the context in which the image is being read plays a critical role as it influences the meaning obtained by the reader. According Barthes' (1977) theory of semiotics the meaning is supplied by the reader through his knowledge of the world and codes while comprehending an image. Scott (2007) furthermore, argued that images of human evolution may communicate ideas far beyond the intention of the original artist or scientist. For example, she notes that students often perceive the process of evolution as a line progress from dark skinned, hairy and naked male ancestors to white skinned male *Homo sapiens* often clothed, and upright. These perceptions have an effect of distorting the concept of human evolution

in a number of ways which include failure to appreciate the branching aspect of human evolution. Furthermore, there is also a potential of stereotyping dark people as inferior, since most early humans are always portrayed with such a complexion. These multiple interpretations could be explained in terms of the denotative and connotative nature of images (Barthes, 1977) and also due to ideological and socio-cultural disposition of the reader of image that might differ from that of its originator. This implies that an image may connote different issues to different people which might be at variance with the intentions of the creator and with what is depicted at the denotative level. According to Barret (2003), the meaning of an image is not limited to the original intention of the artist. This is because the reading of an image is subject to multiple interpretations which are shaped by contextual experiences of viewers. The occurrence of varied opinions regarding an image might be a recipe for a communication break down between the sender and the receiver. This might be a serious challenge in the discourse of human evolution as images are often used with an assumption that they will effectively communicate ideas that cannot be reduced to written texts. Although texts in form of captions may be used to compliment images, there might be complications that arise from captions themselves such as being masked by the image as well as the need of their interpretation in context of the image.

## 2.5 Theoretical frameworks

### 2.5.1 Introduction to semiotics

Semiotics is the study of signs. Although interest in signs and the way they communicate ideas has a long history, Swiss linguist Ferdinand de Saussure and American philosopher Charles Sanders Peirce are thought to be the fathers of modern semiotic analysis (Kress, 2010). Peirce has been credited for coining the term *semiotics* in addition to the proposition

that people can only think efficiently in terms of signs, due to the complex nature of reality. A sign is something that represents reality. That is, a sign translates reality so that it can be understood. Although signs can take many forms such as words, images, sound, acts and objects, our brains make the image that we think we perceive. This seems to imply that interpretation of a sign is a subjective endeavour, with an end result of multiple interpretations.

De Saussure (1916) in Chapman & Routledge (2009) suggested the possibility of semiotic analysis by proposing that a sign has two sided entities like a coin, called the *signifier* and the *signified*. Cobley and Jansz (1997) define the signifier as the material aspect a sign, for instance the vibration of a radio speaker or of a drum indicates that origin of sound is a material in nature (Cobley and Jansz, 1997). That makes the speaker or drum the signifier of sound which is material in nature. In other words, the signifier refers to the form the sign takes. Furthermore, Cobley and Jansz (1997) defined the signified as the mental concept of a sign. As an illustration, if we consider the word “car” (comprised of signifiers/c/, /a/ and /r/), what comes into the listener’s is not a real car but the general mental concept of the car (Cobley and Jansz, 1997). The actual car might be a BMW, Toyota or Honda instead of any other car. This seems to imply that the signified refers to the mental concept that forms in the observer of a sign.

The inseparability of the signified (mental concept) and the signifier (material aspect), prompted de Saussure to produce the diagram in figure 2.1.

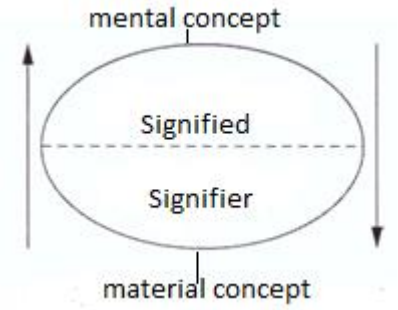



Figure2.1 De Saussure's concept of a sign. From Chapman & Routledge, (2009).

The Saussurean model perceives the sign as a whole resulting from the relationship between the signifier with the signified. Such a relationship has been referred to as the process of *signification* (Chapman & Routledge, 2009). This is represented in figure 2.1 by arrows. The Saussurean model implies that communication through language use involves transfer of the content of the minds (Cobley and Jansz, 1997) by making use of the sign as a code to unlock the contents of the brain of the participants to the act of communication. This encouraged de Saussure to propose the introduction of semiotics, which is the analysis of sign systems of communication.

Semiotic theory spread to the social sciences with the works of Barthes and later post-structuralists in the 1970s and 1980s in what has come to be called the *semiotic turn* in the social sciences and humanities (Chapman & Routledge, 2009). In this study the work of Roland Barthes takes centre stage as it provides a theoretical framework that can be used to analyse images of human evolution. Barthes (1977) demonstrates how the use of *denotative* and *connotative* meanings operates within sign systems, to communicate meanings that can be interpreted.

### 2.5.2 Barthes' theory of semiotic analysis

Roland Barthes applied the semiotic theory of De Saussure, to a range of non-linguistic social phenomena such as the photographs. In developing De Saussure's theory, Barthes (1968) acknowledged that a sign is a compound of a signifier and signified. However, he further proposed that, semiotics deals with a system of signification, sometimes called a sign system.

Systems of signification include things like images, gestures, musical sounds, language and other objects. These aspects can be considered as components of a system of signification because they have conventions which makes it possible to decode according to Barthes (1968)'s theory. That is to say, a system of signification is external information which enables one to generate information. In other words, a system of signification results in subjective experiences of an individual. In this study, images of human evolution are an example of a system of signification. They enable individuals to experiences/visualise the theory of evolution. However, it is important to note that such experiences are subjective rather than objectives due to differences in perceptions that are shaped by socio- cultural, economic and political backgrounds. Therefore, semiotics provided a useful theoretical framework for this study which sought discover what images of human evolution in textbooks denote and connote and how this could influence what is learnt about human evolution.

However, Barthes further proposed that the interpretation of signs occurs at two levels, which are the *denotative* and *connotative* levels (Barthes, 1977). In this study, denotation of an image is its explicit or literal meaning. This differs from its connotation, which has been taken as subjective meaning, as this invokes in the mind of the reader certain associations

that might be unique to the individual. The *denotative* level is the primary level that seeks to understand the signifier, that is, the material means of communication. When applied to images, it answers the question "*what do I see in this image?"* The *connotative* level is the secondary level in Barthes semiotic analyses. It is aimed at uncovering the concept by answering questions such as "what is represented by this image?" or "what connotations does this image have?" Therefore, the denoted message refers to the signifier and the connoted message refers to what is signified.

Barthes' theory can be summarised as illustrated by Table 2.1 below:

| Level of semiotic analysis (signification) | Sign | Components |
|---|---|---|
| Primary | Denotative message | Signifier |
| Secondary | Connotative message | Signified |

Table 2.1. Summary of Barthes' theory of semiotic analysis. From Cobley & Jansz, (1997).

In other words, denotation refers to the descriptive message portrayed by the image/sign that can be read at first sight, that is, what the image points to. This has been referred to as the denotative message in Table 2.1. Bouzida (2014) supports this view of denotation by arguing that denotation deals with the objective meaning of a sign that is independent of contextual and subjective interpretations. Thus the primary level of semiotic analysis involves describing what one sees in the image. Aspects such as the means of representation, lines, colours and background (space), are among the means of communication.

The secondary level of semiotic analysis involves interpreting what is signified through the connotative message, as indicated in Table 2.1. Connotation is subjective, as the reader makes use of socially and historically gathered tools (cultural lenses) to decipher what is connoted, or implied, in an image. This results in varied interpretations since the social contexts of readers are often diverse. Fiske (1996) argues that connotation can be viewed as the result of the interaction between a signifier and the emotions or cultural lens of an individual. The implication of this view is that images and texts are open to multiple interpretations at the connotative level since individuals draw from a large cultural and personal arsenal in trying to make sense of a sign. This implies that people of the same socio-cultural background may interpret images in a similar way, leading to an effective communication of concepts. This might not be the case with people from different socio-cultural groups as they might get different meanings of the same image, thereby reducing effectiveness of cross-cultural communication. However, it is important to note that although multiple meanings are possible, they are kept in check by other signs in the whole system of use. In the case of textbook images, the other signs could include the use of captions, which work together to help the reader understand the particular intended meaning. Thus, it is imperative for the reader to interpret the verbal texts that accompany an image, as they focus him/her to a particular intended meaning (Barthes, 1977). This is of particular importance to scientific images, such as human evolution images, because they are mere illustrations whose intended meaning can be sign posted by their accompanying captions.

It is also important to note that understanding an image means to understand the manner in which both the signifier and the signified work together to produce meaning. This implies

that, the interpretation of an image has a subjective influence. This subjectivity may emanate from a belief that objects are an individual creation, suggesting the influence of one's brain in the interpretive process. Therefore, it can be said that value system of image creator and reader can actively reinforce particular sets of interpretations which might be at variance thereby potentially creating a communication barrier. With respect to human evolution images, the end result could be learners failing to grasp important information essential for them to fully comprehend this important biological concept.

Semiotics is a useful theoretical framework for developing a qualitative model of analysis for understanding images and texts of human evolution from different Grade 12 Life Sciences textbooks, because it enables an exploration of the denoted and connoted meanings. This is essential as it may to shed light on the meanings portrayed by human evolution images in learners' books.

### 2.5.3 Analysis tool

Roland Barthes' (1977) framework for semiotic analysis can be used to unmask the multiple layers of meaning embedded in a sign. Barthes' methods of semiotic analysis has been used by many scholars, including Rose (2012) and Aiello (2008), who developed a critical visual methodology (CVM) for analysing signs. Figure 2.2 shows a summary of Rose's framework.

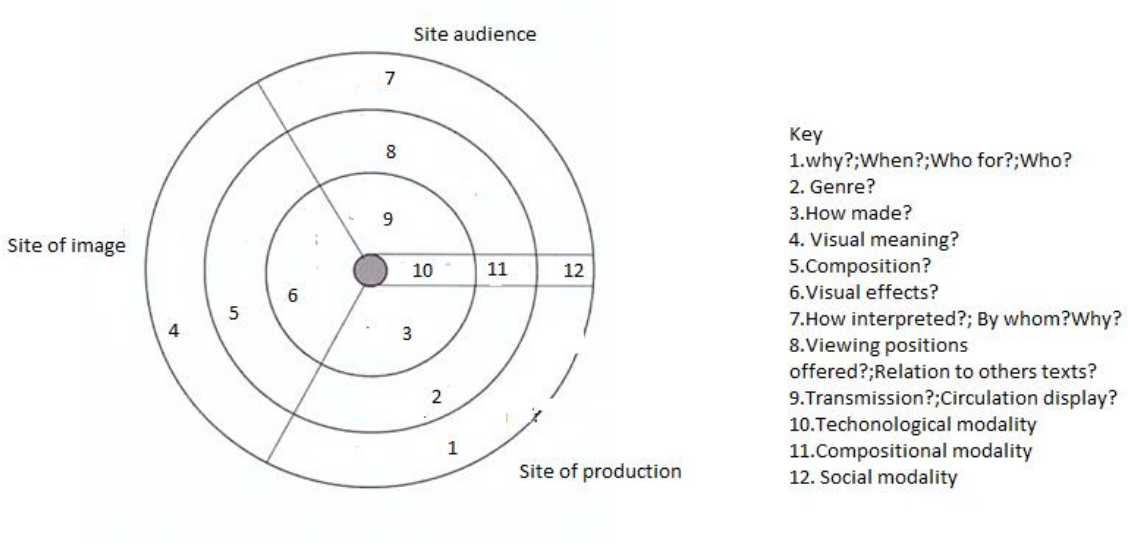



Figure 2.2 Image depicting the sites and modalities for visual analysis of Rose's critical visual methodology. From Rose, (2012).

In constructing my theoretical framework, I borrowed ideas from both Barthes' theory (that has been described in the preceding paragraph) and Rose's theory. As an analytic framework, Rose's framework has three distinct focus areas that can be used in the process of decoding an image. These focus areas as shown in figure 2.2 have been referred to as *sites* (Rose, 2012). They are: *site of production*, *site of image itself* and *site of audience* (Rose, 2012). In the context of this study, the sites of production are the contexts of the curriculum; the sites of the image are the Life Sciences textbook, while the sites of audience are the learners and the teachers in Grade 12.

Within each of these three sites, Rose (2012) suggested three *modalities* which can be made use of during image interpretation and these are: *technological, compositional* and *social*. It is important to note that, since the focus of Rose's theory was solely on pieces of art that have been made in different ways, its perspective has been relevant to this study of textbook images.

T*echnological modalities*, this involves the use of physical tools and technical knowhow that were used in the construction of the image. In this study technological modality refers to how the human evolution image has been constructed, in terms of whether it is a drawing or a photograph of a model. Compositional modality on the other hand deals with how the image looks the elements that accompany the image for example the background, colouring, shape and texture among other things. It seems though that both the technological and compositional modalities appeal to first level of semiotic analysis according to Roland Barthes' perspective, as they describe the appearance of an image. Finally, the social modality deals with social, economic, political and institutional practices that inform the reading of an image resulting in multiplicities of interpretations. In this study, it is believed that all these categories of Rose (2012) can easily be applied to Barthes' two levels of semiotic analysis. In this sense, it implies that when one is describing what an images looks like, one will be focusing on the denotation level, while a description of what one thinks about the image could be deemed a focus on the connotative level.

**2.6 Summary**

This chapter covered the discussion on: curriculum issues in human evolution; challenges in teaching and learning of human evolution; the importance of images of human evolution and the theoretical framework. The next chapter discusses the research methodology used in this study.

# Chapter 3

# Research Methodologies

## 3.1 Introduction

This chapter describes the research method, instrument used for analysis of images, data analysis techniques, unit of analysis, research rigour and limitations.

## 3.2 Method of Research

The objective of this study is to interpret the denotative and connotative meanings of the visual signs, and their accompanying captions that are used to represent human evolution in Grade 12 Life Sciences textbooks commonly used in Gauteng public schools.

The unit of analysis in this research were human evolution images and their captions in Grade 12 Life Sciences textbooks that are commonly used in public schools in Gauteng province in South Africa. The unit of analysis was framed in this research by presenting the content (or signified) in Chapter 4. This provides the base for semiotic analysis that was done in Chapter 5. As an African science teacher, with an experience of teaching the concept of human evolution to learners I felt better positioned to analyse and deliberate on the concept of its representation so as to get a deeper insight on this very important and sometimes emotive and controversial discourse.

Firstly, I purposively sampled Grade 12 Life Sciences textbooks that included a section on human evolution, are commonly used in Gauteng public schools, and have been approved to be appropriate for the new Curriculum Assessment and Policy Statement (CAPS) by the Department of Basic Education. Purposive sampling involves a researcher handpicking a

particular sample because it has a particular attribute of interest to the researcher (Cohen, Manion & Morrison, 2007). CAPS approval is essential as it makes it not only a current book, but also a book that is officially being used in the Life Sciences curriculum. A total of seven of such textbooks were used in this study and a descriptive qualitative method based in semiotics was applied in the subsequent analysis of human evolution images.

The semiotic framework that guided my analysis enabled me to interpret the human evolution images in Grade 12 Life Sciences textbooks by asking questions such as: What is depicted in the images? In what manner are the images depicted? What is connoted in the depiction? Are the images scientifically accurate? These questions arose from the need to understand and explain the apparent (denoted) and latent (connoted) meanings associated with an image. Furthermore, these questions are rooted in Barthes's (1977) semiotic analysis which sought among other things to interpret images from the broader community and personal perspectives. Therefore, in this study the semiotic method of analyses can be understood as the analytic tool, while the images of human evolution and their captions in Grade 12 Life Sciences textbooks can be understood as the research objects.

It is worthy to mention that the semiotic method used in this study has some inherent limitations such as increased subjectivity in viewing issues. As a way of reducing this subjectivity in this study analysis of the images was coupled with the presentation of the actual images analysed. Furthermore, rigorous rigour as explained below was important in framing and guiding the precision of my analysis.

### 3.3 Instrument of analysing visual representations

In pursuing this study, I developed semiotic analytic instrument that I used in the analysis of human evolution images**.** Table 3.1 below illustrate the semiotic analytic instrument that I developed and used in the study of human evolution images in learner textbooks.

**Image** (*copy of the image is pasted here*)

**Author** ……

**Title**……

**Year of Publication**……**Publisher**……..

| **Analysis level** | **Questions** | **Answers** |
|---|---|---|
| Primary (denotation) | 1. What can be seen in the image (detailed description)? | |
| | 2. What mode of representation has been used? | |
| | 3. What is the background (space) of the image? | |
| | 4. If there is caption, what does the caption say? | |
| Secondary (connotation) | 5. What associations do I have when looking at this image? | |
| | | |

| | | |
|---|---|---|
| | 6. What attitudes about human evolution are being communicated by the image? | |
| | 7. What idea(s) about human evolution is/are presented by the image? | |
| | 8. What misunderstanding might arise through this representation? | |

Table 3.1 Analysis instrument used for data gathering in this study incorporating ideas from Barthes (1977) and Rose (2012).

Table 3.1 has been developed borrowing ideas from Barthes (1997) and Rose (2012). Apart from focusing my attention at the denotation and connotation levels of semiotic analysis proposed by Barthes (1977), this instrument helped me answer my research questions through its framework of questions. My research questions, are:

1. How do Grade 12 Life Sciences textbooks portray human evolution?
2. How accurate are human evolution images portrayed in Grade 12 Life Sciences textbooks?
3. What attitudes and ideas are promoted by human evolution images in Grade 12 Life Sciences textbooks?

The analysis instruments helped me to collate my data. During the process of data collection, an image of interest and its caption was collected and attached on the analysis instrument. Information about the name(s) of the author(s), title of the book, year of

publication and name of the publisher were also captured. I then answered the questions on the analysis instrument based on the human evolution image attached. I then used my answers to the questions on the analytic instrument to draw conclusions about the denotative and connotative meanings of the images analysed.

Finally, images of human evolution and their captions in the selected books were analysed through an analysis technique specified above in order to explore their denotative and connotative meanings.

**3.4 Rigour**

Rigour is important in academic research. According to Magarinos de Morentin (2008) a practice can be deemed rigorous if different researchers obtain similar results after applying empirically, a shared practice to the same object of study. However, with respect to semiotic analyses, verification of results is challenging since the researcher's subjective analyses is part of the method. While dealing with artworks, Barret (2003) proposed that rigour can be enhanced if researchers pay particular attention to: coherence; correspondence and inclusiveness during the interpretive process. Coherence refers to making judgements about whether ones' interpretation is making sense irrespective of the presence or absence of the artwork (Barret, 2003). This sense is thought to emanate from the quality of the logical argumentation in the discourse. In this study I ensured coherence by making sure that the description I gave was rationale so that sense can be obtained out of it. With respect to correspondence, interpretation should match the observed object together with its context (Barret, 2003). This implies that the interpretation should take into consideration what the object of analyses is, and the context in which it appears. This has an effect of confining the interpreter so that he/she does not make interpretations that deviate

from the object under observation. For example, an image in a textbook is different to an artwork on a gallery wall. In ensuring correspondence, I tried to make sure that the description I gave matches the object described. Inclusiveness deals with the whole artwork itself and its causal environment (Barret, 2003). This implies that the interpretation should take into consideration the effect that the artwork has on the audience or the context in which the object of analyses appears. In this research the aspect of inclusiveness has been implemented by interrogating the image together with its contexts which included accompanying texts. This is because the context of an image is critical in communicating its meaning(s). Barret (2003) argues that considering coherence; correspondence and inclusiveness during the interpretive process has an effect of enabling one to get a whole range of messages being communicated by the object. In trying to differentiate these aspects, Barret (2003) noted that coherence is an internal criterion; correspondence is an external criterion, while inclusiveness is an overarching criterion that checks on both coherence and correspondence.

Although Barret's ideas referred to artworks, I found them appealing for application in my semiotic study. Despite that the images of human evolution that I am analysing are scientific diagrams; I am employing methods of analysis that are commonly applied to understanding artworks. Therefore, I employed these ideas of Barret, coupled with Barthes's (1977) semiotic theory of in enhancing research rigour of this study.

**3.5 Ethics**

Since this research dealt with textbooks which are neither human nor animal subjects ethical clearance was not sought, as it was felt that no threat is posed to living objects.

### 3.6 Summary

This chapter discussed the research methodology which explains how the research was conducted. The semiotic instrument used to analyse images in this study was also discussed together with how research rigour was enhanced. The next chapter focused on scientific aspects of human evolution so as give a brief scientific background of the study.

# Chapter 4

# Overview of human evolution

## 4.1 Introduction

This chapter gives an overview of the concept of human evolution and also raises issues that are pertinent in my research questions. I have divided this chapter into sections which are: evolutionary trees, hominin clade, challenges of classification of hominin clade, the "March of Progress", and challenges of representing human evolution. This generally follows the grouping of different images used to depict human evolution in learners' textbooks.

## 4.2 The human evolutionary tree (phylogenetic tree)

The evolutionary tree is sometimes called the phylogenetic tree. It is a diagram that shows the evolutionary history of a group of organisms derived from a common ancestor. Evolutionary trees are drawn from biochemical data such as DNA sequence divergence, morphological features and other characters (Raven & Jonson, 1990). Brower & de Salle (1998) viewed sequence divergence as the percentage difference in nucleotide sequences between two related DNA sequences. Raven & Johnson (1990) defined morphology as a branch of biology that deals with the form and structure of living organisms. Organisms that share an evolutionary history have similar DNA sequences and morphological characteristics. Biochemical data and morphological data differ in their level of analysis (aspects of interests). The former focuses on the sub-micro level, while the later deals with the macro- level. Together these data are crucial in the construction of evolutionary history of organisms as they give clues to the point in time when an evolution branch was formed. However, correct interpretation of certain characters is of fundamental importance for the construction of accurate evolutionary trees and this is usually limited by available

knowledge and level of analysis (Raven and Johnson, 1990). Advances in biochemistry and computers have contributed a lot in the construction of more accurate evolutionary trees.

With respect to the phylogeny of primates, the human clade (branch) consists of fossil evidence of modern humans and extinct taxa believed to be closer to modern humans than any other living great ape. A taxon (plural taxa), according to Raven & Johnson (1990), is a group of one or more populations of organisms seen as a unit by taxonomists (biologists who classify organisms into various classes).

For the purpose of this research, the human clade has been referred by the tribe name "*hominin*" and fossils in this taxon as "*hominin* fossils" (Wood, 2010). According to Wood (2010), hominin clade comprises of *Ardipithecus*, *Australopithecines*, *Paranthropus* and *Homo* and species among others. The hominins arose just after the split from the chimpanzees. According to taxonomist, the hominin-chimpanzee branch is the most recent split in the evolution history of primates. *Homo sapiens* of the, genus *Homo*, is the only surviving species of the hominin clade.

According to Huxley (1863), cited by Wood (2010), morphological differences that separate Man from Gorilla and Chimpanzee are not as great as those that separate Gorilla from the other apes. This has been confirmed by biochemical and computer analysis which are technological innovations that have been instrumental in the expansion of frontiers of palaeontology. Evidence from biochemical analysis has revealed that *Homo sapiens* share 98 % of their DNA sequences with chimpanzees (Reece et al., 2013). This seems to suggest that, chimpanzees are the closest living evolutionary relatives of modern humans, probably sharing a common ancestor in comparison with other primates. For the purpose of this study, discussions have been limited to the human clade, hominin, as it encompasses the

human species both extinct and surviving crucial in our understanding of the process of human evolutionary history.

With reference to the phylogenetic tree, the common ancestor is represented by nodes in the tree trunk. Humans and chimps share a common ancestor, humans and chimps and gorillas also share a common ancestor and so on. The common ancestor for all primates would be the root or is the trunk of the tree, whilst organisms that would have arisen from it are placed at the tips of the tree branches. The tips of a phylogenetic tree can be living organisms or fossils that represent an evolutionary lineage. The degree of relationship between groups depends on the closeness of branches and this means that closely related organisms are located on branches close to each other. Figure 4.1 is an example of an evolutionary tree showing primates that have a common ancestor.

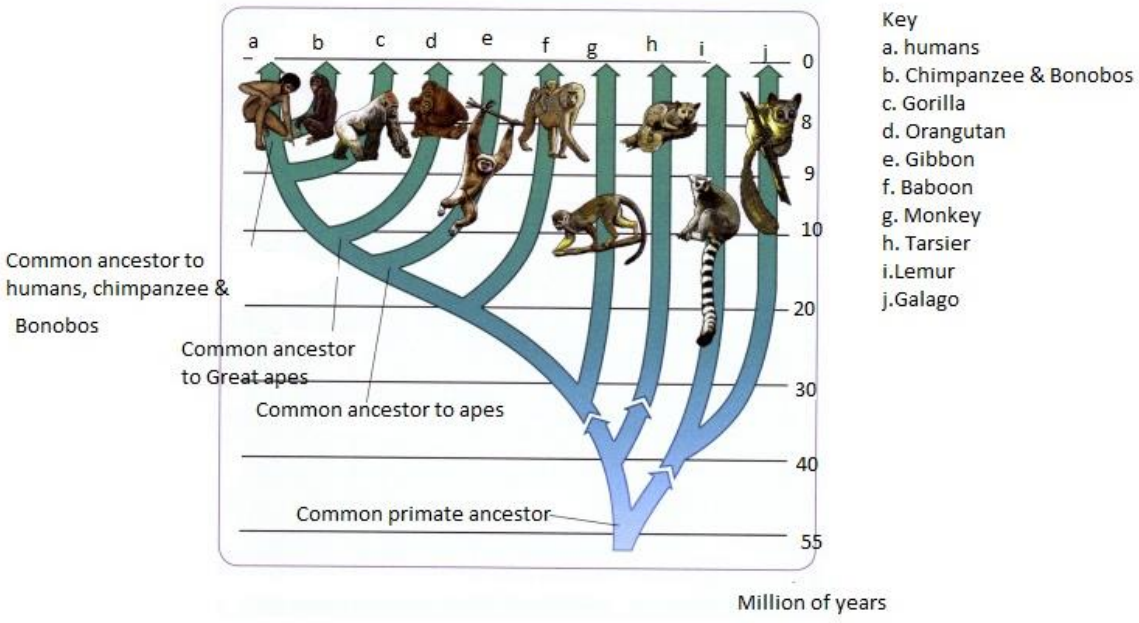



Figure 4.1 Phylogenetic tree showing primates that have a common ancestor. From de Fontaine et al.,2013).

In figure 4.1 it can be seen that the chimpanzees and bonobos branch is closer to the human branch than the gorilla branch. Therefore, one can conclude that humans and chimps/bonobos share a common ancestor which they do not share with gorillas.

**4.3 Hominin clade**

The hominin clade is comprised of modern humans and extinct species. These extinct species can only be accessed through fossil records. In this study, the discussion of hominin clade follows the evolution pattern described in Grade 12 Life Sciences learners' books, that is, from the earliest to the recent hominin clade, i.e. from *Ardipithecus ramidus* to *Homo sapiens*. Figure 4.2 below shows the taxa recognised in a hominin taxonomy arranged according to their temporal ranges, with the earliest hominin clade at the bottom, while the latest one is at the top. The names and characteristics of these species are discussed in detail in the paragraphs and tables below. The discussion of the hominin clade in this study followed a similar pattern, starting with the earliest species and ending with the most recent

species

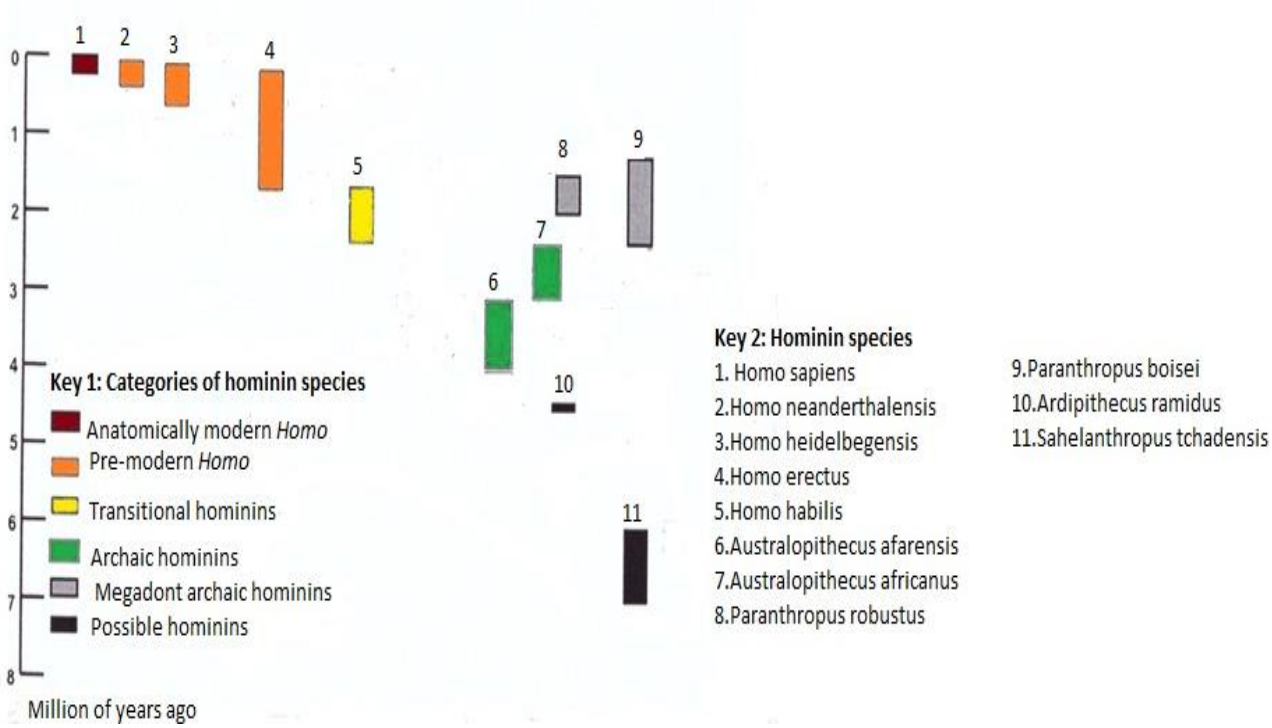



Figure 4.2 The taxa recognised in hominin taxonomy, from Wood (2010).

The height of the columns in figure 4.2 represent the temporal age of a taxon. However, the overlaps in the temporal ranges such as portrayed by *Homo* in Figure 4.2 suggest co-existence of some hominin clade at some point in time. The lack of lack clear cut transitions from one hominin clade to the other also suggest that human evolution process wasn't smooth. The most recent species have been placed at the top of the graph while the earlier ones are at the bottom of the graph.

A further analysis of figure 4.2 reveals that the grade concept rather the clade concept was used in classifying hominin clade. According to Winston (2012) an evolutionary grade is a group of species united by the same level of morphological and physiological characteristics. In other words, a grade is a group of organisms that are at a similar evolutionary level. This is in sharp contrast to a clade, which is a section of the evolutionary tree (phylogenetic unit)

that shows all descendants of one common ancestor (Winston, 2012). According to Wood (2010), the grade concept was made use of in classifying hominin clade as it is handy in sorting these taxa into six broad functional categories which are: *possible hominins, megadont archaic hominins, archaic hominins, transitional hominins, premodern Homo and anatomically modern Homo*. However, the grade concept has a drawback of not showing evolution relationships, while such relationships can be clearly demonstrated by the clade concept. Thus, Wood (2010) classified the hominins from the earliest to the most recent species, without revealing their evolution history. I found Wood's (2010) classification useful in discussing the images in Grade 12 Life sciences textbooks, as it has a similar pattern of presentation to all learner textbooks under study.

Since fossil evidence is mostly hard parts of the cranium (skull), while postcranial parts (other parts besides the skull) are a rare find, it is important to bring to the fore the features that palaeontologists focus on when classifying fossil finds. These are: cranium size; degree of slope of the forehead and face; size of the eye brow ridges (eye socket); position of the foramen magnum (opening at the bottom of the head where it joins the neck); size and shape of teeth; jaw protrusion and chin development. Figure 4.3 show some of the important features, which have been used extensively in this study when discussing different fossil findings

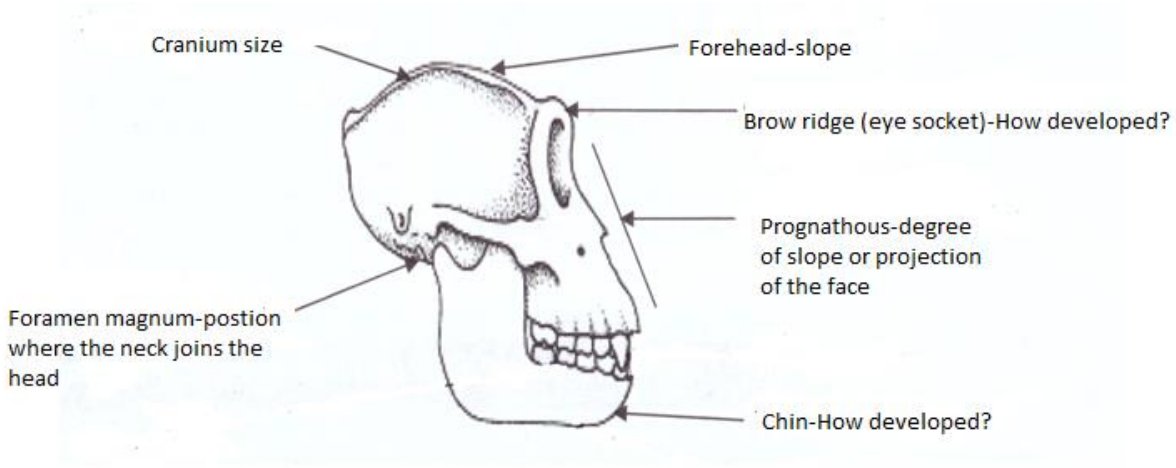



Figure 4.3 Some of the cranium features analysed when studying hominin fossil findings. From Isaac et al. (2013)

### 4.3.1 Possible hominins

Table 4.1 gives a summary of hominin clade in the possible hominin category that are discussed in this section, covering aspects such their taxon, site and year of discovery as well as their temporal range.

| Taxa | Discovery site | Discovery year | Temporal range |
|---|---|---|---|
| *Ardipithecus ramidus* | Aramis in Middle Awash study area, Ethiopia. | 1993 | 4.5-4.3 Ma |
| *Orrorin tugenensis* | Kasomin at Baringo in Tugen Hills, Kenya | 2000 | 6 Ma |
| *Sahelanthropus tchadensis* | Anthrocotheriid Unit at Toros-Menella, Chad | 2001 | 7 Ma |

Table 4.1. Summary of possible hominin taxa.

The Possible hominins category is comprised of three taxa of earliest hominin clade that may belong to the hominin clade namely: *Ardipithecus ramidus* (*Ar. ramidus*), *Orrorin tugenensis* (*O. tugenensis*) and *Sahelanthropus tchadensis* (*S. tchadensis*). According to Wood (2010), these taxa are better referred to as "candidates" for being early members of the human clade because is no conclusive evidence that actually point at them as early hominins. Members of these four taxa could be earliest, hominins, but there is nothing that can rule them not to be members of separate clades of apes that underwent convergent evolution (also referred to as homoplasy) so as to have some features similar to the human clade. According to Reece et al. (2013) convergent evolution occurs when distantly related organisms independently evolve similar traits as an adaptation to similar environmental conditions. For example, bats and birds are dissimilar organisms that do not share a common evolution history but both evolved wings as a necessity to adapt to the terrestrial environment. Such a possibility could have happened with respect to possible hominin clade and until conclusive evidence is discovered their position as human ancestors remain questionable.

*Ar. ramidus* remains were discovered in the middle Awash region of Ethiopia. *Ar. ramidus* has some features that it shares with the surviving species of the Pan (such as the chimpanzees), other African apes and later hominins such as *Australopithecus afarensis* (Wood, 2010). Although, *Ar. ramidus* has less projecting canine teeth than the chimpanzees, its postcanine teeth are relatively smaller and have less enamel covering suggesting that it could have been much closer to chimpanzees than later hominins in terms of its diet. Furthermore, *Ar. ramidus* had ape-like hands and feet and the position of its foramen magnum and shape of the reconstructed pelvic bone suggest that it was an upright biped. This suggests that *Ar. ramidus* could belong to the human clade.

With respect to *O. tugenensis*, the remains were discovered in the Tugen hills of Kenya (Wood, 2010). A morphological study of its thigh bone fragments led to some researchers believing that *O. tugenensis* walked on two legs (Richmond & Jungers,2008), however other researchers used computer processed x-ray images of its thigh- pelvis joint to argue that *O. tugensis* did not walk on two legs all the time (Lovejoy, Ohman & White, 2005). That is to say, it had a capability of walking on two or four of its limbs. Further, a study of its dental structure has indicated that *O. tugensis* was much more like a non-hominin ape than hominins species (Senut et al., 2001). This implies that *O. tugenensis* could possibly be described as an early hominin.

*S. tchadensis* was discovered in 2001 at Toros-Menalla in Chad and had both derived and ancestral features similar to chimpanzee and hominins. An ancestral feature is a trait that has been retained by a species and was inherited from its ancestor while a derived feature is a trait that has just appeared as the organism adjusts to the dynamic nature of its environment (Reece et al. 2013). According to Wood (2010), the cranium of *S. tchadensis*

appeared to be like that of chimpanzee, while the position of the hole at the base its skull through which the spinal cord passes (foramen magnum) was more to the anterior just like that of a hominin. However, Wood (2010) argues that the presence of features such as the eyebrow ridge (eye sockets), thicker tooth enamel and long heavy jaws does not warrant the placement of *S. tchadensis* in the chimpanzee and bonobo branch. This seems to suggest that *S. tchadensis* could belong to the earliest hominin clade.

### 4.3.2 Archaic hominins

Table 4.2 gives a summary of the hominin taxa discussed in this section, their site and year of discovery as well as their temporal range.

| Taxa | Discovery site | Discovery year | Temporal range |
|---|---|---|---|
| *Australopithecus sediba* | Malapa, South Africa. | 2008 | 1.78-195 Ma |
| *Australopithecus africanus* | Taung, Sterkfontein and Makapansgat, South Africa. | 1924 | 3-2.4 Ma |
| *Australopithecus afarensis* | Laetoli, Tanzania<br>Hadar, Ethiopia<br>Turkana West, Kenya | 1974 | 4-3 Ma |
| *Australopithecus anamensis* | Kanapoi, Kenya<br>Middle Awash, Ethiopia | 1994 | 4.2-3.9 Ma |

Table 4.2 Summary of archaic hominins taxa.

Archaic hominins are a group of extinct hominins that could not be precisely placed in the genus *Homo* or *Paranthropus.* The taxa in the category are generally referred to as

Australopithecines. There are four types of *Australopithecines*, which are: *Australopithecus sediba (Berger, 2012)*; *Australopithecus africanus*; *Australopithecus afarensis* and *Australopithecus anamensis* and *Kenyanthropus platyops* (Wood, 2010).

*Australopithecus sediba* (*Au. sediba*), is the latest Australopithecine to be discovered, although many paleoanthropologists argue it should be placed in the genus *Homo* It was discovered in 2008 in Malapa South Africa by Professor L.E Berger of the University of the Witwatersrand. The specimen of *Au. sediba* comprised of the partial cranium and postcranial elements such as thorax; upper and lower limbs (Berger, 2012). According to Berger (2012), the spacemen had both earliest and derived characteristics. The earliest such as ape-like arms, elongated thumb and shortening of fingers characteristics were attributed to Australopithecine species while the derived features such as pelvic structure, foot and angle structures were attributed to the later *Homo* species (Berger, 2012). This could suggest *Au. sediba* as an intermediate species between *Australopithecines* and Homo species. However, *Au. sediba* was classified as an *Australopithecin*e species because its morphology was closer to *Australopithecin*e species than *Homo* species.

*Australopithecus africanus* (*Au. africanus*) remains that comprised of cranial and postcranial skeletons that were discovered at numerous sites such as Sterkfontein in South Africa (Clarke, 2008). Morphological and functional analysis, which is an analysis of how these skeletal parts functioned suggest that *Au. africanus* had relatively large chewing teeth and ape-like skull despite reduced size of its canines (Wood, 2010). In addition, available evidence suggests that *Au. africanus* was capable of walking on two legs, though on a limited scale, however it spends most of its time walking on four legs (Patridge et al. 2003).

The fossil remains of the taxon *Australopithecus afarensis* (*Au. afarensis*) were discovered in East African sites such as Laetoli in Tanzania, Hadar in Ethiopia and West Turkana in Kenya. Its fossilised remains included the skull, partial and fragmented crania and some limb bones (Kimbel and Rak, 2010). It seems though, *Au. afarensis* just like all other australopithecines had post crania characterised by a powerful upper body with long powerful arms. Which were good adaptations for climbing trees. The Laetoli trails of fossil prints (fossilised human-like) discovered in 1978 in Laetoli, Tanzania by Mary Leakey have been thought to belong to *Au. afarensis* (Bennett, 2009), as evidence of its ability to walk on two legs, even though available evidence not conclusive. The recent discoveries of new foot prints in Tanzania attributed once more to *Au. afarensis* further reveals that ancient hominin clade walked on two legs side by side (Sample, 2016). Their feet on the other hand was probably not like that of a modern non-human hominin, but probably had a divergent big toe which could have served the dual function of bipedal walking and gripping when climbing. The feet however, were not like those of modern chimps and bonobos with opposable thumb and curved long fingers. Therefore, the reconstructed feet match the footprints.

The fossil remains that comprised of jaws, teeth, upper and lower limbs of *Australopithecus anamensis* (*Au. anamensis*) were discovered in places such as Kanapoi in Kenya and Middle Awash region of Ethiopia(Wood,2010). *Au. anamensis* and *Au. afarensis* had similar features, such as upper limbs and tibia which suggest arboreal adaptations however differences were observed in details of their dentition, in the sense that the former had more earliest teeth than the later (Wood, 2010), and suggesting differences in their diet.

### 4.3.3 Megadont archaic hominins

A summary of megadont archaic hominins has been shown in Table 4.3 below. These are the hominin clade that have been included in the discussion of this section.

| Taxa | Discovery site | Discovery year | Temporal range |
|---|---|---|---|
| *Paranthropus robustus* | Kromdraai B and Swartkrans among other places in South Africa. | 1938 | 2.0-1.5 Ma |
| *Paranthropus boisei* | Olduvai Gorge, Tanzania. | 1959 | 2.3-1.4 Ma |
| *Paranthropus aethiopicus* | Omo Shungura, Ethiopia. | 1967 | 2.5-2.3 Ma |
| *Australopithecus garhi* | Middle Awash, Ethiopia | 1997 | 2.5 Ma |

Table 4.3. Summary of the megadont archaic taxa.

According to Wood (2010), the term megadont stems from the sheer robust size of the post canine teeth as well their relative size when compared to anterior tooth row. This group include the genus *Paranthropus* and an *Australopithecus* species referred to as *Australopithecus garhi*.

The genus *Paranthropus* is comprised of *Paranthropus robustus*, *Paranthropus boisei* and *Paranthropus aethiopicus*. It is important to note that some scientists still refer to Paranthropus as Australopithecus. The taxon *Paranthropus robustus* (*P. robustus)* had a larger brain, face and chewing teeth than those of the *Australopithecus africanus* but *P. robustus* incisor teeth were relatively smaller (Wood,2010). Furthermore, Wood (2010) argues that although the pelvic-thigh joint structure of *P. robustus* suggests capability of

walking on two legs it couldn't have done so on a full-time basis. This seems to imply that although *P. robustus* was capable of walking on two legs, it did not spend most of its movement time doing so.

*Paranthropus boisei* (*P. boisei*) fossils were discovered in numerous places such as the Olduvai Gorge in Tanzania, and in West Turkana. According to Wood and Konigsberg (1994), *P. boisei* is the only hominin to combine a wide flat face, massive premolars and molars, small anterior teeth and a modest inner volume of the skull. Although, *P. boisei* and *P. robustus* have similar brain volumes, the former had a wider and larger face than the later. Furthermore, Wood (2010) argued that *P. boisei* had a larger and wider body than any other hominin. However, there is no postcranial evidence that can be attributed to *P. boisei* (Wood and Constantino, 2009). Although reconstruction of relationships between various species is believed to be better supported by cranial parts, in comparison to postcranial parts, a more complete idea about an organism from fossil remains can be only be realised if some postcranial parts are available. The absence of postcranial parts of *P. boisei* could result in speculation as to what it really looked like. This could lead to distorted representations of *P. boisei.*

The *Paranthropus aethiopicus (P. aethiopicus)* taxon was introduced to represent an adult mandible that was discovered in Omo Shungura of Ethiopia (Wood, 2010). *P. aethiopicus* had features similar to *P. boisei*. However, it had a more prognathous face, less flexed cranial basis, larger incisors and the postcanine that is not morphologically specialised.

*Australopithecus garhi* (*Au. garhi*) was also among the fossils recovered in the Middle Awash region in Ethiopia. It had an earliest cranium that had large crowned post-canine teeth.

When compared to *P. boisei*, it had larger teeth. However, enamel thickness of such teeth was less in comparison with later species.

### 4.3.4 Transitional hominins

For the purpose of this study *Homo habilis* (*H. habilis*) is the only transitional hominin. Transitional hominin refers to hominin clade that seem to mark the boundary between non-human apes and human-like species. Table 4.4 shows a summary of transitional hominin taxon, its discovery sites, year of discovery and its temporal range. It is important to note that the temporal range of transitional hominin clade overlaps with that of megadont archaic hominin clade. This could suggest that megadont hominins shared a portion of their evolution history with transitional hominins.

| Taxon | Discovery site | Discovery year | Temporal range |
|---|---|---|---|
| *Homo habilis* | Olduvai Gorge, Tanzania<br>Hadar, Ethiopia | 1964 | 2.3-1.4 Ma |

Table 4.4. Summary of transitional hominin taxa.

*H. habilis* fossil remains were recovered at places such as the Olduvai Gorge in Tanzania and Omo Shungura in Kenya. *H. habilis* had cranial skeleton similar to *Australopithecines* with powerful upper body, long arms, shorter legs and was a bipedal walker, (Wood, 2010). These characteristics features suggest that *H. habilis* is a critical stage in human evolution history as the non-human ape like features were now being transformed into human (*Homo sapiens*)-like features.

### 4.3.5 Premodern *Homo*

Premodern *Homo* is the hominin clade that lack the distinctive size and shape of the cranium and postcranial skeleton of modern humans (Wood, 2010). The taxa in this category include *Homo neanderthalensis* (*H. neanderthalensis*), *Homo erectus* (*H. erectus*), and *Homo heidelbergensis* (*H. heidelbergensis*). Table 4.5 is a summary of premodern *Homo* species, showing its different categories, their discovery sites, year of discovery and their temporal ranges.

| Taxa | Discovery site | Discovery year | Temporal range |
|---|---|---|---|
| *Homo neanderthalensis* | Ennis, Belgium<br>Elberfield,Germany | 1829 | 200-28 Ka |
| *Homo erectus* | Olduvai Gorge, Tanzania<br>Trinil, Indonesia | 1891 | 1.8 Ma-70 Ka |
| *Homo heidelbergensis* | Heidelberg, Germany<br>Kabwe,Africa | 1907 | 600-100 Ka |

Table 4.5 Summary of the premodern *Homo* taxa.

The discovery of *H. neanderthalensis* fossil remains has thus far been restricted to European and Asian countries. According to Wood (2010), the *H. neanderthalensis* cranium had a thicker double-arched eye socket, a prognathous face, larger nose, and thinner enamelled teeth in comparison to modern humans. *H. neanderthalensis* walked on two legs, like the modern human (Wood, 2010). The presence of numerous muscle insertions and thick bones suggest a strenuous and a more active life style, prompting some to have an idea that they could have been active hunters and gatherers of food.

The taxon *H. erectus* fossil remains were discovered in places such as Sangiran in Indonesia, Lantian in China and Olduvai Gorge in Africa (Wood, 2010). *H. erectus* crania had a thick low skull roof (Wood, 2010). Although its dental and cranial evidence suggest a human-like diet, and the postcranial structure suggests an upright posture and ability to walk on two legs all the time, it had big jaw bones with larger tooth crowns and lacked a pronounced chin in comparison to *H. sapiens* (Wood, 2010). This seems to suggest the possibility that H. erectus could have been a modern human ancestor.

With respect to the *H. heidelbergensis* taxon, fossil remains were initially discovered in Germany. However, more discoveries of this taxon were later made in other European sites, Africa and China. This seems to suggest that *H. heidelbergensis could have* inhabited a wide range of habitats. Although, *H. heidelbergensis* had skull volume similar with that of *H. sapiens*, the huge size of the postcranial skeleton as well as its remarkable huge eye sockets differentiates it from both *H. sapiens* and *H. neanderthalensis* (Wood, 2010).

### 4.3.6 Anatomically modern *Homo*

Anatomically modern *Homo* is represented with the current living human species, referred to as *Homo sapiens* (*H. sapiens*). This is the only surviving member of the hominin clade. Table 4.6 below is a summary of the taxon *H. sapiens* showing its discovery site, years of discovery and its temporal range.

| Taxon | Discovery site | Discovery year | Temporal range |
|---|---|---|---|
| *Homo sapiens* | Omo Kibish, Ethiopia | 1822-1823 | Less than 200 Ka |

Table 4.6. Summary of the anatomically modern *Homo* taxon.

The earliest fossil evidence of anatomically modern human morphology was discovered in the Omo Kibish region of Ethiopia (McDougall, Brown and Fleagle, 2005). According to Wood (2010), a smooth gradation in morphological traits makes it very difficult for to distinguish between *H. sapiens* and *H. heidelbergensis*. However, the characteristic features of *H. sapiens* include among others: large skull volume, small face, flat forehead, well developed chin, less pronounced eye sockets, and postcranial skeleton well adapted to walking on two legs. This seems to suggest that *H. sapiens* is the most recent member of hominin clade.

### 4.3.7 The challenges of classification of hominin clade

Paleoanthropologists rely extensively on morphology of hominin fossil records in the process of classifying them into various taxa. According to Wood (2010), the differences between modern humans and their closest living relatives, chimpanzees, are marked in their crania and postcranial structures. However, the differences in the ancestral hominins and ancestral chimpanzee were likely to be very subtle (Wood, 2010). This implies the closer the taxa are to the branch node the more difficulty there is to identify differences in their morphology. This appears to be the case with when considering the differences between the anatomy of *H. sapiens* and *H. heidelbergensis.* The gradation in their morphology makes it problematic to identify the boundary between them as their anatomy appears to be seamless. This makes taxonomy and systematics very challenging endeavours. In terms of representation of human evolution, an image plays a crucial role as they are used to depict the differences among hominin clade. This implies that understanding of this differentiation goes a long way in helping one to analyse these image so as to get the message they communicate to the readers. However, it is important to highlight that the construction of

these images is also with challenges, such as stereotyping (having a fixed idea about someone), just like the construction of the hominin clade themselves.

The concept of homoplasy (convergent evolution), presents a further challenge when reconstructing human phylogeny as discussed in one of the preceding section. The challenge with homoplasy is that it gives an impression that two taxa are more closely related than they really are. In the human clade craniofacial morphology has been used to classify human species into different taxa (Wood, 2010). If we are to consider that the craniofacial features among species in the genus *Paranthropus* arose from a common ancestor, then it wouldn't be prudent to separate *P. boisei* and *P. robustus* into different genera. However, if one is to speculate that they arose through homoplasy, as an adaption to have a high mechanical energy needed in the mastication of their perceived rough diet, then it would more rational to place them in different genera. Thus homoplasy complicates phylogenetics.

Another challenge is in the definition of the concept of "species". Biologists have long struggled to define the "species" concept. As a way of negotiating the problem they have resorted to the use of the context related species definition. That is to say, the concept, species, can be defined in relation to the context in which it is being used. For example, in the morphological species concept; a species is defined according morphological differences while in the phylogenetic species concept; a species is defined in terms of ancestry (Reece et al. 2013). Although these contexts- related species definitions are useful when dealing with living organisms, they become problematic when applied to fossil records as they are mostly lifeless hard parts. Thus defining the concept species becomes very elusive when it comes to fossil records which might result in paleoanthropologists having different versions of the same aspect.

As I conclude this section, it is important to emphasise that the difficulty faced by paleoanthropologists in reconstructing the human phylogeny does not end with them. It cascades down into the education system where there are representation challenges in textbooks and then to teachers and learners who are supposed to interpret and make sense out of them. Therefore, I found it necessary to engage with these evolutionary images so as to find out the kind of messages they can communicate to the learners.

**4.4 The "March of Progress"**

Since the characteristics of hominin clade have been described in the preceding sections, this section deals with t*he "March of Progress"*. The *"March of Progress"* is the sequence of human evolution, which is a shorthand representation of human evolution. An illustration of *the "March of Progress"* by Rudolph Zallinger in Howell (1965) has been depicted in figure 4.4 below.

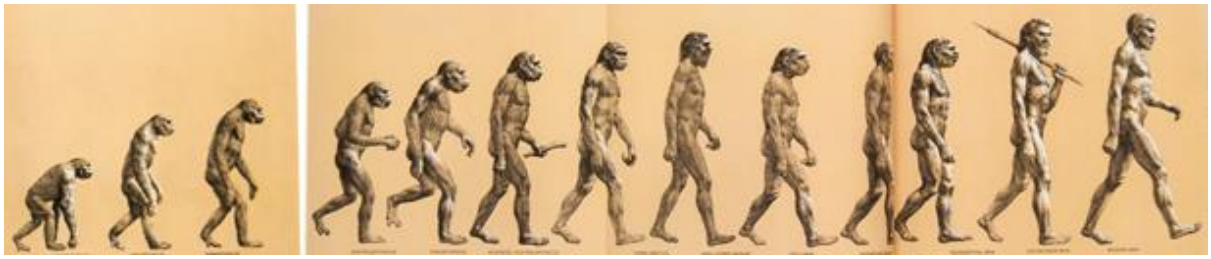


Figure 4.4 Rudolph Zallinger idea of "*The March of Progress"* from Howell (1965).

Representations such as figure 4.4 suggest that, with the passage of time, an ape-like being became a modern human being. Quessada & Clement (2014) and Scott (2007) noted similar images during their studies human evolution images in learners' textbooks and museums respectively. This could suggest that textbook writers and museums have got a similar source of human evolution images.

The problem of such a representation does not only lie in it's over simplification of complex ideas of human evolution, but also in its inaccuracies and potential of propagating gender and racial stereotypes (Pillay, 2010). The gender and racial stereotypes could emanate from the depiction of all male images marching from an earliest bestial dark African male hominin towards a more evolved European man. These ideas shall be discussed in more detail in chapter five. Gould (1989), is among the scholars who critiqued the linear progress of human evolution as purported by the march to progress. He argued that evolution of life should not be viewed in terms of a ladder of predictable progress but rather as a copiously branching bush that is under a constant pruning action of the grim reaper of extinction. The *"March of Progress"* does not portray complexities and different branches of hominin evolution (Pillay, 2010), which has a potential of compromising learner and teacher understanding of the concept of human evolution. Vitti et al., (2012), concur with Gould's and Pillay's perspective in their proposition that the linear progressive depiction of human evolution can to large extent account for the public misunderstanding and mistrust of the concept of human evolution. In particular, Vitti et al., (2012) have pointed out that the notion of the progressive nature of human evolution has given rise to the incorrect idea that modern African populations are ancestral and therefore earliest than other racial groups. In putting across their idea, Vitti et al., (2012) referred to an episode that occurred in 1854 in which Nott and Glidden depicted, as shown in figure 4.5, heads and skulls of a chimpanzee (young chimpanzee), an African man (Negro) and the god Apollo (Apollo Belvedere representing the Greeks) while making an argument that Africans were an intermediate between human and chimpanzee.

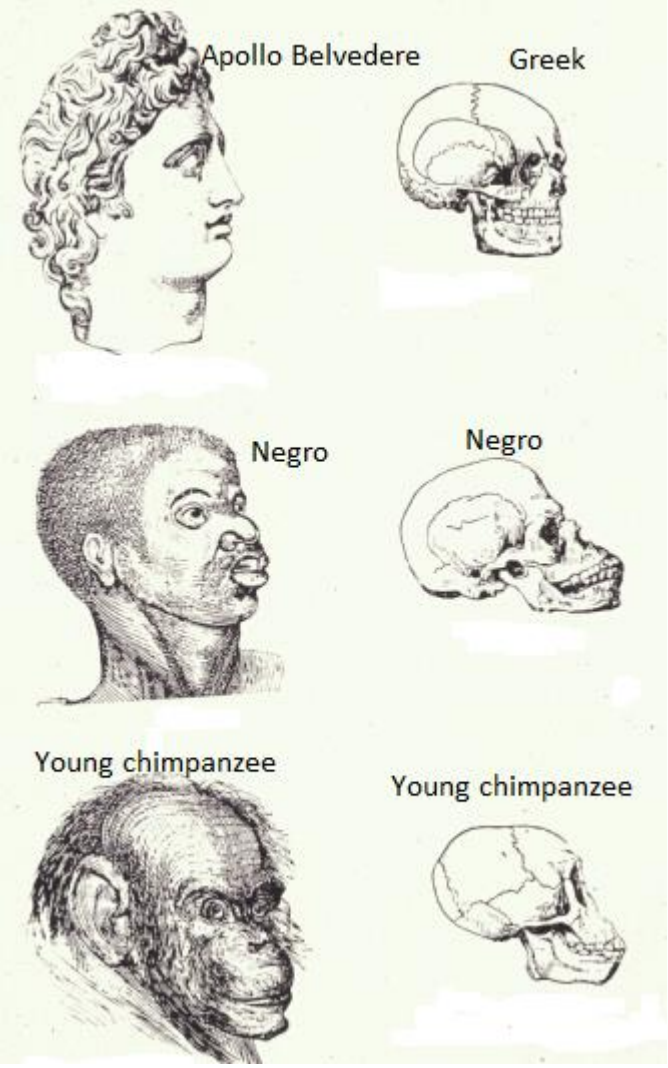



Figure 4.5 Illustration from Josiah Clark Nott and George Glidden's book Types of Mankind, (adapted from Vitti et al.2012).

The depiction in figure 4.5 suggests that, Glidden viewed Africans as non-humans therefore an inferior species in comparisons to the humans represented by Europeans. This perception, although it concurred with European, thinking and philosophy of time, was erroneous as it seems to be a confusion of biological evolution and cultural development. In terms of biological evolution, there is one human species, the Homo sapiens, while in terms cultural development, the human species are at different stages of development depending on their individual environmental conditions. This emanates from the idea that biological

evolution is a result of differential selective pressure on organisms from the environment while cultural development is a result of the human species taming the environment to their own advantage. Furthermore, Gould (1989) and Scott (2007) critiqued *The "March of Progress" imagery* as an incorrect representation of human evolution. Their argument being that human evolution is not unidirectional process but branching one due differential selective pressure from the environment.

The *"March of Progress"* does not only worsen public confusion about human evolution but can also be manipulated by proponents of scientific racism to further their interest of legitimising racism. According to Dennis (1995), scientific socialism is the manipulation of scientific facts in order to fuel racial practices. The use of "intelligent quotient" or IQ test is a good example. IQ test is a standardised test that can be used to measure the level of intelligence of an individual (Dennis, 1995). However, its scores can be manipulated to fuel racial practices such as the validation of Anglo-Saxon superiority (Stark, 1989). Dennis (1995) noted that the IQ test scores can be used as a confirmation of a dominant group's worth, while disregarding fundamental differences in environmental and cultural conditions. This can be viewed as a very unfortunate circumstance that tends to surround research in humans and human evolution in particular. Hence researchers in human evolution must be mindful of the negative consequences of their utterances from research findings to their potential audiences such as learners. This point to the need to exercise extreme caution by researchers in human evolution with regard to the manner in which research findings are disseminated, while in their constitutional duty of inviting public discourse in scientific issues.

### 4.5 The challenges of representing human evolution

Textbooks play a big role in bringing human evolution ideas into the classroom practice. Therefore, teaching and learning of human evolution is mediated by the use of images and texts in learner textbooks. However, these images representing human evolution in learner textbooks embedded with challenges due a number of factors such as the lack of fossil evidence; the interpretation of fossil evidence, and the cultural and political biases that researchers and viewers bring to the interpretation of images.

With respect to interpretation of human evolution images, Scott (2007) suggested that museum visitors interpret its human evolution images from either the dominant and or the negotiated (resistant) perspectives. The intended meaning of an image of evolution is usually the dominant perspective, a narrative that represents a scientific position. However, the same image can be interpreted as a negotiated and oppositional narrative by other societal groups such as the minority and subservient groups. For instance, the depiction of early humans with black skins might be seen from a dominant perspective as emphasising the role of Africa as the cradle of mankind. However, from, a negotiated perspective it might be construed as implying that Africans are ancestral species, still to evolve to assume the superiority currently being enjoyed by Europeans. This has an inherent danger of complicating and distorting the overarching idea of Africa as the origin of mankind. Similar problems can be assumed to occur when teachers and learners encounter human evolution images from textbooks in the classroom, since they will actively interrogate them from their varied cultural, gendered, economic, intellectual and social identities and have their own position about these images.

According to Scott (2007) most of the images depicting human evolution in museums are generally provocative with identifying features such as: the club, animal skins, woolly hair, dark savages, bestial, nakedness, and anatomical that seems to be glossily exaggerated. Furthermore, basing from the African origins perspective, which views Africa as the origin of mankind, early humans are often represented as forest dwellers, among African apes (Scott,2007) in museums. Since these grotesque images find their way into the learners' books, how do learners make sense out them as well as how do they integrate them into their personal identities? Do the human evolution images of the Victorian era still have relevance in this democratic and globalised era?

Although African origins have been represented by black skin it is important to note the notion of Black human forbearers originated in western mythologies, well before the period of the Enlightment (Scott, 2007). The encounter of Black Africans and then the African apes by colonial conquerors during the Enlightment era appeared to have confirmed these origin myths. This appears to be supported by the assertion Dennis (1995), that the colonisers saw it necessary to institute political, economic and control of inferior races so as to bring civilisation to the unenlightened in addition to their own political and economic survival.

The failure by paleoanthropologists, museums and textbook writers to balance the imagery of dark skinned African ancestors with imagery of dark skinned modern humans (Scott, 2007) in this modern democratic era, is a very unfortunate situation as it continues to advocate for scientific racism. According to Dennis (1995), these IQ test confirmed White superiority and bolstered the idea of excluding Blacks from the core culture of the American society. With respect to images of human evolution, the presence and prevalence of dark skin on early humans in science text books and other media on its own can stigmatise Black

individuals as inferior. This appears to agree with Pillay (2010), who noted that depicting modern humans as Black on its own may not be adequate as it might be read as unfinished. Since visual images and discursive representations of African people and African ape-man in popular media historically worked to substantiate their nature as sub-humans, in terms of both biological and cultural parameters (Wiber, 1997), it therefore meant that science has a potential of legitimising racism .Therefore, there is a need for a fundamental change in which new visual images and discursive representations which portrays dark skins (together with White skins) with modernity in popular media. This has a potential of not only offering diversity of the images representing modern humans but also changing the discourse of human evolution altogether. According to Scott (2007), stigmatisation of African people as evolutionary inferior has left political and psychological remnants that are difficulty to erase particularly with respect to slavery and colonisation in which the Black people were severely dehumanised. For instance, modern African people are still being envisioned as embodiments or analogies of African ancestors (Scott, 2007). Although the essence of human evolution images is to construct a narrative of human evolution, it is important to note they might erroneously convey rhetoric far divorced from their primary role thereby contributing to prevalence of misconceptions and stereotypes in its discourse.

**4.6 Summary**

In this chapter, I have discussed aspects of human evolution which are: evolutionary trees; hominin clade; challenges of classifying hominin clade; *The "March of Progress"* and challenges of representing human evolution. This was necessary so as to give an overview of the concept of human evolution and also to raise some issues that are pertinent in my

research questions. The next chapter discusses the analysis of human evolution images in Grade 12 Life Sciences learner textbooks.

# Chapter 5

## Research Findings

### 5.1 Introduction

This chapter presents the results of my analysis of images of human evolution in South African Life Sciences textbooks. The results have been classified according to the types of images that were prevalent in the textbooks used in this study. The types of images are: images portraying the human evolutionary tree images portraying characteristics of hominin clade and images portraying the *"March of Progress"*. In the chapter that follows, I present my discussion of the images in the order in which human evolution concepts are presented in most of textbooks studied.

### 5.2 Distribution of human evolution images

Table 5.1 shows the type and distribution of human evolution images found in learner textbooks. The accompanying key below shows the authors of the textbooks and the identity of human evolution images found in them.

Key for table 5.1

| Textbooks | Images |
|---|---|
| 1. Avis et al. (2012) | A. Primate evolutionary tree |
| 2. Ayerst et al. (2013) | B. Hominin evolutionary tree |
| 3. Bowie et al. (2016) | C. *Ardipithecus ramidus* |
| 4. Clitheroe et al. (2013) | D. *Australopithecus afarensis* |
| 5. De Fontaine et al. (2013) | E. *Australopithecus africanus* |

| | |
|---|---|
| 6. Gebhardt et al. (2013)<br>7. Isaac et al. (2013) | F. *Paranthropus boisei*<br>G. *Paranthropus robustus/Australopithecus robustus*<br>H. *Homo habilis*<br>I. *Homo erectus*<br>J. *Homo heidelbegensis*<br>K. *Homo sapiens*<br>L. *"March of Progress"* |

| **Images** | **Textbooks** | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| A | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ |
| B | ✓ | ✓ | ✓ | ✓ | | | |
| C | | | | ✓ | ✓ | | |
| D | | ✓ | ✓ | | ✓ | | |
| E | | | | ✓ | ✓ | | |
| F | | | | ✓ | ✓ | | |
| G | | | | ✓ | ✓ | | |
| H | | | | ✓ | ✓ | | |
| I | | | | ✓ | ✓ | ✓ | |
| J | | ✓ | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| K | | | | ✓ | ✓ | ✓ | ✓ |
| L | | | | | | | ✓ |

Table 5.1 Distribution of human evolution image.

An observation of Table 5.1 reveals that the majority of the learner textbooks have evolutionary trees in form of the primate and hominin evolution trees. Furthermore, it also reveals that not all images are found in all textbooks, with de Fontaine et al. (2013) and Clitheroe et al. (2013) having most the images in comparison with other textbooks. These images have been discussed in more detail in the proceeding sections.

### 5.3 Images portraying the human evolutionary tree

Human evolutionary trees are graphical representations of the process of human evolution. The use of graphical presentations of human evolutionary trees has an effect of making the presented ideas seem neutral and accurate since graphs are often associated with scientific accuracy and rigour. However, it should be noted that, since a graph is a constructed representation it is potentially biased just like all other forms of representations. The grade 12 Life Sciences textbooks analysed in this study presented different graphical images of the human evolutionary tree.

For the purposes of this study, these graphical images have been classified into two basic groups which are the primate evolutionary tree and the hominin evolutionary tree.

#### 5.3.1 Primate evolutionary tree

This is an evolutionary tree that is inclusive of modern humans and other living primate members such as chimpanzees, and gorillas among others. A primate evolutionary tree can be constructed from morphological similarities or DNA sequences. Morphological

similarities include comparative physical traits such as limbs, crania, posture and vision, while DNA sequencing compares the nucleotide base sequence of humans and apes (Raven & Johnson, 1996). The primate evolutionary trees constructed from morphological similarities or DNA sequencing techniques resemble each other in structure. Most of the textbooks analysed in this study, which include de Fontaine et al. (2013), Clitheroe et al. (2013) and Ayerst et al. (2013) presented both sets of primate evolutionary trees in graphic format.

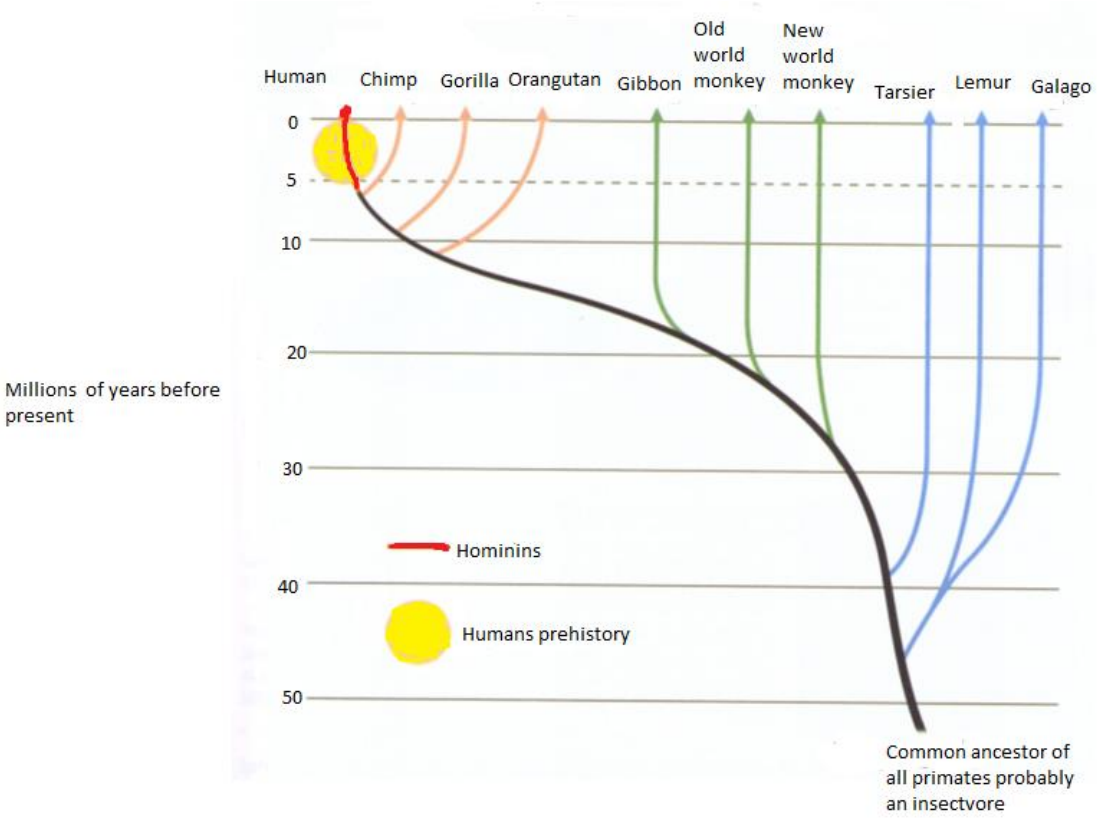



Figure 5.1 “The phylogeny of the main groups of primates”. From Ayerst et al., (2013).

Figure 5.1 depicts a primate evolutionary tree with ten living species branching from a common ancestor with an approximate year of each respective branching based on morphological similarities. The use of line graphs with accompanying arrows in depicting the evolution pathway of species signifies that the process of human evolution is not only

continuous but also incomplete. Thus, it has room to accept change in the near future when additional evidence has been discovered. Furthermore, this graph shows relationships which are believed to be true due to the scientific accuracy and rigour generally associated with the construction of graphs. In figure 5.1, the branches of African apes are closer to the human branch, with the human and chimpanzee branch being portrayed as the most recent branch since it occurred about 7 million years ago. This implies that humans and chimpanzees are closely related species in terms of their evolution. An analysis of human and chimpanzee DNA has shown that they have 98% similar DNA components, confirming that these species are closely related in terms of their evolution (Clitheroe et al., 2013). Furthermore, in this graphic representation, the human branch has been highlighted in the region between 0 and 5 million years. According to Ayerst et al. (2013), such a region is crucial as it covers the temporal range of prehistoric humans essential in understanding human evolution. This may help in clarifying that living African apes are not of human evolution, thereby helping to the correct the general misconception that living African apes are human ancestors.

De Fontaine et al. (2013), Clitheroe et al. (2013), Avis et al. (2013) and Gebhardt et al. (2013) included similar diagrams. However, de Fontaine et al. (2013), Avis et al. (2013) and Clitheroe et al. (2013) used pictorial images of primates such as can be seen in figure 5.2 from Clitheroe et al. (2013) to augment their presentation.

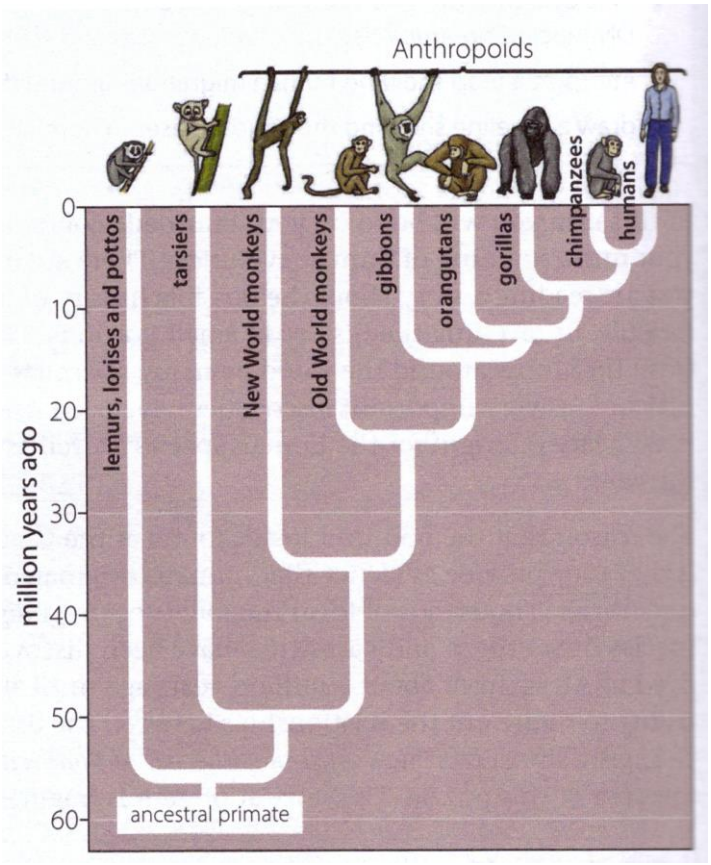



Figure 5.2 *"*Phylogenetic tree showing the relationship of primates*"*,(from Avis et al. 2013:238)

The pictures by Avis et al. (2013) and de Fontaine et al. (2013) were colourful, to make the images seem more naturalistic and engaging for the learners. The use of colour images with representations of the species' physical characteristics helps learners to have a visual representation of the morphological similarities of primates without having to read written texts.

Primate evolutionary trees constructed from comparing the similarities of the DNA components (DNA sequencing data) with no references to morphological structures were present only in two text books, namely de Fontaine et al. (2013) and Clitheroe et al. (2013). It should be noted that both figures 5.1 and 5.2 do not portray chimpanzee as a human

ancestor but rather as a species that shares a common ancestor with humans. The use of DNA sequencing as a means to represent species with common genes not only adds scientific rigour to the graphic presentation of human evolutionary trees but also confirms the branching pattern that was obtained by the use of morphological similarities. The graphs used to represent such data in these textbooks is in line with research by Gould (1989) which suggests that human evolution was not a linear process but rather more of a branching process than anticipated by earlier researchers in the field of human evolution. Furthermore, the primate evolutionary tree seems to be very important as it helps to clarify the idea that human and chimpanzee shares a common ancestor at the point of branching about 5 million years ago, and that the chimpanzee is not an ancestor of modern humans. The inclusion of pictures makes the story of evolution more accessible to learners than the use of names only which are often in Latin and difficult to remember.

### 5.3.2 Hominin evolutionary trees

The hominin evolutionary tree differs from the primate evolutionary tree because it is comprised of hominin clade only. The hominin clade is the part of primate evolution branch that is believed to have led to the emergence of the modern humans. It excludes other primate species. According to Isaac et al. (2013), the hominin clade comprises of modern humans, extinct human taxa and all their intermediate ancestors. The genera associated with hominin evolution include the *Ardipithecus*, *Paranthropus*, *Australopithecus and Homo species*.

Hominin evolutionary trees were found in all the books under study, except for Gebhardt et al. (2013) and Isaac et al. (2013). The hominin evolutionary trees presented were similar in that they had narrow bases with a wider top, as well as included the temporal range of the

species. The narrow base signifies the older species closer to the common ancestor while the wider top signifies the many branches associated with human evolution (Gould, 1989). An example of a hominin evolutionary tree has been represented by figure 5.3.

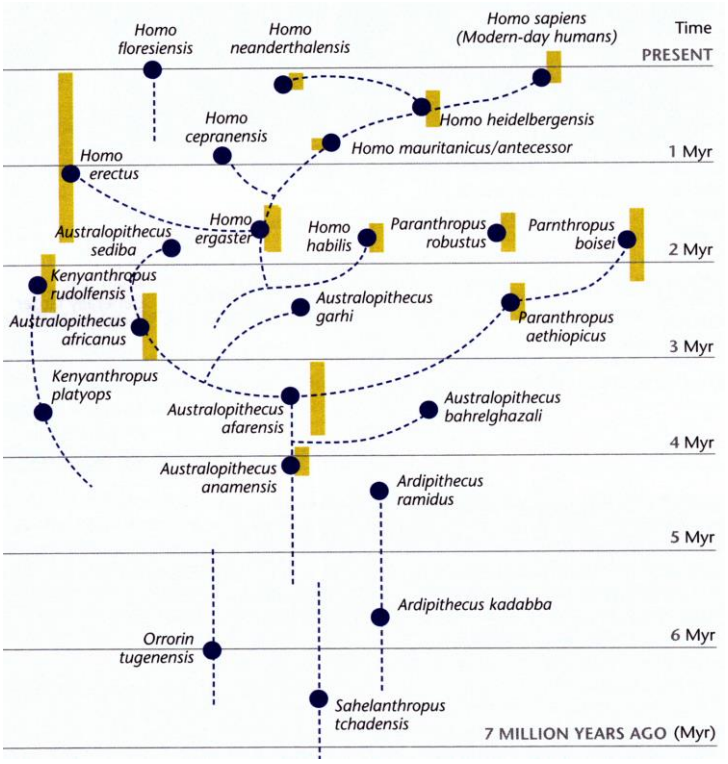



Figure 5.3 “Family tree of hominin fossil species”, from de Fontaine et al., (2013:306).

In figure 5.3 the dotted lines indicate the possible evolutionary line while the numbers in the right margin represent the temporal range of species. It can be observed that some of the evolutionary lines have gaps, which suggest fossil evidence that is yet to be discovered, as exemplified by the missing link between the Homo species and the earlier hominins such as *Australopithecus* and *Paranthropus*. In addition to that, there is an overlap between the earlier *Homo species such as Homo ergaster* and later *Australopithecus* and *Paranthropus* species exemplified by *Australopithecus sediba* and *Paranthropus robustus*.

A comparison of the hominin evolutionary trees of de Fontaine et al. (2013:306) and Avis et al. (2012) shows that they are similar in having a narrow base of oldest fossil species and a

wider top of younger fossils. In addition to that both representations also revealed that hominin clade have got overlapping temporal ranges. This may suggest that the younger hominin clade might have evolved whilst the older ones are still surviving. However, there are some notable differences between the hominin evolutionary trees in the two textbooks such as the inclusion by Avis et al. (2012), of species' crania images, while excluding their evolutionary lines, as shown in figure 5.4 below, while others simply use scientific names with accompanying evolutionary lines as portrayed in figure 5.3 above. Furthermore, figure 5.4 excluded some earlier hominin clade such as *Australopithecus anamensis,* and *Ardipithecus*, which were part of de Fontaine et al. (2013) presentation, while adding chimpanzee and gorilla, which are not part of the hominin clade but are great African apes. I think the exclusion of species such as *Australopithecus anamensis* and *Ardipithecus* can be problematic as they are among the early hominin clade that learners need to know in order to have a complete story of human origins.

The use of images as portrayed in figure 5.4 is advantageous as it can give learners the opportunity to see the changes; in crania of hominin clade as they evolve. Further, such images draw on fossil evidence, rather than speculate about the physical features and skin colour of different species which is contentious, and may have racist overtones.

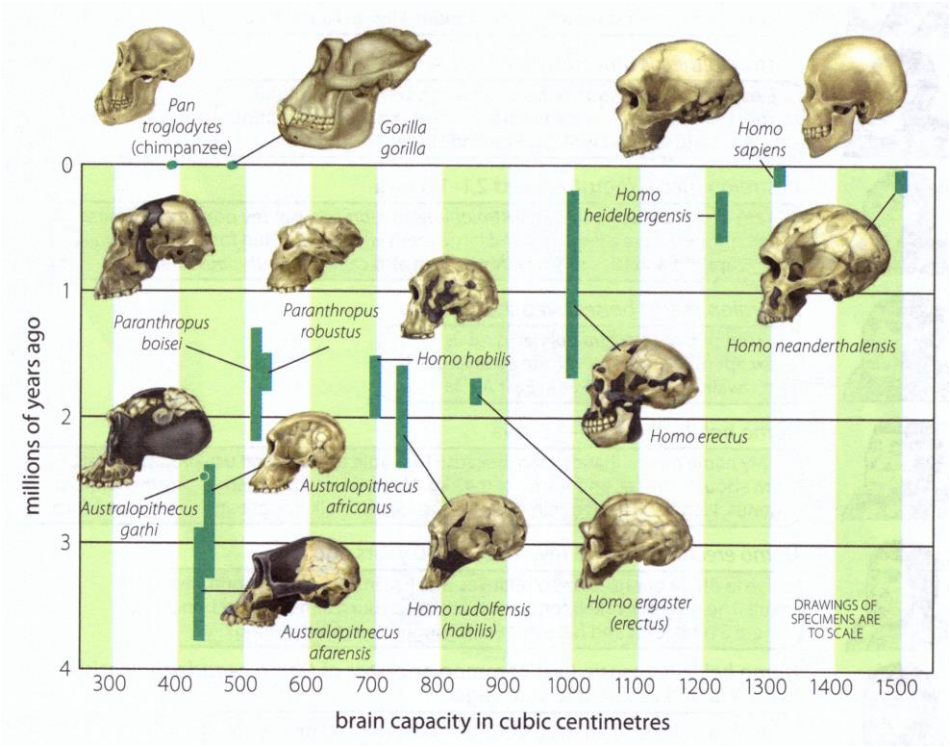



Figure 5.4 “The increase in hominin cranial capacity through various species over time”, From Avis et al., (2013:244).

Although the exclusion of evolutionary lines is important as it avoids the controversy surrounding the issue of ancestry, it has a drawback of masking the branching aspect of hominin evolution which is critical for one to appreciate the complexity of human evolution. Furthermore, the exclusion of earlier hominin clade such *Ardipithecus ramidus* while including chimpanzee and gorilla species is problematic because this may narrow the scope of concepts of human evolution that are learned, and also may add some confusion as chimpanzees and gorillas are not part of the hominin clade (even though they have been referred to as hominin by the caption accompanying the image). Chimpanzees and gorillas follow a different evolution pathway when compared to hominin clade, despite sharing a common ancestor with hominin clade.

Bowie et al. (2013) presented two variations of the hominin evolutionary trees. One variant, shown in figure 5.5, presents a pathway that suggests the emergence of the modern humans from ape likes beings. It is interesting that the image resembles a tree with branches, as indicated by the colour and the relationship of the lines.

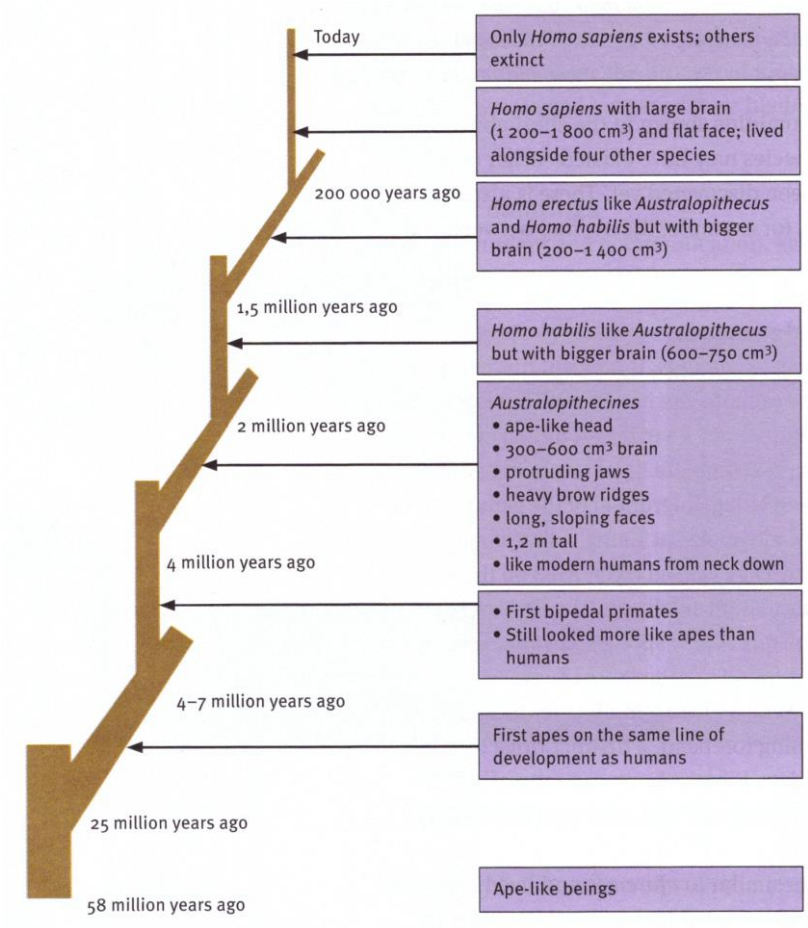



Figure 5.5 "What does this method of representing hominid *(now hominin)* evolution show us? From Bowie et al., (2016:352).

The caption of figure 5.5 is a metaphorical representation of the branching and continuous nature of the process of human evolution. Furthermore, it points to connections (lineage) of the different hominin clade in evolutionary history. Although such a presentation tries to portray branching and continuous nature of the process of human evolution, it appears to

be problematic in the sense that it does not look tree–like due to its directed nature. This has a potential of introducing the misconception that human evolution is a means to an end, that is, a process that leads to the emergence of a specific species, yet it is fundamentally a random process at the mercy of natural selection.

The other variant presented by Bowie et al. (2013:356) shows a hominin evolutionary tree of fossils found in Africa. The vertical axis shows the temporal range of the species, and the horizontal axis shows the African countries and sites where the hominin fossils were discovered. This has been illustrated by figure 5.6 below.

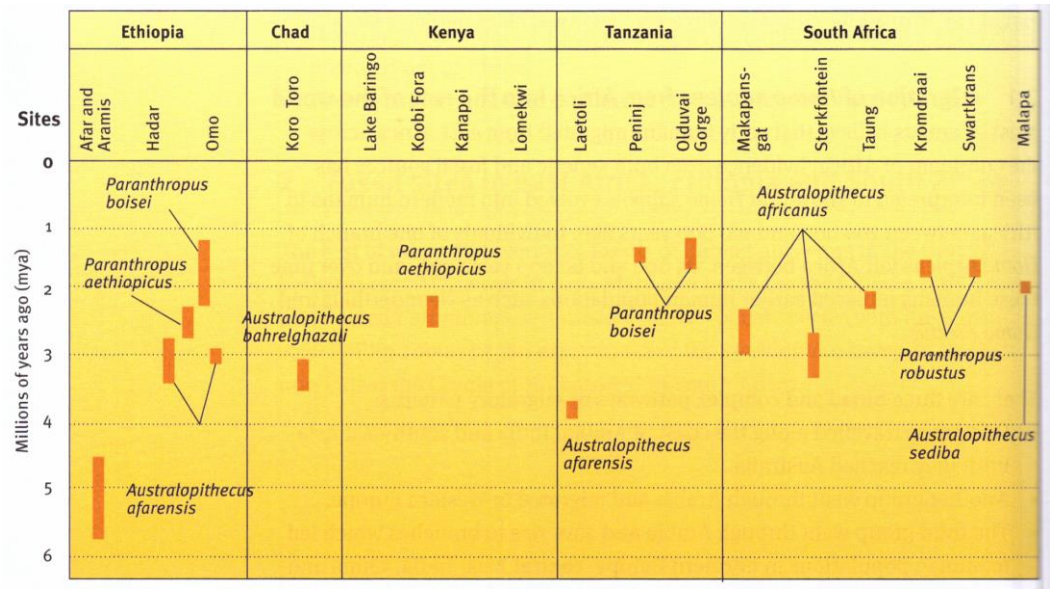



Figure 5.6 “What was the sequence of human evolution from apelike ancestor around 5 mya to *Homo sapiens*?” From Bowie et al. (2013: 356)

Although categorising the species according to the country in which the fossils were found is informative as it helps learners to link hominin and place of discovery as well as highlighting the importance of Africa in human evolution history. Organisation of an image in this manner illustrates that images are human creations and the multiplicity of ways in which information can be communicated to its recipients. Therefore, there is a potential of a

communication breakdown if one does not read carefully and comprehend, taking note the details of a particular type of presentation. As an illustration, since figure 5.6 only depict hominin clade from Africa, one might be tempted to associate modern Africans with early hominin clade, a possibility of erroneously labelling them as living embodiments of human ancestors.

Clitheroe et al. (2013) and de Fontaine et al. (2013) presented a further variation of the hominin evolutionary tree, in which they portrayed it in terms of mitochondrial DNA (mtDNA) variations hominin clade, which has a potential of increasing scientific rigour of their argument. They both presented modern humans branching off from a prehistoric '*African Eve'* with the remarkable omission of the intermediate species (illustrated by figure 5.7 below). Since the cytoplasm of the ovum passes from one generation to the next it implies that the mtDNA contained in the cytoplasm can also flow through generations (Raven and Johnson, 1996), hence it can be traced back to its origins. The origin of human mtDNA is thought to be an African hominin clade that can be referred to as an African Eve. Through tracing of mtDNA it has been found that the African branch of humans has greater diversity in its mtDNA than its non-African counterpart (de Fontaine et al., 2013) and also that the source mtDNA has been found to be an ancestral female who lived in Africa about 150 000 years ago (Isaac et al.,2013). This seems to point to Africa as the origin of the human race. It is worth mentioning that figure 5.7 is the only instance in which human origin is purposely presented as a woman. This is important as breaks the convention of always representing the male species in human evolution, thereby reducing the perceived gender bias of the human evolution images, which have been traditionally skewed toward the masculine gender.

Although Clitheroe et al. (2013) and de Fontaine et al. (2013) presented the same concept they do have a notable difference in their presentation. Clitheroe et al. (2013) presented an evolutionary tree with branches of equal height, while that of de Fontaine et al. (2013) used the image of the actual tree as portrayed by figure 5.7 below in depicting human evolution. With respect to figure 5.7, the visual metaphor helps in denotation of the nature and complexities of the branching phenomenon of human evolution.

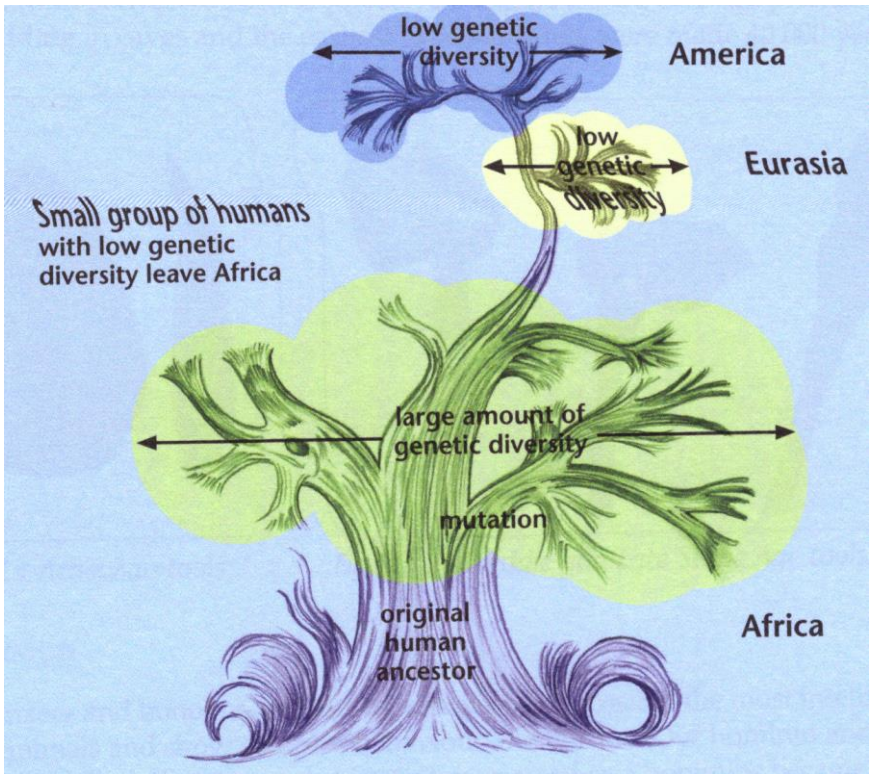



Figure 5.7 Diagram showing how humans in Africa had a wide variety of mtDNA (from de Fontaine et al., 2013:316).

Although figure 5.7 clearly denotes the branching nature of human evolution, it can be problematic as it has a potential of eliciting wrong connotation due to differential heights of the African; Eurasian and American branches. Of particular concern is the probable interpretation that American and Eurasian branches depict the most recent humans since

they are at the top, while the African branch can be seen as depicting earliest humans due to its closeness to the ground.

### 5.4 Images portraying characteristics of hominin clade

For the purposes of this study images that were found exhibiting characteristics of hominin clade in the textbooks used were classified into six categories, which are: possible hominins, archaic hominins, megadontic archaic hominins, transitional hominins, premodern *Homo* and anatomically modern *Homo*. This classification is not only inclusive of the hominin clade discovered so far but has also been informed by the order in which these species appear in the learner textbooks as well as temporal age of each taxon, in addition to reflecting order of presentation in chapter 4 of this report.

#### 5.4.1 Possible hominins

Images of *Ardipithecus ramidus* were the only example of the 'possible hominins' category and they were found in only two textbooks, namely de Fontaine et al. (2013:322) and Clitheroe et al. (2013) page 249. According to de Fontaine et al. (2013) *ardi* means 'earth', *pithecus* means 'ape' and *ramidus* means 'at the root'. Therefore, the name *Ardipithecus ramidus* means the ape that represents the root of the human evolutionary tree. In other words, *Ardipithecus ramidus* is believed to be the ancestral ape of the human evolutionary tree.

At the level of denotation, the image of *Ar. ramidus* exemplified by figure 5.8 in both textbooks is a photograph of a reconstruction of the species. The reconstruction has been denoted by nakedness; dark hairy body prognathous face; sloping forehead; undeveloped chin; large eye brow ridges and opposable toes. Furthermore, she is standing on a rock, with

bushes behind her. Connoting that, she was an apelike being that was intimately associated with nature.

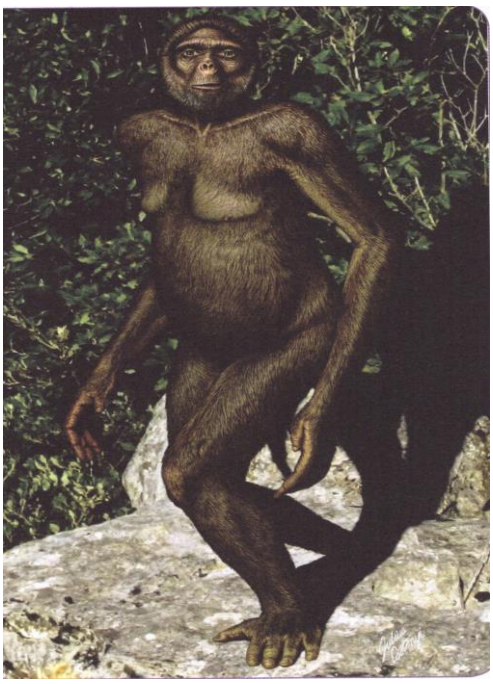


Figure 5.8 “Reconstruction of *Ardi”*. From de Fontaine et al. (2013: 322).

Like all images, this reconstructed model, bears the imagination, philosophy and cultural values of those who constructed it as well as prevailing scientific knowledge during its era of construction.

Like all representations, images of human evolution are laden with values which were dominant during that time in which they were made, that might not be so at this point in time. According to Scott (2007), most images of evolution in most museums were created during the Victorian era based on European mythologies, in which early humans where perceived to be black in complexion and bestial. A similar trend has been observed with human evolution images in learner textbooks as they are closely related to museum images.

This seems to suggest that folklore and politics can initiate and propel scientific narratives that can in future become authoritative (Scott, 2007). Thus with respect to human evolution, western thoughts were critical in idealising and conceptualisation about Africa before the enlightment era. These mythologies were fuelled by the need to understand and explain western identity and civilisation. However, the transformation of European mythologies into science was not a smooth process as some cultural mythologies (Scott, 2007) especially of faraway places are still active in informing crucial scientific concept such as human evolution. The encounter of Africans and apes in sub-Saharan Africa seemed to be a confirmation of such mythologies, coupled by a subsequent discovery of substantial evidence of fossil record (Scott, 2007).

The use of dark skins in portraying early human species can be problematic as it has a potential of being misread by some people and might be a source of controversy. For instance, since black colour has often been used in portrayal of early hominin clade, one might be tempted to associate the complexion of modern Africans with earlier hominin clade and possibly conclude that modern Africans are living early hominin clade. This idea is suggested by Scott (2007:34) who argues that modern African people are often being envisioned as embodiments of African ancestors. Scott (2007:36) further suggests that

African people and a much mythologised African ape man are intimately bound to each other by a common connected belonging and enduring association that has long coloured images of our earliest human ancestors.  An enduring association is long lasting relationship. African people were long time ago identified with nature (Hall, 1997) symbolising their perceived ancestral in contrast to the recent civilised world, a reserve for the Europeans. Therefore, to emphasis such an idea, African people have always been presented in close

proximity with African apes. According to McClintock (1995) in Hall (1997), nineteenth century European thought regarded Africa as arrested developmentally, historically abandoned and inhabited by cannibals, dervishes and witchdoctors. These ideas appeared to have found their way of expression in human evolution images. This appears to agree with Gilman (1985) who noted that images do not present reality but represent it in a manner determined by historical position of the observer, conventions used and the historical time. Thus human evolution appears to be stuck with a historical past which is no longer consistent with modern cherished democratic values. For instance, the association of black complexion and other facial features between modern Africans and early hominin clade might be construed as implying that modern Africans are inferior and to the Caucasian race. According to Scott (2007) stigmatisation of modern Africans as bestial and ape-like has contributed to a pervasive political and psychological thought among people of the world including the Africans, with far reaching consequences such as colonisation, apartheid and dependency syndrome among others. Dependency syndrome with reference to African countries is a scenario where they always look to West for solutions to their problems such drought, governance and poverty without having their own home grown solutions on which the West can give a supportive role.

In one of her lectures at the University of Pittsburgh on 26 January 2015, Elizabeth Daynes commented that early hominins were unjustifiably coloured black, a phenomenon she referred to as “paleo-racism”. In this context *paleo-racism* can be described as a belief that prehistoric members of a certain race have specific qualities that can be used to distinguish them as inferior or superior to another race in evolution terms. Such a belief has its foundation on biological and cultural differences. Therefore, the depiction of early humans

as black has a racial overtone which has a potential of stigmatising some human races, particularly the African race as earliest and therefore inferior to other human races.

According to Piper (2002) defining someone as Black was crucial in the colonial and apartheid eras as it was crucial in maintaining a system of White domination. Colonialism left a legacy of colonial thinking that black complexion signifies the lowest order within non-White and non-western cultures (Scott, 2007). The same also applied in countries such as South Africa where apartheid was practiced. This implies that act of colonisation and apartheid has inculcated a mentality that being black means inferior in character and in all human endeavours. Such colonial sentiments might have far reaching consequences in the teaching and learning of human evolution as blackness of early human species could be associated with racial connotations. This is because human evolution images, as scientific diagrams, can be seen to be reinforcing racism, a phenomenon that can be referred to as paleo-racism or scientific racism. Since human evolution is a story of human history and identity it is very crucial as it helps each one of us to identify ourselves and know our past. However, if this story is laden with racism, it will be very difficult for it to get in the heart and minds of its recipients resulting in a distorted view of its narrative.

### 5.4.2 Archaic hominins

Archaic hominin clade has been represented by *Australopithecine* species in all seven of the learner textbooks under study. These species have been described as transitional hominins by Isaac et al. (2013) since they have the characteristics of species that existed prior to them and after them. The crania of *Australopithecines* appeared to have more ape features than human features. Such features included protruding jaws, heavy brow ridges (eye sockets), long and sloping faces and small brain, while their postcranial structure (from neck down)

appeared like modern humans (Ayerst et.al, 2013; Bowie et al., 2016 and Clitheroe, et al., 2013). In other words, *Australopithecine* species had cranial structures that were ape-like and postcranial structures that were human like. Although several species of *Australopithecines* have been discovered, discussions in this study shall be limited to *Au. afarensis* and *Au. africanus* as they are the only ones portrayed in the learner's books analysed. It is interesting to note that only Clitheroe et al. (2013) has both images of *Au. africanus* and *Au. afarensis* species. Bowie et al. (2016) and Ayerst et al. (2013) include the image of *Au. afarensis* only, while de Fontaine et al. (2013) have the image of *Au. africanus* only. On the other hand, Avis et al. (2013) and Gebhardt et al. (2013) had no images of either species even though they were referred to in the text. Furthermore, although Isaac et al. (2013) has an image of an *Australopithecine* species, they do not specify which of the many possible *Australopithecines* the image represents. This reveals that the modern human origin story is not being narrated to the same detail in learners' books therefore teachers who use these books should be aware of these differences and choose the books they want to use accordingly. Other issues such as the gender of the *Australopithecine* species that include *Lucy* and *Mrs Plessis* are discussed in the proceeding paragraphs.

Three examples of the image of *Au. afarensis* found in learners are represented by figures 5.9; 5.10 and 5.11.

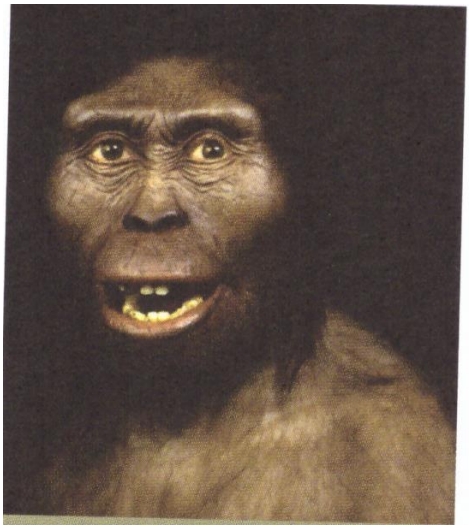


Figure 5.9 “What do scientists think that *Lucy* looked like?” Reproduced from Bowie et al., (2016: 346)



Figure 5.10 *“Australopithecus afarensis*”. From Clitheroe et al. (2013:249).

*Au. afarensis* are signified by a facial photograph image of reconstructed black, hairy male model of *Au. afarensis*, sloping forehead, flat nose, and large eye socket, prognathic face, wide open mouth with large white teeth, less pronounced chin, as can be seen in figure 5.10. In contrast to figure 5.9, Figure 5.10 depicts a complete structure of *Au. afarensis* as well as its posture.

Although the image of *Au. afarensis* from Ayerst et al. (2013) that has been shown in figure 5.11 appeared similar to figure 5.9 above, there are a few notable differences.

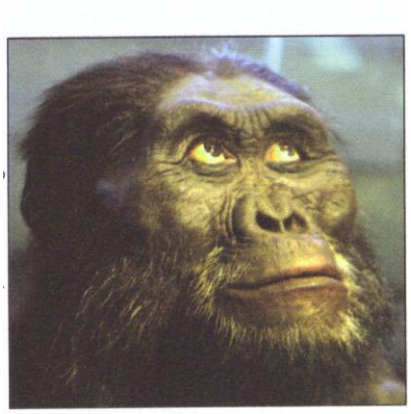


Figure 5.11 "A model of what the head of *Australopithecus afarensis* may have looked like", (from Ayerst et al., 2013:254).

Among the differences between figure, 5.9 and figure 5.11 are that the former has been denoted with an open mouth, appears to be watching and somehow puzzled by the presence of the photographer, while the later has been denoted with a closed mouth and appears not to be concerned with the presence of the photographer, but is rather attracted by a distant object in the sky. It is interesting that in both instances, the species is represented with a reconstructed model, which is portrayed as living. Depiction of these models as alive is interesting as it approximate reality (realism) possibly making them appear authentic, and scientifically accurate. It may also help audiences to relate better to the theories of human evolution that they are used to illustrate.

Furthermore, it is also interesting to note that figures 5.9-5.11 portray characteristics similar to those discussed by Scott (2007) and Pillay (2010), later such as nakedness; body covered by hair; animal-like; exaggerated features and complexion among others. Most of these features seem to relate to Eurocentric Victorian philosophy discussed in the preceding

paragraphs. However, the nakedness could signify an era in human history in which clothing technology was not available. Suggesting that, early humans had a life style similar to that of wild animals.

Clitheroe at al. (2013) presented the image of *Au. afarensis* as a full body drawing. Although it had cranial features typical of *Au. afarensis*, it did not reveal these features clearly as depicted by photographs in Bowie et al. (2016) and Ayerst et al. (2013). However, Clitheroe at al. (2013) shed light on the possible posture of *Au. afarensis*, which suggested that it could not stand firmly upright in posture, characteristic of modern human, as it has been represented in these reconstructions. This is further evidence that such images have modelled along Eurocentric mythologies before their use as scientific diagrams as the vestiges of such mythologies are prevalent in most human evolution images.

With respect to *Au. africanus,* it has been represented in de Fontaine et al. (2013) and Clitheroe et al. (2013) only. The image from de Fontaine et al. (2013) was a photograph of a full body model that has been portrayed by figure 5.12, while that from Clitheroe was a drawing. However, both images appeared to have some degrees of exaggeration particulary with limb proportions, torso and leg proportions, posture, nose structure as well as the structure of the fingers and toes. These features appeared more like an ape than human.

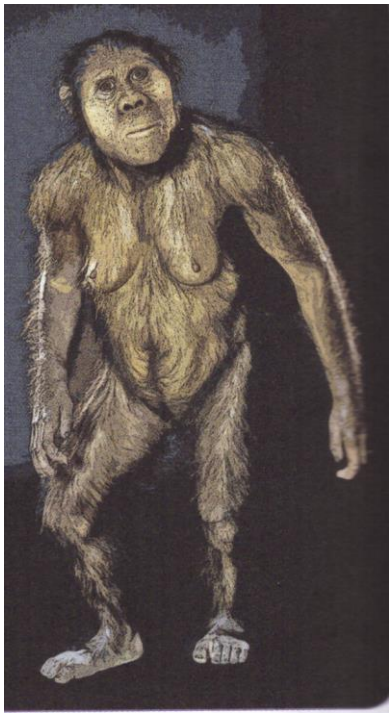


Figure 5.12 “Reconstruction of *Australopithecus africanus*”. From de Fontaine et al. (2013:334).

Figure 5.12 is denoted by features similar to the images in paragraphs above such as nakedness; hairy-body; dark in complexion; female in gender; shorter lower limbs in comparison to upper limbs; apelike appearance; lifelike gaze; forward inclined posture and large nipples on breast. Figure 5.12 connotes among other things that *Au. africanus* was not only closely associated with nature but looked more like a non-human ape than homo sapiens, which has no ability to tame the environment. Furthermore, figure 5.12 can also be seen as a human caricature because of its funny looking face and posture, suggesting that it is an approximation of a human being.

Such a presentation could be problematic as it could be construed as poking fun at the species. This was also observed by Pillay (2010) who argued that the images of human evolution in learner textbooks and popular media seems to make fun of our forbearers who

should revered as heroes and heroines as they struggled to survive in an unforgiving environment so as to give birth to this current generation of humans.

In the human evolution narrative there seems to be double discrimination in the form of racial and gender discrimination. Racial discrimination as explained in the prior paragraphs is view and action that make one racial group inferior to another. With respect to gender discrimination Pokharel (2008) defines it as an unfavourable treatment based on sex. In my analysis the human evolution images in grade 12 Life Sciences textbooks I found out that gender discrimination is prevalent in terms of nature and frequency of representation of women.

In terms of the nature of representation of women, figure 5.12 depicting *Mrs Ples* is a good example. Women sexuality has been revealed by visibly large breasts. This image appears to be a caricature of women. The problem of underrepresentation of women emanates from the frequency of images depicting women in comparison to men since most of these human evolution images in the learner textbooks were predominantly male. Thus human evolution images in the [analysed learner textbooks were not only highly skewed toward male imagery but were also caricatures.

The gender representation has been worsened by the portrayal of *Au. africanus* and *Au. afarensis* as male and female respectively as both images do not agree with their textual representation. *Au. africanus* has been represented and described as a female yet in actual fact it is a male hominin. According to Clarke (2008), Robert Broom and John Robinson who discovered Au. africanus initially thought it was a female hominin and therefore named it *Mrs Ples* However the sex of the specimen is uncertain as it is still a subject of debate among paleoanthropologists. Probably *Mrs Ples* might turn one day to be *Mr Ples*. A similar issue

happened, according to Kimbel and Delezene (2009) when Donald Johnson discovered fossils of *Au. afarensis* in 1974 which he named it *Lucy* (as he was listening to the song "*Lucy in the sky*" by the Beatles during his discoveries). Both these nicknames are still in use to name these two A*ustralopithecine* species as evidenced by their presence in the learner textbooks.

Although the, the gender of portrayal, name and reality of *Au. africanus* is female and that of *Au. afarensis* (*Lucy*)is incongruent which can be confusing to learners can be seen as a problem. There are other problems associated with these representations as well. Among these problems there is the dominance of men in the scientific community and also the naming of fossil findings by these men "women" and claiming ownership of them as well. This seems to suggest that the scientific images, particularly human evolution images, are not natural and therefore not ideologically neutral since they have been ordered by masculine reasoning and interests, which might be at variance to those of feminine. This has a potential of alienating the girl child from pursuing science courses as they may be deemed masculine territories.

### 5.4.3 Megadont archaic hominins

Megadont hominins are those hominin clades with massive dentition. For the purposes of this study *Paranthropus* has been placed in the megadont archaic hominin category since they have huge dentition of which some researchers believe that they were an adaptation for chewing huge, rough and hard vegetation materials thought to be their diet (Wood,2010). These species include *P. boisei* and *P. robustus.* It is important note that de Fontaine et al. (2013) classified *P. boisei* and *Paranthropus robustus* as *Au. boisei* and *Australopithecus* respectively. Images of *Paranthropu*s were only found in two textbooks

which are de Fontaine et al. (2013) and Clitheroe et al. (2013). These images were naked hairy black males with large sagittal crest, broad cheek bones, and flat large nose. Furthermore, the images had prognathous faces and sloping foreheads. In other words, the image of Paranthropus is more ape-like than human as shown by an example of the image of *P. robustus* in figure 5.13.

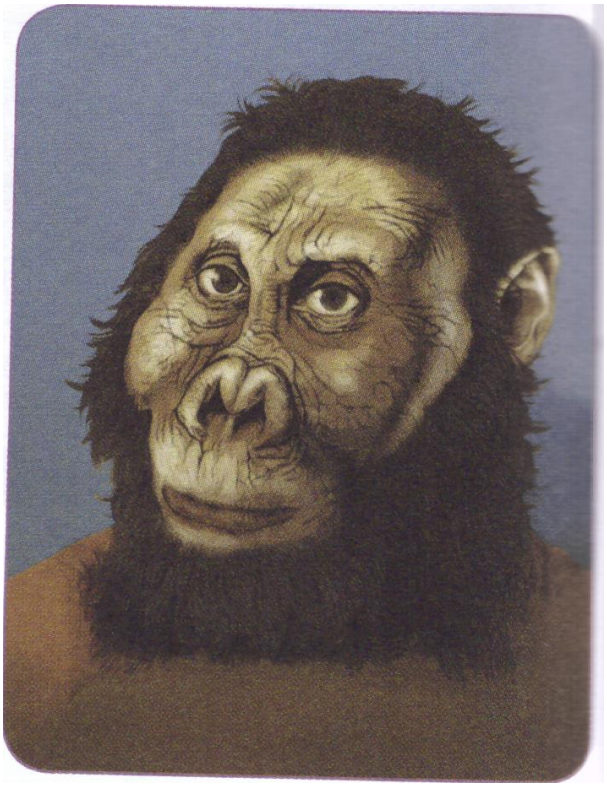


Figure 5.13 "Reconstruction of *Australopithecus robustus",* (referred to as *Paranthropus robustus* in this study and in other learners' books). From de Fontaine et al., (2013: 340).

Figure 5.13 is denoted by a naked black male with a deformed forehead and nasal bridge terminating into a flat and large nasal opening. The image also has large eyes and ears. Its gestures are evocative as if it's still living and in a deep thought. With regard to its facial features, it seems to be a more ape-like than human, particularly with reference to the shape of the mouth, nose, forehead, cheek, ears and lips. A comparison of figure 5.13 to the

image of *P. boisei* in Clitheroe et al. (2013) has revealed that they both have similar facial features. However, it worth mentioning that realism was used in depicting figure 5.13 makes it differs remarkably from the image from Clitheroe et al. (2013) in sense that the later is a drawing, while figure 5.13 approximate life like state. As an application of realism, the image, figure 5.13 is not only colourful but also depicts detailed life like morphological features clearly in comparison to the drawing from Clitheroe et al. (2013). The other difference observed is that figure 5.13 portrays the cranial structure only while the image from Clitheroe et al. (2013) reveals both the cranial and post cranial structures. The portrayed postcranial structures appear to be more humanlike except the hairy skin which is more like an animal than human. However, it is important to note that although the figure 5.13 represents the cranial structure only, it appears to have a more lasting impact on the image of *P. boisei* as it is more lively, colourful and authentic than the drawing from Clitheroe et al. (2013).

Both images are as problematic as other images alluded to in the preceding sections in terms race; gender and exaggeration of features. Furthermore, they have a potential of instilling a misconception that humans originated from apes and that people of colour are at a lower level of evolution in comparison with other races since they portray early humans as dark apelike features.

Although only one textbook (de Fontaine et al., 2013) had the image all the other textbooks that didn't have the image of Paranthropus species, interchangeably used the terms such as *Au. robustus* and *P. robustus*. It is worth mentioning that Australopithecus and Paranthropus are different categories of the hominin clade. So the use of different categories in describing

one species is problematic in the sense that it can be a source of misconception or confusion to learners as they might fail to categorise *Au. robustus* and *P. robustus*.

### 5.4.4 Transitional hominins

Transitional hominins are those hominins that have intermediate characteristics of apes and humans. This category has been represented by *Homo habilis* since it is the only transitional hominin that has images portrayed in learners' books. Images of *H. habilis* were only found in three textbooks which are: de Fontaine et al. (2013), Clitheroe et al. (2013) and Avis et al. (2013).

When compared to *Australopithecu*s and *Paranthropus* species, *H. habilis* had a higher forehead, smaller eye brow ridges and less prognathous face wider in the upper part (Wood, 2010). This seems to imply that *H. habilis* has more features of humans than those of apes. An example of the image of *H. habilis* has been shown below in figure 5.14 below. This image appears to be in agreement with scientific descriptions.



Figure 5.14 "Reconstruction of *H. habilis".* From de Fontaine et al. (2013: 327).

Figure 5.14 has been denoted by a naked and dark hairless man using very basic stone tools while seated on a stone in the forest. Its finger and toes are similar to those of modern humans but the facial and cranium appearance seem to suggest a closer relationship with apes. However, the ability of using tools suggests that *H. habilis* was more evolved than its predecessor, *Paranthropus* species. The problematic nature of figure 5.14 emanates from the racial and gender connotations that have been discussed extensively in the paragraphs above such as association of Black people with closeness to nature and early humans.

### 5.4.5 Premodern *Homo*

This category includes *Homo neanderthalensis* (*H. neanderthalensis*); *Homo erectus* (*H. erectus*); *Homo heidelbergensis* (*H. heidelbergensis*) and *Homo ergaster* (*H. ergaster*) An analysis of learner textbooks in this study has revealed that the image of *H. erectus* appeared in two books, one written by de Fontaine et al. (2013) while the other is written by Bowie et al. (2016). The image of *H. heidelbergensis* only appeared Ayerst et al. (2013). However, there was a notable absence of the image and description of *H. neanderthalensis* and *H. ergaster* in all the learners' textbooks that were analysed, even though they had included it in the construction of hominin evolutionary trees earlier on. The silence in the texts about the characteristics of *H. neanderthalensis* and *H. ergaster* can be attributed to the silence the CAPS document (current Life Sciences syllabus) has on the main hominin clade that must be taught to learners.

#### 5.4.5.1 *H. erectus*

In Bowie et al. (2013), Clitheroe et al. (2013) and de Fontaine et al. (2013), Homo erectus is depicted as a black man with a smooth body with ability to make fire, living as a family in a

bush environment. The figures in the image have reduced eye brow ridges, less prognathous faces in comparison with Homo habilis and postcranial structure similar to modern humans. This suggests that Homo erectus is more evolved than its predecessor, *H. habilis* and is closer to the modern humans. An example of the image of Homo erectus has been as shown in figure 5.15 below.

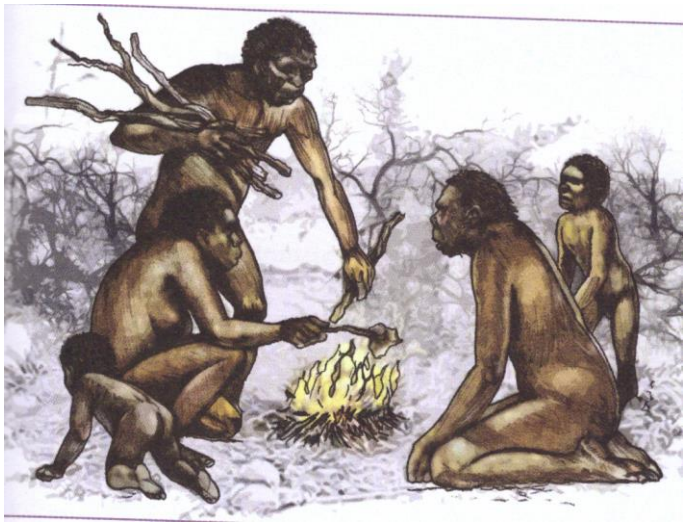


Figure 5.15 "*Homo erectus* may have controlled fire and even used boats", (from de Fontaine et al., 2013:239).

Figure 5.15 has been denoted by a family of five members seating around a fire in a forest environment. The family is comprised of one man and two women and two kids. All the family members are not only dark in complexion but also naked and have hairless bodies. The ability to live as a family life and the use of fire suggest that *H. erectus* was more evolved that its predecessors as it had acquired some means of taming nature. However, the closeness to Nature remains a central story as the image portrays *H. erectus* as forest dwellers with an earliest culture as they live like animals without being conscious of their nakedness. Furthermore, facial and cranial features signify that *H. erectus* still had some

remarkable features of the apes, although it appears to be more evolved in comparison to *H. habilis.*

#### 5.4.5.2 *H. heidelbergensis*

The image of *H. heidelbergensis* in Ayerst et al. (2013) (figure 5. 16) shows a model reconstruction of a naked Black man with an unshaven prognathous face, less sloping forehead, reduced eyebrow ridges and nose shaped as that of modern Africans.

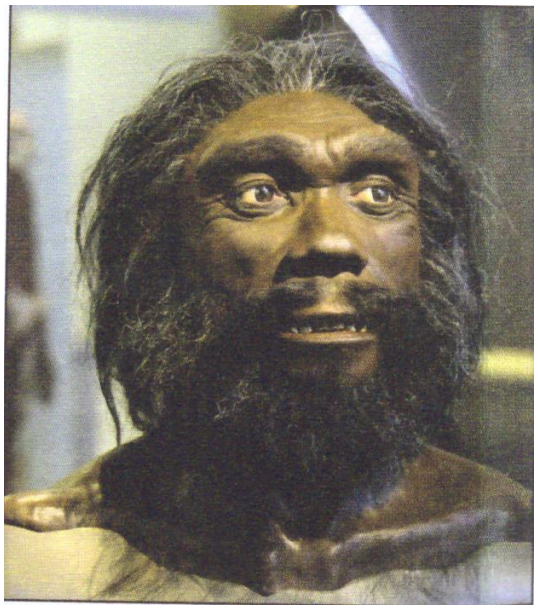


Figure 5.16 "A model of the face of *Homo heidelbergensis* at the Smithsonian Museum of Natural History". From Ayerst et al. (2013:257).

This model of *H*. *heidelbergensis* reproduced from Ayerst et al. (2013) is housed in a Smithsonian museum display cabinet. It looks lively, focusing at a distance object than to the cameramen, as if it has ability to pose for a picture. A mere analysis of the features of image of *H. heidelbergensis* in Ayerst et al. (2013) can reveal that it appears closer to the modern Black human race, yet has some ape-like features. The wild appearance of *H. heidelbergensis* hair in figure 5.16 recalls on the Eurocentric myths which were instrumental

in modelling the majority of the human evolution images. Among such myths was the idea that early humans were believed to be dark bestial savages intimately associated with nature (Scott (2007). Thus, the appearance of figure 5.16 in which the image has been modelled on the image of Africans bearing apelike feature bore evidence of these myths. The similarity of the features of *H. heidelbergensis* to modern Africans may prompts one to speculate that modern Africans are ancestral to the modern human race. Such an opinion might make the concept of human evolution unpalatable to some individuals as there is a potential of bias. According to Scott (2007), dark skin colour does not only stigmatise one to be evolutionary inferior but also remains unchallenged in labelling the lowest point of the evolutionary ladder. Thus the use of dark skin completion and other features peculiar to Africans in depicting early hominins has a labelling effect on both the Africans and non-Africans which such as the perception of Africans as inferior in evolution (both biologically and culturally) terms in comparison with non- African races. In particular Hall (1997) also reported that the *Negro race* was often referred to as the *monkey race*. These ideas trickled in the depictions of early humans as savages, cannibals and close proximity with nature, suggesting that primitivism and blackness became a perfect match. Furthermore, Hall (1997) noted that popular representation stereotyped Blacks with simplified, fixed essential characteristics that can be marked by a few strokes of a pen. The cartooning of dark people in images of human evolution has a potential of condemning Africa and its people as laughing stocks instead of being cherished, revered and respected as sacred source of humanity.

### 5.4.6 Anatomically modern Homo

For the purposes of this study the anatomically modern Homo category is comprised of one taxon which is the *H. sapiens.* This is the only surviving hominin clade and is sometimes referred to as the modern human. The images of *H. sapiens* were only found in three of the seven analysed textbooks. They appeared in de Fontaine et al. (2013), Clitheroe et al. (2013) and Isaac et al. (2013). The characteristics of anatomically modern man include: a round head, small perpendicular face, prominent nose, round and projecting chin. Furthermore, the modern human has a postcranial structure with longer legs relative to arms that is well adapted to bipedalism and a less hairy body. Figures 5.17 and 5.18 illustrate images of Homo sapiens found in learners' textbooks.



Figure 5.17 *Homo sapiens*. From Clitheroe et al. (2013: 251).



Figure 5.18 “Reconstruction of early humans”. From de Fontaine et al. (2013:329).

Figure 5.17 is a drawing that denotes a naked Black man with anatomy of modern humans. Although Figure 5.18 denotes a modern human just like figure 5.17 it has additional information differentiating from figure 5.17. The image (figure 5.18) depicts, a light skinned man as well as his cultural artefacts in form of clothes worn and tools handled. The photograph nature of figure 5.18 contributes to its perception as a more natural image although its caption points out that it’s a reconstructed model. With respects to the cultural materials, their depiction suggests that light skinned *H. sapiens* had acquired the skills to tame nature even though they lived intimately with it. Although cultural aspects are not part of biological evolution, their presence alters nature of the conversation. Referring back to the figure 5.17 and 5.18 one can infer that Africans are inferior in terms of human evolution judging by the way, figure 5.17 is portrayed without cultural evidence while figure 5.18 shows light skinned with his cultural artefacts such as clothing and tools. This has a potential of inciting opinions such as early Africans had no culture of their own. This seems to be in agreement with Scott (2007), who noted that Africans are normally depicted as culturally

and evolutionary inferior by being presented as naked. Thus the context of the image is very important as it has a potential of influencing interpretations.

With respect to captions, figure 5.17 has one that says, "*Homo sapiens*", while figure 5.18 has one that says, "*Reconstruction of early humans*." This difference in caption confers different meaning to the images of the same species, which can be deemed problematic. The problem with the term early humans is that it has also been used to describe other species such as *Australopithecus*, *Paranthropus* and earlier *Hom*o species. Using the same term to describe *H. sapiens* might be a source of confusion, as it suggests that there are later human species beyond *H. sapiens*. Knowing that *H. sapiens* is the latest human species, one may wonder, what could be the implication of the caption of figure 5.18 considering that it is portraying a dark person who appears to be associated with a life in nature, in close proximity to animals as suggested by his animal skin regalia and the spear, a hunting tool. Therefore, one might be compelled to think that the caption "*Reconstruction of early humans*", is referring that people of dark colour are earlier humans in comparison to other human racial groups. Thus the issue of racism is implicit in the caption of figure 5.18.

**5.5 Images portraying the "March of Progress"**

Isaac et al. (2013) was the only textbook that had the images of the *"March of Progress".* The other textbooks were however silent about the *"March of Progress"* in terms of both the texts and images. Although Isaac et al. (2013) had the image of the *"March of Progress"* they pointed out that humans did not evolve from apes as denoted by the *"March of Progress"* imagery. Figure 5.19 below shows the *"March of Progress"* as depicted by Isaac et al. (2013).

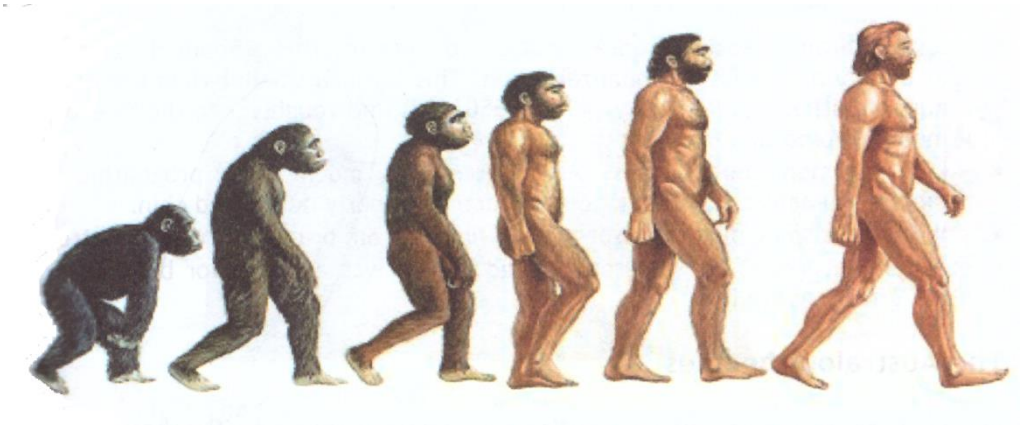


Figure 5.19 Ape-like ancestor→Apemen→Early humans→Modern humans. From Isaac et al. (2013).

Figure 5.19 denotes six naked males marching in a single file from left to right. The depicted men increase in height and also in ability to walk firmly upright from left to right. In addition to that they progressively shade hair and become less dark as they march to the right. There is also a progressive loss of ape-like features and the assumption of human features as the *March Progresses* to the right. The connotations associated with these images include among others that: modern humans evolved from apes; evolution as a process is goal oriented; dark skinned humans are earliest than other categories of the human race.

Although the Isaac et al. (2013) highlighted in their texts that the *March Progress* should not be seen as suggesting that humans came from apes, the presence of the images in the textbook is problematic as it might have far reaching consequences than imagined. One of the problems is that, readers might focus more on the images than the texts thereby failing to get the intended meaning. Other problems are created by the presence of the *"March of Progress"* as it has a high probability of being misread. This might result in prevalence of misconceptions among learners about human evolution. Firstly, the suggestion by figure 5.19 that humans evolved from apes is a misconception. Although Isaac et al. (2013) tried

to dilute this misconception by including textual information that the image does not imply that humans evolved from apes, such textual support may not be sufficient enough in preventing the development of misconceptions. The possible reason being that there is no guarantee that learners will read the image and the text in conjunction so as to acquire the meaning as intended by the textbook.

Secondly the *"March of Progress"* seems oversimplify human evolution to the extent that it might be interpreted as a process whose main goal is to produce *H. sapiens*. This goal directed presentation of human evolution is both erroneous and problematic. Quessada and Clement (2014) in their study of representation of human evolution in biology textbooks from different countries noted that some textbooks still make use of the *"March of Progress"* images even they have been discredited by most members of the scientific community. They highlighted that such images make one to perceive the process of evolution as a means to an end. That is, as a way of which apes can with time become humans. Gould (1989) discredited the means to end perspective as depicted by the *"March of Progress"* and suggested that evolution should be seen as a blind process that is responsible for the branching phenomena of a variety of life forms. Furthermore, the

*"March of Progress"* has an inherent problem that suggests that *H. sapiens* stage has not yet been reached by dark people as they are still marching towards it. This has serious racial implications as alluded to in the earlier sections. The problems and misconceptions associated with the *"March of Progress"* seem to be responsible for its notable exclusion from the other six learner textbooks where it was absent.

## 5.6 Summary

In this chapter the research findings were discussed about the human evolution images in learner textbooks. Among the findings were the issues racism attributed to the frequent use of dark skin colour in the depiction of early humans as well as the nature of their representation. Gender bias was also observed. This emanates from the frequency and nature of representation of women.

While this chapter discussed the analysis of the human evolution images in Grade 12 Life Sciences textbooks, the next chapter is a concluding chapter which discusses the implications, reflection and limitations of the study among other issues.

# Chapter 6

## Conclusions and implications

### 6.1 Introduction

This chapter presents a summary of the analysis and conclusions from this study as well as its implications. The focus of this study was to answer the following questions:

1. How do Grade 12 Life Sciences textbooks portray human evolution?
2. How accurate are the human evolution images portrayed in Grade 12 Life Sciences textbooks?
3. What ideas and attitudes are promoted by human evolution images in Grade 12 Life Sciences textbooks?

In pursuit of this study I analysed human evolution images in seven Grade 12 Life Sciences textbooks using a semiotic instrument I constructed based on the ideas of Barthes (1977) and Rose (2012). In drawing conclusions, I will address each of the above mentioned research questions.

### 6.2 How do Grade 12 Life Sciences textbooks portray human evolution?

I found that the learner textbooks make use of a range of representations which included graphs, drawings and photographs. I also found out that not all textbooks had the same categories of representations and examples. The most common types of representation were graphs followed by drawings and photographs of models respectively.

The graphs in the form of phylogenetic trees were found in all the learner textbooks. These graphs were of two types namely: the primate evolutionary trees and hominin evolutionary

trees. The primate evolutionary trees play a critical role in allaying fears and misconceptions that humans evolved from African apes. This has been demonstrated by illustrating each primate having its own evolution line branching off from a common ancestral species. Although the primate evolutionary tree clearly shows that evolution is a continuous unfinished process by the use of dotted lines, or solid lines with arrows (for example as was seen in figure 5.1), it has a drawback of not revealing what the ancestral species were for each primate line as they are omitted. With respect to hominin evolutionary trees, they are important as they show the human ancestral species that are missing from the primate this might also be a result of lack of knowledge among scientists about what the actual ancestral/decent relations were evolutionary trees. It might be possible to have all the fossils but still handicapped to accurately analyse them, as there may be some limits to our knowledge in palaeontology about who the real ancestor was. However, they do not clearly show the continuity of human evolution as they have some gaps often associated with yet to be discovered fossil evidence. It is important to note that the prevalence of the phylogenetic trees in all the learner textbooks in this study is consistent with the current dominant thinking of paleoanthropologists and scholars such as Gould (1989) who are of the view that the process of human evolution is a series of branching, opposed to the linear as originally thought by Rudolph Zallinger (Howell,1965). Graphs are useful for communicating a lot of information and showing the relationship between concepts in a quick, accessible manner. They are also associated with scientific forms of ordering knowledge, and therefore connote scientific rigour. The presence of so many graphs reinforces a perception of the scientific accuracy of the ideas about human evolution presented in these text books. However, my discussion of the graphs in chapter 5 demonstrated that a scientific diagram might appear to be neutral and factual, yet latently it might have, stereotyping and

prejudicial cues. Furthermore, my discussion showed that it is near impossible for one graph to contain all the information about human evolution, thus each graph is characterised by inclusion and omission. This means that even graphs need accompanying written texts that help explain them.

The drawings and photographs of reconstructed models were also used as different modes of representing hominin clade in most of the learner textbooks in this study. While a number of drawn images of bones and skulls followed the skeletal structure of fossil evidence that was found, the images that attempted to depict how the hominin clade looked were found to be a reflection of the Eurocentric mythologies which were dominant during the Victorian era. In these Victorian images, early hominins were constructed as bestial, dark, earliest savages (Scott, 2007). These mythologies were a Eurocentric way of understanding and explaining European identity and civilization. Their transformation into scientific diagrams of human evolution demonstrates the influential role politics and folklore has in scientific discourses, and how science has been used to further political ideas, such as the colonial idea that the people of Africa were more primitive as compared with the colonisers from Europe. While these Eurocentric ideas are contested in contemporary scholarship, the images which have little changed nevertheless contain the associations of former uses. Therefore, scientific diagrams such as human evolution images and photographs of reconstructed models, like any other form of representation, are a never ideologically neutral as they are laden with values and beliefs, particularly of the dominant groups in society.

In one instance the human evolution images were put in a sequence generally referred to as the *"March of Progress",* specifically the textbook by Isaac et al., (2013). Although, the

*"March of Progress"* imagery was present in Isaac et al., (2013), the authors appear to acknowledge its problematic nature by commenting that such imagery does not imply that humans arose from apes. It is good that there is only one image of in current learner text book although it is still popular in representation of human evolution in museums and other media. Recently, scholars such as Gould (1989) and Quessada et al., (2014) and many others are critical of this imagery as they felt that it does not only contributes to distortion of human evolution but also has been abused for political, social and economic ends in throughout human history. A good example here could be its application in scientific racism in America (Dennis, 1995) and also during the Apartheid past of South Africa. The absence of this imagery from a majority of the learner textbooks demonstrates that the writers of these textbooks are aware of the critique and the problematic nature of representations of the ''*March of Progress".*

**6.3 How accurate are human evolution images portrayed in Grade 12 Life Sciences textbooks?**

The accuracy of the graphic representations of the phylogenetic trees was bolstered by the use of biochemistry in complementing morphological analysis of primates, particularly with regard DNA sequence as in Ayerst (2013). However, the accuracy of hominin evolutionary trees, (a variant of phylogenetic trees but constructed from extinct species of hominin) can be questionable as they are constructed from scarce fossil evidence with no traceable DNA record. This appears to be confirmed by lack of evolutionary lines between hominin clade as in Avis et al. (2013). The presence of dotted evolutionary lines in de Fontaine et al. (2013), represent lack of fossil evidence but also possibly simple lack of knowledge implying that its degree of accuracy is low.

While there is scientific accuracy in many of the drawn images of skulls and skeletal structures that were included in the graphs of early hominin, the representations of how the different species looked or behaved in their habitat's continue to have racist and gender biases. This was seen in particular in figure 5.8 and figure 5.1.2 in which there was racial and gender stereotyping of the Black race as well as Women. These prejudices stem not only through how the images are represented but also through the social stigma attached to the European mythologies about the distant land such as Africa, which persist in many communities today. Furthermore, reconstructed models of early hominin are subject to the bias of their designers whose visual interpretations of early hominin are informed by their ideological and cultural dispensations. This idea is suggested by Scott (2007), who notes that reconstructions of early hominin such as *Ar. ramidus* were inspired by European mythology which had long imagined human ancestors as woollen ape-like, bestial, dark primitive savage species.

With reference to the *"March of Progress"* imagery, the degree of accuracy is in doubt as it is not only disputed by Gould (1989) and Quessada and Clement (2014) among other scholars but also the idea of an ape becoming a human being in the future which such images suggest, is questionable. An additional problem with images of the ''*March of Progress"* is that it presents human evolution as linear rather than branching, contrary to contemporary scientific thought, further putting its accuracy in doubt.

Therefore, in answering question my second question, the degree of accuracy of the images varied depending on the nature of representation. The graphical representations and drawings of the skeletons and cranial features of hominin appeared to be more accurate than images showing how the species looked, or how they lived in their habitats. Since the

graphs and images of the skeletons and cranial structures are the most common images in these text books, I conclude that there is a high degree of scientific accuracy in the representations of human evolution in these text books. However, it should be noted that although the graphical images appear more scientific because they do not at first appear to be falling in to the traps of using the imagination for representation, they are also flawed in that it is impossible for them to contain all the information and so they are inaccurate, and could potentially mislead learners. What is important with all of this is how the information around the image that explains what the image is about, and often includes a disclaimer about what is omitted is essential for understating the images. Thus, the images and the text work together to communicate meaning and it's important to decode both when trying to understand the denoted and connoted messages.

### 6.4 What ideas and attitudes are promoted by human evolution images in Grade 12 Life Sciences textbooks?

The learners' textbooks that were analysed give the impression that human evolution is a branching, and continuous process. This has been revealed by the wide use of graphs in the form of phylogenetic trees. This is crucial as it reduces the misconceptions that human arose from apes and that humans are *H. sapiens* is the pinnacle of human evolution.

So, while there is the potential of some images promoting racist and sexist ideas, such as that the Black race are evolutionary inferior in comparison to other races due to the use of dark colour and other features characteristics of Black people in depicting early human species, most of the images in the textbooks analysed avoid these stereotypes through the use of many graphs, and many illustrations of the skeletal and cranial features rather than of how different species may have actually looked. In those cases, where the images do depict

how the species may have looked, there is the tendency to use the Victorian stereotypes. However, in order for these not to fall into racist traps and also propagation of misconceptions, the text around the images needs to unpack and expose the potential racism and misconceptions in order to neutralise them.

**6.5 Implications of this research**

Through this study I have found out that not all human evolution images are problematic although some reflect contemporary human evolution ideals. Those that were problematic were also accurate in some ways. Most of the problems identified were racial and gender biased in nature and also had potential of instilling misconceptions about human evolution among learners. Therefore, there is a need for more criticality and awareness of the connotations and denotations of images in the science classroom so as to mitigate their negative consequences. Further, it is important to have images that reflect the current modern thinking with regard to human evolution, rather than to remain stuck with the Victorian era imagery that might be no longer relevant to the current issues and discourses.

Although all learner textbooks had graphical representations of human evolution, only two textbooks which are de Fontaine et al. (2013) and Clitheroe et al. (2013) stood out as they consistently represent human species more than other textbooks. There illustrations covered the majority of known human species. This is very important as learners can use the images as documents to access the past so as to have ideas of what human evolution entails.

This study has shown that semiotics can reveal both denotative and connotative meanings associated with human evolution images. It is my desire to promote the use of semiotics in

the science classroom so as that intended meaning of an image is not masked by the prevalence of other meanings associated with it. The end result might be the reduction of misconceptions, misapplications and misunderstandings in the classroom arena.

### 6.6 A reflection on the research process

As a person without a semiotic background but using it in interrogating scientific images, I found the research process both difficulty and interesting. The difficulty arose from being a novice semiotician while the interesting component was looking at with a different lens, which widened my scope and understanding of image communication.

During this semiotic research process, I relied on my understanding of the human evolution images which makes it subjective. Therefore, findings in this study are limited to my perspective. This implies that my findings in this study cannot be generalised but can open a platform for public discourse about representations in human evolution and also a window for an in-depth study in the future.

As a result of this study, I believe that there is a need to interrogate human evolution images in learner textbooks from different perspectives so as to understand the latent and overt ideas that they portray. This might assist in the representation that is sensitive to the needs and aspirations of the intended audiences.

### 6.7 Suggestions for future study

In this study I have used semiotics to interrogate human evolution images in seven Grade 12 Life Sciences learner textbooks. The study has shown that semiotics can reveal both denotative and connotative meanings associated with human evolution images. Since this semiotic study only portrays my perspective about human evolution images in learner

textbooks, there is a need for a broader study of these images from different perspectives so as to get a wider and deeper insight about these images. Therefore, there is a need for the study to be repeated by getting opinions from different sectors of the populations such as students, teachers and other parties to see if similar findings can be obtained.

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