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"Hunter-Gatherer Science: Tracking as an Indication for the Universality of Scientific Reasoning"

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Table of contents

Orthography

The Ju/´hoan (adjective) language contains four clicks:

/ dental click: tip of the tongue is pressed against the front teeth and quickly withdrawn

≠ alveolar – palatal click: tip of tongue is pressed against the alveolar ridge and adjacent palate then released sharply downwards

! palatal click: tongue is pressed against the upper palate and released sharply downwards (something like when a cork is pulled from a bottle)

// lateral click: click sound produced at the side of the tongue when tongue is held pressed against the palate

A reader-friendly pronunciation guide:
/ and = …. can be reasonably pronounced “t”
! and // … can be reasonably pronounced “k”

Ju/´hoansi can therefore be pronounced as “Schu-twan-si”.

Introduction

There are three categorical questions that guide this thesis: What is science? Where does it come from? And what is its purpose? These questions are big in their scope and therefore answering them requires a multidimensional approach. The two dimensions that have been chosen here are the field of philosophy of science as well as hunter-gatherer research within the realm of Social and Cultural Anthropology. The combination of an evolutionary approach and recent ethnographic data sheds light on the three guiding questions.

What is science? The Cambridge Dictionary describes the term *science* as "the careful study of the structure and behaviour of the physical world, especially by watching, measuring, and doing experiments, and the development of theories to describe the results of these activities". This definition might sound reasonable for people who are familiar with the term and who vaguely know the concept of science. But what about people in different cultural settings who do not have an equivalent translation for the word science? Anthropologists are concerned with this question since the 1950s[1]. Within the realm of *cognitive anthropology* they aim at understanding knowledge systems out of specific cultural contexts. Today the field is commonly known as *ethnoecology,* "which refers to the study of how traditional groups organize and classify their knowledge of the environment and environmental processes" (Brosius et al. 1986, p.187). Ethnoecology aims at grasping the system that people use in order to understand their environment – out of their specific cultural perspectives. For it is commonly assumed that „people do not directly respond to their environment but rather to the environment as they conceive of it: e.g., to animals and plants as conceptualized in their minds and labelled by their language" (Brosius et al. 1986, p.188). Moreover it is assumed that classification and conceptualization of objects, activities and events can be grasped through the study of language. Subsequently methodological approaches in this field have always been strongly influenced by linguistic methodologies.

However, very little emphasize has been put on implicit knowledge or in other words on the application and operationalization of indigenous classification systems. Fact is that indigenous knowledge on their environment far exceeds the mere classification of plants, animals and

[1] Ward Goodenough, Charles Frake, Floyd Lounsbury, Harold C. Conklin and others were representatives for what was also called ethnoscience, ethnographic semantics or new ethnography back in the 1950s.

other ecological realms. This point is also linked to the second flaw of ethnoecology, namely the mentalistic reduction when it comes to the explanation of the concept of culture.

This study takes up these two weaknesses by investigating hunter-gatherer science. (Animal) tracking activities among the Ju/ʹhoansi hunter-gatherers of the Northern Kalahari Desert in Namibia serve as a case study. It will be shown that the reasoning processes applied whilst animal tracking are the same ones that are applied in modern science. Also the organization of tracking knowledge within the community shows strong parallels to modern scientific knowledge production. In chapter one a detailed account on these theories will be presented.

Where does science come from? We know today from archaeological as well as from anthropological records that Homo sapiens, who has been existing for about 200.000 to 300.000 years (Hublin 2017), lived as hunter-gatherer until about 20.000 years ago. The analysis of information stemming both from archaeological as well as from ethnographic sources show that tracking is *the* fundamental skill for every kind of subsistence hunting ever applied by human beings. Conversely the faculty of tracking (simple, systematic and speculative) is an indication for the universality of scientific reasoning among human beings (Liebenberg 2013).

Going one step further in chapter two the question will be asked how and when the cognitive ability arose that enabled humans to track other species. The fact is that animals track solely via their distinctive sensory organs whereas humans are the only species able to trail down other species via means of the so-called *symbolic faculty*. In chapter two the focus lies on this very concept as well as on the fact that the emergence of the latter demarcated man from his anthropoid ancestors ever since. It will therefore be examined what is actually meant when we talk about “human beings”, “man” or “Homo sapiens”. Additionally a time scale will be framed in order to raise the question of when in history the symbolic faculty could have evolved.

The whole discussion concerning this unique human faculty requires a subtle understanding of evolution. In that sense basic principles and common miscomprehensions will be outlined. It is the distinct perspectives of *specific* and *general* evolution that will be explained as well as the fact that biological evolution and social evolution are processes that are partly guided by different mechanisms. In that spirit some myths regarding Social Darwinism will be revealed.

Thirdly an answer to the question of *what is the purpose of science* will be sketched. In that sense the question of the origin of science will be expanded to the level of social evolution. Leslie White mentioned two major mechanisms as being outcomes of social evolution (of the symbolic faculty): *science* and *art*. He describes them as two uniquely human ways of dealing

with the environment. A critical investigation of his model shall show that science is not only an ability possessed by individual human beings, in terms of scientific reasoning, but that *sciencing* might also be a mechanism that is guiding human behaviour on a societal level.

1 Tracking and the Origin of Science

1.1 Hunter-Gatherer studies

Hunter-gatherer society is an analytical category that is used among anthropologists to categorize types of societies that share the following main characteristics: kinship-based social organization, non-centralized and non-hierarchical political system, generalized reciprocity, hunting and gathering as a strategy of subsistence and a very low population density. Usually these groups are composed of 20 to 50 individuals and are highly mobile, living a nomadic way of life (Woodburn 1982). Today there are only very few hunter-gatherer societies left world-wide, most of them already semi-nomadic or even sedentary. Some of them are the Piraha in Amazonia, San Bushmen in the Kalahari Desert, Maniq in the rainforest of southern Thailand, Hadza in Tanzania and Agta in the northern coastal part of the Philippines.[2]

Modern hunter-gatherer research is an interdisciplinary endeavour that aims at contributing to the understanding of human organization. It aims at showing the range of ways through which human groups organize themselves. Today not only anthropology but also archaeology, genetics, linguistics, physical anthropology, and other disciplines are working on issues that cover both ancient as well as contemporary hunting and gathering groups. The two major networks in this field of research are CHAGS (International Conference on Hunting and Gathering Societies)[3] and ISHGR (International Society for Hunting and Gathering Societies), both aiming at bringing the disciplines together and fostering interdisciplinary exchange (Warren 2018).

This thesis contributes to the field of hunter-gatherer research by investigating a skill that forms the basis for hunter-gatherer dwelling in different ecological environments - animal tracking.

[2] The mobility strategies of recent hunter-gatherer groups are changing radically because of globally altering circumstances.

[3] Held ten times since 1966 and every third year since 2013.

Up until today only very little ethnographic data on (animal) tracking among hunter-gatherer communities has been collected. Moreover solely the San Bushmen have been target of this kind of investigation. But even here the ethnographic record is scarce. Three major contributions have been made by Louis Liebenberg (2013), who looks at the technical details of the skill as such, Megan Biesele (2001), who tries to broaden the discussion by including tracking skills of female individuals, and Thomas Widlock (1997), who relates tracking activities to mobility strategies and orientation skills[4].

Although some researchers are trying to grasp the art of animal tracking, there is as yet no common sense. The fact is that the spectrum of tracking activities among the Ju/´Hoan San community far exceeds the mere chasing of an animal. Tracking is also applied whilst gathering, monitoring the surrounding wildlife, observing activities of community members, accounting for the group safety or for navigation when foraging. For non-trackers the range of application is difficult to grasp and subsequently tracking as a skill very often becomes black-boxed. Outside academia this circumstance has even led to orientalizing ethnic stereotypes. Up until today many reports of the San people are connected with an ideology[5] that describes them as being able to instinctively find their way in the bush, instinctively know where game is or being born with the knowledge to track. Already 20 years ago, Widlock called for a thorough investigation of tracking skills by stating that "a proper recognition of the social factors involved in cognitive processes helps to put the records straight, and demonstrates also that any adequate model of the mind must be grounded in an ethnography of cognitive processes" (Widlok,1997, p.329). The following pages finally are responding this call.

1.2 The Ju/´hoansi San

The San people are an indigenous community spread over six countries throughout the southern part of Africa. As shown in table 1 the *Working Group of Indigenous Minorities in*

[4] William Bleek and Lucy Lloyd were the first ones collecting data on San culture. Although they did not conduct proper fieldwork they collected data by interviewing bushman prisoners in Captewon in the middle of the 19th century. They mainly tried to document Bushman folklore and mythology yet sometimes mention hunting practices in their book "Specimens of Bushman Folklore" published in 1911. Although they do not specifically write about tracking Bleek and Lloyed yet laid the foundation for most of the following research around the San Bushmen.

[5] This ideology has mainly been developed by the South African Army during the war in Angola and northern Namibia (Widlock 1997, p.317). Also see Hurrlich et. al. 1987, p. 334 and Marshall et. al. 1984, p.7.

Southern Africa (WIMSA) estimates about 96, 800 San people in total distributed over Angola, Botswana, Namibia, South Africa, Zambia and Zimbabwe.

Table 1 Number of San in southern Africa

Country	Population	Size (sq km)	Number of San
Angola	13,068,11	1,246,700	3,500
Botswana	2,029,207	600,370	48,000
Namibia	2,128,471	825,418	34,000
South Africa	49,109,107	1,1221,912	7,500
Zambia	12,056,823	752,614	1,300
Zimbabwe	11,651,858	390,580	2,500
Totals	90,043,776	5,037,594	96,800

Note: Figures estimated as of July 2010.

Source: Data obtained from the Working Group of Indigenous Minorities in Southern Africa (WIMSA)

(Biesele, Hitchcock 2011, p.4)

San is the umbrella term for the aboriginal community of southern Africa, however the community subdivides into several self-identifying groups. All of these groups vary in their language. Concerning their social and cultural customs, their economic practices and histories, they exhibit both similarities and differences. As for Namibia there are ten subcommunities. Table 2 shows their regional distribution.

Table 2 Populations of San in Namibia

Group Name(s)	Location	Population Size
//Anikwe	West Caprivi	400
Khwe	West and East Caprivi, some in Tsumkwe District West, Otjozondjupa region	5,000
!Xun	Okavango, Otjozondjupa regions	6,000
Ju/ʹhoansi	Tsumkwe East, Otjozondjupa, Omaheke, Gobabis	7,000
Hai//om	Oshakati, Uutapi, Tsumeb, Outjo, Etosha National Park, Grootfontein	11,000
Naro	Omaheke region, Otjinene and Gobabis districts	2,000

=Au//eisi	Omaheke region, Otjinene and Gobabis districts	2,000
!Xõó	Omaheke region, Otjinene and Gobabis districts, Mariental region, Hardap district	300
|´Auni	Mariental region, Hardap district	200
N|u (/N-//en)	Mariental region, Hardap district	100
Total		34,000

Source: Data compiled from reports and documents on file in the WIMSA library, the Namibia National Archives, the library of the Kuru Family of Organizations, and published literature (e.g., Gordon and Douglas 2000: 7; Suzman 2001b: 3, table 1.1)

(Biesele, Hitchcock 2011, p.6)

The focus of this study lies on the Ju´/hoansi San that reside in southern territory of Nyae Nyae, which is located in Tsumkwe District (formerly Bushmanland) in the Kalahari Desert, north-eastern Namibia (picture *Kalahari Desert,* 2017). Ju/´hoansi is an endonym, which can be translated into "true" or "ordinary people". The 40 villages within Nyae Nyae area, each encompassing 40-60 members on average, number about 2400 individuals in total.

The first recordings on the Ju/´hoansi go back to the 1850s and derive from encounters with European settlers. Interethnic wars between the Nama San and the Herero population starting in the 1860s then caused first suppression of the Ju/´hoansi in Nyae Nyae. The colonial era that began with the establishment of Namibia as a "German Protectorat" (named Deutsch-Südwestafrika) in 1884 finally brought about many challenges for the local community. Germany annexed their territory, the Rinderpest epidemic strongly affected wildlife and livestock in whole Namibia, the "Bushman Plague" caused attack by German troops and San men were being forced into labour (Biesele, Hitchcok 2011).

A crucial point in the Ju/ʹhoan history was the arrival of the Marshall family in 1951. John Marshall and his family took expeditions to the Nyae Nyae territory over the next seven years. They contributed an extensive amount of ethnographic data. Apart from that the Marshall family has strongly influenced the standing of the indigenous community by giving them a voice and supporting them regarding political matters on a national and international level (Biesele, Hitchcok 2011).

In 1966 the Namibian war of Independence began and lasted until 1988. It was only in 1990 that Namibian independence was declared. Political developments finally led to the event of the foundation of the Nyae Nyae Conservancy (NNC), being the first conservancy on communal land in Namibia.

Today it consists of a small town which has a primary and secondary school, a court house and a police station, a small medical clinic, churches, two groceries and a hotel. The numbers of inhabitants vary strongly from 400 – 1000 depending on the season. An additional 1,500 to 2000 Ju/ʹhoansi live in the 30 remote villages that are scattered throughout the 9000 km² district (informal conversation with the head of Nyae Nyae Conservancy, October 2018).

The variety in living conditions and situations goes hand in hand with the fact that the local community is engaged in a system that can be referred to as a mixed economy (Biesele, Hitchcok 2011). Whereas to some groups and families hunting and gathering activities constitute a major part of the subsistence strategy, others rely on farmed or store-bought food (Lee 2018). Yet, Lee found that, contrary to common assumptions, the reliance on wild food plays a major role in recent subsistence strategies: “After fifty years of life settled on a government station, one would expect that Ju/’hoansi subsistence strategies would have shifted decisively from foraging wild foods to reliance on farmed, store-bought, or government-issued food. Surprisingly, this was not the case” (Lee 2018, p.165). Table 3 shows the dependence of various food sources in Tsumkwe town.

Table 3 Percentage of Informants’ Dependence on Various Food Sources: Wild, Domestic, Government, or Commercial* (Town-based observation 2010)

Food Source	Wild-Foraged	Farmed	Livestock	Hunting	Government- Issued	Store-Bought
Primary or co-primary source	54 %	7%	4%	1%	0%	54 %
Secondary	45 %	54 %	30 %	61 %	94 %	45 %

Percentage using source	99 %	61 %	34 %	62 %	94 %	99 %
Not using source at all	1%	39 %	66 %	38 %	6%	1%

*N = 89; 9 informants were not ascertained on this question.

(Lee 2018, p.165)

For the purpose of this thesis the two most important aspects of this table are the numbers concerning wild-foraged food and hunted meat since it requires tracking skills to obtain both these sources. The table shows that over half of the people that were interviewed stated that wild food was of primary or co-primary importance in their diet. With regard to hunting, although 62 percent of informants stated that they did eat *some* meat from hunting, 38 percent did not. Summing up, almost everybody´s diet relies on wild foraged food, but hunted meat serves as nutrition only for a bit more than half the group. These numbers model the realities in Tsumkwe town (Lee 2018, p.165f). However, in order to get a sense for the different living situations first in Tsumkwe and second in remote villages, the latter findings should be compared with Lee´s findings of 2013. Three years after his survey of Tsumkwe he visited remote settlements (30 – 100 kilometers distant from Tsumkwe) to see if the subsistence mix differed from his town-based observations. Table 4 summarizes his findings.

Table 4 Rank Ordering of the Two Most Important Food Sources at Eight Remote Villages

Village*	Gathering	Hunting	Store-bought	Government
Den/ui 30 km. W	1st	2nd		
/Gau!oma** 35 km. W	1st			2nd
N//oma School** 100 km. NW	2nd			1st
N//oma Village 95 km. NW	1st	2nd		
//Karu** 85 km. SE	1st			2nd
//Kau/oba** 25 km. N		2nd		1st
Makuri 30 km. SE	2nd	1st		
De#toa 15 km. N	2nd		1st	

* Distance in kilometres and direction from Tsumkwe.
** Villages with schools and school feeding programmes.
(Lee 2018, p.167)

The results show a high degree of dependence on gathering (foraging of wild food) as a food source (first or second in 7 of 8 villages) compared to the importance of store-bought food (primary in only 1 of 8 villages). These findings correct what was evidently an urban bias in the survey results from 2010. Another significant finding is the increased rank of hunting as a source of food. In 1 out of 8 villages it was quantitatively more important than gathering. And in 3 others it exceeded store-bought food in importance (Lee 2018).

Since the aim of this study is to examine tracking skills of active trackers, Den/ui was chosen to be the main fieldwork location. Den/ui is a village with about 50-60 inhabitants and is about 30km away from Tsumkwe. Additionally, it is one of the villages that exhibit the highest number of active bow and arrow hunters, which fits Lee´s findings from 2013.
The study is based on ethnographic data that has been collected during two fieldwork periods, the first one being conducted from October-November 2017 (five weeks) and the second one from October-November 2018 (six weeks). I have mainly been working with hunters from Den/ui and //Kau/oba. During the first fieldtrip I mainly joined hunters on a three weeks hunting trip. During the second fieldtrip period I lived with one familiy in Den/ui village and joined hunters on their hunting trips which took either half a day or a full day.
A major part of the first fieldtrip was to accustom to the setting. Working in a field where there are no facilities such as electricity, houses and other common infrastructures requires specific preparation. However, knowing the setting and making preliminary arrangements (concerning a research permit of the Nyae Nyae Conservancy, translators, getting an invitation of the indigenous community to come back and work with them, safety issues regarding the remoteness of the field, etc.) I was prepared for a second fieldtrip period.
In the field the two qualitative methods of informal interviews and participant observation complemented each other. On the one hand the data became richer in terms of getting information that might not be observable. On the other the data gained from the interviews supported or explained indistinct observations.
Participant observation concerning tracking activities of several individuals was performed in two different settings. On the one hand I witnessed active hunts that stem from the initiative from individual trackers / tracker teams and on the other hand I witnessed hunts that were part of the evaluation process executed by *CyberTracker.* CyberTracker is a South African NGO that, together with the local San community, developed an internationally accredited tracking skill evaluation system called *CyberTracker Evaluation*. Its central aim is to test individual “track &

signs" knowledge on a wide range of animals (from insects and reptiles to carnivores, ungulate, etc.) as well as trailing skills of tracker teams (chasing an animal by following its spoor). The highest rank of the evaluation is the *MasterTracker Certificate.* Today this certificate is known worldwide and it officially as well as objectively indicates the high level of skill of indigenous trackers. This in turn opens up job opportunities for the Ju/´hoansi. There is a variety of projects that start employing indigenous San trackers specifically the ones that hold a MasterTracker Certificate. Examples of employment possibilities in Namibia are fields such as wildlife management (*MIT* - Namibian Ministry for Environment and Technology, *CyberTracker, Sapelli*), tourism (*Living Hunters Museum*, Safari Hunting), scientific research (studies on biodiversity, archaeological research – *TrackinginCaves*) and anti-poaching management (*Nyae Nyae Conservancy*). Obviously each of these projects has distinctive agendas, however, all of them aim at employing indigenous *Master Trackers* and therefore improve current income situations and furthermore give young people reasons to keep on learning and mastering their traditional tracking skills.

The actual evaluation procedure which hardly differs from "real" hunting situations[6] has been very revealing concerning the subject of this thesis, especially because of the fact that a translator accompanies these procedures (translating Ju/´haonsi into Afrikaans or English). Other hunts that have been initiated by specific individuals also have been enriching in terms of ethnographic data, however, the information flow has been more limited because of the language barrier.

1.3 Tracking among the Ju/´hoansi

a) Ecological environment

Habitat and climate

The Kalahari Desert is a large basin-like plain of the interior plateau of Southern Africa. It spreads over more than the half of Botswana, the eastern third of Namiba, and a small part of northern South Africa and is divided into the northern, the central and the southern Kalahari.

It is a featureless, undulating, sand-covered plain and is characterized by three types of surfaces: sand sheets, longitudinal dunes, and pans (Silberbauer, Logan 2017).

[6] The evaluation procedure has been developed by indigenous San trackers from Botswana, South Africa and Namibia together with *CyberTracker.*

The area of the Nyae Nyae conservancy is about 1000m above sea level, like almost all the area of the Kalahari Desert. With a highly variable annual rainfall, there are no permanent rivers flowing through the area. After exceptionally heavy rains scattered flooded areas transform into large pools or pans which may hold water for up to six months after the rains have stopped. The area is characterized by broad-leaved trees, shrubs, acacias and other thorny species. There are several species of shade trees, some growing to over 15 m in height. Open woodlands with abundant deep shade are common and are contrasting the sparsely wooded, open grassy plains that characterize most of the Kalahari Desert.

Within the Nyae Nyae area the Ju/´hoansi are provided with an unlimited supply of edible species, firewood and a wide variety of woods for making weapons, tools and domestic articles. The climate is characterised by hot summers with temperatures of up to 45°C and a four-month rainy season. Winters are moderate with temperatures of up to 25°C without rainfall. At night temperatures may drop below 0°C though (Lee 1978).

Nyae Nyae, steppe (Ludwig 2017a)

Nyae Nyae, veld (Ludwig 2017b)

Nyae Nyae, water pan (Ludwig, 2017c)

Nyae Nyae, dry water pan (Ludwig, 2017d)

Fauna

There is an immense number of arthropods, reptiles, amphibians, ground-feeding birds, mammalian predators and herbivores within the Kalahari region. There are around forty species of larger mammals in the Nyae Nyae area. Of particular importance as game are kudu, gemsbok, wildebeest, warthog, antbear, porcupine, steenbok, duiker and spring-hare. Other species that are today killed less often are giraffe, eland, roan antelope and hartebeest. Major African predators including lion, leopard, cheetah, wild dog and two species of hyena are all represented in the area. The smaller carnivores include caracal, wildcat, genet, jackal and several species of mongoose.

Bird life is amazingly rich and varied. Around eighty species have been recorded in the area. Ostriches provide the Ju/ʼhoansi with ostrich-egg shells which are used as water containers and as material for making jewellery.

Some twenty-five species of reptiles and amphibians are known. Of invertebrates, there is an abundance: scorpions, spiders, ticks, centipedes and millipedes, as well as several species of

insects. Among the latter is the poison beetle which is the source of the hunter´s arrow poison (Lee 1978).

b) What is tracking?

Tracking can be defined as the process of recognizing and following the spoor of an animal. This, in a first step, includes the identification of distinct footprints. Depending on the quality and consistency of the footprints trackers can detect aspects such as sex, age, pace and direction by reading them. Even particular individuals, animals as well as humans, can be identified by experienced trackers.

Trackers are also able to interpret the animals´ activities in order to understand and predict their movements. To do so they try to visualize the movements of the feet that created the various disturbances of the ground in and around the imprint.

Nyae Nyae, female leopard (Ludwig, 2017e)

Nyae Nyae, giraffe (Ludwig, 2017f)

Regarding the variety of undergrounds and terrains within the northern Kalahari, tracking, however, requires much more skills and knowledge than recognizing and following footprints.

Apart from the actual ground spoor, tracking involves other crucial aspects that indicate the presence of an animal. Among them are vocal and other auditory signs, scent, vegetation spoor, feeding signs, urine, droppings, saliva, pellets, shelters and dens, skeletal signs, circumstantial signs such as weather, time of the day or the time of the year (Liebenberg 2013).

The matter of ageing of tracks and signs is furthermore a very delicate one. The following description points out to some crucial aspects that only very experienced trackers can handle with reasonable accuracy:

> *"Signs that involve rapid moisture loss may give a fairly accurate indication of the age of the spoor when it is still very fresh, such as droppings that are still slimy or sticky, or fresh urine. Saliva on bushes where an animal was feeding also indicates that the trail is very fresh. When an animal has been drinking at a waterhole, splash marks will be very fresh, since the water evaporates quickly. If it is still early in the morning, and the animal's footprints are superimposed on top of fresh tracks of a diurnal animal, such as a small bird, then there is a reliable upper limit to the age of the tracks. If the animal was resting in the shade, a fairly accurate estimation of the position of the sun at that time can be made. When a very strong wind is blowing, tracks may rapidly lose definition, so clear, distinct footprints will be very fresh"* (Liebenberg 2013, p.67).

Obviously the tracker needs to have a complex knowledge of the animal´s behaviour during different times of the day as well as within different periods of the year. He needs to know its individual behaviour, its group behaviour as well as specific aspects of encounters with other species.

There is a broad spectrum concerning the application of tracking skills. Hunters might not only use them in order to literally trail game but also to protect themselves from dangerous animals, or to watch for helpful signs from other steppe dwellers. Let us have a look at three concrete examples.

<u>Tracking an aardvark</u>

Tracking or *trailing* an animal is a common procedure of hunters when they are actively looking for prey. The following example shows that trackers need to accumulate broad knowledge concerning the physiological composition of the animals surrounding them. They also have to be able to identify tracks and signs within different geological areas featuring different soil conditions as well as a diverging flora.

"Half way up the mountain I found a small rock that was freshly displaced, the only sign that an animal had passed that point. I have been following an imaginary route up the mountain, with no signs of disturbance at all. I was tracking an aardvark over rocky terrain, where footprints are difficult and sometimes impossible to see. The terrain in the Klein Karoo is mountainous, with sandy flood plains in the valleys. In the flood plains it is relatively easy to follow tracks, but as soon as you go up the slope onto the side of a steep hill or mountain, it becomes very rocky, with barely any sand at all to leave tracks. The aardvark has thick, strong claws, which makes it easy to follow on sandy ground, but the claws may also leave feint scuff marks on rocky surfaces, especially if there is a thin layer of wind-blown dust collecting in rocky crevices. Tracking the aardvark in the sandy floodplain made it possible to get a general direction as it headed up the side of the mountain, but as soon as it walked onto the rocky ground, its footprints disappeared. The aardvark has short legs and tends to avoid going over boulders, so I could visualize the most likely route it followed amongst the boulders. Following the easiest path in the general direction up the mountain slope, I could find pebbles that were freshly displaced and the occasional scuff mark on a flat rock. But at one point I completely lost the trail. Looking up at the steep mountain side, I visualized a path going up to the top, and by following the imaginary path, found the one displaced rock, which could have been a sign of the aardvark, but I was not sure. But it was the only sign, so working on the assumption that it was the aardvark, heading up to the top of the mountain. As the ground started to flatten at the top, with sandy areas, I found some fresh tracks where the aardvark was digging for termites. The trail went down the other side of the mountain, and down into the next valley where footprints were once again easy to follow in the sandy ground. Once again it headed up the next slope, where I lost the trail, but were able to follow an imaginary path over the rocky, boulder-strewn mountain side. On the top, where there was sandy soil on the flat plateau, I again picked up the trail where it was digging for termites" (Liebenberg 2013, pp.82).

Aardvark (Alongi 2017)

Trailing the aardvark within this particular area requires a lot of endurance. Louis Liebenberg is sharing his experience when he states that "*nevertheless, when an animal changes direction in an unexpected way, and there are no scuff marks or displaced pebbles to indicate the path it followed, it can simply become impossible the follow the trail. It then requires a lot of persistence to search all the possible routes it may have followed until you find fresh tracks in a sandy area*" (Liebenberg,2013, p.109).

Springbok as an indicator for big cats

Imagine a tracker observes a springbok herd from 20 meter distance. Most members of the herd look into the same direction. The tracker cannot see what the herd is looking at. His gaze is restricted by trees and thick bush. Consequently he is checking the direction of the wind knowing two crucial facts. First animals are able to smell predators that are approaching upwind. Second they have to trust their visual senses when checking all other directions. The herd is located downwind. Therefore the tracker knows that if they do not stop starring into one particular direction some predator must be hiding in the bush. Knowing the springbok´s enemies he can predict that one of the following animals must be close: lion, leopard, cheetah, hyaena, african wild dog, jackal or caracal.

Springbok, Etosha (Ludwig, 2017g)

The jackal´s call

Another aspect of tracking are auditory sounds. The jackal´s call for example is not only a warning sign but can also be a crucial lead for the hunter.

> *"Kalahari hunters are able to interpret the nocturnal calls of jackals. When a jackal gives a long, smooth howl that diminishes in loudness (WHAaaa...), then it is simply maintaining contact with other jackals. If, on the other hand, it gives a shuddering howl,*

diminishing in loudness and ending in a soft cough (WHA-ha-ha-ha...umph), then it is following the spoor of a scavenger or a large predator. Kalahari trackers explain that it "stutters" because it is afraid. If the jackal gives the shuddering howl only once, then it was following a hyaena spoor. It has left the spoor after the first call because it will not get much meat by following the hyaena. If, however, it repeats the shuddering howl several times, then it is following the spoor of a leopard or a lion. It continues to follow the spoor because it knows that the spoor will lead to a lot of meat. Apart from warning the hunters of the danger of lions at night, jackal calls may indicate the recent movements of predators and scavengers, which may be taken into account when planning hunting strategy" (Liebenberg 2013, pp.82).

Systematic and Speculative Tracking

The process of tracking can furthermore be differentiated concerning individual tracking experiences and skills as well as concerning different tracking strategies. The distinction can be subsumed by *systematic* and *speculative tracking*.

Systematic tracking

*"Systematic tracking involves the systematic gathering of information from signs, until it provides a detailed indication of what the animal was doing and where it was going. In order to reconstruct the animal's activities, the emphasis is primarily on gathering empirical evidence in the form of spoor and other signs" (*Liebenberg 2013, p.73).

This tracking strategy is a very down-to-earth approach that does not allow any uncertainties and strictly relies on confirmable evidence as well as on repeated experiences of similar situations. No new facts will be predicted. In that manner, systematic tracking has a very low risk of failing, meaning losing the spoor. The disadvantage of this approach though is that, although it may be very efficient in easy soil conditions, it can be very time-consuming in difficult terrain (Liebenberg 2013).

Speculative tracking

"Speculative tracking involves the creation of a working hypothesis on the basis of initial interpretation of signs, knowledge of the animal's behaviour and knowledge of the terrain. With a hypothetical reconstruction of the animal's activities in mind, trackers then look for signs

where they expect to find them. The emphasis is primarily on speculation, looking for signs only to confirm or refute their expectations" (Liebenberg 2013, p.73).
Following this approach trackers follow an imaginary spoor. While visualizing the animal they are constantly checking different possibilities of the animal´s path. Although speculative tracking may in general save much time trackers are confronted with a much greater risk of losing the spoor and much time may be wasted in finding it again (Liebenberg 2013).

After more than 30 years of fieldwork with the Kalahari San trackers Louis Liebenberg concludes that *"usually tracking conditions will vary between conditions that favour either systematic or speculative tracking, requiring an optimal combination of both types of tracking*" (Liebenberg 2013, p.75).

c) Tracking procedure

The focus shall now be on the procedure of tracking itself and on the various activities of the trackers involved. In November 2017 I could witness a kudu hunt in the Nyae Nyae Conservancy performed by a hunters´ collective consisting of three hunters, /Ui G/aq'o, /Ui /Kunta and #Oma Daqm. The descriptions of the tracking procedure stems from the witnessed hunt. Literature research on other hunts confirmed the described observations.

I) Looking for an animal

On a cloudy day in November 2017 three hunters left their camp at 7 am to go for a hunt.
First of all they had to come up with common intentions concerning the trip in order to be functional as a team. They wanted to chase animals that can be killed by their bows and arrows. In that sense they left all other weapons and hunting devices behind (e.g. the "/Ui" – hunting tool to catch springhare). Apart from that it did not matter which kind of animal it would be.
Once they started the procedure the following questions were taken into account:

Are there animals around us that are visible to the naked eye?
Where do I see tracks?
How fresh are these tracks?
What is the weather like right now?
What time of the day is it?
What time of the year is it?
What is the foreseeable behaviour of specific animals concerning the present conditions?

All three trackers where constantly glancing into the distance to check if there are animals around, looking down to check different kinds of ground spoors and gazing up to the sky to check if birds might be giving any signals (e.g. circling vultures are indicators for fresh prey killed by a predator). They were also capturing all the auditory sounds around them - bird´s twittering, cracking branches, roaring, howling and stamping.
After three failed attempts to shoot an animal they found a fresh male kudu spoor which localized the *problem* that had to be solved.

II) Applying tracking knowledge

Every hunt is built on a series of individual as well as collective experiences and knowledge. In other words the trackers knowledge is to some extent result of their socialization. Having found a fresh kudu track the hunters integrated their collected data into a broader set of knowledge that consists of already known facts. In that sense they were able to ask the following continuative questions:

What do I know about kudu behaviour in general?
Does it move in herds?
Can it generally be killed by a poisonous arrow?
In which case would it attack me?
Is it able to smell me?
Is there a difference in male and female behaviour?

Where is this particular animal going to?
Is it walking around on its own?
Is it running or slowly walking? And why?
Are there predators around stalking it like I do?

III) Interpretation of signs

The combination of already known facts on kudu behaviour in general and new data on one particular individual resulted in a working hypothesis:
Concerning the time of the day, the group behaviour of kudus in general, the individual behaviour of kudus, the sex of this specific kudu, the obvious tracks and signs, the kudu might have walked north-east from here about 15 minutes ago.
Reaching the level of establishing this hypothesis was only possible because more than one hunter was involved. Clearly it was a collective process advanced by the three hunters that were actively engaged. Concerning the spectrum of general knowledge about animal behaviour it becomes obvious that also the entire hunter-gatherer community that perpetuates all kinds of hunting activities for many generations played a major role within this particular trailing event.

IV) Continuous conjecture and refutation by implicating new signs

As a next step the trackers were following the spoor constantly checking if the hypothesis they established can be true. To do so they were applying what has been described in point II) and III). Again, it is important to notice that the whole process was executed parallel and cooperatively by three hunters. There was a constant discussion whether the current hypothesis has to be refused because of divergent evidence or not.

V) Drawing conclusions

Conclusions were drawn repeatedly. Every time new evidence was revealed the hunters collectively decided on the next path or direction to follow. To do so they had to reach consensus. In tracking the procedure of reaching consensus is very present. There is no form of hierarchy during the process of decision making – in terms of deciding which direction to go to in order to follow the animal. Yet consensus is related to the actual and obvious evidence. Together as a team the trackers tried to find out where the animal went. Throughout the process the conclusions were not based on social hierarchies or other cultural norms among the members but rather on actual evidence.

Because of the increasing amount of evidence the working hypothesis obviously got restated several times during the trailing process and accordingly became stronger the closer the trackers got to the actual animal. In the end it was /Ui G/aq'o, who shot this specific kudu:

Nyae Nyae, kudu hunt (Ludwig, 2017)

1.4 Tracking and science

In order to understand the connection between *tracking* and *science* we need to focus on the reasoning processes that are being applied as well as on the procedural steps that trackers and scientists are engaged in. A detailed analysis finally shows that tracking and sciencing are, in their essence, congruent ways of dealing with experience.

a) The reasoning process in tracking

At this point we will focus on cognitive operations of the individual trackers. As already mentioned, there are two approaches in tracking: systematic and speculative tracking. Systematic tracking does not allow any uncertainties and strictly relies on confirmable evidence as well as on repeated experiences of similar situations. No new facts are to be predicted. In speculative tracking, however, the cognitive skill of speculation is required since the tracker is following an imaginary spoor.

These two approaches require clearly distinct reasoning strategies – inductive-deductive reasoning on the one hand and hypothetico-deductive reasoning on the other.

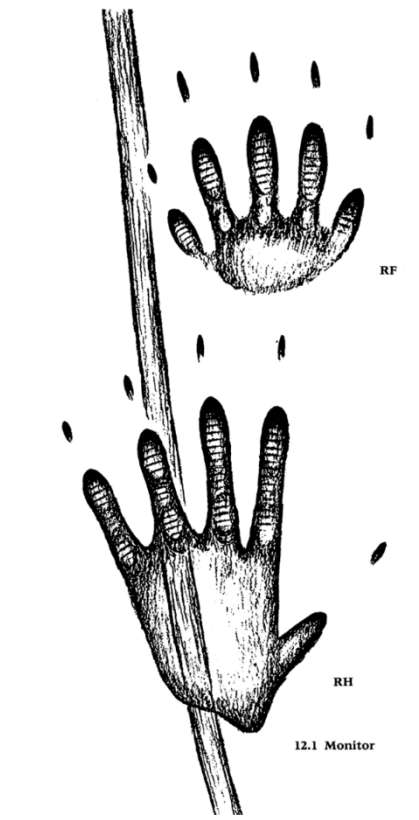
Inductive-deductive reasoning is the strategy applied when performing systematic tracking.

It *"(…) is based on direct observations and ordinarily recognizes apparent regularities in nature. Inductive empirical knowledge, therefore, is based on a trial-and-error accumulation of facts and generalizations derived by simple enumeration of instances. It does not explain observations and cannot result in the prediction of novel facts. It can only predict particular observations similar to those that have been observed in the past. Predictions are therefore simply based on experience"* (Liebenberg 2013, p.21).

The cognitive procedure shall by exemplified by the identification of a monitor lizard´s tracks.

Observation	The tracker recognizes a particular spoor, which is marked by a long line from the hind to the front foot;
⬇	
Recognition of regularities	All monitors that have been observed drag their tale on the ground;
⬇	
- - - - - - Generalization - - - - - - -	All monitors produce tracks that are characterized by a long line from the hind to the front foot;
⬇	
Prediction	Particular tracks have been spotted which exhibit the specific characteristics of the long line between hind and front foot → it must be a monitor´s track (generalization from experience);
⬇	
Checking through observation	Trailing the animal to clarify the prediction.

This cognitive process can be described as a trial-and-error process. Starting with a simple observation the tracker is looking for apparent regularities in nature. He comes up with a generalization which gets constantly checked through new observations.



(Liebenberg 1990, p.85)

Monitor Lizard, Caprivi Region

Hypothetico-deductive reasoning on the other hand is the strategy applied in speculative tracking. It *"(…) involves the explanation of observations in terms of hypothetical causes. The hypotheses may be used as premises in conjunction with initial conditions from which certain implications may be deduced. Some of the implications deduced in such a way may include novel predictions. Hypothetico-deductive reasoning in creative science is an exploratory dialogue between the imaginative and the critical, which alternate and interact"* (Liebenberg 2013, p.21). Another example by *Karel Kleinman tracking a lion* (Liebenberg 2013, p.72) shall help understand the process.

Observation	Observation: the tracker recognizes tracks of a male lion that got up, ran up to some dunes, stood still and then trotted off;
- - - - - - Hypothesis - - - - - - (= explanation of observation)	The lion must have run up to the dunes because it listened to something in the distance - not because it was chasing another animal (= creative imagination); explanation: the lion must have heard a female in the distance;
Novel fact (= prediction based on deduction from hypothesis)	It was a lion that stopped because of the call of a female lion that was on heat;
Checking back through observation	The tracks show that the lion trotted off to find the lioness; farther the lion encountered another male (and the female lion); the two males had been fighting over the female; in the end one of the males went off together with the female;

The idea of the lion running up to the dunes because it listened to something in the distance is the hypothetical cause of the observation. The tracker uses his creative imagination to explain the situation:

> "The interpretation of (…) tracks (is) based not on the evidence of the tracks alone, but also on the trackers' knowledge of animal behaviour, on the context of the tracks in the environment, and on the time of the day. Since tracks may be partly obliterated or difficult to see, they may only exhibit partial evidence, so the reconstruction of these

> animals' activities must be based on creative hypotheses. To interpret the footprints, trackers must use their imagination to visualize what the animal was doing to create such markings. Such a reconstruction will contain more information than is evident from the tracks, and will therefore be partly factual and partly hypothetical. As new factual information is gathered in the process of tracking, hypotheses may have to be revised or substituted by better ones. A hypothetical reconstruction of the animal's behaviours may enable trackers to anticipate and predict the animal's movements" (Liebenberg 2013, p.20).

The approach of hypothetico-deductive reasoning that has been sketched here can also be seen as the trackers epistemological principle which, in other words, is their specific way of dealing with experience and knowledge. In general an epistemology is a specific way of seeing and explaining the world and all the phenomena one is surrounded by. In case of tracking the epistemology is *science*. Together with the epistemological principle there are the ontological, the theoretical and the methodological one. The sum of these principles, the paradigm, explains a specific viewpoint on any phenomenon. Consequently all actions that one takes follow this fundamental components of one´s perspective. The next chapter provides a detailed depiction of the trackers´ type of epistemology.

b) What is science?

In order to draw a connection between tracking and science one has to come up with a definition of science. As a first step it shall be pointed out that the term "science" is literally not appropriate if we want to understand the very essence of scientific knowledge production. *Science* is not an entity as such yet very often gets confused with *academia*, which is an actual institution that is attached to factual professions. Instead the word may be appropriately used as a verb, so one *sciences, "deals with experience according to certain assumptions and with certain techniques"* (White 1949, p.3). Precisely, Leslie White describes sciencing as one of two ways of dealing with experience. The other one, he states, is art. The way these two approaches differ from each other is that art is looking for particularity whereas science is searching for laws and regularities.

> "The purpose of science and art is one: to render experience intelligible, i.e., to assist man to adjust himself to his environment in order that he may live. But although working towards the same goal, science and art approach it from opposite directions. Science deals with particulars in terms of universals (…). Art deals with universals in terms of particulars" (White 1949, p.3). [7]

Hence *sciencing* means to look for laws and regularities in nature by applying certain assumptions and certain techniques. The intention of defining laws and regularities of nature presupposes three suppositions on an epistemological level: the principle of objectivity, logic and systematics. These assumptions hence implicate the following techniques:

Assumption	Techniques
sciencing is objective	Verifiability in practice Testability and falsifiability Objectivity and empiricism
sciencing uses logic	Valid arguments Sound arguments Logic and semantics Deductive and arguments Logic fallacies
sciencing is systematic	Define the problem Review the literature Formulate the hypothesis Collect the data Draw the conclusion

[7] A detailed description of what is meant by the distinction of sciencing and arting follows in chapter three.

Sciencing is objective

To get closer to the understanding of objectivity Lett presents four kinds of knowledge statements. He contrasts propositional with emotive statements and subjective with objective statements.

Propositional and emotive statements

> "(…) Whereas propositional statements assert factual claims that are either true or false on the basis of the evidence, emotive statements assert value preferences that are either attractive or unattractive on the basis of psychological orientation" (Lett 1997, p.28).

The distinction can be made tangible with the help of an example. It is imaginable that a person would disagree with the value assertion that "motherhood is something wonderful" (for example by arguing that motherhood is exhausting on a physical and psychological level) but no reasonable person could disagree with the factual assertion that "the earth is a sphere".

Subjective and objective statements

> "If we are being subjective, we take our self as the relevant subject matter and focus on our own states of thinking and feeling. If we are being objective, we attempt to transcend ourselves and approach the question at hand without prejudice, illusion, or distortion. From a subjective perspective, our own thoughts and feelings are everything; from an objective perspective, they are entirely irrelevant" (Lett 1997, p.29).

Let us imagine getting confronted with the following statements:
There are ethnic groups that do not exhibit any concept of "childhood" within their societal structure – propositional assertion.
It is cruel that within specific ethnic groups children are not able to act out their childhood – emotive assertion.

From a *subjective point of view* we would now ask ourselves "Do I believe this?" in response to the propositional assertion, and "Do I agree with this?" in response to the emotive assertion.

From an *objective point of view* we would ask ourselves "Is this true?" in response to the propositional assertion, and "Is this right?" in response to the emotive assertion" (Lett 1997, p.29).

These examples show a clear cut between two different initial positions.
First, reactions to assertions can start with the phrases *I believe* or *I agree*. In this case one argues out of a subjective point of view.

The other possible reaction to an assertion would be to ask whether the capture of an experience is true – in terms of empirically provable – or right – in terms of analysed out of an objective stance and therefore testable/ falsifiable. Here the initial position would be an objective viewpoint.

Summed up, there are four kinds of knowledge statements:

	Subjective	Objective
Propositional	I believe or disbelieve	It is true or false
Emotive	I like or dislike	It is good or bad

(Lett, 1997, p. 31)

Now what does it mean to implicate the epistemological principle of objectivity into actual scientific operations? James Lett states that the following aspects have to be considered:

Public verifiability in practice

Comparing models and accounts to one another to see which one fits the observations best;

Testability and falsifiability

Constantly checking (= trying to falsify) a model or account against new observations.

Empiricism

All hypotheses and theories are tested against observations of the natural world rather than resting solely on intuition or a priori reasoning;

(Lett 1997, pp.32)

Objections against objectivity?

Within the academic community there is still a long-lasting debate on whether it is generally possible to generate objective data or not or, in other words, on whether it is possible to define statements as *true* or *false.* Opponents argue that science claims to be free of objective bias, error, or fraud, that it claims absolute certainty and denies that the perception of reality is a process of active interpretation rather than of passive reception.

The debate concerns the epistemological level and is therefore, by its nature, unsolvable, meaning that the split between humanism and science is one of everlasting endurance because of the mutual denial on an epistemological level.

Nevertheless James Lett tries to break these well-established objections open. "Science", he states, "claims to be a superior approach to propositional knowledge and to be better able to detect and correct subjective bias, error, and fraud than any of its competitors (…) [It] claims provisional certainty based upon a process of unrelenting sceptical inquiry in which no premise or assumption is ever considered to be beyond question" (Lett 1997, pp.41).

Sciencing uses logic

"Logic can simply be defined as a set of rules governing the validity of inference. The principles of logic are used to evaluate the legitimacy of (…) arguments. An *argument* is a group of statements in which one (the conclusion) is said to follow from the others (the premises). The premises constitute the evidence or reasons from which it is claimed that the conclusion can be derived. The premises are identified, either implicitly or explicitly, by words or phrases such as "since", "because", "for", "as" or "inasmuch as". The conclusion is preceded, either implicitly or explicitly, by words or phrases such as "therefore", "hence", "so", "thus" or "as a result". Determining whether or not the conclusion can be inferred from the premises is the task of logical analysis" (Lett 1997, pp.57).

A logic scientific operation furthermore meets the following criteria:

<u>Valid arguments</u>

Argument one:

All foragers hunt with blow pipes.

The Ju/´hoansi are foragers.

Therefore, the Ju/´hoansi hunt with blow pipes.

Argument two:

All foragers hunt with blow pipes.

The Yagua people hunt with blow pipes.

Therefore the Yagua are foragers.

Argument one is valid, meaning that the form or composition of the argument is constructed logically. Argument two on the other hand is invalid since its form does not meet logical criteria. Yet, and that might be surprising, both arguments come to a false conclusion. That is the case because validity is a mere measure of the arguments form. Valid arguments can still be composed of false premises which is the case in both arguments. "All foragers hunt with blow pipes" is a false premise. Foragers hunt with either blow pipes, bows and arrows, fishing rods or other hunting tools, depending on the ecological conditions of their habitat. The Ju/´hoansi, based in the Kalahari Desert of northern Namibia use hunting tools such as bow and arrow, /Ui[8] and trap devices.

Although some individuals among the Yagua do still hunt with blow pipes, they are not foragers but horticulturalists.

Moreover "the fact that an argument is valid is not [a] sufficient justification for accepting its conclusion. (…) An additional criterion is required before the argument can be regarded as compelling, and that criterion is one philosophers call logical soundness" (Lett 1997, p.61).

<u>Sound arguments</u>

All the premises are *assumed* to be true.[9] Therefore a conclusion is tentative once the argument is *sound.*

"The rule of logic requires that all arguments be sound, but identifying sound arguments requires both the analysis of logical validity and the investigation of empirical fact" (Lett 1997, p.61).

[8] Three to four meters long wooden stick for catching springhare, porcupines, aardvark and other animals living in dens.

[9] Note: In science we can never *prove* that a hypothesis or theory (the premises) are true.

Semantics and empirical fact

All premises as well as the conclusion must have explicit and unequivocal meanings.

Argument:

If bow-and-arrow hunting is a particularity of San Bushmen, then bow-and-arrow hunting should be supported by the international community.

Bow-and-arrow hunting is a particularity of San Bushmen.

Therefore bow-and-arrow hunting should be supported by the international community.

The argument is definitely valid because the form or composition of the argument is logically constructed. But telling whether the argument is sound, so whether the premises are true or not is much more difficult. To do so an explicit definition of the terms used in the argument is required. What exactly is meant by "particularity" – do we speak about an "innate ability" or is it "a cultural characteristic the San Bushmen get financial governmental support with"? And what about the term "supported" – do we talk about support in terms of "hunting rights and laws" or do we talk about support in terms of "tourism marketing"? And whom exactly are we talking about when we say "San Bushmen" – modern San communities? Historical communities? San people in Namibia, Botswana or South Africa?

The ambiguous meanings of the applied terms and notions obviously do not enable a semantically logical argument.

Deductive arguments

"A deductive argument is one in which the conclusion can be inferred from the premise(s) with absolute certainty (i.e., the premises necessarily entail the conclusion)" (Lett 1997, p.62).

Example of a deductive argument:

Since all humans are mortal, and I am a human, then I am mortal.

Logic fallacies

Furthermore James Lett mentions the following logic fallacies: non sequitur, begging the question, fallacy of equivocation, fallacy of composition, fallacy of division, genetic fallacy, false dilemma, straw argument, ad hominem, appeal to ignorance, appeal to authority.[10]

Sciencing is systematic

James Lett (1997) defines "the scientific method" by listing the following six systematic steps:

1) Define the problem: The goal when sciencing is to produce propositional knowledge. To do so the scientist needs to determine the realm of the knowledge to be accumulated.
2) Review the literature: Going through already existing knowledge on a specific topic gives the scientist the chance to learn from successes and failures from other colleagues.
3) Formulate the hypothesis: Scientists are looking for explanations of observed phenomena. Therefore they establish hypothesis, which are used as premises. Testable predictions can be deduced from the latter (the hypothesis, however, will always be tentative).
4) Collect the data: The exact procedures and techniques vary considerably from one scientific discipline to another, but what they all have in common is that they must be publicly verifiable and that the particular technique employed must be capable of either confirming or disconfirming the deduced predictions.
5) Draw the conclusion

   Confirm or deny the hypothesis: "The goal of any scientific discipline is to uncover the operative principles that determine cause and effect within its domain of inquiry and then to articulate those principles in the form of predictive laws. To achieve that goal, science follows a [specific] process, using deductive logic to reach conclusions about the results of hypothetical tests" (Lett 1997, p. 85f).
6) Publish the results

   In order to produce scientific knowledge and to correct error, bias or fraud within the process public verification is indispensable. Sciencing is a collective process that hence can only be fully realized by a community rather than by individuals (Lett 1997, pp.82ff).

[10] Exact definitions of these logic fallacies can be found in Lett 1997, p. 63 to 67.

However an important supplement to this outline of the scientific method is the following:

> "They are not sufficient, because it is possible for scholars to adhere closely to all six procedural steps and still make no contributions to scientific knowledge whatsoever. (…) All they have to do to ultimately fail is abandon the epistemological principles of objectivity and logic" (Lett 1997, p. 86).

Reasoning process

Applying the techniques mentioned above, especially 2) – 4), means to engage in a specific reasoning process. This process is based on three operations, namely *to hypothesise, to theorize* and *to look for laws.* Each of these processes happens on a different level. A hypothesis can be established by one individual person in a relative short time span whereas developing a theory is based on a collective process of (re)formulating and testing a hypothesis over and over. Basically the process one engages in when establishing a theory is based on the same one when creating a hypothesis. Yet the more and more evidence one can find for his/her hypothesis the stronger it gets until it reaches a certain strength to finally become a theory. Therefore a theory needs much more time and effort to be developed. Defining a law can be understood as separate operation. It is the creation of a metaphor for certain regularities that can be observed in the natural and cultural environment. Coming up with a scientific law is only possible if the first two steps – establishing hypothesis and theory – have already been proceeded. Thus even more people and time are required if we look at it from an analytical perspective within the sociology of scientific knowledge production.

1) *Define the problem*
2) ***Review the literature***
3) ***Formulate the hypothesis***
4) ***Collect the data***
5) ***Draw the conclusion***
6) *Publish the results*

The process of establishing a hypothesis and consequently a theory can be called *creative science* (Liebenberg, 2013). Einstein´s graph pictures the inherent procedure.

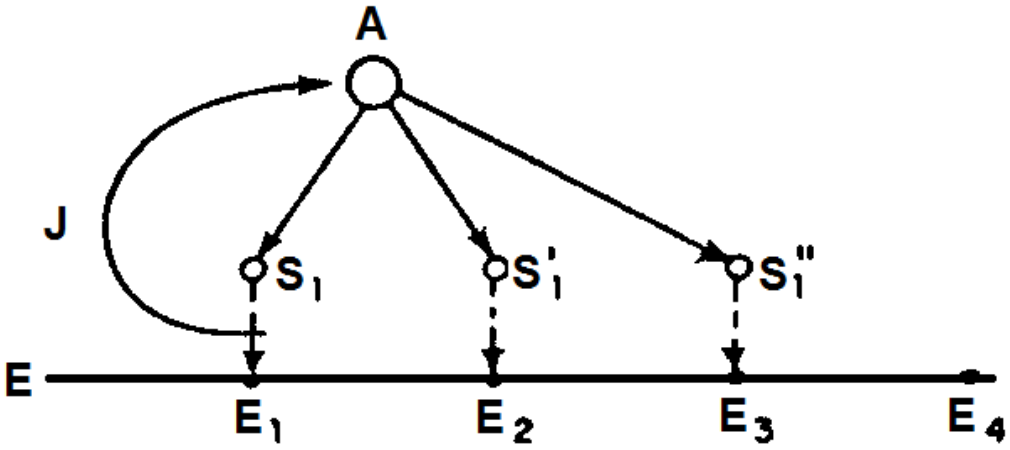


Figure 1. Einstein´s model for constructing a scientific theory (Holton 1986, p. 31)

The circular process of constructing a theory starts with a variety of sensual experiences (E). Einstein explained that "science is the attempt to make the chaotic diversity of our sense-experience correspond to a logically uniform [unified] system of thought" (Holton, 1986, p.32). The chaotic diversity of "facts is mastered by erecting a structure of thought on it that points to relations and order" (Holton 1986, p.31).

To do so, to erect a structure of thought, one draws an intuitive connection from E to A, whereas A is the systems of axioms. This leap, which is a creative imagination of the mind is called "J" in Einstein´s model. Coming from E to A by J is a non-logical (not to be confused with the term *illogical*) path.[11]

The trail from A to S illustrates the deduction of certain assertions, which is a logical one. Starting from the hypothesis and axioms which were proposed, the necessary consequences or predictions are derived. In other words: if A, then S, S', S''.

In a final step S is checked against E, meaning the predictions are tested against the experience. If corresponding observations can be found the predictions have been borne out, providing confidence in starting the circle anew, from E to A to S to E (Liebenberg 2013, pp. 174).

The following scheme finally summarizes the fundamental aspects concerning the definition of science:

[11] At this point we see that science *uses* logic. Therefore the phrase "science is logic" – as used by James Lett (1997) – is by definition incorrect.

Figure 2. Aspects of scientific procedures

c) Congruent ways of dealing with experience

The analysis of the most fundamental aspects of sciencing on the one hand and of tracking procedures executed by Ju/´hoansi trackers in the Kalahari Desert on the other exhibit striking congruency. The observations reveal strong parallels between the criteria of both the scientists´ and the trackers´ operations as well as of the underlying reasoning processes.

Criteria of scientific and tracking operations: systematics, logic and objectivity

James Lett defines "the scientific method" by listing six systematic steps. I argue that this list of tasks is almost congruent with the descriptions in chapter 1.1.3.c which depicts the *tracking procedure* being split into several sequences. However, two slight modifications of Lett´s list are necessary. First, instead of the aspect of "reviewing the literature" it is more precise to use the phrase of "reviewing pre-existing data and hypothesis". As for hunter-gather societies knowledge is passed on orally (not through written text). And secondly, "collecting *new* data and testing hypothesis" is much more precise than Lett´s phrase, which simply is "collect the data". It concerns the step from S to E in Einstein´s model of constructing a scientific theory (Holton 1986). At this point it is not sufficient to just collect *new* data; rather the scientist needs to constantly test the predictions against experience.

Apart from these adjustments the systematic steps of scientists on the one hand and of trackers on the other appear to be consistent:

Academic scientists	San trackers
defining the problem	direct observation in terms of "observing the problem"
reviewing pre-existing data and hypothesis	application of tracking knowledge
formulating the hypothesis	interpretation of signs in terms of creative hypothesis
collecting new data and testing hypothesis	continuous conjecture and refutation by implicating new data
drawing conclusion	drawing conclusion
publish the results	Sharing knowledge within community (e.g. by storytelling)

The second aspect that reappears in both analysis is the principle of logic, in other words of consistent and rational reasoning. If there is no evidence that the chosen direction of following the animal is true then the tracker has to turn back and take another path. This logic decision-

making process is a very down-to-earth approach. It is not necessarily a complex one but a crucial one which is required during the whole tracking procedure.
The principle of objectivity is also applied by both the trackers and the scientists. Trackers are operating with propositional statements, meaning they are operating with factual statements that are either true or false on the basis of the evidence.[12] In that spirit, trackers are constantly testing whether their observations are true or not. The crux of the matter is that all observations are immediately tested and falsified if required. Assumptions such as *these are kudu droppings* or *the kudu was lying in the shade at that point* can either be true or false, nothing in between. It illustrates the objective approach of the trackers.

What has been shown in this chapter is the fact that an ethnography of cognitive processes is needed to grasp and understand the core of the trackers´ activities. Furthermore the congruency of tracking and sciencing has been shown. Both modern academic science as well as tracking are based on creative science and the faculty of coming up with hypothesis on an individual level and with theories and laws on a community level. As for now also the criteria of both operations, being systematics, logic and objectivity, seem to be corresponding.
Einstein´s model of *constructing a scientific theory* therefore does not only account for academic scientists such as for himself but rather also for the reasoning processes of hunters while tracking.
The hypothesis that arises from these observations is that the faculty of hypothetico-deductive reasoning itself is not bound to either science or tracking. It is not bound to a specific institution or profession. Rather it is a capability that characterizes human beings as such. Revealing the hypothetico-deductive reasoning while tracking in turn indicates the universality of the latter. Why this is the case will be shown in the following chapter.

1.5 Tracking and the theory of the origin of science

Louis Liebenberg has been working with San Bushmen of Southern Africa for more than three decades. He extensively focused his inquiries on tracking and hunting. He himself was taught tracking skills by San trackers and applies them ever since. Combining the experience when

[12] Whereas "(…) emotive statements assert value preferences that are either attractive or unattractive on the basis of psychological orientation" (Lett 1997, p.28).

performing tracking himself, data from fieldwork with San hunter-gatherers and a theoretical background in physics and applied mathematics brought him to the conclusion that the origin of the scientific modus operandi can be traced back to tracking.

Bringing into focus the questions of when and why people started *to science* he puts the whole debate about scientific knowledge production comprehensibly into the light of evolution.

In his book "The Origin of Science" he points at the very beginnings of scientific knowledge acquisition, starting with the hunter-gatherer mode of life. He comes up with a reasonable theory:

> "I am (…) proposing an evolutionary definition of science. Scientific reasoning is an adaptation of an organism (*Homo sapiens*) that evolved through natural selection, thereby increasing its chances of survival. And as far as we know, humans are the only species that evolved the ability to develop science. Creative science is essentially a product of the human mind that allows humans to interact with reality in a way that increases our chances of survival" (Liebenberg 2013, p.138).

Liebenberg pictures science as a unique skill of Homo sapiens that evolved to secure his survival. His assumption is getting more precise when sketching science on a fundamental level by differentiating between empirical knowledge and creative science - the first one being based on inductive-deductive reasoning and the latter one on hypothetico-deductive reasoning.

Inductive-deductive reasoning can be understood as a trial and error procedure. Plant-gathering can be linked to this kind of approach:

> "Knowledge acquired in this way can be passed on from one generation to the next. Food-gathering does not require imaginative theories to explain plant life or to predict novel facts based on hypothetico-deductive reasoning. As far as I know, it is not possible for a food-gatherer to predict, for example, whether an unknown plant is edible or not, or which plants can be expected in unknown plant communities. (…) Predictions as to where to look for edible plant foods are based on experience and therefore inductive-deductive reasoning seems to be sufficient for the requirements of finding plant food" (Liebenberg 2013, p. 139f).

The sufficiency conclusion, Liebenberg explains, stems from the observation that animals, which do not practice creative science, are also perfectly capable of finding truffles, roots and other plant foods. He therefore concludes that plant food gathering does not explain *why* humans needed to evolve the ability to do creative science.

Hypothetico-deductive reasoning on the other hand is a more complex procedure.

> “The reasoning processes involved in systematic tracking probably do not differ fundamentally from those used by predators who track down their quarry by following a scent trail. The main difference is that, while other predators rely on their sense of smell to follow scent, human systematic trackers must rely mainly on sight to detect signs that are often very complex and sparse. The greater complexity of signs may require more extensive knowledge and skill to recognize, but the mental processes involved may well be the same. The transition from systematic to speculative tracking, however, may have involved a fundamentally new way of thinking. Apart from information based on direct observations and recognition of signs, speculative tracking also requires the interpretation of signs in terms of creative hypotheses. The speculative tracker creates imaginative reconstructions to explain what the animals were doing, and on this basis, makes novel predictions in unique circumstances. Speculative tracking involves a continuous process of conjecture and refutation to deal with complex, dynamic, ever-changing variables. Speculative tracking requires creative hypothetico-deductive reasoning and may therefore explain how, through natural selection, humans evolved the ability to do creative science“ (Liebenberg 2013, pp.140).

Out of an evolutionary perspective humans developed skills which led from a systematic way of tracking to a speculative one. Whereas predators track their prey in a systematic way by following their trail of scent, humans developed a more complex procedure of tracking to best adapt themselves to their environment. Integrating these skills into their way of tracking and hunting secured their survival.

Now what exactly is the procedural difference between hunting by human trackers and the chasing acts of predators? Prey animals are constantly alert for predators tracking them. Looking back down their own trail from time to time prevents them of an unexpected attack.

Regarding the predators strategies there is no evidence that they are able to recognize or interpret other animal´s tracks. Instead they come up with different strategies in order to track down their prey, namely by following its trail of scent. That is the reason why prey animals are "looking back down their own trail" – since they walk upwind to be able to smell predators ahead of them they constantly need to check if they are behind their backs.

While feeding and resting they also face downwind, since predators usually stalk them from the downwind side, while they can smell predators coming from the upwind side.

It is not clear to what extent prey animals need to learn this mechanism or act them out instinctively. At any rate it is crucial for their survival since they would only have one chance which they must not get wrong (email conversation, Liebenberg 2017).

Accordingly to this distinction between man and animal, Liebenberg understands *sciencing* as an innate ability of mankind. He does not attach the idea of science to a specific time and cultural constitution but rather innovatively recognizes science as an evolutionary product that evolved through the mechanism of natural selection.

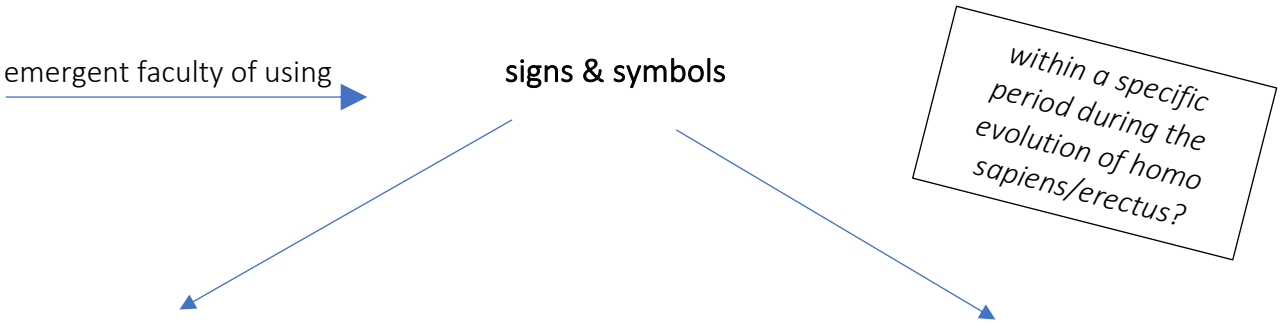
At this point it shall be emphasized that science is a modus operandi in terms of recording experience. Therefore, in its essence, it is not an entity, not an institution, not a part of societal structure. Instead, *to science* is (simply) a way to capture and describe (one´s own) experiences and therefore reality. In that manner science is not "man-made". It did not culturally evolve in ancient Egypt. It was not invented by the ancient Greeks such as Hippocrates and Aristotle and it is not an achievement of European Renaissance.

We must furthermore be careful not to confound the act of *sciencing* with scholarly disciplines. Science does not equal to the sum of present seemingly "scientific disciplines" such as physics, mathematics, biology, geography and alike. Leslie White clears up all these claims stating that:

> "the basic assumptions and techniques which comprise the scientific way of interpreting reality are applicable equally to all of its phases, to the human-social, or cultural as well as to the biological and the physical. This means that we must cease viewing science as an entity which is divisible into a number of qualitatively different parts: some wholly scientific (the "exact sciences"), some quasi-scientific, and some only pseudo-scientific. We must cease identifying science with one or another of its techniques, such as experimentation. We must, in short, view science as a way of behaving, as a way of interpreting reality, rather than as an entity in itself, as a segment of that reality" (White 1949, p.6).

2 Evolution of culture: the emergence of the symbolic faculty

Scientists are speculating about the fact that during a specific period in the evolution of mankind man evolved an ability that would have demarcated him from his animal ancestors ever since. This ability is concerned with a specific form of communication and can be subsumed as "the symbolic faculty“. The hypothesis states that human beings have the ability to communicate via symbols which in turn enables them to live culture. Primates and all other animals on the contrary do communicate via distinctive sensory abilities as well as via signs or indexes (less complex versions of symbols).



phenomena that emerged through **biological evolution:**	phenomena that emerged through **cultural evolution:**
* Biological foundation for hypothetico-deductive reasoning * distinction man vs. animal	* tracking skill * academia

The aim of this chapter is to sketch this hypotheses and to find out what is actually meant when we talk about “human beings”, “man” or “Homo sapiens”. Additionally a time scale will be framed in order to handle the question of when in history the symbolic faculty could have evolved. Framing the discussion concerning the symbolic faculty requires a subtle definition of evolution which will be outlined at the end of the chapter.

2.1 Human symbolic faculty: the hypothesis

In the second chapter of his book *The Science of Culture* Leslie White examines the "origin and basis of human behaviour". Out of an evolutionary perspective he questions the nature of mankind, or more precisely he contrasts the nature of man with the nature of animals. Is there a fundamental difference between the mind of human beings and the mind of animals? Does man differ from animals gradually and therefore can be defined as complex animal or qualitatively and therefore should be recognized as an autonomous category, segregated from animals? Leslie White defends the thesis that "there *is* a fundamental difference between the mind of man and the mind of non-man" and therefore states that man is *not* a complex animal. The difference between man and animal is not one of degree, but one of kind. His hypothesis builds on the assumption that human beings have the ability to communicate via symbols which in turn enables them to live culture. Primates and all other animals on the contrary do communicate via reflexes or tropisms, distinctive sensory abilities as well as via signs or indexes. Given the symbolic faculty, possessed by every human being, he goes one step further stating that symbols are not merely the most basic unit of all human mind but also of civilization (White 1949).

Precisely White´s hypothesis states: *"The natural processes of biological evolution brought into existence in man, and man alone, a new and distinctive ability: the ability to use symbols"* (White 1949, p.39). When he talks about *the natural process* he actually points at the mechanism of natural selection. During a specific period in hominid evolution, man became man by the emergence of the unprecedented ability of using (both signs and) symbols. Whereas the theory of natural selection will be discussed later in this chapter we first shall be concerned with the definition of symbols and signs.

Signs vs. Symbols

Daniel Everett, Leslie White and his students, as well as other scientists that are concerned with the definition of "humanness" are trying to find out the essentials of the human mind as well as of human cultural and social behaviour. One crucial factor, they found out, is the human way of communication. The question at stake is: How do people convey social and cultural information amongst each other? What kind of system do they use? Their analyses show that within the human social and cultural communication system two diverse entities are being applied, namely *signs* and *symbols.* Yet these two types of communication units feature main

functional differences. A sign *indicates* some other thing or event, whereas a symbol *represents* another thing or a complex event. For instance, the height of a column of mercury in a thermostat is a sign which *indicates* the temperature. A gender sign at a bathroom door either *indicates* entrance or entrance restriction. A hurricane sign *indicates* caution.

On the other hand, a symbol fulfils a more complex function. Let us imagine a Christian cross. This piece of wood, metal or any other material represents a whole religious belief system pointing out to its myths, traditions, and practices. In order to create, understand and use this symbol one needs to be able to process ideological and abstract connotations. In that sense it carries meaning and information that is much more complex than that of a sign. Another example would be a wedding ring, which stands for the complex, abstract and culture bound idea of a bond of love, faithfulness and loyalty.

Now focusing on the different applications of signs and symbols we find out that there apparently is a difference between human beings and animals concerning their communication system. It is the *passive* usage of sings by animals that contrasts with the *active* application of both signs and symbols by humans.

It is well-known that dogs are able to grasp the meaning of signs such as *Sit!* or *Down!* and to subsequently realize the stipulated action. Most pet dogs are also able to understand sentences such as *Go and fetch the stick!*.

Concerning our closest ancestors there is even evidence of great apes using sign language. Kanzi the Bonobo (1993) and Koko the Gorilla (1999), the two most famous instances of "speaking apes" - both in public as well as within the scientific community - use sign language to communicate with their trainers. Throughout the documentary "A conversation with Koko the Gorilla" the observer learns that the female gorilla knows over 1000 words and uses 500 of them frequently. It also expresses feelings and emotions via sign language. Some of the hand signals, proposed by the scientists, were even adapted by the gorilla to fit the size of its hands. The narrator describes Koko as "gentle and loving". Apparently the animal even comes up with hand signals on its own. Thus Koko reportedly made up a signal for lettuce pointing to her eyebrows. Also Kanzi seems to be very human-like at first glance. The male bonobo can identify and use a few hundred painted signals in order to communicate its needs or to fulfil several required scientific experiments. Same as Koko, it does not only understand words but also sentences such as "Please Koko, put water into that pot for our noodles!". Scientist use this and

other sentences when they cook a meal together with the bonobo. But why and how is this possible? What is happening behind the scenes?

To the observer in the first place it looks as if pet dogs and apes are acting out human qualities but this can be uncovered at least partly as an illusion. Indeed it is impressive how much gorillas and bonobos can study and remember and to see how much effort researchers and animal trainers have put into these projects. Yet it is partly their credit (because apparently the apes themselves would not have taught sign language of that scale to each other within their natural habitat - because they simply do not need that kind of complex sign language for the maintenance of their group structure).

However, one needs to ask what sign language really is within these particular cases in order to understand what it can do and to understand its actual scope.

First sign language as it is used by Kanzi and Koko literally is *sign* language. It is not symbols they are using but rather signs. They communicate their needs, their emotions and they react when they are required to fulfil a task. Now so far that is not astonishing. They are simply telling their trainers when they are hungry, thirsty or when they are in the mood for playing. They tell them when they are sad and they understand instructions such as *Put water into a pot!*. These are communication skills that every mammal is capable of (at least up to a certain degree). Here is the thing though - there is no evidence that they attach any complex meaning to one of these words. So they would not understand the difference between these two statements: a) ´Please, put water into the pot` and b) ´Put water into the pot´. The small additional word "please" conveys a certain value and implication that can only be grasped within a specific cultural context which is not recognizable for any anthropoid ape.

However, even at that point the critics could argue that we do not know what is going on in the apes´ mind and therefore we cannot register whether they would be able to grasp the meaning of the word "please" or not. Now that is the moment when we need to think about the function of symbols. So far we heard that they convey complex, culture-bound meanings. But other than that, on a higher level of analysis, symbols are considered as being the headstones of culture. White explains that "it was the exercise of the symbolic faculty that brought culture into existence and it is the use of symbols that makes the perpetuation of culture possible" (White, 1949, p.33). In other words, "the emergence of the faculty of symbolling has resulted in the genesis of a new order of phenomena: an extra-somatic, cultural order. All civilizations are born of, and are perpetuated by, the use of symbols" (White 1949, p.39).

Culture through symbolic communication/symbolic faculty

The rational observer will agree that it is impossible for a dog or an ape to have any understanding of the meaning of a Christian cross, or of the complex symbolic character of a wedding ring. No cow would describe itself as holy and no bird would be able to grasp the difference in value between diamonds and gravel.

What we see is that *words* in the end are both symbols and signs to man, but to animals they are merely signs (White 1949).

> "Whether [a dog] is to roll over or go fetch at a given stimulus, or whether the stimulus for roll-over be one combination of sounds or another is a matter in which the dog has nothing whatever to "say". He plays a purely passive role and can do nothing else. He learns the meaning of a vocal command just as his salivary glands may learn to respond to the sound of a bell. But man plays an active role and thus becomes a creator: let x equal three pounds of coal and it does equal three pounds of coal; let removal of the hat in a house of worship indicate respect and it becomes so" (White 1949, p.29).

Man goes beyond the mere sensory recognition of its physical form and receives a higher and more complex meaning of a sign by attaching a symbolic character to it. White explains that:

> "the meaning of a symbol cannot be discovered by mere sensory examination of its physical form. One cannot tell by looking at an x in an algebraic equation what it stands for; one cannot ascertain with the ears alone the symbolic value of the phonetic compund *si;* one cannot tell merely by weighing a pig how much gold he will exchange for; (…) The meaning of a symbol can be grasped only by non-sensory, symbolic means" (White 1949, p.26).

That reveals two conclusions. First, the signification of symbols ultimately derives from the arbitrary imposition of man. And second, "(…) a word is a symbol only when one is concerned with the distinction between its meaning and its physical form" (White 1949, p.26). These conclusions are crucial in terms of understanding human culture.

> "Both human behaviour and culture are expressions and products of symbolling. Human behaviour consist of acts and things, dependent upon symbolling, considered in terms of their relationship to the human organism. Tipping one´s hat is an example of human behaviour. And the hat, too, may be considered as a form, a product, of human behaviour; it is human behaviour locked up in a form and a fabric. But all these things and events that are dependent upon symbolling may be considered in another context,

> also: and extra-Somatic context. That is, instead of regarding them in relationship to human organisms, we can consider them in their relationships to one another and without reference to the human organism. Thus tipping one´s hat may be thought of as a ritual and in terms of its relationship to other rituals, to customs of kinship, to social or class structure, and so on. In short, things and events dependent upon symbolling may be thought of as constituting a continuum, a flow of culture traits form one individual and generation to another" (White 1987, p.271).

Culture is a system that evolved through natural selection and that made it possible for human beings to dominate the planet in terms of resource appropriation. Yet there is evidence that gorillas also use sign language in the wild. And apparently a wide spectrum of animal species show indications of social behaviour. Nevertheless we need to be careful not to confound their communication systems with the cultural symbolic system. It is crucial to understand that they literally are using *sign* language.

In his essay "Four stages in the evolution of minding" White comes up with a useful categorization concerning the division of man and non-man. He writes about the evolution of different types of *minding* and categorizes all living organic organisms by the factor of their minding abilities. By minding he refers to "the reaction of a living organism to some [other] thing or event in the external world" – pointing out to the process of interaction between the organism and a thing or event lying outside of it (White 1987, p.259). This simply means that if organisms engage with their environment (other organisms, things or events) they always react in certain ways – they either approach, withdraw or remain neutral. If it is beneficial (food for instance) an organism may draw near, if it is harmful it may back down and if it is neutral it may remain unresponsive. These reactions are universal and may look the same from an outsider´s perspective when observing different organisms.

But in actual fact what is happening is that all types of organisms come up with these reactions by applying distinct strategies – because the mechanisms that cause their reactions differ in kind from those of humans´. Hence there are four types of organisms that apply four types of minding mechanisms when engaging with their environment.

Type I organisms are the ones that solely interact with things or events of the external world through reflexes. A flower that turns towards the sun is seen as Type I organism. The achievement of the action is not the flower´s active decision but rather a passive tropism.

An organism that belongs to the category of Type II is one who´s reflexes are transformable through an external factor. Pavlov´s dog that first responds to food with salivation and later on reacts to a ringing bell with salivation is one of that type.

A chimpanzee that fetches a hanging banana with a stick belongs to Type III. These kinds of organisms play a dominant role concerning their relationship to the external world. They can partly control external things (stick) but still they are dependent upon intrinsic factors of themselves, the things they use and the circumstances.

Finally, Type IV are human beings who are independent of the intrinsic factors of their surroundings. They can label a hat "hat" and therefore give it a meaning and purpose that is in principle not intrinsic to the fabric and the form of the object.

	Organism plays a subordinate role	Organism plays a dominant role
Dependent upon intrinsic properties	Type I	Type III
Independent of intrinsic properties	Type II	Type IV

Table 5. Comparison of four stages of minding

These types reflect actual stages in the evolution of minding - each stage gave life a new dimension. Type II emancipated living organisms from limitations imposed upon them by the intrinsic properties of external things or events. Type III gave organisms positive control over the latter. And Type IV, symbolling, is the reason why certain primates became human beings (White 1987, p.271). This is where culture came into being:

> "Symbolling has brought a certain kind of things and events into existence. They constitute a continuum, a flow of tools, customs, and beliefs, down through the ages. Into this flow, this extra-somatic continuum called "culture", every human individual and group is born. And the behaviour of these human beings is a function of this extra-somatic continuum: an organism born into Tibetan culture behaves in one way (as a Tibetan); an individual born into Scandinavian culture behaves in another way. Thus the determinants of human behaviour, insofar as the individuals may be considered as typical or average, are no longer the properties of the biological organism; the

> determinants are to be found in the extra-somatic tradition (culture). It is not the nature of the lips, palate, teeth, tongue etc. that determine whether the human organism will speak Tibetan or Swedish; it is the linguistic tradition that determines this. Therefore, in contrast with all other kinds of living organisms, if we wish to learn why a typical individual – a typical Crow Indian or a typical Englishman – behaves as he does, we must concern ourselves not with their bodies, their neuromuscular-sensory-glandular systems, but with the cultures into which they have been born and to which they respond" (White 1987, pp.271).

So it may look human-like when Kanzi and Koko communicate with their trainers but what is happening behind the scenes is that they are applying minding mechanisms of type III, not of type IV. Thus they first of all do not have a complex and abstract understanding of concepts such as, for instance, politeness or Tibetan culture. And second, they are still dependent upon intrinsic factors of themselves, the things they use and the circumstances. They would not attach the idea of holiness to any source of food so that the whole group stops feeding it and they would never execute a ritual dance to wish for a good banana yield. Yet they have a dominant role concerning their relationship towards the external world and can use a stick to fetch a hanging banana. Still they do not go beyond a communication that is based on using signs, nor do they apply symbolic communication in order to secure their survival.

Confusions and black-boxing

Within and outside of Social and Cultural Anthropology there is a broad debate concerning the man-animal distinction, based on the symbolic faculty. It is a matter of epistemological orientation whether academics build their theories on this assumption or not. Thus most socio-biologists would still argue that there is no clear cut between human and animal communication and group behaviour but that they are all based on the same mechanisms and therefore rather manifest a gradual transition. Although facing the fact that discussions on an epistemological level per se have a dead end we should set the record straight concerning two common confusions on the faculty of symbolling.

One problem arises when scholars do not properly define the *mental differences* between man and animals. Darwin, and many other biologists, argued that "(…) the mental powers of higher animals [that form the corresponding power of man] do not differ in kind, though greatly in degree (Darwin, cited in White 1949, p.23). Unfortunately he did not get more precise than

that. Neither did most of his colleagues. They consequently black-box or even dismiss the phenomenon. What does Darwin actually think of when he writes about "mental differences"? Is he pointing out to cognitive abilities, to communication strategies or to something entirely different? To be fair, it was not Darwin´s main concern to deal with "mental differences between man and animals" so we should not be too strict at this point. Nevertheless it is of importance to ask these questions when concerned with fundamental issues such as the definition of *humanness* and *culture*. A distinct definition of the mental difference between man and animal is essential for a sound understanding - not easy generated, though fundamental. Aiming towards this definition is one of the endeavours of this paper.

The second difficulty concerns the confusion of *words* and *symbols.* "It arises, first of all, from a failure to distinguish between the two quite different contexts in which words function. The statements such as: ´The meaning of a word cannot be grasped with the senses´, and: ´The meaning of a word can be grasped with the senses´, though contradictory, are nevertheless equally true" (White, 1949, p.28). In the cases of Kanzi and Koko it has been shown that words *can* function as symbols in one context (for the scientist) and a sign in another context (for the apes). However this has not been fully understood by various scholars (White 1949, p.27).

Symbolic faculty – biological fundament

Whereas the hypothesis is sound on theoretical grounds the biological aspects are only sparsely touched. This might be due to the fact that biological research has not been as elaborate in 1949 as it is today. In his book White mentions the following three physiological aspects:

a) "Very little is known of the organic basis of the symbolic faculty (…)" (White 1949, p.29).
b) "The anatomist has not been able to discover why man can use symbols and apes cannot" (White 1949, p.29).
c) "(…) man has no new kinds of brain cells or brain cell connections"(White 1949, p.30).

For the sake of completeness also the physiological aspects need to be added to the whole discussion. White´s propositions should be compared to recent evidence - cognitive biology would be one of the fields that is concerned with these matters.

Yet this task needs to be carried out by experts on physiology, however, it shall be pointed out that, as a matter of principle, White´s hypothesis does not causally depend upon biological factors precisely because this would turn his ontological assumption upside down. In his own

words he is stressing the fact that "the ´speech areas´ of the brain are merely areas associated with the muscles of the tongue, with the larynx etc. But, as we know, symbolling is not at all confined to the use of these organs. One may symbol with any part of the body that he can move at will" (White 1949, p.32).

Summing up it can be observed that during a specific time in the course of evolution a new ontological category came into being, namely the symbolic faculty of human beings. Due to the biological basis and through the emergent effect within the individual the new superorganic category evolved, meaning that the foundation for *culture* was laid (Carneiro 2000). This qualitative change already happened when inorganic matter turned into biological matter. On a meta level of analysis this emergent effect therefore happened two times in the course of evolution. Consequently we speak of inorganic, biological and social evolution.
The following section will tackle the timeframe within which the latter process (social evolution) might have come about.

2.2 Evolutionary timescale

After all, Homo sapiens is just one of several species of humans that have walked the Earth. Does ´we´ refer to our genus, Homo, or to our species, sapiens?" (Everett 2018, p.1)

When clustering Hominoidea, meaning locating Homo sapiens and his relatives on the evolutionary phylogenetic tree we find out that Homo sapiens has not been the only *Homo*. There have been two other Homo species[13]: Homo erectus and Homo neanderthalensis.[14] So what are we actually referring to if we speak of "us", *human beings*?
The diverse foci of disciplines such as Physical Anthropology, Social Anthropology, Archaeology or Linguistics reveal distinctive characteristics out of different perspectives.

[13] All other Homo species (except Homo sapiens) that have ever existed are distinct today.

[14] Everett (2018) claims that there have only been three Homo species, namely Homo erectus, Homo neanderthalensis and Homo sapiens. Evidence for others, such as Rudolfensis, Ergaster, Heidelbergensis and so on, is unclear. "Finer distinctions among early Homo species are questionable, not only due to the absence of convincing evidence for such divisions but also by other positive evidence" (Everett, 2018).

Within social and cultural anthropology I argue that, based on White´s explanations, agreeing on symbolling as being the unifying characteristic of "us" is the most adequate assumption if we are concerned with the origin of *man* (and consequently of *culture* and *society*).

Subsequently the question of timescale arises - when did it happen, when did the symbolic faculty evolve during the evolution of Homo? How long did it take? Was it a matter of one or two generations, of thousands of years or even of one hundred thousands of years? It is difficult for us to cognitively imagine first a dynamic evolutionary development and second timespans that last over thousands of years. And maybe that is also one of the reasons why we still do not have satisfying answers to these fundamental questions. Nevertheless, although there is no final key there are partial answers and we need to put them together in order to get an idea of the bigger picture.

Leslie White never mentions a concrete time span; instead he stays on a rather theoretical level of analysis. Nevertheless other scientists have taken on his account (partly unknowingly) and tried to time the phenomenon. Compelling hypotheses in that regard have been developed by Louis Liebenberg and Daniel Everett.

Whereas Liebenberg focuses his research on tracking as being the origin of science, Everett concentrates on the origin of language. What their research intentions do have in common is that they are both concerned with the rise of the symbolic faculty since both tracking and language require the ability of symbolling.

Daniel Everett – symbolling, language and Homo erectus

On the question of when the symbolic faculty evolved during the evolution of Homo Daniel Everett (2017) responds via his detailed accounts on the origin of language. By trying to find out what language actually is and what it is there for he reveals ground-breaking facts on the origin of the symbolic faculty.

By showing that Homo erectus already must have had some kind of language he breaks up with the common idea among linguists that language must have originated with Homo sapiens around 150.000 years ago. By showing evidence from a wide range of fields and pointing out to cultural and technological achievements (linguistics, archaeology, biology, anthropology, neuroscience) he reveals that *Homo erectus* had the biological and cognitive equipment for speech 1.5 million years ago. This ground-breaking argumentation causes all scientific concepts of Homo sapiens to totter. It is a very recent idea and the hypothesis apparently needs to be

strengthened but if further evidence can be found this whole new idea would implicate a breakthrough in the conception of human beings.

For what actually is astonishing about the fact of Homo erectus having been able to speak is that he must have been capable of complex thinking. For when asking how language began, we actually do not ask when speech began, but rather we ask when did the *ability to use speech* evolve. And that makes a crucial difference because, and that is Daniel Everett´s main idea, complex thinking came before complex speaking. Accordingly, in order to understand when and how language began, we need to know when and how complex thinking began – and that is where the symbolic faculty comes into play.

Via this deduction Everett dates the emergence of the symbolic faculty (and therefore the evolution of culture) about 1.5 million years ago, with the evolution of Homo erectus (Everett 2017).

Louis Liebenberg – creativity, the origin of science and Homo sapiens

Similarly Louis Liebenberg is concerned with the origin of man´s unique cognitive abilities and therefore with the faculty of symbolling. In the framework of animal tracking among hunter-gatherer groups he focuses on the reasoning processes that are applied during the activity of tracking.

His accounts show that animal tracking can only be performed by human beings because of their unique ability to communicate symbolically.[15] Liebenberg at this point does not explicitly speak of ´symbolling´; rather he uses the concept of the ´creative mind´ and thus focuses on the individual reasoning process of a tracker whilst tracking down an animal. This process requires the ability to hypothetically imagine something that is not tangible in the first place, unseizable with the trackers' mere sensory organs. Thus when the tracker spots a leopard´s footprint on the muddy ground he comes up with a hypothesis through deductive reasoning. He imagines the animal having walked around , for instance, to look for water. Animals on the other hand solely depend on their sensory abilities when preying their quarry. They either see, smell or hear their prey, but they do not creatively imagine its hypothetical actions and future movements.

[15] This refers to ´symbolic communication´ after Leslie White, which has been described in the previous chapter.

Tracking is a human skill that is fundamental to all types of hunting which has been the base of subsistence – in different variations – of Homo sapiens ever since.[16] Liebenberg even states that Homo sapiens became Homo sapiens because of its emerging abilities of tracking. According to him, the ability to apply hypothetico-deductive reasoning is unique to human beings and its emergence separated us from our anthropoid ancestors in the course of biological evolution.
Liebenberg therefore times the rise of the symbolic faculty (which is manifested by the ability of hypothetic-deductive reasoning) around 200.000 years ago, with the evolution of Homo sapiens.

Finally, the question of what we are actually referring to if we speak of "us", human beings, can so far only be answered partially. By now we found out that "it is the symbol that makes man out of his anthropoid ancestors" (White 1949, p.22). But whether the symbolic faculty emerged through Homo erectus around 1.5 million years ago or through Homo sapiens only around 200.000 years ago remains speculation.
However two crucial conclusions can already be drawn: First, it is important to understand that these two thematic approaches are only examples and partial hints towards the understanding of the emergence of the symbolic faculty. Answering *the* big question – when organic evolution gave rise to superorganic evolution[17] - is one of the biggest endeavours of academia of our time. So far we have not been able to answer it. Detailed analysis of tracking and language can only help us to get a little closer.
And second, in order to get a better understanding of the emergence of the symbolic faculty, we need to face the principle of evolution and its guiding mechanisms.

2.3 Evolution: the basic principles

Putting mankind finally under the lens of evolution brings in a dynamic variable. Hence questioning the origin of mankind means to question a process, a dynamic development.

[16] It is assumed that form an evolutionary perspective persistence hunting was the first form of hunting applied by humans. Tracking might have evolved simultaneously.
[17] Spencer differentiates inorganic, organic and superorganic evolution. With this distinction he points out to three branches of evolution which are also known as inorganic, biological and social evolution. Respective definitions will be presented in the next chapter.

In order to understand how and why the symbolic faculty evolved and to understand its impacts we need to understand the dynamics of evolution. So how does evolution work in general and which mechanisms is it guided through?

Evolution is a term that is, both within the public as well within the academic discourse, mostly connected to keywords such as ´Darwin´, ´biology´ or ´survival of the fittest´. Regarding the dominance of these single-edged connotations it seems as if the principle, as such, followed by several evolutionary theories, has not been understood in its whole range. This is illustrated by two common misconceptions: First, evolution is wrongly assumed to be a theory and second, it is repeatedly said that social evolution can only be studied properly in a Darwinian context with the idea of natural selection as the basic explanatory mechanism. It is time to clear up these misapprehensions.

Evolution is not a theory. One clearly needs to distinguish between the *evolution as a theoretical principle* and *evolutionary theories.* A theoretical principle is concerned with the question of what approach we can use to gain knowledge. The principle of evolution is a theoretical one and as such cannot be falsified. It can either be followed or denied (though it should be mentioned at that point that every supposed scientist denying the principle of evolution actually puts himself into the paradigmatic context of creationism). As for the frequently misused term "theory", Daniel Everett explains that "evolution is a well-established fact. Only the explanations of how evolution happens or looks – natural selection, genetic processes and family trees – can be called theories. But evolution itself is not a theory" (Everett 2017, p.21).

Biological evolution does not equal social evolution. Social Darwinism is the result of erroneous linkages between Social Evolution and Darwinian Biological Evolution. It is to say that there are both resemblances and differences in the explanations of these two realms that are guided by evolution but still they are not identical. One major confusion seems to be the theory of natural selection. It shall be shown that although the mechanism of natural selection is operating on both human societies as well as on biological organisms there lies a fine but crucial difference in the two processes.

Evolution is not a theory

Evolution is a process that is guiding three branches of life on earth – we distinguish between inorganic evolution, biological evolution and social evolution.

On the most basal level of analysis all of these branches are composed of both morphology and an information network that helps sustaining the latter. The investigation of all of these types of evolution therefore requires an understanding of both the composing structure as well as the mechanism by which the latter is guided.

	morphology	information network
inorganic evolution	matter	energy
biological evolution	organism	genetics
social evolution	society	culture

Table 6. Matter (in terms of morphology) and its cohesion

What we know is that morphology and the information network feature a certain cohesion. This cohesion derives from the fact that morphology and the corresponding information network condition each other simultaneously and mutually. Consequently if one wants to understand and encompass the whole evolutionary processes one actually needs to imagine matter-energy -, organism-genetics – or society-culture evolution. But, probably in terms of (over-)simplification, academics agreed on terms such as inorganic, biological and social evolution.[18]

Thus it is not sufficient to understand the morphology of a society in order to be able to understand its evolutionary development over time. The same logic applies to inorganic and organic evolution. One cannot understand primatology without looking at genetics or the evolution of kinship structures without looking at culture. In that sense the basic principle of evolution applies to all of these three types. However, the explanations of how and why evolution actually takes place within these distinct realms differ. These explanations (theories) vary from type to type and sometimes also might change over time in the sense that scientific research advances over time. Nonetheless the basic principle of evolution and its epistemological character remain.

However, if it comes to a more in depth definition of evolution, scientists, especially anthropologists, could not come up with a common definition yet:

> "To some anthropologists, evolution is simply change (e.g., Birdsell 1957). To others it is growth or development, which is a special kind of change. Some would outlaw the

[18] Herbert Spencer actually coined the terms inorganic, organic and superorganic evolution. I use *inorganic evolution, biological evolution and social evolution*, because they appear to be more self-explanatory.

> concept of progress from evolution. Others accept "advance" but eschew the term "progress" (Greenberg 1957). Another finds progress of the very essence (White 1959). Evolution in its most significant aspect is "multilinear" we are told by one student of cultural evolution, and in its least significant aspect, "universal" (Steward 1953). It is significantly both, argue others (White 1959; Haag 1959; Kluckhohn 1959). Is evolution "history"? Most of it is, writes Kroeber, and the remainder is probably functionalism or "science" (1946). But evolution and history are distinctly different processes, White replies, and functionalism is still another (1945; 1959)" (Sahlins 1982, p.4f) .

This disarrangement of definitions and perspectives can, at least to a certain extent, be dissolved by introducing two crucial distinctions. First, we need to distinguish between the grand-movement view and the succession-of-forms view and second, we need to keep in mind the different perspectives regarding general versus specific evolution (Sahlins 1982).

The succession-of-forms view emphasizes that "the evolutionist process is characterized by chronological sequences … from B follows A in time, but precedes C. The evolutionist process is concerned with form and function … one form grows out of, and into, another. The evolutionist process is concerned with the progression of forms through time" (White cited in Sahlins 1982, p.6).

The grand-movement view on the other hand is concerned with the assumption that "evolution may be regarded as the process by which the utilization of the earth´s resources by living matter is rendered progressively more efficient" (Huxley, cited in Sahlins 1982, p.7).

Both these views are rather descriptive and do not have an explanatory force. Nevertheless it is important to mention them in terms of a better understanding of the overall process of evolution.

Second, Sahlins and Harding distinguish between two *kinds* of evolution, specific-adaptive and general-progressive, which is the second crucial distinction one has to bear in mind.

> "Evolution moves simultaneously in two directions. On one side, it creates diversity through adaptive modification: new forms differentiate from old. On the other side, evolution generates progress: higher forms arise from, and surpass, lower. The first of these directions is Specific Evolution, and the second, General Evolution. But note that specific and general evolution are not different concrete realities; they are rather aspects of the same total process, which is also to say, two contexts in which we may place the same evolutionary things and events. Any given change in a form of life or

> culture can be viewed either in the perspective of adaptation or from the point of view of overall progress" (Sahlins 1982, pp.12).

What they try to explain is that it strongly depends on the type of question we are asking concerning evolutionary processes. Hence, evolution means advance in terms of an overall progress on the one hand and divergence in terms of variation on the other.

Biological Evolution does not equal Social Evolution

As mentioned above the basic principle of evolution applies to all realms of life on earth, inorganic, organic and superorganic, though the evolutionary theories among them vary. That already reveals the fact that phenomena on the spectrum of social evolution cannot be explained merely by theories borrowed from the biological sector.

Before thinking about the resemblances and differences of their explanatory theories it is crucial to understand the term *social evolution*.

Social evolution technically needs to be divided into *cultural evolution* on the one hand and *social evolution* on the other hand. Cultural evolution is the process that is on hand when cultural phenomena, such as belief systems, customs, languages, values and norms, etc., change (through adaptation) over time. Sahlins and Harding describe culture as "man´s means of adaptation".

> "Culture", they state, "provides the technology for appropriating nature´s energy and putting it to service, as well as the social and ideological means of implanting the process. Economically, politically, and in other ways, a culture also adjust to the other cultures of its milieu, to the superorganic part of its environment. (…) Cultures are organisations for doing something, for perpetuation human life and themselves. Logically as well as empirically, it follows that as the problems of survival vary, cultures accordingly change, that culture undergoes phylogenetic adaptive development" (Sahlins 1982, p.24).

On the other hand we talk about social evolution when the morphology of a society changes (through adaptation) over time. Examples could be continuous transitions of societal organization - from family-level foragers to families with domestication, to clans and villages, to big-man societies - or adaptation from a monarchical system to a democratic one. Another example would be a change in the mode of production, e.g. transitions from hunting and gathering to agriculture.

Now one of the tasks of anthropology is to find out how and why these changes take place - at best, recognizing regularities.[19] To do so it is helpful to understand the various explanatory mechanisms - both the ones coming from the field of biology as well as others that originate from the field of social and cultural anthropology.

For instance there is *natural selection*, a theory that both biologists as well as anthropologists might use to describe evolutionary processes. Carneiro explains:

> "I see natural selection not as bifurcating into two different modes, but as a *unitary* process, operating the same way on culture and on biological organisms. Suppose a new culture trait arises which has an adaptive advantage over another one serving the same function. This advantage leads the new trait to increase in frequency until it becomes firmly established in the society and eventually displaces the old trait. I see no essential difference between this process and what is called natural selection in biology. What happens is really simple and analogous. Variations arise, creating alternate forms which compete for acceptance. The better accepted ones succeed, increasing in frequency at the expense of the less well adapted. Natural selection has acted and change has occurred" (Carneiro 1992, p.117).

Carneiro emphasizes the fact that natural selection is not as bifurcating into two modes and operates both on culture as well as on biological organisms. In that sense he talks about the overall idea of natural selection. Hallpike refines this view by explaining that,

> "(…) it is impossible to apply Darwinian principles to the evolution of human society because they are inherently of the wrong type to be applied to socio cultural-systems. At this point it is important to remember the distinction between a truly Darwinian explanation of social evolution and that of a Spencerian, functionalist type. The second

[19] At this point I want to mark off doctrinal implementations of the so-called *Social Darwinism*, which are mainly utilized to form the basis for certain political ideologies. One form of Social Darwinism, Carneiro postulates, "is the belief that the rapid elimination of "unfit" individuals from a society would benefit the society biologically, and thus the state should do nothing to relieve the condition of the indigent or the infirm, who are deemed to be the less fit" (Carneiro 1992, p.132). The second form of Social Darwinism "holds that a society´s economic system works best if business enterprises are allowed to pursue their own interests unhampered. The state, according to this view, should give free rein to economic competition and should not intervene in the process except to enforce contracts. This is basically the doctrine of *laisse faire* (Carneiro 1992, p.132). These two types clearly are political ideologies and applications and subsequently scientifically not operationalizable.

tradition emphasizes the structural, organic properties of social evolution, while the Darwinian model emphasizes the notion of society as a population of traits, and evolution as the result of changes in their relative frequency over time through variation and selection" (Hallpike 1986, p.32).

At first glance it seems as if Hallpike is arguing against the application of natural selection on social phenomena. But this is not the case. Instead, he is pointing out to a fine but crucial detail. Whereas in Darwinian theory variation is ultimately guided by chance and therefore *random* within social evolution, the central aspect of selection is social *invention*. We see that, although the general orienting and adaptive process stays the same, the synthesis of new traits is based on different sources of variation. Fact is that "(…) there is no significant resemblance between *mutation,* the basic source of variation in the Darwinian scheme of things, and social *invention,* which is purposeful, responsive, and can be diffused. Whereas biological variation can be treated as random, social variation is the product of particular societies and cultural traditions, and therefore far from random" (Hallpike 1986, p.36).

This seemingly small but crucial difference points out to the fact that, although selection is always at stake whether randomly or by invention, biological and social organisms however are, first different in kind (even though they feature resemblances) and, second, need distinct concepts to be explained in evolutionary terms.

Resemblances between societies and organisms:

a) The interrelatedness of organs resembles the interrelatedness of institutions – both preserve their continuity despite changes of individual cells or members.
b) The specialization of organs resembles the social division of labour.
c) Self-maintenance and feedback happen both in organisms and societies.
d) Both respond with adaptation to their physical environment.
e) Transmission of matter, energy and information in organisms happens similarly in societies through trade, communication and the like.

(Hallpike 1986, p.33)

Societies are unlike organisms:

a) Their members are not linked physically (in organisms they are) but by information bonds.

b) They are not clearly bounded. Two societies can e.g. be distinct religiously, but not politically.
c) Since societies do not reproduce (in a way that organisms do) the cultural transmission from one generation to the next is indistinguishable from general process of self-maintenance.
d) Societies are capable of metamorphosis to a degree to which the individual organism is not.
e) Unlike cells the individual members of a society are capable of the following activities: performing with purpose and foresight and learning from experience.
f) Structure and function are less closely related (than in organisms).

(Hallpike 1986, p.33)

Societies resemble species (not organisms):

a) Societies, like species, do not reproduce.
b) Both manifest metamorphosis and phylogenies.
c) Both have competing members.

(Hallpike 1986, pp.33)

Being aware of the differences and resemblances between organisms and societies it becomes obvious that Darwinian concepts cannot be applied to social systems one-to-one. These are five concrete reasons why basic Darwinian concepts are irrelevant to social evolution:

(1) Darwinian theory is based on *reproduction*. Societies do not reproduce, but rather maintain themselves. There is no gene-like unit in societies.
(2) The concept of biological "fitness" is purely statistical and only applicable to structureless agglomerations like gene pools or species. The differential frequencies of components of societal structures tells us nothing about how these structures work or behave.
(3) As for the organism adjusting itself to the environment the latter does not change. On the other side changes in a social system automatically cause changes in the environment. Therefore the concept of biological *adaptation* needs to be substituted by *mutual adjustment* when concerned with social systems.

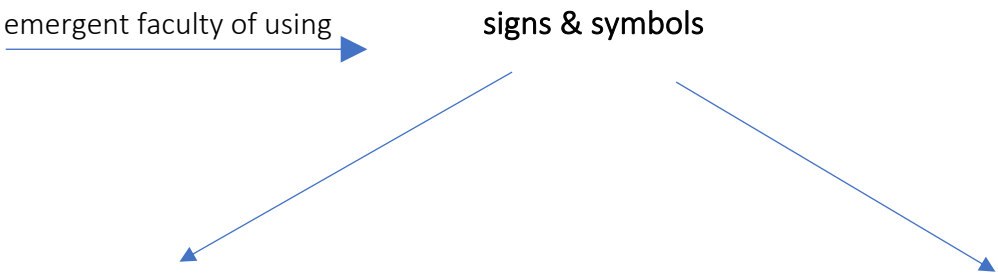
(4) *Competition* is a central aspect in Darwinian theory. It is concerned with the differential rates of survival and reproduction of organisms and genes. Competition among social systems however is only a part of the mutual adjustment in which the different elements also facilitate on another´s operation.
(5) The source of variation differs radically between organisms and societies. Whereas the biological *mutation* can be treated as random, the social *invention* is purposeful, responsive and can be diffused.
(Hallpike 1986, p.36)

Note that natural selection has been utilized at this point to emphasize the fact that biological and social evolution need to be examined separately. There are other explanatory theories such as adaptation, inheritance and variation or competition and cooperation.

This chapter aimed at defining social as well as cultural evolution, the symbolic faculty of human beings and at focusing on the question of when in history the symbolic faculty could have evolved. The general purpose was to propose a model on how the emergence of the social organism could have evolved in the first place and on sketching the mechanisms that guide the latter, in terms of transition.
Building on these assumptions the next chapter focuses on two mechanisms that might as well guide the social organism, however, not in terms of transition but rather in terms of maintaining stability.

3 Sciencing on the level of the social organism

Agreeing on the fact that man differs from animal in kind (and not in degree) and that evolution is the basic principle that life on earth is guided by (in other words, embracing the symbolic faculty as an ontological principle and evolution as an epistemological one) we now will be concerned with the impacts of the emergence of the symbolic faculty. In what way did humanity, or more precisely society, evolve considering the symbolic faculty that is inherent to every individual human being?
We will mainly investigate two particular outcomes of the symbolic faculty: *sciencing* and *art(ing)* – mechanisms that might, as we will see, universally guide human behaviour.



phenomena that emerged through *biological evolution:*	phenomena that emerged through *social evolution:*
* **distinction man vs. animal** * **hypothetico-deductive reasoning** * emotional reasoning	* **sciencing & arting** - **tracking**

The highlighted aspects are the ones that are addressed in this paper. Hypothetico-deductive reasoning (=scientific reasoning) on the biological evolution side and tracking on the social evolution side have been dealt with in chapter one. The animal-man distinction has been explained in chapter two. The focus in this chapter rests on *sciencing* and *arting*, two uniquely human ways of dealing with the environment, i.e. experience.

3.1 Sciencing and Arting: the hypothesis

White´s assumption states that science and art are explicit components that account for the organization of any kind of social organisms. Yet his argumentation is not finalized and not all of his explanations are entirely thought through. There are parts that are more elaborated than others and there are parts that even lack explanations at all.

White innovatively illuminates the assumption that science and art are, within every society, the two basic ways of dealing with experience and therefore guide human behaviour. Sciencing, he explains, means dealing with particulars in terms of universals, whereas art is a way of dealing with universals in terms of particulars (White 1949, p.3). Although these are obviously contradicting approaches, their purpose is the same, namely "to render experience intelligible, i.e., to assist man to adjust himself to his environment in order that he may live" (White 1949, p.3). So when science deals with particulars in terms of universals Queen Elisabeth II disappears in the world history of monarchy. On the other hand, when art deals with universals in terms of particulars Queen Elisabeth II ideologically stands for the whole political apparatus of

monarchy. In this regard White concludes that "art and science thus grasp a common experience, or reality, by opposite but inseparable poles" (White 1949, p.3).

What happens however is that, in the course of his explanations and discussion, he turns science into sciencing but never turns art into *arting.* To me it is a corollary that analytically spoken we also need to understand art not as an institution (such as museums or art colleges) but rather as a way of dealing with experience. *Arting* then is also a mechanism that guides the organization of any kind of social organism. A detailed discussion of the concept of *arting* follows in the next pages.

Chapter one dealt with the practice of sciencing mainly in terms of the cognitive processes applied by individuals. To gain a deeper understanding of sciencing we shall now add the cultural and societal aspects of sciencing and combine these insights with the results of the cognitive perspective.

The question at stake is how do we process information that we get from the outside world? The human organism analyses reality in two steps. Step one is that it receives information via its senses and expresses or processes it into information such as odours, colours, sounds, etc. On the conceptual level, step two, information is expressed or processed with symbolic instruments such as words, figures, (e.g. mathematical, artistic), etc. The first step is possible through the means of the senses and the second through the means of the symbolic faculty. What we can see is that both cognitive and cultural processes are taking place. Making malodour out of a specific smell, making red the colour of love or valuing a loose handshake a wet-fish handshake is nothing more (or less) than combining cognitive and cultural information. This reveals the fact that odours, aesthetics, salutations - even more abstract issues such as matter, energy, time, space, or motion - are conceptual devices with which we merely analyse reality and in terms of which we make our adjustments to it. They are not discrete entities but aspects of a common reality. Rather, what happens is that concrete experience is converted into artificial abstractions (White 1949). In other words, and this is the very essence of science, humans substitute "free inventions of their mind" (to borrow Einstein´s words) for the concrete experience of the senses.

Relationship, as another conceptual device (a symbolic instrument) is the crux of the matter. By means of relating certain experiences and information to each other we render experience intelligible to a higher degree and again effect our adjustments to the outside world.

Further every experience we are confronted with is determined by time and space – at least that is how we conceive reality. Looking at reality, therefore, means to either focus on time, space or on a time-space aspect. These different foci comprise the three ways of sciencing:

> "Sciencing must adapt itself to the structure of reality; its tools must be so shaped and its techniques so ordered as to grasp reality effectively and render it intelligible to us. This means, therefore, that we shall have three ways of sciencing: one which grasps the space-time property of reality in its entirety, and two subsidiary and derivative ways, each of which deal with one of the two aspects of this property, viz., space *and* time. All of "science" or sciencing will be found to be assignable to one or another of these three categories; there is no ways of sciencing apart from these three" (White 1949, p.8).

Space in this sense addresses structure and function of the information we receive. Time on the other hand indicates process. Looking at the time aspect therefore means analysing the temporal appearance of an experience or phenomenon. Thirdly, the time-space aspect is focusing on the developmental or evolutionary aspects of process.

Together they are just different angles of reality – not more and not less. White puts it in a nutshell when stating that "these contexts are, of course, devices of our own making. They are arbitrarily selected points of view from which we regard and consider reality; they are the forms, the channels, so to speak, within which we science" (White 1949, p.13).

After starting with these very fundamental conceptions concerning sciencing White unfortunately rather quickly jumps to the level of applied science within academia. He comes up with a classification that reflects an analysis of former (1940s) academic practice. Instead of using known categories such as biology, linguistics, physics, psychology, etc., he appeals for a new terminology that fits his observations concerning the actual scientific practice. In his figure he shows that within every realm of reality, cultural, biological and physical (or inorganic, organic and superorganic) events can be looked at from different angles – the temporal, the spatial or the spatial-temporal one.

	Temporal	Spatial-temporal	Spatial
Cultural	"History", Culture history, or History of civilization	Cultural Evolution	Non-temporal, repetitive, culturally determined

			processes in human society
Biological	Racial History of Man, History of animal and plant species, genera	Biological Evolution, Growth of Individuals	Non-temporal, repetitive processes in organic behaviour: intra-organismal (physiology), extra-organismal (psychology)
Physical	History of solar system, of the earth, a continent, mountain system, river, drop of water, a grain of sand	Cosmic, solar, stellar, galactic evolution, Disintegration of radio-active substances	Non-temporal, repetitive processes in physics, chemistry, astronomy

Table 7. Classification of academic practice (White 1949, p.19)

This is a valuable assumption but regrettably detaches us a little from the actual task of finding out more about the *very* essence of sciencing. The issues that are raised within White´s table are specifically drawn from an analysis of the academic context of his time. They do not appeal to societies that do not feature an academic institution per se.

Let´s put it differently: Knowing (from chapter one) that hunter-gatherer groups are in fact scientists they would need to fit into this table. Trying to locate their (scientific) tracking practice however turns out to be difficult. The examples that are mentioned in this chart are rather specific and it is therefore difficult to translate them in a way so that tracking practice and procedures fit into it accordingly. Some topics, such as the history of a continent or the galactic evolution, are known not to be of importance within the specific cultural context of hunter-gatherer societies[20]. But that does not mean that hunter-gatherer societies and their ways of dealing with reality factually do not fit into this scheme; rather it means that the scheme needs to be amplified, broken down to an even more conceptual level.

[20] This is reflected in the fact that hunter-gatherer languages do not feature any kind of past tense. To be more precise, it is grammatically not possible to express the temporal aspect of phenomena that happened earlier than a few days ago. This does not mean that individuals of hunter-gatherer societies are not capable of thinking about the past, but rather that *past tense* as a cultural concept has less meaning and necessity.

3.2 Sciencing and arting: an amplified hypothesis

White´s model exhibits four ambiguities that need further clarification. First he is not clearly separating the cognitive (Liebenberg 2013) from the cultural (White 1949) process when talking about *sciencing.* He apparently *does* recognize the cognitive-cultural process as a whole (which is an emergent phenomenon of the combination of the cognitive and the cultural process), but he is not mentioning them separately in the first place. This causes confusion to the reader.

Second, his explanations do not clearly illustrate how sciencing (and arting) are enlaced in the social organism as such. In what way is this mechanism crucial to the social organism? What is the function of this mechanism?

The third aspect is rather a suggestion for improvement. As already mentioned above, trying to locate hunters´ scientific tracking practice is not possible within White´s chart. Breaking down the examples to a more general conceptual level would make it possible to strengthen the fact that sciencing *is* a unique mechanism that guides human behaviour and for that reason can be found among all different types of societies (therefore also among hunter-gatherer societies).

And finally, the forth one, is a firm critic on White´s work concerning the lack of explanation of *art* and *arting.* Although talking about "opposite but inseparable poles" he does not come up with any definition of *art* or *arting* whatsoever. Mentioning arting as *the* counterpart to sciencing makes up a large segment of the argument that indispensably needs further explanation in order for the whole hypothesis to be of scientific value.

a) Cognitive vs. cultural processes of sciencing

In the beginning of White´s chapter "Science is Sciencing" one cannot clearly distinguish whether he talks about the individual scientific reasoning processes or about the holistic mechanism of sciencing that guides the human (cultural) behaviour of the members of a society. He explains: "Science is not merely a collection of facts and formulas. It is pre-eminently a way of dealing with experience. The word may be appropriately used as a verb: one sciences, i.e., deals with experience according to certain assumptions and with certain techniques" (White 1949, p.3). At first sight it is not evident if "one" is the individual (biological) organism or the culture-bound scientist. Working through his text it becomes clearer that he actually talks about none of these aspects in isolation but rather about their combination. I call it the

cultural-cognitive processes of the individual which ultimately are guided and driven by the entire societal organism. In that sense, analytically he is already one step ahead combining the cognitive aspects of sciencing with the cultural ones. He comes up with the following formula: Human behaviour (sciencing being one specific aspect of it) = human organism x cultural stimuli.

Not mentioning the distinct perspectives in the first place nevertheless causes confusion to the reader. I even argue that a distinction between the cognitive and the cultural process is essential for a valid assumption on the phenomenon of *sciencing* as such.

Now what is the difference between them? I claim that sciencing is the holistic process starting with the idea of an individual (containing a non-logical leap) up to the point of scientific findings gained on a societal level. Sciencing is further culturally determined and follows the rules of the social organism. These rules in turn are in line with the needs of society in order to deal with its environment in an efficient way. Efficient in that sense is following the aim of keeping itself (society) stable and to adjust societal structures only when necessary in terms of natural selection (by social invention). It is concerned with the relationship of man towards his (natural) environment. Society (the social organism) as such correlates with the environment in a way in which consumption of surrounding resources is ranked first.

Rational reasoning on the other hand is a process of the individual, within a specific situation, who is thinking about something in order to make a decision. On the level of the individual organism, rational reasoning is a biological strategy and for that reason follows the rules of the individual organism.[21] Also here the goal is the same - to keep itself (individual organism) stable and to adapt behavioural patterns/ thinking patterns when necessary.

These classifications shall stress the fact that we are confronted with two distinct levels of analysis which cannot be compared to each other: Sciencing ≠ rational reasoning.

In this sense we need to find out what exactly is (White´s) *sciencing*.

[21] There are feedback loops connecting the individual organism to the social organism as a whole.

b) In what way is sciencing enlaced in the social organism?

There are two crucial questions that need to be raised at this point. One, what is the *social organism*[22] and how to define it? And second, where and how is sciencing taking place within the social organism?

What is the social organism?

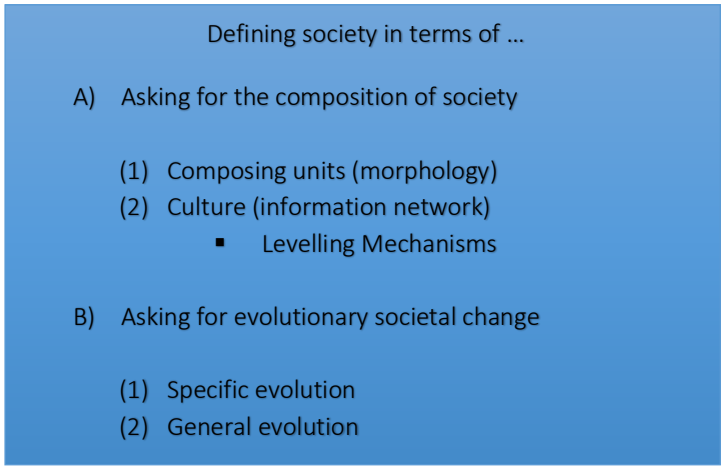
The explanation of any social phenomenon requires unfolding a model of society that lies behind all subsequent reasoning. The model that seems to be the most promising so far is Herbert Spencer´s model of the social organism. It pictures society as a living organism. The main idea is that all elements of the organism have specific functions that in total maintain the stability and cohesiveness of the latter (Spencer 1860). Asking questions about society then means to zoom into the model. In other words one can ask different questions about society or investigate different type of societal phenomena. One might want to know the predominant kinship system of a society, another one wants to learn about demographic aspects, about the development of various technologies, or one might be interested in the evolution of political organizations, in the development of contacts between groups over time, about religious institutions and so on.

By posing all these diverse questions we find out that the aim is not to give *one* distinct definition of society. Contrariwise it would be scientifically unfeasible to do so. That is to say one needs to look at society, or at the social organism, in two different ways, as outlined below.

Either in terms of:

A) Explaining the structure (composition) of society as such

Thus e.g. asking for the predominant kinship systems, demographic aspects, political organization, religious institutions and other aspects.



[22] The term *social organism* has been coined by Herbert Spencer.

Or in terms of:

B) Explaining society underlying evolutionary change

Thus e.g. asking for development of different technologies, for contacts to other groups over time, for evolutionary global distribution and other aspects.

A) Explaining the structure (composition) of society as such

Societies in general are not motionless constructs; rather they can be pictured as living organisms. This analogy is based on Herbert Spencer´s considerations, who originally came up with similarities and differences concerning biological organisms and social organisms. He came up with four peculiarities and four differences between the two.

They have the following aspects in common:

1) They augment in mass over time.
2) They exhibit a continually increasing complexity in structure over time.
3) "…. their parts gradually acquire a mutual dependence which becomes at last so great, that the activity and life of each part is made possible only by the activity and life of the rest" (Peel 1972, p.57).
4) "Life and development of a society is independent of, and far more prolonged than, the life and development of any of its component units" (Peel 1972, p.57).

And at the same time they differ in some aspects:

1) Societies have no specific external form, individual organisms do.
2) "… the living elements of a society do not form a continuous mass" (Spencer 1892, p 59).
3) "… while the ultimate living elements of an individual organism are mostly fixed in their relative positions, those of the social organism are capable of moving from place to place" (Peel, 1972, p.59).
4) "… while in the body of an animal, only a special tissue is endowed with feeling; in a society, all the members are endowed with feeling" (Peel 1972, p.60).

Summing up it can be said that "the *principles* of organization are the same; and the differences are simply differences of application" (Peel 1972, p.61).

Spencer further speaks of “parts that acquire mutual dependence” and of their “activities [that] are only made possible by the activity and life of the rest”. Having his analogy in mind we will see that a definition of society in terms of its composition again has to be split into two aspects. Hence the “parts” and their “activities” are translated into *composing units* and its *levelling mechanisms*.

The *units* are best explained by Frank Elwell´s explanation of Cultural Materialism and the *mechanisms* by James Woodburn´s example of social practices in egalitarian societies.

The explanation of Frank Elwell “… that the various parts of society are interrelated. An institution such as the family cannot be viewed in isolation from the economic, political or religious institutions of a society. When one part of the society changes it has an effect on other parts of the system” (Elwell 1991, p.5) can further clearly be connected to Spencer´s descriptions of society. It is the interrelatedness of societies composing parts that both scientists focus on.

(1) Society and its composing units

The following table shows Harris´ three levelled model of society comprising *infrastructure, structure and superstructure*. Every level is sketched through listing its main elements.

Environment The physical, biological, and chemical restraints to which human action is subject.
Infrastructure 1. Mode of production: The technology and the practices employed for expanding or limiting basic subsistence production, especially the production of food and other forms of energy. A. Technology of subsistence. B. Techno-environmental relationships. C. Work patterns. 2. Mode of reproduction: The technology and the practices employed for expanding, limiting and maintaining population size. A. Demography. B. Mating patterns. C. Fertility, natality, mortality. D. Nurturance of infants. E. Medical control of demographic patterns. F. Contraception, abortion, infanticide.
Structure 3. Primary group structure: Consist of a small number of people who interact on

an intimate basis. They perform many functions, such as regulating reproduction, basic production, socialization, and education, and enforcing domestic discipline. Examples:

A. Family.
B. Community.
C. Voluntary organization.
D. Friendship networks.

4. Secondary group structure: These groups may be large or small, but their members tend to interact without any emotional commitment to one another. These organizations are coordinated through bureaucracies. They perform many functions such as regulating production, reproduction, socialization, and education, and enforcing social discipline. Examples:
   A. Governments, parties, factions, military, and police.
   B. Corporations, businesses, and industries.
   C. Education, media, and other formal socialization agents.
   D. Service and welfare organizations.
   E. Professional and labor organizations.

Superstructure

5. Behavioural superstructure.
   A. Art, music, dance, literature, advertising.
   B. Rituals.
   C. Sports, games, hobbies.
   D. Science.

6. Mental superstructure: Refers to conscious and unconscious motives for human behavior.
   A. Values.
   B. Emotions.
   C. Traditions.
   D. *Zweckrational* (goal-oriented rational action).

(Elwell 1991, p.8)

The fundamental aspect of this model, which distinguishes it from other anthropological models of society, is an infrastructural determinism, meaning that the modes of production and reproduction determine the primary and secondary group structure which, in turn, determines the superstructure. Elwell explains the rationale behind giving the infrastructure such priority when stating that "it rests upon the fact that it is through infrastructural practices that society adapts to its environment. The infrastructure of social systems encompasses sociocultural practices aimed at modifying ecological constraints. It is through infrastructural practices that society modifies the amount and type of resources it requires. Since these infrastructural practices are essential for human life itself, all widespread structural and superstructural patterns must be compatible with these practices. Any change in structure and

superstructure must be compatible with the existing modes of production and reproduction" (Elwell 1991, p.10).

However, while the infrastructure is considered to be of primary importance, the structure and superstructure are not mere reflections of infrastructural processes, but are in interaction with these processes.

Society can further be seen as a very stable system. The cause for that is that any change in the system – whether starting in the infrastructure, structure or superstructure – is resistance in the other sectors of the system. "This ´system-maintaining negative feedback´ is capable of ´deflecting´, ´dampening´, or extinguishing most system changes. The result is either the extinction of the innovation or slight compensatory changes that preserve the fundamental character of the whole system" (Elwell 1991, p.10). This system-maintaining negative feedback is what James Woodburn explains in his text *Egalitarian Societies.*

Harris' model of infrastructure, structure and superstructure is to be seen as a theoretical principle which per definition cannot be falsified. Rather it is generally applicable to any kind of social and cultural phenomena.

(2) Culture – the information network

In chapter two it has been shown that in the course of evolution Homo sapiens evolved the symbolic faculty. The discussion focused on the individual and its ability to communicate via symbols. Now the hypothesis goes further and states that, in turn, this ability and the fact that humans live together in groups brought about the superorganic quality, an emergent phenomenon that finally enabled humans to live culture. Culture in very general terms can be pictured as an information network that helps to maintain the stability of the social organism.

To get a more tangible idea of what that means in practice we will have a look at James Woodburn´s (1982) description of system-maintaining feedback or *levelling mechanisms*. This description illustrates how *culture works* in practice.

During his extensive work with Hadza hunter-gatherers in Tanzania and !Kung bushmen in the Kalahari Desert, Woodburn learned a lot about the hunter-gatherer way of life. After years of fieldwork he embraced all his findings in various theories of societal stability and change. In his text *Egalitarian Societies* he depicts the theory on *levelling mechanisms*. Although his account is only known within hunter-gatherer research communities and remains rather unrecognized

in other fields of anthropology, I certainly see the importance of integrating his ideas into a general model of society, or more specifically of culture.

For the reader to understand the main idea of levelling mechanisms Woodburn draws an analogy to societies with taxation systems:

> "It has often been suggested that meat-sharing is simply a labour-saving form of storage. The hunter surrenders his rights to much of his kill in order to secure rights over parts of the kills of other hunters in future. There are problems with this formulation: as I have already mentioned, hunting success is unequal. Donors often remain on balance donors and may not receive anything like an equivalent return. Entitlement does not depend in any way on donation. Some men who are regular recipients never themselves contribute. Instead of seeing the arrangement as being in the interest of the donor, I think we should be clear that it is imposed on the donor by the community. Instead of seeing the transaction as a form of reciprocal exchange, I would suggest we treat it as analogous to taxation on incomes of the successful in our own society. The successful pay more than the less successful and are obliged to do so. They are not able to establish greater claims in future through having paid more tax and do not derive much prestige from having contributed more to the tax pool than they have withdrawn from it in benefits. The analogy may sound rather crude: certainly the hunter derives more prestige from contributing an animal than any taxpayer does from paying his taxes, but it does bring out the important fact that we are dealing here with a socially imposed levelling mechanism and not a mere practical convenience for the hunter" (Woodburn 1982, p.442).

What Woodburn tries to show in this example is that levelling mechanisms are those social practices that prevent structural change and therefore ensure to keep society in its initial form.

According to Newton the principle of inertia states that an object will stay at rest or maintain its velocity unless acted on by an external force. In that sense levelling mechanisms build a dynamic information network that ensures the cohesion of the composing units of society.

In terms of hunter-gatherer´s living together Woodburn explains the following social practices:

1. The mobility of people and flexibility of spatial arrangements

2. Access to means of coercion
3. Restricted access to food and resources
4. The sharing of resources
5. Sanctions on the accumulation of personal possessions
6. The ready and easy transmission of possessions between people
7. Subversion of leadership in decision-making

So what does Woodburn´s example reveal with regard to Harris' model of infrastructure, structure and superstructure?
In the case of the Hadza and !Kung bushmen concerning the effects of all these mechanisms Woodburn found out that all the social practices mentioned above decouple the members of the group of property and ownership and therefore of dependencies. And this is when the structural and the mechanical level are combined. Structurally we describe hunter-gatherer societies as egalitarian societies with specific political, economic, and kinship organizations that build upon principles of being without individual property and ownership which, in turn, ensures a state of non-dependencies. What Woodburn therefore was able to show is that the social practices ensure exactly this state of non-dependencies which, in turn, is important to let society stay in its initial and stable form.

B) Explaining society underlying evolutionary change

After dealing with the composition of society we will now look at society underlying evolutionary change.
In their book *Evolution and Culture* Sahlins and Harding explain an important distinction of evolutionary processes. They distinguish between *general* and *specific* evolution. Since this is not the main focus of this text, we shall only sketch the main aspects and give a rough overview.

> "(…) Evolution moves simultaneously in two directions. On one side, it creates diversity through adaptive modification: new forms differentiate from old. On the other side, evolution generates progress: higher forms arise from, and surpass, lower. The first of these directions is Specific Evolution, and the second, General Evolution. But note that specific and general evolution are not different concrete realities; they are rather aspects of the same total process, which is also to say, two contexts in which we may place the same evolutionary things and events. Any given change in a form of life or

> culture can be viewed *either* in the perspective of adaptation *or* from the point of view of overall progress" (Sahlins 1973, p.12).

Specific evolution therefore is concerned with phylogeny whereas general evolution is concerned with progress itself, with the classification of stages and levels of development (Sahlins 1973, p.13).

And although cultural evolution takes on distinctive characteristics compared to biological evolution, it still diversifies by adaptation and uninterruptedly produces overall higher forms. Hence, culture continues the evolutionary process – but by new means. Culture is man´s means of adaptation:

> "Culture provides the technology for appropriating nature´s energy and putting it to service, as well as the social and ideological means of implanting the process. Economically, politically, and in other ways, a culture also adjust to the other cultures of its milieu, to the superorganic part of its environment. (…) Cultures are organizations for doing something, for perpetuating human life and themselves. Logically as well as empirically, it follows that as the problems of survival vary, cultures accordingly change, that culture undergoes phylogenetic adaptive development" (Sahlins 1973, p.24).

Second: Where and how is sciencing enlaced/ taking place within the social organism?

As we have heard society can be observed from two different perspectives. Either one wishes to understand the composition or structure of society or one wishes to understand (evolutionary) change and development. Now if one wishes to look for a specific phenomenon or mechanism in society one needs to operate with these two different perspectives. If we ask where and how sciencing is enlaced in the social organism one must not look for it in the composition or morphology of society (infrastructure, structure, superstructure), but in the information network, which is *culture*. The information network shares information through both sciencing and arting. Information that derives directly from nature or concerns the natural environment (resources) is networked/processed through sciencing. Information that derives from the social environment is networked through arting. Both are equally important for the maintenance of the structure of society.

Perspective 1: composition of society

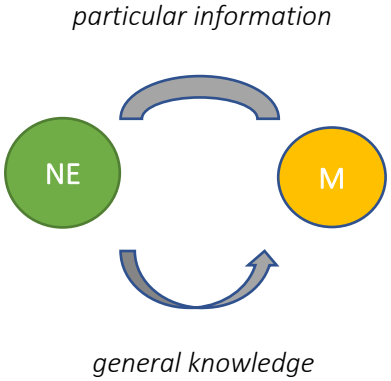
Sciencing is precisely the way of processing *particular information* (experience) about the natural environment into *general knowledge* about the natural environment. The goal throughout this process is to produce knowledge that, in turn, can be used to produce technology. This is a specific way of coping with the environment and of using its resources on a societal level. The aim on a metalevel then is the morphological cohesion of society, more precisely the cohesion of its structure.[23]

A common mistake when working with this model is that *science* or sciencing gets confused with *academia*. It is important to note that these two terms refer to completely different concepts and levels of analysis.

Sciencing, as used in White´s context, refers to an overall mechanisms that guides society as such and is part of the entire information network culture. It is a mechanism that guides human behaviour ever since the symbolic faculty emerged.

Academia, on the other hand, is comparatively a very recent phenomenon, an institution that is only existent in particular types of societies (not in hunter-gatherer societies for example)[24]. It is a phenomenon that emerged in the history of mankind in specific societies with a certain level of complexity.

In that sense we are dealing with a universal mechanism on the one hand and with a specific social phenomenon on the other. This again shows us that the two of are not comparable but are rather matters on very distinct levels of analysis.



Sciencing = way of interpreting reality = way of coping with (natural) environment = way of behaving

Goal: to produce technology/skills

➔ Morphological cohesion (cohesion of structure)

[23] At this point "structure" refers to the model of infrastructure, structure and superstructure that has been described with Elwell (1991).

[24] Moreover academia consists of institutions of science and of art.

Operationalizing this model would mean to find out within which realms this process is exactly taking place and how. This model of a universal mechanism is only the starting point for an anthropological inquiry on specific cultural implementations and at length aims at analysing particular cultural behaviour.

Based on the following concept of sciencing, "processing *particular information* (experience) about the natural environment into *general knowledge* about the natural environment", we first would need to ask:

What is the actual practice of engaging with the natural environment?

Which general knowledge is needed in the particular society to produce which kind of skills and technology?

Who is processing information experience about the natural environment?

Perspective 2: society under evolutionary change

The following model of the evolutionary development of sciencing and arting originates from a general evolution perspective.

I argue that the emergence of the symbolic faculty was an outcome of biological evolutionary processes. This occurrence laid the fundament for rational and emotional reasoning. It was these abilities (inherent to every human individual) that, in turn, rendered possible the development of the mechanisms of sciencing and arting on a societal level.

In that sense we need to distinguish the outcomes of biological evolution (scientific and emotional reasoning) from the outcomes of social evolution (sciencing and arting) – which again demonstrates that scientific and emotional reasoning and sciencing and arting cannot be compared to each other since they need to be regarded as conceptually different phenomena because biological evolution is clearly about the process of evolution of the biological organism (Homo) whereas social evolution is about the process of the evolution of society and culture (humanity).

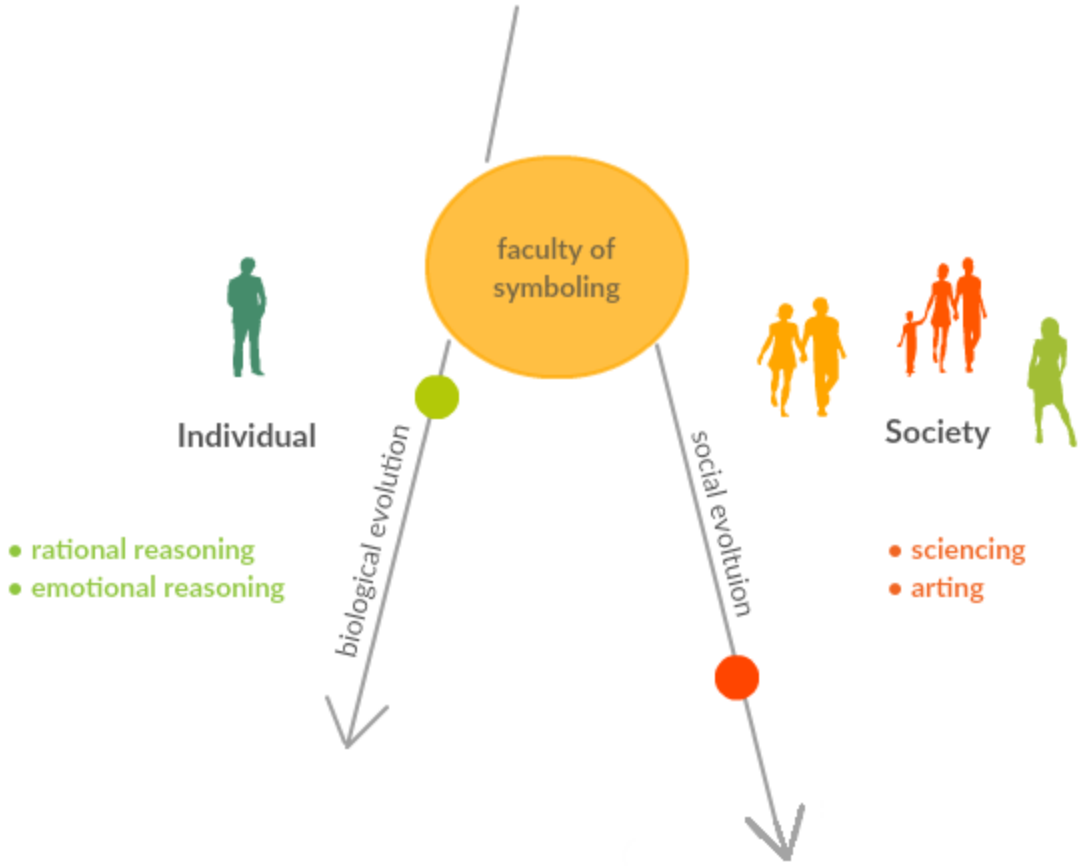


Figure 4. Model of the evolutionary development of sciencing and arting

c) Detecting sciencing among hunter-gatherer societies - example: tracking

What can be detected as a social reality of sciencing among hunter-gatherer communities? In what realms do the members of society process *particular experience* about the natural environment into *general knowledge* about the natural environment? In what way do they produce knowledge that, in turn, can be used to produce technology?

One example for social realities that are guided by the mechanism of sciencing is tracking. Trackers are able to interpret spoors and activities of animals in order to understand and predict their sex, age, pace, movements, feeding- and mating habits. To do so trackers obviously need to hold complex knowledge of animals´ behaviours during different times of the day as well as within different periods of the year. They need to know their individual behaviour, their group behaviour as well as specific aspects of encounters with other species.

Coming back to the questions posed in the previous chapter - What is the actual practice of engaging with the natural environment? Which general knowledge is needed in the particular society to produce which kind of skills and technology? Who is processing information (experience) about the natural environment? – we can conclude that tracking is a skill which can be interpreted as a technology on a societal level. It is the tracking skill that enables the whole social organism to engage with the natural environment it is surrounded by.

Tracking is the hunter-gatherer's way of processing particular information about the natural environment into general knowledge. Experiences such as fresh elephant tracks, an encounter with a leopard, mating sounds of a lion or dry springhare droppings are collected and used to build up a stock of general knowledge on animal behaviour.

The activity of tracking obviously builds on the scientific reasoning abilities of the individual in the first place. Nevertheless tracking could never become the basis of a subsistence strategy (and therefore the basis of survival) if it would not be enlaced in the entire social organism. Thus tracking is not only a skill of an individual hunter but a technology that is intertwined in the entire social organism.

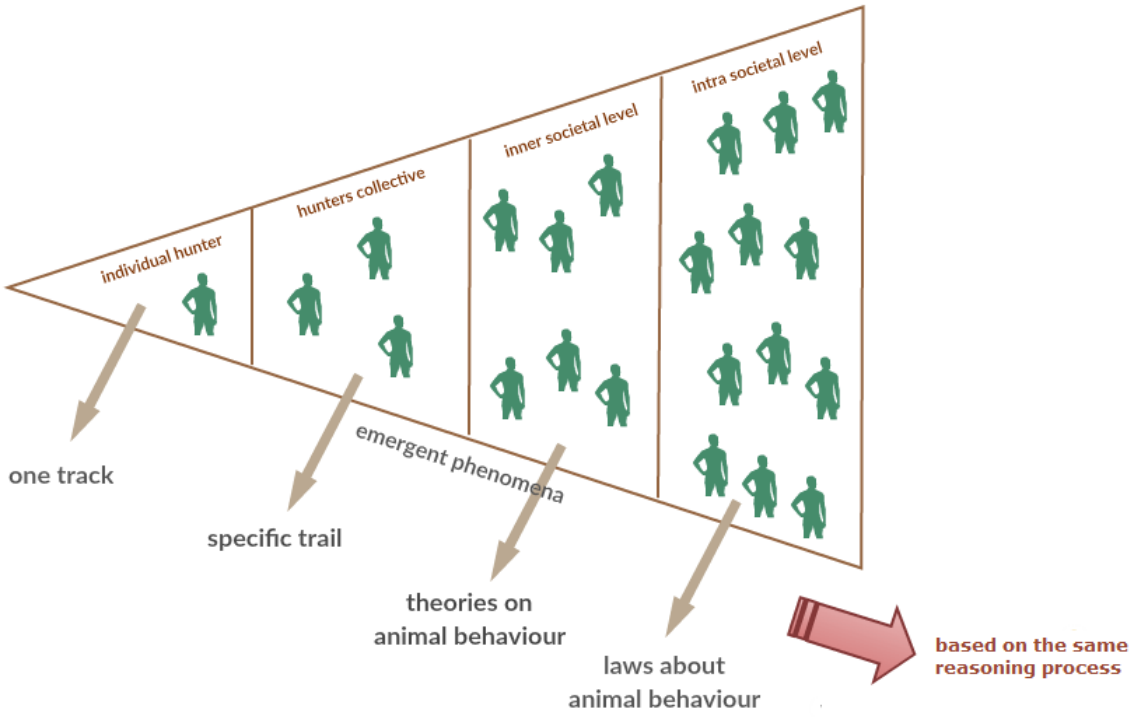


Figure 5. Sciencing on a societal level

What this graph shows is that in order for theories and laws on animal behaviour to be integrated in the general knowledge base of a community the entire incorporation on a societal level is required. It is the entire information network (culture) that needs to be geared to the integration of these specific kinds of general knowledge.

One individual hunter is not able to produce a universally acknowledged law on feeding habits of a kudu. Yet it is the individual hunter who may recognize a specific track but the follow up process of surveying the whole trail is only possible through the engagement of the whole hunters collective. In this way all of these steps are happening on the level of the hunters collective: interpretation of signs, continuous conjecture and refutation by implicating new signs and drawing conclusions.

The development of theories and laws on animal behaviour on the other hand are more complex and longsome endeavours (in order to come up with a theory the community needs a bigger number of hunters to identify case examples, for conjecture, refutation and the drawing of conclusions) and therefore might only be possible on inner- and intra societal levels. However, ethnographic studies would be required to strengthen this hypothesis.

d) Where can arting be detected then?

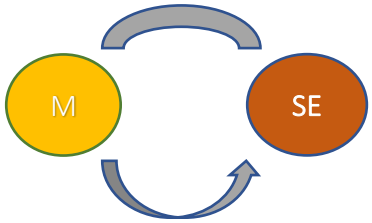
Unfortunately Leslie White´s work lacks any explanation of *art* and *arting* whatsoever. Although the specification of arting as being *the* counterpart to sciencing makes up a large segment of the argument, he does not come up with a precise definition.

The following concept follows from an opposition of science and art as such and, from a logical deduction, from the analysis of sciencing. Hence I hypothesize that also arting needs to be regarded on two different levels: first on the level of the individual organism and therefore as a reasoning process, and second on the level of the social organism and therefore as a mechanism that guides human behaviour.

The counterpart to scientific reasoning subsequently must be something like *artistic reasoning.* But what does that mean? The hypothesis is that when an individual interacts with other human beings its reasoning process is based on an emotional strategy. Therefore we rather speak of *emotional reasoning.* This reasoning process follows the rules of the individual organism and might be governed by the endocrine system. Also here, the aim of the organism is to keep itself stable and to adapt behavioural patterns or thinking patterns when necessary.

Arting on the other hand is the way of processing *general knowledge* about the social environment into *particular experience*. In other words, producing empathy (emotions) among individual members (particular experience) of a society so that, on a metalevel, the cohesion of the superstructure[25] is ensured. It is the entire information network (culture) that needs to be geared towards the evocation of particular experience, or better *emotion*. This is the strategy of the social organism to strengthen ideologies (superstructural level).

general knowledge



particular experience

Arting = way of interpreting reality = way of coping with (social) environment = way of behaving

Goal = to produce empathy / ideology

➔ cohesion of social structure (cohesion of superstructure)

Important to note is that art or arting must not get confused with institutions that deal with art (i.e. a museum) as these two terms refer to entirely different concepts and levels of analysis. Museums, and institutions alike, are expressions of arting on the level of the social organism. Arting, as used in White´s context, on the other hand refers to an overall mechanism that guides society as such and is part of the entire information network, called culture. It is a mechanism that guides human behaviour ever since the symbolic faculty emerged.

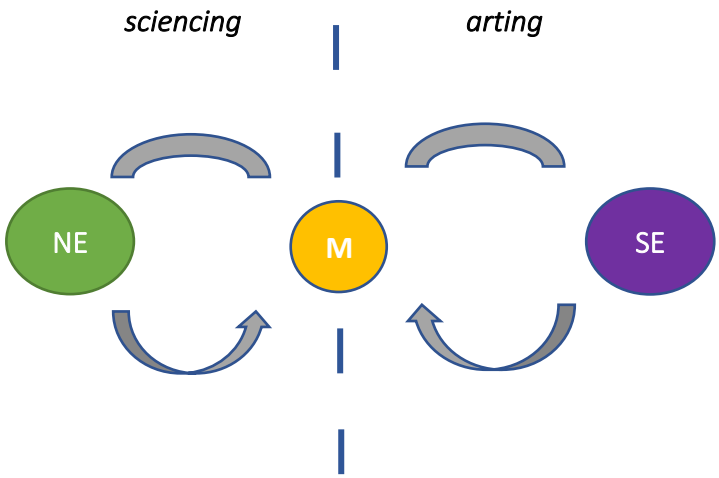
Museum on the other hand is comparatively a very recent phenomenon. An institution that is only existent in particular types of societies (e.g. not in hunter-gatherer societies). It is a phenomenon that emerged in the history of mankind in specific societies with a certain level of complexity.

In that sense we are dealing with a universal mechanism on the one hand and with a specific societal phenomenon on the other. This shows us that the two are not comparable but are rather phenomena on very distinct levels of analysis.

[25] At this point "superstructure" refers to the model of ´infrastructure, structure and superstructure´ that has been described with Elwell (1991).

Examples of arting on the societal level might be the medial sympathizing of the British royal family. The emphasis on private and personal facts about the Queen, the princes and their wives and families are an example of turning general information, in this case about the political system of the monarchy, into particular experience, more precisely into emotions towards the family members. The construction of empathy towards the royal family on a superstructural level is connected to the political organization of monarchy on a structural level.

Finally, putting sciencing and arting together as two ways of dealing with experience make up major guides of human behaviour. It is these mechanisms that channel and direct interactions between man and the natural environment as well as man and the social environment. Both is equally important for the maintenance of society.



Obviously the depiction of arting needs much elaboration. Many important questions remain: What is the cognitive procedure of emotional reasoning? And is it really connected to the endocrine system? If yes, how exactly? What is the pendant to hypothetico-deductive reasoning? In what realms of social reality can arting be detected?
How, when and why did emotional reasoning and arting evolve in the course of evolution? Is arting the origin of empathy? These and many other questions need to stay unanswered for now. Ethnographic fieldwork might be able to give rise to answers and new hypotheses. Participant observation of tracking in a structurally simple society sheds light on various aspects

of sciencing – now the aim is to find an example of arting among hunter-gatherer societies and to try testing the presented hypotheses.

4 Conclusion

There were three initial questions that functioned as the impetus for this paper: What is science? Where does it come from? And what is it there for? These fundamental issues are huge in their scope and can definitely be approached from different angles. Every chosen approach additionally is multidimensional, i.e. it can be classified into its epistemological, theoretical, methodological and ontological dimension.

The angle that has been chosen here is the field of tracking. The examination of tracking skills governs the argumentation in terms of the content. The dimensions in the realm of philosophy of science on the other hand are guided by the following assumptions and principles: the principle of evolution, the assumption that explanations on socio-cultural phenomena are not to be looked for solely in individual thinking or behaving patterns but on a societal level, the assumption that changes on different levels of societal organization are governed by an infrastructural determinism (and its intrinsic feedback loops) and the principle that man compared to animals is not different in degree but in kind.

What could be shown through the investigation of tracking skills and procedures of current San trackers and hunters in the Kalahari Desert is that there are strong parallels with the process of scientific reasoning applied by modern scientists. Speculative tracking, exercised among hunter-gatherers since at least 70.000 years, is based on hypothetico-deductive reasoning which involves the explanation of observations in terms of hypothetical causes. This process is congruent with the reasoning processes of scientists in modern academia (Liebenberg 2013).

Yet not only the individual reasoning processes but also the holistic procedures from observing a problem or a single spoor until the final conclusion (solving the problem) exhibits strong parallels.

Academic scientists	San trackers
defining the problem	direct observation in terms of "observing the problem"
reviewing pre-existing data and hypothesis	recognition of all surrounding signs (with all senses)
formulating the hypothesis	interpretation of signs in terms of creative hypothesis
collecting new data and test hypothesis	continuous conjecture and refutation by implicating new data
drawing conclusion	drawing conclusion
publish the results	Sharing knowledge within community (e.g. by storytelling)

Additionally it has been shown that both modern scientists and trackers apply the following general criteria in their operations: systematics, logic and objectivity.

All this evidence points to the fact that tracking (simple, systematic and speculative) might be an indication for the universality of scientific reasoning.

Now if scientific reasoning is a unique ability of mankind when and how did it evolve? Leslie White´s hypothesis partly serves as an answer to this question. He states that through biological evolution the mechanism of natural selection brought about the unique human ability of man to use symbols (and signs) as a means of information exchange.

We heard that whereas signs *indicate* some other things or events, symbols *represent* other things or complex events (e.g. the height of a column of mercury in a thermostat opposed to a Christian cross). Symbols fulfil an extended function in a sense that they carry meaning and information that is more complex than that of a sign.

Since animals communicate via signs only the evolutionary emergent phenomenon demarcated human beings from animals ever since. Concerning tracking we know that animals merely use their distinctive senses to track down their prey whereas man, additionally to the sensory recognition of its physical form, receives a higher and more complex meaning of a sign by attaching a symbolic character to it. "One cannot tell by looking at an x in an algebraic equation what it stands for; one cannot ascertain with the ears alone the symbolic value of the

phonetic compound *si;* one cannot tell merely by weighing a pig how much gold he will exchange for; (…) The meaning of a symbol can be grasped only by non-sensory, symbolic means“ (White 1949, p.26). Accordingly we can conclude that it was exactly this symbolic faculty that finally enabled Homo sapiens to apply hypothetico-deductive reasoning.

Taking the debate on the universality of scientific reasoning to another level of analysis, namely to a socio-structural level, Leslie White came up with the model of science and art. He describes human behaviour to be guided by the mechanism of sciencing. That is where he detects *universals of human behaviour.* However, the question to be asked when enquiring about the universals of behaviour is how do people generally deal with their environment and with their experiences? It is not about behavioural concepts such as aggression, altruism or jealousy being interpreted as universal human behaviour that is inherent to every human being. Rather, and that is White´s main point, all human behaviour is guided by the same *universal mechanisms*. Independent of time and place human behaviour is driven by the same mechanisms ever since the symbolic faculty emerged. So it is not the sorts of behaviour that are universal (aggression, altruism, etc.) but the mechanisms that are guiding the different kinds of behaviour.

This is a very fundamental assumption and therefore requires a thorough examination. Now, whereas an amplification of Liebenberg´s hypothesis was a detailed comparison of both trackers´ and academics´ concrete modes of operations the amplification of White´s hypothesis on *sciencing* (and arting) comprises four aspects.

First, the cognitive strategy of hypothetico-deductive reasoning needs to be distinguished from the mechanism of sciencing on a societal level. These are two conceptually different phenomena that need to be located on two different levels of analysis (level of the individual organism vs. level of societal structure).

Second, some thoughts and ideas have been shared concerning the operationalisation of White´s model on sciencing and arting. If we ask where and how sciencing is enlaced in the social organism it would mean to find out within which realms this process is exactly taking place and how. Fact is that one must not look for it in the composition or morphology of society (infrastructure, structure, superstructure), but in culture.

Based on the concept of sciencing - processing *particular information* (experience) about the natural environment into *general knowledge* about the natural environment - we would first need to ask: What is the actual practice of engaging with the natural environment? Which general knowledge is needed in the particular society to produce which kind of skills and

technology? Who is processing information experience about the natural environment? These questions would be the starting point for an investigation that at length aims at analysing particular cultural behaviour.

Third, tracking is shown to be an example of the phenomenon of sciencing on a societal level. Tracking is a way of processing particular information about the natural environment into general knowledgea a type of skill that enables the whole social organism to engage with the natural environment it is surrounded by.

The activity of tracking obviously builds on the scientific reasoning abilities of the individual in the first place. Nevertheless tracking could never become the basis of a subsistence strategy (and therefore the basis of survival) if it would not be enlaced in the entire social organism. Thus tracking is not only a skill of an individual hunter but a technology that is intertwined in the entire social organism.

The fourth critical aspect concerns the mechanism of *arting.* Although White does not come up with an exact definition or explanation of arting I hypothesize that also arting needs to be regarded on two different levels. First on the level of the individual organism and therefore as a reasoning process and second on the level of the social organism and therefore as a mechanism that guides human behaviour.

Emotional reasoning is the process man is engaging in when interacting with other human beings. This reasoning process follows the rules of the individual organism and might be governed by the endocrine system. *Arting* on the other hand is the way of processing *general knowledge* about the social environment into *particular experience*. In other words, producing empathy (emotions) among individual members (particular experience) of a society so that, on a metalevel, the cohesion of the superstructure[26] is ensured. It is the entire information network (culture) that needs to be geared towards the evocation of particular experience, or better *emotion*. This is the strategy of the social organism to strengthen ideologies on a superstructural level.

At this point it is crucial to accredit the fact that considerations regarding arting and sciencing remain rather inexplicit and need to be strengthened. Obviously at this level they mainly comprise first reflections and serve for further basic research. However, the aim at length is to operationalize these assumptions in order to come up with falsifiable hypotheses.

[26] At this point "superstructure" refers to the model of infrastructure, structure and superstructure that has been described with Elwell (1991).

Nonetheless, apart from these open questions the main conclusion of this paper states that science is an innate ability of mankind. The concept of science cannot be attached to a specific time and cultural constitution but rather needs to be recognized as an evolutionary product that evolved through the mechanism of natural selection. In that manner science is not “man-made”. It did not culturally evolve in ancient Egypt. It was not invented by the ancient Greeks such as Hippocrates and Aristotle and it is not an achievement of European Renaissance. We must furthermore be careful not to confuse the act of *sciencing* with scholarly disciplines. Science does not equal to the sum of present seemingly “scientific disciplines” such as physics, mathematics, biology, geography and alike. Science is a modus operandi in terms of recording experience. Therefore, in its essence, it is not an entity, not an institution, not a part of societal structure. Instead, *to science* is (simply) a way to capture and describe (one´s own) experiences and therefore reality.

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List of Abbreviations

WIMSA	working group of indigenous minorities in Southern Africa
MET	(Namibian) ministry for environment and tourism
NNC	Nyae Nyae Conservancy

Abstracts

English Abstract

By investigating tracking skills and procedures of current San trackers and hunters in the Kalahari Desert we see that there are strong parallels with the process of scientific reasoning. Speculative tracking, exercised among hunter gatherers since at least 70.000 years, is based on hypothetico-deductive reasoning which involves the explanation of observations in terms of hypothetical causes. This process is congruent with the reasoning processes of scientists in modern academia. Furthermore, the principle of cause and effect, the principle of objectivity, the principle of emics and etics are concepts that both trackers as well as scientists are fundamentally concerned with.

In terms of explaining the evidence I propose the following hypothesis: The mechanism of natural selection brought about the unique human ability to use symbols and signs as a means of information exchange. This faculty essentially enabled Homo sapiens to science and to engage with its environment in a rational manner - interpreting tracks and signs, establishing hypothesis, exchanging information, testing hypothesis against new data and drawing conclusions. Conversely the faculty of tracking (simple, systematic and speculative) is an indication for the universality of scientific reasoning among human beings.

A critical examination of Leslie White´s model on *sciencing* furthermore shows that the hypothesis can even be expanded to a societal level. Sciencing might be a mechanisms that universally guides socio-cultural behaviour.

Deutscher Abstract

Tracking Fähigkeiten und Praktiken (Spurenlesen) der San Jäger und Sammler in der Kalahari Wüste Namibias weisen starke Parallelen mit wissenschaftlichen Schlussfolgerungsprozessen aus der westlich akademischen Praxis auf.

Speculative Tracking (deutsch spekulatives Spurenlesen) wird von Jäger und Sammler Gruppen bereits seit mindestens 70.000 Jahren aktiv praktiziert. Diese spezielle Form des Spurenlesens baut auf einem hypothetisch deduktivem Schlussfolgerungsprozess auf. Dies bedeutet, dass die Erklärung einer Beobachtung in ihrer Essenz auf Spekulation und folglich auf dem Erstellen von Hypothesen aufbaut. Derselbe Schlussfolgerungsprozess findet im akademischen Kontext statt

wenn es darum geht wissenschaftliche Problemstellungen zu lösen oder zu erklären. Überdies werden Konzepte wie das Ursache-Wirkungs-Prinzip, das Objektivitätsprinzip und das Prinzip von Emik und Etic sowohl von AkademikerInnen als auf von Trackern aktiv angewandt.

Zur Erklärung dieser Parallelen wird folgende Hypothese aufgestellt:

Im Zuge natürlicher Selektion kam es zur Herausbildung der menschlichen Fähigkeit Symbole und Zeichen als Mittel des Informationsaustausches einzusetzen. Diese Entwicklung befähigte Homo sapiens schließlich zu spekulativem und kreativem Denken. So wurde auch ein wissenschaftlicher und rational geprägter Umgang mit der eigenen Lebenswelt möglich – nämlich durch die Interpretation von (Tier-) Spuren, das Aufstellen von Hypothesen, den gegenseitigen Informationsaustausch, das Testen von Hypothesen im Vergleich mit anderen Daten sowie das Ziehen von logischen Schlüssen.

Im Umkehrschluss kann also angenommen werden, dass die jahrzehntausende alte Tracking Praxis Homo Sapiens´ ein Indikator für die einzigartige menschliche Fähigkeit wissenschaftlichen und rational geprägten Schlussfolgerns ist.