Joseph Jordania

A New Model of Human Evolution

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How Predators Shaped Human Morphology and Behaviour

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Cover image: www.ingimage.com

Publisher:
LAP LAMBERT Academic Publishing
is a trademark of
International Book Market Service Ltd., member of OmniScriptum Publishing Group
17 Meldrum Street, Beau Bassin 71504, Mauritius

Printed at: see last page
ISBN: 978-3-330-07320-3

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Joseph Jordania

A New Model of Human Evolution: How Predators Shaped Human Morphology and Behaviour

To the memory of
Charles Darwin and
Alfred Russel Wallace

Editors:
Alexander Jordania,
Keith Buffey

This is the second, updated and extended version of the book
"Tigers, Lions and Humans: History of Rivalry, Conflict, Reverence and Love"
(Tbilisi State University, Logos, 2014)

Contents

Foreword 11

CHAPTER ONE

Beginnings 14
Humans and Lions: Evolutionary Twins? 14
The Greatest Migration in Human History 22
Survival Guide for those Who Want to Live on the Ground 23
Singing Lovers are Invited to the Tree Branches 28
When Silence is Golden 28
Excitement and Fear of the New Environment 31
Surviving Predators: Animal and Human Defence Strategies 33
Human Defence Strategies: The Short Survey 34
Hunter, Hunted or Scavenger? 39
Hide, Run, Fight, Bite: Survival Strategies in Animals 42
1. If you cannot see me, you cannot eat me! 43
2. Silence is golden! 44
3. Stay clean and survive! 44
4. Run for your life! 46
5. Be stronger! 46
6. Get bigger teeth! 47
7. Have a thicker and stronger hide 48
8. What about to try to scare away a predator? 49
9. “Bigger kids do not get bullied” 50
10. Stand on your hind legs 52
11. Make threatening sounds 52
12. “I have big eyes and I can see you!” 53
Summary 55
Early Hominid Defence Strategies 56
Did Our Primate Ancestors Become More Invisible to Escape Predators? 56
Did Our Ancestors Become Silent After They Descended to the Ground? 57
What about Escaping Predators with Running? 58
Possibly It Was Sheer Physical Strength? 59

What about Teeth? 60
Hide Behind the Thick and Tough Hide 61
Summary 61

CHAPTER TWO

Aposematism: When the Interests of Prey and Predator Species Coincide . 63
Short History of the Idea of Aposematism 70
A Few Facts and Ideas about Aposematism 76
Bluffing Is Not Enough! 80
Constant and Temporary Aposematic Signals 81
Visual signals 81
Audio signals 85
Olfactory signals 88
Behavioural signals 89
Conclusions 91
The Importance of Being Earnest 92
Conclusion: Aposematism, Cold War and Peace 95
Can a Predator Be an Aposematic Species? 96
A Few Words on Sexual Selection from the Point of View of Natural Selection 99
Aposematic Index: How to Distinguish Aposematic Species 103
Skunk – Classic Case of Aposematism 106
Porcupine – Another Classic Case 107
Norwegian Lemming – Unknown Classic 108
Is There an Elephant in the Room? 109
Gorilla – The Scary Gentle Giant 111
Peacock – The Rise and Fall of a Symbol? 113
Tiger: The Silent Beauty 120
Lions: When Gender Matters 123

CHAPTER THREE

The Descent of Men, and Selection in Relation to Aposematism 127
Visual Signals 130

"The taller the better" or the origins of human bipedalism 130
List of ideas on human bipedalism 132
Long legs: Receipt of beauty and survival..... 143
The mystery of the long head hair 147
Height-weight ratio (HWR)..... 149
Colours! More colours!..... 152
Colours of shame and rage 153
How old is the tradition of body painting? 156
Colour of blood: The colour of life and death..... 159
Clothes: For cold or for show? 161
Behind the mask..... 166
Audio Aposematic Signals 169
Silent killer 170
Avoiding silence – the mystery of contact calls..... 171
Humming as contact calls 174
Whistling, finger drumming, teeth drumming and musical worms 175
Mystery of swan song..... 177
Several practical suggestions: Why and how to avoid silence 178
Vocal grooming, choral lullaby, and elevator music 180
Origins of music and the battle trance..... 183
Theories of music origins..... 185
Origins of human choral singing behaviour..... 194
Mobbing in animals and humans, or the history of human war cry 197
Group vocalization 199
Rhythm..... 199
The Sign of Four, or why Paul McCartney's "Yesterday" is truly unique .205
The importance of low range voice..... 208
Thrilling octaves..... 211
The magic of harmony..... 212
Dissonance: The ultimate sound..... 213
Drumming as a defence tool..... 216
Killing sounds, or why dolphins do not like rave parties..... 218
Olfactory Display, or Why do Humans Have Body Odour..... 223

Behavioural Signals, or Stop for Your Life 227
Whatever You Do, Don't Run! 227
Flight, fight or freeze 235
On aggression, avoiding aggression and bravery 239
Battle trance and collective identity 242
Human sexuality, homosexuality and bisexuality, or who can defeat 300 Spartans? 248
"I love you:" The true meaning of the important words..... 258
Conclusions: Quantifying Human Aposematic index 260
Humans as Aposematic Species: Implications, Paradoxes, Perspectives .. 262
Why we all like to be unique?..... 263
Aposematism and the birth of beauty 265
Can handicap principle be true? 267
Let's get aposematic: We are going to party!..... 268
Oops, Almost Forgot: Primate Behaviour as the Model for Early Hominid Behaviour..... 269

CHAPTER FOUR

The Weapon..... 271
Throwing: For Hunting or for Defence? 277
Division of Defence Roles in Hominids 280
The Beginning of Stone Tool Industry 283
Were Stones the First Talismans in Human History? 284
Night Time Defence Strategies 286
Eyespots in Homo sapiens..... 287
Body Odour as a Night Guard 292
Fight Over the Bodies of Fallen Fighters..... 294
Cannibalism, Rituals, Love and Violence..... 296

CHAPTER FIVE

Rivalry, or the Role of Lions in Human Evolution 304
New Diet: Meat, And How to Get It 305
Why Humans Love Lions and Hate Hyenas 309

Intensifying Conflict: Decline of Physical Strength, Canines and Fur Covered Body 314
Contest and Truce 316
The Lion, as the First God of Humanity 323
The End of the Ancient Truce 324
Conclusions: Three Epochs of Relationship 325
The Epoch of Tree Branches 326
The Epoch of Open Woodlands 326
The Epoch of Open Grasslands 328
In Which Epoch do We Live Today? 330
Why Humans Eat Big Cats? 334
Are the Times Changing? 336
Human Evolution – or Human-Big Cat Co-evolution? 338
Lion Sociality in the Context of Early Lion-Human Rivalry 345

CHAPTER SIX

The Story of the Tiger 352
Tigers and Lions 354
Decline of Tigers 360

CHAPTER SEVEN

Leonardo da Vinci's Masterpiece, or Why We Love Cats 363
Humans on Cats 363
Cats and dogs 373
Why do Humans Love Cats? 378
Cats across the Ages 380
Egypt, or the Cat's "Golden Age" 384
From God to Satan: Medieval Europe, or the Cat's Dark Age 387
Do We Live in an Era of Cat-mania? 393
Is it Possible to Hate Cats and Kittens? 400

CHAPTER EIGHT

Conflict: Man-Eating Cats 405

Why Do Some Big Cats Become Man-Eaters? 407
Accidental Start 408
Wounds and Decline of Food Resources 409
Scavenging 410
Competition for Food Resources 411
Mistaken Identity 412
Salinity and Inability to Mark Territory as a Contributing Factor 413
Differences Between Man-Eating Tiger and Lion Behaviours 415
Gender 415
Time of the hunt 418
Place of hunt 419
Attacking in groups 422
Attacking behaviour 424
Learning man-eating behaviour from others 425
Conclusions: Why Don't All Big Cats Hunt Humans? 426

CHAPTER NINE

Human Intelligence vs. Cat's Sixth Sense 429
Can Cats Feel Human Death? 433
Going Home, or When the GPS Was Invented 436
Psychic Power Struggle 440

CHAPTER TEN

Friendship: Tiger Therapy, Sounds from God, and John Lennon's Double Fantasy 444
With Tigers in Bed 446
Tiger Therapy 449
Tiger Mantra 449
Nowhere Man in the Middle of Nowhere 451
Touching God 454
Depressed God 458

CHAPTER ELEVEN

Individual Selection, Group Selection, and Multi-Level Selection, as Seen through the Eyes of a Dutch Counterintelligence Officer 461
Group Selection vs. Individual Selection: Match in Six Rounds for the Title of "Undisputed Champion of Multi-Level Selection League" 463
Round 1: To have a long life of each individual animal is good for the individual animals, but bad for the group 463
Round 2: To have predators around is bad for the individuals, but is good for the group 465
Round 3: Altruism is bad for the individual but is good for the group 465
Round 4: Having a comfortable life is good for the individual but bad for the group 466
Round 5: Having a tough life, when the big portion of the group is eliminated in a struggle for survival, is good for the general health of the group, but is catastrophic for individuals 467
Round 6: The same is true of death. Basically, death is a tragedy for the individual, but the death of an individual is good for the group 467
From Groupishness to Individualism 469
Conclusions 474
Epilogue 480
Acknowledgements 483
REFERENCES 486
INDEX 523

Foreword

Human evolution is among the rare academic spheres that grab the attention of a wide audience. What kind of forces were involved in turning one of the African primate species that descended from the trees some five million years ago, to become the single most dominating species in the history of Earth? Why we are so overtly social and sexual? Why we are universally involved in communal singing, dancing and the painting of our bodies? Why do we have a sense of rhythm, walk on two feet, or have virtually no hair on our bodies while sporting long hair on our heads?

For a long time, humans seemed so different from animal species that it was believed that we had a different, much more divine origin. Certainly, there are features that distinguish human from animals, but all these features are relatively superficial. We have much more features that unite us to our animal brothers and sisters than those that divide us. There is no question that humans came out from the animal world, and that the same evolutionary powers that formed countless animal species also shaped humans as well. It is no accident that the sphere of evolutionary ecology, the sphere that studies the evolutionary forces that shaped animal species and their behaviours, covers the issues of the evolution of human morphology and behaviour as well.

People are fascinated by human evolutionary history primarily because this is our own history, and we are of course naturally very interested in ourselves. Besides this general interest, the study of our evolutionary past can provide us with a key to many of our contemporary questions and problems. Therefore, it is hardly surprising that the subject of human evolution attracted the endless attention of biologists, paleoanthropologists, primatologists, archaeologists and evolutionary psychologists, to name a few.

The titanic figure of Charles Darwin dominates virtually every aspect of the study of human evolution. In his classic book "On the Origin of Species", published more than 150 years ago, Darwin dedicated only one sentence to the issue of human evolution. This one sentence was so powerful that when Darwin's second great book "The Descent of Man", fully dedicated to the study of human evolution, came out in

1871, the general public was already prepared for the shocking central thesis that humans descended from animals, and that we still share many common features with them.

The evolutionary forces that formed the human species, that made us a bipedal, hairless, toolmaking, talking, singing and dancing species, are still debated. In his 1871 book, Charles Darwin answered the great question of human evolution by proposing that the key factor was the power of sexual selection. For Darwin, the driving force of human evolution was the male desire to obtain mating opportunities with as many female partners as possible. The winner in this evolutionary race was determined by the number of descendants. Darwin's book on human evolution was fully dedicated to sexual selection, and this was clear even from the full title of the book "The Descent of Man and Selection in Relation to Sex." The book caused controversy from the day it was published, and I am not even referring to criticism towards Darwin's work coming from clergy and religious circles. Even some of Darwin's closest friends and supporters (like Alfred Wallace, co-discoverer of the principle of natural Selection) were not convinced that sexual selection was such an important evolutionary power, even in the case of human evolution. The hypothesis proposed by Darwin is still being debated to the present day.

In attributing all the major abilities that humans developed to the power of sexual selection, Darwin completely neglected one of the greatest forces in the evolution of any species – predators. As he could not see that any of the evolutionary developments could be linked to the pressure exerted from predators, Darwin even mused whether humans evolved somewhere on a warm continent or a big island (like Australia, New guinea or Borneo), in a safe environment without any danger from major predators. Here are Darwin's concluding words of the fourth chapter of his 1871 book:

"*The early progenitors of man were, no doubt, inferior in intellect, and probably in social disposition, to the lowest existing savages; but it is quite conceivable to consider that they might have existed, or even flourished, if, while they lost their brute-like powers, such as climbing trees, etc., they at the same time advanced in intellect. But granting that the progenitors of the man were far more helpless and defenceless than any existing savages, if they inhabited some warm*

continent or large island, such as Australia or New Guinea, or Borneo (the latter island being now tenanted by the orang), they would not have been exposed to any special danger. In an area as large as one of these islands, the competition between tribe and tribe would have been sufficient, under favorable conditions, to have raised man, through the survival of the fittest, combined with the inherited effects of habit, to his present high position in the organic world" (citation is from the Princeton University Press 1981 edition, pg.157).

Today we are sure that humans did initially evolve in Africa, an environment known for its abundance of predator species (Darwin also proposed this possibility). Therefore, it is inevitable that there was pressure on our distant ancestors from the African predators. This pressure must have also inevitably intensified after our ancestors had descended from the relatively safe trees to the predator-infested ground floor. This brings us to the question: **how were our distant ancestors dealing with predators? This will be the central question of this book**.

This book is an attempt at proposing a new, alternative model of human evolution, based on a totally different evolutionary force. I will argue that it was not sexual selection, but in fact the pressure from major African predators, that formed the majority of human morphology and behaviour. The new model of human evolution proposed in this book is based on a specific strategy of survival and predator control, known as "aposematism". This new model of evolution could be named as the "aposematic model of human evolution." It is likely that not many readers will be familiar with this technical term from evolutionary ecology. We will have plenty of time for explaining and breaking down this term, and how the aposematic defence operates.

To finish this short introductory note, let me state one more time that, in this new alternative model of human evolution, I am proposing that the long and intense pressure from African predators, particularly modern-day big cats and their ancestors, was the crucial evolutionary factor that shaped how we look and behave in the present day.

CHAPTER ONE

Beginnings

Humans and Lions: Evolutionary Twins?

Let's start from the very beginning.

Have you ever thought what humans and lions might have in common?

Most likely you have never thought of such a strange comparison. So I suggest for the next few minutes that you read through this list of facts on the subject for the first time in your life:

• Humans are unique among all primates as they have long hair on their heads. Lions are unique among all cats as they have long hair on their heads.

• Unlike most other primates, who can easily climb trees and spend most of their time there, humans live on the ground. Unlike most other cats, who can easily climb trees and spend most of their time there, lions live on the ground.

• Human ancestors lived in the trees, but later descended and settled permanently on the ground. Lion ancestors lived in the trees, but later descended and settled permanently on the ground.

• Humans avoid living in tropical forests, although many primates live there. Lions avoid living in tropical forests, although many cats live there.

• Humans have a powerful voice, which they use effectively to frighten their enemies and competitors. Lions have a powerful voice, which they use effectively to frighten their enemies and competitors.

• More specifically, humans routinely use loud group vocalizing in order to intimidate and scare away their enemies and competitors. More specifically, lions routinely use loud group vocalizing in order to intimidate and scare away their enemies and competitors.

• Humans produce a soft humming sound which expresses contentment and serves as a contact call between group members (Jordania, 2010, 2011:130-132). Lions produce a soft humming sound which expresses contentment and serves as a contact call between group members (Schaller, 1972:86, 104; Bertram, 1972:63).

• Humans have very expressive facial features expressing many of their inner states. Lions have very expressive facial features expressing many of their inner states. Their expressions are largely identical (Schaller, 1972:83).

• Humans are social animals, and they spend most of their lives in a group with their kin. Lions, uniquely among cats, are also social animals, and they spend most of their lives in a group with their kin.

• Human females share their responsibilities of raising the young. Lion females share their responsibilities of raising the young (Schaller, 1972:146).

• Human babies are born absolutely helpless, with closed eyes, and depend on parental care. Lion cubs are born absolutely helpless, with closed eyes, and depend on parental care.

• Humans are known sometimes to resort to cannibalism. Lions are known sometimes to resort to cannibalism (Guggisberg, 1961; Schaller, 1972:220).

• Humans care about their old and crippled and they can live for years depending on food shared by the fitter members of the group. Lions care about their old and crippled and they can live for years depending on food shared by the fitter members of the group (Schaller, 1972:91, 358).

• Before going on a hunt, or to war, human societies have specific rituals (mostly based on rhythmic music and dance) to raise the morale and cohesion between the group members. Before going on a hunt lion group members use specific behaviour (rubbing heads intensely and frequently) in order to raise the morale and cohesion between the group members (Schaller, 1972:87).

• Humans have much more sex than is needed for procreation. Many hundreds of copulations occur before the birth of a baby. Lions have much more sex than is needed for procreation. Many hundreds of copulations occur before the birth of a cub (Schaller, 1972:140).

• Women continue to have sex when they are pregnant and lactating, although they do not conceive in this period. Lionesses continue to have sex when they are

pregnant and lactating, although they do not conceive in this period (Schaller, 1972:178).

• Women give birth to babies any time of the year. Lionesses give birth to babies any time of the year (Schaller, 1972:180).

• Among humans sexual life is not restricted to different sexes, homosexuality is quite widespread. Among lions sexual life is not restricted to different sexes, homosexuality is quite widespread (Schaller, 1972:88, 137; Bagemihl, 1999).

• Among humans there are instances of group homosexual behaviour. Among lions there are instances of group homosexual behaviour (Schaller, 1972: 137).

• Among humans there are instances of incest between siblings and between parents and their children. Among lions there are instances of incest between siblings and between parents and their children (Schaller, 1972:44).

• It has been suggested that sex had and still has a strong social function among hominids and humans. It has been suggested that sex had and still has a strong social function among lions (Bagemihl, 1999, Poiani, 2010).

• Women generally take more care of their personal hygiene than men. Female lions generally take more care of their personal hygiene than male lions (Bertram, 1972:59).

• Humans are known sometimes to lie to each other for personal benefit. Lions are known sometimes to lie to each other for personal benefit (Schaller, 1972:268)[1].

• Humans mostly try to avoid serious fights, instead substituting various forms of warning display (shouting, gestures) for fighting. Lions mostly try to avoid serious fight, instead substituting various forms of warning display (roaring, postures) for fighting Schaller, 1972:47).

• Humans evolved in Africa. Lions evolved in Africa.

• More specifically, humans evolved on the woodlands and open grasslands of the African Savannah. More specifically, lions evolved on the woodlands and open grasslands of the African Savannah.

[1] According to Schaller, "After having killed, a lion either begins to eat immediately or else moves the carcass to another location. On several occasions, prey was caught in high grass by a lion which then sat down and looked around casually for as long as 5 minutes, as if its hunt had been unsuccessful. It gave the impression of trying to conceal the presence of the carcass from the others that had taken part in the hunt, for as soon as these lay down or moved away it begun to eat" (Schaller, 1972:268).

• One of the most important archaeological sites for human prehistory is Laetoli in Tanzania, where the earliest (3.5 million years old) hominid footprints were found. One of the most important archaeological sites for lion prehistory is Laetoli in Tanzania, where the earliest (3.5 million years old) lion-like fossil remains were found.

• The distant ancestors of humans diverged from other primates and started their evolutionary transformations more than five million years ago. The distant ancestors of big cats (which also include lions) diverged from other felines and started their evolutionary process about five million years ago (Turner & Anto'n 1997).

• Humans first left their African cradle and started intercontinental travel just under two million years ago. Lions first left their African cradle and started intercontinental travel just under two million years ago.

• After leaving Africa, humans gradually colonized most of Asia, Europe, and North America. After leaving Africa, lions gradually colonized most of Asia, Europe, and North America.

• Humans first appeared in Europe under 1 million years ago. Lions first appeared in Europe under 1 million years ago.

• About 100 000-50 000 years ago the second wave of human populations spread from Africa, possibly replacing the earlier human populations throughout the world. About 100 000-50 000 years ago the second wave of lion populations spread from Africa, possibly replacing the earlier lion populations throughout the world.

• Most contemporary human morphology and behaviours were formed during the last one million years. Most contemporary lion morphology and behaviours were formed during the last one million years.

• From 100 000 to 10 000 years ago humans were the most widespread mammalian species in the world. From 100 000 to 10 000 years ago lions were the second most widespread mammalian species in the world (after humans). Their areas of distribution were virtually the same (except Australia where lions never lived).

• Scholars of human evolution suggested two main conflicting models of human evolution: the multiregional model (Wolpoff, 1999) and the total replacement model (also known as the Recent African Model. Stringer & Andrews, 1988). Scholars of lion evolution suggested two main conflicting models of lion evolution: the

multiregional model (Hemmer, 1974), and the total replacement model (also known as the Recent African Model. Yamaguchi, et al., 2004; see also Barnett, et al., 2006).

• And finally, both humans and lions are "regal" species. Lions are popularly considered as the "king" or animals. Humans, on the other hand, are the true and unchallenged single rulers of our planet. Despite the fact that these titles are unofficial and "unscientific", they certainly are based on a solid factual foundation, as both of these species are so-called "apex predators," or the species which resides on the very top of the food chain.

So, as we can see, humans and lions evolved in the same place and in the same time, and apart from living side by side in African woodlands and savannah, interacting on a daily basis for several million years, and reaching the status of two unrivalled kings of the planet earth, they also started their travels from their shared African cradle simultaneously, and travelled to different parts of the world at virtually the same time. This brings us to the premise that there must have been some kind of historical (or even evolutionary) bond between humans and lions.

The nature and the history of this bond is the central topic of the research of this book.

Despite this long list of parallels in their evolutionary history, behaviour and morphology, lions and humans achieved their regal rankings via totally different strategies. Lions (and other big cats) deserve the title "king" through a lethal mixture of strength, grace, beauty, and the awesome power of their teeth and claws. In short, they are perfect predators, professional killers, a true masterpiece of evolution.

Humans, on the other hand, are slow, awkward-moving, naked primates virtually without teeth and claws, and if they were left with the limited abilities of their naked bodies, they would struggle to kill even a relatively small animal. It were these physical and behavioural features that made Darwin to muse whether humans evolved in an environment without major predators. Despite these shortcomings, humans managed to reach their ruling position among animals with the help of their unprecedented mental abilities, enabling them to transform and use materials from their environment in creative and truly unique ways. There is no doubt that humans are also a true masterpiece of evolution.

So, we have two apex predators, two extremely different masterpieces of evolution, living for millions of years in the same place and at the same time, obviously interacting with each other on a daily basis, and going around the world to settle in the same regions of the world at the same times. Can this be a simple coincidence?

Quite amazingly, despite so many parallels in their history, distribution and even morphology and behaviour, these parallels between humans and lions have never been discussed in the biological sciences.

Possibly with one exception. Elizabeth Marshall Thomas, author of my favourite book on cats, wrote the following words:

"They [lions] are very much like us in their living arrangements, living in groups, sharing child care, owning territories from which others are excluded if possible, hunting cooperatively for the large antelopes but not refusing smaller animals, often hunting as a team with each participant having a special role, much like the people who also hunted cooperatively, also, sometimes, with special roles. Both the lions and the people concealed themselves only when actually stalking a victim and walked around in plain sight the rest of the time…" (Marshal-Thomas, 2006:174).

To explain these parallels, in the pages of this book I will argue that human and lion ancestors were involved in intense direct rivalry, an evolutionary "arms race" in the woodlands and the open spaces of the African savannah. It was this rivalry that turned them into two top species, two unrivalled masterpieces of evolution. To me humans and lions are "evolutionary twins," twin arch-rivals, who look and behave very differently from each other, but still show many similarities. I will argue in this book that if we want to clarify the reasons behind many human and lion morphological and behavioural changes, we need to study their evolutionary histories in their joint context.

The nature of interaction between humans and lions (or more precisely – big cats) is complex and multifaceted. On one hand, they were mortal enemies, arch-rivals who killed (and still kill) each other. On the other hand, they shared and still share an almost mystic reverence for each other. Humans overwhelmingly use the images of lions, tigers and other big cats in their cultures as gods and often deify

them. This deep reverence is also shown by the lions, tigers and other big cats towards humans as well. For some unknown (to us) reasons big cats do not usually attack and kill humans, although, hunting and killing unarmed and slow moving humans would be much easier for them than hunting their usual fast-running and horn-wielding prey. We will specifically address the origins of this mystic reverence between humans and big cats in this book.

Another good example of contradictory feelings between humans and big cats is the human attitude towards the biggest of the big cats, the tiger. For some of us the tiger is primarily a fearsome beast, potential killer and a man-eater, who killed and ate more humans than any other big cat, or possibly any other animal. Very few of us would want to meet a tiger at large, one on one. At the same time, quite mysteriously, when in 2004 the TV giant spectacular "Animal Planet" conducted a huge international survey in order to find our favourite animal, asking viewers to name their favourite animal with 50 000 respondents from 73 countries, the tiger came out as the winner of the contest, beating even such a trusted human friend as the dog.

As the readers of this book might guess, I am among many of those humans who adore big cats. More precisely, all cats. All my friends and many of my ethnomusicologist colleagues know that becoming an expert on big cats was my biggest dream from my teenage years. Well, our life sometimes takes amazing twists and turns. So, following my family tradition, I became an ethnomusicologist, an expert in traditional choral singing. Despite this, my love for big cats was always a big part of my personality and life, to the point that at the age of 20, I was arrested at the zoo for hand-feeding and petting a huge Siberian tiger. Many years later, already being an award-winning ethnomusicologist with two PhDs and several published books, I gradually came to the study of big cats. This happened initially during my work on the text of my book "Who Asked the First Question? The Origins of Human Choral Singing, Intelligence, Language and Speech" (published in 2006), and later working on the text of another book "Why Do People Sing? Music in Human Evolution" (published in 2011). Working on these books I gradually came to the conclusion that human choral singing (the subject of my primary expertise), as well as many elements of human morphology and behaviour, including culture, moral and religion, were formed in a long evolutionary rivalry with African lions and other

related big cats. The circle has been completed. I came back to the big cats. My study of ethnomusicology brought me back to the subject of my first and most passionate love.

Although this book is an example of a popular science book, it nevertheless aims to challenge a number of established and very serious scholarly paradigms about human and animal evolution, and aims to propose several paradigmatic changes to the story of human evolution. For example, I will propose that we should look at the evolution of humans and big cats primarily as a case of the co-evolution of two closely connected species. I will also propose that intimidation of enemies and rivals, and avoiding direct physical violence via ritualized intimidation was (and still is) the chief reason behind many changes of human and animal morphology and behaviour. I will also challenge the established views about the origins of such well-known human morphological and behavioural characteristics, as long hair on our heads, long legs, a naked hairless body, patches of hair in our armpits and genitals, the appearance of eyebrows, walking on two feet, making stone tools, the origins of music, dancing, painting, artistic transformation, the reasons for prehistoric cannibalism, the origins of morality, rituals and religion. I will also challenge the dominant view that sexual selection through female choice was a major force in the evolution of countless animal species (from the peacock's dazzling train to human singing).

I believe, and I will do my best to convince the readers of this book, that our long everyday interaction with our "evolutionary twins", lions and tigers, was the crucial and so-far neglected factor in our own evolutionary history. Hopefully, after reading this book readers will have a better understanding of the mystical reverence humans and big cats share for each other, and will pay more attention to conservation efforts to save these majestic animals on our planet for future generations. In the pages of this book we will see that our long and fascinating evolutionary duel with lions and tigers, containing a mixture of many conflicting feelings, is chiefly responsible for who we are, where we are, how we look, behave, think, believe and love.

The Greatest Migration in Human History

Humans are great travellers, no question about that. They started intercontinental travel from Africa about two million years ago, and gradually populated all the major continents, including such widely distinct places and environments as Central Africa, Australia and Greenland in prehistoric times, becoming the world's widest distributed land animal. During the last century they went on to live for lengthy periods of time in frozen Antarctica, and even left Planet Earth and travelled into cosmic space. And still, if we want to find out which of the migrations was the greatest of all in our evolutionary history, we should all agree that the greatest and by far the riskiest migration that our ancestors ever undertook was a totally different one. Actually, for some this might not be a migration at all, as it was not connected to moving to some distant lands thousands of kilometres away. Instead, it was a migration of several metres only. And still it was the riskiest and by far the most life-changing migration that humans ever undertook. I am talking about the migration from the trees to the ground.

Another famous species from Africa, lions are great migrants too. It is not a coincidence that for a long time humans and lions were the two most widely spread mammalian species in the world. As we know, lions' ancestors, like our human ancestors, moved from tree branches to the ground as well, and when human ancestors came down to the ground, ancestors of the big cats were already there. Let us now concentrate on human migration and subsequent changes in the environment when they moved from tree branches to the ground.

Unlike intercontinental migration, which involves traveling for thousands of kilometres, tree-to-earth migration does not involve long travel. But it was a move to a totally new living environment. This "vertical migration" of only a few metres changed forever the entire lifestyle of our ancestors, including their survival strategy, morphology, and behaviour. It was this shift from the trees to the ground that started the 'long way to the top' of human transformations. Actually, it was not a human migration, because our ancestors at that point were very far from being humans. On the contrary, we can say that **this was the migration that made us human**. It is not

surprising that most of the accounts of the story of human evolution start from the moment when our primate relatives moved from the trees to the ground.

In this chapter we are going to discuss what were the consequences for our primate forebears of coming down from the trees to the ground, and how the first meetings with the ancestors of the big cats went for our distant ancestors.

Survival Guide for those Who Want to Live on the Ground

There is a full and equivocal scholarly agreement about the crucial importance of descending from the trees to the ground of our primate ancestors for the evolution of Homo sapiens. I wholeheartedly join scholars of human evolution on this point. On the other hand, it is difficult for me to comprehend why none of the scholars of human evolution, or even broader, the evolution of animal species, ever researched the existing differences in living circumstances in these two vastly different environments.

So, on the next few pages I will try to demonstrate that there are enormous differences between living and surviving predators in tree branches on one hand, and on the ground on the other hand. I believe that understanding these differences are crucial for understanding most of the morphological and behavioural changes that lead our primate ancestors to the road towards humanity.

So, let us try to analyze what kind of differences we are talking about when we discuss the terrestrial (living on the ground) and the arboreal (living in tree branches) lifestyles.

(1) Two-dimensional environment vs. three-dimensional environment. Animal species living on the ground live in a two-dimensional world, and animal species living in the trees live in a three-dimensional world. This difference is similar to the difference between the two forms of art: painting and sculpture, and is profound in its essence. This third dimension – vertical, which is present in a tree-living environment and is absent in a ground living environment, makes a marked

difference in the survival strategies against predators. As we shall soon see, the discussion of this neglected issue is particularly important in this context concerning the interaction of our primate ancestors with the ancestors of big cats.

(2) Safety standards on the ground vs. safety standards in the trees. Possibly the most important difference between living in tree branches and living on the ground is safety standards. Of course, we can be sure that our primate ancestors were well aware of the prowling ground predators while they were still living up in the trees, like contemporary tree-living monkeys are. What is important for us is that avoiding and surviving these predators was much easier for our primate ancestors while they lived in the trees. All that was needed from our ancestors in order to avoid predators was to stay on the trees' higher branches. They could live and even sleep on higher branches without much fear of almost all predators.

"Well, I agree living up in the trees is effective in order to secure yourself from predators like lions or tigers who do not climb trees," a reader might object, "but what about tree-climbing big cats, like leopards. How can you secure yourself from them in tree branches?"

An excellent and timely question. Leopards, like most of the cats, and unlike heavy lions and tigers, are amazing masters of climbing tree branches. Some man-eating leopards were known to attack (and eat) hunters who were concealed in tree branches to shoot them. And still, I am maintaining that even graceful leopards could not do any harm to our primate ancestors while they were sitting or even sleeping on high tree branches. For one simple reason: in trees, in a three-dimensional environment, you live **according to your weight**. So, if you are lighter, you can climb higher up the tree than other, heavier animals. Leopards are several times heavier than most of the tree-living monkeys. For this reason, 50-60 kilo leopards simply cannot climb high enough up trees to reach a place where 10-20 kilo monkeys are spending their time. The same is true for our distant primate ancestors, small-bodied primates. They were out of reach of not only big cats, who lived on the ground, but also out of reach of the tree-climbing predators like leopards. So today tree branches cannot give us safety against leopards, as after descending from the trees we became much heavier, but our tree-living ancestors were several times lighter. Here is the importance of the third – vertical dimension – in action: the lighter you are, the higher you climb, the higher you climb, the safer you are. It is well

documented that when a group of tree-living monkeys prepares for sleep, the younger generation as a rule climbs higher and sleeps on thinner branches. It is safer up there.

So, let us remember, because of the morphology of most of the trees, which have thicker branches closer to the ground, and thinner branches higher up, tree-living animal species live there according to their weight on different "floors." Lighter animals can climb and spend time higher on the trees, as thinner branches can withstand their weight, but the same branches cannot withstand the weight of heavier animals. By the way, the same tree-climbing leopard, to secure his kill from the prowling lions or hyenas, usually drags his kill up in the tree branches, as 150 kilo lions cannot climb trees as high as leopards can, and hyenas do not climb trees at all.

Living on the ground is a totally different story. The ground has only two dimensions, and irrespective of your weight, you still live in the same territory, the same "ground floor" as all other ground-living species. One kilo rabbits, 150 kilo lions, one tone buffaloes and four tone elephants all share the same territory all their lives. So, unlike the light monkeys who can sleep safe from predators high up in three branches, ground-living rabbits and antelopes are never safe. Their physical existence is under a constant, 24/7 threat from predators.

(3) Fear of falling vs. fear of predators. Well, everything comes with a price, and living in trees creates other problems. Of course, in high tree branches you are safe from most of predators, but you may fall to your death. What would you prefer? Considering both sides of the coin, it is clear that those animal species that live high in tree branches opted for the safety from predators instead of safety from the fall.

As usual, Natural Selection, the best and fairest ally of all living species, provided some means of securing sleep against a fall from the trees for tree-living species, including our primate ancestors. Even today, after millions of the years of leaving the trees for good, humans still possess an ancient mechanism, reflex, which most likely secured our primate ancestors from falling from trees. This is the so-called Moro Reflex, the first and possibly the only unlearned reflex that human children have at birth (Berk, 2009). This reflex is a response to a feeling of a sudden fall. The origin of this reflex (as well as the recurring frightening dream of free falling) can most likely be traced back to our evolutionary heritage from the millions of years spent by our primate ancestors in tree branches.

Another price for having a small and lighter body is that although you are mostly safe from bigger predators, you may easily become a target for formidable birds of prey, like the ancestors of the powerful crowned eagle from sub-Saharan Africa. And still, it would be fair to say that the predator risk is much lower in tree branches than it is on the ground.

Another well-known fact that proves the relative safety of being up in the trees is what humans usually do at night when they are lost in the jungle – as a rule, in order to feel safer from prowling jungle predators in the dark, they climb trees. So, the fear of falling is dwarfed by the dominant fear of becoming dinner for mighty ground predators at night.

So let us agree that while our distant primate ancestors stayed up on the thinner branches of trees they were relatively safe from most of the predators, including the ancestors of the mighty big cats.

So why did they decide to go down to the ground in the first place?

Animals rarely stay all their lives in the same environment, even if it is safer for them. All species, constantly and instinctively, try to push their existing boundaries and widen their living space. We know, for example, that many tree-living animals sometimes search for food on the ground. After all, most of the fruit and seeds eventually end up on the ground. Monkeys and birds, who do not live on the ground, sometimes visit the ground, usually in order to collect food. Most likely the first visits of our primate ancestors were similarly just to collect some fallen food from the ground.

And of course, there was a price for this risky endeavor, a big price. It is well known that the risk of getting killed and eaten for tree-living animals is much higher on the ground than in the trees. Natural selection has an unwritten rule for those who want to visit the ground for feeding. The rule is ominously simple and fair:

"Welcome, if you are visiting the ground for food. There may be plenty of food on the ground, but remember, while you are feeding, you may also become food for someone else."

In this context it is becoming clear that the first meetings of our primate ancestors with bigger ground predators, including the ancestors of the future big cats,

were very one-sided: any time our ancestors were caught unaware on the ground, they were as good as dead. So, during the arboreal (or tree living) period in the evolution of our ancestors, the policy of dealing with bigger predators was very strict: avoid any direct meetings with them. At this stage, interaction between the two species was very simple: they were predators, and we were prey.

Well, those who were still brave enough to visit the ground were keenly aware of another important rule for surviving on the ground. This rule sounds like this:

"If you want to visit the ground and survive, keeping silent is the best option."

Some readers of this book might ask me why keeping silent is so important for your safety if you want to visit the ground. "OK", they would say, "it is obvious that if you suddenly start making loud sounds, then you are asking for trouble as your voice attracts predators. But why the ground only? What about trees?" To answer this question, you must recall our recent discussion. Trees, unlike the ground, have a third, vertical dimension, and different animals live there according to their weight. Therefore, if you are high in the tree branches, in your "safety zone", you would not be afraid of bigger predators, as they could not climb where you are, simply because of their weight. I propose that this is the chief reason why tree-living species are much noisier than ground-living species. There is no other place where the old saying "silence is golden" is as true and appropriate as on the ground.

If we all agree on this point, then I want to make another statement: the fact that tree-living species are much noisier and "talkative" than ground-living species has so far been totally neglected in scholarly literature. As far as I am aware, this issue was discussed for the first time in my 2006 book. Let us discuss this fascinating issue a bit longer.

Singing Lovers are Invited to the Tree Branches

Have you noticed that when you walk in a park or a forest, virtually all the sounds that you hear come from the tree-living and flying species (mostly birds and insects)? Considering that tree-living species can feel safe when they are in their "safety zone" (unlike ground-living species), it is hardly surprising, that there are many more singers among those species, who live in trees, than among those who live on the ground. To be more precise, let us consult numbers. Currently there are about 5400 species who sing. Most singing species live in trees (mostly birds and primates). There are a few singing species, like whales, dolphins, seals and sea lions, living in the water as well. What about ground-living species? Well, apart from the Australian flightless lyre-bird (still a bird!), amazingly, there is only a single singing species which lives on the ground and sings. That's us, humans. To my knowledge this unique fact of human musicality has also been so far neglected despite the staggering current interest in the origins of human musical behaviour. We will recall this fact later when we start discussing the reasons when and why our ancestors started developing their singing abilities.

Let us now come back to the second rule for tree-living animals when they decide to visit the ground. This rule, as we may remember, strongly advises all ground visitors to stay silent. So not only the species who live on the ground must remain silent, but even the tree-living species, usually noisy habitual singers, when they come to the ground for a short visit, should change their habits and become silent. Let us now have a look at the tree-living birds and monkeys. Do they really become silent when they visit the ground?

When Silence is Golden

I remember, when I became interested in the singing behaviour of tree- and ground-living animals, and came to the conclusion that singing in trees is much safer

than on the ground, I first of all checked if information on this could be found anywhere in the vast reserves of the internet and JSTORE libraries. Amazingly, my search yielded no results. There was no research done on this potentially very important topic. So I decided to check this out for myself.

I started checking bird behaviour in the nearby "Margaret Walker Reserve" in Preston, Melbourne. Not the best place to conduct a scholarly experiment, of course, but still OK for the preliminary observations of this new intriguing idea. Several Australian magpies, magnificent singers, were living (and still live) in this park, and for several weeks during the 2007-2008 Australian hot Summer my wife and I silently watched their behaviour. Magpies are amazing singers with a vocal range of up to four octaves, a yodeling technique, the ability to mimic dozens of other species, sometimes including horses, dogs, and humans (Kaplan, 2004). We were struck from the very first on day to see how these large black-and-white birds, exquisite singers, became virtually mute as soon as they stood on the ground. When they were stood even a little bit above the ground, say, on a table or a garden chair, they would start making their famous yodeling sounds. But as soon as they stood on the ground, all their desire for singing and making other sounds disappeared. After several weeks of observations I came to the preliminary conclusion that my initial idea was correct, and magpies did not sing or make other sounds while they were on a ground. After this I contacted one of the world's leading experts on bird singing behaviour, Peter Slater from St Andrews University, and asked him if the silence of birds on the ground could be connected to the fear of predators. Peter confirmed that birds do stop singing while they are on the ground, and that bird experts consider this is primarily for the reason of sound transmission (this idea is well represented in publications), although he also confirmed that one of the reasons for this might be the fear of predators (letter from March 3rd, 2008).

So, most likely for reasons of safety, tree-living species become silent when they descend to the ground. Let us formulate the third rule for those who want to visit the ground:

"If you feel like singing, quickly fly or climb to the higher tree branches and start singing there. The ground is not for singing lovers."

Let us repeat again this phrase several times like a mantra: the ground is not for singing lovers. The ground is not for singing lovers... We will need to recall these words later, when we discuss the potentially very important issue of why our closest relatives, chimpanzees and gorillas, do not sing and why they are so silent in their everyday lives.

Animals that live on the ground or visit the ground sometimes naturally follow this rule, or they run a high risk of being attacked and killed by predators. That's why there are overwhelmingly more sounds coming from the animal species populating tree branches, than the species populating the ground. If you still have any doubts about this idea, I suggest when you go walking in a forest or a park next time, pay attention to the sounds you hear. You will quickly realize that almost all the animal sounds in nature are coming from above, from the tree-living and flying species. These noisy species are predominantly birds and also tree-living monkeys in the tropical forests. You will be very lucky to hear any sound from any ground-living animals either in our forests and parks, or tropical rainforests. Of course, in the parks you can also hear the barking of dogs, but you must remember that dogs are domesticated animals, and the behaviour of domesticated animals is very different from the behaviour of their free-living relatives. Barking itself, for example, is virtually absent in free-living relatives of the domestic dog. In the same way mewing, so widespread among domestic cats, is not present in adult wild cats. These widespread sounds from our canine and feline friends are a late development, the result of domestication, and aimed at their human friends and masters. We know today that barking can naturally appear in domesticated animals. For example, in a truly amazing several-decade experiment, undertaken in Russian Siberia, and reported in 2011 by National Geographic, domesticated Siberian foxes started barking and wagging their tails very much like dogs (see also Trut, 1999).

Therefore, ground-living domestic animals make many more sounds that their wild relatives. This is primarily because after domesticating them, their human masters provided them with better security and also with food. Security from predators and food provision are the two main reasons that encourage both prey and predator species to keep silence in the wild. Apart from this factor, of course, growing up in the extremely noisy environment of a human society also makes our four-legged domesticated friends more vocally active.

We are so used to hearing ubiquitous bird sounds in different environments that we often fail to notice them. You can hear birds chattering and singing not only in forest and parks, but, with a bit of luck, in some urban parts of contemporary western cities as well. At the moment, for example, as I am writing these words at the Mercy College, Coburg, apart from the sound of a lone saxophone coming from the next room and traffic noise from the street, I can clearly hear bird chatter through the open window. Out of these three sounds, two are recent human inventions, but the sound of the birds has been our constant companion for millions of years. If you are reading this book during daytime, there is a fair chance that you might be also hearing this ancient calming sound, sound that accompanied our ancestors' daily existence for millions of years.

Excitement and Fear of the New Environment

There is always a mixture of several feelings when a family moves to a new suburb. If you decide to move to a different city, the feelings are understandably more intense. If you are moving from a mountainous village to the city (or vice versa), the changes and associated feelings might be quite profound. What about moving to a new country with a different language, religion and social norms? Well, as a migrant, I know firsthand the extent of the cultural shock that a person suffers in a new country, even if the new country is as relaxed and happy as Australia, with remarkably welcoming people.

Now, let us go further and try to imagine how it might feel if you are moving to a completely new environment. I mean a **really** new environment. For example, moving from the ground to a completely new life in the water, or moving from the ground to live in trees. Can you imagine the extent of the "cultural shock" from such a different environment and completely new neighbours?

By the way, very much like trees, water is also a three-dimensional environment, and very much like tree branches, there are also several "floors" in the

water. Of course, each of these "floors" occupies a much bigger vertical space in the water than in the trees. This is chiefly because unlike trees, which hardly grow higher than 100 metres, the vertical dimension of the water can reach kilometres. Water, as an environment, should be actually compared to the sky, not trees. Trees represent quite a unique environment, although I believe there are still certain parallels between living in trees and living in the water.

As I have already mentioned, in the water, like trees, there are species who sing (although many times less than in trees). Water-singing animals are mainly mammals – seals, dolphins, whales, or sea lions. But in this book we are not going to discuss the environmental challenges that water puts on animals. So let us go back to our primate ancestors who were anxious about their move from the trees to the welcoming but dangerous ground.

Moving to the ground must be one of the biggest challenges for every living organism, coming either from the water, or from trees. As a two-dimensional-only environment, the ground offers a very constrained living space with the most intense competition for survival among all three major environments (trees, water, and ground).

To assist aspiring migrants to overcome the challenges of the new difficult environment, there is one important positive factor. This factor is time. All these kinds of "environmental migrations", from the trees to the ground, or from the water to the ground, take thousands, hundreds of thousands, and sometimes millions of years. Evolution is never in a rush. This does not mean that the moving process is rather static and unnoticeable. On the contrary, the whole process of adjusting to the new environment is very dynamic, filled with thousands of daily experiments, miraculous escapes, small successes, big tragedies, and, most importantly, a gradual accumulation of myriads of invisible mutations and small genetic changes in morphology and behaviour. The grand process of natural selection, the driving force behind the evolution of all species, thrives on the advent of such big challenges, as every living species is given an opportunity to change itself in order to increase its fitness and the chances of survival in the changing environment. But if you did not manage to change yourself to meet the new needs, well, you will most likely join the countless species that went extinct in the mists of evolutionary history.

After this general introduction to the challenges of living on the ground we can move now to the concrete strategies that ground-living species use to avoid predators. We are gradually coming closer to the initial interaction between the big cats and our distant ancestors about 5-7 million years ago.

Surviving Predators: Animal and Human Defence Strategies

Humans often complain about the rise of crime in big cities, pollution of the environment, financial and job market uncertainty, and many other hazards of contemporary life. Well, all that is true, but ask yourself a question: how many of our 7 billion fellow humans expect every single day of their lives to be killed and eaten? Not many. Well, that's exactly how each member of most of the animal species feels. So, let us keep in mind that the notions of "safety" and "security" have dramatically different meaning for animals than for contemporary humans. For most of us contemporary humans, who live in the safety of the 21st century civilization, it is not easy to imagine the dangers that each member of the animal species experiences every day of their lives.

A few million years ago the life of our ancestors was no different from the life of any other animals. As other animals, our ancestors had to divide their everyday lives between several crucially important activities: (1) finding food, (2) finding mates, (3) raising new generations, and (4) avoiding predators. The last task was of particular importance. The reason for this is that most of the other activities are undertaken only sometimes during the day, or according to a specific season. For example, you look for food when you are hungry, or you look for a mate when your biological time is right, and you raise a new generation when you have one. Unlike these activities, surviving predators is a full time, 24/7 job, as a predator can attack and end your and your offspring's life any minute of the day or night. So, most of the animal species have to carry out all the activities constantly keeping in the front of their minds the primary necessity of looking out for potential predators. As I wrote

in my 2006 book 'Who Asked the First Question?', 'We all can agree, I hope, that it is much more important not to make mistakes in searching for predators than in searching for food. Of course, it might be frustrating if you have not noticed a good stack of bananas, but if you have not noticed a crouching lion, well, you may never need a banana anymore.' The Swiss biologist, known as the father of Zoo biology, Heini Hediger expressed the importance of predation-avoidance more directly: "...hunger and love can take only second place. The satisfaction of hunger and sexual appetite can be postponed; not so escape from a dangerous enemy, and all animals, even the biggest and fiercest, have enemies. As far as higher animals are concerned, escape must thus at any rate be considered as the most important behaviour biologically" (Hediger, 1955).

If you are annoyed by my perseverance in repeating again and again the importance of defence from the predators in animal lives, think of this fact:

Virtually no scholar of human evolution has ever discussed seriously how our distant ancestors survived the threat of predators after they descended from the relatively safe environment of tree branches to the dangerous ground.

To present a more precise picture of the existing suggestions that scholars have made about defence strategies in human evolution, let us discuss some of these suggested strategies in rough chronological order. Not all of these authors discussed the issue of defence from predators, but if their suggestions imply any improvement of the defence capabilities of our ancestors, I have included them as well. So let's have a look:

Human Defence Strategies: The Short Survey

• 1871. Charles Darwin, in his ground-breaking book on human origins, gave this important issue only a passing mention, suggesting, that our ancestors were defending themselves from predators in groups, using stones and clubs (Darwin,

2004: 72, 628), and that bipedalism was a means of allowing our ancestors to use their hands to operate with tools. Darwin gave so little consideration to the problem of defence from predators that he was even considering whether humans evolved somewhere on an isolated island without predators around them.

• 1923, 1949. Raymond Dart initially thought that human ancestors were small-time scavengers, who struggled to survive, but by the 1950s Dart had changed his approach, and suggested that humans were active hunters, vicious killers and cannibals of their own fellows. The "Man the hunter" model was mostly formulated by Dart. In the absence of stone tools Dart suggested that hominids used bones as their hunting tools. As in this model human ancestors were top hunters, the need for defence from predators was not applicable. As one of the means that could be considered as a defence strategy, Dart suggested that standing upright in open habitats was adaptive and helped our hominid ancestors to scan the surroundings in order to see prey and avoid predators. Author and anthropologist Robert Audrey widely publicized Dart's idea of the "killer ape" in his several books.

• From 1942 onwards, several proponents of the "aquatic ape" theory (initially Max Westenhofer, followed by Elaine Morgan and Alister Hardy to name a few of the other more contemporary scholars) suggested that human ancestors lived on the river banks, in shallow water. For some reason living in this environment itself was considered as a very good predator-avoiding strategy. As a matter of fact, the river bank is possibly one of the most dangerous environments in which to avoid predators, both from terrestrial predators like big cats, who often stalk prey on the river bank, to aquatic predators like crocodiles. Most of the predators ambush their prey on the river bank and most of the killing takes place on the river bank. So I suggest that living on the river bank would actually worsen the predator-avoiding chances of our ancestors.

• 1953. George Bartholomew and Joseph Birdsell based their idea on Darwin's suggestion that carrying tools and weapons (for defence and attack) was an important element for the survival of early hominids. According to their suggestions, carrying weapons was one of the key actions that led to the origin of bipedal locomotion. It is

now widely accepted that bipedalism pre-dated the use of stone tools by millions of years.

• 1954. Kenneth Oakley (and Raymond Dart in 1959) suggested that the need to look over tall grass was an important defence/attack strategy that eventually led to bipedalism. It is true that you can see more when you are standing taller on your hind legs, but in this posture you are also more visible to predators as well, particularly if you cannot run fast to escape them. For this reason most animals use a bipedal posture for several seconds only, and after scanning the surroundings they quickly return to a more secure four-legged posture to conceal themselves from predators (or prey).

• 1962. Frank Livingstone (also Roger Wescott in 1967, Nina Jablonski and George Chaplin in 1993) suggested that our hominid ancestors used a bipedal posture to look taller in order to intimidate their enemies and competitors. We know that plenty of animal species use bipedal threat displays to look taller in order to avoid an undesirable fight or to intimidate antagonists during a confrontation. Bipedal posture is certainly a popular strategy for many animal species during inter- and extra-species confrontation, although in animal species this does not lead to habitual bipedalism as happened in our human ancestors. As in the case of scanning their surroundings, after a successful intimidating display animals as a rule quickly return to their usual four-legged posture, unlike humans. We will look at this strategy in much more detail later in the book.

• 1965. Adriaan Kortlandt conducted a series of widely known experiments to find out how our distant ancestors could possibly defend themselves from formidable predators like big cats. He presented a stuffed leopard to the group of chimpanzees, and documented that chimpanzees attacked the stuffed leopard with sticks, accompanying their attack with loud screaming and hooting. These experiments and observations of the behaviour of wild chimpanzees suggested that our ancestors could defend themselves with the use of different objects, like sticks and rocks, and to attack their enemies in groups.

• 1980. Adriaan Kortlandt conducted another interesting experiment to check the possible defence strategy of early small-posture hominids. In his experiment Kortlandt used lions from the new generation of the "Born Free" Elsa lioness's family, and after experiments suggested that thorny branches could have been the earliest defence weapon against big cats. According to Kortlandt, small stature early hominids were too weak to throw rocks at predators, as chimpanzees are able to do in the wild, therefore living in a big group by itself would not provide an effective defence against predation, but would instead lead to a "massacre."

• 1981. Charles Brain published a book, based on analyses of the cave remains of early hominids. He did not pay any attention to early hominid defence strategies as the main theme of the book was to argue against the dominating theory "Man the hunter." Brain argued that in most cases, including some of the classical cases when hominids were seen as hunters and killers, they were actually the prey, hunted by the carnivores of the day. His approach became popular as the "Man the hunted" theory.

• 1982, 1983 and 1992. William Calvin in several publications proposed and elaborated the idea that throwing objects was one of the central means of early hominid hunting success and the development of human cognitive capabilities. Although throwing among primates (and apes) is mostly used as a defence strategy, Calvin considered throwing primarily as a tool for hunting by early hominids. Later in the book we will analyze throwing stones as both the means of hunting and defence.

• 1987. Felix Fifer in his only publication, and independently from him Barbara Isaac in the same year, suggested that our hominid ancestors were actively using stones (and possibly different missiles) as the earliest means of defence. Barbara Isaac provided a useful review of historical sources and cross-cultural accounts of different tribes using stone-throwing as an effective means of defence and attack. This suggestion was further developed by Holly Dunsworth, John Challis, and Alan Walker in 2003. This potentially very important suggestion will receive special attention later in this book.

• 2005 (second edition 2009). Donna Hart and Robert Sussman, in a monograph dedicated to the model "man the hunted" put a highly persuasive argument that pressure from predation was a central force in the evolution of all primate species, including early humans. They proposed a whole set of possible strategies of defence from predation: living in larger groups with several males, a bipedal posture to increase the body size and throwing rocks and sticks at predators. At the same time, according to the Hart-Sussman model, our ancestors were still a prey species, and the ultimate strategy for their survival was climbing trees. Therefore their model did not propose a potent defence mechanism that could enable our human ancestors to successfully colonize open grasslands and savannah, and to allow them to travel into the vastly different environments of the world of at least two million years ago.

This short survey, as any such survey, is incomplete as you would expect, but can give the reader a general view of the subject. I hope we can agree that the important topic of defence strategies has not received adequate attention from the researchers of human evolution. Apart from original experiments by Adriaan Kortlandt and the book by Hart and Sussman the issue of hominid anti-predatory strategies was discussed at best as passing mentions. This cannot do justice to this crucial issue. We will see later, for example, that the list of scholarly works and ideas dedicated to the problem of human bipedalism is several times longer than the list of defence strategies of our distant ancestors after they descended to the ground.

The lack of works and ideas dedicated to the defence strategies and mechanisms in human evolution has several reasons. One of the most likely reasons is that arguably still the most popular hypothesis "Man the hunter" does not require any defence mechanisms from predators, as according to this hypothesis, it was other animal species that needed defence from our blood-thirsty ancestors. On the other hand, the more cautious "Man the hunted" model concentrated on fighting against the "man the hunter" hypothesis and on proving that instead of being vicious hunters, our distant ancestors were in fact included in the diet of the carnivores of the day. Because of this, proponents of the "Man the hunted" hypothesis often neglected the issues of defence as well. Also, in several cases the issue of anti-predatory behaviour was hidden behind the general statement that in every species the most intense

competition goes on between individuals of the same species, not between different species.

Well, I hope we can all agree that competition between the members of the same species does not cancel out the necessity for surviving predators in the first place. It is difficult to argue against the simple fact that members of the same species can only compete with each other if they have valid defence strategies and are able to survive predators in the first place.

Hunter, Hunted or Scavenger?

It is fascinating how much emotion is involved in discussions about the lifestyle of our ancestors. It is understandable that we should look at our evolutionary past with fear and hope, trying to explain our strengths and weaknesses. We are a cooperative species, but we also wage wars against each other. We can love to the point of sacrificing our lives, but at the same time we can participate in mass murders[2]. How can such conflicting behaviours exist in a same creature? Who are we, a loving and cooperative species, or selfish egomaniacs who use moments of altruistic behaviour only to further our selfish interests? We are interested in the evolutionary story of our distant ancestors a bit like a foster child who wants to find out about his or her biological parents. So the question of who were our ancestors and how they survived the relentless everyday struggle of natural selection is a very emotionally charged question.

To summarize the general strategies of early hominid survival, we can say that the current understanding of early hominid survival strategies are based on three

[2] J. Glenn Gray's philosophical meditation on what warfare does to humans ends up with the following words 'War reveals dimensions of human nature both above and below the acceptable standards for humanity' (Gray, 1959).

main models: (1) Man the hunter, (2) Man the hunted, and (3) Man the scavenger. These three models treat the issue of anti-predatory defence very differently.

(1) The "Man the hunter" model, as we have already discussed above, has been possibly the most influential in popular imagination throughout the 20th century. Raymond Dart, discoverer of the first australopithecine (later confirmed as a Homo erectus) proposed, that our human ancestors were themselves top predators, bloodthirsty killers, raining terror on other species (including their own species). According to this model our ancestors had nothing to fear, and as a result, the mechanisms of defence against predators were virtually not applicable. "Killer ape" and "Man the hunter" models of early human evolution created a very strong stereotype of human evolutionary prehistory, and this stereotype seemed particularly pertinent to the nature of humankind after the devastating Second World War with tens of millions of humans killed.

From the 1970s the belief in the hunting prowess of our distant ancestors started to crumble. Charles Brain and Elizabeth Vrba were instrumental in this process. The South African paleontologist Bob Brain analyzed the fossil remains from early archaeological and paleoanthropological sites and came to the conclusion that early human ancestors were not hunters, but were instead a prey species. According to Brain, among many other carnivores of the day, early humans were particularly actively hunted by the ancestors of big cats (Brain, 1981). One of the most influential archaeologists of the 20th century, Lewis Binford, added his own arguments to the demise of the "Man the hunter" hypothesis, suggesting that the main source of the early hominid meat diet was scavenging, not hunting (Binford, 1985).

Despite increasing criticism, the "Man the hunter" hypothesis is a tenacious one, and even after revealing many caveats it still attracts scholars and particularly modern minds. To conclude a discussion of predator-avoiding strategies, we may say that the "Man the hunter" hypothesis virtually neglected the problem of predation, turning the early human ancestors into powerful alpha hunters, or scientifically speaking, into "apex predators" who had nothing and no one to fear.

(2) "Man the hunted" model. While discussing the first model, known as "Man the hunter" model, we have already partly discussed the alternative model, often referred as the "Man the hunted" hypothesis. Bob Brain was possibly the earliest

most important proponent of this model. This model is gradually coming into prominence. In the first decade of the 21st century two St Louis-based anthropologists, Donna Hart and Robert Sussman, combined the information on predation on primates with the existing critique of the "Man the hunter" model. The Bob Brain-coined phrase "Man the hunted" became the title of the Hart-Sussman book. Today the "Man the hunted" hypothesis is becoming an important, if not mainstream, model of human evolution. An important feature of this model is that it takes into account the tremendous pressure put on our distant ancestors from the many predators that shared Africa during the last five million years. In a way this approach is radically different from Darwin's approach to predation. Darwin did not take much notice of this problem, musing whether early hominids lived in total isolation from predators. Hart-Sussman, on the contrary, proposed that predation was the central force that shaped humans. This approach also explains much better the existing fossil record with plenty of marks on the hominid fossil remains made by a killer bite of big cats, fearsome lion-sized extinct hyenas, and other carnivores of the day. The weak point of this approach is that concentrating mostly on the role of early hominids as prey, does not offer a viable explanation of how this slow-breeding, slow-walking and ground-living prey species became the most widespread large mammal during the Pleistocene era, overshadowing even the mighty big cats.

(3) "Man the scavenger" model. After the reign of the "Man the hunter" hypothesis, two alternative hypotheses, the "Man the hunted" and the "Man the scavenger" appeared almost simultaneously. They are closer to each other than to the "Man the hunter" hypothesis. Both of the new hypotheses acknowledge the pressure that predator species put on early hominids. The difference between them is basically in the degree of the predation on hominids, and the degree of meat eating among early hominids. If according to the "Man the hunted" model hominids were mostly a hunted species who only occasionally had access to protein-rich meat, according to the "Man the scavenger" hypothesis hominids were not killing their meat, but instead were using scavenging opportunities, chasing competitors from the kill. This model is possibly the most widely shared today by anthropologists. Lewis Binford was one of the key figures in establishing this hypothesis among leading paleoanthropologists today.

The survival of our species throughout evolution and the widest distribution of humans all over the world in prehistoric times is hard evidence in itself, proving that our ancestors did have highly effective survival strategies. The problem is that we do not know what kind of survival strategies they were using.

To work out this problem, I suggest checking what kind of survival strategies are in the storehouse of Natural Selection, and then check which of these strategies could be applied by our distant relatives. Plenty of animal species run away from predators, and the predator-prey running competition develops amazing running abilities; many animal species can skilfully conceal themselves with matching colours; some have a wonderful sense of smell with which to scent the presence of predators, and some, even non-carnivorous species, develop large canines and horns to fight back against predators and competitors. All these are very popular means of defence from predators, and plenty of animal species use these strategies, often combining them. Some more unique survival strategies include, for example, spraying the predator with an awful-smelling liquid, like the skunk does, and of course, some non-mammalian species also use venom, electric shock charges and other more rare and exotic means.

On the next few pages we shall discuss different strategies that our primate ancestors could have used in order to save their lives after they descended from the trees to the ground and met the ancestors of the big cats, who ruled the ground for millions of years.

Hide, Run, Fight, Bite: Survival Strategies in Animals

It is a somewhat sad fact of life that to stay alive many animal species have to eat each other. Well, another fact is that no individual animal accepts this fact of life as inevitable. So there is a perpetual struggle between predators and prey. This struggle is the very basis of the grand process of Natural Selection. As a result, predators are continually getting better at finding and killing their prey, and prey are

getting continually better at escaping predators. In this perennial struggle both prey and predators change their behaviour and morphology to better suit their own survival needs.

Let us start from a brief survey of basic animal defence strategies (for a more complete list of animal survival strategies see Ruxton at al., 2004). After this survey we will have a better understanding of the defence systems that our ancestors could employ, and then we will check which of these defence strategies were in fact used by our primate ancestors.

Here are some of the most popular and time-tested strategies for defence from predators.

1. If you cannot see me, you cannot eat me!

This is the very first line of defence of many animal species. If you can manage to stay out of sight of predators, you will have a good chance of surviving, reaching adulthood and leaving offspring. This strategy is known by the scholarly term "crypsis." This strategy is so widely known that some consider that all animals are naturally cryptic (as we will see later, this is not correct). Myriads of animal species try to cover their bodies with blending colours so that it is very difficult for a predator to see them. Some non-mammalian species are more ingenious in the use of crypsis than mammals. For example, chameleons can change the colour of their body according to the environment they are in, and octopuses can create a decoy, become colourless, and swim away from danger. Crypsis is widely used not only by prey species, but by predators as well. The reason behind this is not difficult to understand. Predators need to hide from their prey as much as prey need to hide from their predators. Camouflaging tiger stripes were not formed in order to survive from predators, as big cats are on the top of the food chain and have no fear of other predator species. A tiger needs stripes to be able to stalk prey animals unnoticed, the same way as lion colours are well matched with the colours of the sun-bleached Savannah.

So, let us remember, in order to stay unnoticed by prowling predators, plenty of animal species try to blend with their environment. We must also remember that

many predators use the same strategy of hiding in order to be more successful in their hunt.

2. Silence is golden!

Despite the popular conception that crypsis involves only the visual channel, crypsis uses at least two other channels as well. It is obvious that being visually cryptic is only half the strategy. Even if you blend ideally with the environment, if you suddenly start making loud noises, for example, singing, your chances of escaping a predator's attention are drastically reduced. So, trying to stay silent is the second crucially important component of crypsis. We can call this "audio crypsis." Therefore, apart from visual crypsis animals need to maintain audio crypsis as well. We have already discussed the importance of staying silent, particularly for the ground-dwelling species. We may remember the important fact that when tree-dwelling birds or monkeys visit the ground, they as a rule become silent. Very much like visual crypsis, audio crypsis is widely used by predator species as well, for the same obvious reasons as visual crypsis. Most of the predators have to be silent while they are hunting their prey, although predators that hunt in groups (like lions or wolves) may make use of sounds in order to communicate with each other. Because of different hunting tactics dogs and cats are quite different in this regard. Dogs, while hunting, do not stalk their prey, instead they run them down, so being silent is not that important for them. Unlike dogs, being silent stalkers is vitally important for all cat species. Cats, including all small and big cats, are grand masters of silent stalking. That's why it is much easier to hear when a dog comes into a room than a cat.

3. Stay clean and survive!

The third element of crypsis is getting rid of the odour of your own body. In scholarly terminology, odour is an "olfactory factor." Most humans have quite a poor sense of smell (I myself am a perfect example of this, unlike my wife). On the other hand plenty of animals, both predator and prey species, have an excellent sense of smell and use this ability widely in their everyday lives. So, an animal which is

visually well blended with the environment, and is not making any sound, can still be detected by predators if its body emits a more-or-less strong odour. Therefore, in order to stay unnoticed, animals should also control the odour of their bodies. We could call this "olfactory crypsis." And again, this factor is as important for predators as for prey. The most specialised predators of our planet, cats, including both small and big cats, maintain their bodies in a wonderfully clean condition. Later in this book we will find numerous quotes about cats, and we will see that the cat's cleanliness entered folklore a long time ago. Dogs, hyenas and other predators, which usually run down their prey with their extraordinary running ability and group hunting tactics, are not as concerned for their personal hygiene as cats are. As a result, canines are not naturally as odourless as are cats. Many dog owners might disagree with me, and I have seen a few heated discussions on this topic in internet discussion groups. If you really want to find out the answer to this question, you should do what one of the participants of the discussion suggested, namely: allow both dogs and cats to go without washing or any other interference, and check their body odour in a few weeks' time. It will be quite obvious that dogs have much more body odour than cats. As cats hunt by stalking, it is crucially important for them to stay unnoticed, so their proverbial cleanliness is the result of the evolutionary need for their own survival.

According to this logic the cheetah should have more body odour than other big and small cats. The cheetah has superb speed that makes long stalking unnecessary, therefore long cleaning sessions, like other cats perform, evolutionarily speaking, would be a waste of time for a cheetah. On the other hand, lions might also have a bit more body odour than most of the other cats, as the lion's hunting strategy is based on group participation, and stalking unnoticed is not as important for them as, say, for solitary tigers or leopards, who hunt alone. It could be predicted that most of the solitary species, both predators and prey, would have less body odour than social species.

These three factors (visual, audio, olfactory) comprise the general defence strategy, known as crypsis. The survival logo of crypsis is very straightforward: "blend with the environment, hide, be silent and odourless and hopefully predators will fail to notice you." Crypsis is the first line of defence from predators for many

prey species. If crypsis fails, and the animal is detected by a predator, it will drastically change its behaviour and other defence options start operating.

4. Run for your life!

This is by far the most popular means of escaping predators, particularly in the open spaces of the African Savannah, where our ancestors shared space with lions and other animal species for millions of years. We might remember that unlike tree-living species, which can live on "different floors" of the three-dimensional trees according to their weight, and therefore are relatively safe from bigger predators, on the two-dimensional ground the only way to escape predators is to run away from them. Predator running after prey is one of the most profoundly important scenes of the great cycle of life, and it would be natural to assume that both predators and prey are getting better at running as the centuries and millennia pass. Big cats are extremely fast runners, and although they are not built for endurance running, over shorter distances they can develop a speed of about 55-60 km hour, about the same speed as most of their prey species. The power of speed shows in the fact that the fastest running animal, the cheetah, is the most successful hunter in the African savannah, with a rate of about 7 kills out of 10 hunts. The much more powerful lion kills only 2-3 out of 10 hunts. On the other hand, built for speed, not for strength, the cheetah loses many of its kill to other, stronger carnivores (lions, hyenas and leopards), and is forced to go for another kill. Well, everything has its evolutionary price… So, let us remember: the most popular means of defence from predators when you are detected is to run away.

5. Be stronger!

The importance of being stronger for survival is so obvious that I am sure readers do not need any additional arguments. The stronger you are, the better equipped you are to defend yourself against predators and competitors. Considering the dangers of ground living (in comparison with living higher in the threes), it is not surprising that ground-living animals are usually both bigger and stronger than tree-living animals. Besides, in the tree branches a lighter weight is a more of an

advantage for the safety of prey species than on the ground. It goes without saying that predators also try to become stronger, even more than prey species, as predators need to overcome the resistance of the prey species without sustaining serious injuries. Because of this universal evolutionary race to become stronger, animals of every size are as a rule extremely strong for their size. Big cats are arguably one of the strongest animals in regards to the weight/strength ratio in the animal kingdom, which allows them to bring down a much bigger prey.

Although bigger animals are usually stronger as well, we will see later that this is not always the case, and most importantly, the evolution of our own species is a good (although mostly neglected) example of this kind of contradiction. So, without going further with this discussion, let us remember as an axiom – the stronger you are, the better you are equipped to defend yourself against predators.

6. Get bigger teeth!

If you have to fight for your life against predators, professional killers, who literally "kill for a living", you need to have weapons as efficient as possible to fight for your life. Teeth, and particularly canines, are arguably the most popular weapon for fight (both for the offense and for defence) in the animal kingdom. Teeth are of particular importance for those species that live on the ground. If you have some doubts about this claim, consider this fact: most living animals have sharp teeth, but almost all flying species do not have teeth at all! Among the flying species only mammalian bats have teeth (Garfield, 1972:411). The reason why tree-living species have so few or no teeth at all must be a result of several factors: (1) in the trees animals mostly survive predators not by fighting back, but by climbing higher, so, there is less direct physical fighting among tree-living species than among ground-living species, so simply speaking, they do not need teeth, (2) lighter weight for tree-living animals is much more important than teeth as a defence mechanism, and teeth are an extra weight, which is a liability in tree branches, and last but not the least, (3) teeth can decay and create health problems (we human know this only too well!).

So, considering all these factors, it is not surprising that tree-living species gradually discarded their teeth as an unwanted baggage from their evolutionary past. According to fossil evidence, the ancestors of the contemporary birds, some 60

million years ago, also had teeth. Therefore, birds gradually lost their teeth as those individuals with smaller (or no) teeth were surviving better than those who had big teeth.

In the same milieu, if you compare the canines of tree-living monkeys with the canines of ground-living monkeys, you will see a marked difference. Ground-living primates as a rule have bigger teeth. Chacma baboon canines, for example, are bigger than lion canines. Ground-living baboons and mandrills have dog-like muzzles and scary canines which they bare to scare away leopards, and they use them very efficiently when needed in combat. I could even propose an evolutionary motto: "Tell me how much time you spend on the ground and I will tell you how big your canines are." When it comes to big and effective canines, of course, predators, and particularly big cats, are among the most fearsome canine bearers. What about humans? Let us wait a while…

7. Have a thicker and stronger hide

If you have to fight against predators that have long canines and sharp claws, a stronger hide that can withstand an attack would be very useful. Of course, your hide can do little when your throat is grabbed in the lethal vice of a big cat, but in a predator-prey chase there are many moments when you can come out clean if you have a stronger hide. Not surprisingly, virtually all the prey species have a very tough hide. For example, the hide of a spotted deer might seem very soft to us, but this impression is deceiving. In reality, they are so strong that even a tiger needs some extra energy and time to open up the carcass in order to get to the nourishing parts of the body. Following this argument, I would expect that tree-living animals would generally have a softer skin than ground-living species. At least, we know that tree-living birds successfully use their light feather instead of animal fur, and they traded their ancient tough and heavy lizard skin for a fragile and light skin complemented with feathers. As tougher skin in most cases is heavier as well, the factor of the weight also would pressure tree-living species to get a lighter alternative instead of tough hides or lizard armours.

We discussed some of the most widely used defence strategies that ground-living animals use to secure their lives from the attacks of predators. These strategies are those of staying unnoticed by the predators, blending with the environment, staying silent and odourless, running away from a predator, and in the case of the physical confrontation to be stronger, better equipped with weapons (like canines) and be defended by a tough hide.

Apart from these strategies there is one more, completely different general strategy of surviving, and we are going to discuss this strategy now.

8. What about to try to scare away a predator?

The idea of scaring a predator might sound very silly and unrealistic to some readers, but you must realize that this is a perfectly valid option and is routinely used in animal life. If you watch documentaries about animal behaviour or have seen albums of animal photos taken in nature, you may have seen how obviously much smaller and weaker animals try to scare much bigger animals by baring their teeth, making a range of sounds, or trying to look bigger in order to avoid an attack from a deadly predator. Birds are known to make themselves look bigger (by partly opening their wings) in order to avoid being attacked by different predators, including crocodiles, some frogs try to survive against frog-eating snakes by literally inflating their bodies and making themselves look much bigger, and a fragile cheetah sometimes tries to scare away the mighty lion by making threatening gestures and movements. None of these animals could really survive a serious confrontation with the animals they are trying to scare away, but there is always a chance that the predator is not hungry and determined enough at this particular moment, so a predator might decide not to attack a prey if the prey is not running away, and instead suddenly looks bigger, shows a threatening attitude and is most likely going to fight back. We need to remember that during lethal combat predators also run the risks of injury, which can be a death warrant for them.

This factor, how hungry a predator is, is not always taken into serious account. At the same time it is absolutely crucial for predicting a predator's behaviour in any given situation. Not-so-hungry predators can sometimes be easily dissuaded from an attack by a prey's aggressive display and might even run away from a prey species.

A sad story from Canada was reported on the internet recently: a cougar (mountain lion) ran away from a barking dog and took a refuge in a tree, where he was later shot and killed by a farmer. Cougars, as other bigger cats, are known to hunt dogs (leopards are particularly known for this), and no dog has a chance of survival in a confrontation with a cougar or even a lynx, but in this particular case the cougar most likely was not hungry and that's why he tried to avoid confrontation with the aggressively barking dog. On the other hand, if predators are very hungry, they may make an extremely risky decision and attack much bigger animals, animals that are not on their usual diet and can kill the predators. For example, lions and tigers are sometimes known to attack adult bull elephants that are about 20 times heavier than adult tigers and lions.

As we can see, it is a perfectly valid option to try to scare away a predator with an aggressive display. Later in this book we will specially discuss the intimidation of predators and competitors by different audio and visual displays, and we will see that this is an extremely important and relatively overlooked strategy in human evolutionary history.

In order to make aggressive display more effective, animals use plenty of special morphological elements and behaviours. As these techniques will play an important part in our understanding of the defensive behaviour of our primate and hominid ancestors against big cats, let us now discus some of these techniques.

9. "Bigger kids do not get bullied"

That's what we were told when we attended a school talk for parents about bullying among schoolchildren, when we took our son to a primary school in Australia in January 1996. It is highly possible you have heard about this as well, during your own school years, or later, when your kids went to school. It is quite amazing, but even in our civilized epoch, where physical strength and size does not matter that much for success in life, not only the bigger sized boys and girls can usually avoid bullying at school, but even in such a high-profile intellectual race, as the election of the President of the United States, the taller candidate often wins. Millions of years ago, when a struggle for one's own life was an everyday business, having a bigger body was much more beneficial. So, let us remember: if you are

trying to avoid a predator's attack by intimidating the predator, a bigger body will help you to look stronger and more intimidating. Seeing a bigger-sized prey, a predator might think twice before starting an attack.

Everything comes with a price, and a bigger body is more difficult to hide, so it is up to your evolutionary choice, whether you will be a devoted follower of the principle of crypsis and remain a smaller bodied animal, or you will try to look bigger and try to intimidate predators with a bigger body.

Natural selection is extremely inventive. So many animal species found the ideal solution to the dilemma of positive and negative features of smaller and bigger-sized bodies: they can quickly change the size of their bodies. In one moment an animal might be trying to look as small and invisible as possible in order to avoid detection, but in the next moment, as soon as the predator notices the animal and expresses aggression, a smaller animal suddenly drastically changes its posture and behaviour: the hair is fluffed up, the body is often turned sideways (both of these behaviours are designed to look bigger), the teeth are clearly displayed, and the display is often accompanied by threatening sounds. The behaviour of a domestic cat when an unknown dog enters the backyard is a good example of this kind of sudden change of posture and body size.

This kind of threatening display often works. Otherwise natural selection would eliminate this display from the behavioural set of many species. But intimidating a predator does not always work. In those cases when a predator is unfortunately very hungry, it will most likely attack. In this case, you have two choices, known as "flee or fight response": you can run away, or you can fight for your life, using all your weapons and strength. Smaller-sized cats, for example, can sometimes quickly escape into the safer environment of the tree branches, demonstrating once again the life-saving power of the "third dimension."

Let us remember once again that for tree-living animals a smaller-sized body is an advantage in their struggle for survival, as a small weight allows an animal to climb higher on tree branches. But on the ground, which does not have the third, vertical dimension, a bigger-sized, heavier body with more muscles usually offers better protection from predators. It is not surprising that many ground animals have bigger bodies than their tree-living relatives. For example, ground-dwelling primates

are usually bigger than their tree-living relatives, and as we have already mentioned, ground-living primates also have bigger teeth as well.

10. Stand on your hind legs

Arguably the most popular way to suddenly increase your body size is to stand on your hind legs. Many animals stand on their hind legs to drastically increase their height and to intimidate their antagonists with their size. Bears are a classical example of this tactic. If they are confronted with other potentially dangerous animals (for example, leopards or tigers), they as a rule start displaying bipedal posture in order to look much taller. Very often this works (again, if the antagonist is not too hungry). Some predators do not even attack another animal if they are taller than the attacker. The idea that human bipedalism might have initially started from such bipedal intimidating displays was expressed almost half a century ago by Frank Livingstone, and later repeated by different authors several times. We will come back to this idea later in this book.

11. Make threatening sounds

To look bigger is not the only factor that can scare away a predator and save your life. Making loud sounds is another widely known strategy. Plenty of animals, when facing aggression from a predator or a competitor, make loud sounds – cats hiss, growl and scream, lions growl and roar, even ants make clicking sounds, snakes hiss and some of them make rattling sounds. Sometimes the sound itself might not be as loud and blood-curdling by itself, but might have specific associations. For example, many animals are afraid of venomous snakes, so the snake's defensive sound (hissing) became popular universal signal among many unrelated animals who could give other, much louder sounds (for example, small and big cats). This technique is known as “audio mimicry” (Gaul, 1952).

The list of animals using warning sounds can go on, but I do not think we need too many examples, as making sounds for saving life from aggression is a very well-known strategy in the animal kingdom (you can have a look at Ruxton et al., 2004). Basically, the louder the sound, the more effective it is. A lower, deeper sound makes

a particularly good tool for the intimidation of opponents, as lower sounds evoke the sensation of a bigger, heavier and stronger animal.

12. "I have big eyes and I can see you!"

Another popular means of scaring away a predator it to display "big eyes." We are not talking here about the real eyes of animals. For this kind of display animals use other parts of the body with markings that look like eyes. These markings are known as "eyespots" or "ocellus." Eyespots are clearly visible, and they can be on different parts of an animal's body. The use of eyespots as a defence mechanism is particularly popular among butterflies, reptiles and birds.

There are different ideas about the function of the eyespots among scholars. Initially it was believed that eyespots were designed to scare away predators by displaying big eyes that resembles the eyes of other species that the predators are afraid of (Blest, 1957; Stevens, 2005). For example, butterflies display eyespots that might resemble the eyes of the owl, and thus scare away birds who eat butterflies but are afraid of owls. The effectiveness of eyespots as defence mechanisms has been demonstrated in experiments. For, example, in one recent experiment 33 out of 34 Peacock butterflies avoided death from hungry birds by displaying eyespots. Both butterflies and hungry birds were confined to a small room, and butterflies survived continuous attacks during the 30 minutes by just displaying the eyespots (Vallin et al., 2005).

The idea of eyespots, as clearly visible marks, goes against the idea of crypsis. The ingenious power of Natural Selection made it possible for the same animals to be cryptic and to display eyespots only when the animal has been detected. For example, some butterflies have two pairs of wings, and the outer pair is cryptic, blending with the environment, and the inner pair has clearly marked eyespots. Therefore, a resting butterfly is in a "cryptic mode" and is difficult to notice, but if disturbed, a butterfly opens the outer wings and the predator gets a sudden shock with the appearance of scary Big Eyes. The above-mentioned Peacock butterflies use this switching mode from crypsis to aposematism (warning display).

Scholars also suggested that eyespots might be designed to confuse predators by diverting them to less vital parts of the body (see for example, Lonnstedt et al.,

2013). As we know, evolution is very economical, so it is possible that eyespots have several functions.

Among mammals eyespots are not as popular as among butterflies and reptiles, although very importantly for the topic of our book, many big cats have eyespots on the back of their ears. At least one of the possible functions of these markings on the back of the ears is to deceive a potential enemy who is approaching from behind into believing that the enemy has been spotted. It is widely known that cats themselves prefer to attack their prey when the prey is not aware of the cat's presence. For example, one effective means of saving human lives in the marshlands of Sundarbans, where killing villagers by man-eating tigers is a regular occurrence, was putting masks of human faces on the backs of the head of the villagers, in order to avoid tiger attack from behind. So, eyespots are an effective means of preventing an attack of a predator, and as a result, this strategy is employed by countless numbers of animal species from different classes and orders. Leyhausen proposed that as the eyespots on the back of the ears are prominent from the frontal view when a tiger (and a few other cats) flatten their ears in order to show aggression to the antagonist, it has the function of intimidation (Leyhausen, 1960; Schaller, 1972:264).

We are coming to the end of our brief review of animal defence mechanisms. In the next section we will start discussing the defence strategies of our ancestors. But first let us repeat one more time that the strategy to scare away predators is opposite to the strategy of crypsis. In crypsis animals try to stay unnoticed by hiding and being silent. On the contrary, when animals try to scare away predators, they try to look bigger and they make loud sounds. Also, let us remember that a large number of animal species manage to use both of these strategies by instantly shifting from one mode of behaviour to another. For obvious reasons, this shift is always from crypsis to warning display, but never vice versa.

Also, very importantly, apart from such species who use both cryptic and warning modes in different situations, there is also a number of specific species who use the principle of warning display all the time. Such **species, who use warning display as the central strategy of their defence, and who do not try to hide themselves from predators, are known as aposematic species**. The mysterious

word “aposematism” means “warning display.” We will discuss aposematism and aposematic species in detail later in the book.

Summary

Let us summarize the defence strategies among animal species we have already discussed.

The list of the techniques and strategies that we have just discussed is by no means exhaustive, but will give a reader the general idea of the main defence strategies that animal species use in order to avoid predation. If a reader is interested in reading a more detailed account of existing defence strategies, I would suggest reading a recently published book on the subject “Avoiding attack. The evolutionary ecology of crypsis, warning signals, and mimicry” (published in 2004). Of course, different animal species use many more defensive strategies, but I included only those strategies that might apply to the morphology and behaviour of human (and big cat) species. There is little sense in discussing such defence strategies as using venom, electric shock, or horns, when we are discussing the interaction between human ancestors and big cats.

And at the end of this section, dedicated to basic survival strategies used by prey species against predators, I want to remind the reader once more that after our primate ancestors made the historical move from trees to the ground, they had to devote much more time and energy to safety from predators, as the risk of predation was much higher on the ground than it was in the trees.

With this thought clearly in mind, let us now have a closer look at which of the above-mentioned strategies could have been used by our distant ancestors.

Early Hominid Defence Strategies

Here we are, trying to reconstruct the first encounters of our ancestors with ground-living big predators, primarily big cats. We already mentioned that initially the interaction between the ancestors of big cats and humans was the interaction between predators and prey, but gradually our ancestors learned to stand their ground, and to survive the kings of the forests and savannah. The crucial question is: **what strategies could they use for their safety from the fearsome ground predators?**

I fully agree with Hart-Sussman's thesis that predation was a crucial evolutionary force forming the future Homo sapiens. The central thesis of my model of human evolution is that it was primarily the original defence strategy that started the long chain of our morphological and behavioural transformations from primate into Homo sapiens.

Now, to find out which of the known defence strategies might have been followed by our distant ancestors, let us compare the above list of animal defence strategies with the early hominid morphology and lifestyle.

Did Our Primate Ancestors Become More Invisible to Escape Predators?

As we recall hiding (crypsis) is the initial defence strategy for many animal species. They try to stay unnoticed most of the time. We may also remember that hiding from others is very popular not only among prey species, but among predators as well for obvious reasons. Basically, both predators and prey try to stay unnoticed from each other.

What about our ancestors? It seems to me that, according to their upright bipedal posture, it would be logical to conclude that our distant ancestors did not try to hide from predators. Or at least, if they tried, they were not good at it. Some readers might suggest that contrary to my assertion the bipedal posture was not too bad a tool

against predators. For example, Dart suggested in 1925 that a bipedal posture might have helped our ancestors to notice stalking predators. This idea was repeated a few times later by several scholars as well. It is generally true that, if you are taller and your eyes are positioned at a higher point, you can see your surroundings better. On the other hand, the proponents of this idea sometimes do not pay attention to another obvious fact, that in an upright posture your body is also seen better by all other animals as well, including prospective predators. What to do? As is often the case, the genius of Natural Selection found a brilliant solution to make use of both postures: many animal species (both predators and prey) use a bipedal posture for several seconds only. They rise on their hind legs just to scan the territory, and after receiving this visual information they quickly return to their usual four-legged posture to stay out of sight.

In contrast with this very sensible strategy, our ancestors shifted to full-time bipedal locomotion, which was very visible, particularly in the open grasslands of the African savannah. It must be natural to conclude that our ancestors did not try to conceal themselves from the eyes of predators.

And by the way, their highly visible bipedal posture indicates that our ancestors were visible not only to prospective predators, but to prospective prey as well.

Did Our Ancestors Become Silent After They Descended to the Ground?

We may remember that ground-living species are much more silent, than tree-living ones. We may also remember that when tree-living species visit the ground, they as a rule also become silent. So what about our ancestors? In answering this question we can be quite sure that our ancestors were not a silent species. As I have already mentioned earlier, humans are virtually the only species who live on the ground and sing. All other 5400 singing species live away from the ground, on the safer tree branches, or in the water. So we can definitely say that our ancestors did not try to be silent. As a matter of fact, it is virtually impossible to find a noisier animal species than humans.

What about Escaping Predators with Running?

As you remember, running away from lethal predator danger is the most widespread means of avoiding predation, particularly in such an open place as the African savannah. As we know, humans can run, and watching how some of the best athletes run is a great pleasure. The amazing human ability to run was studied and glorified by two American scholars Dennis Bramble and Daniel Lieberman. The reader can easily find on the internet the fascinating 2004 article "Born to run" about their research into human running ability. Bramble and Lieberman studied the importance of running in human prehistory and evolution for a long time. They argue that humans are the best endurance runners among all animals, beating even horses, wolves and antelopes. So it might seem that running was the key factor in how our ancestors survived deadly ground predators in Africa.

Well, I must say that such claims about the effectiveness of human running are not widely shared by scholars, and there are good reasons for this.

Consider several facts. Most importantly humans are not fast runners (this fact is shared by Bramble and Lieberman as well), and that is what counts when it comes to saving yourself from a charging predator. The fastest speed ever to be achieved by the fastest running human, the legendary Jamaican athlete Usain Bolt, was under 45 km per hour for a couple of seconds only. Basically, anyone who can run 100 metres in 10 seconds (10 metres a second), will be most likely participating in the Olympic games as a professional sportsman. So the top speed in human running is about 36 km/h.

If we compare this speed with the speed of other animal species, which live in the open territories of the African savannah, we can see how slow humans are. The minimum speed of most predators and prey on the African savannah is approximately 55-60 km per hour. Even if we forget the amazing cheetah, which can run with a lightning speed of over 90 km/h for several seconds, much heavier lions also can run with a speed of 60km/h. The same is true for most of the prey species, for example, the antelope species. A slow-running antelope is a dead antelope.

So what is the conclusion? Not very positive for running humans and hominids: even if you can beat Usain Bolt on the track, your speed still would not be enough to

save your life from a charging lion, or to catch a running antelope on the African savannah for your diner. There is more. Forget about the lightning speed of the big cats and antelopes. Even our closest relatives, the funny chimpanzees, with their awkward knuckle-walking and running style, can run faster than the slim and spectacular elite of human athletes. Embarrassing for humans, but a fact.

Actually, if humans were as fast as the best runners of the African savannah, we would need to redesign some of our sporting games and gear. For example, in order to play soccer, the soccer federation would need to change the texture of the playing ball, as the currently used soccer ball flies over big distances slower than the running speed of the African savannah animals. So a player with such an "animal" speed would be able to kick the corner and then score himself...

"Wait a minute," a reader might ask, "Dennis Bramble and Daniel Lieberman agree that humans are not sprinters, but they argue that humans are the best endurance runners! What about this?" We will discuss the human long-distance running ability in an evolutionary light later in the book, when discussing the ways our distant ancestors obtained food. Here we are discussing **running as a means of avoiding predation**, and we can all agree that running away was not an option for our ancestors to escape predators if their speed could not match the speed of the attacking predator.

Possibly It Was Sheer Physical Strength?

As you will recall, physical strength is another crucial factor that helps a species in a struggle for survival against deadly predators. How strong are humans and how strong were our hominid ancestors? We look at the muscular bodies of the best human athletes in admiration and awe, but how strong are they compared to animals? The answer to this question is another disappointment for humans. Even the best human athletes are hopelessly weak in comparison with even much smaller animals. For example, when you look at the photos of the huge muscular bodies of the guys like Arnold Schwarzenegger on one side, and a photo of a funny-looking chimpanzee

on the other side, it is very difficult to believe that the much smaller chimpanzee is several times stronger than the seven times Mr. Olympia. By the way, Schwarzenegger not "only looks" strong as some might think. He is extremely strong, and in 1967 he even won the traditional strongman competition in Munich after lifting a 253-kg stone. Some might argue that our hominid ancestors were very different from us, that their physical strength was closer to animal strength. This is most likely true, but it is also true that during the millions of years human physical strength gradually declined during the process of sapienization (or becoming human). So although our bodies were becoming gradually bigger, our "animal" physical strength was gradually disappearing. So our ancestors could not save their lives relying on their physical strength against the ancestors of the big cats.

What about Teeth?

If we needed at least several sentences to discuss the human inadequate abilities in running and physical strength in comparison with animals, here, discussing teeth, we do not need this, as it is too obvious that canine teeth, the most important defence (and offense) evolutionary tool of many animal species, is totally absent in humans and in known hominid ancestors. Teeth have the strongest bone structure of all human bones and can survive better than other bones, so the paleontological evidence on the evolution of hominid teeth is as rich as it can be. The evidence shows that human canines were disappearing for several million years, from the very beginning of the long road to humanity, starting from our very first known ancestor "Toumai," who lived about seven million years ago. So it is clear that our ancestors were unable to defend themselves from predators by fearsome canines, as many other ground-living primates, like baboons or mandrills, could and still can do. Darwin was probably the first to point out that the decrease of canines in human evolution must have been connected to the adoption of tools as weapons, relieving teeth of the function of physical defence. A century later Ralph Holloway suggested that the reduction of canines followed changes in the social organization of our

ancestors and was a selection against aggressiveness (Holloway, 1967). Richard Wrangham recently suggested that it was the invention of cooking, not tools, that played the key role in the decrease in the size and number of hominid teeth (Wrangham, 2006). Whatever the reason, it is clear that teeth could not serve as an adequate weapon to defend our ancestors from the attacks of the big African predators.

Hide Behind the Thick and Tough Hide

Disappointment again. Humans have one of the softest skins in the animal kingdom, and arguably the gentlest and softest skin among the savannah-living animals. So it is clear that our ancestors were devoid of any possibility of protecting themselves with the last resort of defence – a tough hide, one that both prey and predator species use to endure the rough physical contest against each other for survival.

Summary

This brief review of possible hominid defence mechanisms looks like a total strategic disaster. None of the usual popular means of the defence from predators were used by our hominid ancestors! Our ancestors were not hiding from predators, they were not keeping themselves silent, they could not run fast, they were physically very weak, had no teeth, and had no tough skin to defend them against charging predators. And such defenceless creatures were living for millions of years on the open grasslands of the African savannah, both day and nighttime, sharing territories with lions, saber-toothed tigers, lion-sized hyenas and wild dogs, to name a few of the predators of the day. It might seem a miracle that primate-hunting big cats did not eliminate the strange groups of primates, living on the ground and virtually without any defence mechanism.

But of course, our ancestors were not defenceless after all. Louis Leakey once famously said "We were not cat food." Well, we actually were a cat food for a long time, but we gradually developed strategies to become exempt from the diet of the big cats and later even challenged them for the domination of the animal world. We are living proof of this. So what was the key to our success?

We have not yet discussed all the defence mechanisms that animals use to save their lives against predators. Now we need to discuss the totally different strategies that animals use in order to survive the struggle for existence. This strategy is to **intimidate and scare away** predators. We will be pleasantly surprised to learn how efficient our ancestors were at intimidating all predators and competitors. Our ancestors possibly were the best intimidators that the world has even seen. But this unique ability did not come suddenly. It was developed during a long and painful process of selection and elimination through natural selection and the gradual accumulation of new morphological and behavioural characteristics in our species. We shall next discuss this survival strategy.

CHAPTER TWO

Aposematism: When the Interests of Prey and Predator Species Coincide

In two words, "aposematism" is a strategy of intimidation of the opponent by different means – looks, sounds, smells, behaviours. Literally, "apo" means "stay away", and "sematic" means "sign" or a "symbol." So we can translate this term in plain English as "warning display." Contrary to popular belief, the use of aposematic (warning) display is not connected to prey species only. As a matter of fact, there is hardly an animal species that does not use at least some aposematic strategies. Even the strongest of all predators, the mighty big cats use aposematic display in their everyday life, as they often growl and show their fearsome canines in order to be left alone. We all possibly have seen a situation when a big dog corners a cat: the cat arches its back, turns its body partly sideways, erects every hair on its body, bares its teeth, and makes hissing sounds. All these elements are designed to communicate to the dog that, if it comes closer, the cat will fight back. By arching its back, positioning its body sideways and erecting its hair, the cat tries to look as big as possible. The importance of showing teeth is clear without explanation. In regards of hissing, it is an "international" (or interspecies) signal, kind of a "stay away" sign to everyone. We will discuss later the possible reason for such popularity of hissing among various species, as diverse as snakes, geese, cockroaches and tigers.

Apart from intimidating an opponent, many aposematic features were designed by evolutionary forces to enable easy recognition of the species. "Remember me?!" is a very import message communicated by colours, sounds, smells and behaviours. This is an extremely important part of aposematic display. If the cryptic strategy is based on staying as low as possible and surviving predators by avoiding detection, an aposematic strategy, on the contrary, is based on advertising the animal's presence by all means, and scaring predators by looks, sounds, smells, and fearless behaviour, or advertising their unprofitability with the same audio-visual-olfactory signals.

A very important point that distinguishes aposematic from cryptic characteristics is that by its very nature individuals in cryptic species try to be less

individualistic. They try to blend, to look and behave as others, try to be as ordinary as possible. Individuals in cryptic species thrive when they stay unnoticed. On the contrary, aposematic strategy thrives on constantly pushing existing boundaries (colours, shapes, behaviours) and an animal who is a bit more aposematic, more brilliantly coloured, more visible, will have better chances of survival. So for example, if a species have a big-sized body those individuals who are bigger will have an advantage in surviving attacks by predators and finding mates, and will leave more offspring. The same happens with the colours of a body, with louder and lower sounds, with the smell of the body, and with the elements of aposematic behaviour. In short, an aposematic strategy thrives on exaggerated features and constant expansion of the existing elements of warning display, whereas the strategy of crypsis is more conservative in its nature and just tries to blend better with the environment.

Another crucial feature of the strategy of aposematic display is that most of the species use aposematism only sometimes, at the times they need to warn or intimidate their opponents, like bears who stand up only if confronted by a predator or competitor. On the other hand, there are also some very interesting species of animals which use aposematism constantly, as their everyday survival strategy. **These species are known as "aposematic species."**

Now, let me explain the differences between an aposematic display by non-aposematic species, and the use of aposematism by so-called "aposematic species."

As we already know, aposematic display is a means of warning antagonists to stay away. Virtually any animal can use an aposematic display in an appropriate situation when they are harassed or confronted by a competitor or a predator. For example, when dogs or lions growl and bare their teeth while eating, they are communicating (by audio and visual signals) to everyone around that they want to be left alone. Bears and scores of other animal species stand on their hind legs to seem higher and more imposing to their competitors. Lions and many other animals erect all the existing hair on their body and head, in order to seem bigger and to better intimidate their competitors and enemies.

At the same time it is very important to remember that none of the predator species use aposematic display during hunting: lions do not roar, and bears do not stand on their hind legs when they are hunting, on the contrary, they try to stay as

unnoticed, silent and swift as possible, and aposematic display is always connected to losing both speed and the factor of surprise. Of course, in the movies attacking lions and tigers always make fearsome roars, but this is because it is human nature to make loud sounds when engaged in combat (we will see why later). Hunting predators do not try to scare away their potential food; on the contrary, they are silent and swift.

Why is it that animals, particularly powerful beasts like lions, try to intimidate each other? Why do they not just fight? After all, these beasts are born fighters! We may remember from the early evolutionary models that the evolutionary struggle for existence is a relentless and continuous fight by an animal with everyone, from their conspecifics to the members of other species. Here are some famous words from Huxley: "From the point of view of the moralist the animal world is on about the same level as a gladiator's show. The creatures are fairly well treated, and set to fight–whereby the strongest, the swiftest, and the cunningest live to fight another day. The spectator has no need to turn his thumbs down, as no quarter is given. He must admit that the skill and training displayed are wonderful. But he must shut his eyes if he would not see that more or less enduring suffering is the meed of both vanquished and victor. And since the great game is going on in every corner of the world, thousands of times a minute" (Huxley, 1888, pg. 199-200).

Well, this initial bloody model of struggle for existence is not very accurate. In fact, **representatives of the animal kingdom are much more sensible that many scholars give them credit for. Most of the animal species try to avoid unnecessary violence wherever and whenever this is possible**. The reason for this avoidance of violence is not altruism, it is purely practical: if an animal tries to kill another animal, the aggressor should accept that the other animal will be as determined to kill the aggressor, or at least inflict injury to the aggressor. So even if one of the combatants is stronger and can kill the antagonist, there is always a chance that the fight will still result in an injury to the winner. And injury often means loss of fitness, and eventually might cost a life. Therefore, if animals want to avoid injuries, they must avoid physical violence. So, if the opposed animals can avoid physical all-out fight to a lethal ending, figuratively speaking, they are both winners. Although many think that animals use "the rule of tooth and claw" in every encounter

with other animals, those who study animal behaviour seriously know that all-out fight to the total destruction of the opponent (and particularly an opponent of the same species) is much less frequent than most would imagine.

Edward O. Wilson formulated the key question in this regards, asking why do animals prefer pacifism and bluff to escalated fighting. The answer is that direct violence potentially carries very high costs, including possible injury and death. Wilson suggested that for each species there exists some optimal level of aggressiveness above which individual fitness is lowered (Wilson, 2009). The only exception, where there is no way of avoiding fatal violence is hunting, when one animal must kill another for food.

But how can animals resolve the conflict if they do not fight? For example, who decides who the master of the territory is? Or to whom this particular female belongs? These are conflicting situations that somehow must be resolved, but desirably without serious injury to either side. And this is where the power of aposematism steps in.

Instead of starting an all-out fight, animals try to intimidate each other by several means: showing the size of their body, the size of their canines, the power of their voices, and other possible non-violent means of display. This kind of display is usually known as **ritualized fight**, an ingenious aposematic tactic to avoid real, non-ritualized fighting (see, for example, Lorenz, 1964, 1966; Eibl-Eibesfeldt,1979). Ritualized fights as a rule also contain a few non-lethal blows to each other, and the animal which is smaller, or has a softer voice, concedes defeat after a couple of slaps, long before the fight can seriously injure either of the combatants.

When male lions, famous for their fighting abilities and short temper, face each other, they as a rule do not start an all-out fight from the very beginning of a confrontation. In fact, in most case they do not start a real fight at all. For some time they face each other, roar at each other, display their canines, the size of their manes and body, and if neither of the participants in the confrontation backs down, only then do they start their physical conflict. The physical conflict at this stage, as a rule, is still not serious and is only a continuation of the strategy of intimidation. So, although they might seem to human observers to be terrible lethal blows (their blows seem to us lethal as they would certainly be lethal to us), lions still avoid the real "killer" blows and bites that they can certainly deliver.

Let us hear what George Schaller says about lion conflicts and fights in his ground-breaking book "Serengeti Lion" (1972):

"Fights as a rule are short – a slap or two accompanied by much vocalizing and baring of teeth – and biting is infrequent" (pg. 132)… This was characteristic of intra-pride interactions, but the following words describe the violent interactions with the non-pride members, including territorial disputes: "Even though interactions are at times seemingly violent, with the animals growling, slapping, and so forth, injuries, if any, consist of minor cuts. In fact, the combatants give the impression that they avoid physical contact. When a lion pursues a stranger it usually maintains a certain distance, at least 10m, adjusting its speed to that of the intruder; even if it catches the other, actual contact is usually limited to a slap or two. Serious fights do occur but are rare" (pg. 55)… "In over two years of observation on lions in Manyara Park, which has a higher lion density than Nairobi Park, no serious fights were seen…" (pg. 47). This does not mean serious fights and fatal violence is totally absent among lions (see, for example, Schaller, 1972:189), but it is clear that apparently serious fights and all-out violence is much rarer than is popularly believed.

Brian Bertram, another scholar who studied lion behaviour at the same time as Schaller, and published a book in the same year, also wrote that lions try "if possible, to avoid physical conflict…" "In a sense, many threats are a combination of warning and bluff" (Bertram, 1972: 63).

"Warning and bluff" are potent words to describe the essence of aposematic display. So, although it is popularly believed that lion fights are very violent and often lethal, in fact lions try to avoid serious violence between each other. My long search for a lethal lion fight among YOUTUBE videos also had no result, although there are quite a few lion fights on the internet, and some video titles even claim a fight was lethal.

So, let us remember: the central aim of aposematic display is to avoid physical violence by substituting violence with the ritualized display of the size and sounds of the conflicting parties. Audio-Visual-Olfactory Intimidating Display (or AVOID) is very appropriately used to **avoid** unnecessary violence and injuries. No predator uses aposematic display, or AVOID, while hunting. Lions do not roar and erect their

mane when they are pursuing prey. Bears do not stand on their hind legs while hunting and cats do not hiss and erect their hair when hunting mice either.

Ritualized behaviour in many animal species, or as Darwin called them, "antiques", are as a rule aposematic displays, designed to get the needed result without physical violence. With a warning (aposematic) display animals can chase a competitor away from their territories, chase rivals away from desired females, etc. Predators, on the other hand, do not chase away prey species. But prey species, when pursued, try to intimidate predators by showing their size, voice, teeth and horns, clearly indicating that they are ready to fight back with all the means they have. The predator-prey relationship is a relationship that understandably has the highest rate of fatal encounters. No kill – no meal.

No doubt, aposematic display is one of the greatest inventions of Natural Selection. Skilfully designed to minimize unnecessary violent confrontation that could lead to unwanted injuries in the animal kingdom, aposematic display made a strong and still mostly neglected appearance throughout human evolutionary history, from the early hominids' life to the big international politics of contemporary states today.

I hope most of the readers will agree that the central aim of state military powers with many billions of dollars of financial backing is to communicate to everyone that their military forces can answer to any aggressive move toward their interests. Many agree that the most powerful military weapon of humanity, the dreaded nuclear bomb, acts primarily as a potent warning signal, or aposematic symbol, as hardly any of the owners of this weapon are ready to deploy it for affirming their own political interests. A successful test of a nuclear weapon by a country has the same aposematic symbolic meaning, as standing on hind legs for bears, or a growl from the bushes for an irritated tiger: "Leave me alone!"

We have just discussed the fact that most of the animal species have critical moments when they employ aposematic warning displays in order to avoid unnecessary violence. Apart from them we already mentioned that there are also animal species who took the notion of aposematism to the extreme. The whole existence of these animal species, including their morphology and behaviour, are directly connected to the principles of aposematic display. So, if other species use

warning signals in some stressful moments of their lives in order to avoid confrontation, aposematic species display warning signals continuously, at every moment of their daily life (and often during sleep as well). They never try to blend with the environment in order to hide themselves; they do not try to be silent, or to be free of the body odour. On the contrary, with all the possible means they try to be seen, heard, and smelt. Through the millions of years of adherence to the strategy of warning display, their morphology and behaviour have adapted appropriately to their aposematic lifestyle. Their morphology developed in the way that they are easily seen, easily heard, and easily smelt. This is the central reason why aposematic species are often coloured in bright colours, and why they have ostensibly unnecessary and highly visible morphological additions. For the same reason they often produce lots of noise while walking, and their body also often has a strong (and often unpleasant) odour. Aposematic species also developed two behavioural characteristics, signaling to the would-be predators to stay clear of them: (1) they usually walk very slowly and awkwardly, as if to communicate to the would-be predators that they do not need to run for their lives. And also, (2) they often congregate in larger groups. And when they are in large groups, they are becoming virtually impossible to miss as a bunch of highly visible, noisy and smelly individuals.

So let us remember, such species are known as **aposematic species**.

Not all aposematic animals fulfill entirely the whole arsenal of these aposematic characteristics. For example, skunks, classic aposematic mammalian species, do not live in large groups, and some colourful and slowly moving venomous snakes do not have body odour, but there are quite a few aposematic animal species whose morphology and behaviour is entirely dominated by strive towards aposematism.

Short History of the Idea of Aposematism

Every idea has its history, consisting of a birth, early growth and a coming of age. The death of ideas can also happen. Sometimes an idea is stillborn, but an image of successful life is given by caretakers. In other cases a healthy idea is considered stillborn, until someone later manages to revive it and gives it new life. Apart from a biological parent (or parents if it is collaboration), ideas may also have godparents, individuals who will adopt an early idea and raise it into something more widespread. Sometimes the identity of the parent or godparent of an idea is lost in the mists of history, or in the depths of scholarly intrigue. The idea of the warning display, later coined as aposematism, has the most glorious biological parents that the history of evolutionary study can provide: the famed co-discoverers of the theory of natural selection: Charles Darwin and Alfred Wallace. The idea of a warning display, or "warning flags" was born in February 1867, during the communication of these two great scholars. Despite these glorious parents the idea of warning display for some reason never really received its "coming of age", the attention it deserved.

1867 was the year when Darwin was busy writing his second big book, "The Descent of Man." The full title of this book reads as "The Descent of Man, and Selection in Relation to Sex." You can already anticipate from the title of the book that Darwin will attribute sexual selection as having crucial importance in human evolution. The book indeed argues that sexual selection was the driving force in the evolution of humans as well as many other species. Because of this, Darwin's book was criticized both by his contemporaries and following generations of scholars. More precisely, Darwin was criticized for two reasons, (1) that his book was more about sexual selection than about human origins and evolution, and more importantly, (2) that Darwin overrated the importance of sexual selection in human evolution (and in evolution in general).

Scholars still remain divided about the importance of sexual selection in evolution, and in particular in human evolution.

It is true that Darwin was attributing the large diversity of animal species to the forces of sexual selection. Virtually everything that could not be explained by the forces of natural selection through the ubiquitous "struggle for survival", Darwin

attributed to the forces of sexual selection. All the exaggerated morphological features of animal bodies such as the bright colours of insects to the tail of the peacock (known as its "train"), plus all the strange behaviours ("antics") and sounds of many animal species, were stated by Darwin to be the result of the work of sexual selection.

By its potential, the model of sexual selection was about as potent and the model of Creation. The main difference between them is that instead of God's will and desire as the creative power behind all changes, sexual selection puts in the centre of the evolution the will and desire of our female counterparts. Male behaviour and morphology, according to the proponents of sexual selection, totally depended on females' arbitrary choices. This idea is clearly expressed in the following phrase from an American scholar from the University of New Mexico, Geoffrey Miller, one of the most ardent contemporary proponents of sexual selection: "for the most part adult male hominids must have been rather peripheral characters in human evolution, except as bearers of traits sexually selected by females for their amusement value or utility" (Miler, 1998: 109-110).

All was going well for Darwin, as he could find plenty of difference in the shapes, sizes, colours, sounds and behaviours between the different sexes of a vast array of animals. But suddenly he hit a brick wall. It was when he was trying to explain the brilliant colours of several species of caterpillars. You may be thinking that he would not have hesitated to attribute their brilliant colour schemes to the power of sexual selection, but there was one huge problem - caterpillars were not yet sexually active, so sexual selection was theoretically and ultimately ruled out, at least for caterpillars. So what then was the reason for their beauty? As a staunch evolutionist, Darwin was sure that such brilliant colours could not have been developed without a practical reason to do so. He would not accept the dominating theological explanation at the time, suggesting that the existence of beauty was proof of the existence of an almighty and conscious Creator. According to the creationist view, the beauty has no utility other than to give aesthetic pleasure, and that humans (God's 'highest' creatures) are the only creatures who can truly appreciate such beauty.

Finding himself in a troubling situation and unable to use his favourite model of sexual selection to explain the dazzling beauty of caterpillars, Darwin wrote to

Wallace on February 23, 1867, explaining his predicament and asking if his friend had a solution to this problem.

Wallace's answer, written the next day on February 24th, to Darwin is one of the most important letters written in the history of biology. Wallace had noticed that the animal species which had good secondary defences (for example stingers, poison, or an unpalatable/noxious body texture), were also the ones with visible colours, seemingly a warning to predators that it was advisable to refrain from attacking them. Wallace wrote:

"*The animals in question are possessors of some deadly weapons, as stings of poison fangs, or they are uneatable, and are thus so disagreeable to the usual enemies of their kind that they are never attacked when their peculiar powers or properties are known. It is therefore, important that they should not be mistaken for defenceless or eatable species of the same class or order since they might suffer injury, or even death, before their enemies discovered the danger or uselessness of their attack. They require some signal or danger flag which shall serve as a warning to would-be enemies not to attack them, and they have usually obtained this in the form of conspicuous or brilliant colouration, very distinct from the protective tints of the defenceless animals allied to them*" (Wallace, 1889:232).

Continuing this idea, Wallace also suggested that birds and other predators would reject the conspicuously looking prey, and would rather chose the more cryptic, non-conspicuous looking prey or food items. After learning about Wallace's ideas, John Weir from the Entomological Society of London conducted experiments with caterpillars and birds in his aviary, and after a couple of years in 1869, he reported the first experimental evidence of the effectiveness of warning colouration in animals.

Wallace's letter to Darwin contained two brilliant ideas, (1) the idea of a "warning display," later developed by Sir Edward Poulton into the idea of aposematism (Poulton also coined the term "aposematism" in 1890), and (2) the suggestion that predators would reject colourful and unknown preys, developed later into the idea of neophobia among predators (avoidance of new and unusually flamboyant-looking animals).

Darwin's reaction to Wallace's letter was overtly positive. He was very pleased that the dilemma of the conspicuous-looking caterpillars was settled, and he wrote in reply to Wallace's letter: "I have never heard anything more ingenious than your suggestion, and I hope that you may be able to prove it true." Receiving Darwin's letter must have been one of the happiest moments of Wallace's scholarly life.

Here we are closing in on a crucial idea, so far mostly neglected in scholarly literature: animal species can develop distinctive colours, hard-to-explain morphological structures and strange behaviours in order to attract mates on one hand, but on the other hand, animal species can develop exactly the same kind of distinctive colours, sounds, morphological structure and strange behaviours in order to ward off predators and competitors, thereby avoiding unnecessary and violent confrontations. This idea was implicit in Wallace's letter to Darwin, but was unfortunately dismissed by Darwin, as Charles was at the moment still overwhelmed at finding such an abundance of "evidence" of the importance of sexual selection. For Darwin, Wallace's idea was only there to explain the cases of bright colours that did not fit the model of sexual selection.

Quite amazingly, Wallace himself did not grasp the implicit importance of his suggestion regarding the animal kingdom. Just a couple of years later Wallace and Darwin had a discussion about the peacock's amazingly beautiful train. Darwin was sure that the power of sexual selection was at work here. Wallace had another idea, but instead of suggesting that the peacock train could have had a function of scaring away competitors and predators (we will discuss this idea later), Wallace instead came up with a very implausible suggestion that the bright colours and long tails of the peacock were not adaptive in any way. According to him, bright colouration could have been the result from non-adaptive physiological mechanisms. For example, he argued, the internal organs of animals that are impossible to see are often still brightly coloured.

Therefore, we have a very sensitive situation for scholars interested in the mechanisms of both sexual selection and aposematism. Sexual selection and the warning display (aposematism) work using the exact same elements: bright colours, sounds, smells and behaviours, but with totally different driving mechanisms: sexual selection is driven through the female choice (which can be arbitrary) leading to mating success, but aposematism is driven by the mechanisms of natural selection

through the warning display, leading to survival from predators and avoidance of unnecessary violent conflicts. *Attracting* in one case, and *intimidating* in other case.

Of course, there is no good reason why these two forces, aposematism and sexual selection, could not work together. Essentially, females may find attraction the same traits that help their male counterparts avoid violence and survive, particularly as these traits are more colourful, noisier, and generally more attention-grabbing. But here comes the crucial question: Which of these two forces is the primary and which of them is secondary? Proponents of sexual selection of course would suggest that sexual selection is the primary reason, to the extent that certain traits are not only unnecessary for survival, but actually detrimental to it. The idea of this "handicap principle," suggested by the celebrated Israeli evolutionary biologist Amotz Zahavi, proposes that the true ("honest") signal for the mate's choice must in theory be detrimental to survival. A peacock's amazingly beautiful train is the best proof available for this line of thinking and was featured on the cover of Zahavi's book. We will discuss the possible reasons for the beauty of a peacock's train later in the book, but I would like to propose that, in the case of the shared responsibilities of sexual selection and aposematism which are carried by bright colours, loud sounds and exaggerated shapes, the aposematic warning display is most likely the primary force, thereby making sexual selection a secondary objective of these traits. As we are going to discuss this issue in detail a bit later, let us go back to Darwin-Wallace communication about the idea of a warning display.

Unfortunately, whilst reading Wallace's letter, Darwin was too engrossed in the power of sexual selection to be able to appreciate the wider explanatory potential of Wallace's new and brilliant idea. For him the idea of a "warning display" was a good enough explanation for the sexually-immature caterpillar's brilliant colour schemes, and after solving this troubling problem Darwin never looked back to Wallace's idea of warning displays. This is why Darwin did not go any further in considering the importance of warning displays in the evolution of the morphology and behaviour of a large array of conspicuously looking animal species. It was through this process that the big chance for early appreciation of the principle of warning displays was lost.

Here is more evidence that Darwin did not even consider the possibility that brilliant colours, exaggerated morphology and different behavioural displays of

males could serve as anything else but as a means for successful sexual selection through a possibly arbitrary female choice. Arguing for the importance of sexual selection, Darwin famously wrote: 'To suppose that the females do not appreciate the beauty of the males, is to admit that their splendid decorations, all their pomp and display, are useless; and this is incredible' (Darwin, 2004:557). We can all certainly agree with the great scholar that all the 'splendid decorations' and 'all their pomp and display' were definitely created by the forces of evolution for a good reason. This reason was definitely to impress, but to impress who? Were they created to impress females for better mating opportunities, or to impress predators and rivals for better survival chances through avoiding unnecessary violence? Darwin did not even mention the survival benefits of bright colours and unusual behaviours, which means that he never looked at the alternative explanation of brilliant colours. If he did, possibly his book on human origins might have had a different title and quite different content.

It was Poulton who proved Wallace's idea to be true in 1887. And still, even after 130 years, the idea of the warning display remains in the shadow of the more popular idea of sexual selection. The unique position and extremely high authority that Darwin commanded must have been one of the central catalysts to the popularity of the idea of sexual selection on one hand, and also to the neglect of aposematism on the other hand.

Certain progress was definitely made in the subsequent decades, but the idea and notion of aposematism is still very much on the periphery of contemporary biological science. According to my observation, some scholars do not even know what the term "aposematism" means (I have also discovered through my writing that Microsoft Word also does not recognize this term). For a long time even the origin of aposematism itself was considered a puzzle as, according to R. A. Fisher (Fisher, 1930), aposematic individuals have more issues with survival from predators than cryptic ones. It was only by the beginning of the 21st century that scholars came to the more realistic conclusion that aposematic prey individuals might have good chances of survival because of the natural aversion shown by many predators when introduced to new and unusual food. This phenomenon is known as "neophobia."

"There is evidence that predators are particularly cautious in dealing with potential prey having bright colour patterns" suggests the 2008 edition of an

Australian Biology textbook (Campbell et al., 2008: 1223). Furthermore, even in this grandiose book, aposematism is mentioned only once in connection to colours, without mentioning sounds, smells, or behaviours as other important elements of an aposematic display.

Also, it was only in the 21st century that scholars started appreciating the idea of aposematism among plants (see: Lev-Yadun, 2009). Scholars started finding more and more aposematic species not only among insects and reptiles, but among plenty of mammalian species as well. For a long time only the skunk and zorilla (striped polecat) were considered as rare examples of aposematic mammalian species, later studies suggested that the list of the aposematic mammalian species can be indeed rather large (see, for example, Caro, 2009). When discussing the reasons for contrasting colouration, under the categories "aposematism likely" and "aposematism very likely" Tim Caro lists the following animal groups: echidnas, tenrecs, hedgehogs, possums, wolves, foxes, raccoons, enotes, skunks, civets, moonrats, porcupines, weasels, and mongooses. If we remember that in his article Caro is discussing **only** black-and-white coloured species (hence "contrasting colouration"), we can start to get an idea of how large the list of species using aposematic colouration can really be.

A Few Facts and Ideas about Aposematism

As I have already mentioned, aposematism is gradually gaining scholarly recognition despite still being very far from its dues. From personal experience, I can testify that the term "aposematism" is rarely mentioned even by scholars of evolution. The term "warning colouration" is routinely used instead of aposematism. Alternatively, "warning signals" or "warning display" would both be better substitutes for aposematism than "warning colouration", as aposematism definitely involves more elements than colouration. Even the title of the most recent book on animal defence strategies, in which you can learn plenty of things about aposematism, reads like this: "Avoiding attack: The evolutionary ecology of crypsis,

warning signals, and mimicry." If the term "aposematism" was better known, I guess the book would be titled a more fluent "Avoiding attack: The evolutionary ecology of crypsis, aposematism, and mimicry." I myself was considering the title of this book to be "Aposematic Model of Human Evolution," but was advised that this little-known term in the title of the book might confuse potential readers.

By now we already know that aposematism is not only colouration. We know that when aposematic animals try to get attention, they mostly do this by using warning flags in several modalities simultaneously. Apart from colouration, aposematic animals try to look tall and wide, they make various sounds, and they also often emit a body odour. Together with these morphological signals, they also use behavioural signals such as moving slowly and awkwardly, as if signalling to the predator their confidence in that they have no need to run for their lives.

Here is for example a description of the behaviour of a threatened skunk from Wikipedia: "black and white warning colour aside, threatened skunks will go through an elaborate routine of hisses, foot stamping, and tail-high threat postures before resorting to the spray."

As we can see, there is definitely "more than meets the eye."

The aim of this chapter is to give the reader more information about this fascinating and still not-so-well-known evolutionary strategy.

So let us first of all try to classify aposematic warning signals. As the first attempt of this kind, my suggested classification cannot be exhaustive; however, I do hope it will encourage scholars to put some energy and time into creating a more refined classification scheme for aposematic signals.

So, aposematic signals can be:

(1) Visual
(2) Audio
(3) Olfactory
(4) Behavioural

Each of these modalities can be divided further on several sub-types:

(1) Visual signals can be based on use of

(1.1) Bright colours, where the message is “I do not need to hide from anyone!”

(1.2) Contrasting colours (with the same message “I do not need to hide from anyone”).

(1.3) Display of size (“Do not assume I am easy to kill! See how big I can get?”).

(1.4) Display of weapons – spikes, fangs, etc. (“See what I got? If you attack, I **will** use them!”).

(1.5) Display of eyespots (differences in pigmentation that try to simulate the look of open eyes), being preferably bigger ones (“I am always alert! And I am bigger!”).

(1.6) A display of special morphological additions adds several advantages: it can be effective for the increase in the size of the animal (see 1.3), and it often makes animal more colourful (see 1.1), and also sometimes eyespots are also displayed on these extensive morphological additions to further their overall believability in the eyes of a predator (see 1.5).

(2) Audio signals can also be based on several different components, namely:

(2.1) Making sounds as loud as possible (“I am as strong as I am loud, and I am not giving up!”).

(2.2) Making as low/deep as possible sounds (“I am bigger and stronger than you think!”).

(2.3) Making hissing sounds (“I have venom!” – mimicry of the warning sound of a venomous snake).

(2.4) Making sound in groups (“If you attack, we will all fight together!”);

(2.5) Group sounds made deliberately at different pitches, particularly on dissonant intervals, giving any listener the impression of a bigger group, the so called Beau Geste effect (“We are more than you think!”).

(2.6) A wide range of sounds, for example, foot stamping, drumming on external objects, chest beating, can be made without one’s voice. The most popular threatening sound across the wide range of animal species, hissing, also does not need a voice.

(3) Olfactory signals are often quite linear in their range and use, and do not seem to be as varied as visual or audio signals are, but can still send a strong aposematic message:

(3.1) A Strong smell is designed to signal the non-palatability of an animal. The smells often get stronger in danger or excitement ("you would not eat me, so why waste your time and energy killing me?").

(3.2) A not so strong smell is designed simply to advertise the presence of the creator and trigger the predator's memory of an unsuccessful prior meeting. ("Remember me?").

(4) Behavioural signals can take on arguably the widest variety of different forms:

(4.1) Slow walking pace, even when confronted by predator, or even stopping ("You don't represent much of a challenge to me, so why would I avoid you?!").

(4.2) A demonstratively sluggish style of walking ("I can just take my time, I have no need for running away from you at all!").

(4.3) Displays of overtly aggressive behaviour ("I am ready and willing to fight you, so you'd better be absolutely sure!").

(4.4) Congregating in big groups ("We will fight together against you if you decide to attack!").

(4.5) Mobbing ("you don't have a chance when we are united against you!").

(4.6) Strange movements, designed to confuse and dazzle the opponent ("You have no knowledge of my fighting techniques! But you will know them first-hand if you come closer!").

Although we've already distinguished several types and sub-types of aposematic signals, I must say that virtually every sub-type of the above-mentioned list of aposematic signals can be divided further into categories, for example, according to the **factor of time**. Some display signals are constant (such as colouration or eyespots) and some are temporary (appear briefly only when needed, such as a skunk's smell). Caro mentions them as "permanent" and "facultative" signals (Caro, 2004: 261). We will now have a quick look at these categories, as their differences are of great importance.

Bluffing Is Not Enough!

When prey animals communicate the "stay away" signal to predators, they need to have some other, more "real" means of defence (known as secondary defence[3]). We all know that continuous bluffing can lead to disastrous results. Many aposematic species have venom and can sting their attacker (venomous snakes, spiders and wasps are all prime examples), some are highly toxic even to touch (for example, some brightly coloured frogs), some can retaliate via electric charges (such as electric catfish and electric eels), and some are extremely unpleasant or poisonous to ingest (this is particularly popular among insects).

As a matter of fact, bluffing may actually go on for generations. We know that many totally defenceless species have successfully learned the complex game of bluffing. They copy the appearance and even the behaviour of "true" aposematic species (i.e. ones which have potent secondary defences such as poison and non-palatability). This bluffing game is known as "Batesian Mimicry", and the great number of species utilizing this set of principles suggests that bluffing has been used in the animal kingdom for millions of years before humans fine-tuned it as one of their most powerful tools for political games.

It is very important to distinguish the **'aposematic behaviour** of non-aposematic species**'** from outright **'aposematic species'**. Any species of animals can behave aposematically in moments when it is beneficial for them to avoid harm or physical violence, but only certain species can ultimately be labelled as true 'aposematic species'. For example, a domesticated cat might behave aposematically in a critical moment (e.g. hiss and arch its back), but this does not make it an aposematic species. The skunk, on the other hand, is an aposematic species, as it

[3] Quite confusingly, some scholars call "primary defence" the "real" means of the defence (like venom or teeth), and the crypsis and warning display as "secondary defences." In terms of relative effectiveness, venom is arguably more important than hissing and a colourful body, but from the procedural point of view, crypsis and aposematism are the first line of defence for these prey animals, therefore I follow the "timeline" classification of "primary" and "secondary" defences, given in the Ruxton at al., 2004, and consider crypsis and aposematism as the primary defence, and venom and teeth as the secondary defence.

follows the rules of an aposematic lifestyle constantly, having morphology to match its behaviour.

In the next chapter we will discuss the history of the phenomenon of aposematism, and review the prevalence of aposematism in today's animal world – Prepare yourself for some unexpected discoveries.

Constant and Temporary Aposematic Signals

Visual signals

Visual signals are so numerous and abundant that, for a long time, the overall warning display was mostly known as "warning colouration." Visual signals form the following groups and sub-groups:

(1.1) Bright colours – this signal may at first seem to be constant, but there are still some animals that change their colours according to the situations they find themselves in. Apart from well-known examples such as the chameleon or the squid, plenty of animals can intensify the colours on their body or face when they are excited or angry (the colourful face of a mandrill is a good example, as it becomes brighter when it is excited or in danger). Here we should also note that human faces can also change colours when we are excited, afraid, or angry (a common example is blushing, another one being turning pale when extremely afraid).

(1.2) Contrasting colours – possibly the most constant factor in the appearance of many creatures, however there are very few that are able to achieve a sudden transformation into contrasting colours (sailfish is one such rare species, and can change its colours to become light blue with yellowish stripes).

(1.3) Display of size – Although size may also seem as a constant, there are a number of tricks to make your appearance much more impressive in a critical

moment. The presence of a large number of morphological and behavioural tricks of quick size change strongly suggests that in the evolutionary game for survival, size truly matters. Animal species can drastically increase their visual representation with the help of a number of special display patterns. Here are several means with which to reach this the sudden size increase:

(1.3.1) Stand on your hind legs – This behaviour allows the most drastic increase of an animal's size. Plenty of animals stand on their hind legs when they are confronted by competitors or predators. This posture is appropriately labelled as "threat display." A few animals, like bears or some primates, can even move on their hind legs for periods of time without losing balance. It seems that height is arguably the most important measurement of size when an animal wants to impress or intimidate a competitor with its body size. The drastic increase that the visual effect has on the animal's size can be seen clearly in some animal shows. For example, although we know that lions and tigers are heavier and bigger than humans, we only truly appreciate their size when they stand on their hind legs and put their paws on the shoulders of their suddenly dwarfed human trainers or friends.

(1.3.2) Raise any mobile part of your body above your head – This behaviour is not as potent as standing on the hind legs, but is still used by a large number of species. A common example to observe is cats and dogs walking with their tails up in the air when they feel confident and want to be seen. On the contrary, if they are frightened (for example, after sighting a bigger and potentially dangerous animal) they often drop their tails under their legs in an attempt to become as invisible as possible.

(1.3.3) Erect the hair on your body and head – This is possibly one of the most widespread means in the increase of body size in a moment of threat or confrontation. Some animals achieve a noticeably bigger effect with their hair erect. A classic example is the male lion, who erects his long mane when threatened (as if the view of his canines and loud roaring were not already enough for intimidation). Even the fine hairs on a human body instinctively rise up in moments of fear or other strong

emotions, although the visual effect this has is quite negligible considering the amount of hair on a human body relative to creatures with fur coating.

(1.3.4) Stand sideways – strike a pose in order to look bigger. This is a well-known trick known widely among fish, mammals, reptiles and insects. Many fish will readjust in order to appear sideways to their opponents, and many species of birds partly open their wings to increase the size of their body. You may have also noticed how conflicting cats approach each other: also sideways. As the frontal view of many animals does not show their true size, walking at a sideways angle is often the preferred way to approach an opponent.

(1.3.5) Erect, open, raise or display any available morphological structure of your body in order to seem higher and bigger – Even elephants open their huge ears as if their size was not already a sufficient deterrent. Many animal species (for example, many bird species) have seemingly random additional morphological structures that may seem totally useless at first or even a hindrance in the everyday survival game. Darwin explained the presence of such morphological additions as the result of the power of sexual selection. We should not forget though, that such "useless" visual artefact might play an important role in intimidating competitors with a bigger body size and colours, *particularly* when suddenly displayed in a moment of confrontation, as if to suggest to their opponent that the feature is, or relates to, a defence mechanism. So for example, if you are suddenly confronted by a potentially dangerous and aggressively behaving animal, and by chance you happen to have an umbrella with you, I suggest that instead of using it as a club, just open it and raise it above your head. You will be surprised with the outcome.

(1.4) Display of weapons – Showing the opponent your available weapons such as spikes, fangs, or antlers can also be saved for the moment of confrontation (both for defence or offense). Some weapons, like antlers, are carried around permanently in the same "display mood", but other weapons are only consciously displayed in a moment of need. Baring the teeth is possibly the most popular and easily understood gesture of threat across a wide range of species. Showing your canines is a strong warning message, particularly if the canines are of good proportions like in most

carnivores, and also in ground-dwelling primates such as baboons or mandrills. Showing the teeth in a smile or laughter among humans and some primates as a sign of *good* intentions is a very interesting phenomenon, and must be used with caution in order to not to be misunderstood by some animals as a sign of threat (van Hooff, 1972; see also Gregory, 1924; Black, 1984; Harris, 1999). Display of spikes is also very popular among those who are lucky to be endowed with them (e.g. hedgehogs, porcupines). Spikes are usually raised, often shaken and often coloured in easy to see patterns, and can also accompanied with sounds.

(1.5) Display of eyespots – It is not easy to be sure about the precise function of eyespots, but one possible function is definitely the intimidation of competitors and predators. Some eyespots are carried around constantly, like eyespots on the backs of the ears of many big cats, however eyespots of many other species of animals are displayed only in a moment of danger or confrontation. A classic example is several species of butterflies who do not always display eyespots on their wings as their eyespots are placed on the second pair of the wings, which are covered by the first pair of wings. What is the point of having eyespots if you do not display them? Eyespots are hidden when a butterfly is sitting undisturbed. But when disturbed, butterflies suddenly open their top layer of wings (without flying away!), clearly displaying the big eyespots to their attacker (mostly to birds who prey on them). Therefore, a butterfly with such a function can instantly go from a cryptic mode of defence into an aposematic mode of defence (fascinating example of a double primary defence!).

(1.6) Display of morphological additions – Some morphological additions are carried around constantly, like the huge antlers of some species of deer; however, the majority of morphological additions among animals are only displayed in a moment of threat. Insects, reptiles and birds will open (or raise) the usually-hidden morphological additions of their bodies when they face predators or competitors.

(1.7) I propose one more aposematic category which, unlike any other signal, is displaced in time and territory. I am referring to markings that animals leave on different objects, which are on display constantly without requiring the actual

presence of the displaying animal. Examples of such visual aposematic signals are the marks of clawing that big cats leave on the trees, or faeces and urine markings left in strategically important places. I call them "displaced aposematic signals." These signals are addressed to other animals (and usually to the same species) and are aimed to notify them that the territory is occupied. Displaced aposematic signals are an important part of an animal's claim on territory. This kind of displaced aposematic signals can exist only in visual and olfactory modalities, but not in audio and behavioural modalities.

Audio signals

(2) Now we move to audio signals, and see if they too can be categorized as constant or temporary. Because of its nature, audio signals are as a rule used only in a moment of confrontation. Snakes do not hiss, rattlesnakes do not make rattling sounds and lions do not growl in a peaceful, undisturbed moment. At the same time we should remember that producing constant sound (if somehow kept at a low level) can also be a big part of animal behaviour. For example, porcupines are constantly making "booming" sounds when they are on the move. Other aposematic species also have a specific 'careless' moving pattern which creates plenty of accompanying sounds. Such careless locomotion creates a noisy aposematic message to everyone that they are formidable and, as a result, have no need to conceal themselves.

(2.1) Making as loud as possible sounds – Making loud sounds requires strong effort and energy, and this is why loud sounds in most animals are reserved for very specific occasions only. Apart from the use of loud vocalization in a moment of confrontation, a number of animal species also use occasional loud calls to make sure that competitors are aware of their presence and to keep them clear from their territory. It must be said that making loud sounds is a double-edge sword: on the one hand it warns competitors, but on the other hand the noise can work as an invitation for possible predators. Stags making loud calls during a mating season (to simultaneously find mates and scare away competitors) can make them vulnerable, as their call may also invite hungry tigers to the location of the romantically attuned

male. As we have established, loud vocalization among animals that live on the ground always carries an inherent risk factor. Birds on the other hand can advertise their territory and their presence largely without fear of predators, and this is why bird sounds are the most constant of calls heard throughout nature.

(2.2) Making as low (or deep) as possible sounds – also connected to specific critical situations. Bigger animals, as a rule, produce deeper sounds, and emitting such a sound can give the impression that the threatened animal creating the sound is not as small as it may seem. Elephant herds are known to produce low frequency sounds, and apart from keeping in touch with each other, these sounds are used to communicate their presence to everyone, particularly when they cannot be seen in some of their thick forest habitats. Humans (particularly males) produce very low sounds for their relative body size, and we will discuss the possible function of this later in the book.

(2.3) Making hissing sounds – We already mentioned that hissing is used by a wide range of animals, even those whose image does not seem to fit this relatively soft sound (such as big cats). Hissing is a technique employed only when the necessity to scare away competitors and enemies arises. As vocal chords and "true voice" is a relatively late evolutionary product, for many tens or even hundreds of millions years hissing, which does not need vocal chords, must have been the most popular component of an audio warning display. This must be the reason that such a wide range of animal species such as geese, tigers and even some cockroaches all hiss when disturbed.

(2.4) Making sounds together in groups – So far we have been discussing sound production by individuals, but it is obvious that making threatening sounds in groups would also be a very effective way to warn (or intimidate) your enemies or competitors. When a lion pride roars together, they give a powerful message to all the roaming lions in the vicinity that the territory is occupied. Wolves are doing the same with their coordinated howling. The Gibbon family often sings together, very likely to signal that the territory is occupied and also that the resident family has a high level of coherence and unity. In this case the quality of singing communicates

the quality of coalition (see on this topic the enlightening paper by Hagen & Bryant, 2003). Making sounds together can be organised for a special occasion, or as a response to a challenge (for example, when a lion pride hears other lions roaring). Kortlandt wrote that chimpanzees sometimes organize a loud evening "concert," most likely to scare away any potential predators from the vicinity (Kortlandt, 1973). On the other hand, bees and many related insects constantly produce a group sound around their dwelling place, which gives a strong message of their famous cooperative defence to all prospective aggressors.

(2.5) Group sounds made deliberately in different pitches – This is a very interesting audio phenomenon, and particularly interesting for musicians. If you have a group of several animals, singing together in unison, on the same pitch, and another group of the same animals, singing at different pitches, you will hear the difference. The overall sound in the latter, multi-pitch case will be much more impressive. This phenomenon is known as the "Beau Geste" effect. Hearing the sounds of a wolf pack is a good example, as sometimes two or three wolves can create the audio effect of a larger pack of wolves. Hearing the vocal cacophony of a frog choir is yet another example of such group vocalizing. Such sounds can be made in a critical moment of confrontation, or as a warning to a yet-unseen opponent.

(2.6) A wide range of sounds can be made without the voice. Do not forget that voice is a relatively late evolutionary product, and definitely much younger than hearing. The earliest warning audio signals (like hissing) were definitely made before the emergence of voice. Foot stamping, drumming on external objects, or chest beating are other examples of such non-vocal sounds. Most of these sounds are produced when animals are confronted by competitors or predators, but these sounds can also be produced to give a preliminary warning message to everyone in the vicinity (such as the aforementioned chimpanzee evening gala).

Olfactory signals

(3) We need to discuss olfactory signals as well. As we have already established, these signals are not as diverse as visual and audio signals. The question is whether they are produced constantly or in the moment of confrontation.

(3.1) Strong body odour – Strong body odour gives two warning signals, (1) that the animal is not hiding away, and (2) that the animal body might not be an ideal food source for the predator. As we remember, some animals' body odour can give a predator the impression that the body has been dead for a long time and that it is actually already gone off. Importantly for the temporary factor we are discussing, in several animals a pre-existing smell intensifies in a moment of critical confrontation. Huge and strong gorillas also produce strong body door in moments when they are facing the possibility of a physical challenge. This behaviour is known, among others, in two related species: gorillas and humans. Human sweating, as we know all too well, also intensifies in moments of danger. In some animal species (including gorillas and humans) sudden and strong life threatening stress can also induce instant defecation, which is possibly another innate function to increase the strength of smell.

(3.2) The presence of a not-so-strong smell is possibly designed to trigger memories within the mind of a predator, and this feature is most likely a more constant one. Of course, we should remember that not all animals react similarly to the same odours, and that the same odour might be disgusting to some predators but quite acceptable (and even considered a delicacy) to others. Some predators have a bad sense of smell, and this is very bad news for the animals that rely on their faulty odour for protection. Even the legendary skunk is commonly attacked, killed and eaten by the Great Horned Owl which, as scholars have suggested, hardly has any sense of smell at all. This suggestion must be correct, as skunks are avoided by most other predators exactly because of their powerful odour, and that the Great Horned Owl is possibly the only predator that a skunk will desperately try to flee from.

(3.3) Olfactory modality also offers the relatively rare possibility to create "displaced aposematic signals", where the signal is displayed permanently without requiring the displaying animal to be present. This type of displaced warning signal is widely used by territorial animals in order to notify others that the territory belongs to them. Cats, dogs, lemurs and wildebeest all mark their territories by either spraying or leaving faeces in prominent locations, or by rubbing their body parts which contain scent glands against prominent objects (mostly tree branches and leaves). As we may remember, displaced warning signals can be used only in visual and olfactory modalities but not in audio or behavioural modalities. In some cases an olfactory channel can be more effective than any other channel. For example, hyena pups which have never seen lions do not react fearfully upon seeing them, but react fearfully upon detecting their scent.

Behavioural signals

(4) Now we will discuss behavioural warning signals. They can also be divided into the temporary and constant categories. Certain behaviours appear only in a moment of need, but others are present at all times, or at least most of the time. Behavioural warning signals can compete in popularity and variety with visual and audio signals.

(4.1) Slow walking pace – Possibly the most characteristic feature of many animal species that have strong secondary defences. Most venomous snakes and spiders move very slowly. Most of us who have seen hedgehogs and turtles would know that most quill and armour-covered animals also walk very slowly. Even when confronted by a predator, they do not attempt to move any faster. Slow walking animals have another drastic means of warning signal: stopping. When confronted by predators, many slow walking animals stop moving altogether. In this tense moment they usually face their opponent and express their disgust with aggressive sounds, visual gestures, and any other aposematic features at their disposal. Many

predators prefer their prey to run away, and they can actually become confused if their prey does not run away.

(4.2) Sluggish style of walking – In the same vein as slow walking and the freezing instinct, a demonstratively sluggish style of walking is another potent signal to other creatures that the animal has strong secondary defences. This feature also seems to be fairly constant rather than being employed only in confrontations. At the same time, at least in theory, there is the possibility that an animal would be able to walk normally and quite fast, then only adopt the awkward sluggishness in a display of strength when confronted by a predator.

(4.3) Overtly aggressive behaviour – As many politicians and teenagers know, pretending to be aggressive and adopting threatening behaviour is sometimes (only sometimes!) a potent means to avoid further aggression from others. Most such aggressively-behaving animals are gentle and cooperative and friendly with their family group and kin, but can also suddenly become overtly aggressive towards predators and competitors. This overtly aggressive behaviour is more a temporary feature of aposematic display than a constant one.

(4.4) Being in groups – The advantages of having strength in numbers are well known both to animals and humans, but is this feature constant or temporary? This may initially seem like more of a constant feature, as social animals such as lions and many primate species do spend 'relaxed' time together and do not really come together from different parts of the jungle or savannah for a single moment of need. On the other hand, many social animals (especially humans) demonstrate an increase in group density and coherence as the necessity arises. Humans demonstrate a strong tendency of bunching together in moments of perceived strong danger (natural disasters, wars and even protests).

(4.5) Mobbing – Aposematic animals do not only passively aggregate in large groups. Often when there is a danger from a predator, they actively attack the predator simultaneously to drive it away. Mobbing can only work if none of the animals attempt to escape the predator, but instead behave fearlessly and together

harass and try to injure the mortal enemy. Of course, mobbing is solely a temporary function which occurs only in critical moments of survival where there is a need to defend young offspring or the group in general.

(4.6) Strange, obscure movements – unusual behaviours in a moment of confrontation are designed to confuse and dazzle an opponent. Darwin extensively wrote about such behaviours in his "Descent of man" (he called them "antics"). Unfortunately, Darwin was explaining such behaviours as merely the means to attract the attention of the opposite sex. Today we know very well that strange movements can also be a potent weapon in a confrontation. These movements are integral to ritualized fights, and can be designed to avoid an all-out violence.

Conclusions

I hope I did not bore the readers of this book too much with the differing descriptions of a vast array of visual, audio, olfactory and behavioural warning signals. I myself find them extremely fascinating. When animals of the same species are scaring each other with their looks, sounds, and other ritualized behaviours, or when prey animals try to impress their predator using the same means, the central function of all these strategies is the same: to get the required result without the costly all-out fight and associated physical harm.

Aposematism seems to be an integral factor of natural selection for many different classes of animal species for several, sometimes varying reasons:

(1) For predators aposematism is convenient as it allows them to distinguish well defended prey animals from the undefended ones (undefended animals most likely will try to run away, as running away is the most popular means of avoiding predation);

(2) For the prey species aposematism is good as it allows them to demonstrate (or merely remind) to predators that they should not be wasting their time hunting them. For example, if a tiger is approaching a venomous snake, the possibility of both of them getting killed in a lethal confrontation can be avoided once famous

audio signal "sssss" is sounded (most likely from *both* snake and tiger). As a result, they have avoided a dangerous violent confrontation, quite possibly lethal for both.

(3) For conflicting animals of the same species aposematism allows them to avoid an all-out fight and possible death, and instead substitutes real fights with a ritualized means of aposematic display. These displays are known as "ritualized fights" (or as agonistic behaviour, see Scott & Fredericson 1951). This "ritualized fight" is the primary deterrent and reason why many animals do not use their other, possibly lethal means of offense when they are fighting their fellow creatures (even when males are fighting for the attention of females). Most animals use aposematism when dealing with their counterparts and prefer to settle disputes without costly fighting and the associated injuries.

(4) The same is true for some conflicting animals of different species: a ritualized display, in most cases, is enough for the participants to clearly state their interests to each other, and also for them to assess each-other based on the aposematic signals they perceive (this exact process is also prevalent in human street fights and confrontations). As a result the competing animals can usually settle the dispute without having to resort to a physical fight. Therefore, contrary to popular perception, animal life is not only one where the tooth, claw and fang rules. In the animal kingdom body size, colours, shapes, sounds, smells and behaviours also play a fundamental role in the survival of many creatures.

The Importance of Being Earnest

Animal determination and the readiness to fight is a crucial factor of any confrontation. When two animals are displaying their body size and exchanging warning signals, it is not always the bigger and louder one who wins the confrontation. By some subtle, harder-to-notice elements of behaviour, conflicting animals can feel which of them is more determined to fight. As a result, the less determined animal usually backs down, avoiding the confrontation from descending into physical violence. This does not always mean that the lenient animal is weaker;

this only means that in this situation the animal was less ready or less willing to fight than the more determined competitor. A classic situation to illustrate this point is when a huge male backs down when up against the aggressive behaviour of a smaller mother animal that is ready to die defending her young.

And here comes the question: what are the factors that make animals more determined?

These are possibly the two most important factors: hunger and parental instinct.

Hunger is possibly the most widespread factor. This factor is particularly clear in such ubiquitous situations such as confrontations over a recently killed prey animal. For example, when lions (or a single lion) come across feeding hyenas, the outcome can depend immensely on how long the hyenas have been feeding and how hungry the lions are. Sometimes a single lion can be enough to chase away a large group of hyenas, but on the other hand a small pack of hyenas can chase away not only a single lion, but several of them. Most interestingly, those animals that are pushed away by competing animals do not usually go away completely. Instead they wait nearby, allowing time for their stronger (or hungrier) competitors to feast on the kill. After a period of waiting, the waiting animals make a comeback. By this point the second side, who has now been feeding for a while, is not as hungry as before. Therefore, they are now not as ready to fight for a food as they were before, and as a result the side that was originally defeated comes back and reclaims the kill.

When predators are not hungry, they may avoid confrontations with aggressively behaving animals that they could otherwise easily kill. As I have mentioned above, there have been cases of pumas being chased up a tree by a single barking dog. No dog can survive a confrontation against a puma or even a lynx, but when pumas aren't in need of food they will usually try to avoid any confrontation, even if this means running from an attacking (yet weaker) competitor. On the other end of this spectrum, if predators are desperate for food then there is almost nothing that can stop them. Skunks are sometimes killed and eaten (despite their famously smelly defence glands), not only by Great Horned Owls (who do not have a sense of smell), but also by very hungry dogs and coyotes as well, who would normally be disgusted by the skunk's odour. In much the same way, porcupines are also occasionally hunted despite their long and sharp quills. In such cases no display can divert a predator's will, and they attack determined to either kill or to be killed.

Hungry lions have even been known to tackle adult African elephants. This is why the only fully guaranteed defence from a predator is to kill the predator (Ruxton et al., 2004). We can now agree that relative hunger and desperation are both crucial factors in the precarious equation that is a confrontation between two animals.

Defending the young - Another important element that strongly affects animal warning displays and confrontations is parental instinct. Animals (usually mothers with most species) that are defending their young can go into an all-out-battle without reservations and with total neglect to any warning displays used by the opposing side. The silver lining to this kind of attack (if you are attacked) is that the attack usually remains solely as a defence mechanism aimed at protecting their young, so if you have a chance to retreat you will be safe. The inherent negative factor to add is that even if you are not endangering their young and you came close only by mistake, you may not have enough time to demonstrate your good will to the enraged parent. Out of these two factors (hunger and defending the young) the latter seems to me a more potent reason for animals to enter into unprovoked fights without reservations and without any care for their own health.

Apart from hunger and parenting instinct, there are other factors also affecting the determination of conflicting animals. Fighting for mates is one obvious factor, and fighting for territory is another such important factor. Therefore, when there are two animals in a confrontation (for food, territory, defending their young, or for mates) their size, strength and variety of display patterns are not the only signs to observe. Other psychological and physiological factors (offspring located in the vicinity, animal in heat, starving animal) must be taken into consideration if one is to have a true idea of the challenge they are likely to face. Similar to many of the world's human political landscapes, determination and confidence play an undoubtedly integral role in all success.

A true fight to the death is actually a very rare occurrence in animal everyday life (this of course does not include regular hunting undertaken by predator species) A wise strategy of aposematism is a central factor in avoiding unnecessary and damaging confrontations. Huxley was wrong – the battle for survival is **not** the continuous combat of every single animal all other animals of both other and its own species. On the contrary, the battle for survival in the animal kingdom seems to be

more about utilizing psychology and morphology in avoiding all-out combat and fruitless violence.

Conclusion: Aposematism, Cold War and Peace

We come to a somehow surprising conclusion: Aposematism (warning display) is in fact a strategy for peace. A possibly better way to say this is that it allows conflicting animals to avoid physical confrontations and all-out fights, replacing them with ritualized displays of size and power. An aposematic confrontation might seem like a serious fight brewing, with lots of intimidating gestures being thrown around, but in reality none or little serious physical violence actually eventuates.

This strategy from the animal kingdom is somehow close to the international political strategies employed in the notorious "Cold War" between the USSR and the USA, where conflicting parties were often engaged in different (usually bluffing for the most part) displays of their weapons and readiness to engage in combat, yet at the same time both sides would desperately attempt to avoid any real all-out physical engagement in the event that such a confrontation seemed imminent. It is no coincidence that, after the creation of the most devastating weapon, the nuclear bomb, there has been no large-scale all-out wars between any major world powers. The successful detonation of the nuclear bombs above Hiroshima and Nagasaki instantly became the most powerful aposematic tool ever employed by humans. The idea that the emergence of nuclear-powered weapons helped to establish a peace between major world powers (although at the same time increased the danger of catastrophic terrorist attacks) is coined under the term "nuclear peace" and is almost as old as the weapons themselves.

Throughout history we have been shown that if we have to have a conflict with other parties, it is much better to have a ritualized display of strength rather than an all-out fight to a point of mutual destruction. Politicians only realized this during the last half-century. The forces of natural selection realized this many hundreds of millions of years ago.

Can a Predator Be an Aposematic Species?

Predators come in different sizes, shapes and exhibit many different behaviours. If you ask a person in a street to name five species of predators from the top of their heads, most people would probably name the big predators, such as lions, tigers, bears, wolves, sharks and crocodiles among others. Very few would recall that there are in fact many more different forms of predators, with a vast array of sizes, behaviours and types of prey. For example, not many would recall that virtually all birds (not only eagles and falcons) are also predators, which prey upon insects in prodigious quantities. And do not forget, humans are also predators.

Predators differ from each other largely by the prey they hunt (from flies to giraffes and baby blue whales), by their method of getting to their prey (some run or fly after them over large distances, some use stalking, some lure them, some just wait), and also by their method of killing (some use a killer bite in the nap, others suffocate their prey, some tear the prey apart, and some swallow their prey alive). I have only mentioned the most well-known methods of predator behaviour, but in specialised books you can find many more means used for obtaining prey. We are not going into the subtle details of different methods of predation. We need to discuss another, more important and relevant question – can predators in general actually be classified as aposematic species?

The reason I am asking this question is that aposematic species, as we remember, do not try to hide and instead try to demonstrate their presence at all times. It is not too difficult to notice that that the basic strategy of aposematism is in direct contrast with what many predators are trying to do: conceal themselves from the prey animals in order to hunt them with a greater success rate. A lion or a tiger who advertises their presence by walking openly and roaring will starve to death as all their potential prey will be aware of their presence. On the other hand, virtually any animal can use an aposematic display in certain situations, mostly to avoid unwanted violent confrontation. Tigers and lions are no exception, and express their desire to be left alone with growling, as do bears by standing on hind legs and cats by raising their back and hissing and raising their body hair, however these behaviours alone do not necessarily mean that these animals are aposematic species. Aposematic

species are those who use a whole system of aposematic signals virtually all the time. As a rule these are the generally weaker species that have their bodies covered in bright, often contrasting colours, make loud sounds, often emit smells and move slowly and awkwardly. By this definition it is evident that neither lions nor tigers are aposematic species.

The most famous predators of all, the family of big cats, and their domestic descendants are a perfect illustration of the demands survival has put on predator species. They often have camouflaging body colours, they are masters of natural disguise and can stay unnoticed, they can move without making a sound and do not have body odour (herein lies the evolutionary source of domestic cats' legendary cleanliness).

But not all predators have all these heavy demands. Wolves, for example, and the big group of their relatives, known as "canidae," hunt their prey using a different strategy. The hunting method of a canine tribe does not depend on silent stalking and a surprise attack. Instead it is a test of endurance and speed. They run after their prey over long distances, wearing them down, and attack the now-tired prey as a group, leaving virtually no chance for survival. As a result, dogs do not care too much if they are seen by their prey before the chase begins, or if they emit body odour. This is why at least some of their domestic counterparts are coloured in contrastive colours, and also why they do not pay as much attention to their personal hygiene as domestic cats do. Therefore, it would be more common for dogs to have more constant aposematic features, such as clearly seen colours or a strong body odour. We must remember that canine predators cannot afford to use certain aposematic features such as a slow and awkward movement style.

There are many other predators that can maintain aposematic features while remaining skilled in hunting. Many birds, for example, hunt insects and therefore qualify as predators, however they do not care if they are seen by their prey. Another important point to include at this time is that many animal species can be both predators and prey at the same time.

So we come to the conclusion that some aposematic display features are unacceptable for the lifestyles of certain predators, but are acceptable for others. For

example, features such as contrastive body colouring or body odour are acceptable for cursorial predators such as wolves, but not for stalking predators.

I do not want to delve too deep in discussing the presence of aposematic features in a wider range of animals, but I would like to remind the reader that most animals have at least some arsenal of temporary warning display and they use them primarily in order to avoid violent confrontation. We must remember that temporary displays are those which are not permanently present in the apparent morphology or behaviour of an animal. Temporary warning signals can also be used by cryptic species as well, who initiate their aposematic display only after they have been spotted by a predator (for example, certain cryptic butterflies open their first layer of wings to display the second layer of wings with eyespots to attacking predators).

One methodologically important note: there are also other terms used in evolutionary ecology that have somewhat similar meaning to aposematic display. Such terms are "deimatic display" ("frightening display", from Greek "deimatóo" – "to frighten") or a "startle display." Scholars find it difficult to agree on the exact boundaries between these terms (see, for example, Fenton & Licht, 1990). In this book I use only the term "aposematic display" to describe all the display means that warns the predators (or competitors) to stay away.

It would be a grand mistake to attribute the use of aposematism to prey species only. Aposematism has a much larger role in natural selection. It had the crucial evolutionary function of avoiding rampant and endemic physical violence. It was the neglect of the importance of warning displays in natural selection that brought some earlier evolutionists to the erroneous picture of the struggle for existence as a constant physical ("gladiatorial") battle. Aposematism is a natural messenger of peace, a messenger of avoiding unnecessary violence.

A Few Words on Sexual Selection from the Point of View of Natural Selection

Before we continue our discussion on aposematism, I would like to briefly mention several elements of sexual selection which seem to me very important to include (see Jordania, 2011a).

Firstly let us recall that sexual selection operates via two very different mechanisms: (1) male competition, or *intrasexual competition*, and (2) female choice, or *intersexual competition*.

Secondly, male combat itself also contains two different forms of competition (1) intimidation, which is based on a wide set of elements of ritualized display, and (2) physical combat aiming to defeat (or even kill) an opponent.

The differences between these two forms of male combat are too important to view them as simply two elements of the same mechanism. The intimidation tactics of rival males involve the display of aposematic elements and a ritualized showcase of size, colours, smells, behaviours. This display is identical to the other main use of aposematism, which is to avoid predation. The primary aim of the ritualized display in both cases is to avoid violence, and to substitute violence with the ritualized displays. While on the topic of physical combat between males, we need to remember that physical combat in most species as a general rule is very short, and violence very rarely escalates into a real all-out fight. Relatively minor elements of a violent clash in male competition must be understood as a part of intimidation strategy. During a ritualized display of size, colours, sounds, smells and behaviours the bigger and louder animal gradually pushes the smaller opponent towards conceding defeat, and as soon as any actual physical confrontation starts to develop, the smaller male as a rule will retreat backwards. As a result of this, both males will have avoided unnecessary violence and injuries.

I therefore suggest that *intrasexual selection* (competition between males) and aposematism are often directly intertwined. They have the same morphological and behavioural elements, and the same internal forces. Without an aposematic ritualized display, any encounter between confrontational males would lead to the injuries and

deaths of participating animals, and this kind of constant in-fighting between the conflicting males would be disastrous for the species.

On the other hand, there is a considerable difference between aposematism and *intersexual selection*. This is when males try to impress females via the mechanism of female choice, as opposed to merely competing with each-other via the *intrasexual* model. These two mechanisms, natural selection via aposematism and sexual selection via female choice have confusingly similar morphological and behavioural features, but they are driven by two very different internal forces: beauty (or display of healthy genes) on one hand, and the intimidation of an opponent on the other.

Which of these two forces is the primary evolutionary agent for the development of these characteristics? This is a tricky question, and to have a chance at answering it we will need to find cases where natural selection through aposematism and sexual selection through female choice have had conflicting interests. We will now look at two possible scenarios:

(1) In the first scenario it should be possible to demonstrate that a clear and unique visible (or audible) characteristic is very effective for attracting mates, but at the same time the very same feature is harmful for the displaying animal's chances of survival against predation;

(2) In the second scenario it should be possible to demonstrate that an exclusively aposematic feature does not attract females and does not therefore contribute to more offspring.

The first scenario above was proposed by Charles Darwin. As a matter of fact, his entire theory of sexual selection was almost entirely based on the idea of unnecessary (and even harmful) beauty that is favoured by females and leads to more offspring. This intriguing idea was later developed into the well-known notions of the "honest signal" and "handicap principle" (see Zahavi, 1975; Zahavi & Zahavi, 1997). According to this principle, in order to be "honest" the signal has to be costly for the survival of the bearer. The famed peacock's tail is the best-known example of this and a true symbol of this evolutionary principle.

The second scenario can be called true aposematism, or the warning display without any indications of any involvement of female choice. The best examples of this scenario were provided also by Charles Darwin, when he found cases of brilliant

colours used by sexually inactive larvae. Darwin himself could not explain this phenomenon, but an effective and elegant explanation was suggested by Alfred Wallace.

As the author of this book is clearly fascinated by the power and many faces of aposematism, the readers can guess that I believe that, in the complex interaction between the principles of sexual selection via female choice and the aposematism, the latter must be a much more potent evolutionary force than the former. It seems to me logical to propose that females who happen to develop a passion for mates who exhibit traits and behaviours harmful to their survival would be themselves doomed by the forces of natural selection. My suggestion is in direct contradiction with the idea of the "handicap principle" and I want to assure readers that I will soon discuss the "handicap principle" on the example of the best known and the most iconic example of the power of sexual selection via female choice – the famed peacock train.

At the same time, I have to admit that even if we accept the primary power of natural selection as the formation of aposematic signals, we should not exclude the possibility that sexual selection might also be a factor in forming (and particularly intensifying) certain aposematic signals. For example, there is an interesting case study on the strawberry poison frog, and the authors of the study suggest that the power of sexual selection is behind the existing colour differences of local varieties of this frog (Maan & Cummings, 2009). Although it is difficult to be sure whether the existing local sexual preferences are the primary driving force behind these colour differences, the possibility that sexual selection can provide the pressure to form or to intensify aposematic features should not be ignored. As a precautionary tale, I would remind the readers the similar interpretation provided by Charles Darwin on the differences in skin colour of different human populations. Very much like the researchers on the study of strawberry poison frog, Darwin was also sure that the differences in skin colour of different human populations were a result of female choice, not of natural selection via adaptation to the differences in solar intensity. Today the idea of sexual selection determining human skin colour has lost most of its supporters (although see Frost, 2006).

Here I would like to suggest a few concrete suggestions in order to distinguish which of the two central primary forces are behind traits in animals as bright colours,

sounds, smells, and behaviours: (1) sexual selection via female choice, or (2) natural selection via aposematism. Here are the suggestions:

(1) As sexual selection is mostly arbitrary, a single trait (for example, bright colours) can be present in isolation, and it does not have to be intertwined with the other signals (sound, smell and behaviour); Natural selection, on the contrary, is not arbitrary, and if the trait was designed by the forces of natural selection as a warning signal, it will very likely be accompanied by signals in other modalities as well, as aposematic display in several modalities is much more potent than a linear one. Therefore, if the presence of bright colours is the single distinguishable feature of an animal, this is most likely a case of sexual selection, but if bright colours are accompanied by other forms of display: loud sounds, strong (and particularly unpleasant) smells and unusual behaviours, then the primary function of this multi-modal signalling is most likely to be aposematism.

(2) If males of the same species are engaged in direct male-to-male competition for the females, the stronger males win females via this competition and there can be little to no real female choice of the males involved. In such cases a female is more like a "trophy for the winner", than a picky beauty queen with the right of the last decisive word. The factor of female choice in sexual selection in such species must be considered close to nil;

(3) If males and females of the same species both have the same traits such as colours, sounds, smells or behaviours, and particularly if these signals are presented simultaneously, then aposematism must be the preferred logical explanation;

(4) As sexual selection is arbitrary, many of its elements can be unique to the species, so we should expect to have many local varieties of display; aposematic display, on the contrary, is aimed not only to interspecific competitors, but to other, predatory species as well, So, it is supposed to be more like an "international" language, with universal preferences of certain colours, sounds and olfactory signals across the species.

In the next section we will discuss the possibility of measuring the amount of aposematism in particular animal species.

Aposematic Index: How to Distinguish Aposematic Species

In this section I will attempt to introduce a methodology to measure the presence of aposematism in an animal species, I believe there are objective ways to qualify different animal species as "aposematic species." For this purpose I would like to introduce the notion of **"aposematic index."**

What is an aposematic index?

Aposematic Index (AI) is a numerical expression of the relative importance of aposematic warning signals used by any given animal species (both constantly and in specific situations). This functions on a percentage medium, thereby making the maximum AI 100%.

As there are four basic modalities (visual, audio, olfactory, behavioural) I propose to give each of these modalities an equal maximum 'impact' share of 25% to reach a maximum total 100%. If an aposematic element is present only in specific situations and only briefly (like a dog's growl for the defence of a bone, or a cat arching its back to avoid a conflict), this temporary signal will have the value of 5% in any given modality. On the other hand, if an aposematic signal is constantly displayed (like the contrastive colours of a skunk or the spikes of a hedgehog) this will be equivalent to the value of 20%. The presence of both constant and temporary signals in a given modality will result in the maximum of 25%. 100% AI means that a given species is constantly displaying aposematic signals in all four modalities, and that in critical situations it also displays stronger additional signals in all four modalities.

In order to qualify a given species as an "aposematic species", without any doubt the AI should be 100%. This high requirement for qualification derives from the strict demands of natural selection: if a species follows the aposematic lifestyle as a survival strategy for thousands of generations, it will naturally and gradually develop the means to advertise warning signals through all four modalities. Therefore, it is very likely that any true aposematic species will be advertising aposematic signals constantly in all modalities, and they will also have the ability to increase the intensity and possibly variety of warning signals in critical situations.

Let me present some examples of this AI system with brief comments:

For example, when using **visual** signals, an aposematic animal should have a constantly visible body (ideally a large, colourful one). Additionally, in the time of need, an animal should be able to increase its body size more drastically (by changing its body posture, erecting hair, or extending various parts of the body to seem taller or wider). The constant feature on its own gives the animal 20% AI in this modality ("visual"), and the temporary feature gives 5%. The presence of both constant and temporarily features together will give the total 25% in a given modality. According to my observation, animal species that have constant aposematic signals as a general rule will have means to further increase their size (and even colour) in a moment of need. Therefore, when a constant visual signal is present it is most likely that a temporary signal is also available. On the other hand, there are many species that have temporary visual signals, but do not possess constant warning signals (for example, cats raising their back and fluffing their hair). Aposematic animals as a rule have highly visible bodies, often coloured in bright or contrasting colours and sometimes sporting unique patterns or features over prominent areas such as the head or the body.

When using the **audio** modality an aposematic animal is expected to be making some kind of constant noise to advertise its presence. Much in the same way as visual signals, an animal will be able to increase the sound level and make additional, stronger sounds when in a critical moment. There are many animals that remain mostly silent and only make noise when disturbed (for example many different cat species that can walk with incredible silence but can make various sounds when irritated) will only score a 5% in this modality, while animals that exert noise constantly in addition to doing so in critical situations will score the full 25%. Porcupines, for example, most of the time produce a specific booming sound, and if disturbed, add the rattle of quills and other sounds from the rich repertoire of their sounds, ranging from high-pitched whistles to whines, grunts and snuffles. As a rule, aposematic species are more vocal and noisy than non-aposematic species.

When talking about the **olfactory** modality in an aposematic species, we are looking for a constant body odour that the animal's body produces. As the absence of odour is important for hiding from a wide array of predators, the mere presence of a clearly detectable body odour will itself indicate the aposematic nature of that odour. Unlike visual and audio signals that can produce a strong intimidating

impression, body odour is a subtler signal. Porcupine and skunk body odours (without the deadly skunk gland) can illustrate this state. While maintaining a constant body odour, aposematic species often increase their odour production in moments of need, commonly resulting from increased sweat production through excitement. It is theoretically more difficult to produce a strong temporary odour for an animal which does not already have a constant odour in place. We can essentially conclude that body odour can be present either constantly, or both constantly and temporarily (with the stronger smell produced in critical situations).

While discussing the principles of aposematic display and aposematic index (AI), I would like to make a short list – effectively a summary of the most widely used designing features used by the cryptic and aposematic strategies. This list of features is based on binary opposition; with one set belonging to the cryptic strategy of staying unnoticed, and the other belonging to the aposematic display of advertising one's presence with all possible means[4]:

Cryptic	**Aposematic**
Dull colours, matching environment;	Bright, contrastive colours
Staying close to the ground;	Rising on hind legs;
Lowered tail;	Raised tail;
Being silent;	Being noisy;
Absence of body odour;	Presence of body odour;
Swift movements;	Slow movements, or stopping;
Running away from danger;	Aggressive response to danger;

We are now approaching the most interesting part of our discussion, as we are going to analyse several examples of evaluating AI in different species. We will start from very well-known species whose aposematic nature by this point has been established, and then we will move on to more unexpected cases.

[4]Darwin was probably the first who wrote about the principle of antithesis of intentions on the example of play signalling in dogs (Darwin, 1873).

Skunk – Classic Case of Aposematism

The aposematic nature of a skunk's defence is quite well known, albeit the full arsenal of skunk aposematic possibilities is often understated, meaning that only the black & white colour scheme and the notorious odour are widely known. In reality, the skunk uses an array of aposematic signals via each four of the above-mentioned modalities, and what is particularly important is that skunks advertise their warning signals constantly. These signals may also be intensified in critical moments, as per the general rule of aposematism.

Visual signals - Skunk body colours consist of a highly visual and contrastive black-and-white pattern. The skunk also raises its tail when walking (a) to be better seen (b) to look bigger and (c) to look confident (skunks do not lower their tail even when confronted by a predator). In critical moments they cycle through the whole repertoire of visual signals including bipedal posture, raising their tail and stamping their feet. Interestingly, a skunk's bipedal posture is very different from ours in that they stand on their front feet (like some humans who can stand on their hands). Skunks do this in order to gain more impressive height by extending their tail upwards rather than having it sweep at the ground. If they were standing on their hind legs, most of their tail length and potential would not be in clear view and essentially wasted.

Audio signals of the skunk consist of the sounds they make to accompany themselves while walking. Apart from this constant sound, skunks can also hiss (the oldest and the most universal aggressive sound), growl and tap their feet – all these audio signals are employed before the skunk's last resort, when it turns its back and raises its tail in preparation to use its deadliest weapon.

Olfactory signals - Do we really need to discuss this factor? Apart from the famous spray used in critical situations, skunks also produce a constant musky smell. A skunk's deadly spray is actually a combination of its primary and secondary defences.

Behavioural signals consist of demonstratively slow walking with a raised tail and not running away from predators. Instead of running away, skunks gain an arrogant and aggressive confidence in response to many predator advances. The only

behavioural feature that does not fit the typical aposematic framework is that skunks do not aggregate in large groups. Why don't they aggregate? I propose their defence is so relatively potent that they need not rely on "safety in numbers."

Therefore, the morphology and behaviour of skunks clearly defines their constant dependence on the strategy of aposematism. When measured on the Aposematic Index, the skunk scores a full 100%, therefore skunks can be clearly classified as an "aposematic species." Airborne predators (and particularly the Great Horned Owl), catastrophically for the skunk, have zero or minimal sense of smell and are therefore the only predators that are largely invulnerable to the skunk's famous ultimate defence weapon. When sighting an avian predator a skunk quickly forgets about all of its aposematic talents and tries to run away as quick as it can with its not-so-swift feet.

Porcupine – Another Classic Case

Porcupine is another species with an obviously very high AI (Aposematic Index). Let us have a quick look at all four modalities.

Visual signals – consist of long and usually contrastive coloured spikes, which the porcupine can raise and rattle for a better visual and audio effect in a time of critical need. Rising quills also make the porcupine seem bigger to opponents.

Audio signals – while moving, porcupines and their close relatives often make a constant "booming" sound and are basically quite noisy while going about their day-to-day business. The stamping of feet, chattering of teeth and particularly the rattling of the quills of porcupine family members in critical moments are other audio reminders of the deadly power of their quills, which can even seriously injure animals as ferocious as tigers.

Olfactory signal – Porcupines constantly emit a smell which is reminiscent of the odour of sweaty human armpits. Apart from this, when disturbed they also produce a strong noxious odour (used in conjunction with the raising of their quills and chattering of their teeth as warning signs).

Behavioural signals are also clearly present: all members of this family walk slowly and awkwardly, clearly advertising that they do not need to run for their lives. Also, when seeing a predator they usually stop moving altogether. By raising their spikes they also warn predators of their weapon, as well as the raised spikes making their body seem bigger. In a critical situation they will often move threateningly towards the predator, displaying an aggressive character. Very much like skunks, porcupines also do not aggregate in groups, and the same explanation of the potency of their defences can be used as the explanation of this fact.

The conclusion is clear: porcupine AI also reaches the maximum 100% mark, clearly identifying the porcupine as a member of the group of truly aposematic species.

Let us now discuss a relatively unknown case.

Norwegian Lemming – Unknown Classic

This species is definitely not as universally well known as the skunk or the porcupine, but it shows a remarkably high AI. Malte Anderson published a special article in 1976 on the possible aposematic character of the colouration and behaviour of this species (Anderson, 1976).

Unlike all other rodents from the Scandinavian region, who are cryptically coloured and try to conceal themselves from their predators, Lemmings on the contrary are conspicuously coloured with contrasting bright yellow, reddish brown, white and jet black hues. They are also very noisy, making different sounds which include loud calls. Their behaviour is very aggressive towards their usual predator bird of prey, the long-tailed Jaeger. Lemmings are aggressive even towards approaching human observers, first by turning towards the approaching humans and sounding a call. If approached further their call will grow louder, they will rise on their hind legs, leap and try to bite the intruder. Anderson observed lemmings and another local rodent, the vole (which is not aposematic), and specially studied their

survival strategies in their encounters with their mutual natural predators, Long-tailed Jaegers, in the wild. The cryptic vole was killed and eaten in 10 cases out of 12 encounters while the aggressively behaving Lemming was killed only once out of 6 cases. The Jaeger never hesitated to attack a vole, but was always wary of approaching the aggressively behaving lemming. Other important characteristics are that, compared to voles, lemmings are also slower in running, and also that lemmings constantly produce a strong body odour (which resembles sour milk) from a special dorsal skin gland.

The Norwegian lemming has all the attributes of an aposematic species: its body is colourful and highly visible; it makes loud noises and calls, has a strong body odour, runs slower than its relatives, and behaves explicitly aggressively towards possible predators and enemies. Conclusion: Norwegian Lemming has a 100% AI.

After the examination of two well-known species whose aposematic qualities are quite widely known (skunk and porcupine), and one of a relatively unknown species who apparently is also a clear example of aposematic morphology and behaviour, I am now going to surprise readers and discuss a couple of animal species whose morphology and behaviour has never been discussed in relation to aposematism.

Is There an Elephant in the Room?

Is it possible that the elephant is an aposematic species that has never had all of its characteristics and features fully identified? I have never heard of anyone proposing that elephants use an aposematic strategy, and if you do a Google search for “elephant” and “aposematism”, you will most likely find only references for an aposematically coloured frog which has so much poison that it could kill an elephant. Well, we need to remember that aposematism is still a “rare guest” in biological and ethological thinking and publications, so there are potentially thousands of

aposematic animals have not yet been identified as such in scholarly literature. A closer look at elephant morphology and behaviour reveals a very interesting picture.

Visual signals - An elephant body does not have any conspicuous colours, but there is hardly a need for this, as the elephant body is one of the most visually recognizable symbols in the natural world as it is simply the largest land animal on earth. Apart from their extraordinary body size, in critical moments elephants can also open their ears and raise their trunks, making their size even more impressive, particularly when accompanied by their trumpet-like loud calls while running towards an opponent. They even raise their tiny tails to look bigger.

Audio signals - Although elephants can walk silently, when moving around they usually make plenty of noises and are easy to locate. They hardly need to hide their presence as it is, and of course they are able to produce loud and piercing sounds on command when required.

Olfactory signals - Elephants have quite a strong constant body odour, clearly recognizable even by such smell-deprived species as humans. In a specific season (known as "musth"), when male elephants become highly aggressive and dangerous, they activate a smell-producing gland so that the strong smell emitted clearly notifies everyone to stay away from them.

Behavioural signals - An elephant's behavioural strategy also fits very well within the aposematic model of defence. They are slow moving animals and they rarely run away from any other animals. On the contrary, they often charge aggressively towards lions and other possible enemies in order to scare them away with their impressive presence and loud sounds.

Therefore, we can make a conclusion that elephants actively and constantly use aposematic warning signals, and as a result, they should be categorized as aposematic species with an AI of 100%. As aposematic characteristics work according to a principle of "the more the better", the growth of the body size alone could become a factor of permanent selective pressure (unless the size itself becomes problematic for survival). The massive size of an elephant, apart from securing them from predator attacks, is a decisive factor in intimidating bouts between rival males, which as a rule consists of bluffing displays of size and sounds and rarely lead to physical injuries.

In regards to aposematism, we can say that there are a few more elephants in the room.

Gorilla – The Scary Gentle Giant

Gorilla, the biggest and strongest of the primates, also exhibits a number of aposematic characteristics. It is difficult to say whether these characteristics are enough to reach the 100% AI level. So, I would not include the gorilla in a definitive list of aposematic species. Let us examine:

Visual signals - Gorillas are not as visible as elephants, of course, but their size (and particularly the size of a silverback adult gorilla) can definitely be intimidating for predators and competitors alike. Apart from their constant big size, in a moment of confrontation gorillas will rise on their feet, making themselves seem taller. They also shake their arms, beat their chest, and break branches around in what is essentially a display of strength, determination and physical aptitude.

Audio signals – although gorillas are usually silent creatures, some anecdotal evidence allow us to assume that the gorilla groups are not very strict and creates more-or-less constant audio background while they are engaged in everyday activities (for example, moving around, or eating). At least, they are emitting sounds when they are eating, and male gorillas are particularly known for these sounds (Luef et al., 2016). There can be no question about the aposematic display in critical moments, as male gorillas make plenty of sounds, include roaring, beating their chest and breaking tree branches and foliage in their vicinity. Together with the fierce looks and body size, this display is extremely impressive, generating unfounded legends of gorillas' incredible fierceness and lethality. Being strict vegetarians, gorillas are basically gentle giants, and are much more peaceful than the seemingly more 'approachable' chimpanzees. Chimpanzees have been known to exhibit quite violent behaviour, including hunting and killing (not for food) other chimpanzees. I must add that the notion of a "gentle giant" is very aposematic by nature, as animals

(and also humans) with large and intimidating bodies often do not need to be fierce in order to be respected, and are left mostly undisturbed.

Olfactory signals – as we know from various sources, gorillas have a specific musky body odour, and they were even found to communicate with their body odour with each other (see Klailova & Lee, 2014). Male silverback gorillas have particularly strong body odour. Most importantly, in moments of confrontation male gorillas instantly produce a very strong and pungent smell. They also have a habit to defecate in such tense situations, increasing their olfactory presence.

Behavioural signals – Gorillas walk slowly and awkwardly. In moments of confrontation with predators and rivals they do not run away from danger, instead standing their ground to face the threat. Their behaviour in such moments seems very aggressive, albeit their aggression largely consists of sight and sound, rarely reaching the stage of physical violence.

We can conclude that gorillas do exhibit a large number of aposematic signals, possibly a full 100% AI. Another important characteristic when taking into consideration the AI among gorillas is that males are more aposematic than females. This kind of sexual dimorphism in the use of aposematic features is quite common among a wide range of animal species in which males and females differ in size, colours and behaviours. For example, in comparison to males, female gorillas do not engage in audio-visual-olfactory intimidating displays, do not beat their chests, do not break branches, and do not produce a strong smell in critical situations. Despite of this it must be remembered that female gorillas are still incredibly strong and can do plenty of damage to any predator. In a gorilla clan it is the male's duty to provide security for the family, and although a male gorilla may sometimes fall prey to a leopard (usually while sleeping) or a lion, they perform their task admirably. They are able to do so without usually having to resort to violence due to their fierce size, look and their array of effective aposematic signals.

Peacock – The Rise and Fall of a Symbol?

For many readers who strongly believe in the evolutionary power of sexual selection, the discussion of a peacock's aposematic features will be of crucial importance as the peacock train has been an enduring symbol of sexual selection.

Readers should note from the beginning that the term "peacock" refers only to a male. Females of the same species are known by the name "peahen", and the overall species name is "peafowl." Therefore, a peacock is a male peafowl, and in this section we will be predominantly discussing the evolutionary importance of the peacock's tail (correct terminology for their tail is "train").

Through the works of Charles Darwin, the amazing size and dazzling colours of the peacock train became the most prominent symbol of the power of sexual selection. The peacock's visual features were considered so unnecessary for survival, even harmful, that it was believed that the only reason for the peacock sporting the huge train was to entice the female peahens with their beauty. According to this model, a more impressive train ensures the better chances of its bearer in having many offspring. Amotz Zahavi famously dedicated a book to the "handicap principle", where he argued that for a signal of sexual selection to be "honest", it must actually be a hindrance to the bearer. Zahavi placed a picture of a peacock on the cover of the book as the best and undisputed example of a beautiful but harmful morphological addition to a male body.

Before we discuss the possible aposematic nature of some of the peacock's features, we must recall that the morphological and behavioural elements that are routinely discussed as the designing features of sexual selection via female choice (colourful and big sized body, exaggerated morphological additions, various sounds, smells, strange behaviours), are absolutely identical to the designing features used by the aposematic warning display. Therefore, **any scholar dealing with animal species with colourful bodies, ostensibly unnecessary morphological additions or strange behaviours and smells should always take into account that both sexual selection and aposematic strategy use the same visual, audio, olfactory and behavioural signals**.

Unfortunately, as aposematism and warning display have never been properly acknowledged in biological science, plenty of aposematic signals from a vast array of species have never been properly studied. As a result, the model of sexual selection via female choice is virtually reigning unchallenged in discussions on the evolution of the colours, sounds, smells and behaviours of thousands of species, ranging from insects to humans.

This disregard toward the aposematic strategy of natural selection flowered from Charles Darwin. When writing about the amazingly beautiful display of colours and additional morphological features on many animal species, Charles famously wrote: 'To suppose that the females do not appreciate the beauty of the males, is to admit that their splendid decorations, all their pomp and display, are useless; and this is incredible' (Darwin, 2004:557). It is clear from these words that the great scholar did not even consider the possibility that the "beauty and splendid decorations" could all be potent tools to scare away predators and competing rival males.

Because of his one-sided approach, Darwin was sometimes puzzled by the strange features of sexual selection in some species. For example – why, in some species, are females just as distinctly coloured as their male counterparts? Or – why, in species where a male can win a female's affection by physically defeating a competing male, do males still retain these beautiful colours and unusual features that hinder their fighting abilities? The answers to these questions start to become clearer if we take into account that the appearance of colours, morphological additions and strange behaviours may instead be to intimidate rivals and predators. For example, the presence of distinct colouring on both sexes most likely means that their colours are primarily to scare away predators and competitors, avoiding unnecessary physical violence and injuries. The initial notion of natural selection as a total and all out struggle of each living organism against all other living organisms, of different and the same species, is hopelessly outdated. We need to acknowledge that **avoiding physical conflict is a crucially important strategy in the survival of most animal species**. A complex system of ritualized fights with elaborate intimidating displays serves this strategy in an integral manner (Eibl-Eibesfeldt, 1979). This was the crucial point neglected in the writings of Darwin, and the same point is still absent in the writings of most of his contemporary proponents on the sexual selection model.

Now let us return to the discussion of peacocks and their unique look, asking ourselves the crucial question: Was it developed to garner female attention or to scare away rivals and predators? Or was it possibly formed to serve both purposes?

Before proceeding further, let us first assess the peacock's AI (Aposematic Index).

Visual signals - A peacock (the male peafowl) with an opened tail is one of the most spectacular sights of the natural world. First of all it is huge, reaching a height of 1.5 metres and three metres in width, making peacocks one of the largest birds of our planet. The colours of the peacock's body and tail are also possibly one of the most visually impressive sights of our world. Even with a closed tail, a peacock's colourful body and crowned head are amazingly impressive. As if this were not enough, a peacock's opened tail has plenty of eyespots. Eyespots, as we remember, are often used for intimidating predators and competitors. Visually, peacocks are one of the most potent aposematic species on the planet.

Audio signals – When a peacock's beauty is discussed, it is often overlooked that apart from their visually-screaming attire peacocks also make a huge, literally 'screaming' call as well. The volume and persona of a peacock's call are very far from the beauty of its tail, reminding one more of the screaming of some alien species from a horror movie. This call is often described as a negative side to having a peacock as a pet, as the call is much stronger than a rooster's call and can easily disturb the peace of a whole neighbourhood. Their most common calls are a loud *pia-ow* or *may-awe*. The frequency of calling increases before the Monsoon season and may be delivered in alarm or when disturbed by loud noises. In forests, their calls often indicate the presence of predators such as the tiger (Whistler, 1949:401-410; Ali & Ripley, 1980:123-126). Apart from these loud calls, peacocks also make rattling sounds when displaying their train.

Olfactory signals – I have not found any information indicating that peacocks have any constant body odour, but when grabbed by humans (and we could assume, by predators as well) they defecate on them, and according to people lucky enough to have of these beautiful birds the smell of peacock droppings is quite strong. I have never had the pleasure of having this magnificent bird as a pet, but we can read the testimony of a person who has some first-hand experience. When he took the peacock

for the first time in his hands, the peacock defecated on his clothes, and according to him: "…the smell of peacock shit is the worst of all the shits I've ever smelled, cats included. It's true! Peacock poo is bad to match the sound..." Such a strong smell from a mostly non-predatory bird, together with the habit of defecation when constrained against its will, suggests that peacocks also use an olfactory aposematic signal.

Behavioural signals – Aposematic species usually walk slowly, and do not run upon seeing a predator. They instead often behave aggressively, even moving towards an antagonist that is bigger and stronger. Peacocks also walk slowly and are not easily frightened into running away or flying. They often come close to humans and are sometimes known to follow them, which can actually be intimidating considering their size. Peacocks in the wild are not even frightened by the sight of tigers. George Schaller wrote: "The peafowl at Kanha [National Park in India] were not greatly alarmed by the proximity of a tiger. One cock walked past a tigress at a distance of thirty-five feet; on another occasion, when a tigress suddenly stood up in the grass thirty feet from a cock, the bird merely looked up, then continued to forage" (Schaller, 1984:279). These are typical aposematic behavioural signals. Females (peahens) also actively use their (albeit much smaller) tail to scare away competitors or predators.

Darwin noticed how peacocks open their tails when pigs entered the yard but made, in my opinion, the wrong conclusion: "evidently [peacock] wishes for a spectator of some kind, and, as I have often seen, will show off his finery before poultry, or even pigs' (Darwin, 2004:444). Well, if I was to choose out of these two reasons as to why peacocks open their tail when a pig enters the same yard, (1) to show off the beauty of their colourful tail to a pig, or (2) to defend his territory from the intruder – I would definitely choose the latter option.

So, contrary to the opinion (or even the belief) of the long list of distinguished scholars from Darwin to Zahavi, who were/are sure that the peacock's legendarily impressive tail was designed by the forces of sexual selection, I am coming to the conclusion that the **primary force behind the beauty and size of the peacock was natural selection trough the mechanism of warning display (aposematism)**.

Possibly, after all, peacock's train is not as useless and even detrimental as many believe.

Of course, as I have already mentioned several times, these two forces of evolutionary change are not necessarily mutually exclusive. On the contrary, the same signals that can scare away predators and rivals can also attract mates. However, when choosing the primary force behind these signals I opt for natural selection – scaring away rival males and predators and replacing violent fights with ritualized display must essentially be the primary reason behind the dazzling beauty of a peacock.

Unfortunately, we cannot ask the peacocks and peahens about the main reason behind their beauty, but there are other ways to check the relative importance of these two evolutionary forces. Why do scholars need to be guessing whether the peacock train is for sexual selection or for some other reason? Scholars should merely observe peafowl behaviour and see if the males with more beautiful trains have more success with the females!

Sexual selection in peafowl: studies – Amazingly, scholars were so sure about the sexual nature of the attractiveness of a peacock's dazzling display that they did not even consider it necessary to test this tacitly agreed idea with an objective and solid field study. It was only in the beginning of the 1990s that Marion Petrie, Tim Halliday and Carolyn Sanders published the results of their study on peacocks' mating behaviour. According to their results, as it was expected, females were choosing males with bigger trains and with the biggest number of eyespots (Petrie et al., 1991). Unfortunately, the study was not large enough (researchers studied only one Lek of 10 males for a very limited time. A Lek is a congregation of males).

In the second half of the 1990s, a seven year-long study was conducted in Japan to verify the Petrie/Halliday/Sanders findings with a larger sample and ground the sexual nature of the peacock's attributes into popular thinking with solid field results. During seven mating seasons, observed from 1995 to 2001, researchers from the Graduate School of Arts and Sciences at the University of Tokyo, under the leadership of Mariko Takahashi, studied a free-ranging population of Indian peafowl at Izu Cactus Park in Shizuoka, Japan. They naturally expected to find confirmation of the power of sexual selection in a peacock's morphology.

Amazingly for the Japanese researchers as well as a big section of scholars, researchers came to the sensational conclusion that the female peahens were totally indifferent to the peacocks' tail size, and that brilliant colouring and tail condition did not correlate with the reproductive success of their bearers.

The publication of the results of this study, as expected, stirred heated debate. According to an article in Discovery News, "The feather train on male peacocks is among the most striking and beautiful physical attributes in nature, but it fails to excite, much less interest, females, according to new research. The determination throws a wrench in the long-held belief that male peacock feathers evolved in response to female mate choice. It could also indicate that certain other elaborate features in galliformes, a group that includes turkeys, chickens, grouse, quails and pheasants, as well as peacocks, are not necessarily linked to fitness and mating success" (Viegas, 2008).

Creationists also benefited from this unexpected result, suggesting that if sexual selection was not behind the peacock's tail, then what else could be the reason for this 'unnecessary beauty' if not the will and aesthetic sense of the Creator? Petrie and her French colleagues actually wrote a rebuttal of the revealing Takahashi et al. study (Loyau et al., 2008). They suggested that, first of all, more observations were needed to come to final conclusions, and secondly, they proposed that a phenomenon known as 'plasticity of female choice' can be involved. When translated into plain English, this term means that peahens possibly change their taste in choosing males much like humans do, and that contemporary peahens are not as interested in the size and beauty of the classic peacock train as their grandmothers were.

I agree with Marion Petrie and her French colleagues in that more observations are needed to come to final conclusions, but in regards to the "plasticity of female choice" I do have some doubts. It seems quite difficult to believe that, after tens and hundreds of thousands (possibly even millions) of years of female excitement for their male counterparts' trains that suddenly, before the close of the 20th century during a 4-5-year period in the 1990s (between the studies of Marion Petrie and Mariko Takahashi), that they suddenly lost interest towards the peacock's dazzling display.

I strongly suggest to those who will be studying the reasons behind the beauty of a peacock's tail not to discount the possibility that a peacock's tail's amazing size

and beauty, with an immense number of large eyespots (over 150), together with their loud calls, smelly droppings, and fearless behaviour can be a set of warning and intimidating signals to their rivals and predators.

And one more thing – the fact that male peacocks sometimes fight over females proves that the peahen does not have the power of free choice.

Academics are notoriously difficult and reluctant in accepting new ideas and even new facts. The ground-breaking Japanese study of Takahashi sometimes gets simply neglected (see, for example, a recent article by Patricia Brennan from the Department of Ecology and Evolutionary Biology, Yale University, Brennan, 2012). Proponents of sexual selection in peacocks also try to draw on a number of previous short-term studies as well: "The authors [Takahashi and colleagues] seem to ignore the fact that three previous independent studies have found relationships between mating success and train morphology. Rather than consider what is unusual about their study, they conclude that peahens in general do not prefer males with elaborate trains" declared Marion Petrie (Barras, 2008).

Well, as I can understand, the biggest difference between the previous studies that Petrie mentions and the Japanese study is evidently clear: Japanese scholars spent a much longer amount of time in observing the behaviour (seven years as opposed to one). Furthermore, unlike the previous studies, Japanese scholars did not change the peacocks' appearance by erasing their eyespots. We should be grateful that the Japanese team of scholars, despite the fact that they were confused by their findings (they expected their results to merely confirm previous studies), still published their alarming results. It is, unfortunately, a quite common and sad practice among academics that studies with negative/undesirable results are almost never brought to a wider audience.

It would be natural to expect that a bigger study of the peacock train and its importance for sexual selection is currently under way, in an eager bid to prove the Japanese results wrong. Losing this iconic argument will take a heavy toll on the proponents of sexual selection, but will we ever hear of the outcome of such studies if the new results confirm the conclusions of the Japanese study?

Conclusion: if we take into account that to look bigger (and more colourful) is one of natural selection's favourite strategies to scare away predators and competitors and avoid unnecessary physical confrontations, the idea that the peacock train was primarily designed by the forces of natural selection in order to scare away rivals and predators seems very plausible.

Another suggestion: scholars who are interested in researching the power of sexual selection should first acquire a solid knowledge of aposematic signals and strategies, as both aposematism and sexual selection thrive on virtually the same set of morphological and behavioural features. Therefore, completely ignoring one of the two great evolutionary strategies designed by the evolutionary forces is an unwise and detrimental research strategy.

The problem is far from being resolved, as only one long-term study is not enough to settle such an important question. We can say that the old axiom is currently viewed with a healthy dose of skepticism, and for a good reason. The tail of a peacock, arguably the greatest symbol of the power of sexual selection, might in turn become the symbol of the decline of the importance of the theory of sexual selection.

Tiger: The Silent Beauty

After discussing a few cases of the use of aposematic signals and aposematism as a life strategy in several animal species (some expected and some unexpected), let us now discuss what importance aposematism might have in the survival strategy of the three central species of our study, mentioned in title of the first edition of this book: tigers, lions and finally – humans.

As you may recall, aposematism does not go well with a predator's lifestyle, particularly for the predators that use stalking as their central means of hunting. It is hard to imagine a stalking predator who clearly advertises its presence with visual signals, noisy behaviour, body odour, and a slow and awkward walking style. Tigers, like many other cats, are swift and silent killers. They are truly archetypal predators.

Nevertheless, we will still have a point-by-point discussion on the tiger's possible aposematic morphological and behavioural features, including a quantitative assessment of the tiger's Aposematic Index.

Visual signals

Tigers are notoriously difficult to locate in their natural habitat. Unlike another big cat, the lion, which can be often found asleep in the shade of a tree, tigers are very difficult to spot in the wild. I myself spent several days at the Corbett National Park in 2011 and still did not manage to see a tiger during seven three-hour safari sessions, albeit knowing that many visitors had better luck. On the other hand, when I visited the Gir Forest in 2012 to see some unique Asiatic lions, during four three-hour visits to the park I saw 17 lions of all ages including males, females, and cubs. Tigers are famously coloured with black stripes on an orange-brown and white body (these colours are quite aposematic), and they might seem to not have much stealth tactics present in their visual morphology. On the contrary, as Corbett, Schaller and many other tiger experts have noted, tigers' colours and stripes work as the perfect cryptic device to help conceal themselves in the jungles. Because of the difficulty inherent in observing tigers, Schaller was in some cases transferring his knowledge of lions over to tigers (Schaller, 1984:235). Schaller sighted tigers 91 times during the whole period of his study, which lasted for 380 days (Schaller, 1984:236). Each lucky day was followed by three unlucky days.

Tigers do tend to leave visual claims of their territory for all others to see, a common one being leaving claw marks on trees, but when we are discussing visual aposematic signals, we only take into account the signals that point to the physical presence of the animal, not the signals that communicate territorial claims to other animals. Therefore, territory marking with various means (scratching, urine, faeces) cannot qualify as aposematic signalling. It is clear that tigers do not advertise their presence. On the other hand, in critical situations tigers use a few very effective visually intimidating signals: they open their mouth and display their impressive canines, and when meeting with rival males (and also when in the act of fighting) they also rise on their hind legs. Therefore, tigers have only temporary visual warning signals in order to intimidate opponents, and as a result they score a low 5% in the visual category of the AI.

Audio signals

Unlike lions, who frequently advertise their right to the territory via loud roaring (and even by communal roaring), tigers are generally silent. The best chance to hear tiger sounds in the wild is to be in a tiger reserve when tigers are in their mating season. As tigers are mostly solitary animals, they need to call for each other in order to meet during the mating season, unlike lions that often live their lives in a pack. Therefore, tigers do not have any constant audio-aposematic signals, while lions that live in the safety of numbers do. In the event that they are disturbed, tigers can express their frustration by various sounds such as hissing and growling to thunderous roaring (their roar is almost as loud as a lion's). As they display temporary audio signals but not any constant ones, tigers get another 5% in the audio category for their AI total.

Olfactory signal

Tigers are typical cats, and they spend plenty of time licking their body. The absence of body odour is particularly important for a predator that stalks its prey or ambushes it from a hiding place. Of course, in a zoo enclosure some tigers might acquire some body odour, but there are tigers that maintain their cat cleanliness even in inhumanely small cages. On the other hand, tigers do mark their territory by marking trees and defecating on certain spots. Although their body is as clean as possible, they do use olfactory signals to keep unwanted other tigers off their territories. Tigers use olfactory signals for marking their territory, but do not use body odour in order to announce their presence. They also do not produce any smell when in confrontation (unlike gorillas and humans). Therefore, although tigers do use scent to mark their territories, they do not have any odour present on themselves, thereby receiving 0% in the olfactory category.

Behavioural signals

In this category again we find that tigers do not have any elements of constant behavioural advertising signals. They definitely do not walk slowly and awkwardly - on the contrary, their movements are swift and graceful. On the other hand, when they need to, tigers can intimidate virtually any species of animals in their

environment, including humans and even elephants. Tigers receive a 5% for the behavioural AI.

In conclusion, the tiger's AI is a low 15%. Tigers arguably have no constant aposematic signals, however they do display temporary signals in three categories (visual, audio, behavioural), making them classic predators. They remain concealed, silent, clean and swift for most of their lives. Despite their non-aposematic life strategy, when required tigers have a wide range of very potent means (visual, audio, and behavioural) with which to deploy a very effective intimidation strategy. The primary importance of these temporary warning signals is to help them to avoid unnecessary physical violence during situations of conflict. We can also add here that, although there are some minor differences between the size and other elements of life of male and female tigers (for example, unlike mostly solitary males, females are spending a considerable part of their life raising their cubs), both male and female tigers generally share the same tactics and both have an equally low AI.

Lions: When Gender Matters

Although lions and tigers are phylogenetically closely related to each other and can even produce mutual offspring, their behavioural patterns have some very interesting differences. Probably most importantly, lions are social cats, and also have the most expressed sexual dimorphism amongst all cat species (both big and small). I believe that aposematism is behind this dimorphism, and I hope that after reading this section that most readers will agree with me. Male lions use the intimidating and warning power of aposematic signals much more often than females. As a result, embarrassingly for the king of the beasts, male lions are much worse hunters than their female counterparts.

Let us now assess all four modalities: visual, audio, olfactory, and behavioural, and see how both male and female lions score in their Aposematic Index assessment.

Visual signals

Only male lions have the most identifiable unique morphological feature of the species – a big mane around their neck and shoulders. Because of this huge mane, male lions are much worse in approaching a possible victim unnoticed. Female lions do not possess any unnecessary constant morphological features – they are physically slick, silent stalkers and swift killers, and as a rule they provide food for all the members of the pride, including cubs and cumbersome males. The lion mane is effectively a constant aposematic feature. Regarding temporary visual signals, lions of both sexes have plenty of intimidating signals, such as baring teeth and trying to look larger. Even with their temporary visual signals male lions possess more aposematic qualities than females – in critical situations males can also erect their mane. In conclusion, in the visual category males score the maximum 25% AI, against the modest 5% of AI in females.

Audio signals

Both males and females have huge voices which they often use to indulge in loud group roaring sessions, but most of the time remain silent as they are resting or moving. We may remember that making loud sounds on the ground is dangerous as it can attract predators, but lions hardly have any natural enemies, apart from humans. As a result of the human threat to their survival, it has been noticed that in regions where lions are hunted, they roar much less. Although lions can definitely move silently when they need to (particularly when hunting), their loud roaring sessions indicate that they like announcing their royal and dominating presence. Both genders of lions have a loud voice, although the male sound is still superior in strength and is lower in range. For their temporary audio signals both males and females use a variety of growls, hisses and roars when disturbed and when they want to achieve their goal without physical violence. Interestingly, lions never roar when they are chasing their prey. In summary I would say that although lions do not produce a constant noise that characterizes true aposematic animals, their wide arsenal of sounds and roaring sessions during relaxed times makes it possible to give both male and female lions an arguable maximum 25% of AI in the audio modality.

Olfactory signal

Lions are cats, and cats are legendary for their cleanliness. However, according to Brian Bertram, lions are not as good in washing their faces as domestic cats are (Bertram, 1972:56) and adult male lions are less clean than females (Bertram, 1972:59). My own experience in petting lions at the zoo in Georgia during my teenage years in the 1970s also suggests that male lions are less concerned about their cleanliness than females – male lions emit a constant body odour. Apart from this, lions mark their territory with their urine and faeces, but we do not consider this as an aposematic signal, as it does not point to the physical presence of the animal. In this category we can give a full 25% score to the untidy male lions and 0% to the slick and clean females.

Behavioural signals

Lions do not have constant aposematic behavioural signals, they do not walk slowly or awkwardly and they both can run fast enough to catch their prey, with females being quicker and swifter than males. As for their temporary aposematic behavioural signals, both males and females employ a large repertoire of threat signals including aggressive but bluffing attacks, baring of teeth and growling. I think that, in regards of behavioural aposematic signals, we can give a low 5% to both male and female lions.

Overall, lions use a variety of temporary aposematic signals in all four modes in order to avoid unnecessary physical violence in potentially critical situations. Most importantly for our discussion, male lions have a much wider range of aposematic signals than females do, including their constant aposematic visual signal (mane) and olfactory signal (constant body odour). According to my calculations, female lion AI will be 35% (25% for audio modality, and 5% each in visual and behavioural modalities). As for the male lion AI, it will be high 80% (25% in visual, audio and olfactory modalities, and 5% in behavioural modality).

Male and female lions are quite different in their use of aposematic signals. Male lions are much more aposematic than females, and in fact more aposematic than any other cat, wild or domestic. Female lions on the other hand are quite close in behaviour to tigers, although their long roaring sessions in conjunction with the

males indicate that they still use more aposematic signals than tigers. The clue to this intriguing characteristic of male lions is most likely the unique social nature of lions in general. As lions mostly live together, they divide the tasks among pride members. Females have become (or more correctly, stayed as) sleek hunters without any unnecessary hindrance from having constant visual or olfactory aposematic signals. Alternatively, male lions evolved with characteristics to enhance their fighting and intimidating capabilities for their confrontation with rival males and in defending their pride from other serious threats. For males to be better at intimidation and fighting is more important than to be good at hunting. As a result of their higher AI, males are poor hunters and rarely hunt when they are a part of a pride. Females on the other hand cannot afford to be aposematic, as a high AI (e.g. the presence of huge mane or a constant body odour) would make their hunting strategy much less effective.

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Before we start discussing the importance of aposematism in **human** evolution, let us first summarise the idea that I am trying to bring to the attention of the readers of this book:

Aposematism is not only a strategy to avoid predation. The central function of aposematism is **to avoid physical violence and to substitute violence with ritualized forms of display**. Prey species use aposematism to advertise their unprofitability to predators and to get away without fighting for their lives. However even the strongest predators, such as tigers and lions, also widely use an aposematic display in order to avoid physical confrontations with other formidable creatures. And of course, there is a big difference between the aposematic animals that use aposematic display constantly, and the non-aposematic animals that use an aposematic warning display only temporarily.

If we remember these methodologically very important premises, let us now move to the discussion of the importance of aposematism in human evolution.

CHAPTER THREE

The Descent of Men, and Selection in Relation to Aposematism

When Charles Darwin wrote a book on human evolution, the resulting volume was more about sexual selection than about human origins. Darwin was often criticized for this imbalance and for his overrated credit to the power of sexual selection. In the last couple of decades, the popularity of Darwin's ideas on sexual selection has grown considerably, and many human traits that even Darwin was not considering as being the result of sexual selection via female choice, are now considered today by proponents of sexual selection as examples of female choice.

One of the central aims of this book is to give better acknowledgement to the strategy of aposematism (warning display). In this chapter I will argue that humans, who are one of the most visible and noisiest creatures, with plenty of body odour and a slow and awkward walking style, are in fact an aposematic species. Readers will easily notice the resemblance carried in the title of this chapter to Darwin's 1871 book. The mission of this chapter is almost impossible: to prove that almost all morphological and behavioural characteristics of our species were brought on by the perennial strive to become better at aposematic/ritualized warning display. Darwin explained virtually all human evolution to be from sexual selection via female choice, and this chapter will try to explain virtually the same characteristics but via warning display.

I want to say from the very beginning that, for any scholar who believes in evolution, criticizing Darwin feels like a blasphemy to a religious person. Darwin has been my role model for all my conscious life, not only for his brilliant ideas and ability to see the widest picture of the entire world, but also for his disarming honesty and gentle and vulnerable soul. The fact that I also share my birthday with the great scholar made me feel somehow mysteriously connected to him from my teenage years. A few years ago when I first started thinking of the importance of warning display in human evolution, and noticed that warning display could be the central force behind many elements of animal and human morphology and behaviour, and

that it could potentially weaken or even gradually replace the sexual selection model, I had an ambivalent feeling. This feeling was possibly something close to the feeling that Darwin himself had when he did not want to publish his own ideas on evolution. I wrote a letter to my dearest colleague and mentor about my inner conflict regarding Darwin and his legacy of human evolution through sexual selection. His response assured me that being honest and direct in presenting my ideas was the only true course of action with which Darwin himself would have approved. Besides, there has hardly been (or will be) any new development in evolutionary studies that could do any damage to the unique place Darwin holds in the history of biological science.

Any new idea takes many years, sometimes even generations to be noticed, let alone shared by academics, especially in the event that the new idea contradicts the ideas of a distinguished authority such as Charles Darwin.

After modestly suggesting in my 2011 book that humans are an aposematic species, I have not had any response to this idea from the academic community, apart from couple of biologists expressing interest in my ideas. In this book my claims are louder, and are written in the simplest language for anyone to follow my arguments. I believe that if viewed with an unbiased attitude and open mind, the aposematic nature of human morphology and behaviour is just too obvious to reject. At the same time, I am well aware that most of academics and peer review journals are extremely conservative in even acknowledging the presence of new ideas, let alone accepting them.

To begin with a general introduction for this chapter let me say that, very much like in the cases of male lions, elephants and peacocks, I have never seen a discussion of the use of aposematic survival strategies in humans, and of the effects of warning displays on morphology and behaviour throughout human evolution. At the same time, I must note that the idea of human groups possibly scaring away predators by shouting and throwing objects at them (both very aposematic behaviours), was first mentioned by Charles Darwin himself, and is already quite popular in evolutionary literature.

In reviewing the aposematic index of our own species in the same way we have with other animal species, I will have a look at all four modalities (visual, audio, olfactory, behavioural) and check for their presence and aposematic characteristics.

As the readers might guess, we will not be as brief with all human aposematic characteristics as we were with other animals like skunks, lions, tigers, and even peacocks. We will have to discuss numerous aspects of human morphology and behaviour in the next few sections, beginning with visual signals.

Visual Signals

It is often said that the first impression is the strongest. The visual impression often provides the major part of a first impression, hence the importance of visual appearance in animal species and humans. As we remember the most important requirement of a visual aposematic signal is to be clearly visible. I will argue in this section that a big part of our body's morphology was formed by the forces of natural selection with the central aim to look as tall and as visually impressive as possible.

"The taller the better" or the origins of human bipedalism

As we may remember, being tall helps on many accounts both in human and animal life. Taller kids are less likely to be bullied at school, taller presidential candidates are more likely to win the election, taller sales personnel are better at convincing potential buyers into buying their stuff and taller boys and girls often get more attention. On the animal side of the things, taller and bigger animals are less likely to be attacked by predators than smaller animals, and taller and bigger animals are more likely to be successful in their bid to intimidate rivals and obtain territories and mates. We must remember that no trait has only positive sides, and on the negative flip-side for many species (both predators and prey), taller animals find it more difficult to stay unnoticed. Another negative aspect to being big is that predators will sometimes prefer to attack larger prey animals simply because they will 'provide' more food. Overall however, the positive aspects of distinct visual traits outweigh the negatives.

In the next few sections I will argue that human (and hominid) morphology is the direct result of our perennial evolutionary strive to become taller.

We will start our discussion with bipedalism, a trait widely accepted as arguably the first and most important step on the long evolutionary road between our primate ancestors and modern humans. The origin of bipedalism has been one of the most prominent topics of human evolution since Charles Darwin proposed his theories to explain our animal descent. After more than 150 years since the appearance of Darwin's work, the origin of bipedalism is still largely shrouded in mystery. On one

hand, the skeletal adaptation to bipedalism is well documented throughout the evolution of hominids, but on the other hand scholars are still arguing on the exact reasons that could have led to our walking style (which is extremely unusual for mammals).

When discussing the origins of bipedalism, we should be aware that bipedal locomotion had (and still has) both positive and negative effects. On the positive side, for example, bipedalism frees up the hands and allows the bipedal creature to see its surroundings better. On the negative side of the coin, bipedalism uses twice the energy as mammalian quadrupedalism, and bipedalism and associated skeletal changes created several problems for our ancestors, some of which are still visible today. For example, tree climbing became more difficult, our running speed drastically declined, hiding from predators became more difficult, and human lower back and knee joints have since become plagued by osteological problems, predominantly because in bipedal posture these joints support much more weight than in the "normal" quadrupedal walking gait. Some other problems plaguing many fellow humans, such as haemorrhoids or uterus prolapse, are also directly connected to our upright posture - unusual for mammalian species - that exerts tremendous lifelong pressure on the lower parts of our bodies.

Of course we hardly require tree climbing in our contemporary life anymore, and 99% of the time we do not care if we are easily seen while walking in tall grass, but the lower back pain that many readers of this book may have experienced (and some are possibly even experiencing as they read these words) also comes from our constant bipedal posture. In this context I would like to remind readers that traces of osteological problems are apparent in the discovered skeletal remains of prehistoric hunter-gatherers (Koella & Stearns, 2008).

We have discussed how bipedalism has both positive and negative sides, but for a new locomotion model (as for any other morphological or behavioural trait) to be successful, the benefits must outweigh the disadvantages. Several million years of relentless everyday struggle for survival will eliminate any unwanted or too costly morphological or behavioural element. With this strict evolutionary rule in mind, let us remember that none of the other terrestrial mammalian species opted to shift to constant bipedal locomotion, therefore our ancestors must have had very worthy

reasons to shift to this style of locomotion, which was and is so unpopular among other terrestrial animals.

From the moment our ancestors started walking upright habitually more than 4 million years ago, the long process of transformation towards becoming a modern-day human had begun. It is universally agreed that bipedalism evolved well before the enlargement of brain and the development of stone tools. To understand what was behind this crucial change is to understand the main forces at play during the very beginning of the human evolution process – this is why bipedalism is universally accepted as one of the most important behavioural and morphological changes in the evolution of our species. It is no wonder that hardly any other topic of human evolution has received as much attention as bipedalism has.

There had been plenty of hypotheses, ideas and models to explain why and how bipedalism started and consequently became established in human evolution. The different hypotheses are not necessarily mutually exclusive, as different selective forces could have acted in conjunction to lead to hominid bipedalism. Here are some of the best-known ideas on the origins of human bipedalism, presented in chronological order:

List of ideas on human bipedalism

• 1871. Charles Darwin suggested that our ancestors were forced to shift to bipedalism after they became terrestrial, in order to have free hands to carry weapons and meat. The idea of bipedalism freeing hands was later used by many other scholars, but also with many varying functions for the free hands (to carry food, to carry weapons, to throw weapons, to carry children – see below).

• 1923. Arthur Keith, based on the fact that gibbons use bipedalism when on the ground, proposed that human bipedalism had a connection to the gibbons' locomotion pattern.

• 1925. Raymond Dart suggested that standing upright in open habitats would be adaptive to help our hominin ancestors to scan the surroundings in order to see their prey and avoid predators.

• 1936. John de la Marrett came up with a very vague diet-oriented hypothesis, according to which bipedalism was caused by the lack of iodine in early hominid environment.

• 1942. Max Westenhofer suggested that human morphology and behaviour (including bipedal locomotion) evolved in a marine environment. Marine biologist Alister Hardy came to a similar conclusion in 1930, although he published his ideas a staggering 30 years later. The name coined for this hypothesis, "Aquatic Ape," belongs to Desmond Morris. The idea was later popularized in several books written by Elaine Morgan.

• 1953. George Bartholomew and Joseph Birdsell argued that carrying tools and weapons was the key factor for the origin of bipedal locomotion.

• 1954. William Etkins (and later Tanner, 1981) suggested that infant carrying by mothers was the key factor for adopting bipedal posture and locomotion.

• 1954. Kenneth Oakley supported the idea that the need to look over tall grass was the initial motivating factor for hominid bipedalism.

• 1959. Raymond Dart suggested that intra and inter-species conflict and violence was one of the key factors for the adoption of bipedal posture.

• 1959. Raymond Dart and Craig Dennis also supported the idea that looking over the terrain was an important element in establishing bipedalism.

• 1959. Wolfgang Köhler, observing primate behaviour, proposed that moving on muddy and cold substrate (for example, snow) could lead to bipedal locomotion.

• 1960. Alister Hardy, and later also Helen Morgan in several books, suggested that human ancestors went through a long period of living in a coastal area, spending most of their time in the water.

• 1961. Gordon Hewes suggested that the principal reason for hominid bipedalism was freeing hands in order to transport food.

•1962. Frank Livingstone (and later Roger Wescott in 1967, and Nina Jablonski and George Chaplin in 1993) suggested that as plenty of animal species use bipedal threat displays to look taller in order to intimidate antagonists, bipedal threat displays could have been the initial behaviour that led hominids to adopt permanent bipedal posture.

• 1962. Lloyd Du Brul, and later Richard Wrangham (1980) and Rose (1977) suggested that bipedalism was a result of early hominid feeding and gathering activities on the ground.

• 1970. Clifford Jolly suggested that foraging and eating seeds from savannah grasses led to bipedalism.

• 1975. Russell Tuttle suggested an updated version of the gibbon hypothesis, suggesting that human bipedalism evolved from gibbon-like tree climbing abilities.

• 1978. Glynn Isaac suggested that, as a result of scavenging for carcasses on the savannah, hominids had to carry scavenged food back to the group base, and that hominids adopted bipedal locomotion in order to use their arms to hold the food.

• 1978. Valerius Geist proposed that human ancestors started bipedal locomotion while still in the trees, before their move to the ground. According to Geist, our distant ancestors were carnivorous and were obtaining food by stalking silently and killing tree-dwelling species with hand-held rocks.

• 1980. Jack Prost suggested that quadrupedal vertical climbing, used by apes, was the ancestor of human bipedalism

• 1980. Peter Rodman and Henry McHenry proposed that bipedalism evolved as an energy-efficient way of walking long distances, albeit at slow speeds.

• 1980. Adriaan Kortlandt conducted field experiments with lions and proposed that hominid bipedalism was initially used as inter-species intimidating displays, standing upright and using thorny branches to defend themselves from large predators.

• 1981 C. Owen Lovejoy suggested that the origins of bipedalism were linked to monogamy and the male provisioning his family with food, thus improving the survivorship of the offspring and increasing the pair's reproductive rate. The same year Lovejoy suggested another similar hypothesis, but this time based more on a sexual selection model and without suggesting monogamy among early hominids.

• 1981. Nancy Tanner suggested a new version of the sexual selection model, suggesting that the male phallic display could have been the initial incentive for bipedal posture.

• 1983. Matt Cartmill (soon followed by Carrier in 1984 and by Bramble & Lieberman two decades later) suggested that our hominid ancestors were hunters and hunted prey using long-distance endurance hunting, which led to bipedal locomotion.

• 1984. Peter Wheeler proposed that, as bipedal posture raises the body away from the hot ground, it helps to keep the human body temperature lower.

• 1985. Vernon Reynolds suggested that bipedal locomotion started with moving from tree to tree.

• 1986. A.R.E. Sinclair and Pat Shipman virtually simultaneously proposed that hunting, scavenging, and then bringing the meat back to the base camp was the major factor in the gradual acquisition of bipedalism.

• 1987. Felix Fifer (and later Holly Dunsworth, John H, Challis, and Alan Walker in 2003) suggested that the defensive throwing of objects (especially missiles as weapons) was the key driver of hominin bipedalism.

• 1987. Barbara Isaac also wrote about the importance of throwing in human evolution; however, she did not concentrate on the role throwing had in the evolution of human bipedalism.

• 1988. Renate Eickhoff proposed that human ancestors got used to bipedalism while still living on the tree branches, that they were carnivorous, and that their method of hunting was to sit and wait for the prey to approach and then grab them using their upper limbs.

• 1988. Liza J. Shapiro and William L. Jungers suggested that the acquisition of habitual bipedalism in humans probably involved not so much a major change in back muscle action or function, but rather an improvement in the mechanical advantages and architecture of these muscles.

• 1991. Derek Ellis proposed a version of the early "aquatic ape" hypothesis, suggesting that bipedal locomotion could have started after human ancestors spent arid periods of the year in the wetlands.

• 1991. Peter Wheeler suggested that the increased cooling, reduced heat gain, and reduced water requirements in a hot, tropical climate was the driving factor for bipedal posture.

• 1996. Kevin Hunt suggested that human ancestors were initially bipedal only when they ate. According to Hunt, bipedal feeding posture may have been a pre-adaptation for habitual bipedalism which appeared later, only in Homo erectus.

• 1996. Lynne Isbell and Truman Young proposed that the mixture of savannah and scattered forests led to increased terrestrial travel by proto-humans between clusters of trees, and that bipedalism offered greater efficiency for long-distance

travel between these clusters than quadrupedalism.

• 1996, 1998. Richard Potts suggested in his publications that different environmental conditions were chiefly responsible for human ancestors starting bipedal locomotion.

• 2002. 2009. 2013. Algis Kuliukas proposed a hypothesis dubbed the "wading hypothesis", where humans were living in an environment of seasonally-flooding rivers, requiring them to resort to bipedal locomotion to avoid drowning, and that during the dry season they maintained this bipedal posture.

• 2002. Mark Verhaegen, Stephen Munro and Pierre-Francoise Puech suggested the idea of an "aqua-arboreal" phase in human evolution, which came from the Hardy and Morgan idea of "aquatic ape" although in this model our ancestors were also still living in the trees as well as spending plenty of time in the water.

• 2002. Elaine Videan and W.C. McGrew carried out an experiment among chimpanzees and bonobos in order to check various models of the origins of bipedalism, and came to conclusion that food carrying and foraging models are the most effective.

• 2003. According to Jonathan Kingdon, bipedalism arose through adaptations in 'ground apes' whilst feeding on fallen foods on the floor of gallery forests.

• 2004. Richard Dawkins has argued that bipedalism could have begun as a kind of fashion that just caught on and then escalated through sexual selection.

• 2004. Holger Preuschoft suggested that transporting heavy loads was the primal reason for human bipedalism.

• 2004. Weijie Wang and Robin Crompton also suggested that load-carrying was the central reason for human bipedalism, albeit only for establishing the later Homo body proportions.

• 2005, 2009. Donna Hart and Robert Sussman suggested that defence from predators was the key issue in hominid evolution, although according to them none of the adaptive reasons was important for adoption of bipedal posture. Instead, as a part of ape locomotion, it was "given" to hominids and only proved to be advantageous for several purposes after bipedalism had already been adopted as a standard of locomotion.

• 2006. Adam Sylvester suggested that bipedalism was an adaptation in order to maintain the mobility of hominid shoulders.

• 2007. Aaron Filler proposed that bipedalism was a result of a genetic mutation, and according to him human ancestors of some 20 million years ago already had the genes for bipedal locomotion.

• 2007. Susannah Thorpe, Roger Holder and Robin Crompton suggested that Orangutans using an upright posture in thin branches was the precursor to human bipedalism.

• 2009. Herman Pontzer, with David Raichlen and Michael Sockol, suggested that bipedalism was primarily a successful locomotion model because of the lower metabolic cost of walking.

• 2010. Stephanie Braccini, Susan Lambeth, Steve Schapiro, and Tecumseh Fitch researched the relationship between chimpanzee tool use and the ensuing effects on lateralization and posture, and suggested that tool use may have pushed our nearest ancestors upright.

• 2010. Carsten Niemitz supported the so called 'Amphibian Generalist Theory', a version of the wading theory, and suggested that though the earliest of ancestors would have needed hands and arms for many reasons (self-defence, food gathering, infant carrying), it was living in woodlands and thus close to the rivers that was crucial for bipedalism.

• 2011. Kirsty Robertson synthesized earlier suggestions by Wheeler (cooling heat) and Shipman (freeing hands) and came to a conclusion that bipedalism emerged as the need to be energetically efficient for subsistence strategies, such as scavenging.

• 2011. David Carrier proposed that sexual selection via male combat was the decisive factor for the origins of bipedal locomotion, and that bipedal posture was primarily a means to deliver a more powerful punch to rival males.

• 2012. Graeme Ruxton and David Wilkinson suggested that it was only after early humans began walking upright that they began to lose their fur coats, and that these two processes were closely connected in human evolution.

• 2014. Herman Pontzer, David Raichlen and Peter Rodman studied energetics of bipedal and quadrupedal locomotion in chimpanzees and bonobos, and came to conclusion that similarity in cost between bipedal and quadrupedal trials suggests that the adoption of bipedal walking would have had no effect on walking costs for early ape-like hominins.

• 2015. Kwang Hyan Ko proposed that the evolutionary reasons for bipedalism can be found in combination of Savanna-based, Postural feeding, and Provisioning theories.

As we can see, the list of hypotheses and suggestions on the reason of bipedalism goes on and on. Hardly any other human morphological or behavioural trait has received as much attention from scholars as bipedalism has. Despite the large number of hypotheses as seen above, I must remind readers that this list still does not cover every single expressed idea about the origins of human bipedalism – it is merely a somewhat brief overview. Also, it is easy to notice that a number of existing hypotheses use similar reasons for the adoption of bipedalism as others, but sometimes with minor differences. Many scholars and authors tend to group different suggestions on the origins of bipedalism into several general frameworks, such as the "walking hypothesis", "postural feeding hypothesis", "ecology hypothesis", "thermoregulation hypothesis", "enhanced vision hypotheses", "wading hypothesis" and "provisional hypothesis."

Most evolutionary hypotheses constructed to account for the appearance of bipedalism have serious shortfalls. For example, the hypotheses that connect the transition to bipedalism to a shift in environment to the savannah habitat cannot be correct as bipedalism started before this environmental shift. Bipedalism also started long before hominids started using tools. The male "provisional" hypothesis is based on a monogamous relationship between sexes which, in the light of available evidence, is unlikely to be true for our hominid ancestors. In the case of hominids needing to travel long distance, it is not clear why they would choose such an energy-consuming and slow mode of locomotion such as bipedalism. Supporters of the "wading" model fail to notice the fact that the areas in proximity to the river banks are the most predation-prone both from terrestrial predators (lions) and water predators (crocodiles). The more recent hypotheses for bipedalism which focus on male aggressiveness and the advantage in fist fighting also fail to explain why our ancestors were gradually becoming physically weaker if the selection was favouring stronger and more aggressive males.

My own suggestion for the origins of bipedalism is that bipedalism was merely one of the many parts of a grand survival strategy for early hominids known as **aposematism**. Although aposematism is mostly known among scholars as "warning colouration", it is much more than a simple colouration, and also contains audio, olfactory and behavioural signals. I prefer to use a more complex and more precise term: "Audio-Visual-Olfactory Intimidating Display" (or AVOID). As the strategic aim of an aposematic display is generally to avoid predators and to avoid unnecessary physical violence, the acronym which is produced by the above term, "AVOID", seems almost too much of a coincidence to take seriously.

Therefore, I believe that the origins of bipedalism must be explained through the principles of warning display (aposematism). Standing on hind legs, as we can remember from our previous evaluations of other aposematic species, is one of the most widely used means to rapidly increase body size in an aposematic display, and there is a vast number of animals which utilise this form of warning display in tense confrontations.

The idea that human bipedalism could have originated from animal threat display is not new. We may remember from the list of ideas on human bipedalism that it has been postulated by a number of scholars during the last 50 years: Frank Livingstone wrote about this in 1962, as did Roger Wescott in 1967 and Nina Jablonski and George Chaplin in 1993. Furthermore, according to Adriaan Kortlandt (1980) bipedalism was initially used for inter-species intimidating displays as well as standing upright and using thorny branches to defend themselves from large predators.

The largest issue that is pointed out by the critics of this scenario is that, in the animal world, the bipedal threat displays are only used for a few seconds – therefore how could this posture, maintained only for few second in emergency situations, eventually become the constant mode of locomotion? Bears can actually make a few bipedal steps, but they never became constantly bipedal, right? This is absolutely correct. In order to distinguish between bear bipedal steps and hominid bipedal locomotion, we need to remember that aposematic signals can be of two different categories: (1) temporary, used in critical situations only, and (2) constant, or displayed by the animal at all times. Temporary warning signals can be (and are) used by virtually all animal species (bears included), but constant warning signals

are as a general rule used by aposematic animals only, i.e. those who try to constantly advertise their presence in various modalities. What our ancestors did was they turned a temporary warning/intimidating display into a constant aposematic feature. This was a revolutionary change, going from a temporary warning posture into a constant mode of locomotion, and one that indicates that our ancestors were finding the warning display a lifesaving strategy. Bears are not aposematic creatures – humans are.

For all animal species that are able to make several bipedal steps (from bears to African apes), maintaining this upright posture is quite difficult. Shifting to bipedal posture and maintaining this constantly was no doubt equally difficult for our primate ancestors as well. There must have been much stronger pressure for such a behavioural change to qualify through natural selection.

It might sound impossible, but the original pressure from predators that led our ancestors towards bipedal locomotion, is still with us! Do you want proof of this strange proposition?

If you search the internet for survival manuals on how to behave if you suddenly find yourself facing any big and dangerous animals (like a tiger, lion, mountain lion, bear, or a wolf), the most constant and important advice in the list of tips is to stay tall. Bending down, even for a few seconds, may cost your life. When I visited the Corbett National Park in January 2011, forest officials were hunting a man-eating tiger that had, by that point in time, killed two women. Both women, at the time of attack, were not standing erect. One of them was cutting grass and another one was answering the call of nature. Facts proving the importance of maintaining a tall bipedal posture for staying safe in the jungles come from many sources. From documental writings of Jim Corbett, Kenneth Anderson and their peers, who hunted man-eating tigers and leopards, we know that Indian villagers were mostly attacked when they were cutting grass, collecting firewood, going to the toilet, or doing some kind of other activity which requires bending down and generally results in temporary loss of bipedal posture. Staying tall is still a potent aposematic signal, saving human lives in countless encounters with various dangerous animals.

On February 18th 1975 a terrible tragedy took place during a safari at the Namibia-Angola border. As a few cars, full of tourists were viewing a pack of lions, against of all safety precautions a tourist came out of his car and walked up very

close to the lions in order to film them from a closer range. It is difficult to understand where exactly the tourist's common sense had escaped to when he left a car with his wife and two small children in it. There is graphic video footage on YouTube, filmed from another car, showing the tragic scene where the man is eaten alive in full view of his wife and two children. For several seconds the intrusion of the man in the midst of the lion pride is left unpunished, but the last straw that essentially provokes the attack is when the man crouches down. The man with the camera had crouched down to film the snarling male lion at a more effective angle - as soon as he went down to his knees, an unsighted lioness jumped on his crouched figure from behind.

I do not know whether staying tall would have saved the life of the tourist, but I am certain that when he bent down he severed all chances of survival. So remember, if you see a dangerous animal and cannot get to safety quickly, stay tall and you will have a much better chance of survival! If you do not look tall you are in danger! Because of this, children are particularly vulnerable in the presence of big cats and it is advised to keep them in your arms. I am very grateful to Mr. Soulemenn Kalee, a professional hunter from South Africa, who provided me (with the help of our common friend Preetum Gheerawo) important information on why it is very dangerous for children to be next to big cats. Kalee has great experience in dealing with lion attacks on humans, and has also assisted Hajee Mackumboro, the chief ranger of the Selous park in Tanzania, in the hunt for arguably the worst man-eater of the 21st century, the lion pack headed by the notorious male man-eater "Osama." According to Kalee, a child's smaller stature (when the height is less than 140cm) ignites a lion's hunting instinct, and even hand-reared, disciplined lions can become dangerous when they encounter children.

From the evidence above it is obvious that predators would have provided strong evolutionary pressure for the establishment of bipedalism. Early hominids must have noticed that they were being attacked much less when they were staying tall, or more correctly those of our ancestors who were spending more time erect on two legs were attacked less and naturally outlived those who were moving around half crouched, as other apes do. In one way or another, staying tall and bipedal locomotion became a life-saving strategy for our distant ancestors. Staying tall still remains an effective strategy in encounters with dangerous predators to this day, and will remain so in the future.

According to ethnographers and contemporary ethologists (Schaller, 1972; Bertram, 1972; Marshall, 2001), lions flee when they see even an unarmed human on foot. Brian Bertram, who studied lions in the Serengeti the same time as George Schaller, wrote directly on this subject: "All my observations were made from a Land Rover, not for the reasons one might think but because lions in the wild are afraid of humans on foot" (Bertram, 1972:33), and also "If I had got out of my Land Rover and shouted out and waived my arms, the lions would have run off, for almost all wild lions are still afraid of humans on foot" (pg. 43). During a field experiment where two scholars, George Schaller and Gordon Lawther, covered on foot about 160 kilometres in the Serengeti, they encountered a number of lions, and "All the seven lion groups that we encountered while we were on foot fled when we were at distances of 80 to 300 metres" (Schaller & Lowther, 1969:328). But as we just noted, it is a different story if human crouches down and loses the bipedal posture in the presence of lions and other dangerous predators.

The gradual shift to bipedalism must have taken hundreds of thousands, even millions of years, and also very importantly, the establishment of bipedalism must have eventuated while our distant ancestors were still living in the woodlands, well before they moved out into open grasslands. Bipedalism was **not** the *result* of our distant ancestors moving from the woodlands to the open savannah (as some theories of bipedalism suggest), but on the contrary **bipedalism was the necessary condition that allowed early hominids to move to open grasslands**. Our distant ancestors left the safety of the trees because bipedalism (and a number of other aposematic strategies which we will be discussing in the following pages) provided adequate security in a new environment where trees were not around to be climbed up in critical moments. Early models of human evolution were using the open African savannah as the only theoretical environment for early human evolution. We now know that all of the sites discovered in relation to early hominids (before 3 million years ago) seem to have been partially or fully wooded. No early hominids have been discovered to have been living in the open African savannah. The morphology of these early hominids shows adaptations for climbing as well.

Bipedalism was by no means the only new morphologic-behavioural means to look taller. I am sure that contemporary human morphology has several other

important evolutionary developments that have made our ancestors taller and more visually impressive over time. Let us discus these evolutionary developments.

Long legs: Receipt of beauty and survival

Both male and female bodies are considered more attractive if they have long legs. This peculiarity of human taste does not seem to be connected to the influence of Hollywood film stars or the wide range of female and male models endowed with long legs. Our sense of beauty might seem independent from practical everyday needs, but often it is the practicality of certain forms and things that make them beautiful to our senses. Not everyone might agree with this Aristotelian understanding of beauty where the relationship between the beauty and virtue is crucial, but this idea certainly makes evolutionary sense. We can at least all agree that long legs are considered aesthetically attractive as well as having their practical advantages.

So let us ask a simple question: why do humans have such long legs? If you compare pictures of humans and our closest living relatives, apes, you will see that the change of proportions between the length of the body and the legs is striking. It is quite amazing how little attention was paid to this important morphological novelty, particularly if we compare the number of works on this subject with the number of studies on bipedalism. Quite possibly for most scholars the link between bipedalism and longer legs was so obvious that they did not feel any need to explain it further.

The first and the most obvious answer for many readers would be that with the development of longer legs, humans became more efficient in walking and running. Sounds very logical, doesn't it? This would definitely be true if long-legged humans were better at walking, and particularly running, than our short-legged primate relatives – unfortunately this is not true. On the contrary, a chimpanzee, using its awkward knuckle-walking and running style, is much faster than even the best

human professional athletes. The development of long legs did not help our speed, but instead made us run slower.

Could the reason for long legs possibly be the cost-efficiency of long distance walking?

Herman Pontzer, an active researcher of human bipedalism, specially studied the importance of length of the legs for locomotive efficiency, and in a very recent publication of his he seriously questioned whether this factor affected the evolution of animal limb length at all: "Despite the importance of limb length in determining locomotor cost there is little empirical evidence suggesting that locomotor economy or limb length have been a primary target of selection in taxa that range widely. For example, despite their reduced digits and long metapodials, ungulates (artiodactyls and horses) are no more economical than generalised mammals... Similarly, despite the fact that carnivores travel an average of four times farther than herbivores each day, the cost of locomotion for carnivores is no different than that of other mammals, and limb lengths of carnivores are not exceptional; for example, a 25 kg goat and a 25 kg dog have similar limb lengths, about 40 cm. Within carnivores, average daily travel distance, is not correlated with limb bone length" (Pontzer, 2012:7).

Therefore, empirical evidence does not support the view that the length of the legs is a result of an evolutionary strategy for achieving further locomotor efficiency.

Could human bipedal posture have possibly been a more effective way of long-distance running? The story of an informal bet on who was better in long-distance running, a human or a horse, became a media sensation:

"Its originator was a Welsh pub owner named Gordon Green. One day in 1979 he got into an argument with an equestrian friend about the relative strengths of men and horses as distance runners. Green insisted a human could beat a horse in a long race, and to prove his point he helped instigate the marathon in 1980. For the next 24 years, he found himself losing the argument as riders on horseback left human runners behind. But then it finally happened — in 2004 a British man named Huw Lobb won. Three years later Germany's Florian Holzinger outran the horses, as did one other human contestant. The media loved it — a predictable farce had become a man-bites-dog story. Bookies were less enthused; they had to pay out on bets made at 16-to-1 odds favouring the horses" (Stipp, 2012)

American scholars Denis Bramble and Daniel Lieberman wrote in 2004 (pure coincidence with the 2004 man-vs-horse race upset) that humans can perform much better as runners on long distances as opposed to short distances. Their argument on the efficiency of human long-distance running turned into a media frenzy and it was sometimes claimed that humans can outrun (over long distances) horses, dogs, antelopes and other animals known for their running abilities (see for example, Remsen, 2011, "Elegance in running: How Humans Can Beat Cheetahs, 2011). The new possibility that humans were long-distance runners who would follow their prey (for example, an antelope) until it could not run any more gained significant popularity. Some publications started creating an image of humans as champion long-distance runners.

Humans can boast of plenty of achievements, but running more efficiently than best animal runners is a bit of a stretch. Even if they win a race once in 25 years, this does not prove they are better endurance runners than horses or dogs. If we follow the thought process of the authors of some of the articles on this topic, humans can outrun all the animals on long distances, and the 2004 race is the proof. By the same logic we can come to the conclusion that Australians are better at soccer than Brazilians, because the Australian national soccer team won a friendly against Brazil in 2000. The authors are also neglecting the glaring fact that to have humans compete against horses on an even basis, you should possibly allow the horses to compete without having other humans strapped to their backs. Bramble and Lieberman's 2004 Nature Journal article was much more subdued and realistic about the use of this strategy for hunting than this "we are faster than any animal" media frenzy that arose later. In their 2004 Nature publication they concluded that "Although such demanding strategies have been occasionally documented among modern foragers…, they might have been too energetically expensive and low-yield for the benefits to have outweighed the costs."

I agree with the above summary of their 2004 article. Also, if we take into account that, after completing a marathon two to five hour run, successful hunters would then need to walk back all these kilometres that they covered in the long pursuit; if we also take into account that on their way back they had to carry the additional weight of the hunted antelope; and if we take into account that during their long walk back their cargo might have attracted predators, we can safely agree with

the authors of the article in that there were just too many negative sides for this hunting strategy to prevail.

This strategy was possibly a desperate last measure in the open Kalahari Desert, where there are not many options for hunters and you do not see another animal for many kilometres. The strategy of scavenging must have been a much more viable option in the lusher Serengeti as opposed to the more desolate Kalahari. Bushmen themselves, if they see a scavenging opportunity, prefer to seize it rather than following another running antelope to its exhaustion.

And still there is no doubt that humans are much more effective as stayers rather than as sprinters. I propose that, although early humans did not depend on their legs to get away from predators, their speed as long distance runners was still quite important to them. This speed was not however important for running down prey.

You probably know the old saying "time is money," but for our ancestors and other animal species that greatly depended on scavenging, this saying could be modified as "time is food." After the presence of a new kill was advertised in the sky by the vultures, our ancestors needed speed and endurance in order to reach the kill site as soon as possible.

Am I suggesting that our ancestors need longer legs in order to reach the kill site quicker? No. Locomotion is always more efficient when four legs are involved, and if only speed was paramount then our ancestors would not have been walking upright. To look at the true origins of our long human legs we need to recall the aposematic model that we were discussing earlier. This model proposes that one of the most popular ways to achieve more conspicuous visibility is to have a taller body size in order to be visually more impressive and intimidating to rivals and predators. One of the most obvious ways to achieve bigger body height is to have longer legs. I therefore suggest that the gradual appearance of much longer legs was connected to the same evolutionary strategy as bipedalism: it was aimed to look as high and visually as impressive as possible.

Not content with already unusually long logs, we (particularly women) try to prolong our legs and increase height by using awkward and sometimes ridiculous high-heel shoes. Our evolutionary fascination with long legged human figures continues – to the joy of the fashion industry.

The mystery of the long head hair

We take for granted that humans have long head hair, often forgetting that it is one of our most defining unique morphological features. Very few scholars have paid attention to this mysterious addition to the human body. Unlike the length of human legs, which is universally considered better when proportionally long, head hair has very different shapes and functions. The cleanly-shaved trendy head of Yul Brynner, Jimi Hendrix's natural afro, the early Beatles mop-top and the highly stylized spike Mohawk hairstyle are only a few of many hairstyle possibilities. Shaping one's hair in a different fashion has many functions, from altering one's physical appearance to the declaration of that person's ethnic, religious, social or cultural identity.

So let us ask a simple question: why did our ancestors develop to grow such large amounts of hair on their heads? This intriguing question has not been granted even a fraction of the scholarly attention in the studies of human evolution as bipedalism has; nevertheless a few very interesting and plausible ideas have been expressed on the topic.

Most importantly, Nina Jablonski suggested that it was evolutionarily advantageous for hominids to retain the hair on their heads in order to protect the skin there as they walked upright under the intense African sun (Jablonski, 2008). Sounds very plausible and convincing, but an unanswered question still remains: why would hominids (or early humans) need to have five-foot long hair to protect just their scalp? Many animals that live under the same burning African sun are doing fine with a few centimetres of non-coiled hair covering their body and the skin on their head. Although Jablonski's idea does explain the presence of hair on the human head, it does not provide an explanation as to the extraordinary length of human head hair. It seems to me quite obvious that long human hair conveys some kind of visual information.

Desmond Morris suggested that overgrown head hair was used as a species-specific morphological sign for hominids, visible from afar (Morris, 2008). This suggestion also has its merits, as recognizing each other is an important element for any animal species. But herein lies another difficult question: why did our ancestors, who had such unique and visually distinctive morphological features such as bipedal

locomotion, need yet another visual sign? Evolution is extremely economical, and if there are no important reasons for it then wasting energy on the growth of huge hair does not seem justified. What I like in Desmond Morris's idea is that it recognizes the importance of long human head hair as a **visual signal**.

To better understand the evolutionary function of human head hair, we need to remember two important facts about it:

(1) If left alone, untrimmed human head hair grows about 1.5 metres long. After this each individual hear falls out and gets replaced. I am specially mentioning this because in most scholarly reconstructions, our hominid ancestors look as if they just have walked out from a hairdresser, and the potentially very important visual signal is absent in these reconstructions.

Also, (2) most likely the initial style of hominid head hair was a tightly coiled bush of hair on top and around the hominid head, very much like the contemporary untrimmed "Afro" style that all peoples of African origin (including pygmies and bushmen) grow naturally. The long hair of our ancestors was not long and wavy like with many contemporary European rock musicians, but was forming a huge ball of hair like Jimi Hendrix.

My suggestion is that the unusually long hominid hair on top of the human head had the same purpose as long legs and the bipedal posture, and this purpose was to look taller. Of course, because of its coiled design, five feet long hair did not add a full five feet to one's body height, but it must have been worth about a foot of increase in body height. An untrimmed Afro hairstyle is several times as big as the diametre of a human head. Therefore, a huge ball of black hair must have been a significant addition to hominid body height. If you have a look at the tall military helmets of Napoleon hussars, or the colourful headdresses of the men of different tribes, you will see the perennial drive to look taller among human warriors.

One more detail – when we measure human height, as a rule we do not include the hair on top of the head. I do not have any objections to this, but when it comes to measuring the height of our distant ancestors, the length of hair must be taken into account in the most serious way, as an extra foot would have added significantly to their relatively short body length, most probably saving the lives of many of our ancestors, and by extension – us, their descendants. For example, if the height of the body of any of our distant ancestors was 130 or 140cm – but when taking into account

the length of their most likely tightly coiled and untrimmed hair, they would have been about 160 or 170cm tall.

Of course, we have to agree with Nina Jablonski that the skin on top of the human head needed protection, and that head hair provided this protection. We may also agree with Desmond Morris that a huge ball of hair would be an effective species-specific visual sign. But I suggest that the primary evolutionary function of extraordinary long and bushy human head hair was connected to the strategically important drive to look taller and visually more impressive in order to intimidate rivals and predators.

Height-weight ratio (HWR)

The use of bipedal posture as a constant mood of locomotion, longer legs and a huge bush of hair on top of the head were a combination of highly effective visual elements, as all these three morphological features drastically increased the height of our distant ancestor.

The weight and height of animal species are naturally connected to each other, and we would expect heavier animals to be taller as well, but this is not always true, and humans are a great example of the deviation from the general correlation.

To be more objective, I would like to introduce a special ratio to quantify the correlation of animal height and weight, the Height-Weight Ratio (HWR). HWR is very easy to calculate – you just need to take the animal height (in centimetres), and divide it by the animal weight (in kilograms). The taller the animal (in relation to its weight) the bigger is the ratio. For example, a large male lion, weighting about 200 kilos, and as tall (with the raised head) as 140 cm, will have the HWR of 0.7 (140:200=0.7). Tigers are longer and heavier than lions, but male lions are taller than tigers (and remember, male lions are more aposematic!), so the height-weight ratio of the tiger is less than of a lion. For example, a large male Siberian tiger weighting 250kg can be as tall as 130cm, so it will have a HWR about 0.52. The African buffalo has the height of an adult human (about 180cm), but its weight is much bigger (up to

a tonne), so a buffalo's HWR will be much lower. For example, a large 180cm tall male buffalo, which weights 800 kilos, will have a HWR of 0.225 (180:800=0.225). The African elephant is the biggest of the land animals, and although it is very tall (males reach up to 4 metres of height), they still retain a low HWR because of their huge weight (up to 10 tonnes). For example, a large male African elephant that is 350cm tall, and is weighing 5000 kilos, will have a HWR of only 0.07. Now for a stark comparison, an adult male human with the height of 180cm, and a weight of 80 kilos, will have a ratio of 180:80=**2.25**. A large male leopard, which weighs about the same as an adult human (80 kilos), and stands (albeit on four legs) at 90 cm, will have a HRW of only about 1.125 (90:80=1.125).

Of course, animals of the same species come in different shapes and sizes just as humans do, so their HWR will have slight but largely negligible differences. A giraffe, for example, can be as tall as 6 metres, with its weight reaching more than 1500 kg. 600cm divided by 1500 kilos will give us 0.4 HWR (understandably higher than elephants). Some light antelopes can have their HWR even higher than humans. For example, the gazelle is about 60cm tall and weighs about 20 kilos, so the resulting HWR will be 3 (higher than humans). A large wolf as tall as 80cm and weighting about 35 kilos will have the HWR of 2.1 (very close to the human HWR of 2.25). In both the cases of the gazelle and the wolf, we have quadrupeds with a very slender body – the low relative weight is possibly connected to achieving a better running efficiency.

Humans, on the other hand, are very poor runners (although there have been some weakly substantiated suggestions they are very good as long distance runners). We have also discussed this topic couple of pages ago and found that possibly the only time they needed to run was when they were rushing to a kill site to claim their share of food.

Of course, such a crude calculation of the height and weight cannot be very reliable, but I believe HWR might still be a useful tool to keep a rough estimate of the correlation in height and weight in different animal species. In any case, we can definitely say that humans have an amazingly tall body for their weight. The average human weight is close to a leopard's weight, but their height is that of an African buffalo's. High HWR is in essence a very important characteristic if an animal needs to look as tall and as impressive as possible. The high HWR that humans possess was

achieved during the human evolution chiefly by three above-mentioned factors (1) bipedal posture, (2) length of legs, and (3) five-foot long tightly coiled head hair. Here I must express my regret for following the tradition of not counting the length of human head hair when counting human height, although I did suggest earlier that untrimmed human head hair must be taken into consideration when overall human height it measured. Having a big ball of hair on the top of the head, a human's HWR understandably would be higher.

Our strive towards a taller body did not vanish in early human prehistory. As I have already mentioned, even today taller people have a wide range of advantages, from receiving less bullying during their school years, all the way to having better chances of winning a political election. With the appearance of clothes, high heel shoes and particularly head-dresses this perennial strive towards taller bodies has obtained an array of new outlets. Tall and more intimidating head-dresses and helmets been widely used in military campaigns, as intimidating enemies is an important psychological factor of any warfare. Tall military helmets, which, apart from the function of defence of the head from different weapons, also serve the purpose to make the wearer look taller and more intimidating to the opponent. Adding horns and other objects to helmets has the same intimidating function. Remember the ridiculously tall headdresses of Napoleon's Hussars and Grenadiers? Or think of the famous terracotta warriors, sculptures depicting the armies of Qin Shi Huang, the first Emperor of China. They all have a special hairstyle (usually by adding some objects to the top of the head) to make them look taller. The tall and colourful head-dresses of the Native Americans, widely used during warfare, is another example of the use of different means to make a warrior seem taller and more intimidating. Sometimes even the hairstyle itself can be shaped to make a person look much taller: the well-known 'Mohawk' hair style, popular among some contemporary Punk demographics, originated from Native American tribal warriors, and has the advantage of greatly increasing the height of the wearer, making them visually much more impressive.

Apart from the height, the very shape of the human body is ideally designed to make the most impressive visual impact. When we stand head-on-head in front of most of the animals, we see the animal's head, its chest, and the front paws. The shape of most quadrupeds is designed to make movement swifter and not for looks,

so the quadruped locomotion helps the animal body to gradually acquire a streamlined shape. The human body is shaped strategically very differently from animals. Human bodies are shaped for taller and more impressive looks, not for the swiftness of movements. Take a matchbox and find the side where it looks the narrowest and shortest, the side that would be the best for the streamlined movement forward. This will be very close to the shape of most of quadrupedal animals. Now turn the matchbox upright and you get a frontal view that has the matchbox at its tallest and widest. This is very close to the shape of our human body in relation to the quadrupeds. Our body has long lower limbs, a solid torso which is stretched upright with wide shoulders facing with their wide flat side forward, and this already tall body is topped with a fully erect head placed on an upwardly-stretched neck, and there is finally the great bush of long head hair on the very top of the head.

If most of the quadruped animal body is shaped horizontally for more economical and swift movement forward, then the human body is shaped vertically in order to make its visual appearance as impressive as possible.

In conclusion, we have plenty of reasons to think that the evolution of human morphology was dominated by the perennial desire to make the human body visually as impressive as possible. Bipedalism, long legs and long and tightly coiled hair were three central factors in looking tall. In a somewhat shameful history of human warfare these three factors were aided by ridiculously tall headdresses and special hairstyles making the appearance of warriors even taller.

But to look tall is not the only way to look impressive. There is one more very important factor that gives a more impressive look. We will be discussing this additional visual signal next:

Colours! More colours!

Have you though why kings and queens as a general rule have such colourful clothes complemented with their shiny crowns? Or why Elvis had such colourful stage costumes? Or why many truck owners in India or the Middle East paint their

trucks like a Christmas tree? Or why we are so impressed by a peacock's train? In all these cases the answer is simple: because bright and brilliant colours are much more attention-grabbing, impressive and beautiful than dull colours, and tend to stand out considerably more. Therefore, if you want to look visually impressive, apart from increasing your size (for example by using a special hairstyle or an exotic headdress, or high heels) also try to use bright colours. This is the chief reason why aposematic animal body parts are often brightly coloured. Think of the brilliant colour schemes of the many venomous snakes, spiders and frogs of the world, such as the bright red colouring of the Central American Granular Poison Frog. You might say that comparing venomous snakes and spiders to members of the royal family and rock stars is not acceptable, but why not? Being visually impressive is as important for many animal species in their survival as it is for certain humans who want to make their social status and exclusiveness clearly evident. In evolutionary terms and reasoning, "impressive" means "useful." In human terms and reasoning, "impressive" means "beautiful."

"So what…" a reader might ask, "…human bodies are not colourful, so the display of colours has nothing to do with human evolutionary history!" This might seem correct at a first look, but do not jump to any conclusions. Unlike our closest living relatives, the extant apes, human ancestors were using various methods of aposematic display for millions of years, and despite naturally being deprived of the shiny colours that snakes, spiders and peacocks have in abundance, they still found ways with which to produce a stunning display of colours. In the next few sections I will argue that humans have two very different ways to achieve colours: (1) the natural way, which historically came much earlier (and was less effective), and (2) the cultural way, which came around later and is much more effective.

Colours of shame and rage

Have you even seen the face of any of your friends or relatives after they were ridiculed or offended, or were just possibly in an awkward situation? If you have a memory of such an unpleasant incident, you might also remember that in that

moment the face you knew all too well suddenly changed colour and became red. We all know this phenomenon as 'blushing'. Some blush more and some less. Some people even complain that people do not blush today as much as they used to blush before, and attribute this to the gradual decline of morality in contemporary society.

I do not know whether you yourself blush sometimes, or what your attitude is towards blushing, but if we are going to discuss human colour changes we definitely need to start with a few words about blushing, or the general reddening of the face in some awkward or conflicting situations.

There are two related, although caused by somehow different psychological mechanisms, conditions known as blushing and flushing. *Blushing* as a rule is related to embarrassment and *flushing* is generally caused by a rage. Reddening caused by flushing is more prominent than what is caused by blushing and also involves a larger surface area of the human body than blushing. To some readers it might seem that blushing is just a natural by-product of more active blood circulation, but in fact the reddening of skin is quite a complex phenomenon, involving morphological and physiological mechanisms from parts of our skin. We are not going to discuss face reddening caused by the use of alcohol and other substances.

The experience of blushing might cause distress - there are even people who seek professional help to fight their uncontrolled blushing. This help ranges from psychological advice to actual surgery (the surgical operation to stop blushing is apparently known as "endoscopic transthoracic sympathectomy").

Cross-cultural evidence shows that blushing (and flushing) is a universal trait of human physiology and its visibility directly depends on the bearer's skin colour. Interestingly enough, with people of a darker complexion the increased blood circulation causes their colour to get darker rather than becoming red.

In "The Expression of the Emotions in Man and Animals" Darwin mentioned blushing as 'the most peculiar and most human of all expressions' (1871:310). As a uniquely observant person, Darwin paid attention to blushing much earlier, in 1838, when he was 29, by making entries on blushing in one of his notebooks. So what reason can be behind the phenomenon of blushing and flushing? Possibly blushing is an honest signal because it cannot be controlled? Possibly, but be careful – due to the psychological scope of blushing, even a bluff question such as "why are you blushing" to a non-blushing person can also result in real blushing – a wrong

accusation can cause an innocent person to blush and consequently lead to a wrong judgment.

Darwin's question as to whether blushing is a uniquely human behaviour still remains open. As recently as 2010, in a special article dedicated to blushing (Crozier, 2010), the author asked the same unanswered question: "Is it the case that it is a uniquely human expression?"

There are definitely plenty of animal species that do change colours for various reasons – but are these colour changes relevant to our discussion? In many cases there are no connections between these animals and our species, and also no connections between the behaviour patterns of these animals and humans. For example, we cannot consider human blushing and a chameleon's colour changing as related phenomena, simply because chameleons do not change colours because of excitement. A squid's ability to drop colours and create a "ghost copy" is also very close to the chameleon's "vanishing" technique. On the other hand, a sailfish changes colours depending on the situation and mood. Interestingly enough with the sailfish, brighter colours appear in more aggressive situations. For example, when attacking prey, a sailfish's body becomes light blue with yellowish stripes. Another example of mood-related colour change is turkey. A turkey's head turns red when they are excited and ready to fight – there are some functional parallels here between turkeys and humans, particularly with flushing (reddening of face and skin in a conflict situation). Despite the similarity, the closest parallel to human blushing probably comes from a certain primate – the mandrill. Mandrills are the most colourful (and arguably the biggest) of the monkey family and their spectacularly bright face's colours intensify when excited or angry, very much like humans.

I therefore suggest that the change of colours, and particularly gaining a red colouration when excited or angry, is not a uniquely human behaviour. It is present in several unrelated animal species. Of course, it is unlikely that any of the animal species are blushing as a result of embarrassment, but human face reddening because of embarrassing situations is very likely a late development. A more pronounced reddening of the human face, known as flushing, is connected to strong negative emotions and is most likely the ancestor of our embarrassment-related blushing. Flushing is often present when humans are in a rage, and as a general rule flushing is present before humans resort to physical violence.

When discussing the reddening of face it is also important to note that the colour red, the most popular colour used by different animals to indicate emotions of rage and hostility, and as a result is the most widely used colour in warning and intimidation displays. I therefore suggest that blushing among our ancestors was in effect communicating the anger and readiness to behave aggressively if not left alone. It seems plausible to propose that blushing and flushing, as with most other aposematic signals, were designed by the forces of natural selection in order to warn antagonists and predators to stay away and as a result, avoid any unnecessary physical violence.

A change of colours can communicate very different messages and can serve different strategies and purposes. A sudden change of colour can be a cryptic move, aiming to make the animal unnoticeable, such as in the cases of the chameleon and the squid. On the other hand, colour changes can be used to make an animal more visually conspicuous and impressive – this is aposematic use of colours. In sailfish, turkeys, mandrills and humans, the quick change of colours is doing exactly this.

If we have a wider look in virtually all cases of colour changes, both cryptic or aposematic, they serve the same evolutionary function of survival of the species through avoidance of unwanted physical confrontations and injuries.

As we have discussed, blushing can redden our face and can certainly indicate changes in our mood, but apart from this naturally occurring reddening of the face our ancestors found much more effective means to alter their face and body colours in the most drastic possible ways.

How old is the tradition of body painting?

If you Google “body painting”, you will find an amazing variety of sites with plenty of artists, body painting patterns, and body painting festivals. Body painting is certainly a popular part of contemporary western culture, but its popularity is not exclusive only to the Western World. **Body painting, like music and dance, is a universal trait of human culture**. No human culture is known to be completely free

of body painting. For many tribes body painting is an important part of their identity. Body painting in many traditional societies also signifies the status of a person or the moment of life they are experiencing – it also constitutes a very important part of initiation ceremonies in many parts of the world. Body painting was an important ritual for men going into a hunting session or to war. Women were also tattooed. Many readers of this book may also have some tattoos on their body. Apart from permanent body painting, like tattoos, there are many more temporary body paintings in use. Using a lipstick or an eyeliner pencil is so widespread that hardly anyone would consider them to be in the same category as body painting.

So how far back exactly does the tradition of human body painting go?

Plenty of people know about the amazing paintings on the walls of the caves in Southern Europe, and possibly believe that these are the earliest paintings in the human history of arts. In an interesting twist, hundreds of thousands of years before the estimated appearance of the first cave paintings, our ancestors were already using colouring materials – such materials have been found at several archaeological sites, although scholars have never found paintings of such an ancient age. The most likely explanation to this riddle (and one you can see coming by now) is that the first paintings were in fact done on their own human bodies. I am by no means the first or only person to suggest this. Some readers of this book, particularly the lovers of tattooing, may very well know already that body painting is most probably the earliest form of human art. Also, see for examples the following sentence: "Stone nodules containing mineral manganese dioxide, which has been scrapped with stone tools, have been found at several Neanderthal sites… As the Neanderthals have left no traces of pigment on cave walls or artefacts, the most likely explanation is body painting" (Mithen, 2005:230).

Well, even if we agree that the earliest use of painting materials was to paint bodies, why were the bodies painted in the first place?

Of course, just as everything else in human evolutionary history can be, body painting can also be explained by the ubiquitous sexual selection model via the famed female choice. "Humans started using body painting as they were competing with each other for females so beautifying their bodies was a part of their strategy designed to get female attention." This is not a citation, I just made this sentence up to generalise a certain viewpoint, but you can agree it sounds quite plausible to a

degree. The only problem with this approach is that, according to this model, the only problem that our ancestors had when they descended from the trees to ground was how to attract choosy females, as if they had never before experienced problems such as defending from predators or finding food. If you seek an alternative explanation for the tradition of body painting you do not need to go very far. We have already discussed how the strive to become more visually impressive became strategically paramount to our early ancestors. In other words, any physiological or behavioural changes that led hominids to acquire more impressive look (like bipedalism, long legs, long hair, blushing, or body painting) was giving certain hominid groups better chances of survival by intimidating predators and competitors more effectively. This approach places natural selection, not sexual selection via female choice, as the main driving force behind the tradition of body painting.

Scholars often complain that it is impossible to find artefacts of human artistic activity in archaeological records. Unlike vocal music, dance and language, which do not fossilize, there is a unique opportunity to have a glimpse into the artistic roots of body painting via archaeological records. I am talking about the remains of colouring substances most likely used for body painting.

According to the recent article in the Proceedings of the National Academy of Sciences of the United States of America, the use of the most popular and most enduring colouring substance – red ochre has been in use "minimally" for 200-250 kya (kya = 1000 years) (Roebroeks et al., 2012; see also Bednarik, 1997). The users in this case were European Neanderthals, locked behind the ice sheets of ice age Europe. The use of painting substances among Neanderthals was doubted by scholars for decades, but growing evidence suggests that painting was widely used in isolated Europe much earlier than the appearance of anatomically modern Cro-Magnons. Here is an excerpt from the conclusions of the article: "Identification of the Maastricht-Belvédère finds as hematite pushes the use of red ochre by (early) Neanderthals back in time significantly, to minimally 200–250 kya (i.e., to the same time range as the early ochre use in the African record)" (Roebroeks et al., 2012). There are some indications that even *Homo heidelbergensis,* a much earlier, taller and muscular ancestor of the *Homo neanderthalensis* who lived in Europe 600-300 thousand years ago, also used the red ochre for about 400 kya. This evidence, although not universally accepted, comes from the Terra Amata site.

Let us now ask a very important question: is it possible that our ancestors used any other substances before their use of red ochre? I am talking about temporary substances that our ancestors could use to paint themselves before they found and started using durable substances like red ochre. The idea that colouring faces and bodies started long before the use of durable materials is not only plausible, but virtually unavoidable. What materials are we talking about? We are talking about readily available colouring substances, like some colourful berries, clay, even earth, and above all, the liquid of life – blood.

Colour of blood: The colour of life and death

It is difficult to find any other substance or object laden with so much symbolic meanings as blood. Blood is a universal symbol of life and death, a symbol of strength and relatedness, and a centrepiece of the mystery of sacrificial rituals and religion. Many of these symbolic (and real) meanings of blood came from the depth of human prehistory, and were possibly better known to our ancestors than to us. Unlike our ancestors, we mostly encounter fake blood only when watching action or horror movies. Our ancestors could, day-by-day, see how blood was coming out of a body, leading to the death of people or animals. Although I do not want to elaborate on this bottomless subject, I still want to mention to the reader a recurring scene I remember very vividly from my fieldworks throughout the 1980s in the Caucasian mountains. It is the scene of the village elder holding a blood-stained dagger in his hand, drawing red crosses with blood on the foreheads of goats and cattle during religious rituals before sacrificing them to the deities and throwing their severed heads and headless bodies downhill. They consider themselves Christians, but the older-than-Christianity roots of these blood-rich rituals are very obvious. Cutting arms by adult unrelated males and mixing blood as a symbol of becoming 'blood brothers' is another widely known blood-related symbolic tradition in human cultures. It is also not accidental that the colour of blood, red, is by far the most popular colour used in national flags of the world.

I propose that blood, a highly effective colouring substance, widely available to our ancestors, was the very first colouring substance in the history of human art. The very first artistic creations (painted bodies and faces) were done most likely using blood. Red ochre, the earliest and the most popular durable painting substance in the history of human art, most likely substituted the use of real blood in history of body painting largely due to its resemblance to real blood. Among Indigenous Australians for example, in the most secret and sacred male ceremonies participants would extract blood from their veins, exchange it between participants and paint their bodies with it, however in less secret rituals blood was substituted by the red ochre (Lawlor, 1991:102-103). The term "blessing" actually comes from the old English term *blóedsian* which denoted the sprinkling of the blood of sacrificed animals. As the tradition of the Eucharist goes, the wine actually becomes the blood of Jesus for the worshippers to drink. Interestingly, at the Council of Jerusalem (about 50 CE) the apostles strictly prohibited Christians from consuming even a small quantity of blood. On the other hand worshippers were supposed to drink Jesus' blood in the mystery of Eucharist.

This deep symbolic importance of blood and the colour red in the animal world definitely comes from much earlier times than the origin of humans. Used in countless species of insects and reptiles, red is the leading colour for warning and intimidating visual signals. The most venomous amphibians and insects are often coloured in bright red. There could be several reasons for such importance in the colour red for warning display:

(1) Red is the opposite colour of green, thereby making it the most contrasting colour against green tree foliage;

(2) By showing a red colour (colour of blood) an animal was possibly declaring it is ready to fight till the death;

(3) Possibly the red colour was working as a reminder to the opponent of its own blood and death;

(4) And finally, it is also possible that all of these factors were contributing to the strengthening of the message of the colour red as the ultimate warning colour of aposematic display.

The aposematic importance and qualities of body painting are quite obvious. Most tribal warriors, before they went into the battle, decorated their bodies with colourful paintings. Of course showing their allegiance to their tribes was an important part of these decorations, but another, possibly earlier function of the colourful display was to intimidate the enemy with colourful paintings and upsized additions to the warrior's body. One more important function of body painting, which we will discuss in detail in later chapters, was achieving a psychological unity between the warriors, reaching a specific "battle trance" where they were losing their individuality and were religiously dedicating themselves to the best interests of the group, up to the point that group interests were overriding the instincts of self-survival, making individual fighters ready to sacrifice their lives for a common goal.

In conclusion, I suggest that our early hominid ancestors, in a bid to look more aggressive and intimidating, apart from standing upright on long legs, sporting a huge ball of hair and making various sounds (which we will discuss soon in the audio section), were also colouring their bodies with different substances, primarily using red blood. When the red ochre was discovered, it became popular chiefly because of its close resemblance to blood, the symbol of life, strength and relatedness.

We naturally cannot answer the question of when our ancestors started using colouring substances, but we can safely say that the moment when one of our ancestors deliberately painted part of his/her body with fresh blood was the beginning of long and fruitful human artistic career. Also, it seems natural and even inevitable to propose that this must have happened much earlier than the first use of red ochre and manganese dioxide as painting substances.

The human body painted with fresh blood was possibly the first artefact of human creativity.

Clothes: For cold or for show?

Many readers would agree that the most effective means to change one's appearance is the use of clothes, or when put more broadly the use of external subjects covering one's body. We look out of the window to see the weather

conditions and accordingly decide which clothes we should put on. Choosing clothes also depends on what occasion we are going out for, for example for shopping, swimming, work, going to the theatre, or going to a wedding. Choosing clothes also depends on some other factors, for example what transport we will be using – walking, public transport, or a private auto. Our ancestors did not have as many different occasions and activities as we do today, and they hardly had anything more than the odd piece of animal skin to cover their bodies with. The reasons and possible timelines of the first use of crude animal skin as cover by our ancestors is the central subject of our discussion in this section.

Clothes have gradually become a universal element of human culture, generating multi-billion dollar industries containing the production of fabrics in the factories all the way to fashion shows, models, and colourful magazines.

The question of when exactly clothes appeared in human history is far from being settled. Many scholars agree that animal skins and some other ready-made objects provided the first clothing for our ancestors. Scholars also largely agree that the study of the human body louse (more commonly known in its plural form: lice) is possibly the best way to study the appearance of clothing in human history. The reason for this is that human body hair cover is too scarce to sustain a steady louse population, so the use of clothes, or more precisely and importantly closely fitting clothes, is needed to sustain the lice. Scholars did genetic studies on human body lice, ultimately calculating the time that elapsed after human lice separated from its closest relatives, and then calculated the time separating the emergence of body lice from head lice.

According to the DNA study on human body lice, humans started using clothes about 100 000 years ago. For example, group of scholars from the Mark Plank institute (Ralf Kittler, Manfred Kayser, and Mark Stoneking) came to the conclusion that clothes appeared in our evolution together with the appearance of anatomically modern humans, giving a relatively precise date of 107,000 years ago (Kittler at al., 2003).

We should not forget that scholars in this publication are discussing the origins of closely-fitting clothes only. Regarding the timelines of the origins of loosely-covering clothes in human prehistory, we can only have a guess. The first clothes used were most likely animal skins, and their use was not connected to the

appearance of lice, there is therefore no reliable method discovered thus far to find out more on the timeline of their appearance. At best we can only assert that the use of loosely-covering animal skins must be considerably older than that of closely-fitting clothes.

Let us now try to understand the most important functional question for our discussion: what was the primary reason for using the most ancient body cover (animal skins) by our ancestors.

The traditional approach to the origins of clothes is that they give protection from cold weather and other elements of nature. This explanation naturally feels correct, as we can hardly imagine our seasonal lives without different clothes covering our bodies, particularly when it is cold or raining (like at the moment of writing these words during an unusually cold Melbourne winter). And besides, what else could our ancestors have gained from wearing clothes?

Well, I propose that the initial use of clothes could have served three important functions. I will now discuss those three functions, all of them designed by the forces of natural selection to assist in the survival of our ancestors in confrontations against the predators (including the ancestors of lions), in aggressive scavenging situations, and also during possible conflict with other hominid groups:

(1) **Visual intimidation** based on the effect of unusual appearance.

Animals with a changing visual appearance as a rule trigger neophobia (fear/distrust of animals or food with an unusual appearance) in predators, and as a result are more likely to be left alone (unless, as we discussed earlier, the predator is too hungry);

(2) **Deflection** in case of a predator attack.

In the critical moments of a scavenging confrontation, if the hominids' audio-visual intimidation was not working and the lion went into a real attack, hominids and early humans could throw their loosely covering animal skins at the attacking lion. Such a simple and seemingly ineffective action can save lives, as it can break the big cat's attack and allow time for defensive action. For example, when the legendary Jim Corbett was filming wild tigers from a dangerously close range (up to five feet) he used to take a small pillow just in case any of the tigers attacked him.

Throwing a pillow at the attacking tiger (or lion) might seem crazy and pointless, but it can break the attack and give some time for counter measures. Corbett biographer D.C Kala also provided some interesting information on this account. According to Kala, Corbett "on occasions did use his hat to break the charge of a wounded animal in high grass. He found the method useful" (Kala, 2009:71).

(3) **Psychological transformation** of those who were going to challenge the or lion pride (or fight against other hominid groups) and chase big cats from their own kill.

It is well known that changing your outfit can tremendously affect your state of mind. You feel very different in your casual home robe, your office suit, your hiking gear, or your military uniform. Traditional societies, as a rule, had special details and features added onto their outfits when they were about to go into a military campaign or out on a hunt.

Besides, we have only mentioned, but have not yet discussed, a specific altered state of consciousness which I call the *battle trance*, one where humans do not feel fear or pain (Jordania, 2009, 2011, 2011a). This state can be induced by rhythmic drumming, singing, stamping, dancing, as well as by changing the appearance of the participants, a method that helps in obtaining another, group identity. This change of appearance was done by the use of body and face painting, as well as with the use of specific clothes.

I suggest that these groups of hominids and early humans, who were loosely covering themselves with animal hides during scavenging confrontations, would have been more successful with their unusual appearance than other, naked groups. I suggest that these three factors (visual intimidation, deflection, and psychological transformation) were crucial for the early establishment of the use of clothing in human prehistory.

My suggestions on the visual and psychological importance of early clothing do not necessarily contradict the traditional idea of clothing being a defence from weather conditions. I hope we can all agree that clothes could have served both of these functions in human prehistory simultaneously, as they do today. I however still maintain that the intimidation and psychological transformation was the earlier and

primary function for the early emergence of clothing, and that the weather factor came later. Let me explain:

There is a very important difference between these two possible functions of clothes (visual-psychological and cold weather). Clothes as a defence from the cold weather would have become important only after our ancestors moved to other geographical areas with colder climates. On the other hand, clothes as a part of an intimidating strategy would be beneficial from the moment our ancestors descended from the trees onto the ground, a time when our ancestors were still living under the hot African sun. They needed to employ all possible means to better intimidate predators and other human groups as soon as they were down on the more open, competitive ground. Let us all recall the traditional visual appearance of some African tribes living in the hot conditions of equatorial Africa. They spent most of their time without much clothing (as humans do not really need clothes in hot conditions), but when they were preparing to scavenge lion kills, or for warfare, they were putting on visually "screaming" clothing accessories, like tall headdresses and other light but colourful details of outfit. These tall headdresses and colourful pieces of clothing were not designed for defence from the elements or from predators – they were solely designed to make the hunters' and warriors' visual appearance more colourful, more attention-grabbing, and thus more effective. The well-known fondness and fascination among tribal societies for cheap jewellery, has a long evolutionary history.

I therefore propose that our distant ancestors started using clothing items initially for increasing their apparent size and visual representation during confrontations with predators and other competitors. It was only later that they had moved out from sunny Africa to other areas with colder conditions, ensuring that clothes became important also as life-saving protection against the cold weather and other elements. Therefore, the closely fitting clothes were most likely a result of requiring weather protection. When I was discussing the possible function of deflection by throwing animal skin at attacking lions, one more point came to mind: The earliest loosely-covering clothing was arguably more convenient for this purpose than the later, closely-fitting clothes that gave our ancestors warmth and the breeding populations of body lice.

I propose that the earliest style clothing, loosely covering body animal skins, appeared while our distant ancestors were still living under the hot African sun. The initial function for human clothing was for an effective appearance rather than defence from the elements (I think many fashion designers would be happy to hear this). Later, when archaic humans moved out of Africa to colder environments, the function of clothes changed and the defence from cold weather became an important and eventually leading function of clothing. Therefore, the appearance of closely fitting clothes (and as a result, the uninvited companionship of body lice) must be connected with the later stage of human evolution after our African ancestors had moved from sunny Africa to much colder regions of the world.

Behind the mask

Last but not least, we need to discuss at least briefly the ultimate way to change and conceal the identity of a person: the use of masks. The use of the body painting and clothes can definitely change the appearance of a person, but possibly the ultimate way to conceal oneself is to wear a mask. In many societies, a mask (which was traditionally designed as a device that covers a human face only) was used together with other materials which would cover the whole body of the masked person.

Like the tradition of body painting or the use of clothes, a mask is a virtually universal part of human cultures across all continents. From the members of isolated tribes from the Amazon rainforest and the masquerades of West African tribes, to the masked carnivals of ancient Rome and Venice, contemporary carnivals of Brazil and the masked parties at Halloween in western countries, humans use masks for various reasons: for ritual practices, for theatrical performances, for medical protection against viruses and hazardous substances, for concealing identity of both criminals and law enforcement agents, and for various sporting games. Masks may depict animals, gods, spirits, ancestors, mythic dragons; they can be funny but they can be also extremely scary (some horror movies are coming to mind). Masks universally maintain their power and mystery for both their wearers and their viewers.

And of course, very importantly for the subject of our discussion, masks were and still are widely used in combat situations, by gladiators in ancient Rome, by Japanese Samurai, by professional wrestlers on American TV, and by special combat forces, to mention only a few. As some readers may have already guessed (and some possibly noticed before reading this), many of these masks, particularly those designed for combatants, apart from protecting the face and head of the combatant, were also serving the function of intimidating their opponent. Apart from this, masks possess possibly the greatest power to change the wearer's identity and alter the wearer's psychology. In many cultures the ritual wearing of masks is believed to transform a wearer into an animal (or a god, or a spirit, or a predatory beast). Masks can free humans from the boundaries of culturally expected norms and behaviours. Oscar Wilde once said, "Give a man a mask, and he'll tell you the truth." When Bob Dylan wanted to perform some of his most personal songs, he was putting masks on his face. When we are covering our faces with masks, we are possibly freeing ourselves from the lifelong mask of culturally expected norms of behaviour that we live with perennially.

Regarding the origins of the tradition of the use of masks, we do not have such indicators from human prehistory as, for example, the presence of red ochre for the study of body painting, or the emergence of human body lice for the study of the origins of clothes. On the other hand, the universality of masks in human cultures and its continuing emotional strength on humans from very different cultural backgrounds suggests that masks must have been a very ancient development – they were possibly even part of the original set of cultural traditions that our human ancestors took from their African cradle.

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With the discussion on the evolutionary reasons for bipedalism, long legs, long and tightly coiled head hair, blushing, body painting, clothes and the use of masks we have finished our discussion on the visual elements of the intimidating displays of hominids and early humans. We can agree that our distant ancestors had an array of techniques with which to make their appearance more impressive – and more

intimidating to rivals and predators. We are now going to discuss the audio signals that were used by our ancestors in order to intimidate predators and competitors.

Audio Aposematic Signals

For some reason audio warning signals were not as readily noticed by scholars of the theory of evolution as visual signals were, but we must stress that audio signals are no less important for aposematic display than visual signals.

A reader might remember my claim from the earlier parts of this book that humans are possibly the noisiest species on our planet. We make plenty of sounds, and we love to hear lots of sounds around us. Although we often complain that we are tired of noise and crave silence, absolute silence is unbearable to us. This is the reason for the scenario you can find in many contemporary human households, in which a TV or radio is switched on although no one is actually watching or listening. This hatred of silence is also the reason why we start talking to ourselves when we are alone.

Throughout our lives we sing, talk, play musical instruments and listen to iPods, CDs, TV, and radio. We move body parts and dance under loud dance music; we take part in noisy religious rituals. In some cultures we even feel awkward to spend a few seconds together with other humans without talking to them. Of course, it would be naïve to think that we became such a noisy and chatty species only recently – we have been noisy since very far back in our evolutionary past. For example, we may remember that we are a unique species because we are the only terrestrial species who sings (new research suggests the male mouse might be another unique species with complex vocal apparatus and the ability to sing and learn new melodies - see Goldman, 2012). We are also a unique species within the animal kingdom as we have a sense of rhythm and can be entrained in group rhythmic chorusing and dancing. For our four legged friends, pet dogs and cats, we must be quite exhausting due to our constant noise output, both mechanical and human. It is no accident that we have, over time, made our domesticated animal friends more vocal than their wild counterparts.

Humans love making and listening to sounds, and we will have plenty of things to discuss in this "audio" section as the primary expertise of the author of this book is that of human choral singing - so let us get ready for a long and noisy discussion.

The very first thing we will be discussing regarding the noisiest species of our planet is... silence!

Silent killer

Let me ask you a simple question: How long do you think you could you stay in a totally silent and dark room for the sake of a scientific experiment and possibly some reward? Could you stay for a couple of hours? More? Or possibly just until you get too hungry or thirsty? What if you are given food and water as well – could you last for a couple of days, even weeks?

The answer to this question is quite precise: even the toughest humans can withstand total silence for only up to 30 minutes. Most participants ask to stop the experiment after only 5-10 minutes. Such an experiment had been organised for a few years by the personnel of the famous recording studio, the Sound 80 Studio in the Orfield Labs in Minneapolis. Guinness book of records mentions this recording studio for two of its characteristics, (1) as the quietest place on earth, and (2) as the oldest digital recording studio in the World. Bob Dylan famously recorded half of the songs for one of his best albums, 1975's "Blood on the tracks", in this studio. The album's lyrics are mostly about loneliness and heartache, and there is possibly no better place on earth to give you a true feeling of what loneliness is than the studio in Minneapolis – the quietest place in the world.

"Experiment" is actually a very strong word for the informal and friendly wager that the Orfield Labs employees were organizing for a number of years for volunteers. The conditions of the game did not seem too difficult, as one only had to spend 45 minutes alone in the studio. There was also a trophy for the successful contestant – a crate of beer.

If the conditions seem to you not so difficult, you should know that despite the great number of volunteers, not a single contestant lasted more than 30 minutes. If you think you could have done any better, you are probably mistaken. Most tellingly, you should know that the "experiment" was banned in 2011, after one of the attempts ended up like a scene from a horror movie. After staying in the closed studio for an

impressive 26 minutes, a contestant emerged from the studio, to the shock and horror of everyone, bleeding. Apparently, he had started biting his left hand.

What the hell could be happening in a closed and totally silent and dark studio without any real danger to drive a contestant to such an insane and horrible outcome? Nothing supernatural. However, something strange happens as soon as a person is left in a total silence. All the sounds of our body that we do not usually hear, such as heartbeat, breathing and the movements of eyelids increase and keep increasing until they are akin to a train passing by your bedroom window. Apart from this, in total silence ears start to generate sounds, like ringing. We soon lose our feel of space and orientation, lose balance, start hallucinating, and most importantly, a terrifying panic attack gradually overwhelms us.

So, the next time you hear complaints about the inhuman conditions of inmates sitting in an isolated prison cell, you should know that these are in no way exaggerated. Total silence is one of the worst things that can happen to a human being. Of course, no prison cell is built as a sound proof recording studio thankfully, but being in a relatively silent place for a long time is still devastating for the human psyche.

We can survive without food for about 2-4 weeks, we can survive without water for a few days, but we cannot survive without noise for even half an hour. Only our need for breathing fresh air is more urgent that our need to hear sounds around us.

This is the first most important thing I would like the readers of this book to remember: humans are not built to withstand silence. Silence is a killer – In total silence we literally go crazy, start hallucinating and can end up gravely damaging our body like the poor fellow who started biting his own hand out of desperation. In the next section we are going to discuss what evolutionary reasons could have designed such a strong human dependence on constant sounds.

Avoiding silence – the mystery of contact calls

Many social animals make constant sounds when they are in a group. These are not special calls, but rather haphazard sounds accompanying their everyday business,

for example, foraging. Chickens make clucks, baboons make soft barks, wildebeest make grunting sounds, and wild horse and cattle herds also make clearly heard, random and seemingly pointless sounds. Charles Darwin was the first to notice that some herd animals were communicating danger to each other without actually making any alarm call. He wrote in his 1871 book: "Wild horse and cattle do not, I believe, make any danger-signal; but the attitude of any one of them who first discovers an enemy, warns the others" (Darwin, 2004:123). Darwin did not explain what kind of "attitude" he was referring to – so what could it be? It is of silence. In a herd of constantly grunting, clucking, and snorting animals, when one of the herd animals notices any sign of potential danger, instead of giving an alarm call the animal stops moving or making sounds, keeps silent, and keeps looking in the direction of the potential danger. Neighbouring animals quickly realize that someone next to them has stopped making noise, and they follow the first animal by stopping and carefully watching in the same direction. This spreads like a chain reaction and within a few seconds the whole herd is silent and peering in the direction of the potential danger.

Schaller noticed how wildebeest communicated to each-other about danger in the form of their mortal enemy, the lion, using silence: "Wildebeest may stop their incessant grunting when a lion approaches, thereby creating an area of silence which is as effective a stimulus contrast as an alarm call, particularly at night... There is no difference in behaviour toward a lean or gorged lion" (Schaller, 1972:234). In this case also, the signal of danger that is communicated upon the appearance of a lion is silence.

So, seemingly haphazard background sounds that are heard when social animals are going on with their everyday business is not really the "unnecessary audio luggage" of a social animal's groups. These sounds are apparently an extremely important and interesting phenomenon. These sounds are known to scholars under the term "contact calls." Contact calls have two very important functions:

(1) When social animals hear these background sounds they know that they are among their kin and that there are no predators and other dangers around – they can relax;

(2) Social animals can communicate the signal of danger by stopping making contact calls. "Hearing" silence around instinctively means danger for many social animals.

The same phenomenon is well known to some bird species. For example, according to Wickler, "in some species of babblers, one member of the group remains perched above the ground with the rest of the group feeding below. After some time, the individual is replaced by another group member who will take over the role as the sentinel. Coordination of vigilance is regulated acoustically: about every five seconds the sentinel produces a low-pitched, short range, and difficult to locate call, the watchman's song, which informs others that the individual is watchful and that nothing has happened" (Wickler, 1985; cited from Uster and Zuberbuhler, 2001:754). When the birds can hear the "watchman's song", they know that there is no danger around – but as soon as the sentinel notices a danger, it stops producing the song. Foraging birds produce and receive the signal of danger without making or hearing an alarm call, instead using an "alarming silence."

Remember this profoundly important note: **for social animals, silence is a sign of danger**.

Humans, as we know too well, are highly social animals. The millions of years of interdependence between group members for survival created a firm connection between hearing noise emanating from group members and a feeling of relaxation. Just like it is with other social animals, for humans silence is also an instinctive sign of danger - this is the reason we cannot stand silence, the reason many of us start talking to ourselves when we are alone, and the reason we commonly have TV and radio on although no one is watching or listening. Although we know that we are safe at home behind closed doors, or in the historical recording studio where Bob Dylan recorded some of his best songs, we are still overtaken by a panic attack.

Let us now ask a different question: do humans have any special sounds that could work as contact calls? I believe we do.

Humming as contact calls

As we all know, humans can hum. This vocal behaviour is so ubiquitous and so natural that, as often is the case, we largely fail to notice it. According to the results of my preliminary searches, there are no scholarly publications discussing this particular universal element of human musicality.

So, let me ask a few "humming" questions – Why do humans hum? When do humans hum? And most importantly for us: could humming have (or had) any adaptive value in human or hominid life?

Of course, there is always at least a theoretical possibility that there are some humans who have never hummed in their lives, but it would be quite safe to say that most humans hum at least occasionally, and that there are also a few who hum almost constantly. As far as I remember, my late father was from the latter category. He was humming while reading the newspaper, walking, thinking, playing chess and even while eating. As Bernadette, a 14-year-old student from Mercy College in Melbourne told me, she hums during almost every activity. "But of course, I cannot hum at school during my classes," she told me with regret, "as it would be embarrassing… So when I am attending classes, I only hum in my head" (from a conversation on May 30th, 2008). I am sure Bernadette is not unique among humans in her love of humming and her frustration at not being able to hum in as many situations as she would like to. Jeff Titon, a prominent American ethnomusicologist, answering my question if he ever hums, told me that he does, although he only hums in his head (personal communication from October 25th, 2007). I guess the reason for this kind of "silent humming" or "singing in your head" is largely drawn from a concern for the etiquette of behaviour in human society. Another prominent American ethnomusicologist, Tim Rice, also belongs to the category of people who hum most of the time. "When he is at home, he is usually humming, whatever he is doing." His wife Ann tells me. "One day he came back from the University and I noticed right away he was not humming. I immediately guessed something was wrong. I asked him and he said they had had a very unpleasant meeting at the faculty. After about an hour I heard him humming again, and I guessed with relief that he was over it and was feeling fine again" (from a conversation on February 14th, 2008).

There is no need to discuss the many cases of people humming when they're feeling good – the readers of this book would know this very well for themselves. Some might even be humming reading these words. It is not so easy though to notice when we are humming, as with most of us humming is more of an unconscious behaviour. An informal survey conducted by London Zoo (with only 450 participants) in March 2008 found out that 67.7% of people hum when they feel very good. People hum along when listening to music, walking, driving a car, even hum while eating (so my father is not alone), and one even when having sex (Humming makes you happy, 2008). The uniting feature for all these activities is that all these are generally pleasant activities.

Humming can also be used to induce negative feelings. As one of my students confessed "I sometimes hum to annoy my older brother…" The same London zoo survey found out that humming by others can also annoy listeners (important detail: particularly if humming is out of tune).

"Humming" or "humming alone" in colloquial English means "everything is going very well", so the phrases like "keep your refrigerator humming" or "Keep your system humming" (from the ads of mechanical services on the Web), or "Apple keeps humming" (the title of an article about a particularly successful year for the Apple Company) are understood by readers without any trouble. Humming was routinely used instead of clapping as a sign of public approval of a performance or statement in Britain up until the 18th century. In contemporary British slang though, humming can have negative connotations (e.g., "That is humming" means "that smells bad"), but generally the positive meaning of "humming" cross-culturally is overwhelming. You might have noticed how often we use the hum "uh-huh" or "mmhmm" when talking to each other (particularly on the phone) to convey our agreement and approval to the person on the other end of the phone.

Whistling, finger drumming, teeth drumming and musical worms

Whistling is another very interesting and similarly neglected universal human behaviour that is often used with the same symbolic meaning as humming. "Whistle

a happy tune" is not only a well-known phrase from the musical "King and I," it is an important psychological tool in order to feel more confident and improve your life. Saying "whistling in the dark" is a well-known phrase implying that whistling has the positive power of improving the mood of a person who is in an uncertain situation.

Whistling in many cultures is considered to bring a bad luck, evil spirits, snakes, and other undesired visitors, but the desire of many fellow humans to whistle seems to be another means to avoid loneliness and killer silence.

Still another interesting means to avoid silence and be engaged with music is finger tapping. My professor Grigol Chkhikvadze was known among colleagues for almost constantly drumming his fingers. Well, drumming with fingers is considered a bad habit and some workplace manuals prohibit this, citing it as a rude way to tell someone you are bored and not interested. Possibly a more interesting and more widespread way of drumming is teeth-drumming, or playing various rhythms by your own teeth. The big difference from other forms of drumming is that teeth-drumming is mostly heard to the player only, therefore it is socially more acceptable. If a proper study is conducted we may very well find out that teeth-drumming is the most widespread form of drumming. Dave Grohl (former drummer of Nirvana and later front-man of Foo Fighters) does not seem to be the only teeth-drummer among famous rock drummers. Ringo Starr, who was known for his constant drumming on any available subjects from his early childhood, is most likely to be another rock-star teeth drummer. Interestingly, although on the internet there are plenty of places where this phenomenon is discussed, to my knowledge teeth drumming has not been granted any scholarly attention.

Humming, whistling and finger or teeth drumming are mostly unconscious behaviours, and when I inquired among Melbourne University students, I surprisingly found that a large number of students (about 20%) had previously got into trouble during a test or exam because of their unconscious singing, humming, finger drumming or whistling.

There is one similar field though that has received plenty of attention. This is the well-known phenomenon of when a song tune gets stuck in our head for a long time, sometimes to our annoyance. This phenomenon, known under the term "musical worms," is known from the writings of Edgar Allan Poe, Mark Twain,

Arthur Clark, and also to a number of scholars, including among others Theodor Reik, Oliver Sacks, Daniel Levitin and Peter Szendy. According to some estimates 98% of humans experience this phenomenon.

And of course, the relatively new and rapidly progressing sphere of musical therapy is entirely based on our desire to hear relaxing and soothing sounds around, particularly when we do not feel well for any particular identifiable reason.

It seems to me that the positive communicative functions of humming, whistling and drumming are quite obvious, and I doubt I have said anything too unexpected to the reader of this book – but I do suggest for them to pay attention to the manifestations of our need to constantly hear musical sounds and rhythms around us.

Mystery of swan song

People singing when they are in critical situations of life is another strong indication of the healing power of singing and humming. Legendary Georgian mountain climber Mikheil Khergiani was known among his friends to start singing a particular traditional song from Svaneti, his native region, when he was in a desperate situation with imminent death. This habit saved his life at least once (to find out what happened you can see my article "Music and Emotions: Humming in Human Prehistory," freely available on the internet. Jordania, 2010). After his second cardiac arrest, my favourite Georgian writer, Nodar Dumbadze, asked his friends to sing a song together with him before his death. William Blake, the author of the immortal "Tiger", also sung while feeling his approaching death. Charles Darwin's biggest life heartache, the death of his beloved daughter Annie, also provides a sad example of people singing (or trying to sing) when feeling desperately bad. Possibly feeling the approaching death, Annie made two attempts to sing just few hours before her untimely death at the age of 10 (Desmond and Moore, 1991:383).

The possible psychological benefits of hearing music for a dying person are difficult to refuse. Therese Schroeder-Sheker began using music in care for the dying in Colorado in 1973 (from 1992 the same project now operates in Montana). She proposed the special terms "music thanatology," "music vigil," and "prescriptive

music." On the other hand, the singing behaviour of humans before their death and possibly in other critical situations, as far as I know, has never been studied. Possibly someone who reads these words, who will be sufficiently fascinated by this phenomenon, will have enough time and patience first to prepare a time-consuming grant application, and then to gather information on this somber but potentially very important topic.

You have possibly heard the term "swan song." This saying comes from the popular misbelief that swans sing before their death. According to ornithologists, swans do not sing before their death – they basically never sing. Pliny the Elder was possibly the first who refuted this misbelief in the 1st century AD. Well, we are certainly quite good masters of ascribing our feelings and behaviours to others. For another similar example I can mention that ostriches do not bury their heads when in danger. Therefore, although swans do not sing before their death, we humans, or at least some of us, have an instinctive desire to sing or hum when feeling death approaching, and this possibly make us feel better prepared for the mysterious transition.

Several practical suggestions: Why and how to avoid silence

Our constant need to hear sounds around us in order to feel relaxed gives me grounds to make a couple of practical suggestions. The first suggestion is for the educators, and concerns how we conduct exams. Exams, as many would expect, are conducted strictly in silence, and no one is allowed to make any sounds. When I enquired among my students on this subject, quite a few of them confessed that this silence is "clinical" and the resulting atmosphere causes them feelings of anxiety, fear and sometimes causes a panic attack. Many of these students were very good students, and their fear was in no way connected to their fear of exam questions. Let us think about this – I suggest education psychologists should investigate this subject, and if the research shows that a big part of the unnecessary anxiety and fear during exams is connected to the silence in the exam room, I would suggest for them to create a more humane and thinking-friendly environment for students during the

exams. For example, students could have the choice to do their written exams in two different rooms, one traditional silent room and another room with soft music (or even a pre-recording of birds singing) playing in the background. Another, possibly better option would be to allow students to have personal music listening devices during exams.

Educationists will most likely dismiss my suggestion, but I hope there will be at least a few readers that were terrified many years ago by a clinically silent exam situation, who will try to improve the psychological state of students of future generations during the most critical and feared moment of their educational life.

Another practical suggestion regarding silence came to me after reading a thought provoking article on the internet, which suggested that the usual words that police must use as a part of their arrest procedure, strongly suggesting those in custody to remain silent and that anything said can and will be used against them, are in fact quite inhumane. I hope we all agree that if you are arrested by the police, this is one of the most negative and shocking moments of your life. As a result of your anxiety, you naturally want to be vocally active, say something, express your feelings, or ask questions. You do not want to be in silence. Taking someone into custody and virtually forcefully silencing them increases the fear and anxiety of the arrested person. Justice should be just, but not necessarily cruel, particularly if we remember that a person that police suspects for criminal activity may later be found to be innocent of all charges.

Basically any place or situation that is potentially fear-inducing will induce more negative feelings if the place or situation is surrounded by an eerie silence. I remember very well how much I feared my visits to the dentist, and to my great relief I later started visiting a dentist I personally knew, and I could ask her to put on my favourite Beatles recordings during the treatment. I felt much better when hearing music than I did sitting in silence and hearing, with my exaggerated audio sensitivity, only the creepy and ominous sounds of the medical equipment. It is a pity that even in the progressive Australia, when I go for regular blood check-ups and ask nurses to put some music on while they are extracting blood from my vein, they repeatedly tell me they do not have any equipment to do this. At the same time they know that some patients feel bad and sometimes even faint during this simple procedure, and that's where I suggest that hearing background music might help. After all, if we

already know that hearing music helps those who are afraid to go into lifts, why should it be any different for medical patients – after all humans usually fear visiting dentists more than entering lifts…

Vocal grooming, choral lullaby, and elevator music

Taking into account the intensely social nature of a whole human life on one hand, and the fact that humans are arguably the noisiest animals on earth on the other hand, it seems natural to suppose that the universal human habit of humming was routinely accompanying most of the everyday group activities of our distant ancestors. Humming was the ancient hominid "contact call" for our ancestors and retains the same function for contemporary humans. The fact that humming today is a universal expression of our positive feelings suggest that the positive message implicit in humming is not a late cultural development, but instead has a very deep biological, innate basis. Hearing humming just tells us that everything is fine and we can relax – this simple message is especially important if you live under a constant threat to your life. Later we will discuss the opposite musical phenomenon, loud and emotionally rousing singing coupled with drumming, stamping and threatening movements. We will discuss the importance of this kind of rousing intimidating display and the role it played in interactions with big cats, but we should not forget about the soft and difficult-to-notice humming which still plays an important role in everyday human life both in pre-literate and technologically advanced societies.

In 1993 Aiello and Dunbar proposed a very unusual and attractive idea about the origins of language. They proposed that after the hominid contingent had grown, the initial function of the social cohesiveness via scratching each other's back, or physical grooming (very popular among primates, including apes) was replaced by a "vocal grooming." The phenomenon of humming and human contact calls fits in perfectly with the notion of "vocal grooming" suggested by Aiello and Dunbar. The idea of humming as a social bond between humans also fits the idea of the importance of the mother-infant interaction in human evolution proposed by Ellen Dissanayake (Dissanayake, 2000).

We have already mentioned how people sometimes try to sing when they feel death approaching. On the other end of life, and particularly after mentioning the work done by Ellen Dissanayake, we must remember that we have the innate need for soft soothing humming from the moment of our birth. I am of course talking about one of the universal elements of human musical culture, the lullaby - sung by parents (mostly mothers) to their babies from a very young age. A lullaby is mostly hummed or sung softly, and fits perfectly with the model of soft and soothing sounds designed to relax a young baby. The innate basis for the preferences for lullabies in infants has already been proposed (McDermott& Hauser, 2005:33-34). Soft soothing music has also proved to be a helpful aid in the care and development of medically-fragile hospitalized newborn infants (Shoemark, 2012).

The idea that the lullaby is the natural descendant of the ancient human contact calls gives a very different perspective to the origin of the lullaby. As humming sounds were most likely present in hominid groups during various activities, hominid and early human babies were most likely falling asleep while hearing relaxing group humming sounds rather than the solitary sounds of their mothers. In popular culture lullabies are naturally connected to solo singing, as in contemporary cultures lullabies are sung by one person, usually the mother – but this could have been very different in our prehistory. For some readers the idea of "polyphonic lullabies," sung by a group, might sound crazy, but as a matter of fact they are not so rare. In many African and European cultures with vocal polyphonic traditions there are indeed polyphonic group lullabies (see, for example, Kalandadze, 2009). Polyphonic lullabies are performed even today during various ritual activities, like putting a baby in the cradle for the first time, after cutting the baby's hair for the first time, or while at the bed of a sick baby. Lullabies and healing songs have plenty of elements in common (in my native Georgia, they are also often mentioned by the same term "Nana").

As living in separate dwellings is a relatively late development in human history, it is very likely that a mother's solo lullaby replaced the ancient group humming. Both group humming and solo lullabies have the same aim: to relax and put to sleep. Therefore in this model, the **solo lullaby is the descendant of the primordial group humming habit of hominids and early humans**.

The universality of humming as an expression of positive feelings on one hand, and total silence as an expression of a potential danger on the other hand, suggests that the human brain must be pre-programmed to perceive these emotions from hearing (or on the other hand, not hearing) audio background. We have already discussed the fact that prolonged silence affects our emotions in a profoundly negative way. Silence can be perceived as an ancient sign of approaching danger, or as Tim Rice suggested (through a personal communication on October 25, 2007), "one suddenly feels as if he is alone." I love this comment as it is based on the reminiscence of the ancient fear that hominids had of being apart from the group, and therefore vulnerable to predation. When we are surrounded by total silence, even if we know there is no danger around (like in a locked recording studio where Bob Dylan made historic recordings), we suddenly have an uncontrollable and rapidly-increasing, instinctive fear, induced by our several million years of audio experience – a fear that we are in mortal danger, and this fear comes from the fact that we are alone and there are no sounds around. In this situation our ears instinctively try to listen for signs of danger, and with the increased audio sensitivity we even perceive the sounds of our own body as ominous and fear-inducing.

This ancient desire to avoid silence must be the reason why there is so much music everywhere we go – in shopping malls, elevators, cars, trains, sporting events, political rallies, parties, and even funerals. Some complain that hearing music in such places, where people do not really listen to the music, is a sign of decline in musical taste. I believe that this kind of highbrow attitude towards music is not justified and is in fact inhumane. Listening to music for pleasure at organised concerts is a much later phenomenon. We did not "invent" music in order to fill up our free time and have fun with. For millions of years the function of music has been to help humans live more secure and more harmonious lives. In this context the infamous 'background music' is the evolutionary continuation of the ancient human habit of humming, and it has the worthwhile purpose of helping humans feel better, have a more positive attitude, combat their fear of small spaces in the elevators and alleviate their anxiety at exams or in hospitals. Unlike a few of life's other pleasures, like eating, drinking or sex, we cannot harm ourselves with too much music (providing that it is not so loud as to damage our ears). I suggest that this extremely high tolerance towards a musical environment and our generally positive reaction towards

musical sounds is the consequence of our evolutionary past, where soft humming sounds were accompanying virtually every moment of our ancestors' lives, giving them enduring feelings of security and well-being.

Origins of music and the battle trance

The August of 1839 saw possibly the fiercest fight that the war-torn Caucasus has seen to this day. The military forces of the mighty Russian Empire were finishing off the prolonged resistance of the legendary Dagestanian military and religious leader, Imam Shamil. Shamil had been leading an armed resistance against Russian forces for many years. After an epic 80-day-long siege at their mountain stronghold Akhoulgo where each side had lost thousands of men, a small remaining group of Shamil supporters (Shamil himself included) were surrounded by an overwhelming number or Russian troops. Neither side took prisoners in this battle, nor did anyone expect to be spared. The deaths of Shamil and his remaining followers were imminent. In this most critical situation, during a short break between the battles, Shamil suddenly started singing and dancing a traditional dance. His fighters looked at him first with amazement, but he gradually involved all his exhausted fighters in the singing and dancing. The speed of the dance was becoming faster and faster...

Russian soldiers, also exhausted after the fierce 80-day battle, were in total amazement at hearing the sounds of singing and dancing from their encircled enemies. When the tempo and the vigour of the dance reached a boiling point, Shamil suddenly stormed out with his sword in his hand and with a fierce war cry attacked the shocked Russian soldiers. All his surviving fighters followed, and despite an overwhelming number of Russian troops, a few fighters including Shamil himself and his family escaped down the slopes of the treacherous mountains and continued to fight the Russian Empire for many more years.[5]

[55] There are other versions of Shamil's miraculous escape from Akhoulgo as well. Dagestanian traditional dance "Shamil's Dance," composed in 1912 by a Chechen accordion player Magomet Magomedov, was composed to describe Shamil's prayer followed by the invigorating dance performed by Shamil to raise the morale of his fighters.

If you think that this kind of history can only happen with the members of conservative traditional societies, you are not correct. Even now, as you are reading these words, it is possible that a group of American soldiers, positioned somewhere in Iraq or Afghanistan, are together singing and dancing to the loud sounds of heavy metal. Why are they doing this? Because, very much like Shamil and his fighters, they will be soon going into a combat zone where they can be ambushed and killed, and this singing and dancing is so they are prepared for their dangerous mission. It is not easy to prepare yourself for such a hard task – any soldier is a human in the first place, and killing another human for them is as difficult as for us. However, during the battle soldiers, and particularly soldiers with extensive experience, can be transformed psychologically and can reach a very special state of mind.

Imagine going into the battle without feeling of two of the most prominent negative emotions that mortal combat can induce: the fear of imminent death and the pain associated with terrible wounds. But does the ability to achieve one of these states, really exist? Yes, it does. The best way of achieving this state is to listen to loud music and dance together with the members of your unit before going into battle. This coveted state of mind for combatants is known as the 'Battle Trance'. In this state soldiers do not feel any fear, or pain, and can disregard their personal safety in the interests of their friends and the common goal. The term 'Battle Trance' is quite new. In my 2011 book "Why Do People Sing? Music in Human Evolution" I proposed the term 'Battle Trance' for this unique altered state of consciousness (Jordania, 2009, 2011). Achieving this state is the prime goal of the psychological preparation of combat groups, and music (particularly loud and vigorous music) coupled with dance is the best way of attaining it.

According to some fascinating research by Jonathan Pieslak, an American composer, ethnomusicologist, an associate professor of music at City College in NY who specially studied the role that music plays in war, many American soldiers confess that it would have been impossible for them to get into the required combat spirit if they did not listen to heavy and rhythmic rock music. "I'd listen to Slayer to get all into it." Colby Buzzell, an M240 Bravo machine gunner in Iraq, told Pieslak.

We should not forget, that Shamil was generally against music and other human indulgencies, allowing music only on the occasions of weddings and initiations (from Chechen encyclopedia, article "Shamils's Dance", in Russian).

“Sometimes your motivation is down and you’re like, “I don’t want to play soldier today”… But then you hear ‘The Good, the Bad, and the Ugly’ theme song and you’re like, ‘Fuck yeah, hell yeah, I’ll go out on a mission today.” ”You've got to become inhuman to do inhuman things,” Sergeant First Class CJ Grisham, who was a part of the initial US invasion force in Iraq in 2003, told Pieslak. The Eminem song “Go to sleep” became a powerful drug for SFC Grisham to get into the fighting spirit during his deployment, but after returning back from his service the song became unbearable: “Now that I've returned to normal, I can't listen to this song.”

In 2010, after reading Pieslak’s fascinating book, American actor Tom Wiggin started a campaign to distribute personal MP3 players to all soldiers stationed in Iraq and Afghanistan (Villarreal, 2010).

I hope we all can agree that, when a combat unit goes out for a combat mission, it is of paramount importance that they all feel the strength of their unity and an utmost trust towards each other. Something of the same manner is happening when social animals prepare to go out for a hunt. Hunting is a dangerous activity not only for the prey - predators can also be injured or killed during a hunt. This is the reason lion pride members have their means to raise the morale and social bonding between the group members: “At dusk, before setting out on a hunt, group members rub frequently and intensively” (Schaller, 1972:87). What lions do with rubbing, humans do with rhythmic singing and dancing.

This power of music to prepare warriors for battle, to put them into a state where they do not feel fear or pain and where they can sacrifice their lives for their friends is in the very essence of the origins of human music. Before I continue on with this proposal, let me give you a brief chronological account on existing theories on the origins of music.

Theories of music origins

Here is a list organised in chronological order to make it easier for readers to follow the development of the scholarly approach to this currently very “hot” topic. We start with several important ideas expressed in Ancient Greece, as ancient Greek

thinkers were extremely interested in the nature and origins of music, and some of their ideas still circulate in the writings of contemporary scholars (sometimes without them realising).

• 6th-5th centuries BC. Pythagoras proposed that the essence of music was in numbers. His ideas of the consonance as the sound with the simpler mathematical relations and the dissonance as the sound with more complex mathematical relations, was in a way a predecessor to Helmholtz's ideas of musical acoustics based on natural overtones.

• 5th-4th centuries BC. Plato acknowledged the unique emotional power of music, and considered music as the most potent means for instilling morality in the citizens of Ancient Greece. In his writings Plato suggested to promote some scales and to ban other scales for the good of society. Attempts to ban certain musical styles, composers, or compositions had been a policy for many religions and states, including more recent Western societies.

• 4th century BC. Aristotle, one of the greatest Greek philosophers and founder of western philosophy, considered arts and music as a means of imitation of the natural world.

• 4th century BC. Aristoxen, Aristotle's pupil, opposed Pythagoras' mathematical model of music, arguing that emotions, not numbers, are behind the phenomenon of music. For Aristoxen, consonance was primarily a sound that pleases our senses rather than a sound with simpler mathematical relations.

• 1st century BC. According to Philodemus, follower of Epicure, 'music cannot express anything, it can only tickle and please our hearing, very much like the art of culinary'. 21 centuries later, in his 1997 book, Steven Pinker expressed a similar idea with almost the same words, labelling music, to the outrage of many music lovers, as "auditory cheesecake" (see later on this list).

• 1722. Jean-Philippe Rameau published his influential work on harmony, declaring that harmony was the natural basis for music and that melody was derived from harmony.

• 1761. Jean-Jacques Rousseau disagreed with Rameau, suggesting that melody was the original element of music and that harmony was added later. According to his views, both music and speech had a common ancestor – this initial human

communication was based mostly on singing, and it was more passionate and emotion-driven than contemporary human language.

• 1832. William Gardiner, the musician who introduced the music of Beethoven to British audiences, wrote one of the first articles on the origins of music, arguing that music was derived from the sounds of the natural world around us.

• 1857. Herbert Spencer suggested that music evolved from the exaggerated emotional speech of our ancestors, or in other words, from the prosodic elements (or tones) of human speech.

• 1871. Charles Darwin criticized Spencer's idea of music being an outgrowth of human speech, and suggested that, on the contrary, music predated the origin of language, serving the needs of sexual selection through charming the opposite sex (see Kivy, 1959). Maybe even more importantly, Darwin famously declared 'as neither the enjoyment nor the capacity of producing musical notes are faculties of the least use to men in reference to his daily habits of life, they must be ranked amongst the most mysterious [phenomenon] he is endowed.' Darwin's ideas about music and sexual selection are still quite widely known and often shared in contemporary scholarship.

• 1891. Richard Wallaschek suggested that both music and speech originated from a shared primitive stage of communication, and that music came from primordial 'dance-play'.

• 1895. Otto Jespersen hypothesized that language must have begun as 'half-musical unanalysed expressions for individual beings and solitary events'.

• 1895. Ernst Newman proposed that the origin of music was independent of speech, and that humans had the ability to express their emotions through music much earlier than when they developed speech.

• 1911. Carl Stumpf suggested that music came into existence as a means of long-distance communication between early humans.

• 1919. Karl Bucher stressed the important links between music and rhythmic movements, and suggested that music developed out of labour-related rhythmic movements and sounds.

• 1923. Boris Yavorsky introduced the idea of 'intonatsia' [intonation] as the smallest and oldest element of musical language, with it subsequently dominating Russian musicology throughout the 20th century and fundamentally influencing Boris

Asafiev's view on the essence and development of musical culture. Yavorsky suggested that intonation was the earliest form of human language.

• 1930. Boris Asafiev suggested that music and language had a common ancestor that was later separated during the course of human evolution into two related but sometimes conflicting phenomena.

• 1930. Siegfried Nadel proposed that music originated as a supernatural language, used in religion and rituals, and that musical language was added to everyday speech through artistic expression.

• 1943. Curt Sachs suggested that music could have originated from two sources: (1) speech and (2) emotions. Later (in 1962) Sachs rejected all theories on the origins of music as un-provable or wrong.

• 1956 onwards – Bruno Nettl wrote in one of his early works that both music and language were born out of a common ancestor, a specific system of communication that shared elements of both music and language. In his 2000 article and 2015 book, Nettl discussed musical universals and the origin of music as a cultural invention.

• 1973. John Blacking considered music as a purely human creation, inseparable from social context and primarily serving the needs of social cohesion in human groups. His definition of music as 'humanly organised sound' is contradictory, as it excludes the possibility of the presence of elements of music in the animal kingdom (for example, the singing of birds or humpback whales), and implies that human speech is part of music as well.

• 1971. Roger Wescott suggested that the earliest predecessor of human language among Australopithecines was whistling, combined with some other non-vocal sounds like 'hand clapping, foot stamping, and drumming on their chests or on external objects'.

• 1973. Miron Kharlap suggested that the historical development of human musical culture went not from monophony to polyphony, as it was universally believed by music historians, but from polyphony to monophony – from group to individual musical activity.

• 1981. Ivan Fonagy suggested that our ancestors' language was musical and that pitch modulations directly carried the meaning of the communication, and that

speech evolved later as a more complex system to express more complex ideas efficiently.

• 1983. Frank Livingstone suggested that human ancestors as far back as the Australopithecines were communicating by singing, although later he changed his view and linked the origins of singing to the period of tool-making technologies.

• 1984. Juan Roederer specially looked for the survival value of music and suggested that music was developed to play the role of assisting the human brain in acquiring language.

• 1986. Izaly Zemtsovsky stressed the importance of dialogical forms of communication for the origins and the initial forms of group singing. Zemtsovsky and the four following authors were participants in a special conference dedicated to the genesis and specificity of early forms of musical culture, held in Armenia in 1986.

• 1986. Viacheslav Ivanov suggested that the presence of 'personal songs' for each member of society in different cultures might imply that these songs were the oldest form of personal 'naming'. He also stressed the importance of the neurological aspect of musical activity, suggesting that music could play a crucial role in memorizing important texts in early human history, before the invention of a writing system.

• 1986. Boris Frolov and A. Demirkhanian stressed the crucial importance of rhythm in the initial stages of the development of human musical and social activities.

• 1986. Joseph Jordania (the author of this book), in his first publications on this topic, suggested to distinguish musical language (as a means of communication) from musical culture (as a later cultural expression, art), and argued for the specific role of polyphonic group singing in the early stages of human evolution. In 2006 and 2011 he published books on the origins of choral music in the wide context of human evolution.

• 1988. Bo Lawergren proposed that the first fixed vocal and instrumental sounds were formed by humans as part of their hunting activities.

• 1991. James Brown and William Greenhood noted the evolutionary primacy of musical communication and suggested that the melodic utterances of *Homo erectus* changed into staccato-like speech with long utterances when they reached the *Homo sapiens* stage.

• 1991. Nils Wallin researched the biological foundations of human musical ability based on a multidisciplinary approach to the human brain, physiology, auditory and vocal systems. Together with Bjorn Merker and Steven Brown, Wallin organised a cross-disciplinary conference on the origins of music in 1997 that resulted in the release of the ground-breaking volume 'The Origins of Music' in 2000.

• 1992. Bryan Levman provided a good review of existing theories on the origins of music. He suggested that both speech and music must have had a common ancestor, and argued that pitch modulations played a crucial role in the human protolanguage.

• 1993. Bruce Richman suggested that initial choral singing could have been a crucial element in the development of a more complex communication system – human language.

• 1993. Leslie Aiello and Robin Dunbar suggested that about two million years ago, as the size of the groups of homo habilis and Homo rudolfensis were too big to allow grooming, physical grooming was substituted by vocal grooming (i.e. group singing), the precursor of both music and language.

• 1995. John Barrow declared that music had no survival value for humans, and that it derived from an instinctive sensitivity for certain sound patterns that itself was the result of adaptation.

• 1996. Dan Sperber declared that music arose out of the ability to exploit parasitically our cognitive capacity to process complex sound patterns used for early stages of human communication.

• 1997. Steven Pinker famously dismissed the role of music in the evolution of human communication as a late phenomenon, mostly a by-product of language development, and continuing the line of Greek Philosopher Philodemus, infamously labelled music as an 'auditory cheesecake'.

• 1997. Nathan Kogan discussed the possible adaptive functions of music and suggested that music could have enhanced the group movement synchronization and cooperation necessary for hunting.

• 2000. The volume 'The Origins of Music' was published by the MIT Press, providing an important precursor to the explosion of interest towards the origins of music. Several of the following authors published their ideas in this collection. The

publication of this volume virtually opened the gate to myriads of new publications on the same topic.

• 2000. Geoffrey Miller revived and refined the initial idea of Charles Darwin about the role of music in attracting the opposite sex, suggesting that the function of music and dance was to demonstrate to the opposite sex the dancer's fitness to mate.

• 2000. Francois-Bernard Mache demonstrated existing parallels between human music and animal vocalizations and suggested that human musical faculty has strong links with animal singing behaviour.

• 2000. Ellen Dissanayake suggested that the origins of music are intimately connected to mother-infant interactions, particularly during the early stages of infant development.

• 2000. Bjorn Merker proposed that music could have originated among hominids as a group activity, by which competing groups of males were inviting wandering females for mating.

• 2000. Steven Brown suggested the highly influential idea of "musilanguage", a common predecessor of music and language. In 2003 he suggested the model of 'contagious heterophony' for the origins of music. According to this model, group-singing behaviour was at the very beginnings of music, and that mirror neurons played a key role in this process.

• 2000. Thomas Geissmann presented a comparative study of gibbon singing and human singing behaviour, and suggested that one of the early functions of music could be to scare away aggressors and competitors.

• 2000. Peter Marler suggested using animal singing behaviour as a possible model for the study of the origins of human music.

• 2000. Jean Molino proposed that music, language, dance, chanting, poetry, and pretend play have common origins based on rhythmic formulas and imitation.

• 2001. 2006. Ian Cross discussed the possible biological and cultural foundations of human musical faculty, and criticized dismissive attitudes towards music that were often present in the mid-1990s.

• 2001. William Benzon wrote about the particular importance of shared musical creativity from the perspective of a jazz musician, and argued that 'music is a medium through which individual brains are coupled together in shared activity'.

• 2003. Edward Hagen and Gregory Bryant suggested that music and dance were primarily used as an 'honest' signal about the quality of a group's cohesion to be displayed to other human groups.

• 2003. Isabelle Peretz summed up recent studies on the cerebral localization of musical functions: 'In my view, the only consensus that has been reached today about the cerebral organization underlying music concerns pitch contour processing … However, it remains to be determined if this mechanism is music-specific, since the intonation patterns for speech seem to recruit similarly located, if not identical, brain circuitries.'

• 2004. Robin Dunbar also suggested that the evolution of human language went through a musical phase.

• 2005. Steven Mithen suggested a model for the origin of music from the 'Hmmmm communication' (combination of 'Holistic, multi-modal, manipulative, and musical' features), and noted that pre-linguistic hominids may have had better musical abilities than modern humans.

• 2005. Timothy Justus and Jeffrey Hutsler investigated the possibility of innate constraints on the human musical faculty, and suggested that despite the strong possibility of such constraints being innate, they could have emerged from selection pressures in various domains.

• 2003, 2005. Josh McDermott and Marc Hauser offered a comprehensive review of the existing publications on the innateness of several musical faculties. This review was 'motivated by the desire to understand music's evolutionary origins and adaptive significance'.

• 2006. Tecumseh Fitch examined the drumming behaviour of African apes (chimpanzees, bonobos, gorillas) and suggested that drumming among apes could be viewed as a potential precursor to human instrumental music. Fitch also suggested the term 'prosodic protolanguage' as a reference to the pre-linguistic system of communication.

• 2006. David Huron studied the mechanisms of emotional gratification through the process of anticipation, and then presented an interdisciplinary theory on the human emotional response to different elements and styles of music.

• 2006. Erich Jarvis discussed the importance of vocal learning in birds and mammals for the research of the origins of music.

• 2006. Victor Grauer proposed that the primordial music that anatomically modern humans took from Africa about 100 000 years ago was polyphonic and was close to the contrapuntal polyphony of Central African pygmies. According to Grauer, imitating animal sounds was the key factor in the emergence of human musical abilities.

• 2008. Daniel Levitin suggested that six main types of songs constituted the basis of human musical culture, and proposed that the most ancient type of songs, so called 'songs of knowledge' provided a 'powerful mnemonic force for the encoded knowledge'. This idea is close to the idea expressed by Viacheslav Ivanov in 1986, and discussed above. Levitin also mentioned the 'gruesome human invention' of the use of group singing by humans to intimidate opponents before battle.

• 2009. Steven Livingstone and William Thomson continued the non-adaptationist line of Barrow, Sperber, and Pinker, suggesting that music can be a secondary phenomenon originated from Theory of Mind (ToM), the ability of humans to recognize the emotional state of other humans.

• 2009. Andrea Rinaldi provided a review on the biological foundations of music and their relationship with language and speech.

• 2009 Richard Parncutt from Austria, an Australian-born professor of systematic musicology, endorsed the idea that music originally spawned from 'motherese' – the playful voices mothers adopt when speaking to infants and toddlers.

• 2010. Leonid Perlovsky published a wide overview of existing theories on the origins of music, focusing on the emotional power music has on the human brain.

• 2011. Joseph Jordania (the author) suggested that the phenomenon of "Battle trance" and acquiring "Collective Identity" through rhythmic singing and dancing was crucial for human survival.

• 2012. Gary Marcus, true to the ideas of his advisor Steven Pinker, argued that music is not an adaptation, but a cultural invention.

• 2014. Iain Morley proposed that at their most fundamental level musical behaviours (including singing and dance) are forms of deliberate metrically-organised gesture, and constitute a specialised use of systems dedicated to the expression and comprehension of social and emotional information between individuals.

• 2015. Hoeschele, Merchant, Kikuchi, Hattori, and ten Cate proposed that both traditional laboratory studies and studies relating to natural behaviour among animal species are needed to answer the problem of origins of human musicality

• 2015. Honing, ten Cate, Peretz and Trehub emphasised the importance of multicomponent perspective on musicality for the study of the origins and evolution of musical behaviour as an autonomous trait.

• 2015. Tecumseh Fitch discussed four core components of human musicality: song, drumming, social synchronization and dance. He highlighted existing parallels in the animal kingdom (often analogies but in some cases, like drumming, homologies). Fitch also suggested to renew search for universal capacities underlying human musicality.

• 2015. Merker, Morley, and Zuidema proposed five fundamental constraints that bear on theories of how music and some of its features may have originated. (1) cultural transmission, (2) generativity, (3) vocal production learning, (4) entrainment, (5) the universal propensity of humans to gather occasionally to sing and dance together in a group.

• 2015. Tianyan Wang suggested that human appreciation of rhythmic movements and rhythmic events developed from the natural selection of organisms adapting to the internal and external rhythmic environments. He proposed the existence of rhythm-related reward and emotion (RRRE) system in animals.

Despite a long list of authors and ideas, the reader must understand that this overview is far from being comprehensive, although it does present major theories and many of the authors who wrote on the origins of music. Now, after this review, we are ready to move towards the search of the origins of human singing in the context of human evolution.

Origins of human choral singing behaviour

If you have a look through the huge amount of literature on the history of music, you will see that human musical abilities have undergone a long process of

development, kind of a "from caveman to Beethoven" movement. According to the long tradition of musical history, our distant ancestors had only very primitive musical faculties, and then with the development of culture and rise of religion and civilization their musical tastes improved, and initially haphazard sounds were gradually organised into tonalities (also known as 'key').

In this strictly ascending picture of development in human musicality, choral singing comes closer to the very end of our musical development. For those who are unsure, by "choral music" we refer to people singing in different parts, creating harmonies. The natural progress from one-part singing to singing in different parts sounded so natural that no-one took any pains to put this idea in the form of falsifiable hypothesis. After all, there are things that we call "axiomatic", which means they are true merely because everyone can see they are true – there is no need to prove it, and there is no alternative (see, for example, Nettl, 1961:360-361).

Well, the danger of axioms is in the fact that they are blinding to the point that no one can see the possibility of even considering alternatives. Sometimes it is not so easy to oppose and check axiomatic ideas.

One such axiomatically accepted idea was discussed earlier – a peacock's amazingly beautiful train. It was so obvious to all that it was designed by the forces of sexual selection to attract females that, for a long time, no one even thought to do any research. Well, today, as I have already mentioned, at least some scholars have big doubts that the peacock's glimmering train was designed to charm females, as the first long-term study of a free-ranging population of peafowl found the old and seemingly axiomatic idea was not supported by the evident facts.

The origin of human choral singing is an example of another such seemingly axiomatic truth. On one hand it is understandable why this was considered so axiomatic. Think for yourself: a group of people can sing in one part, very much like everyone singing a tune of "happy birthday" at a party, but a group of singers can also sing in several different parts, like they do in professional or well- trained community choirs. Now, if you are asked which out of these two forms of singing is historically earlier and which is later, most likely you would respond that the one-part singing must be the earlier one, and that singing in different parts must have appeared much later, when human music had reached a certain level of complexity. This seems quite obvious, doesn't it? Because it was so obvious, for centuries

musicians and music historians believed that singing in different parts was a cultural invention from somewhere at the end of the first millennium, when professional church composers organised choirs with professional singers who could learn and sing a multi-part composition.

The big problem with this very logical scenario is that it does not agree with the existing facts. If you want to know to which facts exactly I'm referring to, I will detail merely a few of them below:

Most polyphonic singing is found in the most geographically and culturally isolated and hard to reach places of the world, not in cultural centres. For example, in China there is plenty of polyphony in the south-western part of the country in the most impenetrable mountain ranges of the world, which include Tibet, Sichuan and Yunnan provinces, where roads still do not reach some villages today. The Han people, the heart of ancient Chinese civilization and its booming prosperity, sing in one part. Furthermore, people sing in polyphony in remote areas of Papua New Guinea and the mountains of Afghanistan, but not in central France. In the Balkans, the kingdom of polyphony, the richest traditions of polyphony are present in Albania, arguably the most conservative country of the Balkan states. When Europeans reached Polynesia, they virtually refused to believe that natives were singing in different parts. Possibly the most telling of examples is arguably the most intricate vocal polyphony in the world, which is performed by Central African Pygmies – who by no stretch of imagination could be considered to be among the long list of technologically advanced societies.

Basically, music played a much more prominent role in human and hominid prehistory than it did after the development of civilizations and emergence of professional musicians. There are already scholars suggesting that we have actually lost part of our musical abilities compared to our distant ancestors, however I will not discuss this in detail. Victor Grauer (2006, 2007, 2011) and Steven Mithen (2006) wrote about this, and research showing that newborn babies all have absolute pitch also points in the same direction (Safran, 2003; Safran & Griepentrog, 2001)

The author of this text has written three books on the origins and history of human choral singing over the last two decades[6]. After studying the distribution of the tradition of choral singing in the world, and studying all available historical sources from audio recordings, literary sources, and examples of musical notation (which has at least 4000 years of history), a conclusion was made that group singing in parts has been an important part of an early hominid survival strategy, and that polyphonic singing has been in a state of constant decline ever since the advance of the last major acquisition of human evolution – articulated speech.

If a reader is interested to know why there are regions of the world that do not have almost any traces of polyphonic singing, whereas in other regions polyphony is so prevalent, I can suggest reading my 2006 or 2011 books on this subject (both books are freely available on the internet). I would like to mention that the distribution of polyphony all over the world has incredibly interesting parallels with such ostensibly unrelated phenomena as the prevalence of stuttering and dyslexia, the acquisition of a phonological system in different parts of the world, and even the contrast in achievements in literacy between contemporary schoolchildren from East Asian and Western countries.

First let us return to our subject of group singing by our distant ancestors, and find out whether there was any need for developing such a behavioural trait.

Mobbing in animals and humans, or the history of human war cry

The mobbing or intimidation of an enemy, competitor, and particularly a predator is widely known in an animal kingdom. Smaller and less powerful creatures unite their efforts in order to mob and scare away a dangerous enemy. Many species of birds use mobbing to secure their offspring from the predators. There are even

[6] 1989, "Georgian Traditional Polyphony in International Context of Polyphonic Cultures: the problem of the origins of polyphony" (in Russian); 2006 – "Who Asked the first Question? The origins of Human Choral Singing, Intelligence, Language and Speech", 2011 – "Why do People Sing? Music in Human evolution" (all of them published by Tbilisi University Press). Also, the second edition of the book "Who Asked the First Question" with the title "Choral Singing in Human Culture and Evolution," was published in 2015 by Lambert Academic Publishers.

species who are sometimes mobbed, but they are can unite and mob other species. The crow is a great example of such a species that can be on both sides of a mobbing encounter. Mobbing birds use a special call which is different from their regular alarm call. If birds hear the alarm call they try to take cover, but when they hear a mobbing call, many of the birds join forces to create a bigger mobbing group. In its essence mobbing is an altruistic behaviour, as there always is a chance that a predator can lash out and injure or even kill some members of the mobbing group. Another important detail to note: mobbing is a behaviour only exhibited by social animals – non-social animals deal with predators on their own.

Not all attacks of a group of animals on a bigger opponent qualify as a mobbing. A lion pride can, for example, attack a huge buffalo or even an elephant, and while this might look like a mobbing, there is a big difference between mobbing and group hunting, which is what the lions are engaging in. The goal of mobbing is to scare away an opponent (although a mobbing attack can sometimes result in the predator's death), whereas the goal of group hunting is to kill the opponent for food.

Mobbing has all the attributes to be considered a classic case of the aposematic behaviour of social animals. Cows and buffaloes, for example, often unite in numbers to fight against attacking tigers or lions, and their attempts have saved not only the lives of their fellow herd members, but many of their human herdsmen as well.

We will discuss later the possible mental state of altruistically-behaving animals (or humans) in the exact moment when they risk their own lives in order to save another, but for now I want to draw the reader's attention to the audio background of mobbing.

Mobbing as a rule is connected to making loud calls and different intimidating sounds. Our ancestors, as I have already mentioned a few times, were arguably among the noisiest animals and it would be natural to propose that they were using, as they do this today, mobbing behaviour accompanied by mobbing shouts. The most important requirement of a mobbing sound is that it must be as loud as possible. In the next sections we will concentrate on the different ways to make sounds as loud and as intimidating as possible. We will have a look at several elements: (1) making sounds together; (2) making sounds in perfect synchrony; (3) using strong dynamic accents; (4) singing with lower range voice; (5) singing in octaves; (6) using singing

in harmony; even more specifically, (7) using sharply dissonant harmony; and (8) using drumming and stamping on various subjects.

Group vocalization

Although Charles Darwin did not think of the loud sounds made by our ancestors as a tool against predators, in later scholarly works the mention of group shouting and screaming as a part of the hominid and early human defence system became quite usual. There is no reason to think that our ancestors would not use the power of sound when they were standing their ground against such formidable predators as the ancestors of the big cats. It is also obvious that a sound made by several humans is louder than a sound made by a single human – basically the larger the group, the bigger the sound. Our ancestors were by no means unique in using group sounds to fend off predators. Plenty of animals do this (including lions). However the next element our distant ancestors were using in order to make their sound more effective was truly unique. It was the power of perfect synchrony that was making the group sound of our ancestors much more impressive and truly unique in the world. I am talking about the phenomenon of rhythm.

Rhythm

The phenomenon of rhythm and rhythmically organised group vocalization is crucial for understanding the origins of human music and the wider human defence system, human dance and religion. In the animal world we do have several instances of the use of rhythm. For example, fireflies can synchronize their flashing – but synchronizing their sounds in rhythmic unison is alien to the animal kingdom.

You may have possibly watched the wonderfully entertaining TV program "How Music Works" on TV or on the internet. When the researcher and presenter of the program, Howard Goodall, discusses the origins of human rhythm, he presents

theories that human rhythm recalls the regularity with which we walk and of the heartbeat we hear in the womb. This is all correct, but the rhythm of walking and the rhythm of heartbeat cannot explain the presence of rhythm in humans. Plenty of animals walk very rhythmically and can hear a heartbeat while they are in the womb, but they still cannot synchronize their vocalizations and other activities with each-other like humans do. There obviously is something very special in our human sense of rhythm.

The idea that synchronous movement improves group cohesion is quite old. Generals have known for centuries that having recruits march together for many hours and for many weeks improves not only their marching synchrony for parades, but also does miracles to their morale and the dedication of each soldier to each other and to their duties. In his insightful book "Keeping together in time: Dance and drill in Human History" William H. McNeill suggested that not only armies, but churches and communities all benefited from this rhythm-related bonding, which McNeill calls "muscular bonding" (McNeill, 1995). This physical synchrony, which occurs when people move in perfect synchrony with one another, produces positive emotions that weaken the boundaries between the self and the group (Ehrenreich, 2006; Hannah, 1977; Haidt et al., 2008). Durkheim called this phenomenon "collective effervescence" (Durkheim, 1965; Turner, 1995). This phenomenon has been happening throughout human cultures for millennia, if not for millions of years. Radcliffe-Brown wrote that, through synchronized dance, Andaman Islanders become "absorbed in the unified community" (Radcliffe-Brown, 1922:252). The same is happening during carnival dancing, and during long Kandomble dancing sessions. Olaveson analyzed rave dancing in contemporary youth culture to strong-beat music and suggested that humans need that particular feeling of losing themselves in a big shared identity (Olaveson, 2004). Haidt proposed the idea of "hive psychology" and argued that people must occasionally lose themselves in a larger social organism to achieve the highest levels of individual well-being (Haidt et al., 2008).

Losing personal identity and acquiring group identity can happen in very different environments, both in joyful and in stressful situations. A soldier's unit marching, a religious sect singing and a crowd chanting in support of their sporting team are all examples of people absorbing themselves in a shared identity. Trying to

understand the evolutionary roots of this phenomenon without applying the mechanisms of multi-level selection is impossible.

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First of all let us discuss whether the sense of rhythm is absolutely devoid within animal species. As we know today, there are at least a couple of cases of individual animals that have a sense of rhythm and can follow an external beat. An elephant star from the Thai Elephant Orchestra and also the YouTube sensation cockatoo Snowball do exhibit the ability to follow external rhythmic stimulus, although it is debated whether this sense of rhythm is characteristic of their respective species. World-famous African grey parrot Alex was possibly another bird that had the beat running through his veins, but unfortunately, he passed away before the full study of his phenomenon could be conducted.

This is not all. Currently scholars are trying to have a better picture of the presence of the sense of rhythm among animal species, not only among individual animals, and as it looks, we might not be the only owners of this sense (see, for example, Pattel, 2014). But even the presence of very few cases are very important for our understanding of the origins of human rhythmic sense, as they suggest that the ability of rhythmic behaviour can arise in different species independently from each other, most likely as a result of genetic drift.

The fact that rhythm is universally present in humans, and that it remains so even after a stroke is suffered and all other mental abilities are diminished, is another piece of evidence that shows rhythm is a very deep seated, important and ancient mental ability. The crucial question for the origins of human rhythmic sense is of why it became such an important element of human behaviour after it appeared as a result of genetic drift - could sense of rhythm be an adaptation designed by the forces of natural selection?

Yes, it was, and I believe it still is. When American soldiers listen to heavily rhythmic music and stomp and dance together before combat missions, or when Australian aborigines dance and stomp together before going to war or to hunt, they do this not for entertainment. Rhythm is the most potent transformer of human psychology from naturally selfish individuals into religiously dedicated members of

a group. Soldiers who do not undergo exhausting drills for many weeks before combat are much more likely to run away as soon as they hear the first shots and feel that their lives are in danger. Rhythm has saved many lives in our prehistory, and continues to do so. On a more negative edge, we can possibly say that it is the feel of rhythm and resulting intoxicating feeling of the "battle trance" that makes such a horrible thing as war so common.

John Locke famously wrote in 1690 that despite human participation in wars he is by nature cooperative[7]. I would agree with the great English philosopher, the father of classical liberalism, about the cooperative nature of humans but I would like to argue with him about the nature of war. It seems to me that war IS the biggest proof of human cooperative nature. It is cooperation, altruism and love towards fellow humans that forms the foundation for ethnic and religious wars with all the sacrifices towards a common goal. In April 2013 I asked my students at the University of Melbourne a question – "what is war? Is it the example of extreme *cooperation* or the example of the extreme *non-cooperation* between people?" To the credit of my students, they maintained a wise silence for some time, and then started discussing that war can be viewed as the example of both non-cooperation and cooperation – this is true. It is only in a very broad view that war seems only as an extreme case of violence and non-cooperation between people. On the other hand, the same war is a case of extreme altruistic cooperation to the point of self-sacrifice for the good of a bigger group. **Extreme altruism within groups and extreme violence between groups are the two faces of war, and they are inseparable**.

Let us return to rhythm as a tool for defence against predators and the basis for group cooperation. Rhythm has several features that make it one of our most important evolutionary acquisitions as a tool for the intimidation of predators and enemies:

[7] On the cooperation in natural world you can see the Alan Dugatkin's 1997 book "Cooperation among Animals: An Evolutionary Perspective." The book also has a good survey of various ideas and authors on cooperation (on pages 151-155).

(1) Rhythm makes a group sound louder, as putting audio accents together is as important as simultaneously combining the physical force of a group to perform manual labour (for example, lifting a very heavy load or pulling a tree down);

(2) Rhythmic synchronous sound creates an impression of a better-organised and more coherent group. When a predator (or competitor) hears a rhythmically perfectly blended wall of sounds, this gives off a message of the unity and dedication of the group members;

(3) Even more, hearing a well-organised and well blended sound creates the impression that the sound comes from a large super-body rather than a number of smaller individuals;

(4) Perfectly synchronized group movements also create the very interesting visual illusion of a monstrously big living organism. If you have ever watched the perfect marching of German soldiers from World War 2 archival footage you will understand what I mean;

(5) Rhythm is a crucial part of another important human phenomenon, known as entrainment, or synchronization to an external rhythm. Entrainment is a crucial part of dance, another human universality and potent means in achieving a collective identity and acquiring battle trance.

(6) Rhythm has also given way to poetry - a stream of meaningful (well, not always) words that have a rhythmic pulsation, and it is by the virtue of this rhythmic pulsation that poetry creates the particularly strong emotional effect it is famous for;

(7) On the internal side, rhythm is the most potent means in humans to achieve the state of "battle trance." The state of battle trance is absolutely crucial for a successful confrontation against enemies and predators;

As we can see, the appearance of rhythm and the ability of entrainment was an event of profound importance in our evolutionary history, particularly for the ability of selfish individuals to get lost in the intoxicating feel of a collective identity. As the feel of rhythm can appear randomly in individual animals of various species, we can hypothesize that the feel of rhythm among human ancestors also appeared first as a result of random genetic mutation. In the next generation it was most likely transmitted to a few of the offspring of the first ancestral Ringo Starr, and these first

grooving hominids gained a strong survival advantage in their rhythmically united audio display and the enhanced feel of group identity. As a result, with every new generation the number of hominids with the sense of rhythm would increase, until the entire stock of future humans had an amazingly sharp sense of rhythm and the ability to lose themselves to a collective identity.

The spread of new useful genes and behaviours can happen very fast. When the importance of military drills was discovered, or more correctly, re-discovered by the Dutch army of prince Maurice of Orange in the 16th century, it spread throughout the armies of Europe like a bushfire. The reason for this rapid popularity of military drills was the fact that drilled armies were routinely defeating bigger but non-drilled opposition (McNeill, 1995). I suppose that the reason for the universal spread or the sense of rhythm among our ancestors was the same – the deadly and intoxicating power of rhythm to put participants into the coveted battle trance and to fight with a true disregard for their personal safety.

As a phenomenon, rhythm gave our ancestors on one hand a wonderful tool for better audio intimidation of an opponent, and on the other it revolutionised hominid group cohesiveness by introducing the shortest way to reach a specific altered state of consciousness where the interest of the group was overriding all the instinctive fears of self-preservation.

Rhythm and the resulting mental state of the battle trance made possible such profoundly important elements of future human culture as religion and war. Both religion and war are based on a new hierarchy of instincts, where in critical situations group interests are overriding selfish instincts. Rhythm became one of the strongest factors of the group selection mechanisms in the complex interaction of different selective methods of multi-level selection in human evolution (Brown, 2000b). The phenomenon of dance, another universal element of human culture and evolution, became profoundly intertwined with the sense of rhythm and the feel of collective identity.

Maurice de Saxe knew this in the 18th century (and possibly Maurice of Orange in the 16th century). Talking about the secrets of preparing soldiers for action in his classic military tractate *Mes Reveries*, published posthumously in 1757, he proposes that the secret of war "is nevertheless very simple, because it is dictated by nature – it is nothing more than to march in [synchrony] in which alone consists the whole

mystery…Nothing is more common, than to see a number of persons dance together during a whole night, even with pleasure; but deprive them of music, and the most indefatigable amongst them will not be able to bear it for two hours only, which sufficiently proves that [musical] sounds have a secret power over us, disposing our organs to bodily exercises, and, at the same time, deluding… the toil of them." (Maurice de Sax, 1757).

We could go on and on about the importance of rhythm in human evolution and cultural behaviour, but let us now turn our attention to another factor that stemmed from the human ability to follow rhythm, and is known to every reader of this book who has heard rock musicians famously counting in: "One, two three, four…"

The Sign of Four, or why Paul McCartney's "Yesterday" is truly unique

Yesterday evening I watched a wonderful Russian adaptation of Conan Doyle's "The Sign of Four" with Vasily Livanov as Sherlock Holmes. Livanov is outstanding as Holmes – simply the best. It is no accident that, out of all actors to play detective Holmes, a character portrayed over time by more than 70 actors, his Holmes was singled out by Arthur Conan Doyle's youngest daughter Jean Conan Doyle as the best one, and it is also no accident that Livanov was the only actor playing Holmes who received the MBE from Queen Elizabeth for his portrayal of the legendary detective.

Anyway, why did I mention this in the first place? Oh yes, I wanted to discuss the mysterious power of the number four in music.

Number four is a truly universal element of human music and has a dominating position in human music both on a micro and macro level (Brown & Jordania, 2011). Four beats is arguably the most popular length of a unit known as a bar. Four beats in a bar is a time signature so popular that it is known among musicians as "common time" (C, or 4/4). Furthermore, on every level we have the prominence of four-fold increases in the numbers: 4: 8, 12, 16, 24, 32, etc. and even the number of parts of a

classical symphony, arguably the pinnacle of classical music, is four. In all genres of music, from traditional and jazz to classical, pop and rock music, four bars, four sentences, four repetitions of structures is a common practice. I often conduct a simple experiment with my university students: I play them a simple introduction to a song that is unknown to them, playing the same chord, with the basses alternating between the tonic and dominant, and ask the students to raise their hand when they feel it is the right time for a singer to start singing – almost everyone raises their hands after four beats. As a matter of fact, you will struggle to find a pop-music song which has a verse, or a chorus, consisting of seven bars.

There is a famous example of a seven-bar song structure. Paul McCartney's "Yesterday," possibly the most popular pop-song of all time, has one of the most famous verses lasting seven bars. I do not think Paul himself knows this unique fact about possibly his most famous song. In the book specially dedicated to this song (yes, there is such a book, see Coleman, 1995) this unique feature is not even mentioned. It is not easy to notice this asymmetry at all, as the melody flows so effortlessly that unless you count for some reason the number of bars, you will not notice the unusual number of bars. Although I am an avid fan of the music of The Beatles and have arranged dozens of their songs for classical guitar and piano, however it was not until I started arranging this song for a choir and wrote the arrangement as a score, that I realized the verse was only seven bars - this is a truly unique occurrence, particularly for popular music. Hundreds of thousands of musical compositions, from classical music to pop-songs, are based on four and eight bar structures.

Every human universal, I believe, has a strong evolutionary reason. So what evolutionary forces could be behind this magic power of "the sign of four"?

First of all, if you want to create the maximally impressive sound with the use of a group of people, your best shot will be to have them making sound in a well-coordinated rhythmic unity. This was the appearance of the sense of isochronous rhythm, and we have discussed this on previous pages.

The next step to make the sound even more impressive would be to have certain moments where there is a burst of particularly loud sound from everyone. This can be achieved if everyone makes their loudest call exactly at the same moment. If you hear a threatening sound, the effect will be tremendous if the sound gets louder for a

fraction of a second. To achieve this in a group of singers every member of the group needs to know exactly at which moment they need to give their loudest call. This can be achieved if everyone agrees prior to make their loudest call after a certain number of beats, for example, after each three or four beats. But of course, at this distant historical epoch no mathematical abilities were yet present in hominids, so any such mathematical "pre-agreements" had to be formed and maintained purely instinctively. I propose that organizing rhythmic flow in regularly accented patterns was developed by natural selection as an important device to make the group human sound more impressive. This was the birth of a well-known phenomenon that musicians refer to as "musical metre," or the division of musical flow into musical "bars" ("measures"). Apart from making the sound more impressive, synchronous accents show the level of coherence of the group to the opposing side.

OK, but why four? It will be very difficult to correctly guess why such a universal number was chosen to be four, not three, or five, or seven. The number four has several unique features - some objective and some culturally designed. It is the smallest composite number. Even all DNA in every live organism consists of four elements. Most mammals have four limbs. There are four directions of orientation as can be seen on a compass, the Christian cross has four ends, the crossing motion across the chest contains four movements in four directions on four sides, etc. There can be many other factors that empower the number four to become a basis of human sense of rhythm and musical structures. Most likely, there were several factors contributing to the number four becoming the most dominant number in music and human rhythmic feel. We can also propose that the fact that we have two feet (and before we used to walk on four), made us predisposed towards even numbers.

Even if we do not understand what the crucial factors are behind this choice, we have to admit that dynamic accents based on four counts were not a human cultural choice of certain talented musicians, but rather was a choice made by the forces of natural selection in order to assist the survival of our distant ancestors on the woodlands and savannah of Africa. Interestingly, in Japan number four is a number for death (possibly a "completed cycle"?). For our species, the number four was a number for life, symbol for unity, and a number that assisted our survival for millions of years.

The importance of low range voice

If you want to impress or intimidate someone with your voice, apart from having a loud voice, having a low range voice is another great advantage. A lion or a tiger growl is possibly ten times more impressive than the sound of a leopard, although the leopard is not that much smaller and can also easily kill humans. Military officers with lower and more impressive voices, as a general rule, have a better military career.

It is obvious that the range of the sound made is directly connected to the size of the animal making it. Bigger animals can produce lower and louder voices – that is why when you hear a lower sound, you instinctively think of a bigger and stronger animal producing such a sound. Elephants and whales can produce sounds so extremely low (so called 'infra-sounds') that we humans cannot hear them.

The peculiarity of the human voice is that our voice range is much lower and louder than it should be according to our body mass. For the sake of objectivity we possibly should introduce a sound-weight ratio (SWR) to find how strong and how low the sounds are that animals of different species can produce. Unfortunately, unlike the earlier discussed height-weight ratio, sound-weight ratio cannot be easily put in action as there are virtually no works where a wide range of sounds produced by different animals has been be measured or discussed. The ratio itself is easy to measure: you just need to know the weight of an animal (this parameter is easily available for any species of animals), and the lowest range of the sounds that an animal can produce (this is the difficult part, as such information is often absent).

The situation with SWR (sound-weight ratio) is even more complicated as this ration should actually have two versions SWR1, and SWR2: the first that measures the **strength** of the sound in decibels (this will be SWR1), and the second one that measures the **lowest range** of sounds that the animal can produce (SWR2).

Even without precise measuring tools we can say that the SWR1 will be very high in some birds and smaller monkeys, who have incredibly loud voices in comparison of their tiny body mass and weight. Some singing birds, particularly some parrots, are possibly the champions of this category.

Interestingly, although flying, singing and mimicking birds can have incredibly strong voice and respectively very high SWR1, their voice range is not among the lowest of the voices. It seems that it is easier to produce a stronger sound with a smaller body, than it is for that body to make a lower range sound.

Humans, the only singing terrestrial species, can compete with the loudest animal species in the loudness and the range of the produced sounds, including low-range sounds. Lions and tigers are among the animal species that have an incredibly strong and low voice – humans, very tellingly, can imitate the sounds produced by these big cats. Jim Corbett and Kenneth Anderson, as we know, could imitate tiger sounds in order to call them up, and used this skill to get rid of several man-eaters.

It is true that not many of us have voices as strong as Luciano Pavarotti or Paul Robson, but we should remember that we live today in a completely different world with different life concerns and different survival needs than our ancestors had a few million years ago. Today good linguistic and math skills are much more important for attaining general success in life than a loud or low voice, but this was not the case with our distant ancestors. Language and math were not yet around, but groups with more members with stronger and lower voices would have better chances of survival as they were better at intimidating predators and competitors. Therefore, our ancestors most likely were selected for the strength (and range) of their voices.

The telling detail of our voices is that the male voice is unusually lower than a female voice. Sure, males typically have a larger body than females, but this difference is not as much as to create such a large difference in range. We take this difference in voice ranges for granted, but if you pay attention to the facts you will quickly realize how unusual it is for the animal kingdom. Male and female lions and tigers definitely do not have such a big difference in voice ranges. Yes, male lions sound somewhat louder and lower, but the difference is in no way as drastic as it is in human voices. So how big is the difference between male and female voice ranges? Can we measure it objectively? Yes we can.

Directors of choirs know very well that the difference in range between male and female voices is precisely an octave (this means male voices are twice as low as female voices). No other primate has such a huge difference in range, including gorillas where the difference in male and female body masses is huge.

It is clear that our evolutionary predecessors developed such a low voice for good reasons. In explaining this feature of human morphology, both sexual selection and the aposematic model may suggest their explanations with different reasons. I am sure that if the proponents of sexual selection paid attention to the huge difference between male and female voice ranges, they would have suggested that males with lower voices were selected by the choosy females as those with lower voices are perceived as stronger, healthier, and generally better for the role of the prospective father of the offspring. On the other hand, the principles of a warning display (aposematism) suggest that those with lower voices had a better survival chance as they were better at intimidating predators and competitors. Well, as I have already mentioned, we do not need to perceive these two factors as mutually exclusive. On the contrary, the low male voice could have had both functions, and I propose that the factor of warning and intimidating predators and opponents was the primary cause of dropping the male voice range. As a useful morphological feature for survival, it was selected by the forces of natural selection and later also became more attractive to the better half of humanity.

Furthermore, the proponents of sexual selection should also take into account that a lower male voice is not considered better for the attraction of females. Male singers with high voices are doing much better in attracting female admirers – the majority of world famous singers are tenors, not basses. Similarly, the absolute majority of rock star singers also sing very high. Also, in most of the operas charming romantic characters are as a rule tenors, and low voice bearers are often the antagonists. This is another strong argument that the lowering of the male voice evolved for intimidation, not for attraction.

Something similar is happening in animal world as well. An expert of wolf communication, Fred Harrington writes, “Lowering the pitch of a vocalization is a nearly universal sign of increasing aggressiveness in mammals... …an alpha male howls after approaching a stranger who had howled close to the rendezvous site. The long, low-pitched and coarse howls seem designed to scare off the intruder without the need for a face-to-face confrontation” (Harrington, 1997, see also Badridze, 2016). These few sentences sum up the very essence of aposematic audio display: scaring away a competitor with a low voice display without the need to engage in a costly physical confrontation.

So, in explaining the evolutionary reasons for the emergence of the unusually deep male voice, I totally agree with the suggestion of Desmond Morris that a low male voice could have been very useful to "intimidate human rivals, to drive prey or to scare off predators" (Morris, 2008: 92). The low voice of human males was almost certainly a part of the intimidating package that our ancestors used against predators, including the ancestors of contemporary big cats.

Thrilling octaves

Let us discuss the big difference between the male and female voice ranges. The difference, as we remember, is an octave. Let us now ask ourselves, why is it an octave and not any other interval?

Playing (or singing) in octaves is widely used in some cultures where men and women sing together, seemingly in unison. This enables both men and women to sing together and feel as if they are singing the "same thing." Even more so, playing in octaves is also widely used in heavy rock music, and also interestingly enough in Hollywood thrillers. This preference of octave-playing in rock music and Hollywood thrillers is connected to the sound and feelings arising from the sound of the octave interval. An octave often has the emotional feel of suspense, aggression and danger. For rock music's expression of protest, frustration and aggression this is an integral part of the design. This is why, since the appearance of Led Zeppelin's trademark sound where the lead guitar and bass guitar were playing in unison the same riffs an octave or double-octave apart, this sound became arguably the most enduring musical symbol of rock music (particularly heavy metal rock music, known for its aggressive qualities). For the very same reason, movie composers often use the hollow and unsettling sound of octaves (and double or even triple-octaves), as these sounds instill a feeling of concealed danger and are thus very suitable for thrillers and horror movies.

The magic of harmony

We all agree that a group of people singing (or even shouting) together will increase the volume of the sound. However, there are various other ways to achieve a more impressive overall sound – one of them is to sing in harmony, or sing in different parts.

Many choir directors would agree with me that the volume in the sound of a choir increases when its members sing in harmony. When the overtones of different pitches clash with each other in one simultaneous harmonic sound, the result is a more robust overall sound. Another very important effect of singing in harmony is the impression of a bigger number of participants than there is in reality. You may agree that this feature of singing in harmony is of particular importance if you have to scare away predators or competitors with your sound. This phenomenon, when sounds created by a smaller group give the impression of a larger group, is known as the "Beau Geste" effect. If you are interested to know how efficient this effect is, here is a short example of American Civil War history: "General Ulysses S. Grant reported hearing what he took to be a pack of "not more than 20 wolves" while traveling. A short time later he reached the pair of wolves that had been making all the noise!" (Harrington, 1989:217). Fred Harrington, who studies this phenomenon, came to the following conclusion: "The observation that chorus howling by adult pairs is often perceived as that of larger groups with pups suggests that chorus structure has evolved to exaggerate the apparent size of the pack, especially those newly-established or otherwise reduced in number. If so, wolf howling choruses may represent a mammalian example of the Beau Geste effect, made particularly viable because of the relative immunity of the signal to probing" (Harrington, 1997; See also Bardidze, 2016).

The singing in harmony that so many of us enjoy possibly evolved initially in order to make the sound of our distant ancestors deceitfully impressive.

Dissonance: The ultimate sound

We have just discussed that singing in harmony makes the overall sound more robust, creating the impression of a larger and more imposing group. Another question is: what kind of harmony could have been employed by our hominid ancestors? Professional musicians know that there are several different ways of singing in harmony. You can sing in parallel thirds and parallel sixths, and this will lead to a nice relaxing harmony, prevalently used in classical and contemporary pop music. Parallel fourths and fifths make a very different sound – rough and somehow hollow. The opening riff of the classic rock song "Smoke on the Water" uses parallel fourths. Parallel fifths are so prevalent in rock music that a special type of chord, consisting of only a fifth, was created. This chord is known to most as a "power chord", and if you have ever played in a rock band you will most likely have played thousands of power chords. Apart from singing in intervals, you can also use a drone (sustained note) together with a melody, you can sing in very wide or very close intervals; you can also sing in two, three, four, or more parts, and also you can sing in consonant or dissonant intervals and chords.

All these different types of singing in harmony create very different end-results. According to my over 30 years of experience as a choir leader and a university lecturer in various styles of harmony, singing in dissonant intervals and chords creates the most startling, the most robust, and the most impressive overall sound. The interval that is particularly impressive in this regard is the second. The second interval is the closest possible interval. There are two types of seconds: major second and a minor second. Interestingly, the most impressive dissonance is not a minor second, or even a major second, but a neutral second, which is in between the minor and major seconds (you cannot play this interval on tempered instruments). These characteristics make singing in dissonant harmonies, and particularly in seconds, the best possible option for the intimidation of opponents.

In my 2011 book I suggested that singing in harmony and singing in seconds was created by the forces of natural selection, and that this tradition was taken by our distant ancestors from the African 'cradle' to the different regions of the world. I also suggested that some remnants of this primordial polyphonic singing style are still

surviving in the most isolated regions of the world. Is this possible? To search for the answer to this question, the best way would be to search for a polyphonic style with a loud and piercing sound and with very sharp dissonances. And ideally, examples of this style must be found in geographically isolated places, ideally on different continents.

If we look at the stratification of singing styles (discussed in the first chapter of my 2006 and 2011 books), we can see that a very specific polyphonic style stands out in different parts of the world. This is a piercingly loud singing style, based on an acoustically maximally dissonant interval of the second. Even more precisely, this interval is between the major and minor seconds, measuring 14-16 hertz. This is "the most dissonant dissonance" – the neutral second mentioned above. This interval and this type of harmonic singing is known in ethnomusicology under the German term 'Schwebungsdiaphonie' (lit.: "rough sound," "rough harmony").

Another amazing fact is that singing in this style is distributed to the most isolated and distant regions of the world – the Himalayas, the mountain ranges of Hindu-Kush, the Caucasian and Balkan mountain ranges, North Vietnamese and Taiwanese mountains, South-West China's forest-covered mountains, hard to reach regions of Papua New Guinea, some islands of Indonesia and Melanesia, among Gonds of Southern India, the swampy forests of East European Polesie between the Ukraine and Belarus, and the fringes of Europe in the Baltic region. I call this polyphonic style Drone-Dissonant style (D/D Style), referring to the two most important elements of this style (drone and dissonances). Some remnants of D/D style are also found in isolated regions of Africa, in North Japan among the Ainu peoples, and in the Andes among the Q'eros of South America. The amazing similarity between the polyphonic styles of such isolated regions and cultures strongly suggests that these can all be remnants of a common singing tradition. The development of such a specific polyphonic style by so many differing cultures as a coincidence is virtually impossible to imagine.

The striking resemblance between Balkan and Indonesian traditional polyphonies left the brilliant Dutch ethnomusicologist Jaap Kunst totally astonished. He published a book in 1954 on this subject, in which he tried to substantiate a fantastic hypothesis that the there was a major prehistoric migration from the Balkans

to Indonesia. The problem with this hypothesis was that the parallels between the Balkans and Indonesia that he discovered are only one of many such parallels: the same style of singing is present in many other parts of the world, and is abundant in the most isolated localities.

The similarity of stylistic elements and the sound between these traditions is amazing. When, in the 1980s, Austrian-Australian comparative musicologist Florian Messner played a recording from Bulgaria to Indonesian villagers, the Indonesians were sure that this was a recording made in a neighbouring village, and the reaction of Bulgarian villagers was exactly the same upon hearing a recording of the Indonesians' polyphony (Messner, 1989). I can also say that, although I have been studying these polyphonic styles for years, I still cannot distinguish them from each other.

The only serious argument against the suggestion that these polyphonic styles are survivals of pre-historic and even pre-modern human times is the immense stretch of time (literally millions of years) that supposedly passed without much change in these singing traditions. Otherwise the amazing closeness of singing traditions on one hand, and the distribution of this style in many extremely isolated regions on the other hand represents a classic case of 'remnants of an ancient common practice'. Victor Grauer famously declared that Bushmen/Pygmy polyphony (based on yodeling) can be a survival of the earliest singing style of humanity, stretching back for the last 100 000 years. Grauer relies on the 'Recent African' or 'Total Replacement' model. My research and polyphonic data supports more the 'Multiregional Evolution model', also known as the 'network model', where the count for the age of humanity goes on for millions of years rather than thousands.

If we believe that such a long survival of a singing style is impossible, then we are facing the even more difficult task of explaining the presence of amazingly similar and very specific dissonant singing traditions in very specific intervals in such wildly different places of the world. Therefore, I suggest that we should not discount the simple possibility that these are all remnants of the oldest human singing style, the style that helped our ancestors get into the battle trance and obtain collective identity in order to fight together, as a unit, for their common survival.

Some readers may consider this suggestion of the direct links between choral singing, one of the highest expressions of human musical and spiritual culture, and

the singing of prehistoric hominids as a bit of an insult, but for me there is something very deep and very poetic in making evolutionary connections between J.S. Bach's chorales and the final chorus of Beethoven's 9th symphony on one hand, and the trance-inducing loud singing in dissonant harmony of our distant ancestors in order to stand their ground against mighty predators a few million years ago on the other hand.

It is widely known that many cultural inventions that make human life safer, more convenient and more meaningful were initially invented for the reasons of safety and military capability. I suggest that human choral polyphony is one of these elements, a phenomenon that belongs to human culture, but has its roots deep in safety concerns, seemingly out of the realms of human "culture."

Thus, I believe we should not speak about the "invention" of polyphony among early hominids of humans in the same way as we should not speak of the "invention" of rhythm, or music. It was a case of the selection of an advantageous trait by the forces of evolution, very much like the adoption of bipedalism, or the growth of long head hair.

Drumming as a defence tool

Apart from making sounds with voices, humans can make plenty of noise by employing other means as well. Drums, for example, make an effective tool for intimidating the most dangerous predators. Jim Corbett gives a brilliant example of the use of drums for intimidating and driving out a man-eating leopard. Here is an excerpt of Corbett's account from his hunt of the Rudraprayag man-eating leopard, arguably the most famous man-eater in human history, one who's notoriety not only earned it a book, but a film as well.

The last victim of the Rudraprayag leopard was a young boy who was snatched from his own house as he was following his mother and other family members up a staircase, carrying (as others also were) some kitchen utensils they just washed. The boy was last in the queue of family, and when the family members entered the house they heard the noise of fallen kitchen utensils. They naturally assumed that the boy

had dropped the kitchenware and went out to punish the boy for being so clumsy. The fallen kitchenware was lying on the ground, but there was no trace of the boy. They decided that the boy had been embarrassed of his clumsiness and was hiding, and started calling him. It was only then that they noticed, in the fading light, traces of blood and understood that the dreaded man-eating leopard had attacked and took away their boy. Realising this they started drumming the big drum they had in the village, as loud as they possibly could. The result was quite remarkable. The man-eater, a big male leopard who was not afraid to enter a house in broad daylight and wait on the first floor for several hours to snatch a boy from a group of family members (man-eating leopards generally attack humans in the dark) dropped the body of the boy as he was making his exit just past the village walls (unfortunately, the boy was already dead) and ran away. It is not easy to scare away a hungry man-eater and to make it leave its dinner behind, but this is exactly what the drumming did in this well-documented case.

Pygmies, who live in the jungles and are at constant risk of a leopard attack, also use drumming when they know a leopard is in proximity to the village. American artist and author Anne Putnam starts her book about her time spent with Mbuti pygmies with the dramatic account of a leopard attacking a woman in a pygmy village in the middle of the jungle (Putnam and Keller, 1954). Fortunately, this time the victim was rescued from a terrible end, and while villagers were caring for the wounded woman others started frantically playing on a big drum in order to scare away the hungry leopard.

Drumming in order to scare away predators and competitors is a much older practice than readers might think. It is a highly important fact that drumming behaviour, as a tool for intimidation, is present in all three of our closest living relatives – chimpanzees, bonobos and gorillas. In an insightful article about primate drumming behaviour Tecumseh Fitch proposed that there may be direct connections between ape drumming behaviour and the human passion for drumming (Fitch, 2006:2, 9). Apes drum on external objects, usually on trees, and together with drumming they use other elements of aggressive behaviour (shouting, shaking tree branches, stamping on the ground) when they are facing predators and competitors.

If the extremely interesting suggestion by Tecumseh Fitch about the direct evolutionary links between the drumming behaviour of great African apes and humans is correct (and there are no reasons against this suggestion) then drumming must have existed in common human-chimpanzee-bonobo-gorilla ancestors and therefore must have preceded the appearance of the sense of rhythm. There is no question that drumming exists in many other animal species unconnected to humans (for example among rodents such as rabbits and kangaroo rats). Drumming behaviour can arise independently in different unrelated species, but the presence of drumming in apes, our closest living relatives, points to the presence of drumming behaviour being present on the level of our common ancestor.

An interesting conclusion can be made from the notion of the shared tradition of drumming among humans and African apes. As out of them only humans have the confirmed sense of rhythm, it becomes obvious that in our evolutionary history drumming appeared earlier than the sense of rhythm. Drumming even without rhythmic unity is already a potent warning and intimidating tool, but with the presence of rhythm and a synchrony within the group utilizing simultaneous dynamic accents and coupled with singing/shouting, drumming becomes an excellent tool to put group members in an altered state of mind on one hand, and to intimidate the opponent, even the strongest of predators, on the other.

We will now discuss how animals react to loud noises. We will see that animals and humans have quite different levels of tolerance towards loud noise. Knowledge of this sphere is also quite important if we care for putting animals in a friendly and suitable environment.

Killing sounds, or why dolphins do not like rave parties

Humans are incredibly tolerant to loud noises. We can work at the factories where the noise is over 100 DB and we can listen to and even enjoy rock concerts where the sound level is deafening (like 120 DB). Of course, very loud sound can be a dangerous thing even for humans. Apart from gradually losing our hearing if we

are exposed to prolonged loud sounds, extremely loud sound can also put us into shock. For example, the noise from a detonation of a bomb or mine can cause shock and concussion of combatants or civilians who were close to the explosion.

Most animals are terrified by loud sounds – rifles are used against predators for their loud sound almost as much as for their stopping power. Discharging rifles in the air is a very popular way to scare off predators. Some other much less threatening sounds can also terrorize the strongest of predators. Here is a story of a lucky Indian trader who escaped a grim death from arguably the most famous man-eating lions, the Tsavo man-eaters:

"On one occasion an enterprising bunniah (Indian trader) was riding along on his donkey late at night, when suddenly a lion sprang out on him, knocking over both man and beast. The donkey was badly wounded, and the lion was just about to seize the trader, when in some way or other his claws became entangled in a rope by which two empty kerosene tins were strung across the donkey's neck. The rattle and clatter made by these as he dragged them after him gave him such a fright that he turned tail and bolted off into the jungle, to the intense relief of the terrified bunniah, who quickly made his way up the nearest tree and remained there, shivering with fear, throughout the night" (Patterson, 1919:97).

Most animals' level of sound tolerance is much lower than ours, and yet we are still in the infancy of understanding this profoundly important fact. You can sometimes find cases of chickens dying in thousands if their farms are close to a concert or festival site, or to a loud party.

I will recount a tragic story about our gentle aquatic friends, dolphins. This happened in Florida, at the Gulfarium Fort Walton Beach on the Gulf of Mexico in 1957. There was a need to repair the existing aquarium, and the responsible officers decided they could undertake repairs while a group of bottlenose dolphins were inside the huge tank of water. They knew dolphins would be distressed but they did not expect anything too extreme. So they started the repair works that involved loud banging on the tank body. The work was finished, the tank was repaired. What about the dolphins? In several weeks all six dolphins were dead. They died one after

another, with similar symptoms. On examination they were found all to have developed severe duodenal ulcers (Garfield, 1972:374).

It takes a while for humans to learn their lessons – more than half a century later, in 2011, the tragic story was repeated. A loud techno party was organised in Connyland, in the eastern town of Lipperswil, Switzerland, in an amusement park next to where an aquarium is located. Loud dance music went for 16 hours. The result? After three weeks of the party the 8-year old resident dolphin, Shadow, was dead. There was a heated argument over the internet as to whether the dolphin died from sound shock or from some other cause, for example a certain substance fed to the dolphin. Even if there were other possible factors involved, it is useful to remember that loud sound alone is a potent killer to dolphins.

Another tragic example of animals' reaction to sound shock comes from war-torn Yugoslavia. When NATO started bombing Belgrade on March 24th 1999, humans were not the only ones traumatized – the animals from the Belgrade zoo were also affected, probably even more so than humans. According to zoo personnel, as bombs exploded and the sirens sounded their alarm, animals started screaming and howling in desperation, while all the birds fell completely silent. As the result of the audio stress and resulting shock, animals displayed disturbing behaviours. A tigress and the Canadian and European she-wolves killed and ate their offspring. Many zoo birds also killed their young. A pregnant lion, constrictor, zebu and zebra all aborted. Probably the most shockingly, Prince, the zoo's favourite Bengal tiger who was hand-reared and was taken on walks through the city and on motor boats while he was still a cub, became so traumatized that he started eating his own hind legs.

We often do not realize how vulnerable animals are against the human-created loud noise – and humans are masters of making extremely loud noise, both with their voices and with the help of other devices invented over time. Even without amplifiers we can make sounds that can scare away the strongest of the predators. The famed "Wall of Sound" was not Phil Spector's invention. Our ancestors used it with great effect to secure themselves from predators and obtain food by chasing them away. Now as the times when we were in danger of predator attacks are gone for good, and that we have much better tools to make much bigger sounds, we need to consequently be more responsible with this deadly weapon.

Humans cannot stand silence – while traumatized by complete silence for only half an hour a fellow human started biting his left hand.

Animals cannot stand loud sounds – while traumatized by loud sounds, many animals ate their young and a tiger started eating his legs. These are sad parallels.

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Let us now arrive at a conclusion: there is no question that humans have an incredibly wide range of audio signals with which to intimidate predators and competitors. They drum, they shout, they sing, and not only sing, but sing in harmony – and not only sing in harmony, but sing in the most dissonant, startling, attention-grabbing harmonies. And finally, humans have the sense of rhythm, which was not only an important tool to make their audio display more impressive, but through a specific battle trance it created a psychological transformation from a group of selfish individuals to a closely-knit unit of warriors where members were ready to sacrifice their lives for each other and for the common goal.

I do not want to go into the discussion of the amazing variety of war-cries that combatants have universally used and still use in all human cultures. From the popular war cry of Sioux Indians "*Hokahey*" (loosely meaning "today is a good day to die!"), to the "Oorah"of the American Marines and Russian troops during the Second World War, and to the famous Moslem "Allah hu Akbar," the battle cry in various cultures as a rule is shouted at the top of one's lungs in order to raise the spirit of your side and intimidate the opposite side.

The New Zealand Haka is probably the most widely known example of such a display designed to unite the ranks of a combat unit (or in the famous modern case a sporting team) and to intimidate the opposition. The better that the synchronization is, the stronger the impact of such display is to both sides (performers and their enemies). When we were discussing the power of rhythmic synchronized display, my friend Preetum Gheerawo, who provided me with very useful information on man-eating lion habits, sent me his vivid description of the reaction of South African rugby fans witnessing Haka in action for the first time:

"I'm not a particularly avid rugby fan, but when an international match was scheduled in Durban in 1990 prior to the World Cup of 1991, I watched the game together with several of my friends. This was the first game after our exclusion from international competitions. Our proud South African Team was facing what we thought were "headless chickens" because they called themselves Kiwis (we did not even know if it was a name of the fruit or the bird)… Well, what would have been a straight-forward win for the springboks (South African team), was becoming a nightmare from the very first minute before the match started when the Kiwis (or as they would call themselves the Maoris) performed a tribal dance with highly noisy rhythmic group singing and their leader with a shaven head except for a small patch on the forehead. The whole stadium was thereafter hallucinated and our South African players too. On that day New Zealand destroyed us 26-0 or something like this, on our own soil! The most humiliating defeat ever, but thankfully not in official competition as it was a friendly."

I would like to add here that, apart from helping to win a friendly rugby game, this kind of highly synchronized intimidating display helped countless generations of our distant ancestors to win life-and-death encounters with predators and with rival human groups.

Olfactory Display, or Why Do Humans Have Body Odour

Apart from visual and audio signals, aposematism as we may remember also includes an olfactory display, or the display of various smells. Non-aposematic animals try to stay as clear and as odourless as possible. Primary examples of such animals are all species of cats, which are legendary for their cleanliness. Of course, cats are clean not because of some innate strive towards cleanliness – it is their lifestyle and their hunting strategy, based on stealth and stalking, that requires such strict hygiene. A smelly cat has much less chance of hunting success as prey animals can smell their presence.

Male lions have several aposematic elements unusual for other cats, such as their highly visible mane. Also, very unusually for cats, they are less concerned about their cleanliness. As a result, male lions are well-known as probably the worst hunters among the big cats.

Aposematic animals, unlike clean cats, try to advertise their presence by all possible means, and spreading body odour around is one of the most popular means of advertising your presence. This is why virtually all aposematic species have some body odour, some not so strong but some quite overpowering. Body odour, apart from being easily noticeable, also plays the role of negative advertisement, and its message is "see how badly I smell? Do you really want to eat me?"

Also, very importantly for our discussion, in the moments of stress aposematic animals tend to intensify their body odour.

So what about us? Do we have body odour? Some readers might consider our species quite clean and odourless, but in fact we naturally have quite a strong body odour. If you doubt this, imagine yourself staying without a shower for a couple of months, or better, a couple of years. Amazingly, most likely you will not notice your own body odour, but you will definitely notice that people around you are watching you with suspicion. People possibly will also try not to stand too close to you on public transport and in lifts. And now imagine our ancestors who did not have a shower not only for couple of years, but for their whole lives. They stayed unwashed for tens of thousands of generations let alone their own individual lives. It is obvious

that our distant ancestors had quite a strong body odour, and we have indeed inherited this body odour from them.

Body odour is directly connected to the sweat that our body produces. Actually, the sweat itself is virtually odourless, but the bacteria that lives on the skin and thrives on the sweat is the real cause for our body odour. It is well known that human bodies have an unusually large number of sweat glands and that we produce more sweat than most other animals. The best-known explanation for the function of sweating is thermoregulation, or cooling down the body's temperature. It has been also suggested that sweating can be a pheromonal signal to conspecifics, signalling various states (e.g. fear, sexual arousal, aggression).

The aposematic nature of hominid and early human defence systems suggests that sweating and particularly excessive sweating could be a crucial factor for creating a strong body odour in our ancestors. The fact that in moments of anxiety or fear humans produce much more sweat and body odour than they do regularly also points to the aposematic nature of human sweating, also since when we are scared there is no need for thermoregulation.

Humans do not only have body odour, we have even developed special morphological means to achieve more effective and stronger body odour. Have you ever thought why humans have patches of hair around their armpits and genitals? It is notoriously difficult to explain the evolutionary function of these seemingly random patches of hair. Some suggested that they were designed by sexual selection to attract the opposite sex (see Kohl and Francoeur, 2002), which is difficult to believe considering how models try to get rid of any remnants of bodily hair, and how people try to conceal their body odour with the use of different unnatural scents. One of the most popular ideas is that pubic hair allows one to identify a human's level of physical maturity. This is also quite suspicious as, unlike many other animal species, humans (and a few other primate species) have sexual desires from a very early age. The idea that humans start feeling libido only when they are physiologically ready to become parents is a misconception with religious undertones. Some suggest that presence of body hair helps to reduce friction when we move our arms when running, and also during sexual intercourse. This suggestion also does not seem to be very realistic. If we allow the idea that humans are aposematic animals, and that having strong body odour was one of our many ways

in which to communicate our "warning flags" by different modalities, then it becomes clear that the patches of hair must have been developed for what they are still best at: producing a stronger body odour.

I therefore suggest that these hairy patches on our body appeared as the result of the response to natural selection's pressure on our ancestors to produce stronger body odour. Humans have strong body odour as we needed it during the millions of the years of our survival struggle in the open forested areas and grasslands of Africa.

We have a beautiful cat, Socky. She is already 16 years old. Like hundreds of millions of other cat lovers, we all cuddle Socky a lot, and we often express our amazement at how it is possible that she is always cleaner than us despite the fact we shower every day and she has never had a shower or a bath in her entire life. This is the difference that comes from the evolutionary rules of natural selection. This is the difference between the representative of stealthy and cryptic predator species, cats, and aposematic species like us humans. Cats need to stay unnoticed for survival, but we needed to advertise our presence by all means, including body odour.

Humans keep a wide array of different animals as pets, some are aposematic (like skunks and peacocks) and some are cryptic (like cats of different sizes). Aposematic pets have their positive and negative sides: they are generally beautifully coloured, as they need to be clearly seen – think of the same skunk or a peacock. On the more negative side of things, aposematic animals might emit disturbing smells (skunk), or a particularly unpleasant voice (peacock). We humans are clever primates and we have already learned how to get rid of skunk odour glands, and if we ever learn how to get rid of peacock's loud and unpleasant voice, they may also become more popular as pets.

One more suggestion – there are some genetic conditions that cause excessive sweating and may cause excessive body odour. Hyperhidrosis is the medical term for excessive sweating and facial blushing. It is not difficult to imagine the embarrassment and anxiety of people with this condition. Luckily, there are ways to get rid of this condition permanently, which was of course not an option for our ancestors. I think it is possible to propose that this condition could have been much more widespread in earlier periods of our prehistory, when a stronger body odour meant stronger aposematic defence. Therefore, for millions of years our ancestors would have been selected for their stronger body odour. Later however, with the

change of lifestyle and improvement of overall species security, we lost the need for excessive perspiration and strong body odour and this feature started gradually disappearing.

We enjoy virtually all the traits that natural selection and our evolutionary granted us as aposematic species: we love our proud bipedal posture, we enjoy our long legs, we enjoy our long head hair so much that if we start losing it, we desperately search for ways to retain or regenerate it; we cherish our talents as singers and composers and pay money to become better at music, we love dancing and can dance for hours to driving rhythmic music, we love body painting, enjoy tattoos, wearing masks at the masquerades and carnivals, we love artistic transformations, and of course we love our clothes (some even too much). In short, we love who we are, but there is one element of our evolutionary legacy we try to conceal by all means – our body odour. We shower daily and use plenty of deodorants and various perfumes to mask our natural body odour. It has been many thousand years since we needed our body odour to fend off prowling predators. Many other more effective means of defence and security came into our lives – controlled fire, shelters, and man-made weapons are much more effective than body odour. We should still remember that we needed our body odour for millions of long years and that this evolutionary legacy is not going to easily disappear.

Behavioural Signals, or Stop for Your Life

Behavioural signals related to aposematism are also basically to convey two messages, (1) that the animal does not need to get away from the predator, and (2) if the predator decides to attack, it will soon find out this was a very stupid idea. To convey these messages, aposematic animals walk awkwardly and do not run. When approached by predators or competitors, they also behave very aggressively and they start displaying their warning signals through all possible means (visual, audio, olfactory, behavioural). And last but not least, aposematic animals quite often live in big groups.

Whatever You Do, Don't Run!

Aposematic animals, as I have just mentioned, do not run fast. On the contrary, they often walk awkwardly, giving a clear message to predators that they do not need to run for their lives. Many aposematic animals even stop when they face predators. Earlier, when we were discussing human defence strategies, we have already mentioned how bad humans are at running. From an animal's point of view, even our human champion runners do not come anywhere close to the speed of the many mediocre-running animals, let alone the fast ones. Forget cheetahs, antelopes or big cats - even the presence of an awkward knuckle-running chimpanzee at Olympic games would have embarrassed the best human sportsmen. Despite our high regard for our athletes, we must accept that humans are bad at running.

Now think of human walking. Of course, our walking style does not seem strange or awkward to us, but if we try to look at our bipedal locomotion from a more objective perspective, we will find that it looks as slow and awkward to animals as a chimpanzee's bipedal walk seems to us. If you look at the "sexy" walk of the models

on the podium, you will possibly agree with me that for an objective viewer this kind of "catwalk" walking style must seem particularly awkward and sluggish.

The title of this section is taken from a book by professional safari guide from Botswana Peter Allison. The full title reads: "Whatever You Do, Don't Run: True Tales of a Botswana Safari Guide." The idea of the book and title is very simple: only food runs! So, your best option for survival if you meet a big cat or other dangerous predator is to stay still and not to run away.

This advice might sound crazy to some readers. How can it be a good idea not to run when you are facing a dangerous animal like a lion? Some might even remember the joke about a tourist couple who have found a relaxing place during their African safari, and are sitting somewhere next to a river with their feet in the water. Suddenly a lion appears and starts growing menacingly looking at them. The girl starts quickly putting on her runners. "Will not help" says her boyfriend philosophically, "you cannot outrun a lion." The girl, finishing putting on her runners, quickly answers, "I do not need to outrun the lion – I only need to outrun you."

This joke is possibly correct about some boyfriend-girlfriend dynamics. In regards to the lion's behaviour, this joke makes one grave mistake: if the lion from the joke was a real one, and was faced with two human subjects on his territory, one staying in one spot and another running away, the lion would definitely go after the one running! This may sound strange to you, but those who know big cat psychology would agree with me. Here is a first-hand story from a book by Colonel Kesry Singh, professional warden and author of the book "One man and thousand tigers." In this story Colonel Singh wrote how a small party of people, not expecting to see a tiger at all, was within a few minutes attacked twice by two different tigers. Have a look what has happened:

"On the day after the festival called Dashera we Hindus of the military castes have a tradition that one should go out and hunt something. Because of this conventional obligation I set off at about eight o'clock one September morning with my then employer, the Maharajah of Gwalior, and a small party. It was in fact His Highness' intention to shoot nothing more than a buck or two for the table and, so

having fulfilled the duties of his station, return. Because of this he took nothing but a light, small bore rifle with him.

I took the party (we were in a shooting brake) directly to a place called Kuleth about ten miles drive from the palace. This was a preserved area for game and we had no difficulty in coming up with a small herd of black buck consisting of two bucks and their does. Someone in the party had a shot not the Maharajah, I think and missed, as a result of which the black buck galloped away behind a small hill. We followed in the brake, but after a short distance the going became too rough for the vehicle and we had to dismount and continue on foot.

In addition to the Maharajah and myself, the party consisted of a lad called Serje Rao Shetole and two military officers, Colonel Bhow Sahib and Captain Sultan Hussain he who shot the bold tiger that seized his elephant's tail (see page 24). After we had walked a short distance I asked the two soldiers to go off in a slightly different direction towards a point where I hoped they might get a chance if the buck broke back, while the rest of us continued in the wake of the little herd.

Shetole, who was formally engaged to the Maharajah's daughter, walked between his prospective father-in-law and me. He was not more than about twelve years old and naturally quite inexperienced, so that I did not instantly take notice when he whispered that he could see a tiger.

All boys begin by seeing tigers all over the place when they are first taken out after large game, and besides this we were in open country dotted with small bushes, the last sort of terrain where one would expect to find a tiger. In Rajasthan it is essentially a creature of the jungle and close cover.

However, when the boy muttered his absurd fancy to me I muttered back, mildly teasing and making a joke of. The Maharajah wanted to know what we were being so confidential about, and when I told him stopped short and asked Shetole to show us what he had seen. Shetole walked back a few paces and when we had joined him pointed to his right where, about a hundred yards away, a tigress, accompanied by two smallish cubs, was sitting on her haunches watching us.

Had I known as much then as I know now I should not have been so confident that we should not encounter a tiger away from tiger-country; nor should I have allowed the boy to point, or any of us to look directly at the animal. As it was we all followed his outstretched arm with our eyes and stared blankly at the tigress, who as

soon as she realized that her cubs had been seen let out a regular roar and came for us in great bounds, at the same time lashing her tail in great semi-circular sweeps like an angry domestic cat. Meanwhile though we had not much inclination to worry about them at the moment the two cubs must have slipped into some low cover nearby, for we did not see them again.

There was no tree in sight and the nearest vegetation more than boot-high was a small thorn bush about three feet tall, a pace or two to our left. As we moved to step behind this meagre protection the unfortunate Shetole, thinking perhaps that we were going to take to our heels, turned and began running back the way we had come. This of course attracted the tigress' attention and she changed course and went after him. Throwing away the little rifle he was carrying, the boy ran as fast as he could until after a few yards he caught his foot on a stone and pitched head first into a clump of dwarf thorns.

This fall was, to put it mildly, providential, for the tigress who was still some little way away lost sight of him and at once turned back towards us. For our part the Maharajah and I, having nowhere to go, stood firm beside our ridiculous bush and awaited events. The Maharajah had the small-bore Mauser with which he had intended to shoot antelope and I had the case with his cartridges. As she came the tigress made an absolutely deafening noise and I for one was convinced that here stood a couple of sportsmen who would never harm another tiger. However, seeing us stand firm, she suddenly stopped short about fifteen feet away and crouched as if for a final spring, twitching her tail, swaying her snarling head from side to side, and now and again tearing at the ground with the extended talons of her forepaws. We for our part kept watching her without moving. It was a very bad moment indeed.

After she had been terrifying us in this manner for perhaps half a minute I suddenly swung the cartridge bag round my head and shouted, telling my employer to fire at her. This no doubt relieved my feelings and mercifully for all of us the Maharajah disregarded the ill-conceived advice. As it was, my behaviour proved to be the right course of action, for having no doubt come to the conclusion that we stood at bay and were not unduly frightened of her, the tigress suddenly remembered her cubs and wheeling abruptly round went galloping back to where she had left them.

When she was some eighty or ninety yards away the Maharajah coolly raised his Mauser and took a shot at her. Fortunately it was a clean miss. Speaking very quietly I begged him not to shoot again, since if she was hit the chances were that she would return and make an end of us without further ceremony. Unless the shot were more accurately placed than is usually possible with a rapidly moving target it was highly improbable that one of his small calibre bullets would kill or disable her.

We were undoubtedly well shaken, for it was a moment or two before we remembered Shetole. After a little looking around I saw a thin leg sticking out of a thorn bush and going up to it bade the owner come out. It did not move, so I lent down and touched it, at which it reacted with a sort of extraordinary tremor. The poor boy told me afterwards that he was sure in his panic that the tigress had taken hold of him.

Shetole soon realized who had arrived but his head and shoulders had been pushed so far into the bushes that he could not extricate himself without help. When we finally got him out he stood looking round in amazement and asking what had happened. Rather abruptly I told him this was no time for explanations and that we were going to make for the car as quickly as possible. All I wanted from him was his rifle. But this was exactly what he had not got, having thrown it away in his flight.

So now we began to quarter the ground, hunting for the missing weapon. It would have been disgraceful not to have recovered it, but I began to feel a bit anxious lest our loitering should again attract the tigress whom we could still hear nervously coughing and growling some distance off. Owing to the generally open nature of the ground we soon saw the gleam of the metal lying a few yards away in the direction of some thin cover from which the warning sounds were now coming. It was rather nervous work, but advancing quietly in a group and taking care not to stare or point ahead we approached near enough for me to pick it up, after which we walked sedately away. During the whole time we were looking for the rifle we were careful to make no sudden or rapid movement.

Unfortunately the boy's rifle was no better adapted for stopping a tiger than the Maharajah's. However, I saw that it was loaded and having given the cartridges to the boy tucked it under my arm. Then we all set off in the opposite direction with the idea of working our way round to the car.

But our troubles were by no means over. We had only been walking for a few minutes when we again heard the menacing cough of a tiger not far off. Uncertain of the direction from which it came we halted and looked circumspectly round. After a little the unpleasant realization that the noise lay directly ahead was borne in on us and about a minute later a very large male tiger emerged from behind some low cover, perhaps a hundred yards away, and almost immediately charged. It was like some dreadful dream. I remember that the thumping of his pads as he galloped towards us over the hard baked ground sounded oddly like the ringing noise of hoofs. This was no doubt due to his exceptional weight.

As before we stood close together waiting for him, and this time the lad stood between us solid as a rock. Again, exactly like the tigress whose mate he undoubtedly was, the animal stopped about fifteen feet away and menaced us, swaying his great snarling muzzle from side to side close to the ground and switching his tail, making up his mind to pounce. To forestall this I took a quick aim between his swinging ears and fired. Providence was with us that fantastic morning, for not only did I miss, but the report and the cloud of dust raised by the bullet which hit the earth close to his head, as well as the shout which I let out, evidently discouraged him. After another two or three snarl he turned and cantered back to his cover.

The extraordinary way in which we had been attacked twice within a matter of minutes by two unprovoked tigers, coming from different directions, had given us something of the sensation of being surrounded; moreover our constant changes of direction had left us a little disorientated. We knew that the tiger was certainly ahead of us and that in all probability the tigress was still somewhere not far off to our rear. On our left we could see a low hill and on our right a river. The best chance seemed to be to make for the hill, although there was enough cover there for the tigers to stalk us, in the hope that the country on the other side would be open and we should be able from the higher ground to find a route back to the shooting brake. In fact this proved to be the case, and within an hour we had reached it unmolested. Bhow Sahib and Sultan Hussain who were waiting for us were chagrined to see us return empty handed."

As it turned out, tigers were new to this territory and they were trying to establish their family's range. Unfortunately, their intended territory was dangerously close to a human habitat, and soon after the described events, violence started. Conflicts were first with the cattle, but later the male tiger started killing humans. We know that these tigers were aggressively defending their cubs and their territory, and still by standing firmly and not running away from the aggressive display of the tigers (and by the way, shouting as well!), these inadequately-armed humans saved their lives. The only person to put himself in danger was a little boy who tried to escape from the charging tiger by running.

Another interesting detail in this vividly described story is the aggressive and clearly aposematic display of the tigers. The tigers did not want to attack and kill them, they merely wanted to keep intruders away from their family territory using their aggressive display, which included roaring and turning their heads to different sides. This is a well-known means with which predators display their fearsome canines to an opponent – by turning the head sideways. Lions also try to intimidate their competitors (mostly other male lions) exactly the same way, by turning their heads to different sides in order to give a better view of their teeth. In the situation depicted by Colonel Singh, the tigers' display was of an aposematic nature. The tigers wanted humans to leave them alone, so running away from tigers could have been a mortal mistake and was, swiftly transforming the aposematic display to a hunter's reflex to chase after a running target.

Peter Byrne, a professional hunter and author who spent several years in Nepal and India, made a very interesting suggestion. In his book, dedicated to the legendary hunter and conservationist Jim Corbett, he wrote that it is very dangerous to ride a bicycle in the region where tigers are living. The reason is that bicycle speed is faster than human walking speed, so from the animals' point of view a human riding a bicycle looks like running. And for predators, as we can recall, "only food runs."

Byrne gives an amazing account of a West Bengal postman who was delivering all his mail for many years on foot. In 1952, in accordance with the postman's increasing age, he was given a present – a bicycle. The postman was very proud of his bicycle but, as it turned out, it almost cost him his life. About six months after first receiving the bike, the postman came to the office one afternoon with visible

signs of frustration, left his postbag and bike at the office and went home on foot. People in the office were very surprised by his behaviour and, when he came back the next morning, they asked him what frustrated him yesterday. Here was his explanation:

”Sahib, he said, “a tiger chased me. It was very frightening. He came out of the bushes and rushed after me and I thought that I could outrun him but he came faster and faster, growling, with his mouth open. The trail is very narrow and so I had to look ahead to see where I was going and could not look back to see him or I might have fallen off. But I could hear him getting closer and closer.”

“My God,” said Benjy. “Then what happened.”

The old man gave us a reproachful look, one that we ought to know what happened, without his telling us.

“I applied the brakes and stopped and got off the bicycle and turned to face him.”

“And then?” I said.

This time the look was even more reproachful, clearly indicating that I, who am supposed to be something of a *shikari*, obviously knew nothing about tigers.

“Why then, sahib, he saw that I was a man and not an animal, and stopped and looked at me and then walked away.” (Byrne, 2002:292-293)

Many of us would have taken our hats off to the brave postman who had the guts to stop his bicycle and turn towards a chasing tiger – but the old man obviously knew what he was doing. Byrne logically explained this phenomenon and suggested that big cats may be more prone to attack humans on bicycles because they cannot identify the humans by their usual size, upright posture and their usual slow walking, which seems to me absolutely correct. To finish the story, Byrne remarked “the old man, incidentally, spent the remaining of his working days collecting the mail on foot” (Byrne, 2002:293).

Although puma (mountain lion) attacks on humans are rare, cases of pumas chasing and attacking humans on bicycles are well-known of in the USA. In January, 2004 a puma killed and partly ate a mountain biker at Whiting Ranch Wilderness Park in Orange County, California. Only days apart, in the same region, a 30-year-old woman from Santa Ana was pulled off her bike by the same mountain lion. After a tug of war between her friends and the puma, she was rescued by her friend and other bicycle riders and was taken to the hospital in a serious condition (Mountain lion kills bicyclist, 2004).

So remember, whatever happens, don't run – seriously.

Flight, fight or freeze

Have you ever had a nightmare where a terrible monster is approaching, and in the moment in which you need to run away faster than you have ever ran, you suddenly lose the ability to move at all? You are frozen with fear, you are covered with heavy drops of the sweat, and then death seems imminent. What a relief it is when you finally wake up, realising it was just a bad dream.

Most importantly for our topic, this kind of freezing and losing ability to move happens not only in nightmares. Many victims of violent assaults also report that they were totally immobile while they were subjected to the assault. Some start blaming themselves for being so passive (this is quite usual, for example, for rape victims). Psychologists know very well that this kind of self-blaming is not justified, as freezing in a moment of great danger is one of the most widely-known survival strategies, designed by the forces of natural selection. This response is not a result of our conscious decision, it is fully instinctive.

Many readers would know about the "flight or fight response" in dangerous situations. According to this mechanism, we "fly" from the danger as fast as we can if we have time for this, however if it is too late to run away, we "fight." Apart from these two choices, in a number of animals lies another life-saving strategy – to freeze. So there are actually three options to go with the saying: flight, fight, or freeze.

This might seem quite silly to many readers. To freeze means to stop moving, so the predator does not even need to chase or to fight you, right? How on earth could such behaviour possibly enhance your chance of survival?

To fully understand why this is so, we must remember that most animals' (and humans are also animals) behaviour was formed during millions of years of trial and error in billions of deadly encounters with predators and competitors, and if there is an instinctive behaviour that seems silly to us, it means that we are in fact being silly and are not understanding the higher wisdom of natural selection. We need to be vigilant and remember that **whatever animals do instinctively, they do it for survival**. Therefore, animals that freeze in critical situations often save their lives with this behaviour. How?

First of all, we must note that there are at least three different behavioural models of freezing that use different strategic aims, and that all three of them were designed by the forces of natural selection in order to increase the chances of survival against predators and enemies. The first one involves freezing at the early stage, the second one is based on immobilization, and the third one involves freezing at the last stage of an interaction with a predator.

(1) Some animals freeze before they are noticed by the predator, so by freezing they are trying to avoid detection. Therefore the first strategic aim of freezing is crypsis-based and not an aposematic behaviour. This is exactly what rabbits do: they freeze to stay unnoticed, but start running away as soon as they know that a predator has noticed them.

(2) The second strategy of freezing is playing dead. An animal with this type of behaviour drops down once it has identified a critical situation, and assumes all the characteristics of a dead animal: closed eyes, rigid body, and even the smell of decaying meat. This behaviour is based on an aposematic strategy that tries to convince the predator that the prey has been dead and is in an advanced state of decomposing. The Capybara is a famous example of this kind of deception, and crows also can deceive predators by playing dead.

(3) The third strategy of freezing is also based on the principle of aposematism, but unlike the previous case where the aposematism is of a passive nature (with a message "Do you really want to eat me? You see, your food has gone

off!"), the third strategy is an active case of aposematism, in which the prey animal is trying to demonstrate that it does not need to run away. For animals using this strategy freezing means displaying to the predator that they do not need to resort to the "flight" option. In this case, unlike the crypsis-based freezing, animals freeze in the last stage of interaction with the predator – which is when the predator has spotted them and is already approaching.

Animals may use more than one of the above freezing strategies – usually the first and second strategies together, or the first and the third ones. They may freeze when they notice a predator and then later play dead, or they may initially freeze when noticing a predator and later, if the predator approaches, stay frozen and stand still. Humans are quite unique in that they can utilize all three behaviours in different contexts. We may freeze in order to stay put if we notice a lion, tiger or an armed robber in the vicinity. Sometimes humans also play dead in order to survive (particularly with bears and shooting sprees). The most interesting for us is the third type of freezing, when we literally cannot move our limbs when suddenly faced with mortal danger (in much the same way venomous snakes and other aposematic reptiles also do not run when they are facing predators). Therefore, even when we are screaming with fear inside and want to run, the most innate and primitive layers of our brain release the executive order to our body "do not move!" – So we freeze. Of course, freezing is not a 100% survival strategy, but we need to remember that alas, there are no 100% survival strategies against predators in nature (apart from killing them). Freezing apparently must have been more effective in most situations than fleeing or fighting was.

Freezing often comes together with other aposematic intimidating tactics, like loud screaming, erecting the hair on the head and the body, sudden precipitation, and even urinating and defecating in the moments of great danger to life. All these instinctive actions are part of the biological defence mechanisms to advertise one's unprofitability as prey to the predator. In dealing with predators our ancestors possibly had an instinctive response based on fight or freeze – this is why in critical situations in which humans are terrorized by a sudden fear, they freeze and are sometimes unable to run away from the danger. Taking into account predators'

responses to running humans and stationary humans, our instinctive freezing makes prominent evolutionary sense.

Robert Frump describes this reaction in a personal experience when hearing the roar of a lion in a safe enclosure in Kruger, South Africa: "The wave of sound reverberates first in my breastbone, then locks up some part of my brain and freezes me midstep like a lizard caught in the open on a flat rock. I am not frightened – just frozen. I have no clear idea how that happened" (Frump, 2006).

Frump identifies this instinct as an "automatic antipredatory measure hardwired into our systems" which I believe is true. Frump considers freezing as a part of cryptic behaviour – but this depends. When freezing happens before the predator sees the prey, this explanation is justified, but if freezing happens when the prey has been spotted by the predator, then the freezing most likely is of an aposematic nature. In this latter case freezing works as a signal to the predator that the prey is not afraid and has no need to run for its life. Another example is when you approach a hedgehog: it does not run away, but instead freezes. The hedgehog is an aposematic animal and by freezing it tells all potential predators to stay away.

Human freezing behaviour is one more reminder to us that our ancestors were also aposematic animals who tried to stand their ground against the most feared predators. Even when they were overwhelmed by fear, the freezing instinct was ensuring they would not run away. This was a result of millions of years of evolutionary fine-tuning of our aposematic strategy. The everyday struggle for survival taught to our ancestors that running away was a faulty strategy, usually leading to death.

Some animals are made by the natural selection to flee as fast as a breeze; they are sure-footed and can run long distances to stay clear of predators. Some particularly fast-running animals cannot even fight back, therefore fleeing is their only safety strategy. Think of some lightweight antelopes (for example, Thomson's gazelle) and you will understand what I mean by this category. Other prey animals have both fighting and fleeing abilities, so they can give a powerful kick to a predator but they can flee fast as well. Wildebeest and particularly Zebras are from this category. And then there are also some prey species which are built like a tank. As a rule they cannot run fast, but instead have devastating physical strength and fighting ability. These animals are often left alone by even the lion prides and tigers. Different

species of African and Asian buffaloes, rhinos and elephants are from this category. None of these animals use freezing as a survival instinct although they do stand their ground firmly.

If we remember here the survival tips from a professional hunter for the moment where you suddenly find yourself facing a lion or other dangerous animal, "whatever you do, don't run," we can better appreciate the wisdom of natural selection: even if we want to run away with all our instincts screaming, natural selection does not allow us to do this. As a wise adviser, natural selection whispers in our ear the best survival advice in critical moments.

On aggression, avoiding aggression and bravery

Konrad Lorenz made history by noting the survival significance of aggression in nature and in human society (Lorenz, 1966). There is no question about this: in the natural world most of the animal species need to be aggressive towards other species, and often even towards their own species. Not only are predators aggressive, but even the gentle herbivores are thought to be aggressive, as they are aggressive towards plants. If you think plants are happy to be eaten, you must remember that they too use different strategies in order to survive being eaten such as thorns, bad taste and poison.

Despite the obvious importance of aggression, the role of true (physical) aggression was a bit too exaggerated by most of evolutionary scholars. In Darwinian times it was believed that aggression and competition was the only driving force behind natural selection – not only were species against each other, but even each individual animal was in a constant war against every other animal from its own species. Natural life was perceived as a continual struggle against all – for food, for territory, for mates.

I already pointed out that one of the central aims of this book is to argue that although direct physical aggression is an important and unavoidable part of life and natural selection, **avoiding unnecessary violence** is even more important than direct

physical violence. No animal species tries to fight every single animal around them (both of different and their own species). Such total and continuous fighting would have had disastrous consequences for any species and any individual animal because of the unavoidable injuries. Natural selection wisely substituted the direct physical violence with ritualized fights. Ritualized fights may look like real fights to us, but in fact they are devoid of any use of real lethal force (Eibl-Eibesfeldt, 1979). Similar to modern states that do not want to use their deadliest lethal weaponry in any conflict of interest, animals also try to resort to lethal violence only when it is absolutely necessary.

As a result, non-physical forms of aggression and violence are used in nature much more often than physical forms of aggression and violence. In real life it is often more important for animals to show their aggression by screaming and taking aggressive poses rather than resorting to lethal forms of physical violence. Such non-physical violence, or intimidation, is effectively less costly than violence. Therefore when two animals (of same or different species) face each other as antagonists, it is important for both of them to show that they are tough and are not going to back down, although at the same time neither of them actually want to resort to physical violence.

As a result of this strategy of survival, humans (both from individual humans to the world's biggest states) use the strategy of intimidation much more often than they do real physical violence. We are more used to seeing more scenes of angry people shouting at each other and abusing each other verbally and with gestures, at protests or otherwise, rather than the use of lethal violence.

We are masters of intimidating behaviour without using real physical aggression. In some cases our behaviour would hardly seem threatening to us, but to animals our behaviour can seem extremely intimidating. My wife's maternal grand-grandfather's encounter with a bear in the forest is a typical example of such behaviour, of when a scared human instinctively behaves aggressively. Still a young man, he looked up a tree and saw a bear on the tree branches, staring down at him. Profoundly frightened, he followed his natural instinct and screamed as loud as he could (I am sure that simultaneously, and subconsciously, he raised all the hair on his head and body, and widely opened his eyes). The bear, frightened from the sudden reaction, defecated from the tree branches, fell out of the tree and ran away. The

bears reaction proves that it is not only humans who defecate or urinate when experiencing great fear or shock.

But of course, apart from this kind of instinctive reaction that seems aggressive to most animals, humans are also quite courageous in situations that many other animals would not behave as fearlessly in. Virtually unarmed members of pastoralist tribes in Asia and Africa, for example, routinely defend their cattle from much bigger predators (like lions and tigers) with their brave behaviour and hollow threats, like shouting and waving their arms.

Courage is an expensive virtue – fearless warriors die more often than their more cowardly compatriots. Possibly most importantly for our discussion, bravery is a very important element of the behaviour of all aposematic species. As we have already discussed, aposematic species do not run away from a threat, but on the contrary often face the threat and try to behave aggressively even in the face of much bigger and stronger opposition. This is the very nature of aposematism. If we had to have a contest to find the bravest animal, many readers would possibly bet on lions or tigers winning, and this is understandable in the light of our reverence towards these majestic big cats. But despite my love and high regard for the biggest of the big cats, I have to state that lions and tigers could not really compete in courage with some other aposematic animals. Take for example, a Norwegian Lemming, a small rodent that we discussed earlier as one of the aposematic species. Unlike lions and tigers that usually run away when seeing bipedal humans in the wild, lemmings, which are more than 1000 times smaller than lions, do not run away from approaching humans – they instead try to jump up and bite them. Of course, the aggression from lions and tigers seems to us much more impressive over that of a small rodent who could only scratch our fingers or leave tooth marks in our shoes. However, you may agree with me that bravery should be measured by taking into account the size and power of the conflicting animals, thereby rewarding animals for "biting off more than they can chew." We all know the famous epithet "lion heart" for the bravest human warriors, and most of the readers would probably laugh if I were to suggest using another epithet for particularly brave fellow humans – "lemming heart." If taken objectively, and particularly in the light of their respective size and weight of the 200 kg lion and 130 gram lemming against a human, the lemming must be declared as much more courageous than the lion.

Battle trance and collective identity

We have already mentioned several times probably the most important survival tool of our human ancestors – the specific altered state of consciousness which I called in my 2011 book the "battle trance." This is a mental state that allowed hominids and humans not to feel any fear or pain in a critical situation and to show absolute, selfless dedication towards the interests of kin, military unit, religion, or state. In this state of mind humans lose the feel of their individuality, and literally obtain a new, collective identity. In this new state they feel themselves as a small element of a much larger entity. In this state humans stop questioning orders or judging behaviours of their group members; instead they follow others in the most literal and rigid way. In this state humans act in total disregard of their "common" sense. This change of personality can be so intense that, after experiencing the battle trance, group members may experience partial or full amnesia and may not remember their actions. The state of battle trance was appearing in groups of hominids and humans in the most critical moments of survival, chiefly in combat situations against predators or enemy human groups.

The presence of the altered state of consciousness is quite well known, particularly within the military. Barbara Ehrenreich wrote: "The difference between an ordinary man or boy and a reliable killer, as any drill sergeant could attest, is profound. A transformation is required: The man or boy leaves his former self behind and becomes something entirely different, perhaps even taking a new name. In small-scale, traditional societies, the change was usually accomplished through ritual drumming, dancing, fasting, and sexual abstinence – all of which serve to lift a man out of his mundane existence and into a new, warrior like mode of being, denoted by special body paint, masks, and headdresses" (Ehrenreich, 1997:10). "Recruits obtain the first taste of collective identity in the peace time, during the long drill sessions. It is the rhythmic unity of a large group of humans, stamping together, that gives the feel of enlarged ego, or more precisely, shrinking of ego and becoming a small part of a much bigger entity" (MacNeil, 1995). This feel of a new larger unity is the force behind the unquestioning following of military commands, sometimes even in cases where the orders are to shoot civilians. Many scenarios throughout history have also

taught us that a small number of drilled soldiers can defeat a much bigger army of undrilled and unprepared opposition.

Let us now try to trace the hypothetical origins of this specific altered state of consciousness. The origins of this mental state in mammals most likely were developed from the female dedication toward her offspring. When parental (particularly motherly) care became crucial for the survival of a new generation, natural selection wisely re-evaluated the grand scheme of the hierarchy of instincts, and put the instincts of survival for the newer generation higher than the instinct of self-survival. Of course, this happened via the process of natural selection, in which the genes of dedicated mothers were propagated to the next generation better than those who would think of their own survival first and not of their young. This is why the dedication of mothers in many animal species is total and absolute – for the millions of years mother animals were risking their life for the life of their offspring. Even today, the most dangerous situation for a hunter is to deal with a nervous mother who is defending her cubs. In this case if a mother attacks, they usually do not waste time on giving or perceiving an aposematic display and go straight into lethal violence.

The simplest case of putting a human in a state of battle trance still arises when a child is violently and suddenly attacked in the presence of a parent. In this extremely emotional moment humans cannot think rationally. There is a momentary switch in the brain that turns a rational and thinking human into a furious bundle of nails and fists without any reservations or fear for his or her own health and survival.

Many scholars believe that this kind of self-sacrificial dedication can happen only with members of one's own kin. This is the "kin selection model" of altruistic behaviour, proposed by William Donald Hamilton, but the situation is not as simple as it may seem. The complexity is brought by the fact that such selfless actions may be directed to save someone totally unrelated to the fighting person. Humans are known to fight without fear for their pet dogs and cats, receiving horrendous bodily injuries in the process.

Sex and hunger are often considered as the strongest instincts, but escaping predators is stronger – and helping loved ones to escape danger is even stronger than the instinct of self-survival and escape from imminent death. In truly critical

moments of life and death, humans often behave for the good of others, sometimes even without any rational explanation for their motives.

We humans often pride ourselves as thinking animals, but in the most critical moments of life when our life is in imminent danger, we cannot think rationally and we just follow instincts. This is why we can sacrifice our life not only for our children (biologically the most obvious reason), but for our loved ones, for our friends, for our country, or even for our religious ideals. Despite the bad publicity humans are generally getting, we are wired by the powerful forces of natural selection to be concerned primarily for the safety of our loved ones, not for that of our own. Humans often behave the most altruistically when in the most critical situations for survival. Altruism and compassion, although often laughed at and dismissed as unwanted and dangerous features for individual success, are at the very core of our human hierarchy of instincts (Keltner, 2004). It is good news that there are prominent scholars who take human (and even animal) altruism and compassion seriously into account (see, for example, de Waal, 1997). Even such ostensibly unconnected spheres such as compassion and business are sometimes the topic of scholarly discussion (see for example, on the internet: The Compassion and Business Conference and other events, organised by Stanford University's Centre for Compassion and Altruism Research and Education).

Unfortunately, apart from the selfless dedication towards the health and life of others, the battle trance has a negative side as well. The negative part of the battle trance is that in this selfless and altruistic state, humans can perform the most horrendous violent acts as well, such as shooting civilians or participating in mass murders. This may sound unbelievable to some, but self-sacrifice and mass murder are two sides of the same coin, the coin that puts the interests of your group, your country, your religion, your collective identity higher than anything else, including the interests of your own survival, common sense, and the basics of human morality.

Any useful behaviour must be rewarded in order to stay in one's memory. Just being useful in the long term does not help the memory and does not really incite behaviour with altruistic elements. We need the feeling of pleasure, a notorious "instant gratification" (Wallenstein, 2008). If you have ever trained a dog or a cat you would know how long it takes to teach them to behave appropriately in certain situations. But who was training animals or our human ancestors many years ago to

teach them the basics of social behaviour and instill an altruism that actually goes against their instinct of self-survival? And what could have been used as a reward in the process? The trainer was of course: natural selection. The reward (apart from staying alive) was a neurochemically induced incredible physiological pleasure, feelings of euphoria as their personal selves dissolved into collective identity. In this state of collective identity one suddenly felt larger, stronger and without any fear or pain. This coveted feeling can be experienced if you have been a member of a religious group, or a military unit, or a sporting team. This is the feeling that many humans experience when their state declares war, or when they listen to their national anthem after their national team wins. By its intensity this is not a battle trance yet, but the thrilling feel of belonging to a bigger social entity is based on similar mental mechanisms. The battle trance is just the ultimate, most dramatic expression of this mental state in the spectrum of collective identity. The battle trance is able to totally override our selfish interests up to the point of sacrificing our lives for the lives of others or even merely for some abstract ideas.

Now let us discuss the reward used while teaching altruistic behaviour to naturally selfish individuals. In the book "War is a force that gives us meaning" Chris Hedges persuasively wrote about the feeling of war and battle being akin to a "powerful drug," something that is well known to many veterans of combat operations: "The rush of battle is a potent and often lethal addiction, for war is a drug" (Hedges, 2003:3). This incredible feeling of euphoria is achieved by the release of different neurochemicals into our brain. I am not going to discuss all the neurochemicals that possibly induce this feeling, but the participation of neurochemicals is obvious. According to the available literature, oxytocin might be the most important neurochemical that was (and still is) activating the feeling of belonging to a larger entity. Known as a "trust hormone," oxytocin is a perfect tool to feel the strength of social bonds, bonds that may lead to leaving your own self to obtain another, collective identity (Lee et al., 2009).

Oxytocin is released in our brain on a number of activities, such as (1) giving birth, (2) breastfeeding, (3) grooming, (3) dancing together, (4) singing together, (5) praying, (6) sexual arousal and orgasm. Through the increase of trust and reducing of fear oxytocin seems to facilitate even the healing of wounds (Gouin at al., 2010)

It is not accidental that oxytocin is sometimes referred as the "trust hormone" and sometimes as a "love hormone." If we have a look at these activities, we can notice that they all represent moments of life when we are closely connected to other members of our society.

(1) Release of oxytocin when giving birth establishes the positive bond between mother and her offspring (Lee et al., 2009). The presence of oxytocin at birth must have played a particularly important role in the animal species where the vigorous care given by the mother was crucial for the survival of the offspring (particularly within mammals and birds).

(2) Breastfeeding is another crucial activity that links mother and child in the most intimate and personal way, via body contact and receiving/giving food from one organism to another.

(3) Grooming each other establishes a strong social bond between the grooming individuals, and the time spent in grooming each other directly correlates to the strength of the social bond between the individuals. Studies of primates provide ample evidence of the strength of grooming as a social bond (for example, see de Waal, 1989, 2001)

(3) Dancing together in united rhythm, particularly in religious rituals and before combat situations, establishes a strong bond between the participants (McNeil, 1995). We should remember here that dancing together in united rhythm is a uniquely human behaviour, as the sense of rhythm and the ability to be entrained, according to our present knowledge, is not present in any other animal species. Even a human dancing to an internal or external rhythm alone can experience this feeling of entrainment and belonging to a larger entity, as rhythm is one of the strongest agents of social bonding in humans;

(4) Singing together, as a rule, is also united rhythmically, and like dancing it also creates the feel of entrainment. Also similarly to dance, a lone singer can experience the feeling of establishing a connection with a larger entity (for example, with God). Poetry and mantras, due to their **rhythmic** nature, are particularly powerful in creating a feeling of belonging to a much larger entity.

(5) Sexual arousal is another important activity that is mostly connected to the interaction of more than one individual and the release of oxytocin is very natural for sexual arousal and orgasm.

Such human social sentiments, like patriotism and religious belonging, are primarily based on this ancient instinctual desire to experience the intoxicating feeling of collective identity. Situations stressful for survival are powerful incentives to induce the battle trance and collective identity, and to enhance fervour. This is the reason why feelings of group identity, religious fundamentalism and patriotism are becoming particularly strong in the moments of big national or religious upheavals, including wars and natural disasters.

The very fundament of human religion is based on the feeling of collective identity. This is why every human religion is offering to its followers an understanding of our humble role in the larger picture of life, where individual lives are only small particles of a Grand Scheme. The exhilarating religious feeling of belonging to a larger-than-life cause has its roots in the ancient rituals and the altered states of consciousness of the battle trance. This is also why the ritualistic actions that lead to the induction of the battle trance are so universal and so similar to religious rituals.

Let us now sum up the characteristic features of the battle trance, based on seven elements:

(1) Battle trance is a neurochemically induced altered state of consciousness where humans lose their individual identity and acquire a group identity;

(2) Battle trance usually appears when we find that someone or something (a person, group, animal, country, idea) we love is in mortal danger;

(3) This state is characterized by a total neglect of fear and pain, and humans can experience an increase in physical strength;

(4) Instincts of self-survival and self-preservation, as well as notions of calculated "common sense" do not apply in this state of mind. In this state humans are unable to judge or question their group members' or their own behaviour;

(5) People can have a full or partial loss of memory of the events conducted in the state of the battle trance;

(6) This state can be achieved instinctively and instantly when sudden danger arises, or alternatively it can be induced by ritualistic actions, using rhythmic singing, chanting, dancing, body painting or use of masks.

(7) People can go into the battle trance both individually and in groups, of both men and women.

Next we are going to discuss the emotions involved in attachment and love. As we will see, love is the central force that gives us courage and determination to fight for others, so to discuss the mechanisms of the state of the battle trance and collective identity without discussing love and sexuality is simply impossible.

Human sexuality, homosexuality and bisexuality, or who can defeat 300 Spartans?

It is becoming increasingly obvious that human sexuality is much more than a mere tool for procreation. Contrary to the popular misconception that humans develop their sexuality during puberty, humans have sexual desires from the moment of their birth. Some suggest that even while in the mother's womb a baby is already having orgasms. Humans can also have lifelong desires towards the individuals of the same sex, or sometimes even towards inanimate objects, which does not make any sense in procreation.

Hardly any other sphere of human psychology and behaviour commands such widespread public and scholarly interest as sex, and yet it is still so badly understood. Even after the Freudian theory, which put sexuality in the very centre of human psychology, the famous Kinsey Report came as a shock to many and was hidden from public view for decades. For us the principal question is whether sex was a vehicle for competition between humans for mates and procreation (Darwin, Miller), or if sex was a tool for cooperation between the early hominid and human groups until the late introduction of monogamous families. American Evolutionary biologist Joan Roughgarden proposed that sex was primarily used for social cohesion, and

even suggested the original altruistic model of "social selection" which she believes should replace the selfish model of "sexual selection" (Roughgarden, 2004). She was severely criticized by colleagues but it is certainly true that love is probably the most altruistic emotion, a cornerstone of human sociality. It is not accidental that in all religions the climax of religious feeling is presented and described as "love." I do not want to go into details of this incredibly interesting sphere, but in relation to our subject I propose that the intense feel of attachment that love produces between humans has very strong connections to the powerful state of the battle trance. The issues of homosexuality and bisexuality are of crucial importance to this discussion – let me briefly address them.

As a young person raised in the largely homophobic Soviet Union, where homosexuality was a criminal offence, I also considered that sex between individuals of different sexes was the only normal and natural way of interaction. Sexual arousal between the individuals of the same gender seemed a dead end for survival and an unjustified waste of human feelings. This logic seemed so obvious that hardly any argument was given – because of this homosexuality seemed like a corruption of nature. As part of the Soviet intelligentsia, I was against the criminal charges that state put on homosexuals, but still considered it to be somewhat against the "rules" of nature.

Much later, after my migration to Australia and the widening of my spheres of interest into evolutionary topics, I found out that this simply was not true. Plenty of animal species are apparently engaged in homosexual relationships. Elephants, penguins, bison, giraffes, foxes, dogs, cattle, goats, horses, domestic cats, lions, chimpanzees and bonobos, dolphins, and whales are only a few representatives of the strong list of 500 species that definitely exhibit homosexual behaviours. A larger list of about 1000 more animal species may soon be added to the list of confirmed homosexually-behaving species. This list includes not only mammals, but also fish, birds, amphibians, reptiles, and insects (Bagemihl, 1999). These findings shatter the "Sex for procreation only" idea to the very core. How can animals be homosexuals and waste their precious energy and resources on such an evolutionarily useless thing as homosexuality? Possibly with animal homosexuality we are dealing with only several individuals who do not represent a healthy portion of the population? No, we are talking about the behaviour of absolutely healthy animals – the whole species,

not just deranged individuals. Homosexuality is present in every phylum of life, making this behaviour well-established and absolutely "natural" for the natural world. The idea of calling something "unnatural" when most of the natural world is engaged in this kind of behaviour is against the primary law of science – the law of accepting existing facts.

The presence of homosexual behaviour among animals was mostly neglected for many decades. It was not until the 1990s that scholars started noticing the widespread presence of homosexual behaviour in the natural world (Bagemihl, 1999; Terry, 2004). It seems quite safe to propose that our knowledge of the homosexual behaviour in animals will rapidly progress during the next few decades. It is therefore likely that there will be many more animal species to "come out of the closet" of homosexuality and join the growing list of homosexual animals.

Here we must make a very important correction. I probably should have said from the very beginning that it is not homosexuality that is so prevalent among animals, but rather **bisexuality**. All these lions, elephants, penguins and cats as a rule are interested in sexual partnership both with individuals of the same and different sexes.

Another quite amazing fact about animal sexual relationships is that for many animals, homosexual relationships seem to be much more important in their life than their straight heterosexual relationships. Elephants are an excellent example for this. When male elephants are in a homosexual relationship together, they form an intense friendship that can last for their whole lives. On the contrary, the same male elephant's interaction with fertile females has a very fleeting nature and it is over basically when the heat is over. As a result, male elephants are much closer to their homosexual partners than to their female mates. The social function of sex in such species is virtually impossible to reject. A crucially important characteristic of homosexual behaviour is that it is prevalent amongst social animals, particularly with birds and mammals.

Raising questions over the historical and even causal link between sexual reproduction and the establishment of social bonds seems to me very natural. It seems to me that there is a good reason to believe that forging social bonds through physical contact between living organisms could have been the initial force that later gave rise to sexual means of reproduction. First and foremost we need to take into account that

sociality and grouping was present (and is still present) among the most primitive of living organisms, unicellular prokaryotes, species like bacteria, who lived hundreds of millions of years before the appearance of the most primitive cellular organisms (eukaryotes) and long before the sexual means of reproduction. Prokaryotes, the most primitive o known living organisms, show complex social behaviour when they are in groups (Connell at al., 2010). See, for example, what West at al., wrote in 2007: "Our understanding of the social lives of microbes has been revolutionised over the past 20 years. It used to be assumed that bacteria and other microorganisms lived relatively independent unicellular lives, without the cooperative behaviours that have provoked so much interest in mammals, birds, and insects. However, a rapidly expanding body of research has completely overturned this idea, showing that microbes indulge in a variety of social behaviours involving complex systems of cooperation, communication, and synchronization." Therefore, social behaviour is by no means an exclusive characteristic to higher forms of life but on the contrary, sociality was present in the most primitive life forms that were formed on earth some 3.5 billion years ago. And let me repeat once again: sexual division did not exist at that stage of evolution.

The presence of sociality among the most primitive life forms of our planet provides strong support to the suggestion that sociality and bonding played a crucial role for the later development of sexual reproduction. The appearance of this "sex out of bonding" hypothesis seems inevitable to me.

Let us return to human sexuality. It is still difficult to discuss this topic in its entirety and to identify the objective nature of human sexual preferences, as in some countries homosexual relationships are still a criminal offence and people committing this crime are put to death. We need to remember that all major western religions ban homosexuality as an unnatural, immoral activity. Even in the contemporary western society, where homosexuality and bisexuality have become more or less accepted, it is still viewed with a certain awkward social taboo. I remember when our conservative American acquaintance complained that the new democrat president of the United States (Bill Clinton) allowed homosexuals to enter American army in 1993. The conservative opinion, expressed by our guest, was that this would soon have disastrous consequences for the health and fighting spirit of the American armed forces.

If any readers of this book also think that allowing homosexuality among combatants can degrade the warriors' fighting spirit, I would like to remind them that many of the most successful warriors of human history were confirmed homosexuals, and that there were armies that were using homosexuality as a method with which to boost the fighting morale of the members. Sound unbelievable? Here are the facts. Arguably the most dedicated human warriors from the Ancient Greek history, the "Sacred Band of Thebes" consisted of 150 homosexual couples (300 warriors). So in order to become a member of their elite corps, a warrior had to have a homosexual lover – absolutely no straight warriors were allowed! And what was the result of this kind of policy, could they fight efficiently? Oh yes, they could fight.

The amazing force of the Sacred Band of Thebe warriors was tested against some of the toughest opponents in the history of human warfare: the elite Spartan warriors in the height of Spartan military hegemony. The soldiers of Thebes and Sparta were in opposing camps during the Hellenic Wars for hegemony, and they had to face each other in mortal combat. The Theban warriors had two engagements against the Spartans which were crucial for Ancient Greece. In the first encounter, the battle of Tegyra (375 BC) the Thebans defeated the Spartan army. Even more sensationally, the Spartan army had out-numbered the Thebans 2-1. This battle had a tremendous symbolic significance in ancient history as the Spartans had never been defeated before in such circumstances. This is what the flabbergasted Plutarch wrote about this battle in the 17th chapter of "Pelopidas":

"For in all the great wars there had ever been against Greeks or barbarians, the Spartans were never before beaten by a smaller company than their own; nor, indeed, in a set battle, when their number was equal. Hence their courage was thought irresistible, and their high repute before the battle made a conquest already of enemies, who thought themselves no match for the men of Sparta even on equal terms. But this battle first taught the other Greeks, that not only Eurotas, or the country between Babyce and Cnacion, breeds men of courage and resolution; but that where the youth are ashamed of baseness, and ready to venture in a good cause, where they fly disgrace more than danger, there, wherever it be, are found the bravest and most formidable opponents."

Then there was the second battle, the strategically crucial Battle of Leuctra. It was fought four years later, in 371 BC, and again Spartan troops were outnumbering

the Thebans. 300 members of the Sacred band of Thebe were again positioned straight against the Spartan elite force of 700, led by no one else but the Spartan king himself, Agesilaus the 2nd. Not only did the Thebans defeat the Spartan army (killing 400 of them), but they even managed to kill the Spartan king in battle, putting an end to the military dominance of Sparta.

This is how an army of homosexuals fought.

The Sacred Band of Thebes was an undefeated force in Greek history until the appearance of the ingenious military invention of the Macedonian phalanx. In 338BC The Sacred Band of Thebes had a tough war against the Macedonian army, led by none less than Philip II of Macedon, together with his son, 18-year-old Alexander the Great. This was the Battle of Chaeronea (338 BC), in which the Thebans lost and were totally annihilated in a direct fight against the Macedonian phalanx. According to legend, Philip II, profoundly impressed by the courage of Thebans, built a monument, a huge statue of a lion, dedicated to the Sacred Band of Thebes (ironically enough, lions are also known for their homosexuality). The statue still stands at the original site of the battle, near the village of Chaeronea.

I am quite sure that many readers of this book know about the heroic deeds of the Spartans, their most recent (and somewhat embellished) portrayal being in the 2007 film "300" about King Leonidas and his 300-strong army of Spartans fighting off the Persian armies at Thermopylae, showing their inhuman fighting skills, legendary courage and dedication towards each other. On the other hand, I am not sure how many readers knew about the existence of the Sacred Band of Thebes before reading about them in this book. So, here is some food for thought: we have on one side the 300 Spartans, legendary fighters of Ancient Greece, portrayed in several blockbuster films, and on the other hand we have 300 fighters from the Sacred Band of Thebes, similarly legendary warriors, who on two crucial occasions, in direct fights, defeated a more numerous Spartan army, but for some reason we do not have a single film on the 300 Thebans. I wonder if this neglect of the finest warriors of the ancient world is directly due to the widely-known fact of the homosexual love between those warriors in the Sacred Band of Thebes.

Possibly the most ironic part of this situation is that, according to some sources, Spartan warriors were also boosting their morale by homosexual love between warriors (Hanson, 1994: 124), albeit their homosexuality was not as much advertised

in Ancient Greek history as the homosexuality of the Theban warriors. Ancient Greek historians and philosophers were divided on the issue of using homosexual love as the force of raising fighting morale – for example, Xenophon took a very negative view on this approach. The fact that in Ancient Greece military homosexuality was widely practiced (and even applied for practical reasons) is gradually coming out to the general public. I hope that I will be able to see a film on the legendary 300 Theban warriors and their fantastic wins over the famed Spartans in my lifetime. If this was to happen, the Thebans will win another important battle almost 2400 years after their demise – this time being the battle for liberating human sexuality.

Now let us look at the force that destroyed the Theban warriors – Alexander the Great and his father King Phillip the 2nd. I remember reading a review on a recent film about Alexander the Great that criticised the film for portraying Alexander as bisexual. Well, Alexander was not only engaged in bisexual love affairs but arguably the greatest love of his life, Hephaestios, was a young man and not one of his women. Furthermore Alexander's father, the King of Macedon Philip II, learned his military skills with Theban warriors, most probably as a young homosexual "eromenos" to an older and more experienced "erastes" warrior. The homosexuality (or more precisely, bisexuality) of Philip II of Macedon is quite well documented. With these interesting historical facts of both the defeat and annihilation of the legendary Thebans by Phillip II, and that of his fascination in the courage of Theban warriors, gives the topic interesting new overtones.

We can also recall here that Ancient Greek mythic heroes were also known to engage in homosexual activity. Possibly the greatest of them, Achilles, was also a homosexual (or more correctly a bisexual) and at least several ancient Greek writers mention this, including Plato. It was Achilles' famous rage over his slain lover Patroclus that changed the fate of the Trojan War and led to Achilles' own death. We know from history (and certainly from world literature) that some wars started due to the love between a man and a woman, sometimes members of different royal families. With the history of the Trojan War we have a fine example of homosexual love starting a war and changing the course of history.

I hope that after reading this short list of facts on the bravest fighters of ancient Greek history (both real and mythic), some skeptical readers will re-arrange their

negative attitude towards homosexuality in the military. I do not think the western world will ever get to the point of accepting the Theban model of an elite military force consisting of only homosexual pairs, but the fact that homosexuals and bisexuals can be excellent warriors seems to be proven by human history beyond any reasonable doubt.

Therefore, we have good reasons to believe that homosexuality and sexual activity in general could have had an important function for bonding individuals both in animal species and in human groups. Sexuality-based bonding between individuals of same and different sexes was helping to foster the survival of the most socially dedicated animal groups, including our ancestors. This must be the reason why homosexuality and bisexuality were and still are so prevalent in social animals and in human societies. This is also why some of the most celebrated fighters of human history have been spurred on by homosexual love. It would be also logical to propose that homosexuality (and bisexuality) must have been much more prevalent and more acknowledged in earlier, pre-Judeo-Christian religion human societies as there were no strict moral and religious guidelines, obstructions and condemnations to this absolutely normal condition and behaviour of living organisms. If we recall that social interactions through physical touch were present among prokaryotes, a time when there was no sexual division of living organisms, we will come to the interesting conclusion that the first instance of sexual behaviour came from the social interactions of asexual organisms.

In the light of homosexuality (or more correctly, bisexuality) being so prevalent and so important in fostering bonding within social animal groups, it is more probable that it was sociality that triggered the appearance of sexual behaviour, first as a means of bonding among the prokaryotes, and later leading to the formation gender differences and the sexual means of reproduction among the evolving eukaryotes. According to this suggestion the initial body-touch-based bonding sexual games must have been naturally limited to homosexual activities. As gender segregation and development of sexual means of reproduction came much later, the initial sexual-bonding games were conducted between the same sex (or more correctly – genderless individuals). According to this suggestion both homosexuality and bisexuality has been an important part of natural selection in many animal species, particularly in that of social animals. Here I must note that the idea that

sexuality and sexual reproduction were initially formulated as a means of social bonding was first proposed by Nino Tsitsishvili, an ethnomusicologist and evolutionary musicologist, during an informal conversation on June 29th, 2012 as a probable origin of the sexual division of live organisms.

Taking into account the uniquely social human nature, it is not accidental that homosexuality is so prevalent in human societies. Only later, with the development of much larger social groups, the creation of such unnatural entities as states and major state religions, human pan-sexuality became the central element of the religious "sin." It is possible that this targeting of sexuality as a "sin" or "taboo" was a tool, instinctively designed by states and major religions to divide the members of smaller, blood-related human bands from each other and to unite them in their imagined societies of ethnic states and Empires. What we know for a fact is that most major religions ban virtually all sexual activities that do not lead to conception. Homosexuality, bisexuality, sexual activity among teenagers, transgenerational sex, fetishism, promiscuity, group marriage and masturbation were all declared anti-ethical and unnatural. Various punishments were designed, many based on the public execution of all parties involved. It was not accidental that in the atmosphere of considering sex an original sin, the complete absence of sexual activity, or keeping celibate, became a sign of particular moral virtue and wisdom. Some founders of major religions were portrayed as living their life completely without sex, or without sin. Some religious heads are supposed to live their lives without sex, and at least one founder of a major world religion is believed by its followers to have been even conceived without any sexual means of reproduction.

If we take into account that sexual activity is widely used in the natural world for the establishment of bonds in social species, we will understand that many of these bans imposed on human societies by major religions must have led to severe and lasting psychological trauma within certain humans. We need to keep in mind that humans are by their nature more sexual than most social animals, even the ones who practice homo- and bisexuality. The extent of sexual activity in humans is apparent when we take into account that human children are universally engaged in sexual games and have sexual desires from an early age. Unlike the young of many other animals, who do not exhibit sexual interests and desires until adulthood, humans have sexual arousals virtually from the time of birth, and children have been

known to be engaged in sexual games, masturbation, and even sexual intercourse. In some societies (for example among Bushmen) sex between children was considered very natural (Shostak, 1976). Of course, when European missionaries came in contact with Bushmen and learned their traditional behavioural rules, the sexual freedom was a clear sign to the missionaries of their moral decay and barbaric state of society.

Many religions consider humans "naturally sinful." It is quite fascinating how we declare things that happen in nature unnatural and then consider the human-created rules being the highest authority and "natural". Well, the trouble is that even if we try to follow our own rules, we will still face serious problems as major human religions cannot agree exactly what activities should be classified as sinful and what should be counted as permissible. For example, is drinking alcohol, eating meat or marrying more than one woman a sin? Well, we know that existing religious and cultural contradiction is one of the forces that divide our world today, leading to aggression and resentment of the cultures of "others." On the other hand, the rules of the natural world are quite straightforward: **sexuality is a great bonding force and is widely applied in nature in non-reproductive sexual activities**. There are possibly no social animals that do not use sex for social purposes.

We are profoundly social animals, we cannot stand silence, we love singing together, dancing together, we even prefer watching comedies while hearing other people laugh, we talk to ourselves and have TV on all the time just to avoid any gap of silence, yet we are banned from the most natural things of our evolutionary heritage by our cultural and religious values. As a result of these unnatural bans, we suffer from the discrepancies between our natural desires and cultural norms, and as a result we try to fulfill our desires in our fantasies, in dreams, and through different forms of arts.

Imagine forcing bonobos to follow the human moral rules of sexual interactions and banning them from the bisexual and trans-generational promiscuity they actively follow today. This will be the shortest way to turn these happy and peaceful primates, possibly our closest living relatives, into deeply unhappy and aggressive animals. This is most likely what has been done to humanity. It is no wonder that Freud could explain virtually every human fantasy and allusion by means of our banned and thus unfulfilled sexual desires (Freud, 1905).

In a recent study of suicidal attempts in Israel, an alarmingly large percentage of religious homosexual youths attempted suicide, about 20 times more ratio than the general population (Study: Highest Suicide Rates Among Religious Homosexuals, 2012, 5 September). It must surely be the inevitable conflict between religious faith, with its condemning homosexuality as a sin, and natural homosexual desires that provides such a lethal psycho-physiological recipe for disaster to young religious followers.

It is quite obvious that human societies and cultures are gradually becoming more open, and that many more humans will be able to fully open their sexual potential as we progress in time – but there is still a long way to go. Remember that the Kinsey report was met with public disbelief, and a film about 300 Thebans is yet to be made. This will take a long time, as moral codes instilled in our brains by our societies, traditions and cultures are not easy to change. Using myself as an example, even my strong scholarly understanding of the role of sex in nature and human evolution does not help, and I have to confess that it is difficult for me to imagine myself in anything other than a heterosexual monogamous relationship.

I hope that readers can see the clear link between human homo- and bisexuality and the phenomenon of the Battle Trance. We go in the battle trance easier and disregard our personal safety when we truly love those who we need to fight for.

"I love you:" The true meaning of the important words

Charles Darwin once asked a very serious question to himself in his diary: "What passes in a man's mind, when he says he loves a person?" (Desmond & Moore, 2004: 278). Unfortunately, Darwin never came back to discuss this non-trivial issue in his books, even in his book dedicated to sexual selection.

Now, from the new perspectives given above, from all forms of sexuality as the means of strong bonding between individuals to the all-consuming fatal passion of the battle trance, we can possibly answer that difficult question that Darwin asked in his diary. So I suggest that when humans say "I love you" the message is very simple and at the same time very profound. It means the following:

"Your life is more important to me than my own life. You give my life meaning, and I am ready to die for you."

And when we are ready to die for each other, we feel immortal, and that is the only true love. Only when you are in love you have the feeling that there is something in your life that is much bigger and important than you are, and when you have something bigger than your own life, your life has meaning and you are not afraid to die.

Not many readers may agree that our words "I love you" have such a profound meaning to many of our fellow humans. They are most probably right – we do not often need to risk our lives in order to save our loved ones; our life became too safe for such heroic deeds to remain commonplace. But for our ancestors, with their everyday physical struggle for survival and with their constant interdependence on each other, the feeling of love and trust had indeed a very deep meaning. Possibly the closest that comes to the feelings of our hominid ancestors towards each other in contemporary life is the internal friendship and love that members of combat units have for each other. As Sebastian Junger remarked, "The willingness to die for another person is a form of love that even religions fail to inspire, and the experience of it changes a person profoundly" (Junger, 2010:239). We can probably argue that religion also has the power to bolster such profound feelings of love and attachment. These parallels are the result of the fact that both religion and war are based on putting humans into a collective state of mind.

For our hominid ancestors, love was not a romantic feel of heartache – it was a way of life, and this profoundly deep love was expressed without any words. According to Albert Mehrabian from UCLA (Mehrabian, 1971), an expert on verbal and non-verbal communication, there are three elements that we take into account when determining how much we like another person and the message they are giving us: words account for 7%, tone of voice accounts for 38%, and body language accounts for 55%. Human feelings possibly lost their depth after we started communicating with a higher focus on spoken language? Talleyrand , the mastermind of political games, was possibly correct when he said that we need words to conceal our true feelings…

Conclusions: Quantifying Human Aposematic index

We have now finished our review of the aposematic arsenal of humans. We have found that humans use plenty of aposematic signals in all possible modalities: visual, audio, olfactory and behavioural. Building up such a potent aposematic arsenal of warning signals required an array of morphological and behavioural changes during our evolutionary prehistory. We will now assess hominids' and early humans' aposematic characteristics via the 'Aposematic Index' introduced earlier in the book:

Visual modality - Bipedal locomotion, longer legs, and a long tightly coiled bush of hair were utilized in order to be as tall as possible, to stay constantly visible and also to maintain a height advantage against all prevalent predators of the day. Apart from their towering height, our ancestors also widely used very bright colours (very popular among aposematic species as an aposematic tool). Not content with their natural ability to change face and body colours in excitement and rage, hominids came up with new cultural inventions: (1) body painting, (2) use of clothes, and (3) use of masks. Early hominids and early humans were visually very impressive – unusually tall for their modest weight, very colourful with their painted bodies, clothes and masks, and constantly maintaining their threat (bipedal) posture. In moments of need humans would raise their hands above their heads to seem even taller, and they could also make threatening body movements in perfect synchrony in groups, giving the impression of a much bigger super-organism. In the visual modality hominids and early humans had the highest possible AI score of 25%.

Audio modality – Our ancestors gradually became one of the loudest species in the world, employing several ingenious new developments. Unlike many arboreal species who become silent when visiting the ground, they became the only known singing species to live on the ground; they used humming as a constant background sound to maintain contact within the group and to advertise their presence, they started using the gift of their genetic drift – precise rhythm – and developed the ability to be entrained; they started singing in big groups, and developed the tradition of singing with the most effective audio tool: attention-grabbing dissonant harmonies.

Furthermore, because of their flexible vocal apparatus, they became one of the best imitators of other animals' sounds and used this ability to their advantage. In the audio modality they also deserve the highest possible score, 25%.

Olfactory modality – If the high scores in the visual and audio modalities can hardly be contested, there will be readers that may be more conservatively inclined in acknowledging the presence of a strong olfactory element in hominid and early human morphology. I propose that the strong body odour that our ancestors were constantly emitting was designed by natural selection to advertise their presence – particularly during their precarious night-time sleeps in the open (we will discuss this later). I suggest that the development of powerful sweat glands and appearance of patches of hair in the armpit and genital areas were also part of the augmentation of our ancestors' olfactory tools. Apart from the constant strong body odour, our species is also known to drastically increase sweating and body odour during moments of fear, rage or excitement (this is very common for aposematic species). And as several other species do, humans also urinate and defecate in situations where their life is at risk. In the olfactory modality, the AI score for our ancestors is also the highest possible 25%.

Behaviour – An aposematic strategy includes several typical behavioural elements: slow locomotion, an awkward walking style, stopping, unusual threatening movements ("antics"), fearless behaviour in precarious situations, and social lifestyle and aggregation in groups. Humans are fulfilling all these behaviour patterns admirably. We are one of the slowest species that ever walked the African Savannah, we walk strangely and awkwardly on two hind legs, we also often behave fearlessly in dangerous situations (like young village shepherds in Africa who shoo away hungry lions by raising and waving their hands and shouting), we live our whole lives in complex social groups, and we particularly like aggregation in large groups at special times, for example during religious or social celebrations (Ehrenreich, 2006). All these behavioural patterns suggest that humans have been aposematic species for all their evolutionary history. Therefore in the behavioural modality they also deserve a score of 25%.

This brings the total score of human AI to a perfect aposematic score of 100%.

There can be no doubt that humans are an aposematic species, and the large number of evident morphological and behavioural characteristics suggest that they spent most or all of their evolutionary history as an aposematic species. Humans are even more aposematic than the classic aposematic cases of skunk and hedgehog. At least in one of the behavioural characteristics (living in groups) the skunk and hedgehog deviate from the classic aposematic characteristics, unlike humans who stick to virtually all the characteristics of aposematic species.

Humans as Aposematic Species: Implications, Paradoxes, Perspectives

If we accept that humans are an aposematic species, there will be plenty of implications, both in understanding human evolution and in understanding human psychology. Let me only scratch the surface of this huge topic, leaving it for those who will be interested to look deeper in this direction.

First of all, the acknowledgement of aposematism as a central force in the evolution of our species puts the theory of sexual selection in a precarious position. **The aposematic model of evolution is a potent means to explain practically all the elements of visual, audio, olfactory and behavioural display that are traditionally explained by sexual selection**. In this contest the aposematic model has a certain advantage, as it puts defence from predators and obtaining food as the central driving force behind the evolution of human morphology and behaviour. The model of sexual selection virtually neglects the need for defence from predators and places competition for female mates as the central driving force behind human evolution. It was very symptomatic that Darwin, the sole parent of the sexual selection model, suggested that humans could have evolved somewhere on an isolated island, in an environment without predators. As we know today humans evolved in Africa, arguably the most predator-infested continent of our planet, both in the past and in to the present day. Therefore, the need for a viable defence system from predators must have surely been paramount for our distant ancestors.

There are psychological reasons why sexual selection is so attractive to contemporary scholars. Today most humans live without any fear from being attacked and killed by predators. Obtaining food, the perennial problem for any animal species, including our ancestors, is not a problem for us anymore, at least in the developed world. On the contrary, too much eating is increasingly becoming a problem for the citizens of many developed countries. As a result of the change over the many years, the ancient need to save ourselves from predators and fight vigorously for our food has lost its urgency and survival relevance. Today we use our tall bodies, long legs, variously shaped (and coloured) head hair, beautifully curved eyebrows and eyelashes, well-crafted clothes, tattoos, our talents for singing, dancing in rhythm and other related elements of our cultural heritage mostly to impress peers and to attract the attention of the opposite sex. Gaining a higher position in society or in a certain group of people is the new focus and aim of our looks and behaviours.

It is a fundamentally flawed strategy to look at the life of our distant hominid ancestors from the perspective of our own contemporary safe and prosperous life, without taking into consideration the bitter everyday struggle for survival of our distant evolutionary ancestors.

Why we all like to be unique?

The aposematic model also has the potential to explain the well-known psychological strive towards uniqueness among humans. As we may recall, the strategy of aposematism encourages being more conspicuous and noticeable. Aposematic species and each individual within an aposematic species will naturally try to be more visible than others and louder than others. They like changing their appearance, they like bright and shiny colours; basically they strive to have something unique in their appearance – sounds, smells, or behaviour. According to this evolutionary strategy, **the more conspicuous and more aposematic you are the more protected you are**.

The situation with the cryptic species is radically different. According to this strategy, the more blended-in and inconspicuous you are the more protected you are. These different survival strategies profoundly affect how these animals look, sound, smell, and behave.

The drive towards uniqueness within each human individual may be a result of our aposematic evolutionary past. We are still aposematic animals. Every human artist, painter, composer, sculptor and musician tries to be unique, to attract attention, to have a unique style of expression. Great artists as a rule are expected to create their own unique style. Apart from the drive to be unique, the psychology of aposematism also leads to the extroverted nature of some of the most successful individuals. Among the public figures and political leaders many have extroverted characteristics that allow them to stand out from the rest. You often hear about the most popular girls "she gets all the attention wherever she goes." Grabbing everyone's attention is a typical aposematic feat. No doubt there are plenty of fellow humans who prefer to stay unnoticed or to follow others, but it is still this strive towards uniqueness that remains as one of the hallmarks of human psychology. We use makeup, clothing, high heel shoes, hair styles, perfumeries and singing and dancing to stand out and feel unique. Our ancestors were also doing the same. Their primary aim was to survive by attracting more attention. Our aim today is to be more successful by attracting more attention. Times and consequences have changed, although the principles of attracting attention remain the same.

This feature comes with a seemingly paradoxical contradiction. Despite the strive within each human to be unique, humans still prefer to be in groups. It might seem natural to have those who strive to be unique lead a solitary life, but it is a part of aposematic strategy that individuals still like to be in groups. The logic of being in groups for aposematic animals is not difficult to see: a group of colourful, noisy and smelly animals is much more noticeable than one colourful, noisy and smelly animal.

Another paradox of aposematic strategy is connected to the feeling of freedom. We all strive towards individual freedom but, paradoxically, to feel the highest expression of freedom we need to lose our individuality, lose our ability to think rationally, and feel ourselves as a part of something larger. This conflicting strive on

one hand towards individualism, and on the other hand towards "groupishness," is the very essence of humans' aposematic psychic nature.

It is no coincidence that there are much more aposematic species among social species than there are among solitary species. In a way, every social species of animals might have an element of aposematism, as a group is always easier to notice than a lone creature.

I would suggest considering any social species to be aposematic by default, unless it has been demonstrated otherwise.

Aposematism and the birth of beauty

We have one more thing to discuss here. Humans' internal strive to aposematism can also shed some light to the mysterious origins of our aesthetic sense.

Human life is a perennial strive to look beautiful and to live among beautiful things. We spend plenty of time and money to look more attractive, we design useful things to be not only useful but be aesthetically pleasing as well, we prefer to live in beautiful houses with beautiful gardens in beautiful suburbs; we prefer to drive beautiful cars, have beautiful partners and travel to beautiful faraway lands; One of the central functions of human art is also to impress by its beauty. Beauty is everywhere, or at least humans try to have their lives surrounded by beauty. The crucial questions are where this sense of beauty developed from, and why is beauty such a driving force in our lives?

I suggest that our nature as aposematic animals can explain the mystery of humans' aesthetic drive and our strive for beauty. Let me formulate my line of arguments:

Aposematism, as a survival strategy, is based on a system of signals designed to grab everyone's attention by all possible means (visual, audio, olfactory, behavioural); In order to grab everyone's attention, an aposematic display will use bright colours, big morphological ornaments, sounds, smells and unusual behaviours.

Aposematic animals and their displays generally seem beautiful to us as it is based on the use of brilliant and contrastive colours, ornaments, various sounds, smells and fearless actions;

We prefer people and animals who display more aposematic characteristics as we have a natural and innate appreciation of an impressive aposematic display (as our ancestors with better aposematic display were more successful in surviving, thus more popular among their counterparts). This is how and why aposematic appreciation became the basis for the modern human sense of beauty. Or, to put it simply, for humans "aposematic" eventually became "beautiful."

We like the dazzling colours and the size of a peacock's train as it is one of the most attention-grabbing visual displays there is; on the other hand this display can intimidate many potential predators and competitors;

We like the male lion's majestic mane, a potent aposematic element used to scare away rival lions and hyenas, and in most cases to help avoid unnecessary and damaging physical violence;

We like tigers' colourful appearance. Although most likely its dazzling striped skin was formed as a camouflage for concealing the tiger in the dense jungles, tiger colours (yellowish and reddish with black stripes) are known as very potent aposematic colours within many species – think of the colouring on wasps, snakes or even the many venomous frogs found in the Amazon;

We appreciate the brilliant colours of many poisonous snakes although we are well aware of the deadly venom that can come from them. If you travel to an exotic country or tropical forest, any local or guide will most likely warn you to keep clear off all animals that have brightly coloured bodies – this is very good advice, indeed. Remember, **in nature "very beautiful" often means "very dangerous"**!

Many animal species, predators among them, have learnt this lesson from countless conflicts with brightly-coloured and noisy aposematic species. It can be debated whether they understand and appreciate beauty as we do, but they definitely have a very acute sense of danger that is invoked by the sight of these brightly-coloured and noisy animals.

So the same displays, expressed in dazzling colours, sounds, smells and behaviours, aimed to grab everyone's attention, can carry two messages: "I am dangerous" and "I am beautiful." My suggestion is that for the most of natural world

it is the first message, "I am dangerous," that they can comprehend, because this message is life-saving and essentially relevant to any species. Seeing beauty is perhaps possible for only humans.

Of course this is a generalization, and as most generalizations are, it cannot be correct in all cases. There are plenty of dangerous things that we do not consider beautiful (for example, a knife in the hands of a burglar, or a landmine), and there are beautiful things that are not dangerous (for example, a flower, or a kitten).

Can handicap principle be true?

Many aposematic displays were believed for a long time to have no survival value for their bearer. On the contrary, many believed that such splendid decorations made the animal's survival harder. It is time to change our views.

I suggest that the well-known idea that – some morphological additions and colours in animals do not have any survival value and are even detrimental for survival – is basically going against the law of natural selection. I have big suspicions about the widely known idea of the "handicap principle." According to this theory, a signal has to be detrimental in order for it to be honest (Zahavi, 1975; Zahavi & Zahavi, 1997). Although it is quite attractive in its contradictory nature, this theory has some internal failure. To those who will be enraged with my suggestion, I can assure that I do not have any reservations to admit that I was wrong if anyone is able to demonstrate a colourful addition to any animal species morphology that is truly detrimental, and has no function whatsoever other than to impress females. I want to remind everyone that the tail of the peacock, by far the best-known proof of the idea of the costly "handicap principle", apparently does not provide any proof to the claim. Peacocks have not only the dazzling display of their train, but also an extremely loud voice, extremely smelly droppings and extremely fearless behaviour, all clear signs of an aposematic species. The longest and the most vigorous study in this sphere came to the conclusion that a bigger and more colourful train does not give its bearer any advantages in attracting female attention. Therefore peacocks do not exhibit this "handicap principle," and if a clear case of any such animal species

is found, I suggest it also be used for the cover photo of the new edition of Amotz Zahavi's highly interesting, but in my opinion controversial, book.

Let's get aposematic: We are going to party!

When a girl is dressed up to go out on the town, she will generally make plenty of efforts to look more attractive. After using makeup, she will have a face with bigger eyes, brighter red lips, and coloured cheeks. Now the clothes. The girl going to the party will very likely be standing on awkwardly high-heel shoes, both to seem taller and to have longer legs – both are powerful aposematic visual signals. She is most likely wearing clothes that are more attention grabbing than a cozy robe, and of course do not forget to add some shiny jewelry like a necklace, bracelet or earrings.

A girl dressed up like this will look beautiful, or will at least be attracting attention. This is the reason behind dressing up – this attraction comes from the bright colours used in the dress, makeup and jewelry, and this image is extremely aposematic. A girl dressed up for a party will be able to scare away a stray dog better than the same girl who slipped out of home for a second to put out her rubbish bins.

Of course, many westerners, particularly of certain classes and demographics, have a different dress code based on stricter colours and the modest use of jewelry, but in earlier tribal societies the rule was simple: bigger and brighter was more beautiful. Well, let's not talk only about tribal societies; we can recall how medieval European monarchs looked in their official dresses.

Now, as we know the potent primary warning display of our ancestors, we are ready to discuss their secondary, or "real," defence strategy.

Oops, Almost Forgot: Primate Behaviour as the Model for Early Hominid Behaviour

One small but important addition. In their fascinating and insightful book "Man the hunted" Donna Hart and Robert Sussman formulated the methodological background of their approach: "We only have two sources to draw on if we want to fill in the millions of years before historical times. These are *paleontological remains* – a sparse but fascinating fossil record – and the *living primates* – who are our closest relatives" (Hart & Sussman, 2009:5).

I agree regarding the paleontological remains. I have my reservations however about using living primates as the model of behaviour for our ancestors (see below), but before addressing it I would first like to add here two more important sources: (1) human morphology and (2) human behaviour. There are plenty of unique elements of both morphology and behaviour that set apart humans from all our closest living relatives. Humans are different from all other primates as they habitually use bipedal locomotion, have soft naked skin, have long hair on top of their heads and in their armpits and genitals, are the only terrestrial singing primates, have a sense of rhythm, sing in rhythmically coordinated choruses and dance in rhythmically united groups. All these features were formed during the last 6-7 million years of life of our distant ancestors on the open woodlands and savannah in Africa, and it would be natural to propose that most of them were developed as a part of an overall survival strategy.

If we are dedicated followers of the theory of natural selection, we should propose that most of these features could have been developed as a part of the early hominid survival strategy. Therefore we can state with confidence that, apart from paleontological evidence and primate behaviour, there are plenty of unique morphological and behavioural characteristics that must be considered as a rich source for filling in the millions of years of human/hominid prehistory.

Now let me briefly formulate my doubts about the use of primate behaviour as a model for hominid/human evolution. Despite the obvious phylogenic connections between humans and primates, we should not neglect the obvious differences in

morphology and behaviour between them. It is very likely that the above-mentioned differences that set apart humans from all other primates (bipedal locomotion, soft naked skin, long hair on top of our heads, patches of hair in armpits and genitals, being the only terrestrial singing primates, being the only animal who can sing in rhythmically coordinated choruses and dance in rhythmically united groups) reflect the crucial differences in survival and behavioural strategies that human ancestors followed after separating from other primates. In this book I propose that hominids were the only primate species that were using aposematism as their central strategy of survival. No other primates rely on aposematism as their leading strategy of defence. I believe aposematic model of human evolution, proposed in this book, can explain most of these morphological and behavioural differences that separate our species from our closest living relatives.

This is why I am skeptical about the methodological notion that living primate behaviour can explain behavioural patterns of our ancestors. **We look and behave differently because we followed different survival strategies**. As the Georgian sociologist Gigi Tevzadze once suggested, primates show us what humans were not (Tevzadze, 2013).

Therefore, despite the widely accepted fact that primates, and particularly apes, are our closest living relatives, when we are researching our evolutionary roots we should always remember that there is an array of human morphological and behavioural features that are not shared by any of our closest living relatives. These differences are the true indicators of the vast difference between the life strategies of that of our ancestors and that of their closest living relatives. I suggest that it was our choice of aposematic behaviour that put a rift between future humans and our primate origins. Aposematism turned our ancestors into bipedal, tall primates with longer legs and shorter hands; it made us the only singing species on the ground, without canines or a hairy body. Even without our ability to think, ask questions or to use language and speech our primate ancestors were very different from our hominid ancestors. For the reasons outlined above, using apes as a model for early hominid life strategies can be grossly misleading.

The fact that we share 98% of our DNA with chimpanzees can impress us with the level of statistical closeness between the two species, but we should not forget that we also share 60% of our common DNA with bananas.

CHAPTER FOUR

The Weapon

We come to the moment of truth: "show me the weapon!" growls a hungry predator at our distant ancestor. As a rule, aposematic species have secondary or "real" defences, as it is unreliable to rely on only looks, sounds, smells and behaviours to scare away predators with. If a very hungry predator attacks an aposematic animal, it could get a lesson that is hard to forget. Such lessons can be taught by various means, including venom, electric shock, spikes, antlers, horns, a powerful kick, teeth or tusks. Having a noxious unpalatable body, having a repulsive taste and emitting a revolting smell also qualify as potent secondary defences, and predators learn quickly to leave these brightly coloured, noisy, smelly and generally unprofitable animals alone.

Well, as we may remember from our earlier discussion of hominid defence abilities, humans did not use any of the usual means of defence strategies that are widely used by other animals. Hominids did not have venom, antlers, horns, tusks, or thick hides. They could not administer electric shock, and they did not even have strong teeth with decent canines. Amazingly, our ancestors did have much better canines while they were still living on safer tree branches, but mysteriously lost them after their descent to the predator-infested ground.

So, even if we agree that human ancestors had a great arsenal of warning and intimidating signals, they also had to have some kind of physical weapon hidden up their sleeves – just in case a predator was too hungry and too determined to get something for its long overdue dinner.

This chapter is designed to provide an answer to the question what exactly the hominid secondary defence strategies were.

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If you suddenly find yourself somewhere on a country road in the company of aggressively-behaving unfamiliar dog, you will most probably use most of our usual aposematic arsenal, like raising and waving your arms and stamping and shouting in order to try to scare the dog away with your body size and loud voice. In the event that dog comes closer and the threat increases, most likely you will try to get a stone from the village road and throw it at the dog. Actually, you will most likely try stone throwing from the beginning of the encounter, together with your other visual and audio displays. I must say from my own experience that, in most cases, dogs will understand your intention as soon as you bend down for a stone, and will leave you or will be more careful in approaching you in the future.

A stone, or a piece of rock (or any other object suitable for throwing) is the first and the most readily available weapon for any human when he or she finds himself/herself in the need for an appropriate tool. Even in Hollywood action movies you can sometimes see the tough guys throw their handguns at each other once their guns are out of bullets. "Cobble-Stone is a weapon for proletariat" was a famous symbolic statue in the former Soviet Union. This was a statue of a half-naked proletarian bending down for a large boulder. Throwing stones during civil unrests is widely documented. In many countries throwing a stone at a person, or a car, is a serious criminal offence. A precisely-thrown stone can seriously injure or kill a person, or cause a car accident. Stoning is also still a practiced form of capital punishment in certain countries.

As a species, we humans are certainly very weak is comparison to even physically smaller animals, we have gentle skin, we have no canines, and even an awkwardly-moving chimpanzee can defeat our Olympic champions in a running contest, but we are champions of the planet in one very useful activity: our precision and range in the throwing of objects. We have wonderfully adapted our whole body, particularly the arms and shoulders, in order to throw objects with more effectiveness. Both men and women are good at throwing, but males are particularly good at this activity. Look at the human body: on one hand, wide male shoulders allow us to make an impressive frontal visual appearance, and on the other hand, the same wide shoulders allow us the flexibility and strength to throw objects much further and with much more accuracy than any other animal on our planet can.

There are a few animal species that can and do throw different objects, from rocks and branches to poison and even faeces. Chimpanzees, for example, arguably our closest living relatives, can throw rocks and tree branches at leopards and other unwelcome guests. Despite their crushing physical strength, the efficiency of their throwing is no better than of a toddler. All other apes, including gorillas, bonobos, orangutans and gibbons also throw objects occasionally but not with great efficiency. Spitting cobras can eject their venom and aim for one's eyes quite precisely, when defending themselves, but only at a range of a couple of metres. The skunk is a bit better, as it can use its deadly spray accurately at a range of up to 3 metres. In comparison to humans, who can hit a target from the range of 20-30 metres (or even much further depending on the individual), all the other throwing animals seem like lousy amateurs. So finally, after being humiliated by the rest of the natural world in such activities as running, jumping, swimming, climbing, wrestling and weightlifting, we finally have a sporting activity in which we are the champions of the World: throwing objects at a distance. Although I prefer watching soccer, I must admit that baseball and cricket are essentially the most "humane" sports.

The same way as we are in awe from the running of a cheetah, the power of a tiger or the jumping of a puma, all the animals watch in awe, jealousy and fear as we throw various objects with unprecedented range and accuracy.

Although the use of throwing together with the use of clubs was mentioned by Darwin, the importance of stone throwing only seriously came into the scope of human evolutionary study in the 1980s. In two years, 1983 and 1987, four important pieces of work on the effectiveness of throwing were published. In an article "The adoption of bipedalism by the hominids: A new hypothesis", in the journal "Human evolution", Mary Marzke argued that one of the central reasons of the appearance of bipedalism was stone throwing among early hominids (Marzke, 1983). One of the conclusions of this article was "…throwing could have been an effective component of (A. Afarensis) strategies for food acquisition and protection from predators' (Marzke, 1983: 84).

In the same year of 1983 William Calvin's influential collection of evolutionary essays, "Throwing Madonna" was also published. William Calvin became the greatest and best known proponent of the importance of throwing in human evolution. He was able to persuade many evolutionists that aimed throwing was a

crucially important part of human evolution. Throwing, he suggested, was not only important for hunting, but for the development of our neural asymmetry and faculties such as language and logical thinking.

1987 was another "year of throwing." Paleoanthropologist Barbara Isaac, who was instrumental in starting paleoanthropological research at the world famous Dmanisi site, published a ground-breaking article on throwing in human evolution. This was the first publication researching in full depth the potential importance of throwing in human history and evolution. The article presented not only a theoretical postulation of the idea, but provided wide historical evidence of throwing as a powerful military tool for defence and assault.

In the same year Felix Fifer from the UK published an article on human bipedalism. Similar to Mary Marzke, Fifer proposed that stone throwing was the central force behind the human bipedal posture and locomotion.

Barbara Isaac's article is of particular importance. She noted in the introduction of the article: "For the last hundred years or so, the throwing of unmodified stones and the wielding of sticks has been mentioned in various accounts of aggression among peoples without highly developed technologies. Nevertheless modern scholars seem unaware that throwing stones could have made a significant contribution to early hominid survival."

Barbara then gives an impressive historical-ethnographic account of the power of stone throwing. For example, in the fourteenth century the Portuguese, armed with crossbows (it was before the era of firearms), had a clash with indigenous Canary Islanders who had only horn-tipped wooden lances and stones. The encounter was a total disaster for the Portuguese, and they bitterly lost with their "heads bloodied, arms and legs broken by blows from stones." The witness of the encounter also wrote about the quick changes of position by the natives: "they run like hares." The situation was repeated on the same canary island after some time: natives were quickly shifting their weight, allowing them to manoeuvre quickly, and throwing stones with deadly accuracy: "It happened that when the cross-bow men shot their bolts they did little harm, for the Guanches never remained in one place, but kept moving about, so that it was difficult to take aim. They hurled stones with much more effect, breaking a shield in pieces and the arm behind it."

One comment: the habit of dynamic positioning while throwing stones tells us that natives were using stone-throwing in intertribal clashes. Encounters with animals (both predators and preys) do not require quick position changes, but in a hostile exchange where stones are thrown (or in our example, the Portuguese crossbows against the natives' stones) such position changes would be very effective.

During their Pacific exploration European explorers were already equipped with firearms, but they still had occasional losses incurred from stone-throwing natives of the Pacific. La Perouse and Captain Cook were both attacked with stones. Thrown stones were disabling invading warriors who were subsequently finished off with clubs - Captain Cook was himself killed in such an encounter. According to Wood's *Natural History of Man* report (1870), native Australians were also great experts of stone throwing: "The man has fired at the native, who, by dodging about has prevented the enemy from taking correct aim, and then has been simply cut to pieces by a shower of stones, picked up and hurled with a force and precision that must be seen to be believed..." (Wood, 1870).

The same mastery of stone throwing was shown by Hottentots and Fuegians. Darwin was impressed by the mastery of stone throwing by Fuegians (1871:49). In 1870 Wood described the amazing throwing ability of a mortally wounded Fuegian, who, before he died, hurled 4 stones that "struck the master, smashed his powder horn to pieces, and nearly knocked him down. The two next were hurled at the heads of the nearest seamen, who just escaped by stooping as the missiles were thrown (1870, 2:518). At the fourth attempt to throw, the man fell dead."

Hottentots could "hit a target the size of a coin with a stone at 100 paces (about 60-70 metres) [apart]" (Isaac, 1987:9). La Perouz claimed that natives were able to throw large stones weighting up to 1.4 kilos. According to Barbara Isaac, the size of several "War hand-stones stored in museums, support this claim" (Isaac, 1987:9).

Archaeological remains also support the idea of throwing by early hominids, as large amounts of unmodified stones of a type unsuitable for flaked tools were found at early sites. Australopithecines apparently used smaller stones, most likely because they were smaller themselves. Later, about 1.8 million years ago, hominids started using flint tools, most likely to cut up carcasses. But how were they obtaining the carcasses in the first place? In regards to this important question, Barbara Isaac

(along with other leading archaeologists of the time, for example Lewis Binford) suggested the scenario of confrontational scavenging: hominids were scaring away lions and other predators from their kills.

Another interesting piece of evidence to support the use of stones as weapons is that a major portion of early archaeological sites are associated with stream channels, where pebbles would have been plentiful. We must remember here that living at a river is not a safe option for most prey animals, as many predators attack their prey at water-holes and river banks. The fact that early hominids lived at the rivers points to the possibility that they had a valid defence strategy against predation – that they were using the readily available pebbles as tools of defence. Let us remember here that hominids also had the ability to create a loud group sound, to make synchronous threatening movements, and to go into a battle trance where they did not feel fear or pain. As a result of all these factors, we have a fearsome bunch of religiously dedicated warriors, real kings of scavenging confrontations. (Albeit – still very poor hunters themselves.)

Barbara Isaac's conclusion that "Throwing could have been an effective component of (australopithecine) strategies for food acquisition and protection from predators" seems quite plausible.

Unlike Barbara Isaac's article, which became a classic work for everyone interested in the history of throwing in human evolution, Felix Fifer's article, which was dedicated more to the origins of bipedalism rather than throwing, was partly lost among the large number of works dedicated to human bipedal locomotion. The central idea of Fifer's article was that defensive throwing was the key driver of hominin bipedalism. In the 21st century Holly Dunsworth, John H, Challis, and Alan Walker supported this argument (Dunsworth et al., 2003). Although I believe that the suggestion of Felix Fifer (and several other scholars) that throwing rocks and other subjects was a tremendously important strategy of survival of early hominids, I do not think this was the central force that led to bipedalism. It is true that our closest living relatives, chimpanzees, have been observed throwing objects both in captivity and in the wild – however at the same time they have rarely been observed throwing objects while in a bipedal posture. Throwing whilst standing seems more likely to be a consequence of our bipedalism rather than a cause of it – I suggest that the central cause of bipedalism was the perennial strive to display the tallest possible

body in order to intimidate predators and other possible opponents.

Now let us concentrate on another topic. Throwing can have two functions: (1) defence and (2) attack. In evolutionary terminology "defence" mostly means defence from predators, and "attack" means hunting. However, we will soon see that this is not a very precise classification of these situations, but let us first start by discussing these two basic functions of throwing.

Throwing: For Hunting or for Defence?

For some readers this division of the functions might sound groundless. "What is the difference between throwing for hunting and throwing for defence?" you might ask, "If you can throw, then not just use this ability for both? You can use a firearm or even knife for both defence and attack, can't you?" This is true. We know all too well that all the world's military powers, even the most aggressive ones, refer to their military contingents as "defence forces," and all wars start, as a rule, by these "defence forces." So is there really any important difference between these two throwing strategies?

It is true that on first sight hunting throwing and defence throwing may look very similar, but on closer examination we will find out that there are very subtle yet important strategic differences between these two activities. For the evolution of the human ability of throwing, as we will soon find out, these differences were crucial. Chimpanzees and skunks, for example, use their throwing ability only for defence – I believe that our distant ancestors also started throwing primarily as a defence tool. William Calvin, the biggest authority on throwing in human evolution, would not agree with this suggestion – in his writings he was mostly discussing throwing as a hunting tool.

Here is a list of the differences between throwing for defence and throwing for hunting. I hope after reading this list an inquisitive reader will agree that defence

throwing would be much more effective for our hominid ancestors than throwing for hunting.

- The distance is much closer in defence throwing. When an animal (for example, an attacking lion) is approaching you, it is your choice when to throw the rock. The later the throw, the closer the target, the deadlier the result. On the other hand, when you throw for hunting, the target (for example, an antelope) tries to stay clear from you, and getting closer to the prey is not easy. Of course, waiting for an attacking lion to approach you virtually until the point of contact is a tough psychological feat. One of the Maasai warriors noted: "It is not every young man that can wait until the lion is close enough to hunt him with a spear" (Lichtenfeld, 2005: 37).

- It is much easier to aim accurately and hit a target in defence throwing, simply because the target is running towards you. In hunting throwing the hunter is approaching the prey, most likely, from the back side to stay unseen. Also, upon the commencement of throwing the target most likely starts running away from the hunter. Because of these two factors hitting the target in hunting throwing becomes much more challenging;

- Defence throwing is also more effective as it has more of a chance to strike vulnerable parts of the body. When a target is running towards you, the most likely place a thrown rock will hit is on the head. In hunting throwing, when the prey is generally running away from you, the most likely place to strike is the hind quarters;

- The size and the weight of the thrown missiles can be drastically different in defence and hunting throwing. Much larger rocks can be used in defence throwing, as the distance required to make an effective and realistic shot is much smaller. So, unlike more distant hunting throwing, where the best sized rock ideally should be less than 0.3 kilo, much larger rock can be thrown in defence throwing;

- In defence throwing, when an attacking animal is coming close to the point of contact, a thrower can lift and throw a much bigger single stone using both of his hands, being able to greatly increase the size and the weight of the missile being

used. A close-range overhead throw of a much bigger rock would increase the damaging force of the hit dramatically;

- In defence throwing, when a target is running towards you the speed of the running animal is augmenting the speed of the thrown rock, much in the same way a car crash is made worse by two oncoming cars colliding rather than a back-front collision. In hunting throwing on the contrary, the target is usually running away, thereby decreasing the speed that the thrown rock will strike at;

- We can add a psychological factor as well. Believe me, you will use the full strength of your body, and possibly even the hidden reserves of your "supernatural strength" in the moment when an attacking lion is running towards you. Hardly the same desperate supernatural force will come to you in aid when you are trying to hit and kill an animal for a dinner.

The conclusion is clear: defence throwing is much more effective than throwing for hunting for many mechanical reasons. In defence throwing you can throw a much bigger rock, from a much closer range, and the rock will most probably hit the attacking opponent in the head. When throwing for hunting the hunter has to use smaller rocks, the distance to the target is usually longer, and the chances of hitting the target in a vital body part are extremely slim.

Sure, the disabling or killing of lion requires a much stronger hitting force than the disabling of a fragile antelope, but the much greater efficiency of defence throwing can provide the needed power to account for this difference.

Sensing the many shortcomings of hunting-throwing, Calvin suggested that the throwing hominids were most likely not killing their prey with stones or rocks. Instead, he suggested that with a large herd of prey, it was merely enough to hit an animal with a large branch, and then the slightly confused or fallen animal would be finished off by hoofs of the fellow antelopes stampeding. This is of course possible, although it would be difficult to rely all the time on such lucky circumstances – aggressive scavenging would have provided a much steadier source of food.

Most relevant for us, defence throwing can be successfully applied for obtaining food, not via hunting the fast running prey, but via aggressive scavenging of a kill

made by other predators. When Stone wielding and rhythmically shouting hominids were approaching lions at their kill, they were giving lions two options: (1) to clear the scene, or (2) to defend their kill by attacking the hominids. The first scenario was of course more welcome for our ancestors and I propose that this was mostly the case – but the times were changing not only during Bob Dylan's lifetime. Sometimes food was scarce, and each lion kill could have had a much larger importance for the survival of the pride. In such situations lions would generally attack hominids in defence of their hard-earned, and rare, kill. Their frontal attack would give the hominids all the advantages of more efficient strategy of defence throwing. As we can see, it is not easy to classify hominid behaviour: was their advance on feeding lions an attack, or a form of defence? Early hominid behaviour was akin to more recent military forces advancing on a territory belonging to somebody else, and then giving them an ultimatum to clear the territory or engage. Therefore I think we can qualify the hominids' advance on lions as an attack, but their use of throwing was still used in a strategically defensive way.

Division of Defence Roles in Hominids

Taking onto account that hominids could use different sized stones during their defence from large predators, I would like to propose that early hominid groups might have had a primitive division of defence strategy during their scavenging confrontations. Hominids could use stones and rocks of very different sizes and weights. There could be several group members holding lighter sized stones and throwing them at the predator from some distance (for example, at the beginning of the scavenging confrontation). At the same time, there could be one or two strong males who would be holding much larger and heavier stones with both hands in case if any of the lions attacked and came to the point of contact. Lions often use fake attacks when they want to clear any competitors from the carcass. They rush with growling towards the intruders and then stop only a few metres before reaching them – this dash has an intimidating function and usually works very effectively on hyenas and other competing animals.

Despite this, hominids in the state of the battle trance were different. They would stand their ground – running was not an option, and most likely they would increase the intensity of their attacks. A fake lion attack would essentially not work on the hominids as it did on other animals. However, sometimes a hungry lion would leap into a real attack, therefore physical violence was impossible to avoid. There can be a little doubt that attacking lions could kill and injure a few of the hominid defenders, but a shower of different-sized stones, including huge 10-15 kilo stones thrown from point-blank range to the head, could seriously damage or even kill an attacking lion. These two-arm overhead thrown rocks were very much like the contemporary pump-action combat shotguns – useless at a distance, but devastating in close combat.

One more factor to increase the deadly power of overhead thrown large stones could be chipping off some parts from the large stone in order to make one (or all) of the stone sides sharp. On a violent contact with a skull, a stone with a sharp edge can do much more damage than one without a sharp edge. Let us also remember that a thrower at such a close range can control the contacting side of the stone – so how effective were these big rocks thrown at close range?

I searched for many months to find results of experiments on the effectiveness of hand-thrown large boulders in close combat. To my surprise, I found no serious answers to this simple question. A big part of my internet findings on stone-throwing as a human weapon were news reports about Palestinians throwing stones at Israeli soldiers, confirming that the earliest hominid weapon is still in active use – no calculations of the power and the damaging capability of the stones though. Apparently, no one has yet seriously tried to find out the actual potential of the earliest human weapon – a thrown stone. If such experiments have actually been conducted and my search was not good enough to find them, then I have to admit that the results of such experiments were extremely well hidden. Of course, measuring kinetic energy is simple but is not enough, as many more factors should be taken into consideration in such situations (particularly with large boulders thrown over the head with both hands).

My suggestion is that a chunky 10-15-kilogram stone with a sharp edge, thrown at point blank distance towards the head, must have had devastating power and could seriously damage the skull of such formidable predators as bears and lions. Of

course, lions would not be standing and waiting for our ancestors to deliver their best blows to their heads. The best way to deliver a killer stone blow to the head of the attacking predator was possibly, for example, while the predator was biting one of the group member hominids on the ground.

Well, a reader might ask, if there ever was such a devastating weapon as sharpened heavy stones for crushing the skulls of predators, then examples of such weapons must have survived, right? So where is the evidence?

Actually, the evidence is available, but so far it has never been considered as an evidence of projectile (throwing) weapons.

Archaeologists were puzzled by the sheer size of some stone tools found in Africa. They are so large (more than 30cm in size) and heavy that it is impossible to imagine them as a simple cutting device. It has been suggested that such large hand axes may possibly have had a ceremonial or monetary function; or that they may have been used for very heavy work such as butchering large animals or milling branches or trees into fire fuel. It has been also suggested that these huge hand axes did not have any utilitarian function and were made simply as a tool for sexual selection, or in other words – they were made simply to impress women (see, for example, Mithen, 2005). I propose that, in explaining the function of these tools, we should not neglect the possibility that these massive and sharp stone tools were made in order to deliver a killer blow to the skull of an attacking predator at point blank range.

Apart from these massive stone tools, which mostly come from relatively late period of hominid evolution (about 1 million years ago, from the so-called Acheulean tool industry), there are also large amounts of "unfinished tools" of different size from earlier periods. I think it is possible to propose that some of the larger "unfinished" stone tools were in fact finished, but their function was not for the cutting of a carcass, but instead to deliver a crushing blow to the skull of an attacking predator. This matter needs more evidence and free-minded consideration.

The Beginning of Stone Tool Industry

Let us briefly discuss the hypothetical beginning of the human stone tool industry. It is still not clear how the idea of transforming boulders into stone tools came to our distant ancestors. Was it through the insight of a genius hominid (or an ape) that saw a future tool in a boulder? Or was a boulder possibly accidentally shattered and thus turned into sharpened stones that gave our ancestors an idea of their effectiveness?

It seems to me that the latter was most probably the case. A few scholars who have tried to accomplish the task of making a stone tool with their bare hands found that making even the most basic stone tool is an arduously difficult task. The talented bonobo, Kanzi, despite his impressive achievements in acquiring the basics of human language at an early age, learned to manufacture stone tools only after many years of dedicated teaching from his human mentors. Our ancestors had no such mentors. So, how this could have started in the first place?

I suggest that the AVOID, the Audio-Visual-Olfactory Intimidating Display, can provide us with a plausible scenario to answer this question. As we have already mentioned, one of the central elements of the AVOID strategy was the use of stones. Stones were most likely used for two important purposes: (1) to make loud and rhythmic sounds by hitting two stones against each other while approaching a kill-site with predators present, and (2) to throw them at predators if the audio and visual display was not effective. In this scenario we have an excellent situation to have shattered stones: we have a group of hungry hominids in the heat of a life-and-death confrontation. Many of them are holding and using two stones as the simplest rhythmic devices. They are hitting the stones against each other with all the power they have – the louder the sound, the bigger is the effect. They are hitting stones, shouting, singing and stamping in perfect rhythmic unison. They are in the battle trance, ready to stand their ground if the predators attack. The force they are hitting the stones with is further augmented by them being in a state of battle trance – as a result, every such dynamic confrontation would provide our ancestors with at least a couple of shattered stones.

A few minutes after their intimidating display, or even a battle, they were feasting on a carcass. It was here, while they were trying to separate meat from the bones, that the presence of the shattered pieces of stone with sharp edges would provide hominids with a subtle hint. This event provided an excellent opportunity to realize the effectiveness of the sharp-edged pieces of stone. It is difficult to be sure how quickly they acquired the idea, but they had all the time in the world at their disposal. Possibly only after a few hundred generations, our ancestors started intentionally making stones with sharp edges. Therefore, in my proposed model for the introduction of stone tools, which appeared later, it began initially as an accidental by-product of vigorous 'drumming sessions' during scavenging confrontations with large African predators (particularly lions).

Let us remember here the general love humans have towards drumming, with their socially awkward habits of finger drumming, teeth drumming or moving parts of their body to a rhythm. It is quite obvious that this universal desire to make pulsating rhythmic sounds comes from our evolutionary past – it is not a late cultural invention. Actually, drumming is a very good candidate for the proverbial "first profession" in the history of humanity.

Were Stones the First Talismans in Human History?

Here is another small idea stemming out from the AVOID strategy. The Geography of stone tools in paleoarchaeological findings suggests that they were carried by hominids for many kilometres from the sites where the tools were made. Hominids were most likely carrying their tools with them all the time, or at least most of the time – and the difficulty of manufacturing stone tools also corroborates this possibility. Stone tools were carried even when no predators were around and it was relatively safe. Of course, we can be sure that our hominid ancestors' and our ideas of "safety" are quite different. Even if they could not see predators around, there was always a chance that they were being watched by a hungry predator. With the habit

of carrying stone tools (weapons), we can hypothesize that because of the initially very practical meaning these tools contained, they gradually obtained some symbolic and possibly even sacred power. The sacredness of stone tools started because of the practicality of it: it was simply safer to carry stones and stone tools all the time. However, the situation later changed – after being carried for millions of years, stones and stone tools obtained a function of a magical protection, the precursor of traditional talismans.

In many traditional societies men are still carrying daggers, swords and other weapons as a ritualistic part of their "manly behaviour." In my native Georgia men were generally carrying daggers tied to their waist until the 20th century. Most of them did not need these weapons and would not use them during their entire lives, but they still felt more secure with these weapons available to them. The distant ancestors of our species, the Dmanisi hominids, who lived on the territory of contemporary Georgia some 1.8 million years ago, were possibly also carrying stone tools with them, and many years later on the same territory Georgians were carrying daggers for their safety. The safety standards have undoubtedly changed since the Dmanisi hominids' time, and Georgians in the 19th century did not expect to meet a hungry lion in a city or town. Yet still, the feel of security and power that a gun or some other weapon can give to us is still within us – and who said that large predators are the most dangerous to us? Other humans are today by far more dangerous to us than any predators. It is not easy to give up this powerful talisman of personal safety, and many Americans still carry handguns in their pockets up to the 21st century for the same reason – for peace of mind.

Guns and knives are hardly a talisman you could say, and you would probably be correct – but only partly correct. What I am suggesting is that the idea of the talisman came out from carrying around available and very practical weapons for safety. It was only much later that people started carrying around other, non-practical objects loaded with mysterious powers to avert danger and bad luck. In my proposed model, guns, knives and other weapons are the direct descendants of the ancient stone tool, the most potent weapon of our species at the time. Carrying "real" talismans, devoid of any practical use, is the result of our long-held beliefs that some objects can have magic powers to avert danger and bad luck.

If you, the reader of this book, are carrying with you a cross, a ring, a small statuette, a coin, a claw of a tiger, or any other object, even a tattoo for the aversion of evil forces, you are continuing the ancient tradition of carrying external objects for protection from any possible dangers. It is not easy to discard the habits that were put in our genes by millions of years of evolutionary experience – and why should we discard them? If it gives you a feeling of safety, then it is fully justified for its psychological importance, kind of a "symbolic placebo."

Night Time Defence Strategies

Humans and apes are diurnal (nocturnal's lesser-known opposite) animals, and there can be no doubt that our hominid ancestors were active during the daytime as well. Many predators, on the other hand, are active predominantly during the night. What were hominids doing at night? Sleeping obviously – but where? On the ground – was it safe there? Well… Lions and tigers can hunt any time of the day or night, but their preferred hunting time is dawn and dusk. This was one of the serious issues of hominid survival – even if hominids could stand their ground against the biggest predators during the day, sleeping in the open savannah for the poorly-equipped hominids must have been a very serious challenge. They were devoid of many of their AVOID strategic elements while they slept: they did not have their bipedal posture and towering height and they were most likely silent while they slept – so what was their secret to night-time security?

Some insightful ideas have been expressed on this topic. Adriaan Kortlandt made a brilliant suggestion that one of the ways to secure night time sleep was to organize a loud evening 'concert' to scare away potential predators. Kortlandt cites the behaviour of groups of Chimpanzees, who sometimes organize loud 'concerts' before they sleep, and cites also the behaviour of African tribes living in the forests, who organize the same kind of loud evening displays (Kortlandt, 1973). I can

imagine very easily how, at the end of the day, hominids would start a loud night-concert. Jungles and forests are particularly alive with sound during sunrise and nightfall, and our ancestors made up an important part of this natural concert. They would sing rhythmically and dance vigorously, together with rhythmic stamping, clapping, and possibly stone-hitting. It is difficult to measure how long such concerts would have gone on for – a perfect example is when pygmies do not feel safe, they continue such concerts throughout the night.

Most concerts are still organised in the evenings – is this a legacy of our evolutionary strategy for night time security?..

Apart from evening noisy concerts, there were several other strategies employed to secure night-time sleep for early hominids. Let us briefly discuss them.

Eyespots in Homo sapiens

Eyespots are clearly visible marks on the body of an animal which more or less resemble the shape of an eye. These spots resemble an eye in order to deceive predators and antagonists – extremely effective against predation and attacks because most potential attackers seek a certain moment for their attack, when their target is not looking at them. If lions and tigers notice that the prey has noticed them approaching, they generally lose interest in that prey and find another potential meal. Humans learned the benefits of eyespots and began to use them when dealing with potential attacks from a wide array of dangers, from the attacks of a tiger to the attacks of swooping birds. Have a look at the safety precautions I found next to my local library in Preston, a suburb of Melbourne, Australia:

- Do not run
- Carry a stick or umbrella
- Bike riders should wear helmets, dismount and walk through the area
- Travel in a group

- Draw a pair of eyes and attach to the back of your hat or bike helmet
- Wear sunglasses on the back of your head

The last two points of this list of six suggestions are about the use of artificial eyespots on the back of your head. Although these are safety suggestions from bird attacks, the exact same safety mechanisms are working well against much more dangerous opponents, such as lions and tigers. Other methods to help ward off a tiger attack are: (1) do not run away (2) carry some weapon (even symbolic), (3) do not ride a bike in order to get away (remember the brave Indian postman's story?), (4) be with a group (always safer), and suggestions 5 and 6 are about the use of artificial eyespots. These safety mechanics, which have lasted millions of years, are also why the cheap plastic masks worn on the back of the head became very effective in deterring the man-eating tigers of the Sundarbans national park from attacking humans.

Well, you might say, our hominid ancestors did not have cheap plastic masks and sunglasses, so there is no use in talking about eyespots when we are dealing with our less advanced very distant human ancestors. Humans do not have any natural eyespots, and neither do apes. As a matter of fact, eyespots are characteristic of much more primitive animal species, such as butterflies and many other insects, some reptiles, and some birds.

However, we must remember that eyespots are also present on one of the most evolutionarily advanced animal species – big cats. Many big cats, as we already mentioned, have eyespots on the back of their ears, and most importantly for us, cats are very sensitive in noticing eyespots on others. As humans, we are very bad in noticing eyespots, and some struggle to see the eyespots on big cats even when they are told about this.

Big cats have eyespots on the back of their heads - these are their defence tools from an attack from behind. These eyespots are also clearly seen from the frontal side when cats have their ears flat on their heads (Leyhausen, 1960). There is a possibility that, with this flattening of the ears on their head, cats show their eyespots to any antagonists in front of them. If you view the face of a big cat with flattened ears, you will notice that their false eyes (eyespots on the back of their ears) are clearly displayed, and are bigger and spaced much wider that their real eyes. This

display of bigger and wider set eyes may trick an antagonist into believing that the animal in front of them is bigger than it really is.

We have touched on how tigers, lions, leopards all have eyespots and how they can use them for defence from attack both from behind and from the frontal area. However, there is no sense of discussing eyespots in humans, as not a single scholar has ever written that humans may have eyespots. Well, no-one until I did in my 2011 book – I believe we do have eyespots but we fail to notice them because of two reasons:

(1) Humans are generally bad at noticing eyespots, and also, more characteristically,

(2) Because we only have them… when we are sleeping.

If you have a family member with well-defined eyebrows, ask him (or her) to close their eyes, and look at their 'sleeping' face. You may notice that the eyebrows, arched upwards, and the eyelashes, arched downwards, form quite visible oval - eyespots on the 'sleeping' human face.

Of course, I have already mentioned, that it is not easy for humans to notice the resemblance of human eyebrows and eyelashes to the eye. We are generally bad at noticing eyespots. But we need to remember that eyespots on our face were not designed by the forces of natural selection for humans to notice. They were designed by evolution to be noticed by big African predators, particularly predators from the cat family, and the cats are particularly good at recognizing eyespots.

I suggest that when our hominid ancestors started sleeping on the open savannah, those individuals that had longer and more arched eyebrows were less attacked by the prowling big cats, as they looked to predators as if they were still looking at them. Generation after generation, the individuals with more "classical" long and arched eyebrows and with long beautiful eyelashes were surviving. Of course, after humans stopped sleeping on the open savannah, the pressure to have nicely arched eyebrows and eyelashes disappeared, but we still like faces with clearly defined and arched eyebrows and eyelashes.

According to the generally accepted view, the main function of the human eyebrow is to prevent moisture, mostly salty sweat and rain, from flowing into the

eye. Desmond Morris, discussing the possible function of the eyebrow in human evolution, criticized this suggestion as non-effective and suggested that the primary function of the eyebrows was to signal the changing moods of their bearers (Morris, 2008). There is no doubt that eyebrows are excellent communicators of our moods, but I suggest that their primary function in human evolution was as anti-predatory defence at night. They were "night-time angels" for our hominid ancestors during the thousands of generations of their life in the open savannah.

Another small addition to our section about eyespots on the human body: there is long-lasting debate about the function of the unnaturally large breasts of human women. The initial and most natural explanation, that the increase of female breasts was a requirement for a healthier baby, does not work as the size of breasts has nothing to do with the quality of the feeding – most breasts are in fact a fatty tissue. Another very logical explanation, suggesting that women had grown larger breasts to attract males, will definitely have many male readers of this book nodding in agreement. Unfortunately for his suggestion, in many less "civilized" tribes where women are walking topless, breasts are not viewed as an attraction at all – therefore it seems that breasts became an exciting item only after they had been banned from public viewing and were concealed (well, this is a part of a human nature, isn't it?).

Desmond Morris suggested that women had grown breasts to satisfy male longing for their buttocks after hominids changed their copulation position from rear to frontal positioning (Morris, 2007). This is an interesting modification of the previous idea, based on sexual selection. Bonobos, who also copulate in the same frontal position and are more sexually active than humans, do not have larger breasts. There was also a more sexually neutral suggestion, coming, naturally, from a female scholar. According to Gillian Bentley, the size of female breasts have increased for an easier baby-feeding process, as the long primate face (look at the chimpanzee face) receded into a human face during the long process of "humanization" (Bentley, 2001).

There is another idea as well. This idea takes into account the size of women's breasts, their rounded form, and the different colour of the nipples positioned in the centre of the breasts. This idea also takes into account the facts that these fatty round morphological additions were not connected to better feeding, or to sexual attraction among naked hominids. According to this idea, women's rounded breasts with

centrally positioned darker nipples might have been created as eyespots. Yes, oversized eyespots designed to scare predators away, not to attract males or to feed a baby. Unfortunately, although this idea has never been published, I cannot claim it. I heard this idea one evening from my wife, after she finished an evening shower. Probably this idea came to her after hearing my views about the evolutionary roots of eyebrows and eyelashes.

When I told her that I was going to include this idea in my book, she was terrified. Well, neglecting an idea with even the smallest explanatory power is never a good research policy – so here you are, reading about this new evolutionary explanation of rounded female breasts.

Out of all existing explanations on the reasons behind the development of women's rounded breasts this is the only one that looks at the topic in an inter-species context.

So, if we take into account that:

(1) Humans are possibly one of the most aposematic species on our planet;

(2) That most of our morphology and behaviour were most likely formed in order to survive on the predator-infested African open woodlands and savannah;

(3) That rounded female breasts with usually darker nipples do look like oversized eyes;

(4) And that display of larger eyespots is a very effective means to stop a predator attack, then the chance of this new idea being right increases.

Unlike the earlier discussed eyespots, formed by closed human eyes (eyebrows and eyelashes), these eyespots were active both during the daytime and the night-time. And it is also natural that this sexually neutral idea came from a more neutral viewer than a male.

Body Odour as a Night Guard

We have already discussed humans' prodigious sweating and its aposematic nature. Very few, if any, other animals sweat as much as we do (see, for example, Robertshaw & Taylor, 1969). It is generally believed that humans started sweating more profusely after they started walking upright and lost their body hair. It has been suggested that sweating was cooling down their overheated bodies. However, in order to cool down a body, sweating does not need to produce a strong odour – as sweating also results in a strong and quite an unpleasant odour, there must be a good evolutionary reason for this.

There was also the suggestion that sweating and associated body odour was developed as a factor of sexual selection (see, for example, Wedekind, 2007). However, if we take into account the negative human attitude towards strong body odour and the desire to get rid of (or mask) it, it is difficult to believe that we developed this unpleasant odour in order to **attract** the opposite sex. If it was indeed about sexual attraction, the wise evolutionary move would have been to make this odour pleasant to our noses. Despite my disagreement, I do agree with the suggestion that one of the central functions of sweating was to produce a stronger odour.

As you may remember I proposed that our body odour is directly connected to the aposematic strategy of survival. I suggest that the strong body odour coming from a group of our ancestors was a strong signal aimed at predators. Predators always (or at least – mostly) approach potential prey against the wind so that the prey animals cannot smell the approaching predator. This method also means that the smell of the prey will be travelling with the wind towards the predator's senses. In this situation it was inevitable that keen-nosed predators would sense our ancestor's body odour from quite a distance.

With the renowned power of all human secretive glands, and without a shower literally for millions of years, this must have been quite a powerful body odour for our ancestors, spreading by the wind possibly for kilometres. The smell would also be particularly strong after their evening concert of loud singing and vigorous dancing. This strong odour was aimed at any prowling carnivores that had even the faintest sense of smell. At night when hominids were sleeping, their famous bipedal

posture and noisy behaviour (visual, audio, behavioural signals) were switched off until the morning, but their body odour was on a permanent night vigil. This strong odour was clearly communicating to predators the identity and size of the sleeping hominid group, making them think twice as to whether they really wanted to approach the sleeping hominids. Therefore, I suggest that strong body odour was the very first line of defence for our sleeping ancestors.

Some readers might ask: if body odour could already give a strong signal about the identity of the sleeping prey, why would our ancestors need eyespots as well – would their body odour not be enough to turn the predators away? Well, first of all, we should know that lions sometimes approach the prey without any regards to the direction of the wind (Schaller, 1972). Probably even more importantly, the determination of a predator towards an attack strongly depends on how hungry the predator is (Ruxton at al, 2004). If the predator is too hungry, it will still continue the hunt despite receiving troubling signals – one more warning signal, another line of defence, would not go astray. Sometimes even the strongest warning signals cannot save a creature from attack. For example, even though any living being tries to avoid the skunk for its legendarily repulsive odour, skunks still get attacked, killed and eaten by predators on rare occasions. In such cases the predator is simply too hungry to take into account the disgusting smell of the food item. It is very much the same when starving humans start eating items that they would never consider in normal circumstances (like gone-off food, rats, cats, leather boots, or other humans). Therefore, despite the several lines of defence I am sure that cases of night-time attacks on hominids and early humans were still occurring, but these attacks were considerably rarer than they would be without the evening concerts, presence of body odour and eyespots.

In the case of an attack still taking place, the whole group of hominids would be up on their feet within seconds. Frantic shouting, stone throwing and stone hitting would merge with predator growling into a horror night symphony. Despite their brave fighting and dedication to each other, there must still have been cases of night losses to predators. Sometimes the bodies of badly injured and killed hominids would be left on the ground, but other times the bodies were taken.

We are now approaching another important and more dramatic chapter in the human strategy of predator control.

Fight Over the Bodies of Fallen Fighters

When a predator kills its prey, it intends to eat the kill. Unlike many human hunters, predators do not kill for fun or prestige. Prey animals, even after defending their family members with utmost ferocity, usually stop fighting if the attacked member of their group is already dead. Therefore, as soon as the kill is made there is no more confrontation – the predator got what it wanted, the fight is over and they can now enjoy their meal.

The case was very different with hominids and humans – they were superb masters of intimidation, able to chase away even the strongest predators. If their member was killed and taken by a predator, I propose that they would follow the hungry predator and reclaim the dead and possibly half-eaten body.

"What is the aim of such crazy bravery?" a bemused reader might ask, "you cannot bring to life a dead member of your group, so is it not better to leave the body with a predator and spare yourself the danger?" No, definitely not better. When you fight for the body of the fallen fellow hominid, you give a strong message to predators that, every time they attack your group and kill someone, you are not going to give them a chance to eat the dead body in peace. This behaviour, repeated generation after generation, would teach predators a very important lesson and build somewhat of a reputation for our hominid ancestors. Yes, possibly hominids were the worst armed animals in African savannah, so tracking and killing a single human was much easier than killing an antelope or zebra; but it was a totally different story when it came to eating the kill. Unlike hominids and humans, antelope or zebra family members did not start a massive attack on the predator after the kill was made. Therefore, from a predator's point of view, humans were easy to kill but very hard to eat, essentially making them unprofitable prey.

In light of the ongoing argument it is clear that there was a very good evolutionary reason for hominids to attack deadly predators and reclaim bodies of their fellow hominids. With this method they would prevent more attacks from predators, or as scholars call this, would "educate" the predators. The price of these "lessons," without doubt, was extremely high both for predators and for hominids.

Alas, a good education has never been cheap...

The human need to retrieve the remains of fellow members of their family, tribe, military unit, or a country is one of the universal innate drives in all human cultures – even in situations when leaving the dead bodies to a predator or enemy would be the much more reasonable thing to do. In the case of man-eating tigers, for example, villagers would often go in a big group to scare away the tiger and retrieve the body. While the villagers felt they needed to do so, this behaviour was against certain logic: a man-eating tiger almost always kills a human prey for food as it is too incapacitated to kill other, normal prey. When you deprive the man-eater of its dinner, you are forcing it to make another kill quicker – therefore if you cannot kill the man-eater, you are better off leaving the body to the killer, as the well-fed man-eater will leave the community in relative safety for some time. This situation reminds me of a popular fairy tale theme where a tribe, village, or a country has to regularly provide a human sacrifice to a dragon within a regimented time period in order to be spared from a much worse fate from the same dragon.

Well, leaving the body was possibly an option for our more civilized ancestors, but it was not a viable option for our much more distant hominid ancestors who had no other cover from big predators other than their display of intimidating strategy and pieces of rocks, bound together by bravery and loyalty. At that distant time they were fighting for their place on the ground, so it was crucial for them to give predators a message that killing a hominid would not go unpunished. It was their long and dedicated fight for the bodies of their killed fellow members that taught big cats to leave all later generations of hominids and humans in peace. It is the legacy of the self-sacrificing loyalty of our hominid and early human ancestors that stops lions and other big cats mostly avoid attacking humans unless they are incapacitated to the point they cannot hunt their usual prey.

After the dramatic fight against a predator for the body of a slain group member, a new problem would emerge: what to do with the body? This is the topic of the next discussion, where the drama deepens and gains some spiritual overtones.

Cannibalism, Rituals, Love and Violence

There are several options on how to deal with the remains of dead human bodies. You can bury them, burn them, you can put them on a boat and let it go sailing, you can mummify them and put them into a specially-built sarcophagus, you can feed them to vultures, keep them in coffins hanging from rocks, etc. Burning bodies and scattering the ashes is quite popular, although burying is probably still more widespread in the contemporary world. Throwing bodies to the sea, or putting them on a boat, was traditionally an option for sailors and some tribal cultures. Apart from the abovementioned ways of disposing human bodies, there is also another option – to eat the dead bodies. Of course, this last option is the least acceptable for us, but unfortunately our early ancestors did not have many options. To be precise, they had only two options on how to deal with the dead bodies: (1) to eat them, or (2) to leave them. All other options came much later with the development of new technologies.

These two options had different, short-term and long-term consequences. In the short term, if you do not eat the dead body, the predators will eat it – goods such as food never go wasted in nature. You might think this does not matter as the person was already dead, but it does matter in the long run, because if predators can easily obtain and eat human/hominid corpses, there is a good chance that they will become habitual man-eaters. Arguably the biggest expert on man-eating tigers and leopards, Jim Corbett, noted that after the terrible bout of infectious disease that spread through India in the beginning of the 20th century, some of the worst man-eating leopards started their man-eating activities. Leopards apparently were attracted by the readily available human corpses left, unburied, during the disease (Corbett, 2003:xiii). For the very same reason that caused these leopards to adopt their new behaviours, it was important for our ancestors to make sure that no human corpses were available for scavenging predators to eat.

I therefore suggest that those groups of our ancestors, who would eat the bodies of their dead fellow members, would have forced lions in their neighbourhood to stop hunting humans as a source of food (Jordania, 2011:119-121). As probably the best expert on ancient cannibalism, Tim White noted that not eating the dead body

of your fellow group member is a waste of high quality food – but I think this was a secondary reason. The primary reason of cannibalism must have been to deprive predators access to hominid and human corpses. Despite the well-understood repulsive reaction of the readers of this book to my idea, I have to suggest that cannibalism was an important evolutionary strategy of predator control for our ancestors.

There have been wide-ranging disputes over this emotionally charged behaviour in human history and prehistory. The popular image of early human ancestors as big game hunters was enhanced by Raymond Dart's influential theory that early men were violent hunters and ruthless cannibals. As a legacy of our colonial past, it was widely believed until the mid-1960s that many non-European tribes were practicing cannibalism as a cultural practice until recent times. Afterwards came a period when the presence of cannibalism in various cultures was mostly denied. William Arens is particularly well known for his relentless fight to eradicate this shameful legacy from human cultural history (Arens, 1979). In his works, Arens denies virtually all existing evidence that humans were practicing cannibalism in any of their societies as a cultural practice. We must give credit to Arens' revisionist findings, as colonial and religious forces were using cannibalism as a powerful tool with which to prove the moral advantage of "civilized" societies.

From the 1990s onwards, with an accumulating array of the evidence, it became difficult to refute the evidence pointing to a history of cannibalism. The activities of Tim White were paramount in establishing a more realistic picture of cannibalism in human prehistory. According to White, cannibalism was very common in human societies prior to the beginning of the Upper Palaeolithic period (White, 2006). This theory is based on the large amount of 'butchered' human bones found in Neanderthal and other Lower/Middle Palaeolithic sites. Food shortages are generally considered as the main reason for cannibalism. Timothy Taylor also suggested that Cannibalism was a usual practice in all continents at different times in human history (Taylor, 2002:58-60).

It is important to remember that I am not suggesting that hominids were killing and eating fellow hominids (as is suggested in the famous "man the hunter" hypothesis). Instead, I am proposing that hominid groups were co-operatively and self-sacrificially fighting against predators, and only in the case of a fatal attack from

predators were they collectively attacking predators to reclaim the bodies of their killed group members, and then cannibalizing them in a ritualistic manner. To fight against predators for the body of a fallen group member, and then to cannibalize the body in a ritualized way, has totally different evolutionary and moral overtones. Our distant ancestors are getting undeserved bad publicity for their habit of cannibalism, but I maintain that this was an important survival strategy aimed to stop predators attacking early hominids, largely based on the notion that predators would stop seeing them as a profitable food source if the bodies were regularly claimed back before being devoured. Most of the contemporary big and powerful predators that can easily kill humans do not usually include humans in their diet unless they are incapacitated by wounds and prompted by circumstances – this aversion towards hunting humans is the lasting result of millions of years of 'predator education' and 'strategic cannibalism' by our ancestors.

Apart from forming the attitudes of various predators, cannibalism was an important catalyst in the emergence of ritualistic behaviour and religious sentiment. We can be quite sure that eating the body of a fellow member killed by a predator must have been a highly emotional and highly ritualized act. Let us remember that, in the first place, every member of a hominid group was loved enough that every other member of the group was ready to fight for their dead body. Ritualistic cannibalizing of the body became a very long-practiced tradition, an expression of the utmost love to the member of a group. Until the 20th century, the body of a dead person was ritually eaten by their relatives within at least several tribes on different continents. For example, some indigenous Australians were performing ritual cannibalism mostly as an act of respect. Some Native American tribes believed that one could gain a particular characteristic of a deceased rival by eating their body parts. In various societies, during funeral rituals a respected member of one's own clan was also eaten to ensure immortality.

We have plenty of evidence of this ancient expression of respect and love in our contemporary lives – we just fail to notice them. Have you even thought, why you are saying when you see a particularly cute baby, kitten, puppy, or even a young girl (or a boy) "She is so cute I want to eat her?" Or also why we say "You are so sweet," comparing someone you like very much to a sensation related to eating. Have you

also thought of why the Communion, the most widespread Christian ritual, is actually based on the ritualized consuming of the flesh and the blood of Jesus Christ?

Cannibalism today is a horrible taboo, making headlines when it occurs for whatever reason, out of starvation, as a part of obscure ritualistic practices or just as a psychological deviation. When Christian missionaries were describing the savagery of many native tribes in America, Africa, Asia and Australia, the thing generally on top of the list of sins committed by these peoples was listed as cannibalism. Five hundred years ago Queen Isabella of Spain decreed that conquistadores could only enslave the Native American tribes who practiced cannibalism. Apart from ritualized and cultural cannibalism, even starvation-triggered cannibalism was sometimes considered unacceptable. In the middle of the 20th century, non-religious Soviet Union authorities were imprisoning and executing those who participated in cannibalism within the besieged Leningrad. Leningrad was effectively left without any food for almost three years, and once all the pets, birds, and rats were already consumed by the starving population the only food that was left was the population itself. I remember myself meeting a distant relative from Leningrad in the first half of the 1980s, and remember my shock when I asked whether her grandmother was still alive, she swiftly answered “No. She was eaten by her neighbours in Leningrad.”

Cannibalism is gradually losing its shock value. In 2011 there had been a well-publicized case of a televised act of cannibalism, when two Dutch TV presenters on a live TV show ate a few grams of each other in the presence of an equally disgusted and excited live audience (Yahoo news, 2011). Famed Mexican painter/muralist Diego River claimed in his autobiography that, in 1904, he and his companions ate human meat on numerous occasions which they had purchased from the local morgue. River even proposed for cannibalism to become a part of the future, to better human society, claiming that "I believe that when man evolves a civilization higher than the mechanized but still primitive one he has now, the eating of human flesh will be sanctioned. For then man will have thrown off all of his superstitions and irrational taboos."

I am not sure whether there will be a time (at least in the next couple of centuries) when a person will be able to buy a piece of human flesh for dinner at a

local Woolworths or Aldi store, but I do hope that our views on the reasons and evolutionary history of cannibalism will be changing relatively soon.

According to the Encyclopaedia Britannica, "There is no one satisfactory and all-inclusive explanation for cannibalism. Different peoples have practiced it for different reasons, and a group may practice cannibalism in one context and view it with horror in another." I suggest, that although practices of cannibalism were in use in various regions of the world during the last few centuries, this practice came from a single origin: eliminating the presence of hominid and human dead bodies in the environment so that predators did not have access to readily available corpses – I do not think hominids and humans were violent creatures who were killing each other in order to eat each other.

Basically, the violence of early hominids seems to be grossly exaggerated. Human morphology does not support this model of ancient violence amongst hominids and early humans. If we imagine that our ancestors were very violent towards each other, natural selection would favour the strongest males and would gradually increase their physical strength. In reality we have a totally opposing picture: during the process of sapienization, male physical strength drastically dropped. We are laughably weak not only in comparison to our closest living relatives – the great apes, but even in comparison to many smaller monkeys. This can only mean that male-to-male combat for female attention, and the selection for stronger males (see, for example Puts, 2010), was simply not happening during our evolution. Comparing male strength with females is not a justified argument. Yes, males had to do more defence from predators than females, so they had to be stronger than females, but if the competition between males involved violence against each other then the loss of their previous strength is totally unexplainable.

The decrease of male physical strength is a hard fact that must be always taken into consideration when male violent nature is discussed. The central element of inter-group social interactions was an unbounded and self-sacrificing dedication towards each other - their violence was mostly directed towards predators and other groups threatening their survival.

Of course, humans have the capacity to be violent – they can be particularly violent as a group. This is mostly the case when a group of people, for different reasons (mostly out of frustration, anger or nationalistic or religious fervour), goes

into a state of collective identity and the individuals lose their ability to logically think for themselves. Human brain chemistry and activity change radically in this state. They do not feel fear, they do not feel pain, and they do not have the inhibitions against violence that humans usually do. This is the 'battle trance', feared for civil society and coveted within the military forces. In this state humans blindly follow orders or the behaviour of their fellow group members. While in this state, humans are in fact not humans any more, as they lose the ability to think rationally – a crucial difference that sets us apart from other animals. In this state violence is not only allowed, but even welcome. In some cases humans can have memory loss of their actions while in the collective state of mind and in some cases those who remember their actions cannot understand how they could behave so inhumanely. In spite of all this, we should remember that the source of this blind violence is often the loyalty and love for one's religion, state, unit or family.

So is cannibalism violence? Although cannibalism might seem to us as the pinnacle of abhorrent behaviour and heinous violence, if viewed historically it was a ritual practice aimed to safeguard our ancestors from the attacks of the predators, and in many cultures consuming the body itself was considered as an honour to the person who was eaten, and also sometimes as a great spiritual and physical advantage to those who ate their fellow group member (Conklin, 2011:xxvi).

According to Beth Conklin, the author of a recent book on cannibalism, the challenge is to understand each case of cannibalism in its own terms and within the social context in which it was practiced. With this approach, cannibalism starts to look less exotic and more like something with which other people can identify with. "'Wari' elders have told me they can't understand why outsiders are so obsessed with the idea of eating bodies." Wrote Conklin, "They say it's important to look at the whole picture of what went on in their mourning practices, not just focus on the one act of eating. I think we can learn something by listening to them" (Conklin, 2011). Mourning the death of loved ones is a universal human experience, yet the grieving process between different cultures differs greatly. Until the 1960s, the Wari' Indians of the western Amazonian rainforest ate the roasted flesh of their dead as an expression of compassion to the deceased and his or her close relatives. By removing and transforming the corpse, which embodied ties between the living and the dead and was a focus of grief for the family of the deceased, Wari' death rites helped the

kin accept their loss. Cannibalism had also another meaning for the Wari' – apart from their relatives and loved ones, they also feasted on defeated enemies including intruding Portuguese settlers and their hired gunmen. The motivating factors in these two different cases were also different: "Killing and consuming the enemy outsider was partly equating the victim with animals that are hunted -- the manner of eating was explicitly similar to the eating of animals." It was, Conklin says, a way of "marking human dominance over the victim." In a stark contrast, the 'funeral' cannibalism performed on fallen group members was intended to evoke emotional healing after a death.

A recent finding of the skull of a young hominid, reported in the July 2010 issue of National Geographic with Tim White's comments, confirmed one more time the widespread tradition of ritualistic cannibalism among our ancestors.

Apart from archaeological evidence, there is also genetic proof of the past practice of cannibalism in our ancestors. Many humans have a special gene which protects us against brain diseases (known as prion diseases) that can be contracted by eating contaminated flesh - more specifically the brains of deceased humans. These diseases include Creutzfeld Jacob disease and kuru in humans, as well as mad cow disease – "The discovery of this genetic resistance, which shows signs of having spread as a result of natural selection, supports the physical evidence for cannibalism" wrote John Roach (Roach, 2003).

As time went on, our ancestors obtained tools that made grave-digging possible. Also, their food supply improved, so burying and burning the bodies became a more feasible option than cannibalism, eventuating into the only accepted option to deal with dead bodies. Cannibalism fell out of favour in most of the societies with major state institutions, Aztecs probably being the only exclusion.

To conclude this section on cannibalism, I want to remind readers that there are three main reasons for cannibalism which are generally accepted among scholars: (1) cultural norm, (2) necessity in extreme situations of famine, and (3) insanity or social deviancy. None of them acknowledges the possible evolutionary significance of cannibalism. I suggest adding one more – the primary reason for prehistoric cannibalism: **cannibalism as a mechanism of predator control among early hominids**.

Yes, we are all descendants of cannibals, but the root of cannibalism was not violence. It was of respect, total dedication and love towards the dead. The next time you hear somebody expressing his or her love with the words "I want to eat her" (or him, or a baby, or a kitten, or a cub, or any cute creature), hopefully you will recall where this strange expression of intense affection derives from.

CHAPTER FIVE

Rivalry, or the Role of Lions in Human Evolution

We know by now that the means of survival of our early hominid ancestors were quite different from other apes, and in fact from all other animals. Hominids were unique for keeping their tradition of singing after they had descended on the ground; they were unique for their erect bipedal posture; they were unique for developing a sense of rhythm and a state of 'battle trance'; they were unique among primates for their total loyalty to the aposematic model of survival; they were unique in their ability in the aimed throwing of heavy object; and of course later they found much more creative uses for their free hands and perfected their tool making talents.

The development of AVOID, or the Audio-Visual-Olfactory Intimidating Display, was the central aim of several millions of years of evolutionary changes in human morphology and behaviour. Shifting from the trees to a new environment (the ground) forced our ancestors to change their survival strategy. Initially developed in order to shield themselves from feared ground predators, this strategy later proved itself as a potent means of obtaining food as well.

This fruitful strategy was of course in the making for a very long time. There were plenty of morphological and behavioural characteristics to develop: bipedal posture, longer legs, long hair on the head, development of group rhythmic singing in dissonant harmonies, synchronous dancing, aimed throwing, use of animal hides and different substances in order to paint their faces and bodies and change their appearance, and above all the specific altered state of consciousness which allowed them to obtain a shared collective identity and to fight with suicidal dedication for the interests of the common group.

Although it might seem difficult to say for sure which came first, defence or attack, it seems logical to me to propose that the AVOID strategy was initially formed as a defence tool. More precisely, while hominids were in the process of making all the necessary evolutionary changes to form a potent means of confrontation, they also had to constantly defend themselves from predation. As they were fruit-eaters

by default, they could continue their primary diet while perfecting their defence system. The majority of ripe fruits, as we know, generally fall off their tree and end up on the ground, so staying on the ground for prolonged periods without fear of predator attacks was a welcome and important change in their life, a change that their developing strategy would allow them to do. However, as soon as their defence system became a potent tool with which to withstand the major predators of the day, our ancestors were also able to use their defence arsenal more aggressively, in order to obtain protein-rich food – meat.

New Diet: Meat, and How to Get It

Let me remind readers that scavenging is traditionally divided into two related but still quite different activities: pure (or passive, or obligate) scavenging, and confrontational scavenging. Those who wish for an easier and non-confrontational way of obtaining food should accept that, in most cases, (unless they found the dead animal first) not much will be left for them after other predators finish their dinner. Those who wish to get a bigger piece of the kill have to confront other meat-eaters and, if necessary, fight for the food. With their multi-layered and potent system of intimidation, hominids were well geared for confrontational scavenging situations against any possible opponent.

Hominids did not have the speed to catch prey, and they did not have effective weapons to go after bigger animals (in order to feed the whole group), but at the dead carcass hominids could scare away virtually any predator with their communal shouting-singing-drumming-stamping, coupled with their impressive tall bodies, fearless behaviour and stone throwing.

The scavenging scenario gradually entered mainstream scholarship from the 1980s. It was noticed that stone tool cut-marks were indicating the early access of hominids to killed prey. But, as David Watts puts it, “Early carcass access did not

necessarily entail hunting. O'Connell et al. (2002) agreed that bone-modification data and actualistic patterns show early access to many carcasses, but contended that lack of projectile technology prevented Plio-Pleistocene hominins from hunting large game, and that they gained early access by aggressively confronting predators at relatively fresh kills" (Watts, 2008:126). In the same year Stiner also argued that, while hunting of smaller prey probably occurred, large mammals ''would have been difficult to kill with Oldowan or early Acheulean technology" (Steiner, 2002: 6). O'Connell et al. (2002) also argued that high carnivore tooth-mark counts on bones from Oldowan sites indicate aggressive scavenging of carcasses already defleshed to varying degrees, not hunting. Bunn and Kroll (1986), and Potts (1984), relying on the features of relevant archaeological assemblages, also suggested that hominids could chase away large predators from kills" (Watts, 2008).

Some scholars had various reservations about scavenging. Robert Blumenschine argued that apart from leopard kills, the risks in trying to steal fresh carcasses from large carnivores (mostly various ancestral forms of big cats) would have been extremely high (Blumenschine, 1991). Some argued that confrontational scavenging would have been successful only if our ancestors had considerable numerical superiority, or if they could use weapons more efficiently (for example, see Shipman, 1986). After studying the Tanzanian tribe Hadza scavenging for some time, scholars concluded that confrontational scavenging could have been only a source of occasional windfalls for Oldowan hominids (O'Connell et al., 1988, 1088a). Later it was suggested that alternative strategies of early human behaviour should be also taken into account (Lupo & O'Connell, 2002).

Other scholars still supported the traditional hunting hypothesis, arguing that hominids probably had a spear-like tool and were able to hunt large creatures (see for example, Dominguez-Rodrigo, 2002).

I received quite a detailed description of Hadza scavenging strategy from a professional hunter from the Republic of South Africa, Soulemenn Kalee, who has firsthand knowledge of the Hadza and their scavenging strategies. He was also working with the group of scholars studying Hadza scavenging in the 1980s. Here is Mr Kalee's description brought to me by Preetum Gheerawo (letter from 13 April 2011):

“According to Mr Kalee, Hadza tribesmen make a noisy approach to make sure to break any other lion from cover if there is any. A minimum of three men are needed to make two lions retreat. Their slings are already swiveling at great speed whilst approaching. Walking towards the carcass the party splits leaving a central man approaching and on each of his side, both team-mates enlarge the range of the approach and shouting synchronously (Mr Kalee says it is similar in concept to group singing) the stones from the slings are released accompanied by a voice by the shooter as if to mimic that the stone had been shot from a rifle. This is done synchronously. . . Mr Kalee says an estimated 20 stones are 'fired' by each man in an interval of a couple of minutes or so, therefore one stone every six seconds, accompanied by synchronous "loud singing" and the "firing" sound.”

“Mr Kalee did witness a situation when two lions were present but they called for retreat after receiving [several stones] each. The first stone reached the eating lion and he attempted a charge before being hit by a second stone which brought him roaring backwards and when the second lion appeared, seeing his brother retreating, also retreated.”

“Mr Kalee told me in another instance, a single lion put up a very brave fight to four Hadza tribesmen. He received stone after stone, each of his charge was arrested by another stone, until it came dangerously close to one Hadza who used his spear as intimidation first, but subsequently wounded the lion on its belly. The lion was more furious after being hit by the spear, but a further few rounds of stones convinced him that he had enough and went running for its life.”

It is unlikely that slings or spears were already present during our earliest confrontations with lions, and that our ancestors used the “firing sound” in order to scare away lions. The absence of a sling would naturally make stone-throwing range shorter as well. On the other hand, synchronous shouting/singing, coupled with stone throwing by Hadza men gives quite an accurate picture of the possible hominid/early human scavenging strategy.

During the ongoing discussion on the possibilities of confrontational scavenging in the 1980s, noted biologist and former student of Konrad Lorenz, and accidentally my former countryman (as a citizen of the former USSR by birth), Valerius Geist, asked a providential question: "If scavenging was important, how did it lead to the adaptations characteristic of Homo?" and he himself answered this very

important question negatively: "Scavenging is not part of a sufficient explanation of human adaptations – at least not yet" (Geist, 1987). Linguist Derek Bickerton and evolutionary biologist Eörs Szathmáry recently tried to answer this question by pointing out the importance of language and cooperation development in human evolution in the context of aggressive scavenging (Bickerton & Szathmáry, 2011).

The evolutionary scenario presented in this book provides a direct and positive answer to Geist's question. In several dozens of previous pages in this book I argue that virtually all the morphological and behavioural adaptations that distinguish us from primates are directly connected to the strategy of defence and confrontational scavenging via aposematic display. The list of these adaptations is very long and contains erect bipedal posture, longer legs, long bushy hair on the top of the head, body and face painting, use of clothes and possibly masks, human singing ability, low male voice, sense of rhythm, loud group synchronous singing in dissonant harmonies, dancing and the ability to go into the battle trance and obtain collective identity. **All these changes** in our morphology and behaviour were directly connected to achieving a better intimidation display, primarily for defence from predators and for scavenging situations. In short, I suggested that the strategy of confrontational scavenging was the centrepiece for human morphological and behavioural adaptations. It was confrontational scavenging that largely determined how we look and behave as humans.

Although the notion of scavenging might still sound repulsive to many, if we look carefully it is easy to see how big and aggressive states throughout human history were behaving like big aggressive scavengers. They were and still are cowing smaller states into submission and subordination with their military might in order to obtain their natural resources like oil, gas, or just territory. Full war is not really necessary in the conflict of interests of unequal sides, as smaller and weaker states usually quickly submit to the hostile display of bigger aggressive states.

Humans developed lethal weapons much later than most predatory species, and we did not have time for the necessary evolutionary instincts restricting ourselves using them against each other to evolve. No other animal species is using violence as unrestrictedly as humans have during the last several thousands of the years of conflicts between different human groups. It is only with the development of nuclear

weapons that humans have, for the first time, started applying the brakes against their own destructive instinct.

Why Humans Love Lions and Hate Hyenas

As scavengers, early hominids were for sure watching skies, or more precisely, watching for vultures in the sky. This is the essential activity to be aware of for every scavenging opportunist in the open savannah. Vultures circling in the sky indicate that there is a kill below them, but the fact that they are circling and not on the ground signifies that the kill is still attended by a predator (most likely the same one that made the kill). Lions and hyenas, like hominids, were also avid sky watchers, as none of them minded trying their luck in displacing other predators at kill-site (Schaller, 1972, 216; Bertram, 1972:126). As open sky allows a better chance to spot scavenging opportunities, moving out from open woodlands to open grasslands seemed a logical choice for our distant ancestors.

As we have discussed earlier, after developing the AVOID strategy, a spectacular intimidating display involving an array of visual, audio, olfactory and behaviour signals, our ancestors gradually managed to displace even the strongest predators of Africa – lions, along with their felidae ancestors and relatives – displacing hyenas would have been even easier. Hominids gradually became a leading force at confrontational scavenging situations, a strange mixture of meat-eaters without the real ability to kill their prey. They needed other, specialised predators to kill the fast running prey, and then after the kill was accomplished by other predators they could scare away the original predator and take the loot. Due to this strategy of food-gathering, being alert to the warning signs for freshly killed large animals became of paramount importance. News about the available carcasses in the vicinity of many kilometres was regularly "published" in the sky by the circling vultures, and for savannah dwellers read like welcome news: "breaking news! There is a new kill right under us!" By watching for vultures in the sky, hominids would

find out where the kill was located and would go there, most likely taking a supply of stones and probably other throwing objects with which to defend themselves if necessary.

For a long time it was believed that hunting and scavenging were totally unconnected activities, and that some animals were principally hunters while others were scavengers. For example, lions were believed to be noble hunters who would not find it in their nature to scavenge someone else's kill. Hyenas, on the other hand, were believed to be true scavengers, but in the 1970s the newly available information shattered this long-held belief. According to Kruuk (1972), both lions and hyenas use scavenging to obtain roughly half of their meals (an exception is the spotted hyena, who is much more a hunter than it is a scavenger). If there was a full-time scavenger among the terrestrial meat-eaters, our ancestors would probably fit this profile best. Armed with a powerful intimidating technique, hominids were using aggressive and confrontational scavenging on many occasions. To be an aggressive scavenger, you have to be able to intimidate other predators and stand your ground. The cheetah is possibly the best example of a full-time hunter, partly due to its lightning speed. As the most prolific hunter on African savannah, an average Cheetah is successful in about half of its hunting attempts. On the other hand however, because of its fragile body built for speed, a cheetah will lose many of its kills to scavenging lions, hyenas, and leopards.

It is interesting that, if we compare the two top predators of the African savannah (the lion and the hyena), we see such a vast difference in human attitudes towards them. In all known cultures humans love and respect lions (we will have a special chapter on the reasons and depth of this feeling), characterizing them as brave and noble animals. This is a universal feature of virtually all known cultures where lions and tigers are at least vaguely known. In regards to hyenas however, humans universally despise them, characterizing them as ugly, cowardly and stupid scavengers who dig up human corpses and eat them, steal children, and among the many medieval horror tales can take on a human form.

We can all agree that lions are majestic animals – beautiful, strong and on top of the food chain. Humans love or at least respect strength, so humans universally consider lions as kings. But on the other hand why would hominids hate hyenas with such a passion?

First of all, when discussing hyenas we should remember that there are four extant (opposite of extinct) species of hyenas known today. They are of different sizes and have different eating habits and behaviours. The largest of the four is the spotted hyena, a skilled hunter and a very social animal with a matriarchal structure (females are also physically larger) – they are also the most widespread of all hyenas. The striped hyena is primarily a scavenger, only occasionally killing smaller animals and also indulging in fruits. The brown hyena is mostly a scavenger, with a more wolf-like social order within its group (an alpha male and an alpha female). The smallest of the 4 hyenas is the aardwolf, predominantly an insect-eater. Because of their abundance relative to the other three species, spotted hyenas are generally the "representatives" of all hyenas, and when we mention and think of hyenas we generally refer to spotted hyenas.

Hyenas are social animals, like lions. They hunt a larger prey in groups, like lions. They rest about 20 hours a day, like lions. They scavenge lion kills in the same way that lions scavenge hyena kills. As a matter of fact, if you watch them closely, hyenas are more non-violent and cooperative in their social groups than lions are. Unlike lions, they never fight with each-other over food. Well, where is this hatred from? Why are they still hated as much as lions are loved and respected? In an interesting article "The spotted hyena from Aristotle to the Lion King: Reputation is everything," the author, Stephen Glickman, investigates this unfounded hate towards hyenas. "To know is to love them" is the conclusion of the author (Glickman, 1995:87). The author finishes the article with a moving photo of an affectionate pet hyena with its owner. Yes, they can also make great pets.

People from all ages and cultures have created extremely negative images of hyenas – that they are feeding only by scavenging decomposed remains, that they are cowards and silly, that they dig up graves and eat human corpses, that they steal children, that they are hermaphrodites, and many more. Many of these beliefs were universally spread in time and in cultures: see for example the title of the mentioned article: "…from Aristotle to Lion King." Glickman discusses and refutes many of these beliefs. He found out that many of these traits are either incorrect or a part of many other "normal" predators' behaviour, including that of the much-adored lion. So why are hyenas the most hated animals in human cultures?

I think this irrational hatred has quite an earthly explanation. It rests on a firm evolutionary reason stemming from the millions of years of our co-habitation on the African savannah with lions and hyenas – let me explain. In most of their behaviours they are very similar: lions and hyenas are both predators, they both can kill larger prey using the power of group coordination; both of them scavenge roughly half of their meals (including each other's kills); both of them have been known to attack humans, and on occasion even eat them.

In spite of all these similarities there is one big difference that may at first seem totally irrelevant to our discussion:

hyenas eat their kills very fast, while lions eat their kills slowly.

Hyenas do not have any ranking order at their "dinner table", they all start together and they never fight over a kill – they just try to eat their share as quickly as possible. Because of this system of distribution, hyenas can finish off most of their kills in about half an hour. Lion prides, like hyena clans, are also without a strict hierarchical order, and in most occasions the pride is run by the oldest female (also similar to hyenas) – but when it comes to eating, it is a different story. Lions often eat their kills according to their appalling patriarchal rankings: male lions usually chase away females and do not allow them to feed until the males are finished. If we remember that, the kill is generally made by females, this injustice is more apparent and appalling. Cubs, whether male or female, are often allowed to eat with the dominant males at the kill. Also, lions love taking time when they eat – a lion dinner can last many hours.

"So what?" a bemused reader might ask, "How could this difference on the speed of eating affect human sentiments towards lions and hyenas so deeply?" To answer this question, we must first remember that our ancestors were scavengers – they depended on other, larger carnivores to make the kill. They were obtaining their food by watching for vultures and, once having sighted them circling, making their way to the kill-site in a group and displacing feeding predators. It is here where the seemingly minute and irrelevant difference between lions and hyenas comes into play: as hyenas were eating their kill very fast, by the time our ancestors would get to their kill most of the carcass would already be gone. Therefore our ancestors, after covering a few kilometres in search of dinner, were suddenly left empty-handed. If you are hungry and you have just expended energy to get to a dinner site, only to

realize that all the dinner is gone, you will get angry and frustrated. Imagine this frustration, largely as a result of hyenas and their ways, happening over and over again for millions of years. It is no wonder we have an almost genetic predisposition of hatred towards hyenas, and particularly their hasty eating habits.

A very important confirmation of my suggestion is highlighted in the above-mentioned article on human attitudes towards hyenas. In one of the sections of the article, the author discusses the reasons why hyenas are hated in different cultures. People have various reasons and ideas with which to hate hyenas, but in Africa, in the original place of long human-hyena association, a place where people are still naturally interacting with hyenas, the most widely cited negative feature of the hyena character is their… gluttony. Africans are free of the many laughable medieval inventions about hyenas, but the fact that their eating habit is still disgusting to African tribes is obvious.

The same scenario can also explain the appalling patriarchal eating order of the lions. Imagine for a second male lions being true gentlemen and allowing the females to have the first bite. In this scenario, when the uninvited hominids would appear and chase them away, the male lions, pathetic hunters themselves, would be left starving. Even if male lions ever had such noble aspirations, they would quickly learn the cruel reality: it was illusory for them to hope that their females, the able hunters (with already heavy stomachs), would go and try to make another kill just for the sake of their beloved males.

By exerting pressure on the lions with their scavenging incursions, hominids were forcing lions to increase their kill rate.

There is another creature on the African savannah that humans hate probably as much as hyenas: vultures. Vultures do not kill their food themselves, so was this possibly the chief reason for their appalling reputation? We must remember that this was exactly what hominids were doing themselves for the millions of the years – scavenging without killing. The reason, I think, was different – competition. Of course, our ancestors were finding their kills via watching vultures in the first place, so we should be grateful to them for this – however once arriving at the kill, the hominids did not take kindly to the appetites of the vultures. At kill-sites vultures were basically becoming our scavenging rivals. I suggest that humans hate scavengers basically because we ourselves were scavengers for most of our lives.

Very much like most of our contemporary human societies with free markets, our distant ancestors also did not like competitors, and transferred their dislike into their descendants in the form of various beliefs and superstitions against hyenas and vultures, our fellow co-scavengers.

Intensifying Conflict: Decline of Physical Strength, Canines and Fur Covered Body

Hominids emerged from the shady woodlands onto the African savannahs about 3 million years ago as a force to be reckoned with – their duel for the dominance of the environment with the leading predators of the day had started. Before that, at the start of the hominid-lion interaction, some 6 to 3 million years ago, it was not a duel – lion ancestors were much more powerful. They were simply the top predators and included our ancestors and other primates in their diet. After several painfully slow changes in hominid morphology and behaviour the balance of power started to shift. With the development of a potent audio-visual-olfactory intimidating display (AVOID), our ancestors finally reached a stage where they were exempt from the diet of the powerful big cats.

After achieving this historical goal the real duel ensued. It was an interesting if unusual duel. In order to compete, hominids did not try to become better and stronger predators that lion ancestors - this was simply impossible at that stage. Instead their morphology and behaviour developed in another direction, towards becoming better at intimidating rather than actually fighting. Although they were already bipeds and a singing species, they became even taller, noisier, more aggressive and fearless in confrontations. Confrontational scavenging itself is naturally suited to aposematic animals. Aposematic display is based on the most effective display of body size, colours, sounds, smells, and fearless behaviour. Even when non-aposematic predators face each other at the kill, they usually put to use not

their hunting talents, but their aposematic arsenal: they bare their teeth, raise hair on their body to seem bigger, growl menacingly, and make threatening false dashes towards the opponent. Also, luckily for our ancestors, confrontational scavenging did not require quick running ability. Running, as we remember, was the "Achilles' heel" for our ancestors. On the contrary, staying put without running away was required to effectively utilise their intimidation strategy. Their lack of other animals' physical strength was compensated by the sheer power of the large stones, thrown from middle and close range with one or both hands.

With their intimidating display and the ability to throw stones, hominids actually developed a **unique non-contact form of combat**. I mention this system as non-contact form of combat, as in most cases they did not require bodily contact with the antagonist animals during their defence, as well as during their aggressive scavenging confrontations. Together with the development of the non-contact combat, human physical power declined.

As the new defensive weapon (throwing stones) did not require body contact with predators, canines and tough skin lost their evolutionary function and were slowly phased out. This non-contact strategy of defence allowed our ancestors to get rid of not only canines and tough skin, but the animal fur as well, which cover the bodies of early hominids. The primary reason for the disappearance of fur was most likely to free themselves from skin parasites that plague the lives of all fur-covered animals. Only later with the introduction of closely fitting clothes did a new type of parasite come to live with us.

And finally, arguably the most important element of their intimidating ability was the power of the united and perfectly tuned chorus of a group of wonderful singers with powerful voices specially selected by natural selection – kind of an ancestral choir consisting of groups of Paul Robsons and Joan Sutherlands.

Even today, very rarely can animals stand their ground when they hear a loud sound made by a group of humans. Jim Corbett described a dramatic but non-violent confrontation of a single man-eating tigress with a large group of workers in Kumaon. On November 29, 1938, an unarmed group of five thousand forest workers, trembling from sheer terror at night inside their buildings, shouted at the top of their lungs to an approaching roaring man-eating tigress to scare her away. On the

contrary, their shouting infuriated the tigress and she cowed workers into silence with her replies – however such cases are extremely rare.

The decline of hominid physical strength is also interesting for understanding the internal dynamics of hominid groups. Unlike predators in scavenging conflicts, which were most likely kept at a certain distance (say 3-5 metres) before throwing bigger killer stones, in internal conflicts the conflicting parties were usually much closer to each other and bodily contact would be often used. Therefore, if our distant ancestors were as violent towards each other as is often portrayed, males would have gotten stronger and stronger, or at least would have stayed as strong as they were – this was not the case. The decline in human physical strength inevitably indicates that, after finding effective measures to defend themselves from predators, hominids did not need strength in order to actively and often fight within their group against each other.

As I have mentioned above, the decline of male physical strength is usually neglected by supporters of the "violent male" school of thought. If male hominids were fighting against each other, as is often portrayed, for dominance, females, food etc., then stronger males would have been constantly passing their genes in comparison to the weaker and unsuccessful males; therefore a decline in male strength simply would not occur. On the contrary, the most likely survivors of the evolutionary struggle were not stronger and more aggressive males, but more cooperative ones. In much the same way, the disappearance of canines also indicates the more peaceful internal life of early hominids and early humans than what is usually presented in evolutionary scenarios.

Contest and Truce

Without question the 'long way to the top' of the scavenging ladder was not easy. When our primate ancestors settled on the ground, lion ancestors must have already been dominating the African savannah both as top predators and as top

scavengers. This was the reason why for a long time our ancestors were only "part time" ground dwellers in the woodlands, retreating to the tree branches in times of danger. Gradually, as hominid height increased, as united sound was augmented by the rhythmic unity, lowered male voice and the force of dissonant harmonies, as their threatening movements became synchronous like one monstrous organism, and as the dedication of group members to their group reached a level of deep and religious devotion, hominids started contesting lions' domination of the land.

But why was it necessary to contest lions, the top predators? Hyenas or leopards could have been easier to dominate at a kill-site, as a field experiment by Louis and Richard Leakey showed. Well this is of course correct, but dominating hyenas or leopards would not have paid any serious dividends to our ancestors. Hyenas were chasing their prey for many kilometres and were finishing their dinner very quickly - you may recall our earlier discussion on how African tribes despise hyenas primarily for their gluttony. When hominids were getting to the hyena kill, on most occasions there was simply nothing left. Meanwhile, leopards were hunting much smaller prey and therefore did not provide a sizeable enough amount of food for our ancestors. Lions were very different from the two previous animals. They were killing their prey without the multi-kilometre chase, and usually had a prolonged royal dinner that gave our ancestors ample time to interrupt the party – a longer affair also due to the meal being larger, of course. These factors combined gave giving hominids the best available chance to interrupt in time and claim their share of the kill.

Would they also displace the male lions that were usually eating first? I think it would have largely depended on the circumstances. Hominids may have waited some time until the male lions had finished their portion – with their huge royal mane, male lions would certainly conduct more respect and fear from hominids, such as is the case with hyenas today. According to the insight gained from watching contemporary Hadza tribe, hominids could also chase away male lions if needed. As we have discussed earlier, chased-away animals often stay in the vicinity and often reclaim their kill after giving the aggressor some time to relax. If the third-hand remains were too meager for the lions, the still hungry female lions (who were yet to eat due to the pecking order during feeding time) would go for another hunt. In this scenario humans and lions were avoiding physical violence on most occasions. Lions, without

doubt, would always be unhappy to see approaching humans, but unless the season was very scarce with food they would not opt for a direct confrontation.

The initial interaction between lions and early hominids gradually changed probably some two to three million years ago. They became rivals, but their rivalry was quite unusual, and very different from the lion-hyena rivalry we can watch today in Africa. Humans were not predators themselves – they did not have the required speed, claws, teeth or tools to make a kill themselves at that stage. Their throwing at a distance was proficient but nowhere near good enough for hunting serious game that could feed the entire group. On the other hand, their throwing at medium and particularly close range, virtually at point blank range, had devastating power. Gradually, after many tragic (for both sides) confrontations, something in the form of a truce was formed between hominids and lions. Without signing any documents both lions and hominids, like two world superpowers, acknowledged the necessity of a peaceful coexistence, and tried to avoid direct physical violence despite many disputes over kills. Elizabeth Marshall Thomas wrote about this truce eloquently in my favourite book about cats, "The Tribe of Tiger" (2001 [first published in 1994]). The same idea of the same author is also featured in a later book "The Old Way: A Story of the first People" (2006) Let me say a few words about this remarkable, if unorthodox, idea.

Although the books by Elizabeth Marshall Thomas are not as widely referenced in scholarly publications as the works of George Schaller or Craig Packer and some other lion experts, they have a unique place in lion (and big cat) literature. Apart from the fact that Marshall Thomas had first-hand experience of witnessing human-lion interactions in the Kalahari from 1951 onwards, she has an uncanny ability to see connections between ostensibly unconnected phenomena. At that time, when Marshall Thomas observed lion-human interactions, both sides (lions and local Bushmen) were unspoiled by the advancing technology civilization which gradually overtook Africa and introduced in the relationship new characters such as hunters, poachers, cattle-breeders and tourists. The interaction between hunter-gatherer humans and lions in Kalahari in the 1950s probably was the closest we will ever be able to come to replicating the situation of our ancestors interacting with big cats millions of years in the past. It was from the results of her observation of lion-bushmen daily interactions that Marshall Thomas proposed the idea of an ancient

truce existing between humans and lions. Marshall Thomas uses this expression more as a metaphor. "No one can explain the truce because no one understands it. The truce was simply taken for granted, as most situations involving animals are" (Marshall Thomas, 1994:126). Even if some readers disagree with the use of such a 'logical' term in a human-animal relationship, the phenomenon behind the term is extremely interesting. This was kind of a "pact of non-aggression" between humans and lions, where taking food from each other was permitted. The central unwritten and unspoken statement of this truce probably can be formulated as follows: "We do not want to resort to violence between each other – the hungriest shows more will and takes the meal first."

This principle also seems to be working in the lion-hyena relationship (at least partly). They are both known to take kills from each other, and often the victor of a takeover attempt depends on the numbers on both sides involved. But as Schaller notes, sometimes the balance of power and numbers is not really reflected in a takeover. "I was often surprised that a few lions were able to take a kill with impunity from many hyenas. For example, one sub-adult male took a carcass from 17 hyenas, and 2 lionesses appropriated one from 32 hyenas. A communal attack by the hyenas could easily have driven these lions off, and this indeed happens occasionally as the detailed descriptions by Kruuk (1972) show" (Schaller, 1972:272-273). At such unusual scenarios, the lions were most likely hungrier and hyenas could feel this through their behaviour very well – let us remember that no one needs unnecessary violence and injuries. In a typical scenario hyenas wait while the lions are feasting, and after some time once the lions are presumably not as hungry as before, they stage their takeover. According to Schaller, in 44% of lion dinners the kills were taken over by hyenas before the lions were finished with them (Schaller,, 1972:273). This means that lions would not mind in staying at a kill longer, but their desire to fight for the meat was considerably reduced once they were not hungry, and they were eventually giving in to the pressure from the hungrier hyenas. "Usually hyenas gathered around the kill, circling it, whooping, drawing closer then retreating, playing, it seemed, a game of psychological warfare, until the lions became uneasy and departed. On three occasions they drove lions off forcibly" (Schaller, 1972:273). And of course, at a takeover attempt the entire arsenals of warning displays were at

work: hyenas approached lions with their "bushy tails raised, emitting roaring sounds" (Schaller, 1972:273).

While both sides were following this truce, there was very little direct physical conflict between lions and early humans. Conflicts got ugly and violent after humans started farming and obtained cattle. Marshall Thomas cites a very interesting thought with deep evolutionary implications, proposed by a Ju/Wa (Bushman) hunter: "Lions are dangerous only at the cattle posts. The lions around here don't harm people. Where lions aren't hunted, they aren't dangerous. As for us, we live in peace with them" (Marshall Thomas, 1994:119). According to these words, the troubles in human-lion interactions and the deadly clashes of interests mostly started (or at least intensified) after humans became pastoralists.

There is substance behind the words of the Ju/Wa hunter. According to Marshall Thomas, "the success of the Bushmen/lion truce seemed truly remarkable. While we were in the Kalahari in the 1950s, we knew of only one Ju/Wa person who had been injured by a lion – a man who had been mauled while helping a group of Herero ranchers hunt a cattle killer in the Bechuanaland Protectorate. Being a Bushman and a servant, he had been conscripted as a foot soldier in the Herero-lion wars and during the advance on the lions had been forced to the front with the dogs. There the lion had mauled him. We knew of no one who had been killed by lions."

Possibly even more importantly, there was a genealogical study conducted in the 1980s by John Marshall, noted anthropologist and filmmaker, and his colleague Claire Ritchie. While making the well-known 1984 documentary "Where are the Ju/'hoansi of Nyae Nyae? Changes in a Bushman Society 1950–1981," they attempted to collect information about the causes of death of Bushmen. Apparently, in the memory of all living Ju/Wasi and in their memories of their ancestors, only one person was killed by a lion in the many decades of observation – this was a young paraplegic girl (Marshall Thomas, 1994:122).

There is another interesting detail of big cat psychology, so far mostly neglected in scientific literature: lions and tigers can clearly identify the difference between a healthy human and a human which for one reason or another does not look or behave like a usual human. Think back to the young paraplegic, the only Ju/Wa killed by a lion. Clare Ritchie, who herself has a disabled daughter, noticed that her own daughter also gets more attention from big cats during zoo visits. Ritchie proposed

that possibly "it is the girl's motion – slow, uneven, and low to the ground – caused lions to regard her differently from the way they regard able-bodied people" (Marshall Thomas, 1994:122). Predators are known to attack humans sometimes as a result of mistaken identity. This mostly happens when humans, for some reason or another, lose their usual bipedal posture. Attacks on humans are prevalent when they are collecting firewood, cutting grass, riding bikes or answering the call of nature. Danger may arise from another factor as well – people heavily intoxicated by alcohol (or other substances) and struggling to stay bipedal may also fail to make an impression of a normal and healthy human (I think many would agree with this). According to Marshall Thomas, "On certain roadsides in East Africa, for instance, lions occasionally wait for drunken people to come staggering home at night from bars" (pg. 125). It is here that the hazard of excessive drinking truly gains another dimension.

According to Elizabeth Marshall Thomas, Bushmen had a totally different relationship with leopards. Leopards, unlike lions, killed many Ju/Wasi and their behaviour was also very different from lion behaviour. Leopards were very easy to scare away from their kills – even a single woman with a digging stick could scare away a leopard, but at the same time leopards attacked and killed Ju/Wasi quite regularly. Two important facts about the behaviour of man-eating leopards in the Kalahari from Marshall Thomas: (1) leopards attacked humans only at night, and (2) leopards scavenged human corpses left unburied during epidemics. Both of these behaviours were described by the legendary Jim Corbett with regards to Indian leopards (Corbett, 2003, introduction). Corbett also pointed out connections between leopards scavenging during epidemics and the practice of man-eating among them. Two of the most notorious man-eating leopards killed by Corbett, the Rudraprayag and Panar man-eaters, both appeared after two devastating epidemics: the first one after the so called "Spanish Flu," the worst pandemic ever to hit humanity in 1918; and the second one after the particularly severe bout of cholera in the beginning of 20th century. These two leopards devoured between them a total of 525 humans.

Let us come back to human-lion interactions and look at a few more citations from Marshall Thomas' book. Here is a good example of Bushmen taking a kill from lions without any violence – ethnographer and filmmaker John Marshall was the witness of this extraordinary scene: "Ju/Wasi shot poisoned arrow at the wildebeest,

and next day they found the sick wildebeest surrounded by an unusually large lion pride (about 30). The four Ju/Wasi took in the situation, then slowly advanced on the lionesses. Speaking firmly but respectfully, they announced that the meat belonged to people. The lionesses rumbled unpleasantly. Some stood their ground, but others turned tail and retreated to the bushes. And then, although the bushes seemed alive with huge, tan forms pacing and rumbling, the Ju/Wa hunters descended on the wildebeest, tossing clumps of earth at the lionesses, speaking and respectfully as they did so. The last of the lionesses slowly and unwillingly backed off, and as soon as the lions and lionesses were screened by the bushes the Ju/Wa hunters seemed to give them little further thought and turned their attention to the wildebeest; they surrounded it, killed it, skinned it, and cut it into strips to carry home, leaving nothing behind a but a green cud of partly chewed grass" (Marshall Thomas, 1994:118).

The following citations about the human-lion interaction sound like the question to scholars: "A truce if ever there was one, the people-lion relationship wouldn't have worked unless both sides had participated. Yet how and when the truce started, and what the lions gained from it – and therefore what they put into it – have never been precisely determined" (Marshall Thomas, 1994:119). According to the model of human-lion interaction suggested in this book, this truce was the product of daily interactions between lion and human ancestors in the woodlands and open savannah of Africa. Lions played the central role in the truce – the role of donors. They were active hunters, most likely the most able hunters of the day. In return for their compliance in the truce, lions were avoiding violent showdown with the kings of scavenging – suicidal groups of stone-throwing early humans.

Hominids and early humans were the central 'recipients' of the situation. As a result of their boundless dedication and bravery in their state of battle trance they were able to chase away lion ancestors and obtain their kills. Therefore, for the lions the truce was taking away only part of their hunting profits, but for hominids and early humans the truce was much more important and was the difference between food or possibly no food at all. They were ready to sacrifice their lives, and this ultimate dedication paid dividends in the form of respect from predators – as a result of the respect bestowed upon them by their predator rivals, early humans had a steady source of protein-rich meat.

The Lion, as the First God of Humanity

The "truce" was not an agreement of two equal sides. Lions did not need hominids and early humans for their survival, but our ancestors needed lions. It is not a miracle that, for our ancestors, lions gradually became revered as gods. Hominids and early humans were looking up at lions with unbounded awe and admiration. A single lion, with its speed, fearsome canines, sharp claws, strength and hunting skills, was immeasurably more powerful than several hominids. Lions could easily kill them, and they very occasionally did. Yet still, lions were mostly ready to share their food with us. It is no wonder that lion images are the earliest and the most enduring element of human art, such as the 32,000-36,000-year-old paintings of lions from the Chauvet Cave, or the images of lions engraved on the most ancient temples. Possibly even more tellingly, in many early depictions we see combinations of human and lion body parts, indicating the existence of a deep connection between humans and lions – it is sometimes a human body with a lion head, or a lion body with a human head. For example, 32,000-40,000-year-old mammoth-ivory sculptures from Germany show a human body with a lion's head, similar to the figure of Sandas, the so called "lion god" among Hittites, who also had a human body and lion head. On the other hand, the mysterious Great Sphinx has a lion's body with a human head attached.

The lion is prominently present in later periods as a potent religious symbol. In the earliest and the most important Neolithic site in Çatalhöyük, Turkey, the figure of a seated goddess was flanked by two lionesses. Even the first coins, made in Lydia in 6th century BC, feature a lion's head.

This ancient reverence was still present among Bushmen in the 1950s. "Bushmen deeply respected lions and their hunting skills… the Bushmen recognized a supernatural quality in lions. The word for lion n!i – like the name of God, could not be uttered in the daytime. And people attributed human qualities to lions" (Marshall Thomas, 1994:121). Bushmen's relationship to Kalahari lions before the onset of technological advancement was most likely of the closest possible

resemblance to the relationship of our distant ancestors with the ancestors of the big cats we can find anywhere on our planet.

Millions of years of close interaction taught lions to respect and to be wary of humans. According to two of my favourite authors on lions, lions are not afraid even of thunder, but they are instinctively afraid of humans, even in the moment when they attack humans. Here is Marshall Thomas again: "Not even thunder awes a lion, or so it would seem. In fact, the lions of Gauscha sometimes answered thunder. As if God were roaring at them from the sky, a lion might roar right back." (Marshal-Thomas, 2006:176). On the other hand lions, even when attacking humans, have an ever-present element of fear. According to George Schaller, lions attack their prey animals with a so-called "alert face", silently, with a closed mouth, and with forward-pointing ears – however they attack humans with open mouth, ears back and growling, exactly the same way as they attack their fellow lions. "As mentioned before, the cat uses the alert face in such a situation [when hunting], not a bared-teeth face as is usually indicated in museum exhibits. On the other hand … lions attack man with bared teeth. The exposed teeth represent a defensive reaction, whether in response to another lion, man, or an attacking prey animal; in other words, they contain an element of fear" (Schaller, 1972:98). We can also recall here the fact confirmed by both Schaller and Bertram, that lions generally clear the scene when they see a human approaching in a bipedal stance. This instinctive fear of human does come only from the period when humans obtained firearms – the ancient truce between lions and humans can explain this mixture of respect and fear from both sides much more effectively.

The End of the Ancient Truce

A model of interaction between humans and lions which is very different from the Bushmen/lion relationship comes from Tanzania and Kenya. This model represents a much later epoch of interaction, the era of pastoralists. Maasais are

powerful hunters, and they also have herds of grazing animals – by no means do they depend on lion kills for food. They do not have a truce with lions as they simply do not need it. On the contrary, lions are their enemies and they attack and kill their cattle given half a chance – in return the Maasais kill lions in order to guard their herds. They also hunt lions to assert their bravery and masculinity. We can recall here the words of the old Ju-Wa hunter, who noted that lions only attack humans in places where humans have cattle and consequently kill lions to guard their cattle. We can say that it was humans who violated the old truce of non-violence: As they became pastoralists and their weapons improved, they started killing their former co-signatories, who had now become merely rival hunters. Hunter-gatherers, or more specifically hunter-scavenger-gatherer Bushmen, in the 1950s were still in the old non-violent relationship with lions. For Bushmen lions were not a dangerous and prestigious trophy with which to assert their own masculinity and dominance. For the Bushmen lions were feared yet at the same time were much-loved deities, superb hunters and noble food providers who had kept their side of the truce impeccably. As soon as pastoralism and farming started, lions became rivals and pests - although still commanding deep respect, they were being killed by early cattle-breeders for several reasons: to guard their cattle, to show their bravery and to assert their dominance over nature and over the animals they had treated as gods for millions of years.

It must be a part of human nature to kill their gods.

Conclusions: Three Epochs of Relationship

In conclusion let me summarize a historical picture of the changing relationship between lion ancestors and human ancestors. I propose to distinguish three principal epochs, labelled according to the three distinct environments our ancestors went through during their evolution: the epoch of tree branches, the epoch of open woodlands, and the epoch of open grasslands.

The Epoch of Tree Branches

This was the initial stage of interaction between human and lion ancestors, when our primate ancestors were still living on the tree branches. Our ancestors were much lighter than the ancestral forms of the big cats that roamed the ground and the lower, thicker tree branches as the dominant predators. As tree-dwelling primates were smaller and lighter than most cats, climbing to higher and lighter branches was the most effective lifesaving strategy for our ancestors. Night-time security was achieved by the same means – by sleeping on the highest possible branches. Their occasional visits to the ground were relatively rare, undoubtedly brief and always very dangerous. Visits to the ground were mostly aimed to gather ripened fruits of the trees, which naturally end up on the ground.

This period can hardly be classified as the true beginning of the interaction between human and big cat ancestors, as at this stage they mostly lived in different environments and their paths were crossing only occasionally. Rare meetings between them at this stage, as you may guess, always led to tragic consequences for our ancestors. This period lasted for many millions of the years in a relatively static state of interaction. The beginning of this period goes back to the mists of our evolutionary past when the distant ancestors of cats hunted the ancestral forms of primates. The end of this period is relatively easy to pinpoint. About 6-7 million years ago the common ancestors of all apes (including us) started moving from trees to the ground, heralding the end of our tree-dwelling epoch. I propose to label this period, until its end 6-7 million years ago, as the Epoch of Tree Branches.

The Epoch of Open Woodlands

The next stage was a transitional one, as our ancestors gradually became partly terrestrial and had to deal with ground predators more frequently. This was the period when human/chimpanzee/bonobo/gorilla/orangutan common ancestors came down

to the ground. They had to follow a strategy that could provide security in their new environment. Unlike Asian apes – orangutans, and the "lesser" apes – gibbons, who still live in the trees, all African apes, gorillas, chimpanzees (and bonobos) have moved to ground for good. During this period, in a bid to become bigger as their body size grow, terrestrial apes could not climb as high in the trees as they had before, and they became more vulnerable to leopard-like predators. It was in this epoch that the evolutionary paths between future humans and their primate relatives separated for good. This was primarily due to the different strategies of survival they each followed. The ancestors of chimpanzees, bonobos and gorillas followed the usual path of increasing their canines and becoming silent dwellers. Our ancestors, instead of becoming silent, gradually increased their vocalization, made it very effective with the introduction of rhythm and group synchrony, made the common bipedal threat posture into a constant means of display and locomotion, increased the length of their legs, increased head hair, and improved their throwing ability. As the new system of protection from predators was based on a non-contact form of defence, the need for long canines and a fur-covered tough hide disappeared. Therefore, unlike gorilla and chimpanzees with their lion-like canines, hominid canines started to disappear. Furthermore, as their defence was based on non-contact combat, they started losing the hairy covering on their bodies, most likely to get rid of fur-residing parasites.

This was a dynamic period of conflicts with ground predators and a period of gradual accumulation of the above-mentioned morphological and behavioural changes among our ancestors. During this period early hominids still stayed in woodlands, in the vicinity of the trees, and during this period they had the combination of bipedal longer legs and long tree-climbing hands. Longer legs evolved to make their bodies taller, not for more efficient running (as running is always more efficient with four legs). As the hominid defence system improved, all the predators of the day, including the ancestors of the big cats, gradually learned to leave the groups of noisy primates alone. During this epoch the strategy of intimidating display was used chiefly for the defence from predators, not for obtaining food via aggressive scavenging (for this see the next epoch). This period lasted approximately from 6 million to 3.6 million years ago. I propose to call this evolutionary period as the Epoch of Open Woodlands.

The Epoch of Open Grasslands

After securing their lives from ground predators during the previous epoch, our ancestors turned their highly effective intimidation system to a new goal: obtaining protein rich food: meat. This change must have also occurred gradually, with the gradual increase of hominid intimidation capabilities. Hominids became challenging competitors at the kill, trying to displace predators without waiting for the end of their feast. Predators, including ancestors and relatives to big cats, most likely strongly resented them and were fiercely defending their kills against hominids. Possibly after a series of violent clashes with heavy casualties from both sides, predators gradually started avoiding direct confrontation with approaching groups of noisy and stone-wielding hominids. Hominids' body size, size of their legs and length of head hair increased further from the pressure of the conflict with predators, sort of an arms race. Bipedal posture was already the only way of locomotion, but the long hands and tree-climbing abilities were gradually lost during this epoch – hands and shoulders instead became perfect throwing machines.

As the problem of safety from predators was mostly settled, hominids did not have to stay close to the trees for a quick escape any more. As they moved out onto the open grasslands, aggressive scavenging became an increasingly important source of food – open terrain was much better suited for seizing scavenging opportunities. Therefore, I suggest that our ancestors moved out from the forests into the open savannah not because of the reduction of the forest massifs, but because open terrain betted suited their scavenging food-obtaining strategy. Hominids learned to watch vultures in the sky in order to attend the "advertised" kill sites. Running became an important part of their food acquisition policy – not as a strategy to kill or capture the prey, but in order to get to the kill site relatively quickly. This was the time when our ancestors started appreciating the prolonged lion dinner and started to despise the quick eating habits of hyena packs.

Moving to the open grasslands also brought with it another serious yet obvious problem: the problem of night-time security. During the previous epoch, in open woodlands, hominids could stay relatively safe at night on the high tree branches – on the open savannah the night time was much more dangerous. While sleeping all

audio, visual and behavioural signals were switched off, and new means of security were needed to ensure a safe passage to the morning. The tradition of vigorous evening singing, drumming and dancing concerts most likely originated at this point. These concerts were designed to scare away predators in the vicinity and to advertise the size and cohesion of the group. On more dangerous nights they probably kept singing, dancing and drumming throughout the night, as Pygmies still do to this day (Turnbull, 1961).

Apart from loud evening concerts, hominids also developed a more effective way of advertising their presence during their sleep: via strong body odour. Body odour was probably already present in the previous epoch, as aposematic species very often have a constant body odour, but during this period the intensity of their odour most likely increased. To strengthen body odour the number of existing sweating glands was increased, and strategically placed patches of hair appeared in armpits and genital areas of the hominid body. By this time most of the hominid body was probably devoid of primate fur, as their defence strategy was based on non-contact forms of combat and did not need tough and fur-covered skin to withstand bites and scratches. Apart from body odour, eyespots also appeared on the sleeping human face and even possibly on female chests as well, adding a visual element to complement the existing body odour.

All predators, including the big cats, had to respond to the appearance of the new "king of scavenging" on the savannah some 3.6 million years ago. Several species of African predators went extinct in this period, yet it is difficult to know whether hominids directly contributed to their extinction by constantly taking away their kills with their newfound scavenging strategy. For example, several of the fearsome sabre-toothed cat families went extinct in Africa when our ancestors stepped out from woodlands to open grasslands. It is also difficult to determine whether the pressure of the competition with hominids made the big cat ancestors change some of their morphology or behaviour to compete. I have already put forward the idea that the challenges from the hominid groups would have made the great cat ancestors become social, or at least more social – essentially "teaming up" against a new common enemy. This was later maintained among the lions, the only big cat that stayed in direct competition with early humans in Africa. This ancient sociality was lost in other big cats, despite all big cats maintaining very expressive

facial and audio communications, pointing to the possibility that their common ancestor was once a social animal. It is also probable that the royal mane of the male lion was developed in response to the increased intimidating capability of the hominid body.

It was during this last period, the epoch of the "Open Grasslands," that our ancestors "crossed the cognitive Rubicon" and made the historical transition from hominids to humans. As I have already written in 2006, I suggest that developing the cognitive ability to ask questions was the single biggest element of this transition from animal to human intelligence (Jordania, 2006). I proposed that when our ancestors started migrating out of Africa, they had already crossed the "Cognitive Rubicon," despite not yet having developed fully articulated speech. I agree with the proponents of the multiregional hypothesis, in that the awkward and imprecise taxon Homo erectus should be abandoned, and Homo erectus should be classified as archaic Homo sapiens[8]. Despite their cognitive revolution, the newly-born humans still depended on "professional" predators to kill their prey for them. They were still scavengers and occasional small game hunters, so in most cases they depended on lion ancestors to make the kill. This was the reason why they followed big cat ancestors to the different parts of the world, gradually becoming the two most widespread mammalian species on our planet.

In Which Epoch Do We Live Today?

The three epochs we discussed above encompass virtually the whole timeline of human evolution. The third epoch finished when humans developed pastoralism and agriculture. With the development of pastoralism and agriculture about 10 thousand years ago, the human-big cat relationship entered totally new, uncharted territory. After developing farming and better technologies big cats were no longer needed as designated prey killers and food providers – humans had animals that they

[8] The name Homo erectus should be abandoned at least for the reason that it is hopelessly outdated because meaning of the term, "erected man." Fully bipedal posture was characteristic for our earlier ancestors, Homo habilis, and even the pre-homo australopithecines about 4 million years ago.

used for food now living with them. Herds of cattle started occasionally attracting the interest of big cats, and humans, unlike the lions from the previous epoch, were against sharing their food. One more factor added to the intensity to the new situation: with the development of metallurgy about 7-8 thousand years ago humans obtained metallic and much more lethal weapons. A combination of these factors was dangerous to big cats: they were not needed, they were looked upon as dangerous pests roaming for human cattle and human lives, and they could be now hunted and killed more efficiently with new and more powerful weapons.

These factors combined caused crucial changes in the human-lion relationship. The old truce went out of the window. Apart from defending their cattle, humans started killing lions and other big cats for another reason as well, for prestige and to show their domination over animal kingdom. 10 thousand years ago lions had a very wide distribution – this was a time when lions were the second most widely distributed land mammal in the world (after humans, of course). For millions of years humans were looking up with envy at lions and other predators that were able to kill their own prey. Now, as they had finally obtained effective ways with which to kill their prey and even the strongest predators, humans started enjoying killing probably more than any other animal.

We know that many animal species that have lethal weapons do not use them in conflict situations against their fellow animals – snakes do not use poison against other snakes, and lions and tigers very rarely use lethal bites against fellow cats. Whenever natural selection was providing lethal weapons to animals, it was also teaching animals to use their weapons responsibly – the inhibition to use lethal force comes from millions of years of life lessons taught by natural selection. It was natural selection that provided a myriad of ways to replace violent combat with non-violent forms of display of body size, sounds, smells, and behaviours. When an animal species acquires a powerful weapon, initially they may use it with devastating results for their fellow animals without harbouring any inhibitions against its use in a situation. Doves, ironically the symbol of the peace, are an example of such a violent and "uneducated" species. Dove beaks apparently have been formed relatively recently and their bearers still do not have any inhibitions when using it against each other. Humans are another sad example of the irresponsible use of lethal weapons against each other. We obtained powerful weapons only a few thousand years ago,

yet we did not have time to develop strong-enough instinctive inhibitions against the irresponsible use of these weapons. Human history of the last 10,000 years is full of the results of this irresponsible use of our own intelligence and strength. Plenty of wars against other groups of humans have been waged, plenty of animal species have gone extinct, and many more have come to the brink of the extinction during this period. We only started realising the real danger of our own weapons once we had created weapons of mass destruction that could collectively destroy the whole planet.

After introducing farming the human population started to grow more rapidly. This basic indication of the success of humans gradually became one of the central issues for the future of our planet. The danger in gradually replacing the world's animal diversity by the increasing numbers of humans on every continent is very real. Two factors led to the explosion of human population growth: The development of farming several thousand years ago was the first powerful factor, as a steady, measurable and constant source of food became readily available. As the human population started to grow, natural selection put a check into action in the form of medical problems. Deadly pandemics and high childhood death plagued early civilizations, and for several thousands of years the rapid growth of the human population was slowed. Then the second factor of population growth kicked in – the progress of medicine. Advances in human knowledge of bacteria and viruses reduced the effectiveness of pandemics and the development of effective medicines reduced the child mortality rate and greatly increased the average length of human life.

As a result, the human population started to increase exponentially from about the time of the Second World War. After millions of years of history, humanity had reached the first billion, in the beginning of the 19th century – it took us another 123 years before we reached the second billion mark. Accumulating the third billion took a much shorter, 33 years. After this, things went faster, and accumulating three next billion benchmarks took 13, 12, and again 13 years respectively. If this speed is be maintained until 2100, the human population of earth could reach a staggering 16 billion. In comparison with the devastating and still not-fully-realized effects that the increase of the human population has on the environment, the debates on climate change will soon be dwarfed. Climate, as we know from earth's prehistory, goes up and down – but the human population moves only up and up. Scholars are hopeful that this catastrophic rise of numbers will not become an uncomfortable reality.

Apparently, it will not reach this stage however – according to their predictions, the world population will more or less stabilize at a level of about 10 billion – but this surely cannot just happen by itself. During my recent trips to India I was told that, in order to ensure safer retirement, many Indians try to have more children. This strategy leads to a more rapid increase of population within the area and exerts enormous pressure on the environment. In India, together with the 1.3 billion humans, about 2000 Bengal tigers are struggling to survive in the wild year by year. The constant growth of population, illegal grazing on the territories of national parks and conflicts with local wildlife puts enormous pressure on the whole ecosystem to keep up with human use, and abuse. Of course, not every species is put under as much pressure as tigers currently are. Some species are in fact greatly benefiting from the increase in human numbers and the rise of cities and enormous infrastructure to sustain civilization. Rats and cockroaches, for example, are truly thriving as 'companions' to our growing civilization.

Well, what about big cats, our long-time companions and rivals?

As humans started gradually overtaking most of the world, lions and tigers gradually became more of a nuisance, or even worse than a nuisance – pests, dangerous predators that have no place in a human neighbourhood. Big cats were poisoned, killed, and chased away from adjacent territories to human settlements, and they were killed in the hundreds and thousands within the gladiatorial arenas of the Roman Empire. After the development of firearms technology the situation for the big cats became truly catastrophic. Hunters were given rewards for killing lions and tigers in many countries – m killing lions and tigers became particularly popular as sport, either for the money or just for the thrill and prestige that a hunt brought. Several hunters boasted that they killed many hundreds of lions and tigers each, much more than any number of human victims that any man-eating lion or tiger had ever killed. The results were devastating. If in the beginning of the 20th century, when the big cat territories were already decimated, there were possibly about 60 000 or 100 000 tigers, by the end of the 1960s there were probably no more than 2-3 thousand tigers left in the wild. Although the situation with lions was not as catastrophic as it was with tigers, the decline of lion numbers and disappearance of several lion subspecies is still equally alarming.

Why Humans Eat Big Cats?

Possibly the most symbolic element of the woeful new state of interaction between humans and the kings of the animal kingdom is that in some western restaurants you can apparently order lion meat for dinner. I today signed an internet petition posted by Cheryl Semcer, sometimes referred to as "The Lion Lady." She was asking for support to help to qualify lions as endangered species. As one of the victories she mentioned in the letter of appeal she told of a petition she started to get a restaurant in Kansas to stop serving lion meat – the petition had a positive outcome. She has also initiated another petition to get the authorities to ban lion meat throughout the country.

The interaction of lions and humans went through several stages. We respected and deified lions, we depended on them for food, we worked out a truce together which we both respected for millions of years, and finally we got to a point when we started not only killing, but eating lions. It is a fact that six-seven million years ago lions ate us for food. We were primates, and cats eat primates. Then we became humans, but for a long time we lived in harmony with nature. And then, with the accumulation of power and resources, “humanism” somehow turned into “humanocentrism,” the philosophy of human supremacy at the expense of all other animal species and life forms.

Eating lions and tigers might be a sign of another more hidden, religious factor. Although in this book we mostly look at human-big cat relationships, I would like to mention in this connection the ancient bear worship rituals around the world. Scholars find elements of bear cults in a wide range of cultures where bears existed (bears are widespread in the Northern Hemisphere and in South America). Some religious artefacts related to bear cults were even found at Neanderthal sites (see Wunn, 2000:434-435; Lascu at al., 1996; Maringer 1956). André Leroi-Gourhan excavated seven cave bear skulls arranged in a circle in Furtins Cave, Saône-et-Loire, central-east France (Leroi-Gourhan, 1981). The idea that Neanderthals had religious practices is still debated (Wunn, 2000).

Interestingly, probably the closest analogy to the Neanderthal practice was found among Ainus, the oldest inhabitants of the Japanese Islands. For Ainus the bear is a sacred animal, the God. Ainus would typically raise a bear cub from infancy. Sometimes cubs were even fed by a lactating human female, and were given the best available food. In the end, at the age of a year or two, the festival central to Ainu culture, the so called "Bear Festival" (known as Iomante) was organised. The bear, having been lovingly raised for years since infancy, was killed in a ritualistic manner and eaten by the villagers. This was believed to be the way of communicating with the gods – through eating one of the gods. The bear's skull and skin were saved. If the readers remember my suggestion for the double-meaning of cannibalism (1) as direct and ultimate violence, and (2) as the ultimate love and respect, then the ritual of eating the bears, lions, tigers and other god-like figures (including the ritual of Eucharist, the holy communion), takes an interesting religious dimension. In a recent internet publication it was claimed that a demanding Chinese market is increasingly using lions instead of tigers – taking into account lions' genetic links and their role in human cultures as ancient gods, this was to be anticipated.

It is not easy to classify this current epoch and give it an appropriate name. I suggest naming it as the "Epoch of Human Civilization" but I will be happy if somebody suggests a better name. This name gives acknowledgement to the meteoric rise of the human and the creation of huge infrastructure aimed at increasing human wellbeing. At the same time this name has negative overtones, indicating that humans were at the very centre of this epoch, with little or no consideration given to the environment and the diversity of life on our planet.

Are the Times Changing?

To be more precise about the current state of our interaction with big cats, we need to acknowledge that there has been an important change in attitudes towards big cats and towards nature in general. By 1950 the development of the human civilization reached a breaking point – we were armed with powerful and destructive weapons that could destroy the whole planet and many animal species had gone extinct as a result of various human activities. We gradually realized that the biggest problem to our survival and that of the planet was the irresponsible use of our own power. We realized that if we had continued the same way as we had been until the 1960s, in a few more decades it would have been impossible to save a healthy environment on the planet.

In this process of awakening about the state of nature on our planet, big cats played a crucial role. Probably the best-known case is the struggle for the survival of Bengal Tigers in India. It was acknowledged that the key for the survival of tigers is maintaining pristine forests with plenty of wildlife, healthy vegetation and a sustainable water supply. If tigers have a good healthy environment, then all the other wildlife has a good healthy environment. Tiger, as the Lord of the jungle, takes care that the healthy way of life in the whole ecosystem is maintained, much in the same way a successful monarchy rules its kingdom.

If we look at the historic change in attitudes toward big cats and tigers in particular, the name of a legendary Irish-born British-Indian hunter, author and conservationist Jim Corbett comes to mind. Jim Corbett has been my lifelong hero – he was blessed with three great talents. His first talent was that he was a superb naturalist and a great hunter. Very few could match his knowledge of the North Indian jungles. His acute observations about tigers, leopards and other animal species are still referenced to this day in the most prestigious scholarly journals. His ideas on the reasons of why certain big cats become man-eaters are still arguably the most authoritative in the field. His hunting abilities were truly legendary. None of the man-eaters that he was asked to get rid of survived his skills. His second talent was his absolute honesty and true humility. Corbett did not suffer the "hunters' virus" of dramatizing hunting stories, and he was one of the most non-assuming, humble and

trusted persons ever to walk our planet - he was ready to help anyone and risk his life without any pretence or prompt. His third talent was his writing style. This talent became apparent much later, during the last decade of his life. After numerous requests from his friends to put his extraordinary hunting stories to paper, he finally relented and wrote ten stories for his now-classic volume "Man-eaters of Kumaon." Typically for him, Corbett gave all the royalties of his bestselling book to the blind Indian soldiers returning from the Second World War (as the book came out in 1944 during a harsh period of wartime shortages).

It was Corbett who started campaigning for the survival of tigers back in the 1930s, when the craze of tiger killing was in its heyday. Corbett proposed and lobbied to allocate special territories – pristine forests – where tigers and other wildlife could roam freely without human interference. The first such park was opened in 1936, and today it is fittingly known as the Jim Corbett National Park. Preserving forest territories from intruders had been in practice for a long time already, but this was generally only to stop the public hunting on areas where noblemen and royals would go to hunt. Corbett's name was also honoured in 1968, when Czech biologist Vratislav Mazak named the newly discovered tiger subspecies, the Indochinese tiger, after Jim Corbett (*Panthera tigris corbetti)* (Mazak, 1968).

Corbett National Park is the oldest National Park in India. When in 1973 Indian Prime Minister Indira Gandhi initialized the "Project Tiger," Corbett National Park was the first area to come under the project. Today there are about 50 tiger reserves in India, and saving the tigers has today become one of the biggest international animal conservation issues, involving thousands of volunteers from the heads of state to Hollywood superstars. The effort to save the tiger is probably the best-known animal conservation effort in the history of our civilization.

Before we go back to discuss the evolutionary aspect of the human-big cat relationship, I would like to discuss whether we need to give a different name to the current historical period of our interaction with big cats. I do not think we should really consider it as a new epoch – it is still a part of the epoch of civilization. We are still very much the most destructive force on our planet, following the motto "All for humans." However, from the second half of the 20th century something has changed, or at least started to change in our mentality. Important changes took place in our relationship with the big cats as well, and this is why I believe our time

deserves to be considered as a new sub-epoch, the sub-epoch of the Epoch of Civilization. I would like to propose to name this period as *the Epoch of Responsible Civilization*. This name instils certain hope for the future of our world; hope that from now on we will be more responsible as 'owners' of the planet than we have been during the last ten thousand years. After finding this name for the current period of time I thought we could label the period of time from the beginnings of pastoralism and agriculture (10,000 years ago) until the end of the Second World War as the "Epoch of Aggressive Civilization," or as the "Epoch of Irresponsible Civilization." I am not sure if this is necessary, and the name "Epoch of Human Civilization" is probably enough. This was the epoch of humans, the epoch when humans placed themselves in the very centre of the priorities of the whole planet, in more or less complete disregard of all other animal species. The last 10 thousand years of our civilization, with the rise of cities and empires, the destruction of pristine ecosystems and hundreds of animal species, world wars and weapons of mass destruction, have been almost undoubtedly the most dangerous and harmful period in the long history of life on our planet. I hope that our current period of time will be seen by future generations of more responsible humans as the *beginning* of the "Epoch of Responsible Civilization."

Human Evolution – or Human-Big Cat Co-evolution?

If we look at various models of Human evolution, we will see that they look at the human evolution as a more or less autonomous process. For example, the two most popular models, the Recent African Model and the Multiregional Evolution Model, never discuss any specific evolutionary interaction that humans had with any other animal species. In this book I suggest that our interaction with the big cats was a crucial factor in the evolution of human morphology and behaviour.

If we try to look at different theories of human evolution in the light of our history of interacting with predators (the topic of the majority of this book), existing viewpoints can be reduced to the two main conflicting models:

(1) According to the first model, surviving predator attacks has never been a driving force in human evolution. The evolution of Homo sapiens was mostly the result of our internal interactions – we shaped each-other through social interaction and the power games we played with each other in order to gain resources, mates, and domination over fellow humans. In this model sexual selection was considered the most important driving force in shaping human morphology, behaviour, and culture – including music and dance. Charles Darwin was the Founding Father of this model. The beginning of the 21st century saw the comeback of the Darwinian model of human evolution, in which charming the opposite sex was the only worthy major issue that our ancestors had in life (see for example, Miller, 2000). According to this model, predators had such little impact on human evolution that Darwin was musing whether humans evolved in total isolation from any predators, probably even on an isolated island.

(2) According to the second model, surviving predator attacks was the most important single driving force of human evolution. We were not formed on an isolated island – on the contrary, we were formed on a continent where big predators were in abundance. According to this model, building a defence system from predators made us the way we are: noisy social primates with bipedal posture, long legs, head hear, music, dance, sense of rhythm, sweat glands and body odour, use of clothes, masks, feel of collective identity and the desire to be cooperative and be united in religion and tribal/national groups in critical situations. Elements of this model had been present whenever scholars were considering the importance of predators and predation in human evolution. Adriaan Kortlandt's experiments on primate and early hominid defence strategies, Charles Brain's model of "man the hunted," Heart & Sussman's book on the importance of predation in early human evolution and the ideas of Felix Fifer and Barbara Isaac on the importance of stone throwing along with several other ideas are all founding elements of this model. I believe that this model that acknowledges the crucial importance that predation played in our evolution is much closer to the historical reality than the first model.

Well, how does the second model explain human sexuality? Unlike the first model, which sees sex as the field for competition between males for the females, the second model sees sex as one of the central elements of **cooperation and social cohesion** in human groups, cohesion between all members of the group (not only between men and women). According to this model physical touch, sexual games and intercourse played a huge role in bonding between early humans. The second model can explain why sex was not restricted to opposite genders. Homosexuality and bisexuality is a fatal dilemma for the first model, a model where sex was a field of competition between males for the females for procreation only. For the second model bisexuality is the initial and most natural state of human sexuality. For the first model monogamy (exclusive relationship between one man and one woman) and polygamy (relationship between one male and many wives) are the proposed systems of sexual relationships. For the second model a group interaction amongst bisexual hominids, where all group members were engaged in unrestricted sexual games for bonding, is the proposed system of sexual relationships. For the second model, monogamy and polygyny, prevalent in contemporary societies, is the development of a later epoch, when the initial group unity was not required for survival any more. For the first model the instances of group marriage in some societies, homosexuality, bisexuality, sexual desire and relationships among children, incestual relationships and intergenerational sex are all deviations from the norm. For the second model these all were a natural part of our evolutionary history, and monogamy is a socially imposed type of relationship.

Anyway, with regards to our relationship with big cats, I would like to go one step further. Not only were humans profoundly affected by the pressure from predators, but I believe we should classify the long evolutionary interaction of humans with predators, and primarily with the ancestors of the big cats, as a case of *co-evolution*.

Co-evolution is the parallel evolution of two or more genetically unrelated species. This can be an evolutionary interaction between the parasite and its host, between a flower and an insect, or between a predator and its prey. In co-evolution

the interacting species are affecting each other's development directly, shaping each other's morphology and behaviour. Co-evolution is not a simple case of the daily interactions of different species – for the co-evolution to emerge, the interactions must be a matter of life and death. Co-evolution can be co-operative, or mutualistic, like between the bird-pollinated flowers and hummingbirds, or can be competitive, like between a predator and its prey. A classic case of the competitive co-evolution is the interactions between the Thomson's gazelle and the cheetah. Speed became the critical feature for the gazelle in order to survive a cheetah's attack, and speed became the critical feature for the cheetah in order to catch a gazelle for food. The co-evolution of competing species leads to an "evolutionary arms race." In the case of the gazelle and cheetah the term "race" has the most literal meaning as the evolutionary race was primarily geared around speed. For hundreds of thousands, if not millions, of years, cheetahs and gazelles had daily competitions, and the prize for winning was life on one side, and dinner on the other. As a result, the cheetah and the gazelle are among the fastest land animals of the world today, and both are built for speed and not for power. Another interesting case is the North American pronghorn antelope, which has much faster speed than any of the North American predators. Why did the pronghorn develop such lightning speed? Scholars found the answer to this question when they discovered that a cheetah-like fast-running predator once existed in North America – therefore it is highly likely the pronghorn developed its speed in competition.

The evolutionary scenario presented in this book suggests the existence of an intense direct evolutionary rivalry and resulting co-evolution between the ancestors of the big cats and human ancestors. The nature of our interactions was changing during those six million years. From the moment when our primate ancestors descended from the trees to the ground, they faced lethal danger from the ancestors of the big cats. At that stage the evolutionary pressure was one-sided, so it was not a true co-evolution yet – our ancestors had to develop strategies to cope with predation first. As dominant predators, big cats dictated a number of morphological and behavioural changes in early hominids. Like several other primate species that moved to the ground, our ancestors also needed to adjust their morphology and behaviour to the demands of the new environment. *The big difference between the*

ancestors of future Homo sapiens and other terrestrial primates was that only our ancestors followed the model of aposematic defence from predators.

Instead of growing longer canines and becoming more silent (as other apes did), our ancestors opted for a louder and more visible advertisement of their presence. Aposematism, or in other words, warning display, became the leading survival strategy for the evolution of our species. The warning display was aimed primarily at the eyes, ears and nostrils of the big cats. Such universal attributes of human morphology and behaviour as bipedalism, long legs and head hair, a great number of sweating glands, hair patches in armpits and genitals, coordinated singing in groups, sense of rhythm, synchronic dance, use of stones (and later stone tools), body painting, use of clothes and masks, the phenomenon of the battle trance and the collective identity, all were formed as aposematic defences against the direct pressure coming from the big cat predators.

After developing the most successful intimidating strategy ever seen on our planet, hominids became the leading force in confrontational scavenging. Now it was the ancestors of the big cats who needed to update their intimidation arsenal, otherwise hominid groups would become devastatingly successful against any predatory cat. This was the moment when the co-evolution became two-sided and fulfilled the true notion of "co-evolution." Lion sociality and living in prides, I suggest, was their response to the successful intimidating display of hominid groups and their tendency to live in groups. As lion ancestors started living in groups, male lions obtained several elements for an effective warning display. Most importantly, they obtained huge manes, which made their appearance visually much more impressive and domineering. They also obtained a low and more powerful voice. Because of these changes male lions lost the qualities of a good hunter, as aposematic species are generally poor as stealthy predators. Female lions subsequently became the leading hunters of a lion pride. The alliance of two or more male lions also became more welcome, with male lions becoming more tolerant towards other males being in the pride. They accepted a model of a "peaceful co-ownership" of the female lions of the pride. As an even larger parallel, as many other social species do (including us), lions started practicing homosexuality (or bisexuality to put it more accurately), as love-making between partners was strengthening bonds between males on one side and females on the other. Also, possibly taught by their bitter

experiences in dealing with scavenging human ancestors, male lions forgot their gentlemanly manners and started eating the kill first – cubs were also allowed to a kill earlier than females were. This patriarchal eating strategy was in a way life-saving for male lions, as in the case of an interrupted dinner it was usually the females who remained hungry, which was convenient for the males as their aposematic evolution had lost them their supreme hunting abilities. Therefore, the lion kill rate also increased under the pressure from scavenging hominid groups.

It was probably at this point that lions became the first god-like figures for hominids. Lions were admired as powerful hunters and gracious and noble animals – gracious enough to leave part of their dinner for the hominids. For sure lions were feared, but at the same time they were worshipped for their enviable physical strength, for their speed, for their graceful movements, and above all, for their mastery in killing their prey. Many nature lovers still watch with a strange mix of awe and guilty pleasure the dynamic and violent documentaries of lions and tigers hunting their prey, usually set to the voice of David Attenborough. It is no wonder that lions were considered gods and deities in virtually every human culture in which they had come into contact with humans.

Of course, we should not fool ourselves into hoping that our deep feeling of awe towards the lions was mutual. We needed lions, but the lions did not need us. We were basically a nuisance for them, a noisy stone-throwing parasite that was arriving and taking their food. It was only after many violent confrontations that lions grudgingly learned that it was better to give part of their food to hominids instead of fighting against these suicidal fighters who could throw heavy stones with deadly force. Considering the new situation, it would be natural to suppose that lions were trying to get away from hominids and humans – and I believe there are indications that they did exactly this.

Let us remember that humans and lions were the two most widely distributed mammalian species on the earth from 100,000 years ago until about 10,000 years ago. Apart from sharing the two top places in the range of distribution, virtually all the regions of their distribution, as well as their timelines or arrival and movement, were coinciding. They were going and living in new places together. Was this a mere coincidence? Were they possibly both following the herds of ungulates? Or was one of them following the other?

Scenarios of human evolution proposed in the past have suggested that when our ancestors went out of Africa, they were mostly following the migrating herds of their prey. In this scenario our ancestors were big game hunters, a very popular image of our early ancestors until just a few decades ago. Today the idea that our distant ancestors were able big game hunters is out of favour as the evidence mounts against this old theory. Following the herds of ungulates would be of very little practical value for our ancestors if they could not actually hunt them – so what could be the reason for their worldwide migrations?

I suggest that humans did not follow the herds of the ungulates. It was lions who followed the herds of the ungulates – and the humans followed the lion prides. Against their will, lions became the designated killers for hominids. I suggest that it was lions that started the gradual colonization of different continents, probably in order to get away from hominids and early humans. Our ancestors, in turn, tried to stay close to their "designated feeders", and as a result wherever lions went in search of new hunting grounds, be it on the vast territories of Asia, Europe or North and Central America, sooner or later the groups of humans were showing up in the same territories to claim their "human" share of the lion kill.

Of course, there is the possibility that lions left Africa about two million years ago as a natural expansion to their territory without any pressure from anyone else. It is also possible that humans also took their own way around the world, and that it was a mere coincidence that they came to similar places at roughly similar times. Overall however, if we take into account the lion-human interactions, their travel itineraries, the timelines of their travel to different regions of the world, it is difficult to believe that these were just coincidences. Two facts support my suggestion:

(1) In their intercontinental travels humans and lions went further than any other land mammalian species. This fact suggests that they possibly had had some extra pressure to search for the new territories. Also,

(2) The timelines of the appearance of the lion ancestors and early humans in Europe, Asia and America also support this scenario – as a rule, lions were arriving to a new territory earlier than humans. The only place where prehistoric humans migrated on their own, without following lions, was Australia.

Instead of the mutual pressure and constant bloody conflict for dominance and for the title of top animal of the African savannah, something like a truce between

the king predators and king scavengers was formed. The notion of the truce, proposed by Elizabeth Marshall Thomas in 1994, describes very well the mutual agreement between human and lion ancestors for millions of years. It was during this period (the Epoch of Open Grasslands) that hominids "crossed the cognitive line" and became humans (Jordania, 2006), and it was in this period that contemporary lions evolved. It was also during this period that lions started their intercontinental travel out of Africa, to be closely followed by humans. As a result of the lion-human co-evolution in the open woodlands and open grasslands/savannah we shaped each other into the two unrivalled kings and rulers of our planet that we are today.

Human evolution was not the evolution of a primate species in isolation from predatory animals. On the contrary, predators, and particularly ancestors of the big cats, truly had a lion's share in the evolution of human morphological and behavioural characteristics. In much the same way, humans contributed handsomely in making lions what they are today, the magnificent big cat with a social life unique to all cats, a mane unique to all cats, a powerful low voice, and also uniquely for many other predators, close interaction with humans.

Lion Sociality in the Context of Early Lion-Human Rivalry

During the majority of this book we have been discussing the role that big African predators, primarily the lion, played in the evolution of human morphology and behaviour. This was unavoidable, as at the first stage of our long interaction with the ancestors of the big cats our ancestors were in a vastly inferior position. Big cats were predators and we were their prey. Of course, apart from big cats many other predators hunted our ancestors, but big cats were most likely the biggest threat for our ancestors. For countless generations hominids were struggling to form a decent defensive strategy against these big cat predators. This strategy was based on a

system of warning display (aposematism). During this time early hominids were only part-time ground dwellers, and they were trying to not stray too far from the trees.

The development of an aposematic strategy gradually paid dividends, and hominids eventually managed to shift to full-time ground living. As their strategic defence improved, humans started using aposematic display for another purpose, in order to obtain protein rich-food via aggressive scavenging. Countless generations of human and big cat ancestors were spent in more or less direct conflicts, involving occasional heavy losses on both sides. Finally, hominids started gradually dominating in scavenging situations – lions responded to the change of balance in power in several ways.

We are going now to discuss these possible changes in lion morphology and behaviour. At the end of the previous chapter we discussed the possible role of human pressure on lions in forcing them to undertake wide intercontinental migrations – now I would like to discuss the evolution of lions' social nature in the context of lion-human interactions.

Lions are today the only cats that live in groups. Lions sometimes hunt together, raise cubs in nursery groups together and also defend their territory together. Craig Packer studied this phenomenon for more than 30 years and came to the conclusion that none of the traditional hypotheses of lion's sociality can explain this problem without leaving serious gaps. In several publications on this topic Craig addressed the various models of lion sociality.

The most widely known is the hypothesis that lions benefit from hunting in groups. As Craig Packer showed in a number of papers published in the 1990s, lions hunt together very occasionally – only if the prey is too big and dangerous for a single lion to attack. Buffaloes are the most popular prey for communal hunting, and Zebras are also sometimes hunted in groups. In Botswana lions even hunt elephants in groups – in such an extreme case they need the cooperation of a very large lion coalition (about 25-30 lions). Smaller animals, including wildebeest, are usually hunted by a single lion, and other pride members merely spectate the solo hunting effort if nearby. Packer also demonstrated that being in a group does not mean better feeding for individual lions. The life of all other cats, both big and small, also

indicates that cats generally prefer to live and hunt alone. Cats, unlike dogs, are individualists, and one of the central reasons for this is that individual cats are better hunters than individual dogs. Therefore, in order to feed better cats prefer to hunt alone.

Raising cubs in social groups is another way in which to benefit from group living. Female lions often give birth close to each other. As the cubs grow, mothers are inseparable from each other, sometimes even taking care of and feeding other cubs than their own. Another advantage of female cooperation is in defence from stranger male lions which are often deadly dangerous for cubs – when outside males encounter a mother with small cubs, they kill the cubs to force her to return to mating. It would be natural to assume that cubs of cooperating female lions are far more likely to survive these encounters than cubs raised by single mothers. "Groups of mothers can successfully counter-attack the invading males, whereas a female has no chance one-on-one against a fully grown male" wrote Craig Packer on the website of his study group.

Well, there are recorded encounters of wandering males with single mothers, and lionesses are often successful in driving aggressive males away. As we may remember, lions try to avoid using lethal force against each other in order to avoid injuries, however in these situations determination is a very important factor. A mother who fights to defend her cub's life is often more determined to use the lethal force than a male who fights for sex. Most importantly, virtually all other cats, big and small, are familiar with infanticide by stranger males, yet these species are solitary, indicating that determined mothers can defend cubs from stronger males. Considering other species do not require social living to defend their young, this shows that communal upbringing and the defence against infanticide is not the main reason why lions are the only social cats.

According to Craig Packer's own solution to the question, the key factor in lion sociality is in their joint defence of the territory. When roaming males come to an already occupied territory, it is important for the defenders to have a numerical advantage over the intruders. As lions need territories where water, food and shelter are available, for them defending a territory is a key factor in their survival.

This explanation seems quite convincing, but one question still remains. This explanation sounds very similar to the justification of why human societies need big

states. The argument can be summarized like this: "we need to be united in states in order to defend ourselves from the attacks of other states." This logic does not explain the reason why the first state was created. When it comes to the origin of the first human state in the "fertile crescent," we know, for example, that the first states were taking care of such things as complex systems of irrigation. Similarly, the model of lion defence from other groups does not make it easier to understand why lions started living in social groups in the first place. Let us remember that:

(1) All cats are territorial;

(2) All of them need to fight for territories;

(3) None of them need to have a numerical advantage to defend their territories from their fellow Felidae; and

(4) As a result, all cats (except lions) live solitary lives.

So why do lions not live, mate, raise their cubs and defend their territories as single animals, like all other cats do?

It is true that lions can together defend themselves from the challenges of other lion groups, but in the same way a group of tigers or group of lynx could do a better job in protecting their territory against other tigers or lynx. All cats apart from lions live alone, and challenging intruders in their territory are also single animals. Basically, all cats are perfect predators and they can survive on their own in drastically different environments. Therefore, in my opinion, the explanation of lion sociality for defence of their common territory is very effective in explaining the current status quo, but this model does not provide the **evolutionary reason** (the so called "ultimate reason") for the initial emergence of group living among lions.

I suggest that the initial force that made lions a social animal was coming from outside, not from competition with other lions. Let us remember that, for several million years, lions and early hominids lived side by side in the open woodlands and open savannah. Once hominids mastered their intimidating strategy possibly some 2.5 – 2 million years ago, their groups became a menace for all major predators of the day, including such fearful animals as Homotherium, Dinofelis, and many other true or so called "false" sabre-toothed predators. These were akin to horror-movie characters looking like a cross between a lion and hyena, and some with canines the

size of a walrus'. Yet still, once hominid intimidating strategy was perfected they could chase away all these much stronger and very intimidating predators. Hominid groups would create a loud rhythmic sound, and with threatening synchronous movements and battle trance-induced dedication would chase these mighty predators from their kills. Loud sounds made by humans today still scare all animal species in every environment. It is not clear whether these powerful pre-historic animals lived solitary lives, but if they did they would have been particularly vulnerable against the socialised hominid groups.

I suggest that it was hominid and early human groups who provided the initial pressure on the common big cat ancestor and pushed it towards a more social life – a single predatory cat was unable to withstand a group of taller standing, noisy and stone-throwing opponents. Gradually all the fearful ancestors and distant relatives of big cats were threatened in survival by the now-competing hominids. To counteract hominid pressure, the big cat ancestors developed sociality and started living in prides. Big cat ancestors most likely survived as they became social animals and could withstand the pressure from hominid groups better than solitary animals. They became the sole survivors of the wider gallery of ancient cat-predators of the African Pliocene savannah. Additional pressure for lions' sociality could have been coming from the ancestral hyena packs – no single hyena can stand its ground against a single lion, but when it comes to a pack of hyenas they have a chance against a single lion or even a small group of lions. I suggest that lion sociality was a response to their lifestyle of living in the open savannah, which included confrontations primarily with groups of hominids and other predators.

All the above-mentioned brings to us to a conclusion that, although most big cats today are solitary animals, they all are most likely descendants of a social animal, the common ancestor of all contemporary big cats. As lions stayed closest to the environment of the big cat ancestor species, they retained their sociality while other cats avoided the competition with humans by changing their environments and size, and as a result became solitary hunters with different habitats.

One more possible evolutionary link between lion sociality and the pressure from hominids is that the size of a lion pride and the size of an early hominid group were similar in size. Let me give another citation from Elizabeth Marshall Thomas: "Most of the time, the people preferred to stay in groups of twenty or thirty, while

the lions apparently preferred to stay in groups of six or seven. Hence, in a way, the group size was the same: the people were more numerous, but the lions were larger. Each group would have weighted about three thousand pounds, so on a cosmic set of scales the groups would have balanced each other. A meat meal big enough for the people was also big enough for the lions. . . Perhaps for this reason, the lions and the Ju/Wasi helped themselves to each other's kills" (Marshall Thomas, 1994:177).

All cats have one interesting characteristic feature which is very interesting in the context of our discussion: their faces are unusually expressive for solitary animals. This feature has been noted by many scholars who studied cat behaviour, including Paul Leyhausen, Konrad Lorenz, and George Schaller. "There are few animals in whose faces a knowledgeable observer can so clearly read a prevailing mood and predict what actions – friendly or hostile – are likely to follow" noted Lorenz about cats (Lorenz, 1964). Schaller made this point more clear: "This expressiveness of cats is in some ways surprising, for most are solitary animals which, it could be assumed, do not need such an array of complex signals. In their communicatory system they resemble the social primates and canids more than they do such relatively asocial animals as bears" (Schaller, 1972:83). Nikolai Pavlenko, a world-renowned tiger trainer and tamer from Russia and my dear friend for over 40 years, told me back in October 1974 that bears are one of the most dangerous animals for trainers. The reason? Their relatively expression-less faces. "It is more difficult to guess by looking at the bear what it will do next" explained Nikolai, who worked with an array of different predatory animals in his younger years.

Therefore, I suggest that a cat's very expressive face is a legacy of its common ancestor's group-living pattern. The lion is the only contemporary big cat that lived and still lives in the same environment as the ancestral big cat: in the savannah and in direct competition with hominids and humans – this must be the reason why lions have retained their social lifestyles. As soon as big cat ancestors started to diversify and formed the variety of big cat species that we know today, some smaller and some bigger, they all turned to a solitary lifestyle – some of them went up the trees as tree branches were now a hominid and human-free environment. Cats are the most specialised and the most powerful predatory family, and they have done extremely well as solitary animals all over the world. Despite their solitary living, cat faces have retained the initial plasticity of their common ancestor – I therefore suggest that cats'

expressive faces are the legacy of the social life of their common ancestor, the common felidae ancestor that, some 6-7 million years ago, was also possibly a social animal. A biological answer to cats' evolutionary connections is difficult to obtain as all cat fossil remains look very much alike, differentiating only in size.

But what about the tiger, the biggest cat of all, and probably the most feared man-eater? The tiger did not climb the tree to avoid human competition, and tigers have evolved as solitary animals, yet still it must have been in direct competition with our ancestors. So why are they not social? Let us now try to answer this question.

CHAPTER SIX

The Story of the Tiger

Out of all big cats, the species closest to lions is the tiger. Their body size is very similar to each other; they both live on the ground and hunt much bigger, hoofed prey. They can both easily kill and eat humans, and are possibly the most well-known man-eater species in the animal kingdom. At the same time they both usually avoid facing humans on foot and do not usually include humans in their diet. They are also both revered in many human cultures as gods and divine beings.

At the same time they also have plenty of things that separate them. Visually they are very different with their skin colour: monochromic against striped. The tiger is a bit longer and heavier, but the lion is a bit taller. A male tiger is definitely a better hunter than a male lion. Male lions, as we may recall from earlier in the book, have plenty of morphological and behavioural patterns of aposematic species – for obvious reasons these characteristics are a heavy liability for any stealthy predator. For this reason male lions often have to rely on the hunting talents of their female counterparts for food. Because of their aposematic characteristics, male lions are most likely better than tigers when it comes to intimidating opponents. And of course, tigers, like all other cats, are solitary animals (except when a mother is raising cubs), and lions are famously social, often being found at zoos and savannah lazily congregating around a shady patch of ground.

Sometimes these differences are not as stark and finite as they may seem. For example, Nikolai Baikov suggested that Siberian tigers sometimes hunt prey together (Baikov, 1936). Corbett also described a man-eating tigress who was hunting humans with the help of her adult son (see a story on Chowgarh tigers from "Man-eaters of Kumaon"). Very interestingly, tigers are particularly social when they are at a kill. During his study of tigers in India, Schaller spent 11 nights at tiger kills watching them eating. In more than half of the cases (7 out of 11) there was more than one tiger at the kill (Schaller, 1972:249-250).

Schaller was also surprised to find that tigers have more peaceful eating habits than the social lions. Here are Schaller's words: "…once the male tiger waited two

and a half hours at a kill until the tigress and cubs had eaten before he proceeded to eat; on another occasion the male did not feed at all when he met the same tigress and her cubs at a kill although he had obviously not eaten much the previous night (Schaller, 1972:250). William Baze (1957) saw a "female eat on a freshly killed deer while the male sat nearby "awaiting his turn." According to Schaller, unlike with lions where the stronger male chases away the females and feeds first, among tigers the rules are different: those who kill eat first, and bigger tigers do not generally chase smaller tigers away (Schaller, 1972:250). Probably most interestingly, Schaller got the impression that, after making large kills, tigers actually invited other tigers to the kill by calling loudly: "tiger gives the impression of trying to draw attention to its ample food supply" (Schaller, 1972:259). Schaller's conclusion about tigers, that although the cat is "essentially solitary yet not unsociable", is justified. Groups of tigers as large as nine or even eleven present at a single kill have also been reported (Thapar, 1998).

Tiger facial expressions, very similarly to other cats, also prove that they are quite social in a way. "The photographs and descriptions of primate facial expressions published by Van Hooff (1967), Marler (1965) and others are almost identical to those of lions except that cats have more mobile ears than monkeys. Similar expressions include the alert face, relaxed open-mouth face, tense open-mouth face, and bared-teeth face. I may have overlooked some subtle but distinct expressions, and the cats may therefore share with primates as large a repertoire as the latter do with canids. The fact that many expressions in primates, cats, and dogs are not elicited by the same type of social situation but also have the same function suggests that similar selective pressures operated on all their societies to help produce mobile lips and prominent teeth as mediators of certain emotions" (Schaller, 1972:98).

Tigers and Lions

The tiger is possibly the only rival to the lion for the throne of the "king of animals." Despite the popularity of the "Lion vs. Tiger" websites with different opinions and different YouTube compilations, in reality if such powerful predators were to face each other, they would most likely (and very wisely) avoid a direct physical confrontation.

The phylogenetic closeness of lions and tigers allows them to produce common offspring. *Liger* and *tigon* (sometimes *tiglon*) are the result of such unnatural breeding efforts between captive lions and tigers. There are other hybrids between different big cats, generally the result of various zoo experiments. These hybrids take their names from the names of both of their parents: *leopon*, *jagupard*, *leguar*, *jaglion*, *leoniguar*, *tigard*, *tiguar*. There is even a prominent "rock-star" among them – *Jagger* (combination of "jaguar" and "tiger").

As is often the case, the common offspring of such hybrids are infertile. More precisely, males are infertile, but certain females can be fertile. For example, the female offspring of a cross between a jaguar and leopard can be fertile while its male 'brother' will not be. Apart from that specific combination, the female offspring off a lion and tiger can also produce offspring, albeit not with a male lion/tiger hybrid. According to Guggisberg (1975), a 15-year-old female liger mated with an African lion and produced a female cub. The cub had fragile health but was raised to adulthood. Very recently, an eight-year-old female liger (hybrid between lion and tiger), Zita, gave a birth to a female baby, Kiara. The father of the newborn was a young African (pure) lion Samson (2 years 10 months at the moment of fertilization). According to the scientific portmanteau naming system, Kiara is a liliger (lion + lion/tiger hybrid). So, Kiara is ¾ lion and ¼ tiger.

I am very grateful to Zina Solovyova, the head of the big cat department of the Novosibirsk zoo where Kiara was born, who gave me details that were not available on the internet. "When we put Zita with Samson, we did not expect for them to really mate and produce offspring," she told me, "because Samson was very young (2 years and 10 months). But after their mating we noticed that Zita's behaviour changed and it became obvious that she was pregnant." A single female cub was born on August

13th, 2012. Apparently, Zita was a very good mother, extremely protective of her cub. On the morning after the cub was born, for the first time, Zita did not allow Samson to enter the compartment where the newborn cub was kept. In fact, that morning, for the first time in her life she seriously attacked Samson. Mother and cub were separated from Samson. For the first five days Zita did not take any food and only drank water. Although Zita's behaviour was very protective towards her cub, she still could not feed the cub properly, and after ten days zoo personnel decided to remove the malnourished cub from her care. Solovyova took care of the newborn cub, very much like she had in several other cases before where the cubs of big cats needed care. For the first three weeks the cub was cared both by Solovyova and her domesticated sand cat. "Although I was trying my best to give the cub a good massage of the whole body, of course the cat was doing a much better job by licking the cub all over the body." The cub started gaining weight fast, was very playful, and was put into contact with other young animals.

On November 7th Solovyova had a scare, as Kiara jumped from a tall ledge and broke her right front paw. She was operated on by a zoo veterinarian on November 12th and she has since made a full recovery. According to Solovyova, Kiara has the same elements of lion and tiger appearance very much like her mother, although she is ¾ lion and only ¼ tiger, unlike her mother who is 50/50 lion and tiger.

The birth of Kiara, unique as it was, was not a single unique occurrence. Less than a year later on May 16th 2013 Zita and Samson, once again inseparable, gave birth to three more liligers: Lina, Sandra, and Eva. As all the newborn liligers were also female, they may also be fertile as well. According to Solovyova, Zita became a much better adapted mother after her second pregnancy. She did not allow anyone (both cub's father and human careers) close to the cubs, fed them and took all the necessary care herself. In 2015 all four liligers were transferred to other Russian zoos.

Many experts express their negative attitude towards breeding of unnatural crosses between various species (see, for example, Andreassi, 2012). At the same time, enforcing this kind of biological "apartheid" in cases where animals of different species become mates of their own volition also raises moral concerns. Samson and Zita still remain together, although the Novosibirsk Zoo personnel started using contraceptives to avoid the appearance of new generations of liligers.

Despite the fact, that lions and tigers are so close phylogenetically and genetically, there is a world of difference between their behavioural patterns. These differences are most likely the result of the difference in their lifestyles, and I would suggest also due to their various degrees of interaction with hominids and humans. Here is a list of their behavioural differences:

• Lions are social animals. They live together, hunt together, raise their cubs together, and defend territories together. Tigers are solitary animals. They live alone (except when a mother is raising cubs), hunt alone, raise cubs alone, and defend their territories alone.

• Lions live in open grasslands. Tigers live in dense forests and tropical jungles.

• Lions do not try to conceal themselves apart from when they are hunting. Tigers are very secretive at all times.

• Lions are mostly monochromic, ranging from yellowish to brownish. Tigers are a combination of light red, yellow, and white with black stripes.

• Lions have manes – tigers don't.

• Lions always lived in the same environment where hominids and early humans lived, and they had been interacting with each other from the very beginning of their common evolutionary beginnings. Tigers lived in jungles and dense forests, the same environment that was avoided by humans, so their interaction was much rarer and their lifestyles were influenced by humans a lot less.

This last point is the most important for our discussion. For the majority of their speciation from common big cat ancestor, tigers were probably formed in the jungles. As a result tigers avoided close contacts with humans, who generally do not live in the dense jungles. Only during the last century or so, when humans started advancing into heavily wooded forests and jungles, did we come into close contact with tigers. Let us recall that at the beginning of the 20th century the world population was less than 2 billion, but by the end of the 20th century the population had reached 6 billion, and only about one decade of the 21st century was needed to raise it another billion to 7. For a stark contrast, we can recall the world population of tigers: the total number of wild tigers, according to the most optimistic viewpoint, was about 100 000, but by the beginning of the 21st century there is fewer than 5 thousands. A more

conservative estimate is almost half of that number – and the numbers are constantly dropping. These numbers give us an understanding of the extent of pressure we exert on their natural habitat. In India, one of the world's tiger centres, there are about four thousand villages where the population is over 10,000.

Historically, lions and humans have been companions. More precisely, humans were lion's uninvited parasitic neighbours. It was humans who pushed lions to migrate to new regions – and humans would then follow lions to their new territories. This strategy of shared migration resulted in a very wide distribution of both species all over the world. Let us recall that, by the end of Pleistocene, Lions and humans became the two most widely spread land mammals of our planet. Much later, with the invention of more effective weapons like spears or the bow and arrow, and particularly after inventing metal weapons, the initial harmony between lions and humans was shattered. Humans started big game hunting and did not need lions any more as designated killers. The new epoch in interaction between lions and humans had started. On a sadder note, humans mostly forgot the feeling of gratitude towards the lions that had fed them for millions of years, and instead started hunting them. Apart from eliminating hunting rivals and dangerous neighbours, lion hunting became the symbolic way of asserting the dominance of humans over nature.

The fact that lions and humans always lived in a shared habitat greatly contributed to the quick decline of the lion population during the last several millennia. Lions have never been secretive animals, and rulers and kings of early Middle-Eastern civilizations had no problems finding them for trophy hunting. By the beginning of the 1st century CE, lions were already pushed out of many former territories. For example, when the Persian King Xerxes was advancing in Greece in 480 BC, there was not only the legendary 300 Spartans to be wary of – lions were apparently quite common in Greece at the time and on several occasions they attacked Xerxes' camels that were carrying supplies to the great army. After only about one hundred years, according to Aristotle, lions were quite rare in Greece – by 100BC they were gone.

The most difficult period for lions was after firearms were invented and used against them, from the 18th till the 20th century. The last lions of Turkey were hunted into extinction by the 19th century, and in Iran the last signs of wild lions were seen during the Second World War. The last evidence of the former worldwide

distribution of lions is the single population of Asiatic lions in western India. When I visited the Gir Forest in April 2012, there were over 400 lions. In May 2015, the lion population was estimated to be 523. There are ongoing discussions about re-resetting excess Gir lions into some other regions of India. There is rationale to this suggestion, particularly if we take into account that lions in the Gir forest are in good condition, and if the breeding continues it will be difficult to keep them all within Gujarat. Lions lived in many parts of India until the 18th and 19th centuries. In fact, a lion was the national animal of India until the start of the widely known "Project Tiger" in 1972. From 1972 the tiger has been the national animal of India.

Unlike lions, tigers have never been human companions. Tigers live in more closed environments, jungles and dense forests, environments that allow their secretive lifestyles. Humans do not live in the jungles and dense forest, and as a result tigers and humans had different living environments and rarely had contact with one-another. Possibly the only people who traditionally lived and still live in the jungles are Pygmies, but most pygmies lived in Africa, where tigers never lived. Even the equatorial tribes who live in the jungle-covered regions still practice a "slash-and-burn" economy – instead of living in the jungles like pygmies, they clear the forests in order to make it more suitable for human living.

Because of these factors tiger and human paths did not cross as intensely as lion and human paths did. As a result, tigers evaded the human onslaught for much longer than lions. The lion population started to suffer from human aggression already thousands of years ago – tigers and humans came into conflict mostly during the 20th century, when the expansion of human population required the clearing of jungles and dense forests (traditional tiger habitat), and also when high powered rifles became available. And we all know the results: from about 100 000 tigers at the beginning of the century, in about 70 years only about 2-3 thousand tigers are left in the wild in India.

This also brings us to the question of the origin of tigers in the first place. The big cat-human interaction can give us a plausible answer to this interesting question. As we remember, humans were most likely subsisting on big cat ancestor kills. Big cat ancestors naturally were not happy with this arrangement, and it was probably one of the reasons why they started their large intercontinental travels around the world. At some point, I suggest that a group of common big cat ancestors made a

different migration: instead of going into another wide-open terrain, they went into a dense jungle environment – and for the first time, our ancestors did not follow them. Humans preferred (and still prefer) living on open terrain.

I propose that this avoidance of closed environments (forests, jungles) was connected to the human scavenging lifestyle. Jungles give much less possibilities for scavenging, as in such a closed environment with so little visibility it is very difficult to learn about carcass availability – the "news" about a carcass is not available in the sky any more, as vultures themselves could not see the carcasses under the dense vegetation of the jungles. Even if vultures could spot a carcass, no animal could see vultures in the sky from the ground through the dense foliage of the forest/jungle.

Relieved of their noisy and parasitic companions, the common big cat ancestors that had moved into the jungles started adjusting their morphology and behaviour to their new environment. The new environment demanded new survival strategies. Living in groups was not a winning strategy any more, and each hunter was better off taking care of itself. As the pressure from scavenging hominid/human groups disappeared, the former ancestral social predators started living separately from each other – their social lifestyle was abandoned (mostly). Their visual appearance had to change as well – in accordance with their new secretive lifestyle, the new jungle predator needed more camouflaging colours. The forces of natural selection intervened, and after some time the former lion-like, mostly monochromic body was bartered for a striking multi-colour and striped hide. Also, if any of these big cat ancestors already had any aposematic features (like a large mane, or the united territorial calls), the new solitary tigers could not afford such things and these features died off through the process of evolution. Male lions could count on their females for making kills, but the now solitary tigers had to get their own kill.

If you take a male lion, put him into the jungles instead of the open savannah, deprive him family company, make him a solitary hunter, take away his mane, and colour his skin into a stripped camouflage pattern, you will get a tiger. A tiger, according to this model, is the evolution of the former big cat ancestor which entered a new environment (the jungles) and changed its morphology and lifestyle according to the new environment of dense foliage. The central reason for going into this new environment was primarily to avoid confrontations over carcasses for meat with early humans on the open grasslands.

I want the reader to remember, that every time when I mention "lion" or "lion ancestor" in relation to hominids and early humans, I am always talking about the ancestors of the big cats. There are still discussions and confusion about when and where the lion as we know it today appeared, but most scholars agree that it was possibly no more than 700 000 years ago that the lion, as we know and see today, was formed – although the remains of lion-like ancestral animals were found some 3.5 million years ago in Laetoli, Tanzania.

Decline of Tigers

For a long time the tiger lifestyle proved to be a winning strategy in the jungle. It shielded them from human expansion within the dense forests, and tigers avoided the few thousand years of human hunting threats while lions were massacred or driven out as a result from most of their previous territories. By the end of the 19th century the lion population had declined considerably, and the tiger replaced the lion as the second most widely distributed mammal on our planet (after humans, of course). Unfortunately for tigers, this situation did not last long. Soon hunters realized the adrenalin rush that came from the new and unique challenge of a tiger hunt. They also realized the beauty of the tiger skins as a display of one's hunting prowess – so the onslaught on the tiger began. Within only a few decades the population of tigers had dropped catastrophically. By the end of the 1960s the population of tigers within India was down from an initial 100,000 to about 2,000 tigers.

The troubles did not stop here – even after the sporting hunt of tigers was totally banned in 1972, their killing continued at an alarming rate. The reason was not so much their beautiful pelts, but instead because in some cultures tigers are very highly prized as magic health cures. Among these cultures, unfortunately, is China, the country with the biggest population including plenty of rich citizens with money to pay for tiger products. People with the resources do not mind paying hundreds or

thousands of dollars for tiger body parts, as tigers are believed by some to have amazing health benefits.

The reader may be recalling at this point the deep-seated beliefs connected to the ritual of cannibalism. Eating the body of a good fighter, enemy or friend, human or animal, was believed to give the consumer great courage and other supernatural benefits – and who could be stronger or better than the biggest of the big cats? It is no coincidence that a tiger's forehead has a marking which resembles the Chinese character 王. This character is pronounced as "Wang," and it means "king." Eating the flesh of our gods, from the Ainus eating the sacred bear flesh to devoted Catholics eating the transformed flesh and drinking the blood of their savior, of contemporary Chinese eating the flesh of a tiger, all have similar religious connotations and are deeply engraved within our psyche.

As a matter of fact, big cats are not that bad as food. In the 1980s, during the study of Hadza aggressive scavenging practices, scholars witnessed that one of the lions who refused to give up a carcass was also killed and later eaten by the Hadza. Apparently, lions and other big cats do not have as tough meat as you might think. Although big cats are extremely muscular, they have quite tender meat, and in an abundance due to their muscular bodies.

During his travel on the Beagle, while crossing Argentina with local gauchos in September 1833, the father of evolutionary biology Charles Darwin consumed a meal made from the puma – Darwin referred to the dish as "one of the very favourite dishes of the country" (Desmond & Moore, 2009:142). As we touched on earlier, to the horror of conservationists there may be lion meat still being served at some restaurants in the USA. Tiger meat cannot be served at a restaurant, as the tiger is classified as a critically endangered species and it is illegal to sell or eat tiger body parts. Officially, governmental officers are doing everything in their power to restrict access to tiger bodies. Nikolai Pavlenko, the tiger trainer from Russia whom I have previously mentioned, wrote to me about how one of his older tigers died while he was on tour in China with his tigers in 2006. The deceased tiger body was placed in a big metal casket, and there was a policeman patrolling this casket day and night for many days at the local circus. At the same time, in China there are "tiger farms" where tigers are bred and then sometimes sold for their body parts, mainly due to their alleged mysterious health benefits.

The grand image of big cats as powerful deities, instilled in humans by our evolutionary past, is essentially giving them a bad service. The same way like with the Eucharist, where Christians receive blessing by symbolically consuming the flesh of the Savior, some humans believe they inherit divine benefits by eating the body parts of a much more ancient deity and God – the Tiger.

This is not a simple situation – reasonable scientific arguments that tiger body parts do not provide any benefits other than sustenance are as useless as atheistic arguments aimed to convert strong believers into atheists. What to do? Unless governments are ready to introduce capital punishment for tiger poaching – like Richard Leakey did in order to stop ivory poaching in Kenya – it is difficult to expect any kind of noticeable decline in poaching. The idea that tigers are raised on farms like domestic cattle and then killed and sold for body parts is a conservationist's nightmare, however closing such farms without applying tougher penalties for poaching will merely put the free roaming tigers in more danger than they already are. According to the Guardian, there are more than 5,000 tigers in Chinese tiger farms alone – this is already more that the population of tigers living in the wild. There are also tiger farms in Thailand, Vietnam and Laos. Closing all of them could be a death sentence for the remaining free-roaming tigers – it is a very difficult situation with no simple solution.

We started our interaction with the ancestors of big cats several millions of years ago, as a humble prey – today we are discussing how to persuade humans to stop killing and eating big cats. Tigers were safe for a few million years as they went into the dense forests and jungles where they largely avoided human contact, but during the last century they have come into closer contact with humans and have quickly been stretched to the critical point of extinction.

In life and after death, lions and tigers command immense respect and reverence from humans, even if this reverence sometimes takes a very harmful and unfortunate form of expression.

CHAPTER SEVEN

Leonardo da Vinci's Masterpiece, or Why We Love Cats

If there are very few humans whom we can trust in distinguishing true masterpieces from other great works of art, Leonardo da Vinci is certainly one of them. Leonardo combined the mind of a brilliant scholar with the mind of a visionary artist and is rightly considered one of the greatest geniuses of humankind. Although Leonardo left us a great number of true masterpieces, we do not know many phenomena or works of art Leonardo appreciated himself as "masterpieces." We know two instances when Leonardo directly acknowledged something to be a true masterpiece. The first case is the anatomy of a human foot: "Human foot is a masterpiece of engineering" declared da Vinci. Any contemporary scholar, biologist or engineer would agree with these words. In the second case Leonardo used his highest praise for a cat: "Little feline is a masterpiece."

Leonardo was by no means the only scholar or artist who was fascinated by cats. Hundreds or even thousands of writers, poets, musicians, scholars, and politicians left us quotes that capture the human fascination with cats. To fill the love and reverence towards cats that we humans have, it is best to hear the words of these scholars, writers, poets and artists about cats.

Humans on Cats

I want to start with possibly the most disputed quote about cats: "Time spent with cats is never wasted." These words are attributed to three different authors: father of psychoanalyses, Austrian Sigmund Freud, Sidonie Gabrielle Colette, a French writer and author of Gigi, better known as Colette, and American poet and

writer Eleanore Marie Sarton, better known as May Sarton. Establishing authorship should not be so difficult if the writings of these authors are carefully checked, but the authorship of Freud seems questionable – Freud was a more of a dog person. Some readers may know Freud's famous words about dogs: "Dogs love their friends and bite their enemies, quite unlike people, who are incapable of pure love and always have to mix love and hate in their object relations." Although one of the greatest thinkers of the 20th century and discoverer of the human unconscious mind, Freud largely failed to acknowledge the beauty of the human unconscious world, and ascribed to it a role of a depository of tabooed thoughts and traumatic memories. Symptomatically, Freud disliked and distrusted music, as he could not understand where its mysterious emotional power came from. It seems to me more likely that the mysterious character of cats would have made him suspicious the same way music did.

Hector Hugh Munro, a British writer in the beginning of the 20th century better known as Saki, could not hide his fascination with cats. Here are three quotes from him: "The animal which the Egyptians worshipped as divine, which the Romans venerated as a symbol of liberty... has displayed to all ages two closely blended characteristics courage and self-respect." Saki again: "Confront a child, a puppy, and a kitten with a sudden danger; the child will turn instinctively for assistance, the puppy will grovel in abject submission, the kitten will brace its tiny body for a frantic resistance." And the more from Saki: "The cat of the slums and alleys, starved, outcast, harried, ... still displays the self-reliant watchfulness which man has never taught it to lay aside." Jean-Jacques Rousseau, one of the brilliant minds of the18th century, philosopher and composer, had a somewhat similar view of cats: "Watch a cat when it enters a room for the first time. It searches and smells about, it is not quiet for a moment, it trusts nothing until it has examined and made acquaintance with everything." Colette is also the author of another quote that cat lovers would agree with it: "There are no ordinary cats."

Rod McKuen, American poet and songwriter wrote with respect: "Cats have it all - admiration, an endless sleep, and company only when they want it." Mark Twain, a certified cat-lover, could not express his love for cats enough: "I simply can't resist a cat, particularly a purring one. They are the cleanest, most cunning, and most intelligent things I know, outside of the girl you love, of course." Eric Gurney,

20th century Canadian-American cartoonist and illustrator, drew on another cat quality: "The really great thing about cats is their endless variety. One can pick a cat to fit almost any kind of decor, colour scheme, income, personality, mood. But under the fur, whatever colour it may be, there still lies, essentially unchanged, one of the world's free souls."

Barbara L. Diamond is particularly fascinated by cat purring: "If there were to be a universal sound depicting peace, I would surely vote for the purr." Lenny Rubenstein sees purring as a universal language to the human heart: "Even if you have just destroyed a Ming Vase, purr. Usually all will be forgiven." And what about cat's beauty? "Cats never strike a pose that isn't photogenic" (Lillian Jackson Braun); "Like a graceful vase, a cat, even when motionless, seems to flow" (George F. Will); "A cat pours his body on the floor like water" (William Lyon Phelps). Henry David Thoreau was fascinated with the flexibility of cats: "A kitten is so flexible that she is almost double; the hind parts are equivalent to another kitten with which the forepart plays. She does not discover that her tail belongs to her until you tread on it." There is an evolutionary wisdom about the cat family in the words of Andrew Lang, Scott poet and anthropologist: "Of all animals, he alone attains to the Contemplative Life." Ernest Menaul goes onto spiritual and emotional overtones: "The cat has too much spirit to have no heart." And here is a philosophical question from Robert Stearns: "Since each of us is blessed with only one life, why not live it with a cat?"

Through these many saying it is apparent that humans consider cats as equals in many different ways, and believe that we should treat cats the same way we would want to be treated. Mark Twain: "If you shamefully misuse a cat once she will always maintain a dignified reserve toward you afterward – you will never get her full confidence again." Probably one of the most popular cat sayings belongs to Ellen Perry Berkeley, former senior editor at *The Architectural Forum* in New York City: "As every cat owner knows, nobody owns a cat." Kinky Friedman, American singer, writer and politician put this into a humorous form: "I rarely meddled in the cat's personal affairs and she rarely meddled in mine. Neither of us was foolish enough to attribute human emotions to our pets." Montaigne, 16th century French writer and politician and one of the most influential writers, who influenced a cohort of writers from William Shakespeare to Isaac Asimov, wrote: "When I play with my cat, who knows if I am not a pastime to her more than she to me?" Even if we are annoyed or

angry, we need to remember to treat cats with dignity. Charlotte Gray, Canadian historian and author, once said: "After scolding one's cat one looks into its face and is seized by the ugly suspicion that it understood every word – and has filed it for reference." Peter Gray's words have a feel of fine equality: "One must love a cat on its own terms." Or another one from Paul Gray: "Cats were put into the world to disprove the dogma that all things were created to serve man." Theophile Gautier, 19th century French dramatist, widely esteemed by writers as diverse as Balzac and Baudelaire to Proust and Oscar Wilde, once said: "If you are worthy of its affection, a cat will be your friend, but never your slave." Some even complain we treat cats better than each other. For example, Martin Buxbaum, American author remarked: "If we treated everyone we meet with the same affection we bestow upon our favourite cat, they, too, would purr." I think many would agree – I myself cannot even dream that my wife would treat me with the same adulation as she treats our kitten Gigi. Lexie Saige once said: "If I tried to tell you how much I love my cats, you wouldn't believe me – unless your heart is also meow-shaped and covered in stray fur." True. And of course, cat lovers sometimes praise each other. Susan Easterly, author of the book "Your Older Cat," declared: "People who love cats have some of the biggest hearts around."

It is quite probably that humans, being noisy and smelly aposematic primates that we are, sometimes annoy cats, who are famous for their love of cleanliness, calm and serenity. Some suggest that cats have already learned how to deal with noisy humans. Stephen Baker, British animal behaviourist and humourist, is probably right in his assertion: "Cats' hearing apparatus is built to allow the human voice to easily go in one ear and out the other." Here is an observation on cat intellect and pride from Patricia Hitchcock, British/American actress: "If your cat falls out of a tree, go indoors to laugh." Sir Compton MacKenzie, Scottish author and co-founder of the Scottish National Party, an outspoken enemy of the domestication of both animals and nations, asked a question in amazement: "The only mystery about the cat is why it ever decided to become a domesticated animal."

Theophile Gautier, who was already mentioned, put cats in the rank of philosophical creatures. "It is difficult to obtain the friendship of a cat. It is a philosophical animal...one that does not place its affections thoughtlessly." Dilys Laing, American writer, poet and artist, brought this idea even further: "I put down

my book, The Meaning of Zen, and see the cat smiling into her fur as she delicately combs it with her rough pink tongue. "Cat, I would lend you this book to study but it appears you have already read it." She looks up and gives me her full gaze. "Don't be ridiculous," she purrs, "I wrote it."

The human fascination with cats does not stop at admitting them as equals – there are also sayings claiming that cats are superior to humans. Of course, many of them include a healthy dose of humor, but as the popular saying goes "there's a grain of truth in every joke."

Fernand Mery was one of the greatest advocates of animal rights, one of those who gradually started the "Epoch of Responsible Civilization" from the middle of the 20th century. In 1953 he founded the association "Friends of the beasts" and his fight led to an important law passed in 1963 against people mistreating animals. In 1970 he found the "National Council for Animal Protection," affecting regulations on the hunting of fur animals as well as the treatment of animals destined for slaughter. In 1974 he published a declaration, *Twelve duties of man towards animals,* which collected two million signatures and was the source of the Universal Declaration of Animal Rights by UNESCO in 1978. Fernand Mery asked quite a serious question: "With the qualities of cleanliness, affection, patience, dignity, and courage that cats have, how many of us, I ask you, would be capable of becoming cats?" Mark Twain, answered this question with a characteristic humor: "If man could be crossed with a cat, it would improve the man, but it would deteriorate the cat." Jerome K. Jerome, English writer and humorist, continued in the same milieu: "A cat's got her own opinion of human beings. She don't say much, but you can tell enough to make you anxious not to hear the whole of it." Ernest Hemingway, Nobel Prize winning writer, who had quite contradictory views on some animal-related issues, apparently loved cats very much for his own reasons: "A cat has absolute honesty, human beings, for one reason or another, may hide their feelings but a cat does not." Following Hemingway's testament, cats still live and roam freely in his house-museum in Key West, Florida. There are approximately sixty cats residing there, served by a full-time vet.

One of the greatest politicians of the 20th century, Winston Churchill, famously declared: "I am fond of pigs. Dogs look up to us. Cats look down. Pigs treat us as equals." Despite his self-proclaimed love towards pigs, Churchill actually adored

cats so much that he was sending his staff members to find his cat before he would start eating dinner. Also, very much like in the case of Hemingway, cats still freely roam the house-museum of the great politician. The reader can visit Churchill's cat's website to see how the newest resident ginger cat, Jock IV, is doing – the place is quite popular according to remarks left on the website.

An article in the "Daily Mail" from February 21, 2013 tells us that the love for cats that characterized the most famous British Prime Minister continues in the recent UK government. The author of the article, Becky Evans, wrote about the two 'high-ranking' cats that belonged to the current Prime Minister and the current Chancellor of the Exchequer of Great Britain. Apparently Larry, Prime Minister David Cameron's pet cat, and Freya, Chancellor Osborne's pet cat, found themselves upset when they found one of their favourite prowling routes (leading to the Office of Foreign Affairs) blocked by a plastic shield. Apparently, complaints were lodged by some staff members with allergies to cats, and a shield was installed to stop the cats from entering the building. However, a last minute intervention from a senior political figure seemed to have given the cats a reprieve. Foreign Affairs Secretary William Hague asked for the cat-proof barrier be taken down. …A Foreign Affairs Office spokesman said: "Freya and Larry visit the Foreign Office a lot and they seem to like the building. 'The vast majority of our staff enjoy seeing them. Some including those allergic to cats have raised concerns. 'Measures were taken to address these concerns. Whether these measures were appropriate to the concerns is under active review." The Foreign Secretary asked that the cat proof barrier be removed immediately.

Larry was brought in to the corridors of power in February 2011 to deal with the rodent problem in Downing Street. However, it took him 18 months to record his first confirmed kill and he was subject to accusations of 'chillaxing' after pictures emerged of him lying in Downing Street and being petted by politicians and police officers. There was even an amusing story of the Prime Minister trying to gain Larry's attention, who was sleeping in a nearby armchair, when a brave mouse had appeared in the office of the PM. The response was quite indicatory – Larry changed his position on the chair and continued to sleep, indicating to the PM that if he had a problem with the mice he could try to chase them himself. As we can also remember from Churchill, cats look down on even the most powerful of humans…What can

we say? Even if Larry did not help with rodents, he surely helped to improve the public image of British politicians and police officers. On his visit to the British PM, President Obama surely was flattered Larry liked him and allowed a pet.

Through many sayings and sentiments it is apparent that the master-pet relationship maybe reversed in its very essence when that pet is a cat. Bill Dana, American comedian, actor and screenwriter remarked joyfully "I had been told that the training procedure with cats was difficult. It's not. Mine had me trained in two days." Paul Gray, prolific author of cat-related sayings, put a gentle warning to cat-owners "Cats are kindly masters, just so long as you remember your place." James K. Olson, D.V.M., cat surgeon, is optimistic: "Usually, if you are very lucky, the cat will treat you as an equal." Cleveland Amory, American author and influential animal rights activist, gives humans more hope: "As anyone who has ever been around a cat for any length of time well knows cats have enormous patience with the limitations of human kind." Karen Brademeyer, widely known for his quotes on cats, has probably summed up our attitude towards cats with this one: "Who among us hasn't envied a cat's ability to ignore the cares of daily life and to relax completely?" An anonymous author noticed something cat lovers could have guessed themselves: "It's really the cat's house – we just pay the mortgage."

Here is some good advice from Susan Howatch, an English author, to all those who want to gain a cat's appreciation: "I have noticed that what cats most appreciate in a human being is not the ability to produce food which they take for granted – but his or her entertainment value." Another advice: if your girlfriend loves her cat, remember never to make any bad remarks towards the cat, or god forbid try to get rid of it. Here are two sad lessons from an anonymous cat-loving author: "My husband said it was him or the cat... I miss him sometimes." And a second one: "I got rid of my husband. The cat was allergic."

Cats have been particularly popular with authors and poets, and for different reasons. Edgar Allan Poe, American writer, inventor and the re-inventor of two of the most popular contemporary writing genres, detective fiction and science fiction, wrote with envy about his desire to learn from cats: "I wish I could write as mysterious as a cat." Here are the words of Hippolyte Taine, the 19th century French historian who profoundly influenced great French Literature of the 19th century: "I have studied many philosophers and many cats. The wisdom of cats is infinitely

superior." There are authors who try to find positive points for humans when compared to cats. For example, Stephen Jay Gould, evolutionary biologist and one of the most influential and popular science book writers, once said: "My cat may manipulate me psychologically, but he'll never type or play the piano."– 1 point for humans. Dan Greenburg, American author and humourist, noted a well-known danger for many writers: "Cats are dangerous companions for writers because cat watching is a near-perfect method of writing avoidance." I know this for myself, and even if a cat is not sitting next to me I will often go to search for them myself.

Barbara Holland, an American author, remarked: "A cat-less writer is almost inconceivable. It's a perverse taste, really, since it would be easier to write with a herd of buffalo in the room than even one cat; they make nests in the notes and bite the end of the pen and walk on the typewriter keys." Robertson Davies, one of the most loved Canadian novelists, expressed well the mutual enjoyment that authors and cats bring to each other "Authors like cats because they are such quiet, lovable, wise creatures, and cats like authors for the same reasons." Aldous Huxley, the 20th century prominent English writer and author of "The Brave New World", gave advice to aspiring authors: "If you want to be a psychological novelist & write about human beings, the best thing you can do is to keep a pair of cats." Charles Dickens, one of the most popular writers of the 19th century, remarked: "What greater gift than the love of a cat?"

The therapeutic qualities of cats have been noted long before contemporary scholars did scholarly studies on this topic. An anonymous author expressed this beautifully: "A loving cat can mend a wounded heart." Here is some more anonymous wisdom with a solid background: "Cats are magical... the more you pet them the longer you both live." Stuart McMillan's words are more poetic, but get the message across:"A meow massages the heart." Here is an interesting suggestion for pharmaceutical companies from Alexis F. Hope: "If purring could be encapsulated, it'd be the most powerful anti-depressant on the pharmaceutical market." Do not believe? Listen to Jane Pauley "You can't look at a sleeping cat and be tense." Or listen to these words: "There are few things in life more heart-warming than to be welcomed by a cat" (Tay Homoff). I do not think there will be many cat-haters reading this book, but if you have even a slight suspicion that cats are selfish animals without much feelings and sympathy, listen to Florence Nightingale, celebrated

English founder of modern nursing, who definitely knew what sympathy was about: "Cats possessed more feeling and sympathy than people."

If you still do not believe in cats' magic therapeutic qualities, then listen to the dry language of scientific research. A recent scholarly study confirmed what cat lovers knew for ages, that cats are wonderful for human health (Qureshi et al., 2009). The study concludes in very simple, if a bit dry, medical jargon: "A decreased risk for death due to MI and all cardiovascular diseases (including stroke) was observed among persons with cats. Acquisition of cats as domestic pets may represent a novel strategy for reducing the risk of cardiovascular diseases in high-risk individuals" (Qureshi et al., 2009). In plain English, if you have any problems with your heart or blood pressure, just adopt a kitten.

Albert Schweitzer, influential doctor and humanitarian, made a very interesting proposition that contemporary science is gradually coming to acknowledge: "There are two means of refuge from the misery of life – music and cats." Establishing of the therapeutic power of music was one of the major developments during the last several decades, but the establishment of the full potential of "feline therapy" is still only in its infancy.

Cats are sexy – at least according to Spanish actor Antonio Banderas, who definitely knows what this means: "If you call a cat, he may not come. Which doesn't happen with dogs. They're different types of animals. Cats are very sexy I think too in the way they move." It is no surprise that beautiful women are often compared to cats. Sometimes women literally dream themselves to be cats. Here are the words of Bridget Bardot, one of the most influential actresses and beauty icons of the 20th century: "I really am a cat transformed into a woman... I purr. I scratch. And sometimes I bite."

Cats survive amazing things: Florida Senator Ken Myer's cat Andy fell from the 16th floor and survived. In 1999, a cat survived 80 days being trapped in a wrecked building after an earthquake in Taiwan. A kitten survived a transatlantic flight from China to USA with sub-zero temperatures, in a box of bicycle parts, for over two months until it was found in USA. Jules Verne, brilliant expert of science fiction, would not be surprised by these facts: "I believe cats to be spirits come to earth. A cat, I am sure, could walk on a cloud without coming through."

For Jean Cocteau, one of the most influential artists and thinkers from France, cats were a spiritual symbol of home: “I love cats because I enjoy my home; and little by little, they become its visible soul.” Freddie Mercury would call to London when on tour to talk to his cats, and he dedicated Queen’s last album, Innuendo, to his cats and to all cat lovers.

Here are a few traditional sayings about cats and cat lovers. The first is a Colonial American Proverb: “You will always be lucky if you know how to make friends with strange cats.” I like very much the Celtic saying which acknowledges the deep religious feelings that our ancestors most likely had for cats: “The Mind of God may be glimpsed in the eyes of a cat.”

Although the bible does not mention cats, and cats were persecuted for centuries, in contemporary popular image cats belong to the imagery of heaven. It is difficult to disagree with these words from an anonymous author: “Kittens are angels with whiskers.” Here is another anonymous saying: “No heaven will not ever Heaven be unless my cats are there to welcome me.” Robert A. Heinlein, one of the most influential science fiction writers, had this piece of advice for those who are concerned of their status after their death: “How we behave toward cats here below determines our status in heaven.” Abraham Lincoln, one of the most loved American Presidents, declared quite sternly: “I care not for a man's religion whose dog and cat are not the better for it.”

Possibly the most interesting part of these cat quotes are those which suggest that even a cat’s negative characteristics are seen in a positive light. Here is a good example from Missy Dizick: “Some people say that cats are sneaky, evil, and cruel. True, and they have many other fine qualities as well.” Or listen to Fernand Mery again: “Are cats lazy? Well, more power to them if they are. Which one of us has not entertained the dream of doing just as he likes, when and how he likes, and as much as he likes?” P.J. O'Rourke, American writer, solved the question of why cats became the favourite pet for Americans: “It is easy to understand why the cat has eclipsed the dog as modern America's favourite pet. People like pets to possess the same qualities they do. Cats are irresponsible and recognize no authority, yet are completely dependent on others for their material needs. Cats cannot be made to do anything useful. Cats are mean for the fun of it. In fact, cats possess so many of the

same qualities as some people that it is often hard to tell the people and the cats apart."

And one final quote - my favourite saying about cats belongs to Darwin. Pity, this is not the great Charles Darwin, my lifelong hero and role model, but his grandfather Erasmus Darwin, a brilliant free-thinker, inventor and encyclopaedist. Erasmus Darwin's saying does not constitute only a few beautiful words expressing the human awe for cats, but it also contains a great deal of truth about the development of higher moral and aesthetic qualities among humans during our evolution. So here is the quote: "To respect the cat is the beginning of the aesthetic sense." I love it.

Cats and dogs

Dogs have been for a long time praised as "man's best friend" – and there is indeed great wisdom in these words. It is impossible to find any other domesticated animal which has served humans with such loyalty and love as dogs have. Being pack animals by nature, dogs are easily incorporated into a human family and accept humans as leaders. Although we both belong to social species, we are still quite different. For example, are humans a "dog's best friend" as well? Humans sometimes have complex relationships with those who treat them with too much adulation – taking for granted some of the most precious things in life is undoubtedly in our nature. Of course, those humans who can appreciate a dog's love and loyalty can be best friends to their dogs as well, but even the most loving dog owners will have to accept the sad fact that they will never be able to love their dogs as much as their dogs love them.

We humans are lucky if love visits us in our lifetime, but dogs are born with love in their blood. Yes, in critical situations some humans are ready to sacrifice their lives for others, but dogs behave as if they are in a battle trance every time they are together with their pack or master, ready to sacrifice their interest and life for others.

My favourite dog quote comes from an unknown dog lover: “My goal in life is to be as good of a person my dog already thinks I am.” Cats are very different in this regard – in the best possible scenario a cat will treat you as a friend, but without the adulation that dogs grant us.

The profound difference between dogs and cats comes from the well-known fact that dogs are social pack animals, and that cats are mostly solitary animals. Cats are often unhappy if an owner brings in a house another cat; however dogs are usually happy with new dogs arriving as soon as they work out their ranking. As a matter of fact, a single dog as a sole owner of a backyard is usually an unhappy one, dreaming of some company to share the space with. A lonely cat on the premises, in contrast, is a happy one, providing that there are humans who can provide entertainment whenever the cat wants it.

A large portion of quotes about dogs stress the enormity of affection, love and adulation that dogs have for their human masters. Possibly Josh Billings expressed this affection the best: “A dog is the only thing on earth that loves you more than you love yourself.” Or listen to this: “The dog is the only animal that has seen his god” – there is no need for the anonymous author of this quote to specify who the God is in this context. Again, the same idea expressed with almost the same words, but this time by Holbrook Jackson, British journalist and publisher: “Man is a dog's idea of what God should be.” Aldous Huxley, whom readers may remember from his advice to authors to keep a pair of cats in order to better understand human psychology, commented on the character of dogs as well: “To his dog, every man is Napoleon; hence the constant popularity of dogs.” The great Konrad Lorenz had a deservedly high belief in dogs’ moral integrity: “There is no faith which has never yet been broken, except that of a truly faithful dog.” A dog’s legendary devotion and selflessness is often taken for granted. Here are the words of Ramona C. Albert: “When a dog wants to hang out the "Do Not Disturb" sign, as all of us do now and then, he is regarded as a traitor to his species.” Dogs are often doing dirty jobs for their masters – the unknown author of this quote put this into a humorous light: “I loathe people who keep dogs. They are cowards who haven't got the guts to bite people themselves.”

Dogs are sometimes portrayed adoring their masters even if there is probably not much to adore. Dave Barry, Pulitzer Prize winner American writer and

humourist, captured the dog character very well: “You can say any foolish thing to a dog, and the dog will give you a look that says, 'Wow, you're right! I never would've thought of that!” Or listen to Christopher Morley, American journalist and author: “No one appreciates the very special genius of your conversation as the dog does.” Robertson Davies, the Canadian writer who expressed his opinion on why cats and authors like each other, had these words to say about dogs: “The dog is a yes-animal, very popular with people who can't afford to keep a yes-man.”

Sometimes friendship with dogs can be viewed as a problem – here are words from Edward Abbey, American author and environmentalist: “When a man's best friend is his dog, that dog has a problem.

Dogs are also honoured in traditional sayings for their unrestricted love. Here is a Polish Proverb: “The greatest love is a mother's; then a dog's; then a sweetheart's.”

In the words of American conservationist Roger Caras we can feel the predominantly one-sided love between humans and dogs: “Dogs have given us their absolute all. We are the centre of their universe. We are the focus of their love and faith and trust. They serve us in return for scraps. It is without a doubt the best deal man has ever made.”

Well, if after reading these quotes about the religious adulation of dogs for their masters you are thinking dogs are non-discrete towards any human, you are mistaken. Listen to Will Rogers, American cowboy, columnist, and one of the most popular movie stars of the 1930th: “If you get to thinking you're a person of some influence, try ordering somebody else's dog around.” (The difference between dogs and cats is that cat owners cannot even order around their own cats.)

Exactly as is the case with cats, dogs are also believed by some to be superior in a certain sense to humans. Mark Twain, whose love for cats was shown in several of his quotes, had an extremely positive view of dogs as well: “The dog is a gentleman; I hope to go to his heaven, not man's.” Andy Rooney, American radio and TV personality, is probably correct in his assertion: “The average dog is a nicer person than the average person.” Some also think that dogs’ mastery of communicating their emotion is also superior to human eloquence: “A dog can express more with his tail in seconds than his owner can express with his tongue in hours” (an unknown author).

Very much like cats, dogs are excellent therapeutic aids. Here is a quote from Ben Williams, British character actor: “There is no psychiatrist in the world like a puppy licking your face.” Another quote highlighting the bond between humans and dogs: “If your dog is fat, you're not getting enough exercise” (an unknown author). According to Herman Melville, the author of “Moby-Dick” and one of the founders of American literature, dogs and horses can understand humans better than even the greatest thinkers: “No philosophers so thoroughly comprehend us as dogs and horses.”

In the beautiful book “Dogs make us human”, the authors Jeffrey Masson and Art Wolfe write: “As a former Freudian psychoanalyst, I have always claimed that just about any dog would make a better therapist than just about any human. You hope your therapist is not too interested in your status, your colour, your money, your social class, but you can be absolutely certain that your dog is not.” By the way, although the book is dedicated to dogs, there is couple of words about cats: “I adore cats.”

French writer Colette, famous among cat lovers for her sayings, was also a great fan of dogs: “Bulldogs are adorable, with faces like toads that have been sat on.” Another certified cat-lover, Winston Churchill, made an evolutionarily potent observation: “The nose of the bulldog has been slanted backwards so that he can breathe without letting go.”

There are plenty of differences between dogs and cats, and the attitude between dogs and cats is truly proverbial: “If you can look at a dog and not feel vicarious excitement and affection, you must be a cat” (an unknown author). Robert Brault found an interesting difference between cats and dogs: “A cat, after being scolded, goes about its business. A dog slinks off into a corner and pretends to be doing a serious self-reappraisal.” Desmond Morris, English zoologist, sociobiologist and author of popular science books, made another interesting suggestion that may need some additional research: “Artists like cats; soldiers like dogs”, but generalising all artists to be free spirits and all soldiers to be discipline enthusiast might prove incorrect – yes, as we will see later, most dictators hated cats, but there were also some artists among the cat-haters as well.

In regards to human-cat and human-dog relationships, there is not so much disagreement among different authors. Here are three more anonymous quotes:

"Dogs have masters: cats have staff," and "Dogs believe they are Human, Cats Know They are Gods!" or, "A dog says 'You pet me, you feed me, you shelter me, and you love me, you must be God.' A cat says,' You pet me, you feed me, you shelter me, and you love me, I must be God.'" Hal Holbrook, American actor, put down a gentle warning for men and dogs: "Women and cats will do as they please, and men and dogs should relax and get used to the idea." Derek Bruce: "In order to keep a true perspective of one's importance, everyone should have a dog that will worship him and a cat that will ignore him."

George Mikes, a British author and comedian of Hungarian origin who dedicated a book to his cat, is the author of the two following quotes: "You can keep a dog; but it is the cat who keeps people, because cats find humans useful domestic animals," and "A dog will flatter you but you have to flatter the cat." Vicki Brown, 20th century English singer, expressed dogs' overtly positive attitude and cats' more realistic view of humans: "Dogs believe every stranger is a friend they haven't met yet. Cats wait for a proper invitation."

Mark Twain, who loved both cats and dogs, still admitted a big difference between them: "If animals could speak, the dog would be a blundering outspoken fellow; but the cat would have the rare grace of never saying a word too much." Doug Larson, American editor and columnist, also emphasised a cat's laconic communication: "The cat could very well be man's best friend but would never stoop to admitting it."

Some express their preference of cats quite directly. For example, here is Jean Burden, American poet and author. "A dog, I have always said, is prose; a cat is a poem." Ann Taylor, English poet and literary critic of the 19th century, compared their eating habits: "Dogs eat. Cats dine."

But we must admit that not all sayings favour cats. For example, the dog was definitely the preferred animal for those who composed the Bible – as W. E. Farbstein asserts: "The dog is mentioned in the Bible eighteen times – the cat not even once." Another example of the higher appreciation of dogs is Alfred North Whitehead, who stressed cats' selfish character in comparison with dogs': "If a dog jumps into your lap, it is because he is fond of you; but if a cat does the same thing, it is because your lap is warmer." I am sure that some cat lovers, reading this quote,

would disagree. It seems to me that they both jump to your lap because they like you, but the only difference is that it is much more difficult to gain a cat's affection.

If we take humans, dogs and cats, and look at the attitudes in between the three of them, we can see an interesting "love triangle." Dogs love and deify humans. Humans also love dogs but their feelings towards cats are somehow stronger – but what about cats, who do they love? Well, they definitely love some of their human careers, although they are usually not as expressive in showing their feelings as dogs are.

It is ironic that cat lovers adore cats virtually the same way as dogs adore their human masters. There are differences though – as a rule, cat lovers adore all cats, but the same cannot be said about dogs. Dogs, human and cats form a loose triangle of love, where dogs love humans and humans love cats. Dogs and cats, as true rivals, generally dislike each other.

Why do Humans Love Cats?

Even if we can all agree that humans love both cats and dogs, there is a difference in the intensity of human affection towards these two animal families. The interesting question is why do humans love cats to such religious adulation? When we love dogs, there is at least some logical explanation for this – they are useful animals. Dogs have been serving humans for thousands of years, helping them protecting their territories and cattle, helping during the hunts, and as some scholars suggest, providing food in dire times. In regards to cats, the only directly positive thing is that cats can keep the rodent population down. Well, is that all? Is this the only reason why humans have cat-shaped gods? Even humans in the cities adore cats when they do not have any big agricultural resources to defend. To some readers this topic may not sound worthy of attention, but I believe this is a very serious scholarly question – as anything related to love is.

Although left-handed, the celebrated German doctor, humanitarian and musician, the winner of the Nobel Prize, Albert Schweitzer would often write prescriptions with his right hand because his beloved cat "Sizi" liked to sleep on his left arm and could not be disturbed. Sizi sat on his desk as he wrote, often falling asleep on his left arm, which of course the doctor dared not move. And for how long did this go on? 23 years! Sizi had been rescued by Dr. Schweitzer when she was a kitten after he heard her plaintive "meow" under the floor of a building that was under construction.

Or take the case of Albert Einstein – his cat had a tendency to be depressed on rainy days. And Einstein, a scholar who always had a few things on hand to do, would talk to his cat to alleviate his depression. Charles Dickens also had a cat who kept him company while he wrote, and in typical cat fashion this cat would extinguish his reading candles when it was time to get the writer's full attention when it was time for play.

So, why do we love them so much? Well, a cat lover might say they are truly amazing animals. Cats have eyes that are able to see in the near complete darkness, and at the same time are able to look directly at the Sun; Cats have the amazing ability to sit for hours ready for action, and when needed, act as swift as only cats can – as if they had taken only the optimal amount of time needed to prepare. What about their sense of balance? Hearing? Flexibility? And what about their cleanliness? These are all impressive qualities in an animal, yet this still does not explain why we love cats to the level of deifying them and creating religions with cats as the central gods. Herein also lies the question of why we love big cats as well, who do not help with rodents but instead occasionally kill and eat us, humans.

Humans can feel the presence of a certain mystery around cats. Short stories and novels about cats, films and internet discussions provide plenty of food for thought for those who believe in cats' mysterious powers. This could be a mysterious "sixth sense" which we will discuss later, or just the reasons for our excessive fascination with cats. Henry David Thoreau, a 19th century American author, philosopher and transcendentalist, expressed this in the following words: "What sort of philosophers are we who know absolutely nothing about the origin and destiny of cats?" Or listen to Hazel Nicholson from the Bristol Naturalists' Society: "A cat is a puzzle for which there is no solution." Sir Walter Scott was fascinated by a cat's

internal world: “Cats are a mysterious kind of folk. There is more passing in their minds than we are aware of.” Even when living comfortably in a house, a cat retains a mystery. Here are the words of Jean Burden, American poet and author, put very poetically: “Prowling his own quiet backyard or asleep by the fire, he is still only a whisker away from the wilds.”

Cats are essentially a small carbon copy of all these majestic big cats – leopards, jaguars, snow leopards, and above all – tigers and lions. They look the same, walk the same way, behave the same way, and although they do not give us the feel of overwhelming power that being close to big cats creates, small cats are often looked at with similar admiration of their beauty, agility, and power. There is definitely truth in the following popular quotes: “God made the cat so that man might have the pleasure of caressing the tiger.” This one was from Fernand Mery, already mentioned previously in this book and one of the most widely known cat lovers. The next one has no known author: “A cat is a tiger that is fed by hand.” And by the way, Einstein named his cat “Tiger.”

Finally, I want to mention one of the most fascinating book reviews, found in countless Amazon stores. In this review the author candidly confesses he has not read the book, but still readily gives five stars to the book mostly for the love of the tigers: “It looks to be a fabulous book & as I'm nutty about tigers, I'm sure I'll love it. However, a family member has hidden the book as it's for me for Christmas, so I can't really say much about it, but I have typed in 5 stars as I'm sure it will be, as I have read Stephen Mills articles in the BBC Wildlife magazine & they are great.” It seems a new generation of tiger and cat lovers is coming along.

Cats across the Ages

The adulation that cats are subject to in the contemporary world is not a new phenomenon brought by a human desire to get close to our natural roots. Cats have been a part of traditional tales, beliefs and superstitions across the ages and across the cultures.

Very informative blog, “Cats in the Ancient World”, was published by Joshua J. Mark on 17 November 2012 (under the license of Creative Commons) and I suggest all cat lovers to have a look at it.

It was believed for a long time that cats were domesticated by Egyptians some 4-5 thousand years ago – today the date has been shifted back in history. It is now believed that cats had been domesticated approximately 12,000 BCE, at about the same time as dogs and other domestic animals, in Mesopotamia. A special project headed by Dr. Andrew Kitchener, a Zoologist at the National Museums of Scotland, came to the following conclusion in 2007: "This shows that the origin of domestic cats was not ancient Egypt – which is the prevailing view – but Mesopotamia and that it occurred much earlier than was thought.” The discovery of a cat skeleton in Cyprus in a grave dating to 9,500 BCE, made by archaeologist Alain le Brun, was also important in revealing this, as Cyprus had no indigenous cat population and it is unlikely that settlers would have brought a wild cat, by boat, to the island. In Ancient Babylon, a cat was believed to be a host for certain holy human souls after death. The soul stayed in the cat as long as the cat lived and only in this way could the soul gain entry to Paradise – a very nice prospect indeed for every cat lover!

Although the Bible does not mention any cats at all (we will discuss the possible reasons for this neglect later), according to Hebrew folklore the Biblical Noah needed a cat to keep the rat population in his ark low. Apparently, when Noah asked the Lord for his help in controlling the rats, the Lord caused the lion to sneeze and out came a cat. According to another early Christian folktale, a little tabby kitten was the only one who could put baby Jesus to sleep – she curled up beside him in the manger, purring a lullaby, and the future savior quickly fell asleep. All tabby cats have an "M" in their fur pattern on their foreheads, and according to Christian folk-lore this stands for “Mary” as a testament to its kindness. A Muslim tale has a different explanation for the same “M” sign. According to the traditional tale, it came from the Prophet Muhammad and his cat Muezza. When Muhammad heard a call to go for a day prayer, he found that his little cat had fallen asleep upon the sleeve of his robe. Needing to get to the afternoon prayer, Muhammad cut off the sleeve so as not to disturb his cat’s slumber (sounds familiar), winning the heart of many cat lovers. According to Moslem interpretation, the letter “M” on the forehead of tabby cats (the oldest of the domestic cats) is for Mohammed. The Japanese have a tale about

Maneki-neko, a cat with one paw raised, a potent symbol of good luck. Legend says that such a cat brought great fortune to the poor temple of Gotoko-ji in Tokyo. Italian genius Petrarch, the father of humanism who conceived the idea of the Dark Ages in the 14th century, loved his cat so much that they were buried together. Despite the medieval distrust and fear of cats, Cardinal Richelieu (16-17th centuries) reserved one of his rooms for his cats, where overseers fed them chicken pates twice a day – he also built a cattery at Versailles for his wards.

The fact that the cats are seen as more than just a method of pest control is substantiated by the reverence accorded to felines in the literature of India. The Indian folk tale in the *Panchatantra* from the 5th century BCE became the basis for the famous story of Puss in Boots more than two thousand years later (by Charles Perrault). The goddess, Sastht had the same role as the Egyptian Bastet (cat goddess) and was as greatly revered.

Persians claim that the first Persian cat came to be created by a magician as a token of gratitude to Rustam, who saved him from a band of thieves. There is an ancient Chinese myth about the beginning of the world – the gods appointed cats to oversee the running of their new creation, and in order for communication to be clear granted cats the power of speech. Cats, being the free spirits that they were, spent most of the time in playing or sleeping. Cats explained to the God that they had no interest in running the world and subsequently nominated human beings for that responsibility. The power of speech was then taken from the cats and given to humans but, as humans seemed incapable of understanding the words of the gods, cats remained entrusted with the important task of keeping time and therefore maintaining order.

It was thought that one could tell the time of day by looking into a cat's eyes, and this belief is still maintained in China. The Romans regarded the cat as a symbol of independence and not as a creature of utility. Cats were kept as pets by both Greeks and Romans and were regarded highly.

The Ancient Greeks believed that the Sun and Moon created all animals - whereby the Sun created the lion and the Moon that created the cat. The Roman Moon-Goddess Diana became linked with the cat and the number nine and was believed to have endowed the cat with nine lives. John Lennon, with his mystical love of the number nine and his love of cats, would certainly agree that cats had

inherited something from the goddess – it is sad John himself did not have nine lives…

Sir Isaac Newton loved cats and many of us use one of his most popular inventions – the so-called "cat-flap", which he invented for his cats to get in and out of his laboratory on their own. French poet Charles Baudelaire apparently loved cats so much that when he was stroking and kissing them he would not even hear his friends talking to him. Celebrated American aviator Charles Lindbergh loved cats and often took them in the air with him. Although he did not take his favourite black kitten Patsy on his historical trance-Atlantic flight from New York to Paris, there is a touching postal stamp showing Patsy watching the take-off of his master. Cat lovers can understand Charles' explanation why he did not take the kitten with him on the Transatlantic flight: "It's too dangerous a journey to risk the cat's life."

Even in Medieval France, where cats were linked with the Christian Devil in the form of Lucifer, people believed in a mystical cat called *matagot*, or magician cat, that could bring great wealth to its master if treated with the utmost respect. Another such cat was the *chat d'argent*, a silver or money cat, thought to be able to bring wealth to nine masters. In Roman tradition the cat was linked to Venus, the goddess of love – with its long association with fertility, sex and the femininity.

Ireland has many legends of mystical cats – Cat-Kings, who symbolized the underworld. In Norse mythology, the cat was closely linked to Freya, goddess of fertility, creation and death – her followers were mainly female fortune-tellers or mystics and they used cats in their rituals. Freya also owned a chariot which was drawn by two huge cats. The Norwegian Forest Cat, a large natural breed of the area, was said to be highly regarded by the Vikings and to be carried into battle upon the shoulders of their masters where they assisted by clawing at the faces of their enemies. A Finnish myth describes the cat as a guide through Hell to Paradise for the souls of men.

Black cats have a special place in human cultures. In Europe, early America and China the black cat was feared as an omen of bad luck. Britain was different – a black cat was believed to bring good luck, for example, assisting in finding buried treasure. According to Buddhist superstitions cats could bring silver, gold, and protect a house from fire. Cats with extra claws on their paws were also believed to bring luck. Young girls in France were careful not to step on a cat's tail, as that would mean they

would marry that year, but hearing cat sounds on the eve of her wedding or on the wedding day was a good omen. In some cultures cats were believed to grant family wishes for children, and in some cultures cats were consulted about matrimonial issues. In Russia, when a family is moving to a new place, the cat must be the first one to enter the new home – this practice continues to this day.

But of course, we also need to discuss the absolutely unique situation with cats in Ancient Egypt, where the reverence for cats reached its highest level ever seen in recorded human history.

Egypt, or the Cat's "Golden Age"

We live in an age when animal rights are legally guarded. For the mistreatment of the animals people might pay hefty fines or even go to jail. Cats enjoy such protection no less than other animals. Well, it must be the golden age for animals then, right? Actually, it is not. In regards to cats, they definitely had their golden age long ago, during one of the first civilizations of the ancient world. Egyptians treated their cats simply as Gods.

If you think this is a poetic exaggeration of our past, think of this fact: in Ancient Egypt, every case of a cat dying was to be investigated by a priest – and if the cat was found to have died because of human violence or mistreatment, the culprit (yes, human culprit) was put to death. Even today, we cannot say that cats are protected as much as they were during thousands of years in the old Egyptian civilization. Very much like Pharaohs, cats were mummified and kept in tombs. Hundreds of thousands of mummified cats have been found all over Egypt, and from Beni Hasan, an ancient Egyptian cemetery, 19 tons of mummified cats were taken to England to be used as fertilizer. It seems in Egypt more cats were mummified than people.

Cats were believed to be of protective value against the bites of poisonous snakes. The cat goddess Mafdet was protecting the Pharaoh against serpents in the royal palace. In the Egyptian "Book of the Dead," the God Ra (known as Mau) is

depicted as a cat slaying a huge python, the representative of darkness. In this way, the cat and serpent represented the struggle between light and darkness, with the Sun-God Ra being victorious in the slaying of the serpent.

Sacred cats were kept in a sanctuary in ancient Egypt. They were carefully guarded by priests day and night. The priests were interpreting the slightest of any of the cat's movements like a twitch of a whisker, a yawn or a stretch in their divination and predictions for the future. Cats had a very prominent place in Egyptian mythology – a cat was the guardian of the Tree of Life, known as Persea Tree. The Egyptian Sun-God Ra proclaimed his direct connections to a cat: "I am the Great Cat which fought hard by the Persea tree." Scholars generally agree that "Persea tree" is the tree known by Christians as the Tree of Life. The depiction of Satan in the Bible as a snake at the tree suggests that the cat may have been guarding the tree from the serpent, and we know that cats were defenders of humans from serpents in Egyptian mythology, and probably to some extent in life as well. In an amazing twist of luck though, the same cat who was fighting against Satan later became the representative of Satan – we will discuss the reasons of this transformation later. In pre-Christian times the cat was believed to have knowledge of both good and evil without representing either. Therefore, without taking sides the cat represented balance and wisdom.

It was strictly prohibited to extradite cats out from Egypt, and this prohibition had religious and not economic basis. There were also governmental officers responsible for finding and returning cats which had been smuggled out. According to Herodotus, Egyptians cared so much for their cats that they placed their safety above human life and property. When a house caught fire, the Egyptians would concern themselves more with rescuing the cats than with anything else, often running back into a burning building or forming a perimetre around the flames to keep rescued cats at a safe distance. In the case of cat death (which was always investigated by a priest), "all the inhabitants of a house would shave their eyebrows [as a sign of deep mourning]. Dead cats were taken to Bubastis where they were embalmed and buried in sacred receptacles" (Nardo, 2008:117).

Possibly the greatest proof of Egyptian devotion to the cat, however, comes from the historical Battle of Pelusium (525 BCE) against the Persians. According to the Macedonian historian Polyaenus, knowing of the Egyptian's love for cats

Cambyses had his men take cats with them into battle as 'feline shields', and Persian soldiers also painted images of cats on their shields. The Egyptians did not fight in fear of harming the cats and, demoralized at seeing the image of Bastet on the enemy's shields, surrendered the city. It was after the success of this battle that the Persians established a Persian dynasty in Egypt.

There are often comparisons made between the cat reverence in ancient Egypt and the sacred reverence of cows in India. This comparison is indeed not far from reality, although there still seem to be certain important differences. Basically, cows have been revered in India as Mothers, while cats were revered in Egypt as Gods.

Bast (sometimes called Bastet) was the Egyptian cat-headed goddess. She had a special city, Bubastis, which she ruled over. During 10^{th}-6^{th} centuries BC Bubastis was a resident of the Egyptian Pharaohs. Bubastis is usually identified alongside the Biblical city "Phibeseth." The City of Bubastis housed Bastet statutes and a shrine. An annual festival in the city was described by Herodotus as the most joyous festival out of all Egyptian events. During this festival a large image of the cat (or the lioness) Bastet was transported on a barge towards the city, accompanied by dancing, singing and drinking, and ended in sacrifices and a ritual feast.

The beginnings of the religious importance of cats and lions in Ancient Egypt are lost in the mist of time. The origins and the age of the mysterious Sphinx statue, with the body of a lion, and the head of a human, are still uncertain. We should not be surprised if some symbolic connections are found between the sphinx and the much older European figures of humans with lion-heads.

Even the word "cat" comes from the Egyptians. It came from the North African word for the cat, "quattah." As a legacy to Egypt's reverence for cats, virtually every other European nation employs variations on this word: from English "cat" and French "chat" to German "katze," Russian "kot", and Georgian "kata." The word `puss' or `pussy' also has Egyptian origin. It comes from the word `Pasht', an often used name for the Egyptian cat-goddess Bastet.

If you have an image of Egypt as a country where cats essentially ruled over humans, you are actually not too far from the reality. Many cat lovers may understand the Egyptian reverence and love towards cats very well, and it could be said that domestic cats are still the rulers of many modern households. Of course, we do not watch their smallest movements to interpret our future and we do not mummify them

(well, most of the time), but the mysterious fascination and reverence towards cats obviously still remains within us.

From God to Satan: Medieval Europe, or the Cat's Dark Age

After the Egyptian religious reverence towards big and small cats, times started to change. Greeks and Romans had a very favorable attitude towards cats, if not a religious veneration. There were some superstitions against cats in Greece, but without any actual serious repercussions for cats. When Christianity came to the Middle East and adjacent territories, troubles for cats started quite swiftly. Symbolically, a cat is not mentioned at all in the text of the Bible. The situation worsened from the 12th century onwards, and particularly after Pope Gregory IX in the papal bull (1232-1234) *Vox in Rama* condemned people worshipping Satan in the form of black cats. Donald Engels claims that *Vox in Rama* was "a death warrant for the [cat], which would be continued to be slaughtered without mercy until the early nineteenth century. It is said that very few all-black cats survive in Western Europe as a result" (Engels, 2001).

During the rule of Pope Gregory IX (1227-1241) Christians began persecuting cats in great numbers. Cats were executed in the hundreds of thousands and possibly millions. The Medieval Christian Church gave us the most chilling examples of the morbid hatred of cats. They were hanged, burned alive, and thrown out from very high buildings. Furthermore, it was not only cats that were persecuted – cat lovers were also viewed as carriers of dark satanic powers. One infamous medieval witch-hunt tallied conservatively at an estimate of 40 or 60 thousand lives (human lives) – the cat tally was at least ten times higher. One of the most obvious pieces of evidence with which a medieval Christian court could sentence a woman for being a witch and an agent for Satan was her love and compassion for cats. Caring for a cat in those dark times was virtually as dangerous as caring for a Jew in a Nazi-occupied territory.

Gregory IX's attack on cats was not a single occurrence in the history of the Catholic Church. Pope Innocent VII (1336-1415) and Pope Innocent VIII (1432-1492) continued the tradition of cat torture and killing. Even in the 21th century, in some cultures there are still vivid remainders of these medieval prejudices against black cats.

There are ongoing debates whether the slaughter of cats contributed to the devastating pandemic of Bubonic Plague that started in 1348 and killed between 75 and 200 million people. Europe, where the slaughter of cats brought their population almost to extinction, was hit the hardest by the plague.

According to Desmond Morris, "Because the cat was seen as evil, all kinds of frightening powers were attributed to it by the writers of the day. Its teeth were said to be venomous, its flesh poisonous, its hair lethal (causing suffocation if a few were accidentally swallowed), and its breath infectious, destroying human lungs and causing consumption" (Morris, 1987:158).

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Why were cats, treated as a God in Ancient Egypt and revered among Romans and Greeks, suddenly viewed in such a negative light? It seems to me that **the reason of the morbid hatred of cats was exactly this ancient reverence towards big cats, and by default small cats as well**. The new religious system was trying to destroy one of the strongest symbols of the ancient religious system. The true motive of the new Christian religion was to replace, banish, eradicate, and destroy the strongest existing subject of love and religious adulation, together with its staunchest followers. As many cat lovers were women, particularly single women, both cats and single women became the main target of religious hatred, known to us as a "witch-hunt."

The cat's dark ages continued with some short reliefs up until the 19th century. Even brilliant artists and serious scholars were affected by this hatred. For example, William Shakespeare, one of the greatest humanists, mentioned cats in his writings many times, always in a negative light, often calling them "vile." During Shakespeare's lifetime (1564–1616) witch-hunts were rampant in England. People linked cats, particularly black cats, to witches. Cats were destroyed, cat lovers were

viewed with suspicion and if they were lonely women, hanged. For a popular writer it was virtually impossible to neglect the very strict penalties towards cat lovers. Another example of cat hatred was Edward Topsell, author of the monumental books on animals, *The History of Four-footed Beasts* (1607), *The History of Serpents* (1608), and the later reprinted together as *The History of Four-Footed Beasts and Serpents* in 1658, he wrote: "the familiars of Witches do most ordinarily appear in the shape of Cats, which is an argument that this beast is dangerous to soul and body" (cited from Morris, 1987:158).

The infamous witch-hunts of the late middle-ages involving cats and cat-lovers as one of the primary targets are one of the darkest pages in the history of our interactions with animals. I wonder if one day I will be able to watch a drama-suspense-horror movie about the life of cats and single women who cared for them despite the mortal danger during the dark 14th-18th centuries.

Pope John Paul II, one of the greatest humanitarians, made over one hundred apologies for the wrongdoings of the Catholic Church over many centuries. The apology to cats, our most loved pets, is still pending. To my joy I found that the medieval persecution of cats by the church was probably hidden deep in the heart of the humanitarian Pope. According to the Polish emigrant, Antony Gronowicz, who allegedly interviewed the Pope twice privately, the Pope had a very vivid dream about a mother cat followed by six kittens as they were trying to find shelter during a snowy and freezing New York winter night.

I want the readers to know that the authenticity of the whole book where this story comes from was officially debated by Vatican, and that the book was withdrawn by the publisher. But even with this suspicion in our minds, the story seems to me very symbolic, as a sign of changing attitudes towards cats in the Vatican. This story shows the deep embarrassment of humanistic Christians for the cruelty that cats suffered from the medieval Christian Church. Here is the whole story from the book:

"In the midst of this discussion of his trip to Canada (in 1969), the Pope abruptly changed the subject and said: "The night before my departure from Canada to New York, which I had never seen, I had a strange dream." But his dream was not of beautiful forests, warm with the summer sun. It was of a crowded city, frigid with

the cold of a northern winter. And although he had never been there, his dream captured the way Manhattan looks and feels, after a major snow storm.

"It was a terribly severe winter in New York, the city was completely covered with snow. Inhabitants were well-off and warmly dressed, and walking slowly along roads because cars, due to mountains of snow, could not be operated. I was happy that I could walk on top of the snow on avenues of white.

"All my physical effort was spent on walking. To this day, pictures of huge apartment houses on both sides of the avenue are instilled in my mind, and the doormen quickly closing and opening entrance doors as though trying to prevent humanity and warmth from escaping.

"On top of the snow, I noticed a brown cat emerge from a side street and walk on the snow. I looked closer, and to my surprise, saw that this big cat was being followed by six small brown-and-white kittens, all of them following the big brown cat in a perfect line. The mother cat looked back from time to time to see if her babies were there, but her main concern was to reach the entrance door. I presumed she was trying to find warmth for herself and her children, but as soon as she reached the door, a man in a well-pressed uniform, jumped at her with a broom and chased them away. I followed this procession and prepared to deliver a speech to the doorman. I opened my mouth and tried to complain, 'Where is your proverbial American generosity? Where is your American good heart and fair play? Let them in. Let them in!!

"I tried to speak, but the words would not come out. Maybe I was afraid of the doorman with the broom. I started searching my cassock pockets for a piece of bread, found some crumbs and put them on my palms, calling: 'Kitty, kitty, kitty.' But the words would not come from my supposedly intelligent mouth. Instead, the wind blew the crumbs from my palm and I said, 'what can I do? I can't speak to the cats. I can't speak to the doorman. But there are many hungry birds. They might pick up the crumbs.'

"Again, I walked after the cats, now with a pain in my chest, feeling tremendous cold. On the left I saw a church building and thought, 'There we will find help.' I heard singing and again, the idea occurred to me that it must be a Catholic church. The music grew louder, as though trying to convince God that they were praying to Him.

“The mother cat jumped in front of me and climbed the stairs, followed by her kittens. I raised my head and saw a tall Jesuit priest chasing the cats off the steps. But as I was about to shout at the Jesuit 'I am a cardinal!' and give an order to accept the cats, the mother cat and her offspring ran behind the church, because from there came the appetizing aroma of food. Probably there was a kitchen there. But a second Jesuit appeared at the kitchen door and scared the cats away. They returned to the avenue and started walking north.”

"They walked on the same side of the avenue as the Jesuit church and I followed. Then they reached an imposing red brick church. An Anglican bishop appeared and said to the cats, 'My dear animal children, please go immediately to the animal shelter. There is food for you there. We Anglican clergy donate lots of money to the animal shelter, every year, at Christmas time.'

"The mother cat and her kittens didn't even meow. They knew the authoritative voice of the Anglican bishop. They walked uptown and gradually the luxurious buildings disappeared, together with the doormen, and we saw drab dilapidated apartments.”

"As they walked and the buildings grew shabbier and dirty, a door was opened, not by a doorman but by an old wrinkled woman in a cotton dress. [She saw the cats] and shouted 'Oh, little mother,' and when she opened her mouth I saw she had few teeth. She gently ushered the mother cat and kittens inside, who jumped happily about because the warmth of the house embraced them."

According to J.R. Hyland, the author of the article on the website, “the narrative ended as the cats found a safe haven with the woman who had little enough, herself. When the Pope concluded his dream the author to whom he related it did not make

any comment on what had been said. But he did write that "I had never seen such a sad expression on the face of this man." Considering that this was the same man who had related the horrors of his young manhood, under Nazi occupation, the author's remark shows the deep impact this dream had on the Pope."

The next Pope that followed John Paul II in 2003, Benedict XVI, apparently has always been known for his love of cats. He spends time talking to cats and according to many witnesses the cats, who do not care for his high status, come running towards him. Cat lovers know very well that cats can sense the people who truly love them. During the Pope's visit to Australia, knowing about his love of cats the Pope was given a grey cat called Bella. Pope Benedict XVI is probably the first Pope who has a biography written from the point of view of a cat (Perego, 2008). Although the world has seen two recent popes who both loved cats, the apology to our beloved pets is still pending.

Cats' fortunes started to change from the 19th century onwards. Stories of cat worship in Egypt, published in archaeological journals of the time, apparently had a big impression on Queen Victoria, who ruled from 1837 to 1901. The Queen became interested in cats and adopted two Blue Persian cats. These cats were treated as members of her court – the story of the Queen's cats became widespread and people became interested in having cats of their own. Love towards cats had grown in the USA as well. The most popular magazine in America at the time, *Godey's Lady's Book* published an article in 1860 suggesting Americans should embrace the "love and virtue" of a cat. The first cat show was held in Crystal Palace in London in 1871, and appreciation of cats was elevated to such a level that, for the first time, cats were given "specific standards and classes" which are still used to felines today (Morris, 2008:148). After two decades of success in England a cat show was held in America in 1895 at a place no less famous than Madison Square Garden in Manhattan. Cat popularity in the United States steadily grew, recently reaching a point at which cats displaced dogs as the country's favourite household pet.

Cats are said to have nine lives. Not many animals have suffered as gravely at the mercy of humans for centuries as cats have – and yet they still they managed to recover. They are with us, bathing in our love and adulation. Our lasting love towards cats proves that the first love never really goes away.

Do We Live in an Era of Cat-mania?

As William Shakespeare famously claimed, love is blind. Well, everything must have its reason, even love, and particularly if it is so strong as to make us blind. When love goes for millennia, and reaches the forms of religious adulation, there must be some very serious reasons for this. So what can be the reason of our fascination with cats – both small and big? Is it their beauty? The notion of beauty is very subjective, so theoretically cats are no more beautiful than, say, bats or hyenas.

I recently found an interesting article: "The Million Dollar Question: Why Does the Web Love Cats?" (published on Oct 22, 2010). Mind this is not a discussion about why we love cats, but on the reason of cats' immense popularity on the internet, both in videos and the millions of pictures and "memes" catalogued on countless websites. With a healthy dose of humor, as is so common for many popular websites, the author of the article, Amy-Mae Elliott, talks to internet experts, cat-themed content creators, viral content experts and other commentators from within the industry in order to try and find and answer this interesting phenomenon. The consensus is that while dogs have had a few notable successes online, apparently they are nowhere near to matching their feline rivals for popularity. Several possible reasons were discussed in this entertaining article – I will list a few below, sometimes with my own comments included:

1. Cats are popular because they are simply cute. Elspeth Rountree, the co-founder of Know Your Meme, suggests that we've always adored the feline family, it's just that the Internet provides a modern, one-click way to share such content. Also, images and videos of cute cats were popular before the advent of the Internet. A comment from the author of this book: Very true. And do not forget that images of big cats are the very first images that ancient humans created, more than 30,000 years ago.

2. Cats are not only cute, but there is something else about them. Cory Alder, the creator of the popular iPhone app "CatPaint," does not agree with the "cute" explanation: "I can say it's not just because they're cute. That would be a huge over-simplification… Cats are awesome and enigmatic. They even have a hint of danger about them." Comment from the author of this book: Very true. If cats were merely cute, we would not be worshipping big cats as gods in our prehistory.

3. The next suggestion is that the web loves cats because they're the perfect canvas for human projection. "Cats have very expressive facial and body expressions, so they are a perfect canvas for human emotion, which makes them awesome for captioning and anthropomorphization," says South Korean internet entrepreneur Ben Huh, CEO of the Cheezburger Network. Sam Ford, the Director of Digital Strategy at Peppercomm and co-author of Spreadable Media, suggests that dogs are just too easy to read: "Throughout the history of civilization, humans have had a deep fascination with cats. While dogs' forms of communication — and understanding of language — are more closely aligned with humans, cats are particularly fascinating because they are not necessarily as easy to read." A comment from the author of this book: Very true. I think if we ask cats they also may say the same thing – which is that humans are not easy to read – this is so because we are so similar to cats in this feature. For more on this subject see the discussion a bit later in this book entitled "Human Intelligence vs. Cat's Sixth Sense."

4. Another idea is that showing cats in humorous situations is funnier because of their self-respect and pomp. These words of Brad O'Farrell, creator of the *Play Him Off, Keyboard Cat* video, most likely will anger cat lovers. "Most of us who have dealt with cats know that cats are jerks, and while outright abuse is never popular, I think a lot of people just like to see cats get their comeuppance." Tom Cox, author of the book "Under the Paw – Confessions of a Cat Man" expressed a similar idea with a bit more respect: "Cats have a combination of incredible dignity, but also comedy about them. Cats can be so ridiculously pleased with themselves — and you don't get that with dogs. Because they are so proud and so aware of that dignity, when it is punctured it's the funniest thing in the world." Comment: Possibly true as well. A cat's dignity is an important part of its personality, and although we do not usually make fun of big cats, smaller cats can be made funny (provided the joke does not really hurt their feelings!).

5. There is also the suggestion that cats are popular on the internet as computer experts like cats, primarily because of their lifestyle. “Cats require relatively little maintenance (no baths, no walks) and are basically nocturnal animals, so they're a perfect match for the Internet geek/coder/hacker lifestyle.” Comment: this is also possibly a contributing factor, but if we recall here the love of cats that authors, poets and philosophers had, I would suggest instead that cats are loved by all people who are engaged in intellectual work, whether it be philosophizing many years ago or working with modern technology, as a cat’s more complex inner world provides bigger possibilities for fascination and possibly imagination.

6. There is also even the tongue-in-cheek suggestion that all this is a part of cats taking over human civilization. Jack Schofield shared his favourite quote on the topic of a cat-dominated Internet. "David Burge (the owner of a popular Iowahawk blog) once said that “When John Atanasoff and Clifford Berry developed the first digital computing machine at Iowa State University in 1937, little did they know that their invention would become an integral part of a sophisticated worldwide cat picture distribution system.” This is funny because it's true.” Matt Smith added a historical dimension to the joke (hopefully): “Cats have been domesticating and harvesting humans for at least two millennia, albeit slowly, generation by generation. With the Internet, they are moving much faster, and in only two or three more generations, we will be completely incapable of sustaining a line of thought for more than half a second, and therefore effectively be zombies in the service of our feline masters who will use lame Photoshoppers to communicate with us.” Author’s comment: Power to cats! Cats have been as gods for millions of years – they shaped us into what we are today. With the appearance of big state religions we humans lost the sight of nature and instead made ourselves the center of the whole universe. Our contemporary liberal world frees our thoughts from humanocentrist dogmas and slowly brings us back to our natural states of mind. The comeback of fascination with cats is welcome and natural. It heralds the acquisition of the wider view of the world, a world where humans are a part of the natural world and not above it. Cats, particularly big cats, are the symbol of nature for us – they teach us humility.

In the conclusion of the article, in the words of Burnell Yow (the internet sensation “Nora The Piano cat’s” personal assistant): “Cats seem totally comfortable

being exactly what they are, and they are totally alive to the moment, which is something we, as humans, have lost sight of, though we are trying to get back to that enlightened state… Why do you think so many people meditate and practice yoga? We are seeking to be more cat-like, and perhaps our embracing of cats is simply the embracing of what we know to be essential in ourselves." A comment from the author: totally agree – cats bring us back to our natural selves. They free us, in a Freudian sense, from many unwanted constrains of civilization. They remind us what we are, and how much we can enjoy our lives by feeling more integrated with the rest of the natural world.

William Calvin proposed a well-received idea among scholars in his essay "The Lovable Cat: Mimicry Strikes Again" from his book "Throwing Madonna." According to Calvin, our fascination with cats comes from the resemblance between cats and small babies. According to this point of view, with their large eyes cats look like human babies, and as humans love babies for obvious reasons, they also find cat faces equally attractive. Well, we can have arguments as to whether the resemblance is really there, as cat's fur covered faces, much larger and mobile ears and whiskers hardly resemble the features of a human baby. If resemblance was the key to our affection, it would be logical that we loved baby chimpanzees and bonobos more than kittens, as there are so many direct parallels in looks and behaviour between our closest genetic relatives. To me this 'aesthetic' attraction does not seem to be the case. And of course, it would be even more difficult to explain our love and fascination towards such cats as tigers and lions by their supposed resemblance to human babies. I believe many would agree that these majestic cats are amazingly beautiful regardless.

As a reader of this book would remember, I believe that human ancestors had a long and close relationship with the cat family during the whole time of our co-evolution since we came down from the trees. I also believe that our adulation with small cats as pets has a lot to do with our evolutionary past, as small cats do look very much like big cats – we also need to remember that this history of our interaction with small cats is a relatively recent phenomenon. The initial belief that Egypt was the place where cats were domesticated does not look convincing after much earlier traces of cat domestication have since been found on the island Cyprus. Therefore, now the official timelines for the domestication of the cat stretches back about 11,000

years. 11,000 years might sound impressive, but this ancient date is dwarfed when compared to the 6 million years that we spent interacting with big cats. Our dependence and close interactions with the ancestors of big cats lasted for millions of years – for all these years we looked up to them and deified them. We formed our morphology and behaviour firstly in order to become exempt from their diet, and then later to challenge them at their kills and steal from their diet. Even when we became their direct rivals at a kill, we still largely depended on their skills as prime predators. This balance was forever changed, but only when humans started big game hunting and farming, and this happened probably as recently as 10-12 thousand years ago.

The next major religious subject in human history, the Sun, has been deified possibly as long as since the beginning of agriculture, some 10 thousand years ago. Very interestingly, two most important gods in human prehistory – the animal and astral gods, lion and Sun – were found to have connections with the natural world and with each other. Humans cannot look at a midday Sun directly, but lions (and all other cats) can do this without any problem. This connection between cats and the Sun was believed to be the proof of their divine connection. The god Ra, represented as the Sun, was also known as a Lioness. The closeness of the images of a male lion with his majestic mane around his head, and that of the Sun, surrounded by the brilliant life-giving rays, was also noticed. Even the lion and Sun colours are generally matching each other. The formidable 10-thousand-year history of human farming is dwarfed next to about 6 million years of interactions with big cats. The history of major contemporary world religions does not go further than 2-3 thousand years back in history and in comparison seems like the blink of an eye.

If we look at the 6 million years of human evolutionary history since our ancestors came down from the trees for good, and compress those 6 million years into one year, we will have the following picture:

About the first six months we find our distant ancestors in a desperate bid to create a decent defence strategy against big cats, still living in the open woodlands of Africa. This was a time when the basics of hominid morphology and behaviour were formed, from bipedalism, long head hair, long legs, obtaining the sense of

rhythm, the state of the battle trance and the elements of primary religious practices, based on collective consciousness;

During the remaining six months our ancestors start challenging the ancestors of the big cats; Their intimidation strategy allows them to confront and chase away even the strongest of predators. Big cat and human ancestors come to the mutual conclusion that it is better to avoid physical clashes. Hominids in turn developed a deep reverence towards big cat ancestors, and big cats developed a natural avoidance of biped hominids. This was also the time when big cat ancestors and early humans started travelling across the continents; It was at the final stages of this period that the first surviving artefact of arts, first paintings and sculptures, tellingly connected to the images of lions, appeared about 32,000 years ago – on our calendar this 32,000 years ago would already be December 29th.

Only on the last day of our compressed year-long timeline, on December 31st, a few hours into the morning we would see the introduction of farming and the appearance of the Sun as a new central deity in some advanced groups of people as the first civilizations (Mesopotamia, Egypt, China). In regards to the appearance of Christianity, Islam, Buddhism and other big religions, they would make their appearance only during the evening hours on December 31st, only a few hours before the end of the year.

Of course, with our ability of logical thinking we can understand that the Sun was the principal factor in the emergence and sustenance of life on our planet. Humans, lions and all other forms of life depend on the Sun. It is one thing to understand something by logical thinking, but another thing to interpret the message within your emotional experience of your own past. Very much like children's character and social connections are based on their early childhood memories, the emotional memory of our species is firmly connected to our evolutionary past. We spent most of our evolutionary history measuring up against the ancestors of the big cats, and it is natural that big cats have such a firm place in the human collective psyche. We look at them with awe and envy, we are mesmerized by their beauty and power. We love them and at the same time we are afraid of them – they made us who we are. Yes, in the evolutionary arms race we eventually outstripped all other animal species, including big cats. Today we can kill them, we can use their body parts for

medicines, we can put them into zoos and watch them in the circus, but we still retain our immense respect and deep seated love for these majestic animals.

Terry Pratchett, English best-selling author of the 1990s, produced one of the best-known cat quotes "In ancient times cats were worshipped as gods; they have not forgotten this." I like that Terry does not specify to which "Ancient times" he is referring to. Many would understand this as a reference to Egypt, and possibly Terry himself had Egypt in his mind as well. Well, I hope the readers of this book already know my point of view that our love and deifying of cats did not start in Ancient Egypt. Our reverence and deep religious respect towards cats started not millennia, but millions of years before the Egyptian civilization even started. The Egyptian civilization was possibly the last epoch of ancient religious reverence of cats, and probably one of the first epochs deifying the Sun. In Egypt two religious systems, cats on one side and the Sun on another side peacefully co-existed. Their coexistence was possibly connected to the fact that both animals and celestial objects were the part of the natural world. Unfortunately, the peaceful coexistence of different religions became impossible with the later development of world religions, where monotheistic gods obtained human faces and the whole world was considered to be created for the purpose to serve and please the Human race.

We are gradually recovering from the deep selfish humanocentrist delusions we have suffered for several millennia. We are starting to acknowledge the importance of finding humans' place within nature instead of finding the role of nature in human life. At the same time, our little furry companions are helping us to recover the lost humility in our hearts and our instinctive sense of fascination with nature.

Our planet unites peoples and cultures with very different cultural histories. Not every indigenous culture has undergone the upheaval and "development" of city-based civil societies. It is quite difficult to build a civil society and nation-states in some tribe-based cultures – Monotheism has not become the religious worldview for all cultures, and this is also why so-called pagan elements are still so strong in many cultures recently converted to monotheism. Even the Sun and other celestial objects have not obtained religious significance in some cultures where farming was not practiced for centuries and millennia, so there is indeed a wide range of historical memories and historical worldviews throughout the world.

However, all human societies, without any exceptions, have a deep-seated memory of our first gods, the majestic big cats, despite the difference in cultures, we all come from the same evolutionary past. The memory of millions of years of vigorous everyday fighting for survival will most likely stay with us forever. We all still look and behave as big cats shaped us, and we should not be too surprised if we gradually realize that we live in a catmania-stricken world.

We suffered catmania for millions of years, so it is no wonder we are now finally reviving this ancient state.

Is it Possible to Hate Cats and Kittens?

It is very difficult for cat lovers to imagine that there are some humans who do not like cats, do not find them cute and beautiful – and that some are even morbidly afraid of cats. We discussed the long list of artists, writers, poets, musicians, scholars and religious and political leaders who loved cats to the point that the term "catmania" would be appropriate to use. Cats are by far on top of the any list of animals in terms of internet and general culture popularity.

But not everything has been this rosy all the time – it was not only in the dark medieval times that the beautiful cats had more than their share of haters. There are those who actively dislike cats in today's world, and people of different professions are represented in this category. There is even a special term describing the fear of cats: "Ailurophobia," or "cat phobia."

It is very symptomatic that ambitious politicians and dictators are over-represented in the list of cat haters. Genghis Khan, great conqueror from Asia, Alexander the Great, Julius Caesar and Nero from the Ancient Greece and Rome, Ivan the Terrible, Napoleon, Hitler, Stalin, Mussolini, all hated or were afraid (or both) of cats, sometimes even kittens. They were exterminating cats very much like free thinkers in their own countries and empires – those who did not want to submit and follow their orders. Henri III of France and King Louis XIV of France were the

perpetrators of a particularly cruel extermination of thousands of cats. Dwight D. Eisenhower has the dubious title of being the most cat-hating American president. Cat haters were also among scholars, for example Georges Louis Leclerc de Buffon, French naturalist of 18th century, and Noah Webster, the American educator and lexicographer of 18th-19th century. They did not organize cat massacres, yet still described cat's character not very far from the medieval Christian treatise.

According to several websites, Chicago banker Rockwell Sayre was one of the world's worst cat-haters. He lived in the early 1920's, and started a campaign to rid the entire world of cats by the year 1925. He offered financial rewards to cat killers, giving 10 cents to anyone who would bring a dead cat to his house. Allegedly, Sayre boasted that he inspired the killing of seven million cats during the first three months of his campaign. According to him cats were "filthy and useless." In 1925 he extended his campaign for a further ten years, as there were many cats still left – fortunately soon after he died himself (was shot dead by his own son in 1930). Cats had taken their revenge – the Chicago banker probably would have died of a heart attack anyway if he had a chance to see the popularity that cats have attained in contemporary America.

There are few very unexpected names on the list of cat haters. These are people from the world of art. Artists, as a rule, love cats and many artists are known for their strong feelings towards cats – so cases of artists hating cats are more difficult to explain.

To explain why American dancer Isadora Duncan hated cats is very difficult, as at the turn of the 20th century the witch-hunts were long gone in the United States. For a dancer who was famous for seeking more natural movements in the art of dancing, a cat's gracious movements should have been a source of eternal fascination and inspiration rather than a morbid hatred and desire to hang them. Either Isadora had some very traumatic childhood memories connected to cats, or possibly the over-ambitious dancer could not bear the idea that cats naturally had such grace in their movements that was impossible for her or any other human dancer ever to achieve through practice and dedication.

Another unexpected case is of the composer Johannes Brahms, who enjoyed killing cats in his neighbourhood with a bow and arrow. Musicians and composers, from Chopin and Shostakovich to John Lennon and Freddy Mercury, make a long

list of cat-lovers. In Brahms's case probably the free spirit of cats was unacceptable to the composer who disliked the contemporary romanticism and free expression of emotions both in life and in music. Brahms was cold and unappreciative when meeting Franz Liszt, one of the greatest humanists and romantic composers (allegedly, he fell asleep when Liszt was performing for him). In his aesthetics Brahms was striving for the stricter past, the epoch of baroque and classicism. Brahms never married, and he was known to destroy all his early compositions that in his view did not answer his highest aesthetic aspirations.

Of course we know the history of our interactions with cats has had truly darker times, and the few cat-haters that we mentioned above only form a miniscule amount in comparison to hundreds of years ago. Cats lived through centuries when they had to use their numerous lives and intelligence daily in order to survive. It is not a coincidence that these ages, ages where democracy and cats were both stamped out, are known today as the "dark ages." Cats showed an amazing resilience – they not only survived mass persecution, but by the beginning of the 21st century they became the world's favourite pet. And not only the world's favourite pet – according to an "Animal Planet" poll, the title of world's favourite animal also belongs to a cat, this time to the biggest of all cats – the tiger.

A cat is an eternal reminder of our profound connections to nature. Cats make our society less humanocentrist and more altruistic. In our love towards small and big cats we pay them back for millions of years of taking care of our ancestors, for feeding us, for punishing us for being non-cooperative and for encouraging us to be more altruistic. Cats made us the bipedal, tool-using, intelligent species of primates with culture, science and religion that we are today. Cats served us as the subjects of our envy and fascination, served as models for the development of our aesthetic sense and served as the models for our first cultural artefact.

Cats' popularity is steadily increasing. Taking into account our common evolutionary history and our mutual respect, the popularity of cats will most likely not have a usual fashion-like fluctuation, although there can be change in forms of expression that may make this seem so. There will be no more Dark Ages for cats – in the epoch of increasing of spiritual and personal freedom and a comeback to the

nature, we have finally rediscovered our first God, the most revered and possibly still the best loved God. The future of cats in human society seems to be extremely bright.

Although cats' popularity on the internet is truly dazzling, advertising companies have not yet realized the full potential of cats as advertising agents, although there are some signs of the popularity of cats in attracting potential buyers.

The 21st century has seen yet another expression of our love for cats emerge: the so called "cat-cafes" which are now taking the world by storm. A cat-café is a café where visitors, while waiting for and then consuming food and beverages, can entertain themselves by playing with and stroking numerous roaming cats and kittens. The very first cat-café, according to sources from Wikipedia, appeared in Taipei, Taiwan in 1998. The café became very popular, particularly with Japanese tourists, and it was no surprise that in 2004 the first cat-café was opened in Japan, in Osaka. Today there are at least 39 cat-cafes in Tokyo alone – by the time this book is out, there will most likely there be a few more. Cat-cafes are also becoming popular in Europe – 2013 saw cat-cafes opened in the UK, Hungary, Germany, Spain and France. The first cat-café opened in Paris, "café les Chats" has many formerly-homeless cats roaming around, creating for the visitor, as the owner calls it, "purr therapy." The opening week of the first Paris cat-cafe was huge, and saw bookings completely filled for the next two months.

When our family visited Paris for the first time in 1999, there were no cat-cafes in Paris, but we remember very well a small boutique where the owner had a very cute and playful kitten named "Sidonie", who would roam around the store and relax at the counter. We dubbed the boutique "Sidonie's Shop" and returned to the place on numerous occasions in our short 10-day stay in Paris. I am also quite sure the cute Sidonie would have attracted a few more people to this shop in much the same way. As we can be sure that this was also not the only place in the world to have such a situation, we can basically say that the concept of cat-cafes was already around for a while and was just waiting to be taken to the next level.

There are already some other indications of the power of cat magnetism in some publications. For example, in an innovative article by Elizabeth Haggarty (Haggarty, 2011) it is claimed that ads with images of the cats attracted 78% more attention from Facebook users than any other ads. But this is only the beginning – I think we will see in the next decade or so a drastic increase of advertisements involving cats, both

small and big cats, instead of human models, launching new products from sofas to new model cars. I also believe we will gradually see powerful politicians advertising their love towards cats before election campaigns in order to raise their public ratings. And finally and most importantly, research of cats' amazing senses and psychic powers can lead to new scholarly breakthroughs, causing paradigmatic changes in several spheres. The 21st century has a good chance to become the "cat century," or the beginning of the "cat millennia."

CHAPTER EIGHT

Conflict: Man-Eating Cats

Now let us make a big change of topic in discussions on our interaction with cats. From the topic of why and how humans love and deify cats, we are now going to discuss one of the lowest points of human-big cat interaction – no book can be written on the interactions between humans and big cats without discussing the issues of man-eating among big cats. This issue is very important for the evolutionary perspective of human-big cat relationship.

Humans are instinctively terrified by man-eating animals – this fear lies somewhere very deep in our psyche. A shark coming from the deep of the sea to grab your leg, or a leopard coming silently through an open window on a hot summer night to attack your throat are some of the worst nightmares that might be happening somewhere in the world right now. It is obvious that this fear of man-eating animals comes from our evolutionary past, from the times when our direct ancestors were vulnerable to the attacks of predators in their everyday life. Of course, these times are gone for good and most of us do not have a steady fear of man-eating animals, but the fear is still there, sitting deep in our psyche.

Of course there are still man-eating tigers, lions and leopards in our world, and people in some regions of our planet still live in constant fear of their lives as the declining number of fierce predators still living in the pristine forests are sometimes very close to human settlements.

Nima Flora, our good friend and a wife of our colleague ethnomusicologist from the University of Melbourne, Reis Flora, is originally from Almora, India, a district in the region known as Kumaon. She has been living in Melbourne since 1990. Nima told me about her childhood in Almora during the 1940s and 1950s, a time when the forests were closer to the town.

"In the evenings as the cook prepared food in the kitchen, which was a metre and a half from the house, we had to walk between the kitchen and house several times in the dark. Sometimes, especially during the winter months, leopards lurked close by, primarily to get our dogs. As a precaution, we [children] were not allowed

to go alone between the house and the kitchen in the dark. In the morning we saw leopard pug marks around the house and in areas close by."

In April 2012 the author of this book was in India, in Kumaon – in search of the legacy of legendary conservationist and author Jim Corbett. This was my second visit to India, and I was there with several other Jim Corbett fans and researchers. We spent several nights in tents, in the villages of Thak and Chuka, on the Indian side of the river Sarda, separating India from Nepal. A few months after our trip we found out that, while we were camping on the Indian side of the Sarda River, on the opposite Nepalese side of the same river, a man-eating leopard was operating for more than a year. The leopard achieved considerable international notoriety by the end of 2012 – during 2011-2012 the leopard killed and consumed 15 victims, mostly women and children. Our party, when we were camping at Sarda River, had two girls, 8 and 10 years old. In November 2012 the Nepalese government declared a bounty on the leopard's head and news about the man-eating leopard spread quickly over the internet. In January of 2013 it was announced on the news that the leopard had been killed, although there are some doubts as to whether the slain leopard was the correct one. Only after several months, time enough to watch for more killings, will it be clear if the man-eater has disappeared for good. According to unconfirmed sources, killings unfortunately continued and by the September of 2013 the death toll was already 23. Professional hunter and author, Peter Byrne, who hunted man-eating tigers in Nepal close to where this particular leopard operated, wrote to me that such a leopard, if it is still alive, would be extremely difficult to kill. They do not come back to their kills, and change locations very often. According to him, such animals often live until old age and die of natural causes. If the man-eater is still alive, such a prospect would not sound very encouraging to the villagers of the Nepalese side of the Sarda River. There were also mentions of the leopard attacks on the Indian side of the Sarda River, but it seems to me that this information has not been confirmed. While we were in this region and communicated with locals and the Indian Border Police, we did not hear anything of these leopard attacks.

The Nepalese man-eating leopard had been operating in the western part of Nepal, in a region called Baitadi. Historically Baitadi was a part of Kumaon, a region made famous by Jim Corbett, the legendary British-Indian hunter and pioneer tiger

conservationist. His book "Man-Eaters of Kumaon" became a rare successful combination of riveting reading and a world class scholarly account of man-eating issues. The book instantly became a world bestseller. I am not going to discuss this book, hoping that most cat-loving and tiger-loving readers would know about this remarkable book, or at least be compelled to seek it out. I would however like to discuss some points from the foreword to the book, written by Corbett, in order to help explain the reasons why some tigers and leopards become man-eaters. The results of several studies and opinions of other more contemporary scholars on this subject will be also taken into consideration.

Why Do Some Big Cats Become Man-Eaters?

Contrary to the popular image that all tigers, lions and leopards are naturally potential man-eaters and kill and eat humans if given the chance, all big cats generally avoid humans whenever they can – we discussed earlier the opinion on this matter expressed by George Schaller, Brian Bertram, and Elizabeth Marshall Thomas. In fact, virtually all scholars note that, possibly to the surprise of some readers, lions are by nature afraid of humans on foot. Corbett was also very clear on this topic: "all tigers and leopards naturally avoid humans."[9] The reason: "Human beings are not the natural prey of tigers, and it is only when tigers have been incapacitated through wounds or old age that, in order to live, they are compelled to take a diet of human flesh." We should not understand these words as that all wounded or old tigers and lions naturally start hunting humans as the easiest prey and their last resort. If this was the case, then virtually every tiger would be turning to eating humans before dying of natural causes (or even a slow injury). Tigers, and

[9]All the citations belonging to Jim Corbett, comes from the introduction to his book "Man-Eaters of Kumaon." The book was first published in 1944, and has never been out of print since. In 2003 I bought a 26th edition. I first read this book in the 1970s (it was a Georgian translation).

probably lions, while incapacitated by wounds or the old age, still require another factor to become a man-eater – an accident.

Accidental Start

Big cats are known on occasions to kill humans as a tragic accident. This can happen when a human inadvertently surprises a big cat at a kill, or wakes a sleeping cat, or accidentally approaches a mother with cubs. In such tragic cases, the "accident" cannot be labelled as an attack of a man-eater since the original intent of the attack is not for food. However, if a tiger "accidentally" kills a human while already in a vulnerable situation (for example, recovering from wounds or starving), then there is a good chance that the accidental kill will become a precedent and the big cat will become a true man-eater and will start stalking and hunting humans as a standard. Humans are still too slow and too weak to withstand the attack of even an old or injured big cat.

To qualify as a man-eater, the tiger (or lion or leopard) should stalk and kill their human prey without provocation, and should do so on a relatively regular basis. Furthermore, recovering from wounds is not as difficult for lions as it is for tigers, as a lion pride provides food for members that are not in good physical shape. Due to their solitary nature, tigers are much more vulnerable to health conditions and have more chances to become man-eaters than social lions.

Wounds and Decline of Food Resources

Wounds may come from two sources: (1) human-inflicted gunshots, and (2) the result of encounters with other animals. Gunshot-inflicted wounds were one of the leading causes in the man-eating tigers encountered by Corbett. The very first man-eating tiger, the notorious Champawat man-eater, the Guinness book record holder which consumed 436 recorded human victims, and the two last man-eaters, known respectively as the Chuka and Thak man-eaters, all became man-eaters after receiving gunshot wounds. The Champawat tigress had her top right canine broken in half, and lower canine broken to the bone by gunshot wounds, and the Chuka and Thak tigers both had many gunshot wounds received from old muzzle-loaders.

Among the wounds caused by other animals, surprisingly enough porcupines are the leaders. Porcupine quills can cause horrible wounds to tigers. At least three man-eaters killed by Corbett – Muktesar, Mohan, and Talla-Des man-eaters – all had heavy porcupine quill wounds. The Muktesar tigress, for example, a young female, lost one of her eyes after an encounter with a porcupine, and over fifty quills got embedded in the arm and under the pad of her right foreleg. The Mohan tigress was injured to the point that she was moaning from pain while walking. When a formidable predator like a tiger suddenly finds itself incapacitated from hunting its usual prey and is in pain it only takes one tragic accident that provides a human victim, and a new man-eater is born. In the case of the Muktesar tigress two humans approached her hiding place while she was recovering after the fateful meeting with the porcupine. Annoyed and enraged by the wounds, she killed both. The first kill was left without any mutilation, but before leaving the dead body of her second victim, the starving tigress consumed a small portion of the body. The next human victim was stalked and killed on purpose, without any provocation (Corbett, 2003B:38). Without these two tragic accidents, the tigress would have probably died of starvation without realising the life-saving strategy of hunting humans.

Another factor contributing to big cats becoming man-eaters, as mentioned by Corbett, was the decline of natural food sources. This is a well-known chain of events. The increase of human cattle numbers, the overgrazing of natural resources and hunting of wild game leads big predators running out of their natural prey to

hunt. Attacks on cattle are a natural following occurrence. Conflict arises, and in some cases humans can become victims while defending their livestock.

Scavenging

Still another important factor in turning predators into man-eaters is the scavenging of readily available human corpses. Humans in every culture dispose of bodies through different means, and generally in a highly ritualistic manner. Humans bury their dead, burn them, hang them in high places, put bodies into the water, feed them to the predator birds (but not to ground predators that can hunt and kill humans). Cannibalism, or eating the bodies of the deceased members of your group in order to get rid of the corpse, was probably the earliest employed means to dispose the human corpses. This so-called "mortuary cannibalism" still exists in some tribal societies (Conklin, 2001).

As a result of these cultural traditions, human bodies are usually not available to predators that could potentially become man-eaters. Despite this, in some special cases dead bodies are left unburied, sometimes even in large numbers. This happens, for example, in cases of natural disasters, or severe outbreaks of infectious deceases. In such disasters there are often no resources or able-bodied people around to take required care of the dead bodies, and consequently predators have easy access to human flesh. Corbett considered this factor to be important primarily for leopards. He himself killed two notorious man-eating leopards, together responsible for combined 525 human deaths – both of them became man-eaters after an infectious decease epidemic: the Panar man-eater started attacking humans after a severe cholera outbreak and the famous Rudraprayag leopard, killed in 1926, started its illustrious career after the1918 "Spanish Flu" outbreak, the biggest pandemic in human history. Although Corbett considered tigers to be mostly non-scavenging predators, we know today that tigers on occasions also scavenge kills made by others (G. Neumann-Denzau, 2006). Corbett himself described two facts known to him

about tigers scavenging others' kills – both these facts are mentioned in the story of the Thak man-eater. Cases of tigers feeding on readily available human corpses and later becoming man-eaters are also known from the history of the Second World War (Perry, 1964:197) and Vietnam War (Jackson, 2001:75).

In an excellent paper on the subject, Kerbis Peterhans and Gnoske suggested that scavenging of dead human bodies, provided by the slave trade and epidemics during the 19th century, could have given easy access to human corpses and could have contributed to the man-eating habit of the Tsavo lions (Kerbis Peterhans, Gnoske, 2001:9-12). In addition to natural disasters, Gertrud Neumann-Denzau describes the tradition of a floating burial of snakebite victims in the surroundings of the Sundarbans, famous for its great number of human victims killed and eaten by tigers. Bengal has the highest annual number of snakebite victims in India and a person who dies from a snake is set adrift on a raft as goes the age-old tradition. When stranded in the mud banks, these human corpses are easily accessible to tigers (Neumann-Denzau. 2006:6-8).

I proposed that the desire to dispose of the bodies of dead fellow humans and hominids was the central factor as to why cannibalism was such a widespread cultural-religious practice in human prehistory. Eating the body of a fallen group member was the only available option to hominids and early humans in order to remove the body remains and discourage predators from scavenging the meat. As we can also see from more recent cases, removing human body remains still remains important in order to avoid predators becoming man-eaters.

Competition for Food Resources

There has been also a suggestion made that it is the competition for resources that drives less successful tigers to the less fertile regions, or into the dangerous buffer zones. Carrington-Turner explained the big number of man-eaters in the mountainous region of Kumaon with this factor, as mountains usually do not have the abundance of prey that flat forests do (Carrington Turner, 1959:103-107). Charles

McDougal also noted that man-eaters are more common in regions where there are problems with their natural food (McDougal, 1987:443). The importance of so-called "buffer zones," vulnerable regions situated between national parks and human settlements, for developing man-eating tendencies is also supported by scholars (Nyhus & Tilson, 2010:125-141; McDougal et al., 2004:3).

Mistaken Identity

Many fatal incidents with tigers and lions have taken place when a victim was in a bent or squatting position. This can happen while humans are cutting grass or answering the 'call of nature'. This is a very important factor, as the majority of victims of man-eaters were, at the moment of being attacked, not standing in their usual human bipedal posture. Humans are recognized by their erect bipedal posture, and at least in some cases an attack can simply be triggered by this kind of mistaken identity. The reader may remember how an Indian post officer had to stop his bike and turn to face a chasing tiger to show the tiger that he was a human, and that this action saved his life. For Richard Perry it is significant that women and children are often stooping when becoming a man-eater's victim. Perry also tells of several instances in Burma where hunters have been stalked and seized by tigers when they were crawling after pig or deer (Perry, 1964:180).

There is an interesting documentary "Man-Eaters" about man-eating lions which studies four cases of lion-human attacks. Interestingly, in all cases humans were not in their usual upright walking position: in the first case a 32-year-old man was attacked in the middle of the night, in the second case a group of travelers were attacked while riding horses, in the third case tourists were sitting in a car and came too close to a couple of mating lions, and in the final case a game ranger was attacked while riding a bike. Placing the third and fourth of these attacks in a film dedicated to man-eaters is not justified in my opinion. Lion attacks they are – yes, but of man-eating lions – no. When a lion protects its privacy with a lioness, or when lions chase

a man riding a bike (and not killing the man), are such cases that cannot be qualified as attacks of man-eaters by any standards.

Kailash Sankhala, founder-director of Project Tiger, performed an interesting experiment in Delhi Zoo where he found that "tigers start stalking as soon as they find a man in a bent position, but lose interest when he stands up" (Sankhala,1993:122). This experiment is not difficult to replicate, and was actually quite well known to me and my friends, as we would visit my native Tbilisi zoo daily to watch big cats in the first half of the 1970s. Bent humans, and also running humans, definitely provoke tigers and other big cats to start stalking and chasing. Stephen Mills humorously assumed that "if every tourist who visited Bandhavgarh was expected to crawl through the bushes on all-fours, a lot would get eaten" (Mills, 2004:112). Mills proposed that tigers might fear an upright human for another factor. Animals that walk on four legs are usually longer than taller, and when tigers and lions look at humans they might that, using the afore-mentioned ratio, a 6-foot tall human would be a huge animal. If the reader remembers our discussion on the "Visual Index" among humans and different animals ("Visual Index" is a simple correlation between the height and the weight of an animal) humans are as tall as wild buffaloes who weigh about a ton, but a human's weight is about the same as that of a leopard. We are very impressive when we stand erect, and for many fellow humans who live in the vicinity of big cats staying erect is a life-saving habit – I believe it was the same a few million years ago. If readers of this book remember our discussion on the reasons of human bipedal locomotion, they might remember my proposal that, when fully erected, our ancestors were much less attacked by the fearsome African predators.

Salinity and Inability to Mark Territory as a Contributing Factor

The tigers living in Sundarbans, the delta region of the River confluence of the Padma, Brahmaputra, and Meghna rivers, are known for their reputation as man-

eaters. When explaining the unusually high aggressiveness and the attacks on human in Sundarbans mangrove region, German biologist Hubert Hendrichs proposed in the early 1970s that there was a positive correlation between the degree of salinity in different forest ranges and the number of tiger attacks: The higher the salinity, the more attacks. From this it was assumed that high degrees of salinity affected the liver and kidney of the animals, making them extraordinarily aggressive (McDougal, 1987:443). However, when Siddiqi and Choudhury tried to confirm the suggested correlation in later years, they found there was no such correlation (Siddiqi & Choudhury, 1987). Neumann-Denzau and Denzau think there is a possibility that Sundarbans tigers could suffer from hypertonicity from excessive salinity, leading to increased activity and aggressiveness (Neumann-Denzau & Denzau, 2010a:6; 2010).

The aggressiveness of the Sundarbans tigers might be connected to another reason as well. Tigers mark their territories with permanent marks: pulling their claws down the trunk of a tree or by leaving scent marks up to 5 feet above the ground. Marking is an important element for dividing territories and avoiding unnecessary clashes between rival tigers. The environment of the Sundarbans usually lacks appropriate trees, and tidal waters erase scent marks. Therefore, such reduced intra-specific communication can lead to more overtly aggressive forms of confrontations between individual tigers. Charles McDougal refers to this possibility, calling it "highly speculative" (McDougal, 1987:435-448). Hans Kruuk noticed another peculiarity of Sundarbans man-eating tigers which could point to their overt aggressiveness – unlike the rest of India's man-eating tigers, in the Sundarbans the man-eaters are apparently mostly males (Kruuk, 2002:57) – Manfred Waltl, who wrote an excellent paper on the subject, proposed that this factor may be more important than the salinity factor (Waltl, 2016). To me also, the factor of marking seems a more promising explanation for the aggressiveness of Sundarbans tigers than the salinity of the water, although as is often the case there can be several contributing factors working in unison.

Differences Between Man-Eating Tiger and Lion Behaviours

There are several important differences between man-eating tigers and lions (and sometimes leopards). These differences comprise of many aspects of man-eating behaviour, from the gender of the man-eaters to the time of the day when they hunt humans, to their hunting behaviour and methods or their choice of prey. In the following section I will briefly discuss these differences.

Gender

There is an interesting and conspicuous difference in man-eating tigers and lions in terms of their gender. It is clear from Corbett's writings that most of the tiger man-eaters he encountered were females. In two Corbett books dedicated to his hunting stories, eight stories specifically discuss cases of various man-eating tigers. In one case (Kanda tiger story) the gender is not clear, but in the other seven cases it is clear. Out of seven man-eating tigers, six were females: Champawat, Chowgarh mother, Mohan, Thak, Muktesar, and Talla Des man-eaters. Three of them had cubs during their man-eating activity (Chowgarh, Talla Des, and Thak man-eaters). In at least one case a grown male cub was actively assisting his older mother in making human kills, and when Corbett shot the cub the old tigress' attack success rate drastically dropped. Amazingly among all the man-eating tigers from Corbett books, only one, the Chuka man-eater, was a male tiger (and possibly Kanda man-eater). Even in this single case there are still controversies as to whether the tiger was a true man-eater or mostly a cattle-lifter. All three of the Chuka man-eater's human kills were connected to circumstances where cattle were also involved. Also, the Chuka tiger made his three human kills during a long period of 17 months, which is very unusual for man-eaters and indicates that they were not his primary diet.

Therefore the prevalence of females among man-eating tigers is very obvious. Richard Perry supported this view and added that this was the case all over India, not only in Kumaon (Perry, 1964:201).

In the case of man-eating lions, the gender balance is reversed. Starting with a pair of male man-eaters from Tsavo, of all the most well-known lion man-eaters of all times, including the recent case of the infamous Osama, most of them have been males.

If we want to explain this gender misbalance between the man-eating tigers and lions, we must look at the difference in their lifestyles and in their food-acquiring strategies. Tigers are solitary hunters, so both male and female tigers have a fair chance to successfully hunt prey. However, female tigers have an additional burden during their lives: they give birth to and care for each generation of cubs for roughly 2 years – in this period the pressure on them to provide ample food is much greater. Additionally, as a tigress with cubs is more dangerous and is more likely to attack at the first sign of any danger to her cubs, there is an increased possibility for a caring female tiger to suffer more wounds and injuries through the increased risk of violent confrontations – this applies to inadvertently approaching humans as much as it does to other animals.

I therefore propose that for the female tigers, the time when they have cubs is when they are particularly vulnerable to becoming man-eaters, as this is the time when (1) the demand for food increases, (2) the aggressiveness of the tigress also increases, which consequently means that (3) the possibilities of injuries increases, and (4) the possibility of attacks on humans also increases. Male tigers, even when wounded, have a better chance to recover in seclusion without having starving cubs desperately asking for food. These factors, I propose, can explain why there are so much more man-eaters among female tigers than there are among males.

In the case of lions, the situation for the food acquisition strategy is profoundly different. Lions of both sexes are not equally good hunters like tigers are. Among lions, the slick and fast females are much better hunters than the cumbersome males with their imposing manes. Male lions, if we remember, have obvious features of aposematic animals such as smell and particularly their conspicuous mane. Manes make male lions appear larger and are therefore very effective when male lions need to intimidate the opponents (for example, rival male lions, or hyenas at a kill). However, when it comes to hunting, the big and clearly visible mane is a liability, as is their increased olfactory production. A mane makes a concealed approach to the prey very difficult. For their more "royal" look and better intimidating capabilities

male lions pay the price by being inherently worse hunters. Male lions are excellent at scavenging situations, but for chasing live prey themselves they are not rated too highly.

Also, unlike female lions who mostly stay within the pride of their birth, male lions leave the pride of their birth as soon as they achieve adulthood, and have two different optional lifestyles: (1) to find and fight for a pride, or (2) to be a wandering male without a family. Male lions that live with prides are more secure from food shortages as female lions, being the able hunters that they are, take the responsibility of food provision. The so-called 'nomadic' lions are in a less favorable position as they need to hunt for themselves, even with all their aposematic disadvantages. Even in such rare cases where a female lion is chased from her pride and becomes a solitary wanderer, it is still easier for her to hunt than for a wandering male.

The situation of a solitary wandering female may be different when that single female lion gives birth – as is so with tigers, the pressure to provide food suddenly increases. This pressure comes from the fact that she does not have any help from fellow females, both during the hunt and also in minding the cubs. I do not know if such a study has been done, but it seems reasonable to propose that single mothers (without a pride) with cubs will have a somewhat bigger chance to start attacking cattle, and even humans, than female lions who live in a pride. Nomadic males seem to be the primary source of man-eating lions in Africa. Furthermore, the fact that there is an unusually large number of mane-less lions among the man-eating population might be explained by the fact that, for the mane-less lions, it will be almost impossible for them to drive away rival males and assert dominance in order to acquire the safety of their own pride. Although without a mane a lion's hunting chances maybe better, males are still built too cumbersome for the quick and sleek movements needed for hunting their usual, fast-running prey.

If you are a powerful predator and you are starving for one reason or another, at some point you will realize that hunting cattle is a much easier option than chasing antelopes around. Human cattle were specially designed to be better in providing more meat and milk, not in defending themselves vigorously or running away from approaching predators. Given the relative ease that comes with hunting fenced cattle, for a big cat hunting unarmed humans is still easier than hunting the slow and awkward cattle.

Therefore, the difference in the lifestyles and hunting traditions of tigers and lions must be responsible for the fact that most man-eaters among tigers are females, and why most man-eaters among lions are males.

Time of the hunt

Interestingly enough, the time of attacks on humans is also different among man-eating tigers and lions.

Man-eating tigers generally hunt humans during the day. Corbett is very clear, even categorical, about this. When he comparing the habits of man-eating tigers and leopards, he wrote:

"In the case of human beings killed by carnivora, the doubt is often expressed' as to whether the animal responsible for the kill is a tiger or leopard. As a general rule to which I have seen no exceptions tigers are responsible for all kills that take place in daylight, and leopards are responsible for all kills that take place in the dark."

When Corbett says "I have seen no exceptions" it means something, as hardly anyone knew and saw more about the habits of man-eating tigers and leopards in India than Corbett did. It is interesting to note that although man-eating tigers kill people during the day, humans are still much more afraid of being attacked by man-eating tigers at night than during the day. Corbett explains this difference between tigers and leopards with the fact that tigers have more courage than leopards, and after realising that their prey is active during the daytime they adjust their hunting habits to match the daily routine of their prey. Leopards, according to Corbett, even the man-eating ones, never lose their fear for man and are as a result afraid to face humans during the daytime – but it is a completely different story at night. Like horror movie characters, as the sunlight disappears man-eating leopards become active and extremely bold. In the dark they enter human houses through open doors and windows, and are known even to break the doors or flimsy house walls. It might sound silly to some readers, but it is a fact that if you are on the territory of a man-eating leopard, it is safer to be in the middle of the jungle during the daytime, than

to be locked inside your house during the night-time. Tigers, on the contrary, are never known to enter a completely human habitat, unlike leopards.

These behavioural characteristics must be taken into account very seriously by all hunters who go to get rid of man-eating tigers or leopards in India. According to Corbett, "Owing to these characteristics of the two animals, namely, that one loses its fear of human beings and kills in the daylight, while the other retains its fear and kills in the dark, man-eating tigers are easier to shoot than man-eating leopards" (Corbett, 2003:X). The confirmation of Corbett's words is the stories of his hunts of two man-eating leopards, which were both eventually killed by Corbett. These were the Panar man-eater (killed in 1911; or possibly in 1910 – see Gheerawo, 2016) and the Rudraprayag man-eater (killed in 1926). Both leopards were active for many years and were reigning terror on the local population. The Panar leopard killed 400 victims. Although less prolific (only 125 kills), the Rudraprayag man-eater was by far the most infamous leopard man-eater in Indian (and possibly human) history. For eight long years he was terrorizing pilgrims on their way to the religious site Badrinath. Both of these leopards were killed by Corbett in the dark. On the contrary, all the man-eating tigers were killed by Corbett during the day-time. Basically, man-eating tigers both hunt humans and get hunted in the daytime, and the same goes for man-eating leopards at night-time.

Man-eating lions' habits are close to those of leopards. They mostly hunt at night, although daytime attacks are still possible. Tsavo lions, for example, were generally attacking humans during the night – most of Osama's attacks also happened at night. Moonless, darker nights are considered to be more dangerous. Lions, also very much like leopards, may sometimes enter a human dwelling to get to their target (see next section).

Place of hunt

The places where man-eating tigers, lions and leopards attack humans also vary. Tigers stalk humans mostly in the forests or jungle – forests and bushes close to villages are the most dangerous zones in regions where man-eating tigers are

operating. Tigers stalk humans like any other of their usual prey – if humans see them before the attack, tigers often abandon the attack like they do with any other prey. Tigers also approach humans downwind as they do with their usual prey, even though humans do not have a keen sense of smell like most of the ungulates have. This characteristic of tiger stalking is life-saving for the hunters of man-eaters, since if they are aware of the wind direction they can accurately anticipate from which direction the danger might come from.

Tigers are not known to enter human settlements, and even more so human houses. In the case of the Thak tigress though, she did enter the village Thak and, according to the pugmarks, entered the houses as well – however, the village at that point was completely deserted due to fears of the man-eater, and the doors of many houses were left open. This particular tigress exhibited some other unusual characteristics. She killed her first victim in the middle of a village, and on another occasion she approached the camp of woodcutters while ignoring their attempts to drive her off with noise. The woodcutter camp, comprising of a strong group of five thousand male contractors, shouted at the top of their voices in order to drive her away. Instead of going away, the infuriated tigress came closer to the houses and, with her roaring, coved the woodcutters into silence – such cases are a great rarity however.

Man-eating lions are generally bolder and more aggressive than tigers. Lions attack humans both on their own territory in the bush, and on human's territory. They have been known to actively enter human villages to search for prey. For example, I will cite the words of Soulemenn Kalee, professional hunter from the Republic of South Africa. Kalee was called by the Tanzanian authorities to help to hunt the infamous man eater known as Osama in Selous park, near the Rufiji River. Kalee teamed up with Hajee Mackumboro, the chief ranger of the park.

According to the information provided by Mr. Kalee, the lion entered the same house more than once. On the first occasion he killed the husband of a terrorized wife who was also inside the house. After six months, the same lion came back, entered the same house from the same hole and killed both the mother and father of the same unfortunate woman – he then took the father's dead body for food. During the killings of both her husband and parents, while the lion was still inside the house the woman was trying to stay absolutely still in her bed, not even allowing her stomach to move

for breathing – her state could have been also connected to the life-saving freezing instinct in humans. Mr. Kalee is convinced that by staying absolutely still she most likely saved her life. Unlike man-eating lions, man-eating tigers do not enter human's houses and they never kill more than one human at once – they kill only for food. The habit of entering houses and villages, and generally being bolder, also makes man-eating lions easier to track and kill than man-eating tigers.

The hardest ones to kill, as we remember, are man-eating leopards. Man-eating leopards attack humans almost exclusively at night, and frequently stay hidden during the day. Corbett was very clear on this account:

"Both animals [tigers and leopards] are semi-nocturnal forest-dwellers, have much the same habits, employ similar methods of killing, and both are capable of carrying their human victims for long distances. It would be natural, therefore, to expect them to hunt at the same hours; and that they do not do so is due to the difference in courage of the two animals. When a tiger becomes a man-eater it loses all fear of human beings and, as human beings move about more freely in the day than they do at night, it is able to secure its victims during daylight hours and there is no necessity for it to visit their habitations at night. A leopard on the other hand, even after it has killed scores of human beings, never loses its fear of man; and, as it is unwilling to face up to human beings in daylight, it secures its victims when they are moving about at night, or by breaking into their houses at night."

These last words are particularly ominous. A man-eating leopard taking a victim from inside a house is particularly terrorizing, as humans usually feel secure when they are inside their house with other family members, sleeping in their beds. In a book dedicated to the Rudraprayag leopard, Corbett specially wrote a chapter called "fear" where he described several attacks by a man-eating leopard. In all these cases the victims were in locked houses or on a verandah, usually with many people sleeping in the same place. Unlike the man-eating lions that usually wreak havoc when entering a house for the kill, man-eating leopards are as silent as a shadow during the whole attack. Often people who are asleep in the same room, do not hear anything during the attack – they only realize a person is missing and see the spilt blood in the morning. Leopards are also known to go after a particular person in the

room, even if that person is the hardest to get to. In one case the Rudraprayag leopard entered a house in the middle of the night through a small open window which had kitchen utensils resting on the window sill. The house consisted of two rooms consisting of family members who were attending a dying relative – everyone was sleeping. The leopard went in between the beds in the first room then snuck under the bed that was placed next to the dying woman, and killed her. The leopard then took the body out from bed, dragged her under the sleeping relative's bed and through the other room – it was only when the leopard was trying to take the body out through the same small window that the kitchen utensils fell from the window sill, alerting the sleeping relatives – the leopard dropped the body and ran away. In another case the leopard broke into an animal barn, did not pay attention to dozens of goats (perfect food for any leopard) and killed the only human present there, a shepherd boy who was spending the night with the animals.

Attacking in groups

Man-eaters are popularly known as single individuals, but this is not always the case. Both tigers and lions can attack human prey in groups. Of course, because of the tiger's solitary lifestyle it is extremely unlikely to see a big group of tigers attacking human victims. In a tigers' case it is always a mother with a grown-up cub or cubs. The best-known case for tigers attacking humans together is probably the Chowgarh man-eating tigress, who was assisted during the attacks by her own grown male cub. When Corbett shot the cub, the old tigress continued her attacks on humans but at a less successful rate – many of her last victims were injured instead of killed.

Lions, as we know, often live in groups, and in some rare cases a whole group can exhibit man-eating behaviour. When Kalee and Hajee started their hunt for the infamous man-eating lion Osama, they were alerted by witnesses that the lion was not acting alone – a whole pride of 6-7 lions were taking part in the attacks. As a result they started shooting all the lions in the local area. A post-mortem of one of the killed female lions from the local pride, shot by Kalee and Hajee, showed that she had human remains in her stomach, confirming that the lions were sharing hunted

human flesh. There is another confirmation of this – after Osama was shot by Hajee in 2004, leading contemporary lion expert Craig Packer made a post-mortem and found out that Osama was a relatively young male, only 3.5 years old. Therefore, it became clear that Osama could not be responsible for all the killings that were going on for so many years. Osama was almost certainly trained to hunt humans in his own pride, after which he apparently became a standout with his boldness and aggression. According to Kalee's words, the man-eating pride was decimated after their 18th human victim. After this there were no human killings for seven months, but then the killing spree was renewed once again.

This time all the killings were connected to a single lion which was attacking humans only by night. At least 35 more people were killed between 2002 and 2004, and in all probability by one individual male. When all villagers had vacated the east banks of the Rufiji River to move to the west bank in order to avoid the man-eating lion, the killing continued on the other side of the river as well – the lion must have crossed the river by swimming. As we know lions dislike water, but Osama's hunger was so great that he followed the villagers even across the river. Finally, this last remaining male of the deviant pride, Osama, was killed by Hajee Mackumboro. This happened on April 21st 2004, after his 49th victim. The attacks stopped after this date. Interestingly, Osama was also a mane-less male lion like Tsavo man-eaters had been. Such cases, when a whole pride includes humans as their staple food, are extremely rare (see also below).

Leopards have never been known to attack humans in groups. A leopard is a solitary hunter, although leopards also become social while they are nursing and raising their cubs. Therefore, there is a theoretical possibility for a female man-eating leopard to hunt humans with her almost-adult cub, but such cases seem to be absent as of yet – the fact that almost all man-eating leopards are male also makes this occurrence very unlikely.

Attacking behaviour

The attacking behaviours of tigers and lions also have notable differences. Although tigers change the time of hunt from predominantly nighttime to exclusively daytime when becoming man-eaters, otherwise their hunting behaviour remains the same – tigers ambush humans and attack them unseen. As a rule, the human victim realizes he or she is under attack until once the tiger has made bodily contact with the victim. Tigers hunt humans as they do any other prey – silently and unseen, mostly waiting for them in silence until the right moment arrives.

Lions, as we have already mentioned, are different. Apart from the fact that they sometimes come into the villages and even enter the houses in search of prey, lions can also attack a group of people. According to Kalee, the man-eating lion Osama would break from cover in front of a party of unarmed men and start angrily roaring until the pandemonium hit the party and everyone fled in their own direction – the lion was then simply left to choose a victim among the numerous humans running away. We may remember that running away from any of the big cats (even from non-man-eaters) is the worst thing a human can do to aid their survival, and it is interesting and characteristic that the experienced Osama tried first to scare potential prey into fleeing, and then went to catch one of them running away. I tried to find out if there was even a single instance of when a whole group stood their ground against Osama, but I was unable to find such a case. For his second victim, a man with two wives, Osama used an interesting and somewhat similar strategy. The wives stayed in huts about 100 metres away from each other, and the man had a habit of alternating between them. At night, the lion started roaring next to the hut where he did not sleep. The frightened lone wife naturally started screaming and cried for help. When the concerned husband came running from the other hut, he was ambushed and carried away by the lion.

Learning man-eating behaviour from others

Are all man-eaters learning from and adapting to their own life experience and problems? Well, most of them are, but there are a few exceptions as well. Sometimes this behaviour is taught to them by their family members – and there is a marked difference in this between tigers and lions. Tigers do not learn man-eating habits from anyone else, even if a mother is a man-eater and her cub is raised assisting the mother in making human kills. According to Corbett, "A cub will eat whatever its mother provides, and I have even known of tiger cubs assisting their mother to kill human beings: but I do not know of a single instance of a cub, after it had left the protection of its parent, or after that parent had been killed, taking to killing human beings" (Corbett, 2003:ix) Scholarly literature also does not provide any examples of tiger cubs learning man-eating behaviour from parents, proving the precision of Corbett's observations. Here I must add that Corbett came to this conclusion later in his life – earlier in his career, as a hunter of man-eating tigers, he had an idea that cubs and even mates of man-eaters could take to man-eating independently as a result. For example, when a Thak tigress started killing humans, Corbett was quite sure that she learned this habit from her mate, the infamous Chuka man-eater, which was killed five months before she started killing humans. It was only after Corbett shot her and did a post-mortem examination that he noticed that the tigress, like her mate, was shot several times from a muzzle-loading rifle and that one of the wounds had become septic – the reason of her becoming man-eater was her own wounds, not the example set by her mate.

It is a different matter with lions. As they often live in prides, it has been observed that prey preferences are passed along in prides, sometimes from one generation to another. Similar prides under similar conditions can still develop different preferences for food, as Chris Harvey and Peter Kat found out in Botswana (see Frump, 2006:94). There is even a pride in Botswana that, for many years, has been hunting elephants for food (Joubert, 2006). In very rare occasions, if for some reason a lion has developed a preference for humans as food, this can spread through the whole pride and continue into the next generations. According to Guggisberg, such cases were reported from Uganda, Tanganyika and Mozambique, where man-

eating behaviour was practiced by entire prides and lasted for decades (Guggisberg, 1960:223-226).

According to George Rushby, who hunted the infamous man-eaters named the "Njombe lions", man-eaters represented at least three generations of the pride. Lions killed between 1000 and 1500 humans in South Tanganyika between 1932 and 1947. According to Rushby, "…most of these lions were born and brought up to man-eating" (Kerbis Peterhans and Gnoske, 2001: 18). This prolonged spree of man-eating should be attributed to the establishment of a large game-free zone to prevent the spread of rinderpest (cattle-plague) to livestock, therefore causing a severe prey shortage for the lions (Kerbis Peterhans and Gnoske, 2001:18). Also, according to Kerbis Peterhans and Gnoske, in the case of the Tsavo lions the man-eating behaviour from other lions occurred at this place before Patterson arrived there and continued after he had left the scene, even though Patterson shot the two most active man-eaters (Kerbis Peterhans and Gnoske, 2001:18-20).

In regards to the reasons as to why big cats become man-eaters, experts are coming to the most likely conclusion that man-eating is a multi-causal phenomenon both among tigers and lions (McDougal, 1987:435-448; Kerbis Peterhans and Gnoske, 2001:35; Patterson, 2001:97; Waltl, 2016).

Conclusions: Why Don't All Big Cats Hunt Humans?

Finally, we will discuss the most important subject for our line of conversation. Many scholars note that the crucial question about man-eating tigers and lions is not why some of these big cats become man-eaters, but in fact why all tigers, lions and leopards do not choose to hunt humans as their usual prey. We know that primates are the usual prey of all the big cats – primates are always in great danger when they are caught unaware on the ground by any of these predators. So why are we humans, also primates, mostly exempt from the big cats' diets when we are slow walking, weak, easy to see and easy to kill?

Those who study big cat behaviour also ask similar questions. For example, Stephen Mills, the author of the book "Tiger", asked "Why, in fact, are so few tigers man-eaters?" (Mills, 2004:102). Kerbis Peterhans and Gnoske stated that the basic question is not why individual animals become man-eaters, but why don't they all regularly feed on human beings? (from Kerbis Peterhans personal communication to Philip Caputo. Caputo, 2002:131). This universal avoidance of humans by such powerful predators is one of the big mysteries of big cat psychology. Let us make no mistake – unarmed humans are the easiest prey for big cats – humans cannot run fast to avoid predators, and they have no canines or any other real physical defences to use against them. Yet still big cats, mighty predators that can kill buffalos and even on occasion feed on elephants, do not normally consider humans as prey. Why?

Some big cat experts are sure that this is a late acquired behaviour, mostly connected to the appearance of firearms. For example, Reginald Burton wrote in the early 20th century that in the places where big cats had no prior knowledge of men, they were unafraid of him (Burton, 1931:35). Peter Boomgard is also sure that tigers learned to avoid humans during the deadly years of the use of firearms – he collected historical material from Indonesia and came to the conclusion that the tiger learned to avoid humans during the last 150 or so years. According to him, before 1870, instead of aversion tigers were making "a `rational´ choice between easy and difficult, unarmed and armed, weak and strong" humans (Boomgaard, 2001:86).

There is definitely a healthy weight to this argument, but the issue is still not as straightforward as it may seem. Of course, Schaller, Bertram, Packer and other contemporary scholars of big cats made their observations in the second half of the 20th century, so it is difficult to exclude the importance of the deadly experiences that several generations of big cats had with armed humans. At the same time, we should remember that all the mentioned scholars were studying lions which had lived for generations in national parks and which were not subject to hunting as much as ones in the wild. The most widely surveyed was the Serengeti National Park, which was quite well protected from hunters and poachers, particularly while the legendary Myles Turner was in charge.

Most importantly, if we accept that lions developed their fear of humans on foot from their meetings with armed poachers, it is hard to understand why they would not be afraid of humans sitting in cars – as is commonly known, poachers were and

are still using cars as a deadly tool to quickly approach animals, shot them, and then make a quick getaway from the rangers. Despite such fearful experiences, lions in the Serengeti (and probably in the whole of Africa) are not afraid of cars but still run away from humans on foot. Even a single unarmed human on foot is more intimidating to lions than a group of noisy Land Rovers – loaded with potentially armed poachers. It is difficult to believe that lions learned to avoid human poachers on foot, but for some unknown reason they were unable to learn that the same danger could very well come from a car driven by human poachers. Therefore, in my opinion the idea that this behaviour is very late and is connected to the use of firearms does not clarify the situation. Instead, I believe that big cats have a natural and inborn aversion and fear of humans on foot.

Charles McDougal also proposed that tigers have an inborn fear of humans: "…normal tiger exhibits a deep-rooted aversion to man, with whom he avoids contact." McDougal put this observation in a historical context. In his opinion, "…at some stage during the prehistorical interaction with humans, avoidance of bipedal man became an adaptive behavioural strategy" (McDougal, 1987:435).

According to the view of the author of the book that you are holding in your hands, Charles McDougal is absolutely correct. The answer to the question of why big cats are afraid of humans on foot can be found throughout the long prehistoric interactions of human and big cat ancestors. During the countless generations of daily interaction between big cat and human ancestors, the King Predator (big cat ancestors) and the King Scavenger (human ancestors), gradually came to an important conclusion that it was better to avoid direct physical conflicts with each other – violent conflicts were leading to heavy losses on both sides. This avoidance lasted for millions of years. Countless years of following this strategy must be the chief reason why all big cats still prefer to flee the scene when they see humans approaching on foot. The model of the ancient "truce" between lions and humans, proposed by Elizabeth Marshall Thomas, seems to me evolutionarily the most viable.

The only change I would make in Marshall Thomas' excellent model is that I would substitute "lions" with "the ancestors of big cats," and would push the onset of this truce to a much deeper and earlier period of our evolutionary prehistory.

CHAPTER NINE

Human Intelligence vs. Cat's Sixth Sense

As Leonardo da Vinci certified, cats are one of nature's true masterpieces. They have truly amazing morphology and behaviour. Cats' skeletons permit maximum flexibility to their whole body. The vertebrae are largely held together by muscles instead of ligaments, allowing the cat to twist, compress, lengthen, and turn in pursuit of prey. Cats are also flexible because their front legs are attached directly to the shoulder blades. This allows the cat to stalk with its belly touching the ground, and to squeeze through any space where the cat skull can squeeze. This also allows the cat to spin around its front legs and grasp prey with its claws. Much of a cat's body weight consists of muscles. Their skin is baggy, like the cape of Superman, allowing the cat a wide range of motion and helping to protect their internal organs during fights. Cats' eyes appear to glow in the dark. This is because a special membrane behind the retina, known as tapetum lucidum, reflects light and increases the cat's night vision. A cat can look directly at the sun without damaging its eyes (unlike humans), and they can see very well in almost absolute darkness (also unlike humans). Their sense of hearing, balance, speed, ability to land on their paws from any position and any height, are all legendary. These are cat qualities that create a wide range of feelings among humans, from liking to enthrallment and religious adulation. There cannot be a question about this: Leonardo was correct, the cat is a true masterpiece of evolution.

And as if all of this is not enough, cats have something else, something extra on top of their morphological and behavioural evolutionary achievements. This something is hard to comprehend even with our scholarly sophistication of the 21st century. This mysterious something is sometimes known as the proverbial "sixth sense."

Talking about the sixth sense might not seem to some readers very scientific, much like discussions about the alien abductions or bigfoot, but we should never forget that we are not at the top end of human civilization. Although for us the 21st century seems like the top of human scholarly development, it is only a relatively

dark 21st century, definitely more civilized than the 20th or 19th centuries, but a far cry from 25th or even the 22nd centuries. There are still plenty of phenomena around that we cannot explain. Some phenomena we cannot even see yet, and in some cases, we refuse to see. It might sound unbelievable to many readers of this book, but many academics seem to suffer neophobia, a fear of new ideas and new facts that might destroy the established picture. According to commonly accepted conviction among skeptics (and most of the reputable scholars try to be skeptics), if a scholar cannot explain the phenomenon, the very existence of the phenomenon is rejected. There are many cases when the new powerful idea was vehemently rejected by peers. Sometimes even simple facts were totally ignored.

The life story of the Hungarian Ignaz Philipp Semmelweis is a perfect example of peer bullying of a talented and innovative individual. In 1847 when he was only 29 years old, Semmelweis proposed that washing hands with chlorinated solution for surgeons in maternity wards could save many lives of women and their newborn children from puerperal fever, the biggest killer of newborn children and their mothers. Today this seems like something that does not even need discussion, but in the middle of the 19th century this was a radically new idea. Doctors did not believe Semmelweis, although he had very telling facts to back his claims: in the ward where he introduced obligatory hand washing, mortality dropped from a whopping 10-35% to less than 1%. The explanation from Semmelweis was not convincing and was not accepted by his peers, so the very fact of the drastic decline of mortality was simply ignored. To feel the times when Semmelweis was trying to introduce hand washing, we can listen to the words of the leading obstetrician and teacher of the time, Dr. Charles Meigs from Philadelphia: "Doctors are gentlemen, and gentlemen's hands are clean." How could anyone argue against such a deadly scholarly argument of a high ranked professional doctor?

Doctors neglected the obvious fact of the effectiveness of Semmelweis' methodology and accused their innovative Hungarian colleague of ignorance of the principles of medicine. Only a couple of decades later, after Louis Pasteur proved the existence of microbes, did people understand the true reason behind the effectiveness of Semmelweis' suggestion. Because of this criminal neglect of the obvious facts by the medical establishment, not only did thousands of children and mothers die in the clinics during these decades, but brilliant Semmelweis, embittered

and ostracized, lost his nerve, and started writing open letters to his peers, calling them "irresponsible murderers." The end of the story was truly tragic. Semmelweis was forcefully placed in a psychiatric clinic. There he was severely beaten up by the guards when he tried to leave. After this beating he was locked in a dark room, where he died after two weeks from internal injuries. This happened in 1865. He was 47 years old. Around the same years, when Semmelweis was forcibly placed in the mental asylum and died, Louis Pasteur was doing his ground-breaking research on microbes. Understandably, some professional doctors do not like being reminded of the case of Ignaz Semmelweis.

If you think that similar mistakes of medical and scholarly neglect and non-appreciation cannot happen in our enlightened 21st century, you are deeply mistaken. If someone reads these words in the 23rd or even 22nd century, I would love to hear their opinion towards the mistakes that professional scholarly and medical establishments made in our enlightened, peer-reviewed and web-connected 21st century. We often forget, that we make our biggest mistakes not when we are hesitating, but when we are absolutely sure. As Leonardo da Vinci said, "There are three classes of people: those who see, those who see when they are shown, those who do not see." Among scholars the last category is particularly strongly represented among the staunchest believers of the infallibility of the system of peer review.

Well, let's go back to our kitties and their mysterious sixth sense.

We already discussed that humans and big cats are two unrivalled kings of the world. Humans are distinguished by their intelligence, and although it is difficult to be sure of how much intelligence other animals have, it is quite obvious that there is something that makes human society so technologically advanced and dominant. I do not want to discuss the issue of human intelligence in this book, as I have already discussed it in my 2006 book "Who Asked the First Question?" In that book I suggested that the defining moment of the evolution of human intelligence

was when our ancestors learned how to formulate and ask questions (Jordania, 2006). According to my suggestion, as soon as our ancestors started asking questions, their brains started self-developing at an exponential rate. Asking questions brought to a human society a new quality – collective intelligence with the ability to solve problems using combined potential of all society members. Most importantly for my

argument, humans are the only animals on the earth that can ask questions, although answering questions is not that unique in the animal world. Despite their amazing achievements in language acquisition, chimpanzees and bonobos are still unable to ask questions, although they understand words and properly answer complex questions and requests from their trainers. Unlike apes, human children start their intellectual development by asking questions from a very early age, at the pre-linguistic level of their development. Initially they are asking questions without language, using only a rising question intonation (Crystal, 1987:143, 241). Throughout the history of civilization humans invented plenty of technologies in order to ask questions and share information, from writing system and book publishing to the advance of the internet.

Cats, even the big cats, as far as we know, do not ask questions. But they do have something that is very difficult to comprehend even for our intelligent species. Real or not real, human beliefs in cats' supernatural qualities were one of the central reasons for their massive destruction during the middle ages. These beliefs are still with us in various forms, from portraying cats as the mediums between the dead and the living in Hollywood blockbusters (remember "The Ghost"?), to the serious reports of scholars about cats saving people from disasters, or predicting human deaths.

There are too many traditional beliefs to mention them all. Cats were believed to foretell or even influence the weather. It was believed that cats could sense an imminent earthquake 10-15 minutes before it strikes, due to their sensitivity to vibrations. Peasants who live on Mt. Etna keep cats as early warning devices. Cats have also been known to alert people to such things as fires and air-raids. Some people believe that cats are able to see the human aura, the energy field that surrounds each of us, and some people believe that cats may be able to see the spectre of Death. Such views are understandably looked on with a great deal of suspicion, as anything connected to the extrasensory abilities both among humans or animals. In some cases it is extremely difficult though, if not impossible, to reject that something unexplained, colloquially known as "the sixths sense," is present in some cats.

Let us first state that the term "the sixth sense" is highly controversial as humans have a few more than five senses provided by our evolution. Sense of timing is one of them. We already discussed the unique role that the sense of rhythm played in our

early evolution and physical survival. Sense of balance, hunger and thirst are other candidates for the list of basic human senses. Without going into the argument as to which of these senses deserves to be added to the initial five, let us acknowledge that the five senses do not cover the full spectrum of human senses.

I suggest to future researchers to entertain the idea that both human intelligence and the cat's ultra-sensitivity, or the fabled "sixth sense" were developed during the long process of co-evolution of cats and humans, as a part of their perennial arms race. Humans developed intelligence based on reason and logical thinking. Cats in return acquired extra sensitivity. The results of human intelligence are all around us in the form of cities, libraries, airports and the internet, but it is not easy to see the cat's ultra-sensitivity. We can only see (sometimes!) the results of cats' sensitivity. Cats seem to us extraordinary creatures as they can see, or hear, or feel what humans cannot, even with our sophisticated technology. Two interesting examples follow.

Can Cats Feel Human Death?

Oscar the cat is a good example of such an unexplained and well documented case. He is a cat at a nursing home at the Rhode Island Hospital in Providence, USA, where people with terminal illnesses spend their last few weeks and months of life. Since he was adopted as a kitten, Oscar exhibited an extraordinary ability to forecast which of the patients were going to die in the next few hours. An assistant professor of medicine at the Warren Alpert Medical School of Brown University, Dr David Dosa, a geriatrician at Steere House Nursing and Rehabilitation Center in Providence, Rhode Island, made careful examination of the cat's behaviour and was convinced of the cat's ability to predict the imminent death of patients. Here is an excerpt from Dosa's 2007 article from the "New England Journal of Medicine":

"Oscar […] leaps up onto the bed. He surveys Mrs. T. She is clearly in the terminal phase of illness, and her breathing is labored. Oscar's examination is

interrupted by a nurse, who walks in to ask the daughter whether Mrs. T. is uncomfortable and needs more morphine. The daughter shakes her head, and the nurse retreats. Oscar returns to his work. He sniffs the air, gives Mrs. T. one final look, then jumps off the bed and quickly leaves the room. Not today."

"Making his way back up the hallway, Oscar arrives at Room 313. The door is open, and he proceeds inside. Mrs. K. is resting peacefully in her bed, her breathing steady but shallow. She is surrounded by photographs of her grandchildren and one from her wedding day. Despite these keepsakes, she is alone. Oscar jumps onto her bed and again sniffs the air. He pauses to consider the situation, and then turns around twice before curling up beside Mrs. K."

"One hour passes. Oscar waits. A nurse walks into the room to check on her patient. She pauses to note Oscar's presence. Concerned, she hurriedly leaves the room and returns to her desk. She grabs Mrs. K.'s chart off the medical-records rack and begins to make phone calls."

"Within a half hour the family starts to arrive. Chairs are brought into the room, where the relatives begin their vigil. The priest is called to deliver last rites. And still, Oscar has not budged, instead purring and gently nuzzling Mrs. K. A young grandson asks his mother, "What is the cat doing here?" The mother, fighting back tears, tells him, "He is here to help Grandma get to heaven." Thirty minutes later, Mrs. K. takes her last earthly breath. With this, Oscar sits up, looks around, then departs the room so quietly that the grieving family barely notices."

"On his way back to the charting area, Oscar passes a plaque mounted on the wall. On it is engraved a commendation from a local hospice agency: "For his compassionate hospice care, this plaque is awarded to Oscar the Cat." Oscar takes a quick drink of water and returns to his desk to curl up for a long rest. His day's work is done. There will be no more deaths today, not in Room 310 or in any other room for that matter. After all, no one dies on the third floor unless Oscar pays a visit and stays awhile."

The article is accompanied by a following note:

"Since he was adopted by staff members as a kitten, Oscar the cat has had an uncanny ability to predict when residents are about to die. Thus far, he has presided over the deaths of more than 25 residents on the third floor of Steere House Nursing and Rehabilitation Center in Providence, Rhode Island. His mere presence at the bedside is viewed by physicians and nursing home staff as an almost absolute

indicator of impending death, allowing staff members to adequately notify families. Oscar has also provided companionship to those who would otherwise have died alone. For his work, he is highly regarded by the physicians and staff at Steere House and by the families of the residents whom he serves.”

According to another article about Oscar, written by Tom Leonard in New York three years later, in 2010, “the cat has gone on to double the number of imminent deaths... Five years of records showed Oscar rarely erring, sometimes proving medical staff at the New England nursing home wrong in their predictions over which patients were close to death.”

If you take into account that we have professional human doctors with professional knowledge of all of their patient histories, their conditions, knowledge of the illness, and the data from expensive contemporary medical technologies on one side, and a simple two year old cat on another side, without any professional knowledge of the illnesses, the patient’s history or the data from the medical technology, it is difficult to believe that the cat knows about the approaching death better that professional doctors. According to the article, “nurses once placed the cat on the bed of a patient they thought close to death, Oscar "charged out" and went to sit beside someone in another room. The cat's judgment was better than that of the nurses: the second patient died that evening, while the first lived for two more days.”

Dr Dosa’s book, "Making rounds with Oscar: the extraordinary gift of an ordinary cat", came out in 2010. The author tried to explain Oscar's behaviour by suggesting that Oscar is able to detect ketones, the distinctly-odoured biochemicals given off by dying cells. As the mystery is still open, we should not neglect this possibility among others, although the sense of smell might not be among cat’s natural strengths. It is possible that the secret of cat’s accurate prediction might be connected to some other factors, factors that contemporary science is not yet able to detect.

We should not forget that there are also publications criticizing Dr Dosa’s free, non-vigorous writing style and the anecdotal nature of his article and book (see, for example, Nickell, 2010). I would not be surprised if cat studies will become one of the leading spheres in the coming years.

Going Home, or When the GPS Was Invented

Apart from feeling approaching death in humans, cats have quite a mysterious homing sense. They are able sometimes to come home covering hundreds and thousands of kilometres. Here is couple of well documented examples:

- A cat named Sooty managed to find his way 100 miles to return to his old home when his family moved to another place.
- Pillsbury, an eight-year old cat in England travelled back to his former home forty times. His old home was eight miles away.
- In 1996 Ninja, a tomcat moved with his owners from Utah to Washington State. He vanished soon after the move, turning up at the old address (850 miles away) one year later!

This phenomenon is known as "homing instinct." This term refers to the ability of an animal to perceive direction that is beyond the usual human five senses. There are two types of homing instinct: one type refers to the ability of an animal, after being moved away by owners, stolen, or lost outside their territory, to return to their home, after covering a formidable distance.

Scientists in Germany and the US have tested cats to find out if they had the ability to return to home after being removed. In the US test they sedated a bunch of cats (so that the cats could not consciously remember the route by sight, sound, smell, touch or taste), drove them on a very circuitous route to a big maze and then released the awakened cats, one by one. The maze had openings in 15 degree increments. The cats were left to wander at their leisure and exit if they wanted. More often than not, the cat exited the maze at the closest point towards their home. Older cats performed better than younger. Homing ability dropped off with distances greater than 7.5 miles from home.

The best available theory to explain this ability is that cats have sensitivity to the earth's magnetic field. The theory seems to have factual basis, as when cats had magnets attached, the homing ability was disrupted.

Although we possibly cannot fully understand the mechanism of such an ability to travel we can feel that this is possible. Why not? If some birds and fish can find ways to faraway destinations, why would more intelligent cats not do it? Coming back to the places animals love seems possible too.

But how on earth could cats find not their homes, but their beloved human friends when they move to a new city or even a new state, thousands of kilometres away? Can such a thing be true?

Apparently yes. Dr. Joseph Rhine of Duke University documented a number of well authenticated cases. I mention "well authenticated" as skeptics were asking for the hard evidences that the cat that was left behind and the cat that arrived at the house were the same. Some of the cases were authenticated positively as the animal had some unique distinguishing mark, abnormality, or previous injury by which the owner could positively identify the pet. Dr. Rhine coined the term "Psi-Trailing" to refer to animals managing to locate their owners after the owner moves away and leaves the animal behind.

Rupert Sheldrake, an English biochemist and author, explains the strange connection between humans and their pets by the existence of specific "morphic fields," which allows animals and sometimes humans to have telepathic connections. That's how our pets know, Sheldrake tells us, when their owner is coming back home and they wait at the door. According to Sheldrake, all mammals have this ability (more or less). When the psychical link is broken by a long distance, it breaks the rhythms the pet feels and that may be what leads a cat back home.

Scientists do not know why this extraordinary navigational ability exists, but those who are not afraid to admit that we do not know everything, admit that in rare instances this ability does exist and is very effective. One more important point: if we want to give a rough estimate of how widely this ability is represented among cats, we must very seriously take into account that not all the cats, that have this ability and could come home, reach their beloved owners safely. When a cat needs to cover hundreds, sometimes thousands of kilometres between the cities, very often they need to go through rough and dangerous terrain, survive predators, rivers, deserts, and find food in a totally new environment. We will never know how many unsuccessful attempts are behind every successful trip.

If any of the cats that reached their owners through so many challenges could write the tale of their adventures, this would probably become a bestseller. It is unlikely that we will ever know how many loving cats were killed by cars, hunger, drowned in rivers, or killed by coyotes or dogs when they were in the middle of their trail of love, or possibly heartbreakingly close to their owners.

Because of the possibility of confusing a similarly marked new cat with the owner's pet left behind, researchers have insisted that there be incontestable distinguishing marks, physical abnormalities, specific previous injuries or specific behaviour patterns that would rule out it simply being a case of mistaken identity. Of the documented cases studied by Dr. Rhine, 54 were found to be credible (for more details on the cases mentioned in this section, see Rhine, 1983).

For example, in one case a cat followed its owner, a veterinarian, from New York to California. After five month when the cat disappeared in New York, the similar cat appeared at the house in California where the owner lived. The “new cat” looked exactly the same as the “old cat,” found and immediately settled down in the “old cat's” favourite chair, and, when the puzzled veterinarian examined the cat with the x-rays, he found that the “new” cat also had the same physical abnormality as the “old cat.”

Another case authenticated by Dr Joseph Rhine and Dr Sara Feather of Duke University involved a pet cat, known as Beau Cat. The cat was reported to be missing while the family was looking for a house in Texas. The father stayed in Texas and the family came home but there was still no sign of Beau Cat. The cat was missing for five months. When the family was already well settled in Texas, the cat suddenly appeared, not at its new home, but in the schoolyard where two members of the family happened to be. The mother worked at this school as a teacher, and her son was a pupil. Still another cat that was left behind in California, appeared 14 months later in Oklahoma at the address it never knew.

It must be obvious that not only American cats are able to undertake such incredible journeys. Unfortunately, not many cases are authenticated in other countries, but there are still a few. For example, a loving cat in France left home and followed his owner, a young man, who left home for military service. The cat traveled 75 miles through the Vosges Mountains in eastern France, close to the

border with Germany, and eleven days later he reached his owner's barracks. As we can see, the saying "artists love cats and soldiers love dogs" is not always accurate.

Dr. Myrna Milani, D.V.M., the author of seven books on human-animal interaction, tried to explain this phenomenon with the use of Bell's Theorem. Physicist John Bell proposed that all electrons function in pairs, with each electron spinning in the opposite direction to the other electron. He speculated that if you change the spin of one electron, the other electron would "sense" it and alter its direction according to the one whose spin was altered. Dr. Milani surmised that as all organisms are made of cells, molecules, and atoms, maybe the bond between two creatures can be established on a cellular or atomic level (see for example, Milani, 1987). Further study of this phenomenon can lead to unexpected new discoveries.

The legendary expert in animal behaviour, Nobel Prize winner Nikko Tinbergen, was confident that there are kinds of perception that are not yet known to scholars. These are his words: "if one applies the term [extrasensory perception] to perception by processes not yet known to us, extrasensory perception among living creatures may well apply widely." (Tinbergen, 1951: 201). Unfortunately, not many scholars have such an open-minded approach and a wide grasp of the general picture of the scholarly development. Instead, many of the skeptics and peers probably would demand scholarly explanation in order to accept the fact. Hopefully, the more open society that we are going into with the help of the internet will gradually change this neophobic attitude towards the development of science.

It seems quite a logical way of accumulating new knowledge by first accepting the existence of unexplained fact. And then you try to explain it. You never know, it might take several generations to fully explain the fact, but by dismissing the fact you are blocking the breathing pipeline of scholarly development.

Cats' amazing homing and psi-trailing ability seem to be bound to bring us to the breakthrough towards a better understanding of the universe around us.

At the end of the discussion of cat's homing instinct let me tell you one of my favourite jokes on this subject. A grumpy husband decides to get rid of a family cat. He drives for several kilometres, taking the family cat along, and then dumps it. When he comes back, the cat is already at home, sitting on a favourite sofa. The upset husband goes for longer and longer trips. Finally he takes a good supply of food, and goes for a whole day of driving. He drives for several hundred kilometres, goes out

of his city, and makes wild direction changes on country roads to confuse the cat. After many hours, in the late evening, he decides this is enough, dumps the cat, and starts driving home. Soon he realizes that he is lost somewhere on a country road. After a few hours of driving without much progress, he finally calls home. His wife answers the phone. "Is our cat already home?" he asks, "Yes." "Give him a phone. Let him explain to me how I should get back home."

The joke does not say if the clever cat asked in return for his services to the grumpy man to start behaving adequately towards the cat. Alternatively, if the cat enjoyed this mildly challenging fun, he might have asked the man to take him even bigger distances. You never know what's in a cat's mind!

Psychic Power Struggle

Establishment of psychic connections between cats and humans could have had a totally different original reason, not love and affection. Evolutionarily speaking, humans and big cats were competitors and rivals throughout their lives, even after the "truce" was established. It must have been during this long duel that humans and big cats started not only respecting each other, but started feeling each other's presence. Interestingly, some humans show the unexplained feel of the presence of big cats, particularly when their presence means deadly danger. Jim Corbett, the legendary hunter and conservationist, refers several times to the sense of danger, when he was hunting man-eating tigers. On quite a few crucial moments of his hunts, he was saved by this feeling. Here is one of the examples of him sensing that the unseen man-eater was waiting to ambush him. The text is written in the Fennimore Cooper-like detailed and suspense description of the real events, so characteristic of Corbett. This is from a story about a Mohan man-eating tiger (Corbett, 2003:122):

"On the fourth evening when I was returning at sunset after visiting the buffalo on the ridge, as I came round a bend in the road thirty yards from the

overhanging rock, I suddenly, and for the first time since my arrival at Kartkanoula, felt I was in danger, and that the danger that threatened me was on the rock in front of me. For five minutes I stood perfectly still with my eyes fixed on the upper edge of the rock, watching for movement. At that short range the flicker of an eyelid would have caught my eyes, but there was not even this small movement; and after going forward ten paces, I again stood watching for several minutes. The fact that I had seen no movement did not in any way reassure me the man-eater was on the rock, of that I was sure; and the question was, what was I going to do about it? The hill, as I have already told you, was very steep, had great rocks jutting out of it, and was overgrown with long grass and tree and scrub jungle. Bad as the going was, had it been earlier in the day I would have gone back and worked round and above the tiger to try to get a shot at him, but with only half an hour of daylight left, and the best part of a mile still to go, it would have been madness to have left the road. So, slipping up the safety-catch and putting the rifle to my shoulder, I started to pass the rock.

The road here was about eight feet wide, and going to the extreme outer edge I started walking crab-fashion, feeling each step with my feet before putting my weight down to keep from stepping off into space. Progress was slow and difficult, but as I drew level with the overhanging rock and then began to pass it, hope rose high that the tiger would remain where he was until I reached that part of the road from which the flat bit of ground above the rock, on which he was lying, was visible. The tiger, however, having failed to catch me off my guard was taking no chances, and I had just got clear of the rock when I heard a low muttered growl above me, and a little later first a kakar went off barking to the right, and then two hind sambur started belling near the crest of the triangular hill."

Here is another example, described by Corbett. This is from the story of Chowgarh tigress, who killed 64 humans before Corbett managed to kill her (Corbett, 2003:81-82):

"I have made mention elsewhere of the sense that warns us of impending danger, and will not labour the subject further beyond stating that this sense is a very real one and that I do not know, and therefore cannot explain, what brings it into operation. On this occasion I had neither heard nor seen the tigress, nor had I received

any indication from bird or beast of her presence, and yet I knew, without any shadow of doubt, that she was lying up for me among the rocks. I had been out for many hours that day and had covered many miles of jungle with unflagging caution, but without one moment's unease, and then, on cresting the ridge, and coming in sight of the rocks, I knew they held danger for me, and this knowledge was confirmed a few minutes later by the kakar's warning call to the jungle folk, and by my finding the man-eater's pug marks superimposed on my footprints."

One more excerpt from Corbett's story of Chowgarh tigress. Here the sense of tiger presence appears together with the tiger's silent arrival at the scene. Interestingly, apart from Corbett, the buffalo at the scene also became aware of the presence of the tiger after a few seconds, although the tiger would have approached the scene downwind (Corbett, 2003:81-82):

"The man on the ground had made several trips with the grass he had cut, and Madho Singh on the tree was alternately shouting and singing lustily, while I stood on the rock smoking, with the rifle in the hollow of my left arm, when, all at once, I became aware that the man-eater had arrived. Beckoning urgently to the man on the ground to come to me, I whistled to attract Madho Singh's attention and signalled to him to remain quiet. The ground on three sides was comparatively open. Madho Singh on the tree was to my left front, the man cutting grass had been in front of me, while the buffalo now showing signs of uneasiness was to my right front. In this area the tigress could not have approached without my seeing her; and as she had approached, there was only one place where she could now be, and that was behind and immediately below me.

When taking up my position I had noticed that the further side of the rock was steep and smooth, that it extended down the hill for eight or ten feet, and that the lower portion of it was masked by thick undergrowth and young pine saplings. It would have been a little difficult, but quite possible, for the tigress to have climbed the rock, and I relied for my safety on hearing her in the undergrowth should she make the attempt.

I have no doubt that the tigress, attracted, as I had intended she should be, by the noise Madho Singh was making, had come to the rock, and that it was while

she was looking up at me and planning her next move that I had become aware of her presence. My change of front, coupled with the silence of the men, may have made her suspicious; anyway, after a lapse of a few minutes, I heard a dry twig snap a little way down the hill; thereafter the feeling of unease left me, and the tension relaxed."

It was exactly the same unexplained feeling that helped Corbett to avoid death while he was following the blood trail of his first man-eater in Champawat in 1907. He became so traumatized and absorbed in examining the severed leg of the last victim of the tigress found on the river bank, that he forgot for a few seconds about the danger of the man-eater. The same sense helped Corbett many others times, including his hunt of the Rudraprayag leopard and Kanda tiger. Corbett himself coined a new term, "jungle sensitivity," to describe this feeling. Contemporary science is unable to explain the materialistic basis of this sense. Corbett's detailed accounts of his hunts are possibly the best starting point for a research if someone is interested to unveil the mechanism behind this fascinating phenomenon. D.C. Kala in his biography of Jim Corbett mentions the work (manuscript) done by American doctor Jack Phelan on this subject, but despite an extensive search with the help of my Corbett friends, no trace of the work had been found.

As we can see, not only can cats can feel humans, but humans can also feel cats, particularly big cats. When there is a need for survival (and feeling big cats had a great practical importance, we can agree), the wisdom of natural selection will often provide a solution for this need.

Unfortunately, human technological mastery is not good enough yet to understand the mechanisms not only of some more complex animal senses, but even of our own human senses. And let us remember: if we would like to explain this phenomenon sometime in the future, we need first to accept its existence.

CHAPTER TEN

Friendship: Tiger Therapy, Sounds from God, and John Lennon's Double Fantasy

Many readers of this book would agree that humans and their pet cats can be great friends. True friendship and dedication does not happen very often, but when it happens, this can reach truly amazing levels of loyalty. This is the strength of this attachment that drives cats across the countries and continents to cover hundreds and even thousands of kilometres to find their beloved friends in a totally new territory. This is the strength of this love that makes human to go into the altered state of consciousness without the feel of fear or pain fight, receiving horrible wounds, for the life of their beloved cat or dog against the attack of a much bigger and vicious dog. But can humans and big cats also form such a strong attachment?

My suggestion is that the love that we have for our pet cats has deep evolutionary connections to our profound feelings towards big cats. As I tried to argue in this book, our reverence and respect towards the big cats has a long history of shared evolution, or, more precisely, co-evolution. Big cats were the most important environmental agent for our distant ancestors. They pushed our ancestors to adopt a revolutionary new survival strategy. This new strategy changed forever the ancestral ape's way of locomotion, looking, making sounds, smells and behaviours. These changes led to the establishment of a new species with an array of unique features. We became the only species that lives on the ground and sings, the only land species that habitually walks on two hind legs, the only species that has the ability to follow the external rhythm and can be entrained, the only species that uses various substances to change the colour of its own body, the only species that can ask questions and has a complex language and speech, the only species that can use fire, cook food, use cloth, write books and make computers.

In this long line of changes we were always profoundly influenced by big cats. We were initially afraid of the big cats as their humble prey, but later we started challenging them with powerful warning displays, with the power of stone throwing, and our legendary unity. We became the Kings of scavenging situations, displacing

even the Kings of the Animals at their kills. We were feeding on their kills and followed them all around the world. For most of our evolutionary history, we were regarding and treating them as our gods, gracious and sometimes bloodthirsty, but always powerful and magnificent. We were always revering and envying their strength, speed, beauty, cleanliness, relaxed way of life. On their side, big cats gradually learned to revere fighting spirit of the group of bipedal primates in the powerful state of the battle trance. We both started avoiding direct violent conflicts and formed one of the longest and the most successful running truces between the competing species. This truce enabled our species to become two unrivaled rulers of the planet earth, and two of the most widely spread land species on our planet.

Then came time when the long running truce was abandoned and we entered the shameful historical period of our interaction with the big cats. The species of bipedal and noisy primates without the natural means to kill their prey, received the deadliest weapons in their hands. They became intoxicated by the feel of their own power and the ability to kill. This was a period lasting about ten thousand years, when our ancestors started establishing themselves as the single most powerful species on the planet. And what could be a more direct way to establish this superiority over the entire nature if not by killing the previous rulers of the natural world, our long-time benefactors, big cats! So we started killing our feared, loved and respected Gods. I agree with Barbara Ehrenreich that the central point of hunting was not so much obtaining food, as by that time humans started much more profitable agriculture, but gaining power over the rest of the world and gaining respect among fellow humans (Ehrenreich, 1997).

But in the end the millions of the years spent in respecting and adoring big cats showed itself. The years of shared life of our ancestors and big cats with their fears, joys and behaviours did not vanish without a trace. These memories still live in our collective psyche, even in our contemporary, internet and digital media dominated world, shows in our behaviours and thoughts, in our nightmares, fears, beauty standards, aspirations and moments of joy.

Evolutionary memory is a great force. We are still afraid of often harmless spiders more than guns which are much more dangerous; we are more afraid of heights and flying than driving cars, although we are more likely to die in a car crash, than in a airplane disaster; and we are still mesmerized by the beauty and the lethal

grace of the big cats and still consider them the kings of the animals. In the deepest layers of our psyche, they are still gods. It was not the Ancient Egyptians who started worshipping cats and lions. We were worshipping them for their entire our life as a species. And we still worship them. We find them the most beautiful and the most majestic creatures.

With Tigers in Bed

The 20th century started a very interesting new phenomenon – keeping big cats as pets. Of course, some ancient rulers kept big cats as pets, as a sign of their ruling of the whole world, both humans and animals, but in the 20th century this phenomenon acquired new colours. According to some estimates, there are currently about 10-12 thousand tigers living as pets at homes in the USA alone and the number is growing. This is much more than the number of all the tigers living in the wild in the entire world. The idea of keeping tigers and lions as pets in the bedrooms seems like a nightmare for family security, but apparently for those who do this the joy of interacting with these magnificent animals outweighs the possibility of their attack.

"Touching a face of a tiger is like touching a face of God" says Steve Sipek, American actor who lives with several big cats, "I feel that enormous, overwhelming pleasure." Sipek is better known under his acting name Steve Hawkes. He fittingly played Tarzan in the films "Tarzan, King of the Jungle" and "Tarzan and the Brown Prince." According to Sipek, the reason for his passion is not dominating the strongest predators. "It's love. Once you love something you lose your fear. You can trust them and they can trust you. Once that happens, you're home free." In the words of the actor you can feel that his interaction with his big cats has very clear spiritual overtones. He was so sure of the possibility of true spiritual connections with big cats that his only son was raised in the same house together with grown up lions and tigers, sleeping in the same bedroom on the same bunk bed.

Well, we can argue whether the idea of having tigers and lions in your bedroom is good or bad, but for sure there are people on both sides of the argument. Dangerous as it is, this raises question whether many other activities that humans do and are associated with certain danger, make people happier than keeping big cats. Gloria Johnson, another lover of big cats, puts a sensible argument: "If you're an adult, and you want to do something risky like sky dive or bungee jump... that's ridiculously dangerous to me, but I don't ban your right to do it." Another interesting dimension in this argument is that plenty of risky behaviours are done to prove yourself something, or for the rush of adrenaline. Steve and Gloria, and many other owners of big cats do this for love, not for the thrill of danger.

According to Gloria Johnson, who is known to cuddle and sometimes sleep next to her pet white tiger, "They give you something that people can't – they give you unconditional love. The bonding with a wild animal is something you can't explain. It's like a religious experience."

Carole Baskin, another great lover of big cats, sees the situation in a totally different light. In her opinion the ownership of big cats in unacceptable as in a large number of cases big cats are loved and cared for while they are adorable cubs, but are abandoned as they grow older. If we see the numbers of the fatal big cat attacks on humans and compare this number with the numbers of the abandoned big cats, we can come to conclusion that big cats have much bigger chances to be abandoned by the owners than their owners to be attacked by their lethal pets. There had been five lethal cases of tigers attacks, mostly to the breeders, in five years, against 150 felines that live in the sanctuary organised by Baskin. Big cats are better in keeping their promises than we are.

Big cats are loved by more than only a very few odd individuals. When Bobo, the pet tiger escaped from Steve's house in July 2004, Florida, and was shot by a police officer, it brought such a public outcry, that for some time the police officers were advised to do their job without their uniform to avoid harassment. According to the police statement, they received several hundred phone calls from angry citizens, including death threats. Even though we know tigers and lions cannot live on the streets and are not to be trusted completely, we still have the religious love and reverence for them, and we want to believe the true and safe friendship between humans, tigers and lions is possible. That is the reason for the popularity of YouTube

videos of humans, tigers and lions embracing each other, or even sleeping in the same bed. On one of the YouTube video, where a man was sleeping with an adult Bengal tiger in the same bed, somebody wrote a comment "I have never been so jealous in my entire life."

Humans and big cats were usually believed to be unable to co-exist in the environment of civilization. Many wildlife reserve experts vouch for total segregation of humans and big cats in order to avoid unnecessary clashes between them. Our love and adulation towards the big cats is gradually changing this old axiom. It is difficult to see what will happen in the next 30, 50 or 100 years, but it is quite clear that human love for big cats will require some form of better regulated environment. Big cats will never be fully safe, and it seems to me that some humans are ready to accept the risk. If you think such people are crazy, please remember, that no one can guarantee that our dogs will never attack and injure or kill their owners or their children, but millions of people still want to have dogs around.

Forget dogs. Being killed by husbands is one of the leading causes for untimely death for women worldwide. In the USA alone, more than three women are murdered by their husbands and boyfriends **every day**. And remember, the killer is a person who gave an oath to care and love the victim for life. So if some humans want to have big cats around, they should not ask for a full guarantee of safety. No one can give them such a guarantee. If we accept the risks of living with families, with the possibility that our family members might kill us, if we accept the risks of living with dogs, with the possibility that our dogs might attack us, if we accept the risk of going to city centres, with the possibility that we might become a victim of a terrorist attack, and if we accept the risks of driving cars and flying on planes, possibly one day we will accept the risks of living with big cats. In the past we treated big cats like gods (some of us still treat them like gods), so we have to accept that "God works in mysterious ways." Some well-balanced set of regulations in human-big cat interactions might save both of us from unnecessary anxiety, heated debates, sad mistakes and tragic accidents.

Tiger Therapy

Animal Assisted Therapy is becoming quite an important part among various branches of modern therapy. When Freud was taking his dog, Chow Chow Jofi to his psychoanalyses sessions, he could see how the dog's presence was relaxing a troubled person. Children were particularly responding positively to the appearance of the dog. Apart from the dog, now various animals are used to assist human anxiety, autism, and other conditions.

Animals are believed chiefly to relax a tense human, and give a sense of security and social acceptance. The term biophilia, first used by Erich Fromm, and later developed into the "biophilia hypothesis" by Edward O. Wilson, is based on an assumption that humans naturally love to be surrounded by other living beings.

In the gradually widening world of the benefits of interaction with animals and the natural world, the role of the big cats can be unique. And our long association and our deep religious fascination with the big cats, our natural love towards them might have plenty of therapeutic benefits. I want to discuss a couple of the examples and put forward some prospects.

Tiger Mantra

When I was attending meditation sessions in India in January 2010 during the educational congress, I was fascinated to hear the most potent chanting formula that starts virtually all the meditation sessions. This is the syllable "Aum", or "Om." The formula is often pronounced by prolonging every vowel of the chant, so it sounds as "Aaauuummm." I was fascinated because the long drown-out "Aaauuummm" is the best "transcription" of the mating call of the tiger. Lucky visitors might hear this call in tiger reserves and national parks in India all year around, particularly from November to April. Without doubt, various peoples populating the Indian subcontinent were hearing this sound with a deep-rooted reverence and fear for

thousands of years. So let us ask a simple question: Is it a coincidence that the most potent meditative chanting syllable in India sounds exactly like a long drawn-out tiger call? Even if there are no direct historical and linguistic connections between the Aum mantra and the tiger call, it is possible to propose that this drowned out syllable became so powerful in reaching our deepest centres of the brain because it reminds us of the sound of the biggest of all big cats, our first god, whom we both revered and feared.

There is more. According to Indian tradition, "Aum" and "Om" mantras are so powerful because this sound itself was the name of God, and it was also the first sounds made by God. In Sanskrit, the om/aum mantra is sometimes referred to as *praṇava*, literally "that which is sounded out loudly." At the end of the prayer, accompanying the sacrifice, this sound was used as an invitation to the God to accept the sacrifice. These three letters A, U, and M, have their own meaning, connected to creation, preservation and destruction. In short we can say that the mantra "Aum" forms the very foundation of Hindu religion and philosophy.

If we recall that in many cultures various animals and birds were referred by the sounds they make, then giving the name "Aum" to the dominant animal, who was making this sound, would be quite logical. At least two ancient peoples from Siberia, Udege and Nanai, call the tiger the name "Amba," a name that bears certain resemblance to the tiger call. These people, characteristically, consider tiger a god-like creature, referring to it as "Grandfather" or "Old man."

A loud meditating sound, originating from the deep forest, and coming from the ancient God, the God that was combining the merciful benefactor and the ferocious killer, is as mysterious as the depth of human-tiger interaction. After all, these esoteric elements possibly had much more direct practical evolutionary meanings to our ancestors than it is usually believed.

I hope that some scholars, reading these words, will be interested to conduct intricate psychological experiments, using both the recorded sounds of meditative chant and the sounds of the tiger call, to research this fascinating topic. I would propose that hearing the tiger's mating call can be a potent trance-inducing means. Craig Packer once said: "Big cats are disappearing fast all over the world, but their evolutionary impact on our psychology will likely persist forever" (Packer, 2011). I agree with these words and would like to add, that further research of this impact

might bring unexpected revelations to the understanding of our own psychology and evolutionary history.

Nowhere Man in the Middle of Nowhere

There are other venues for "tiger therapy" as well. Humans do plenty of dangerous activities in order to make their lives more challenging and interesting. I discussed this topic briefly in my 2011 book, dedicated to the role of music in human evolution (Jordania, 2011). As a natural product of our evolutionary past, humans occasionally need life-challenging events, when our deepest survival brain centres are activated. As a result, at least some of us enjoy life the most when we have to overcome life-threatening situations. But such situations are not a part of our everyday civilized life. So we create them. Jumping from the airplanes, swimming with sharks, bungee jumping, running in front of racing cars (or bulls), or climbing cliffs are some of these dangerous and invigorating activities. For others doing such unsafe activities and paying handsome amounts of money in addition is nothing short of madness. Many feel thrilled enough by attending bull-fighting and Formula 1 races, or even better, watching the thrillers and horror-movies on a TV screen, to see how others are doing dangerous activities. But of course, not everyone is into these dangerous activities and instead prefer safe and comfort-guaranteed lives. Possibly this is one of the reasons there are so many of our fellow humans who suffer from depression. Depression is a psychological plague of contemporary civilized life. Widespread depression is probably the price humanity pays for making human life too safe and devoid of any serious challenges. Nothing is good in excess. Safety is good, but too much safety in every aspect of life can lead to depression and losing interest in life.

When people face mortal danger, when they have to overcome serious obstacles and threats to their life and life of their loved ones, depression as a rule goes out of the window. This is confirmed by the stories of some of those who survived suicide

attempts. At the moment of suicide, when you look death in the eyes, people often feel the craving for life and, if they survive, they might feel much better. If you have seen the confronting documentary film "The Bridge" by Eric Steel about suicidal jumps from the Golden Gate Bridge, you know what I am talking about. Sometimes soldiers, coming back from the hell of the active combat zone, find themselves so used to the intoxicating feel of facing challenges of survival that they cannot cope with normal life, and go back to the dreaded war zone. Those who had seen the Academy Award winner "The Hurt Locker" know what I am talking about. In this context, engaging people in dangerous activities can provide a feeling of fullness of life and help with depression.

The life of my beloved Beatles presents a very good example of the invigorating power of life-threatening situations. Everyone, even the most successful of humans, might experience moments of depression, but for some this becomes an overwhelming power of their lives. John Lennon was particularly prone to depression. He was known to stay in bed for weeks, doing nothing, without even bothering to get up. Journalist Maureen Cleave famously said that Lennon was probably the laziest person in England. This was said in a 1966 "Evening Standard" interview, best known for the "more popular than Jesus" comment. As the challenge of getting on the top of the popular music world was completed by 1966, Lennon lost interest. Until 1980, when he was killed, Lennon's life was a mixture of moments of activity (mostly prompted by his friend and rival Paul McCartney's incessant activity), and by long periods of inactivity and depression. The last year of John's life, 1980, began in a state of such acute depression that he could overhear the servants wondering if John and Yoko would both commit suicide (Rosen, 2001).

Then, in the beginning of June, just six months before his shocking assassination, John fulfilled his dream and went on a sea journey from Rhode Island to Bermuda. It was a 1000 kilometre, six-day trip across half of the Atlantic, and on the third day of the trip they were hit by a violent storm. The 13-metre-long schooner was thrown up and down by huge waves. "It was a huge storm and everyone thought we might die," said one of the four guests on this memorable trip. "We were in the middle of it and the waves looked like the size of buildings." John Lennon could have been locked in his cabin, trying to watch TV, but he instead decided to join

Captain Hank at the wheel, dressed in wet-weather gear. By that time all the members of the crew were seasick. Captain Hank gave the wheel to John, and when he saw the Beatle was able to guide the schooner through the frightening waves, he left John alone at the wheel, complaining that he was seasick as well.

Here he was, the millionaire and much adored Beatle, who was often not bothering himself to get up, in the middle of a perfect adventure, with a challenge to save himself and his friends in a stormy ocean. Lennon later said in an interview that the feeling was just like going on stage. "At first you panic and then you're ready to throw up your guts, but once you get out there and start doing all the stuff, you forget your fears and you got high on your performance… So there I was at the wheel with the wind and sea lashing out at me. At first I was terrified, but Captain Hank was at my side so I felt relatively safe because I knew he wouldn't let me do anything stupid. After a while Captain Hank wasn't feeling too well so he went to the cabin below." Captain Hank was absolutely correct in acknowledging the inner toughness of the seemingly moody and lazy rock star.

"Once I accepted the reality of the situation, something greater than me took over and all of a sudden I lost my fear. I actually began to enjoy the experience and I started to shout out old sea shanties in the face of the storm, screaming at the thundering sky."

The result of the experience was truly amazing. None of the therapies could have matched the cathartic experience of sailing through the stormy weather of the notorious Bermuda Triangle. When they arrived to Bermuda, Lennon was a different man. Not a shred of the depression was left. In the following weeks, Lennon worked like crazy, his creativity had no boundaries, and one of his best albums, "Double Fantasy" was soon recorded. Lennon considered the Bermuda trip one of the most important events of his life.

Challenges play the same role in our lives as bushfires rejuvenate nature.

Touching God

Close interaction with tigers and other big cats, including feeding them and touching them, can have a profound psychological effect on any human being. Closeness with the big cats provides a combination of the deep-seated fear and fascination with them. Big cats are the symbol of lethal danger to human life. Every second you spent next to a tiger or a lion can be the last second of your life. And yet when you are next to them you are just mesmerized by their majestic beauty and immense power.

Taking into account the profound psychological effect that close proximity to big cats can provide, I would like to propose the creation of the "big cat therapy sessions." I suggest that depression sufferers will be feeling much better after close interaction with hand reared tigers and lions.

Some readers and health professionals will definitely object to this prospect, claiming that this will never happen, and this should not happen, for many reasons. Above all, we will never be totally safe from the killer instincts of the big cats. This is correct, as correct as the sad fact we will never be safe from the attacks of our domesticated dogs. 4.7 million Americans are bitten by dogs every year, and an average 26 humans are killed from dog attacks in a year in the USA. You need to ask insurance companies how safe dogs are. Apparently, 50% of insurance payouts in the USA go to dog attack victims. Well, pet tiger attacks can definitely be more lethal than dog attacks, although despite the presence of more than 10 000 tigers kept in private ownership, there is on average only one fatal attack per year (mostly among tiger breeding organizations). As I have already mentioned, tigers are much more likely to suffer from neglect and abuse from their owners than their owners to suffer a lethal attack from their tigers.

As mentioned above, the fear of possible tiger attack does not stop some animal lovers from keeping tigers and lions in their homes and even bedrooms. Spending a few minutes with big cats, attended by a trained professional in handling animals, is much safer than having a tiger constantly in your bedroom. If a depressed person finds a remedy from his debilitating condition from the close proximity of the tigers or other big cats, I think the minimal risk will be justified. Also bear in mind that it

is the feeling of risk that gives particular therapeutic power to our interaction with big cats and other dangerous activities.

Let me express one prediction. If the trend of keeping big cats as pets continues, with every generation, the most placid offspring will be selected for breeding. Therefore, it is possible that at some point in the future, scholars will start discussing the "domestication" of big cats. I am sure many animal lovers will vehemently object to this crazy prospect. Apart from the danger to humans, they will say that a real tiger is only the one that roams jungles. I believe they are right, but only partly. Life on our planet has changed, and many animals are finding their place in the human-created world to survive and thrive. If some big cats can be raised by humans and become relatively safe to humans, this could be put to good use for the well-being of both big cats and humans. We should remember that ancestors of dogs, horses and cattle were living a free and wild life before their domestication. Today there are many more dogs than their ancestors, wolves, in the world.

Of course, tigers and lions most likely will never be fully domesticated. Our current favourite pet, the house cat is a good example of this. Despite millennia of living with humans, house cats still are independent creatures. On the other hand, "domestication" of big cats might take less time than domestic cats, as the breeders will be understandably much more careful in breeding big cats for safety than when breeding house cats. A short-tempered house cat is not as threatening as a short-tempered house tiger. So the creation of the breed of "therapy tigers" might sound as totally absurd for animal lovers today, but from the eyes of a person from the middle of the 21st century or the beginning of the 22nd century, this idea might be not only the acceptable idea, but a hard reality.

To start with, there are already quite a few places where animal lovers can have close contact with lethal predators in controlled environments. Australia, New Zealand, UK, Argentina, Thailand, South Africa, Zimbabwe, Zambia, Kenya – all offer a possibility of such encounters.

Dreamworld in Australia, Zoo Lujan in Argentina and Tiger Temple in Thailand are possibly some of the best known among these places. I visited Zoo Lujan in September and October of 2013, and in July of 2014. Several dozens of hand-reared tigers and lions in the zoo have been accepting hundreds of visitors daily for almost two decades without any major incidents so far. Of course, it would be silly to declare

such encounters 100% safe – let us remember that even wife-husband interactions cannot be declared fully safe.

I was particularly impressed by the fact that Zoo Lujan personnel do not make any selections from the available young cubs in order to have more placid adults in the future. According to their principles, any cub will grow up without developing a hunting instinct if they are brought up from their infancy in a way that they do not experience hunger and competition for food. Apart from this, tigers and lions are raised together with dogs, and social dogs apparently help big cats to enhance their social skills and teach them to be gentler when playing. The widely-held misconception that Zoo Lujan animal handlers drug their animals comes from the fact that big cats naturally spend most of the day resting and sleeping. Because of this same fact, for example, Australian Dreamworld organizes their famous "tiger walks" with visitors only in the early morning hours when the tigers are active.

We can boil down the Zoo Lujan's 20-year practice into a single question: is it, in principle, possible to raise tigers and lions so that they actually do not develop their hunting and killing instincts? At first sight this seems like a no-brainer. "How on earth can anyone even think of raising tigers and lions without them developing their hunting instinct, when even small, domesticated house cats that have been living with humans for thousands of years still maintain a strong hunting instinct?" I asked myself. Quite paradoxically, it is exactly this comparison between house cats on one hand, and tigers and lions on the other hand, that provides support to this seemingly impossible idea.

Think of these two simple and quite well known facts about house cats on one hand, and tigers and lions on the other:

(1) If you raise a young kitten for several years, providing all the needed care and food, and then for some reason leave the now full-grown cat without any support or care out on the street or in a forest, that cat will most likely survive on its own – therefore cats do not need to be taught to become hunters – they are essentially natural born hunters. On the other hand, tigers and lions, when raised by humans in a contained environment, will most likely die from starvation if left on their own in the jungle – tigers and lions need to be taught how to hunt, and the role of the teacher is generally undertaken by their mother (or pride). Therefore, unlike house cats who

can hunt without being taught so in the past, tigers and lions are not natural born hunters.

(2) Now think about this: virtually all well cared-for and often over-fed house cats still kill various types of prey from mice to birds to butterflies, regardless of their existing sources of food. On the other hand, lions and tigers rarely kill unless they are genuinely hungry and in need of the sustenance. It seems that tigers and lions kill to eat while domesticated cats merely kill for the excitement of it.

These differences in behaviour seem to point to the possibility that our house cats, who spend hours on our sofas and beds sleeping peacefully and gently purring, are much more inclined to killing other animals indiscriminately than the ferocious tigers and lions are. I expect many readers of this book not to agree with my conclusions above, but instead to take this information as food for thought.

As I have also been to Dreamworld in Australia (in 2011), let me make a brief and informal comparison between these two places. Apart from the rather serious price difference in getting intimate with the tigers in Australia and Argentina (respectively about 350$ and about 25$ for a single visitor), there are several other notable differences for visitors. First of all, at Dreamworld there are set times for contact with tigers (all in the morning), while at Zoo Lujan you can go to both the tigers and lions at any time. Secondly, before entering into an enclosure with a tiger inside, in Dreamworld you have to sign a declaration stating that you do not hold Dreamworld responsible for the risk involved; In the Argentinean zoo you do not sign any papers, and if you decide to enter the enclosure your only problem is that you need to wait in the queue. Apart from this, at Dreamworld you can take only photos, not videos – at Zoo Lujan you can take both photos and videos. And finally, all the photos of the session are taken by a Dreamworld photographer, and the photos officially belong to Dreamworld. Therefore visitors cannot put any of the photos on the YouTube or other public places due to copyright infringement. Conversely, all the photos (and videos) are taken at Zoo Lujan by the visitors, belong to visitors and as expected, many of them share their excitement with others via YouTube and other media-sharing platforms.

As one would expect, there are mixed opinions about getting close to lethal predators, from skeptical and negative to absolutely excited and supportive ones.

Negative comments are divided into two usual topics: (1) it is unsafe to have humans and lethal predators interacting so closely, and (2) wild animals should run wild and not be treated as domestic animals. As I mentioned earlier, I agree that there is no way to guarantee 100% safety in such interactions in much the same way as no one can guarantee when giving you a puppy that it will never attack you or your child. Answering the second argument, I also agree that the best place for tigers and lions to live is the jungles and open savanna. Unfortunately, human population growth has already made this option impossible. Even if conservationists manage to return all these 30+ thousand tigers that live today in private houses, tiger farms and zoos to the wild, there is simply no safe space left for them out there. The matter needs much more serious consideration and study than heated comments from opposing sides on internet forums.

In my opinion, if big cats are kept happy and content in a decent environment, and during the day they accept a few awestruck humans who come to them in order to regain their interest in life, this might be worthy of the minimal risk involved in these interactions.

Depressed God

As it feels like a time for new controversial proposals, let me tell you another one. This time not my own idea but from the author Elizabeth Thomas Marshal. She proposed that big cats feel much happier at the circus than at zoos. This idea overturns the western model, popular with animal lovers, that the circus is a totally unacceptable environment for wild animals. According to this widespread belief, animals suffer from the unnatural behaviours they are asked to perform at the circus. Contrary to this popular viewpoint, Marshal Thomas describes her impressions of seeing the big cat behaviour at the circus and at the zoo, and suggests that big cats find the environment of the circus much more interesting and suitable for their intellectual development than being the passive live exhibits at the zoo.

I support this proposal. I have spent many hours, days and weeks both at the zoo and at the circus, watching the behaviour of big cats, and I believe Marshall Thomas is correct. Even if they have a good territory, even if zoo keepers hide their food, making them search for it, and give them toys, the zoo environment is still too dull and unchallenging for the intelligent and active big cats. Like humans, suffering from depression in a dull and safe city life and craving for some real challenges, many big cats are suffering from the dull and safe life of playing the role of immobile exhibits of the zoo territory. On the contrary, tigers at the circus are always waiting for the moment when their life changes, moments when the rehearsals and performances are on. I have seen on many occasions, when the time for their performance approaches, they instantly light up, stand up on their feet, feel alert and alive.

I am not sure if the Western World will listen to this argument and will allow the shows with big cats to be back to the circus. If such a miracle happens, there will be two possible problems for the big cats at the circus: (1) the possible violence from the trainers to the animals, and (2) the lack of space for the animals to move freely. For most of the animal-lovers the first problem would seem much more important. As a matter of fact, most of the trainers stopped using violence decades ago. My good friend, Russian tiger training legend Nikolai Pavlenko, recorded every rehearsal of raising and training one of his tiger cubs. Thousands of hours of training are on video. You can see how the cub learns, by virtue of the trainer's patience and the system of reward, to do complex moves and how he is integrated gradually in the performance with other tigers. Any violence is out of the question.

The second problem, the problem of space, is more daunting than it might seem to readers. Animals are sometimes crammed in small cages, particularly during their transportation. Sometimes their transportation turns into a catastrophe. This was the case with Nikolai Skvirsky, a Russian lion trainer. In 1999, the show was returning from the successful tour in Saudi Arabia. Before the flight started, the lions were kept for long hours in a cargo section of a plane under the sun on the runway, and without the proper ventilation. Finally, when the plane arrived in Moscow, four out of seven lions were found dead in their cages. They apparently died from dehydration and asphyxiation.

If the circus managers solve the problem of space and environment for the big cats, living with the challenges of the circus life might be found to benefit lions and tigers. Nikolai Pavlenko told me several times that he cannot imagine himself retiring and no longer entering the cage full of his beloved tigers. At the age of 73 he still cannot imagine his life without the daily exciting interaction with his dangerous friends. The same way, I believe, if you free all his tigers from the circus performances and place them in large territories of contemporary western zoos, the tigers will start missing the challenging and interesting life at the circus, where they were enacting the most ancient and the longest running show on the earth: a six-million-year-old story of rivalry and reverence between humans and big cats.

CHAPTER ELEVEN

Individual Selection, Group Selection, and Multi-Level Selection, as Seen through the Eyes of a Dutch Counterintelligence Officer

Before we conclude, I would like to discuss briefly one aspect of the group and individual selection models from the point of view of our discussion of the evolutionary interaction between humans and big cats. The notion of battle trance gives us particularly good food for thought. Battle trance seems to be the clear example of the proverbial group selection model. But can we really talk about this "discredited" (for some) or the "resurrecting" (for others) evolutionary model seriously?

Contemporary evolutionary science mostly concentrates on the notion of the "selfish gene" and the idea of individual survival, suggesting that selfishness is the ultimate winner in the evolutionary struggle. This theory, and generally the idea that we are by our nature selfish and ruthless creatures, has a particularly strong grip on human minds. This was the case with the "man the hunter" hypothesis according to which we are descendants of selfish, ruthless killers and cannibals. The theory of "man the hunter" still has plenty of supporters, although it is gradually losing its supportive factual evidence. The same is true of the "selfish gene" theory. It has a stronger grip on our psyche because it tells us how bad we are.

You can find on YouTube an interesting recording of the 2006 meeting between Joan Roughgarden and Richard Dawkins. These two distinguished scholars are in different methodological camps. Roughgarden argues that humans by nature generally are cooperative and altruistic. The founder of the Selfish Gene theory, Richard Dawkins has a totally different view, and during the meeting he made an interesting comparison between the reality of the "nasty ruthless unpleasant view of the world," and human wish to have "a nice, cooperative, friendly, unselfish view of the world." He concluded with the words: "what matters is what's true not what makes us feel good."

Dawkins' words seem true to many humans as we have an inherent trust of the "bitter truth" than the "rosy dreams that make us feel good." This is a very interesting psychological phenomenon which was very well described (in practice) in the books of Oreste Pinto, Lieutenant-Colonel of the allied intelligence during the Second World War, a legendary Dutch counterintelligence officer, whom Eisenhower famously declared "the greatest living authority on security."

Pinto wrote that when allied intelligence were preparing spies to send them behind the German lines, they were supplying them with two cover stories: the first one was the official story to reveal to the German officials (for example, "I am a school teacher searching for my kids"), but in case there was suspicion and distrust of the legend, there was a second legend, presenting a spy in a more negative light. This second legend was presenting the spy, for example, as a petty thief, or as a crook, or as an unscrupulous gigolo. As an excellent psychologist, Pinto explained that when there is a suspicion over some issue, people (colleagues, friends, wives, judges, police) as a rule believe more readily a negative story, or "bitter truth," than "rosy dreams." I call this phenomenon, when we believe in equally false information more readily when it is negative, the "Pinto Syndrome." Psychologists have known for a long time, that bad news grabs our attention better than good news (see, for example, Baumeister at al., 2001). Apparently bad news grabs not only our attention, but our trust as well.

So, let us be aware that we are instinctively inclined to trust more in negative information than positive. As a result, when a proponent of the selfish gene tells us that we humans are by our nature selfish and violent, we believe it more readily, than the alternative suggestion that humans are by nature a cooperative and altruistic species. Ironically, on this point, Richard Dawkins, arguably the most celebrated atheist of our times, is very close to the view on human nature expressed by Medieval religious leaders who for centuries were instilling in us that we humans are by nature selfish and sinful creatures.

This book is by no means dedicated to this huge problem, although my sympathy towards the "group selection model" of evolution is not difficult to notice. And it is good that there are some positive changes in the air for the group selection model. After a few decades of domination of the "individual selection model" the group selection model is finally making a comeback. The model of group selection

has been resurrected by Edward Wilson, David Wilson and Elliot Sober in the form of "multilevel selection theory" (see, for example, Wilson, 2009; Wilson & Sober, 1998). This theory does not lean towards individual or group selection but can be used to evaluate the balance between group selection and individual selection on a case-by-case basis.

I want to discuss here a single but important issue: what happens when the interests of individual survival and the interests of group survival are in direct conflict with each other? The idea of possible contradiction between the interests of the group and the individual is crucially important, but not always taken seriously into account. So let me outline a few situations where these two principal evolutionary forces clash with each other, and see what happens.

Group Selection vs. Individual Selection: Match in Six Rounds for the Title of "Undisputed Champion of Multi-Level Selection League"

Here is the brief account of the grand match between the forces of individual and group selection. This match that has been taking place since life originated on our planet. In every round various situations with the direct conflict of interests between individual and group selection forces are discussed.

Round 1: To have a long life of each individual animal is good for the individual animals, but bad for the group

LOGIC: Each individual animal living for many years can naturally be considered good for an individual. Animals with longer individual life can have more offspring, and generally make a larger imprint on the life of its own and related species. But is the long life of each individual animal good for the group (species)?

To answer this question, we should remember that one of the key elements of the survival of the species through the evolutionary difficult times is the ability to quickly adapt their genetics and behaviour to the changing environment. In those species where the individual lifespan (and the reproductive age) is shorter, species have much more flexibility to adapt to the new demands of life, whereas species where each individual has a longer life and later reproductive age, the necessary genetic changes will take a much longer time and the species might go extinct without adapting to the new environmental demands.

To find good examples for this idea, you can look at the life of two very different classes of animals: insects and mammals. The life of many insects lasts only a few days, and the reproductive activity obviously also happens within days, sometimes even hours. Among mammals, the life span is usually counted in years, and the reproductive age is also often counted in years. For example, if the climate of our planet starts cooling down, bringing another ice age, and this cooling down takes, say, 100 years of gradual changes, large bodied animals like elephants, with their reproductive age of about 20 years, will have only five generations to adapt to the climate change, which is very tight for necessary changes. In reality, the reproductive cycle of elephants is even longer, as it is mature bull elephants of the age of 40 or 50 who mostly mate with females, thus leaving time for only a couple of generations within the critical 100 years.

Insects, on the other hand, whose reproductive age is only a couple of days, will have over ten thousand generations during the same 100 years, which is more than enough to adapt to climate change via gradual genetic mutations. No wonder that in the epochs of climatic changes, megefauna are most affected and go into mass extinction. The natural result of this asymmetry is that there are much more numerous insect species than mammalian species. Compare yourself: according to the International Union for Conservation of Nature (IUCN) there are 5488 mammalian species in the world (Initiatives, 2010), and there are from 6 to 10 million species of insects, representing about 90% of the existing species of the world. Do not forget, millions of insect species have not been described yet. Possibly they are evolving faster than we can classify them. Changing environment is the greatest bottleneck for the “long living” species, and animal species with a shorter lifespan have a great advantage in such critical survival periods of time.

Darwin asked in one of his diaries a profound question: "Why is life so short?" and came out with a precise answer: "if climate alters, species can respond quickly" (Desmond & More, 2004:229). A simple and profound question and a clear and brilliant answer.

Result of the first round: animals with shorter lifespan win the evolutionary race. They are much more numerous and better prepared for any possible challenges of life on our planet, because of their short life. 1:0 for the group selection forces.

Round 2: To have predators around is bad for the individuals, but is good for the group

LOGIC: Having a predator-free environment is great news for each individual animal, as they will be spared from predator attacks and loss of life. All the suspicions and fears of a predator lurking in the bushed are gone, and everyone can relax. Isn't that great? Well, apparently not so great for the groups and species. It is well known that losing predators in the environment leads to the degradation of the group and species, as predators often attack and kill the most vulnerable individuals of the prey species, thus contributing to the elimination of the inferior genes from getting transported into the next generation. Therefore, a predator attacking and killing an individual is tragic for an individual, but this tragic individual loss pays off in the long run with increased inclusive fitness of the group (species). The need of a healthy balance between predator and prey species is so well known in biological and environmental studies there is hardly a need for me to point to the references.

Result of the second round: animals who have natural predators win the evolutionary race. 2:0 for the group selection forces.

Round 3: Altruism is bad for the individual but is good for the group

LOGIC: When an individual acts altruistically (for example, warns group members about the presence of predators with alarm-call, or fights against enemies and sacrifices itself) this is bad for the individual. The tragic end of altruistic

individuals is often cited in biological science as the bottom line of the grand design of ruthless natural selection: selfish individuals thrive, and altruistic individuals die.

On the other hand, altruism is not only good, but even necessary for the group (species), so the groups with many such dedicated altruistic individuals have much better chances to warn each other of the danger and to avoid big losses at the expense of losing one individual. According to the proponents of the "selfish gene" vision of the evolution thus proves that evolution does not work on a group level. According to their approach, the altruistic individual who gets killed is eliminated from the future gene pool, and the selfish individual, on the contrary, replicates its own genes.

Unfortunately, this logic looks only at the short-term consequences of the altruistic behaviour, forgetting about the long-term consequences. With this logic, where altruistic individuals get killed and selfish individuals continue their genes, after several predator attacks only the selfish individuals will be left in a group, and the whole group, devoid of the dedicated altruistic defenders and their genes, will be eliminated as a group. On the contrary, the group where each (or most) individuals are programmed to forget about their individual survival in critical situations, and to act in the best interests of the group, will survive, as the group of dedicated individuals is always stronger than the simple sum of the participating individuals. So, the presence of altruistic individuals increases the inclusive fitness of the whole group and participating individuals.

Result of the third round: social animals with altruistically behaving members win the evolutionary race. 3:0 for the group selection forces.

Round 4: Having a comfortable life is good for the individual but bad for the group

LOGIC: It is great for each individual to have a protected and predator-free life, when they do not need to struggle for their food or survival, when they are cared for in sickness and live to old age in comfort. If we look at this scenario in the long run, we will see that this comfortable, protected and struggle-free life leads to the gradual decline of the health of the group and the species, accumulation of various genetic diseases, and gradual deterioration of the overall survival potential of the group and

the species. Contemporary humans are now in this precarious situation when most of the stresses that other animals have in everyday life are eliminated and natural selection loses most of its invigorating power over the species.

Result of the fourth round: animals with a more challenging lifestyle win the evolutionary race. 4:0 for the group selection forces.

Round 5: Having a tough life, when the big portion of the group is eliminated in a struggle for survival, is good for the general health of the group, but is catastrophic for individuals

LOGIC: When there are many challenges for survival, the struggle for existence is very tough and only a few survive. Such situations are catastrophic for a big part of the individuals, as many perish in such "bottleneck" situations. But the surviving part of the group will be stronger and genetically healthier, as the increasing of the challenges for survival, according to the principle of the "survival of the strongest" will lead to the increased inclusive fitness of the group/species and elimination of the less fit and less adaptive individuals.

Result of the fifth round: animals who need to struggle for their survival win the evolutionary race. 5:0 for the group selection forces.

Round 6: The same is true of death. Basically, death is a tragedy for the individual, but the death of an individual is good for the group

LOGIC: Death is not only something that can happen to individuals, it can happen to the whole group, to the whole species as well. Individual organisms are naturally concerned for their own survival, but individual survival and individual life is always temporary. On the other hand, as groups will always live longer than the individuals, evolution is primarily concerned about the life of the group (species) and natural selection designed various means to foster group interests over the interests of individuals in the most critical of survival moments.

Each of us, individually, tries to make our life as long and comfortable as possible, but the great design of natural selection is working towards the survival of the group/species. In the long run, to win an evolutionary race, the interests of the individuals are often neglected. Short individual life is preferred for the survival of species though times of changes, the same way as the presence of predators, bottlenecks and other life challenges are

Result of the sixth round: animals who die early give longer life to the group. 6:0 for the group selection forces.

Final result: Group selection forces clearly win the evolutionary race, despite the fact, that longer life, not having predators, cheating others for individual benefit, living a comfortable life, absence of daily struggle and avoidance of death are all blessings for each individual. To understand the logic of the evolutionary game, we need to remember that evolution always works in the long run.

Let us now make the following conclusions:

(1) What is good for the individual animal is often not good for the group, and what is good for the group, is often not good for the individual.

(2) The interests of the individual are mostly for short term benefits, but the interests of the group are mostly for the long-term benefits.

(3) So, although each individual animal is mostly concerned by its own short-term individual interests, its own survival and propagation of its own genes, the forces of natural selection are mainly concerned with large time spans and the interests of the groups and species, not individuals.

So, basically, more comfortable, well cared for, and long life is good for the individual, but bad for the group, but on the contrary, a more challenging, ordeal-filled and shorter life is bad for the individual but good for the species and a group.

This tense contradiction between individual and group survival interests is sometimes neglected, and part of contemporary biological scholarship researches evolutionary strategies only from the short-term perspective, or the perspective of the selfish individuals.

Natural selection is akin to a wise general during a war, who is more concerned about winning the war than the survival of each individual soldier.

From Groupishness to Individualism

Evolution is acting simultaneously on different levels. We can easily see the chain of everyday events with the countless wins and losses of individual lives, but we should be able to see also a generic picture on a bigger scale behind these everyday events. In the long run, evolution is always working on a group level. If selfishness was such a winning strategy as proponents of strict individual survival strategy want to portray, in several generations, social species would only consist of selfish individuals, and such species would vanish from the evolutionary tree. But this is not the case.

The mechanism of the battle trance is a vivid example of the wise strategy of natural selection to favour interests of the group over the individual interests in the most critical situations. Altruism and heroism were not left to the noble decisions of each individual human. In critical moments, under the pressure of imminent danger, humans instinctively (yes, instinctively, not by rational choice) lose their individuality and are united in a neurochemically induced exhilarating feeling of collective identity. In this state, each individual life seems very small and insignificant in comparison with the life of the kin, group, country, or even the idea. Natural selection made sure that this altruistic self-sacrificial drive was not leading to the pain and suffering of the sacrificing individuals. On the contrary, the moments of being in collective identity are the happiest moments of any human's life, as this mental state is induced by powerful drugs, neurochemicals, which are eliminating any shreds of hesitation, fear and pain, and induce the feeling of a coveted religious

trance. In this state individuals experience something much bigger and more important than their own life, the experience known under different names: altered state of consciousness, feeling high, spiritual awakening, religious experience, sudden enlightenment, or ecstatic trance.

Even dying for something bigger than the individual's own life can also induce an extreme feeling of happiness. This neurochemically induced powerful feeling of collective identity was and still is the central force behind most human ritual actions, behind the sacrifices we make for our loved ones, family, country, religious beliefs, and cultural norms. We sacrifice ourselves basically in the name of love, because true love, as we might remember, is a feeling when we value something (or someone) more than our own life. On the other side of the coin we kill, as a rule, also in the name of love. Love is the force that creates both the biggest altruism and the strongest violence.

If looked at in a historical perspective, it would be natural to propose that in the earlier historical epoch, when hominids and early humans were struggling for survival, a strong sense of collective identity was paramount for the survival not only of the group, but for each member of the group. Struggle for survival favoured those who had a strong feeling of group identity. Some scholars somehow have a view I believe to be wrong, that the "free riders" would be the winners in a mostly altruistic society. This can only be true in some situations, but not the most critical situations. In the most critical situations for survival, individuals act according to their instincts, and it is here where the power of group identity takes over. Individuals, who were devoid of the feeling of collective identity, would not stand together with others in critical moments, for example, when facing predators. In critical situations, selfish individuals would probably try to run and hide from the predators, leaving others to deal with them. But the remarkable thing is that predators, as we know, chase running prey, not the group which stands its ground. Therefore, fleeing selfish individuals were the most likely victims of the predator attacks. We can say that selfish hominids were "psychologically unfit" members of the group, and were eliminated by predators as a result of their selfish instinctive behaviour.

But during the last ten thousand or so years the situation has changed. Civilization changed the balance of survival. Humans started farming, started living

in increasingly secure houses, cities, gained deadly weapons, and started accumulating material wealth. Most importantly for our discussion, their security from predators and other elements drastically increased. Selfish individuals, devoid of the strong feel of collective identity and doomed for extinction in earlier epochs, found a much more suitable environment for survival. **There was much less need for the group cooperation for survival, so their survival rate increased, and the number of selfish individuals started to grow**.

It will be very difficult to classify people clearly and put them into "individualist" or "groupish" categories. It is difficult to know your own nature until you experience moment of great need, like a war, terrorist attack, or a natural disaster. In such critical situations, most people will display amazing unity and altruism, but there will also be individuals who probably have lost the ancient gene for the joy of belonging to something bigger than their own self, so they might even start using the disaster for their own individual advantage totally forgetting the interests of others.

Selfish individuals today are better represented in certain social layers of society. They are most likely overrepresented, for example, among those who own big parts of the world's wealth; or those who believe that humans and all living organisms are inherently selfish; or those, who cannot see psychological and evolutionary necessity for the creation of religion. The first of them, who already have a big part of human wealth, still want more; those who believe in the selfish nature of humankind see selfishness even when someone sacrifices his or her life for others; and those who see religion only as a irrational nuisance, argue that those who experience the joy of collective identity have to open their eyes and see the truth about life without religion. It is not accidental that Richard Dawkins, the father of the idea of the selfish gene, is also the most celebrated atheist of his generation.

Contemporary humanity is the result of these two contradictory tendencies: (1) our evolutionary past with the strong striving towards collective identity and finding the full meaning of life only when we obtain something bigger than our own life, and (2) the new emerging striving towards individualism and accumulation of personal wealth, often at the expense of "others" (other classes, races, countries, companies, individual people). I do not want to go into politics and start discussing the ideas of socialism and capitalism in this context, although the implicit tendencies of socialism towards social justice on one hand, and on the other hand, the striving towards

individual wealth and prosperity, paramount for capitalism, are not too difficult to notice.

Ancestors of lions, tigers and other big cats were the primary force that literally forced us to create the foundations of the human group identity and altruistic nature. Religious fervour, when individual humans are ready to sacrifice their lives for something larger than their own lives, for the group, for their land, or for ideas, came from our long interaction with big cats. We were already a social species when we met the big cats, no question about that, but in order to stand our ground against the big cats, we had to become super-social. And what does "super-social" mean?

According to Edward Wilson, humans are a eusocial species (Wilson, 2009). This idea might sound crazy to the representatives of the selfish gene dominated scholarly world, but why not? We live in big multi-generational colonies; we divide tasks within various professions; we care about children communally; we have groups of people who are trained to risk their lives during internal and external critical moments, women in their adult life lose fertility possibly to provide help in raising their grandchildren (Foster & Ratnieks, 2005); in the moments of crisis for the life of the whole colony we are all ready to lose our individual rights and many are even ready to sacrifice our lives for group interests. And in such moments, we are all in the collective consciousness, we feel as one, we do not feel fear or pain. Despite the fact that unlike ants and wasps, we can write books, answer emails, have discussions on the existence of altruism, and can fly to the Moon, we behave very much like other eusocial species, and I do not see a good reason why humans should not be characterized as one.

Yes, we are different from other eusocial species, those who possibly are in the eusocial state most of the time. We have two states of mind, and only one of them sets us truly in the category of eusocial species. In this state we forget about our individual needs and act like one super-organism. And although the state that is responsible for our eusocial nature appears very rarely, it appears in the moments when it really matters, in the moments when our physical survival is on the line. So, although our group nature truly and totally kicks in rarely, only when there is a moment critical for survival, this state is dominating our psyche, and the orders coming from this state can override any fears and concerns of individual safety.

If you have several friends, you will find out who your true friend is if you happen to be in a critical situation of survival. Our ability to go into the state of collective identity, the state when we feel ourselves as a small part of a super-organism, has been our greatest evolutionary friend in the moments when it really matters.

Although we rarely need to be united in a single super-organism, we still live as a super-organism, where different classes of people are doing different jobs. Our distant ancestors had the super-organism within their small group, a group of mostly blood-related people. Today we are united in much larger "imagined societies" (Anderson, 2006), like multimillion cities and states. Despite the artificial nature of these imagined societies, many of us can still relate with this society in the moments when the unity matters (wars, natural disasters). Possibly it might seem as an exaggeration, but we live, as Jonathan Haidt suggested, as a bee hive (Haidt et al., 2008).

The origins of human arts in the form of body painting, use of masks, clothes, singing, dancing and artistic transformation were all parts of the Great Unifying Rituals (Tevzadze, 2013). Human groups survived throughout our evolutionary history as these rituals were crucial for our survival. I would call them "Great Transforming Rituals" as their aim was to transform the odd mixture of selfish individuals into one single minded, single identity bearing, tightly knit super-organism. Our culture and religion, two of the greatest creations of human intellect, are colourful testaments of our eusocial nature.

Conclusions

And finally, here are some of the most important points of the book that I would like readers to remember.

(1) Although the idea of aposematism is as old as the ideas of natural selection and sexual selection (it was born in communication between Darwin and Wallace), its true importance is still unacknowledged. I propose that the **strategy of aposematism was developed by the forces of natural selection primarily in order to avoid damaging all-out physical conflict among the wide range of animal species**. Adoption of aposematism by the prey species was possibly the secondary function of aposematic display. Aposematism was substituting the damaging physical violence with the ritualized forms of display, known as ritualized fight.

(2) The strategy of aposematism is based on advertising warning signals by several modalities: bright and contrastive colours, morphological additions to the body, display of eyespots, various sounds, smells, slow walking, unusual and threatening body postures and movements. **These display patterns are absolutely identical to the display patterns described by proponents of sexual selection**. Instead of acknowledging the practical importance of aposematic display for survival, proponents of sexual selection claimed (and still claim) that these display patterns are detrimental for survival. This attitude towards aposematic display should change. I suggest to the proponents of the "handicap principle" and sexual selection to take into the account the strategic power of aposematic display as the tool for survival in the most serious way. I suggest that many dazzling looking animal species, including the iconic peacock, use their colourful display not for attracting females, but for scaring away competitors and predators.

(3) There are two basic forms of aposematic display. The first form is only activated during a conflict situation, and the second form is present constantly. Cats' hissing and arching of their back is an example of a temporary aposematic display, and skunk's contrasting colours and noisy locomotion is an example of constant

aposematic display. Temporary aposematic display is distributed extremely widely in the animal world, and there is hardly an animal species that does not use at least some element of aposematic display in conflict situations. **Animal species that display aposematic signals constantly are aposematic species**. Morphology and behaviour of aposematic species were formed by natural selection in the way that they are constantly advertising their presence by all four modalities.

(4) As humans evolved in Africa, the continent of great abundance of predatory species, there must have been an immense pressure coming from predators as soon as our ancestors descended from the trees to the ground. After reviewing defence mechanisms in the animal kingdom and humans, I proposed the aposematic model of human evolution. According to this model, hominids developed a unique non-contact defence and attack strategy, based on a powerful set of warning signals. I call this defence system AVOID (Audio-Visual-Olfactory Intimidating Display). This system was initially developed for the defence from predator attacks. After perfecting the system of defence, hominids started using it for confrontational scavenging with great success. **Humans are a classic example of aposematic species as they have a rich arsenal of aposematic display signals in all four modalities. Human aposematic index (AI) reaches the maximum 100%.**

(5) **Ancestors of big cats were the primary force that influenced the development of human morphology and behaviour**. Our erect posture and bipedal locomotion, our long legs, our long head hair evolved for us to look more intimidating; Our loud singing voice, the sense of rhythm, the ability to be entranced in the isometric rhythm, the ability of choral polyphonic singing in dissonant intervals evolved in order to make our audio display more effective. Our sweat glands evolved in order to make our body odour as strong as possible, in order to declare our presence and advertise our non-profitability to predators, particularly during the night sleep. Our slow locomotion, aggregation in large groups, instinct of freezing and screaming in the moments of imminent danger also evolved to advertise our aggressive nature. Throwing stones initially had a defensive function, as defence throwing was much more effective than hunting throwing.

(6) On the other hand, human ancestors also affected the evolution of big cats. Out of all cats, only lions and their ancestors stayed in direct competition with hominids and early humans, and their morphology and behaviour shows some elements that might have developed in the long co-evolutionary rivalry with our ancestors. Lions' social nature was probably developed as an answer to the group attacks from our ancestors and probably other social predators (like hyena packs) at the kill. The royal mane and the thundering low voice were possibly also developed in order to have a better intimidating capacity against early hominids. Human ancestors probably were also the key factor that forced lion ancestors to start wide intercontinental migrations, leading both species to the widest distribution among land mammals in the world. **As the evolutionary "arms race" was long and reciprocal, I suggest viewing human and big cat evolution as a case of co-evolution**.

(7) Male lions have an unusually high aposematic index. Apart from their impressive mane and thunderous voice, they also exhibit limited concern for their cleanliness, lazy movement and staying in plain sight most of the time, all are possible elements of constant aposematic display. At the same time, aposematic display does not go well with the lifestyle of the stealth predator. As a result, the male lion's hunting ability dropped, and in a pride they as a rule depend on female lions for hunting the prey. The male lion's reduced hunting ability can be one of the factors that contribute to the well-known fact that most of the man-eaters among lions are males. Female lions do not have any constant aposematic advertising signs.

(8) Interaction between humans and big cats went through several stages during the 6 million years spent by our ancestors on the ground. It started as a simple predator-prey interaction. Later it grew into a more complex interaction based on rivalry and conflict. And finally, they settled on a relatively neutral form of interaction in which both parties were avoiding damaging direct physical violence. At this stage they divided the spheres of influence. **Lion ancestors were the top predators, and human ancestors were the top scavengers**. I propose to use the term "Alpha-Scavengers" for the position that hominids held in the African ecosystem after developing their intimidating strategy (AVOID). Lions and big cat

ancestors became reluctant donors, and hominids and early humans became parasites who chased big cats from their kills.

(9) **As a result of our dependence on big cats during the millions of the years, they became our first Gods**, both kind and lethally dangerous at the same time as all Gods are. Most of the earliest artefact of human culture, from the lion-headed figures and cave paintings found in Europe, to the colossal lion-bodied Sphinx in Africa and the first metal coins in West Asia, provide hard evidence of the religious reverence of big cats in human collective psyche. Millions of years of religious reverence made an eternal imprint on our brains. That must be the reason why watching tigers and lions, and particularly touching them, gives us an awesome spiritual feeling that comes close to the feel of the presence of God.

(10) Tiger ancestors came out from the common big cat ancestral line, when a branch of big cats went to the different environment of the dense forests and jungles of Asia. One of the reasons for this move was probably the desire to avoid scavenging hominid/human groups. Jungles do not provide as many scavenging opportunities as open savanna does, and therefore jungles were not suitable for hominids and early humans. In the new environment of the jungles and dense forests, the common big cat ancestor developed camouflaging striped skin and a solitary hunting and living lifestyle. In the dense jungles, where humans did not live, tigers maintained their independence from humans for millennia. Because of this reason, after the lion habitat range was depleted, tigers became the second most widely distributed land mammal in the world (after humans).

(11) The first ritual practice of our ancestors was developed in order to put ritual participants into the altered state of consciousness, the Battle Trance. The Battle Trance was a crucial element of the intimidating display during scavenging confrontations. In this state all group members were losing their individuality, they were losing the feeling of fear and pain, were neglecting their instincts of self-preservation, and were ready to sacrifice their lives for the group interests. In this state, hominids and humans were losing the ability to think rationally, and were sometimes suffering full or partial amnesia. The Battle Trance is still actively

employed in contemporary military forces, virtually with the same function as it was utilized by our hominid ancestors. Strategies to get into the state of battle trance comprises rhythmic singing and dance, body painting, wearing special clothes and masks, and possibly the consumption of hallucinogenic substances. **Ritual practices that were designed by the forces of natural selection in order to reach the state of the battle trance laid the foundation of human arts**.

(12) Battle Trance provides a powerful model for the origins of human religious feeling as well. In an altered state of consciousness, individuals feel themselves as a part of something much bigger. Being in a state of collective identity is related to the feeling of intense pleasure, known often as religious trance or ecstasy. Battle trance provides the foundation for human behaviours on both extremes, from the extremely altruistic behaviour to the point of sacrificing the individual's own life for others, to the most violent atrocities during wars. **Both acts of altruism and mass violence are often the result of humans being in the state of the battle trance (collective identity) where they cannot consciously control their actions**. All religious practices and rituals are generally designed to evoke the loss of individual self and obtaining the collective, "oceanic" feel.

(13) **The human feeling of love came out from the new hierarchy of instincts where in the most critical situations for survival, the instinct of saving loved ones (group members) was superseding the instincts of self-survival**. Sexual games and sex most likely was not the arena of in-group competition and conflicts, but powerful social glue for all the members of the hominid/early human groups. Great numbers of taboos on most of the sexual activities, from incest and intergenerational sex to homosexuality, masturbation and even avoiding sexual pleasure, were introduced later as strict cultural and religious beliefs and norms. From the second half of the 20th century humanity started discarding some of the unnatural bans on human sexuality.

And finally, our love and deep reverence for big cats can explain our love for our small feline friends, our pet cats. We did not start deifying cats in Egypt, or even earlier, some 10 or 11 thousand years ago, when the first instances of domesticated

cats are observed. We love our cats as they remind us of our powerful rivals and gods from our evolutionary past. Some of the brightest and most creative humans left plenty of expressions of their love for cats. Leonardo da Vinci called them a masterpiece. Churchill said cats look down on us. Mark Twain said if you cross humans with cats, it will improve humans and deteriorate the cat. And if Albert Schweitzer, Mohamed, Albert Einstein, Charles Dickens, and thousands of others political and spiritual leaders, artists, philosophers, and authors, were totally besotted with cats, what is left to us, other than to continue this tradition?

Today I watched a funny YouTube video about loving cats. The whole video consists of the childish and repetitive emotional speech of a young woman, a cat lover, who cannot hold her emotions when talking about her love for cats. You might think I was one of the rare viewers of such a strange and not so exciting video. The video was watched by over 26 million people! By the time of the second edition of this book, viewers grow to 31 million (and a songified version of the video has been viewed over 37 million times). A new generation of cat lovers is growing. Power to them. Hopefully the new generation of cat and nature lovers will bring out our instinctive love and reverence towards the natural world and towards our evolutionary twins, cats, gradually freeing us from the blind humanocentrism we are still suffering.

Epilogue

I never had a pet tiger or a lion at home, but I do understand the incredible sensation of looking in the eyes of a tiger from a close distance and touching them. I did some desperate things in my earlier life in order to be close to the big cats. As I have mentioned in the introduction to this book, in my early twenties (actually, when I was twenty) I was arrested by the police for hand-feeding and petting a tiger at the Tbilisi zoo. The year was 1974, when I lived in the USSR. The tiger was a huge Siberian male, called Mars. Mars was one of the biggest tigers I have ever seen, and although he was kept in a ridiculously small place, (two interconnected cages, each 3X5 metres) he kept his wild instincts of cleanliness intact. Mars was seen pacing in his tiny cage most of the time. He had a tragic life story. A drunken visitor once came close to his cage and wanted to extinguish a cigarette on the tiger's nose. Mars caught his arm and despite a severe beating and water dousing, in a primal rage he completely tore the arm of the perpetrator. After this he was considered almost a man-eater and was as feared as death by both zoo staff and the public. He was very aggressive to anyone approaching his cage, and was showing his aggression by thunderous roaring and attacking the iron bars.

I used to watch this majestic animal, sometimes for hours as he was pacing, or even just sleeping in his cage. I was clearly attracted to him, his wild untamed nature and his tragic life story. For me he was a symbol of nature, breathtakingly beautiful and lethally dangerous at the same time (now I understand better where my deep feelings were coming from). And then came the time when I decided I would do my best to become his friend, so that he had someone in his life he would be happy to see. First I started adding water to his bowl (most of the animals at Tbilisi zoo in the 1970s did not have running water), then I started bringing him pieces of meat and bottles of milk. And I was constantly talking to him.

Mars started recognizing me very quickly, and started distinguishing my voice. First he stopped roaring on my approach. Later he started taking food from my hand. From my ninth visit on, Mars allowed me to pet his huge head and neck. For the first time this happened on August 29th, 1974. I do not think I have ever been as happy in my entire life as on that day. This was probably the closest that I will ever come to

the feeling of closeness to God. I started writing my first diary just to remember for life all the details of my visits to Mars and his behaviour. I also bought my first camera because of Mars, in order to take Mars' photos, in 1975. I was visiting him every day, sometimes twice, and even three times a day. My meagre lunch money was not enough for both of us, so for many weeks I was skipping my lunch. Then came a terrible blow, when I was caught red-handed by the head of the big cats department as I was feeding Mars, and was thrown out of the zoo. For the whole week I was unable to visit Mars, as the person who banned me from the zoo was working six days a week, except Monday. It was a true torture not to seeing Mars for a week…

When I came back to see Mars a week later, on Monday, November 11th, I found out that Mars was dying. It was a complete shock for me. He stopped feeding for no apparent reasons for the whole week. Tigers can live without food for a few weeks, so this was not the worst part of his condition. The worst was that Mars was lying in the corner of his small cage the whole week with his eyes closed, as if losing his interest for life. I talked later to the zoo personnel (including Margot Kapanadze, the Head of the Big Cat department of the Tbilisi Zoo) and they told me they had no idea what was the reason that made Mars stop feeding. I do not know myself. Of course, the first thing that came to my mind the moment I was told about his condition was that Mars had stopped feeding as I suddenly disappeared, but this is unlikely. Tigers are not known to refuse feeding if they suddenly lose their friends or masters, like very dedicated dogs sometimes do. All I know is that after I came back to the zoo that Monday November 11th 1974, and saw Mars in a terrible state, he got up for the first time during that week and started feeding again. He lived six more years and died (again, not without a mystery) in 1980. If the readers have seen the first edition of this book and remember the unusual dedication of this book, I hope they can understand it better now.

I believe that our love towards cats, both small and big cats, is not a fashion that will go away. It will change forms but the love and reverence we feel for them will stay with us forever. This love has a very solid evolutionary basis. For several million years, humans and big cats were tied together by our shared history of co-evolution. We helped each other to evolve into the two unrivaled kings and rulers of Planet

Earth. We shaped each other's morphology and behaviour, we travelled together to new lands and became the two most widespread mammals on our planet. We were constantly measuring against each other, we worked out a unique truce that we both followed for millions of the years, and we learned to avoid unnecessary violence as much as it was possible. They were our first gods, who fed us, who led us to new territories, and who punished us for not being cooperative. Then came a time when humans developed effective weapons to hunt and to kill, and intoxicated by this new ability to take lives, humans suffered an arrogant blindness towards the rest of the living world. We started killing not only prey animals, but our first gods as well. This lasted for about ten thousand years. During these years we forgot about Mother Nature and believed that the whole world was created to serve human needs. We have only recently recovered from this lethal confusion and hopefully we will never fall back in that shameful state of mind again.

Our fascination and love for cats will guard us from this danger. When we look into the deep eyes of our small feline friends, true masterpieces of the natural world, or the eyes of the majestic tigers and lions, our first gods, we will always feel the spiritual connection with the rest of the living world. The epic story of the interaction between tigers, lions and humans, the story of bitter rivalry, deadly conflicts, deep reverence and intense love continues.

Acknowledgements

Writing a book is always a complex endeavour involving people who encourage us with their support, and people who invigorate us with their critical comments.

Many scholarly works start from thanking the funding bodies for their support. I cannot thank any funding body for supporting my work for this book, as I did not even think of applying for any grant. And I must say that the feeling of freedom I felt while writing this book was tremendous. I am gradually coming to the conclusion that for scholars who want to follow the call of their heart freely, it is not the best option to depend on grant giving bodies. When scholars try to receive funding, they instinctively start bending their projects in order to suit the requirements of the funding bodies. So, the book you have just read is a result of my lifelong love for all cats on one side, and for my lifelong fascination with the problem of human evolution on the other side.

I will not give a long list of scholars that had an important influence on my views on big cats and human evolution, from Charles Darwin and Alfred Wallace to George Schaller and Elizabeth Marshall Thomas.

My lifelong hero, hunter-turned-conservationist and author Jim Corbett always had a very special place in my heart and thoughts. I am happy that during writing this book I co-wrote, with several other avid Corbett fans, a book on Corbett related topics (Gadhvi et al., 2016).

The chapter on the man-eating behaviour of tigers and lions was greatly expanded by the help of two scholars, Manfred Waltl from Germany and Preetum Gheerawo (Kristoff Kotecha) from Mauritius. Manfred – for making his excellent (and unpublished until recently) research paper on man-eating available to me, and Preetum both for his advice and for bringing to my attention many interesting facts about man-eating lions, chiefly from the professional warden, Soulemenn Kalee from South Africa. Big thanks to Soulemenn Kalee as well. I hope to meet him in person one day.

I want to thank my long-time friend Nikolai Pavlenko, the world-renowned tiger tamer from Russia, winner of the most prestigious International awards, for his long friendship and many conversations and insights into tiger behaviour. I remember

very well how I took Nikolai to Tbilisi zoo in the beginning of 1975 and showed him Mars, who recovered from his mysterious hunger strike just a few weeks before. In a recent (2017 February) skype conversation, Nikolai, a brilliant expert of big cat tiger psychology, told me about his observation that the smaller the cats are, the stronger their killer instinct. This observation is definitely worthy of further study.

I want to thank Cathy Falk and Reis Flora from the University of Melbourne for their continual support in many of my initiatives and projects; Nima Flora for her help and valuable memories from Kumaon.

Very special thanks go to Izaly Zemtsovsky from the Stanford University, my mentor and older colleague, to whom I dedicated one of my previous books, and who was often the first to learn about my most controversial ideas; Zurab Kiknadze, Gigi Tevzadze and Zaza Kikvadze from Tbilisi Ilia University, as well as legendary Georgian expert of the behaviour of wolves, Jason Badridze, were helpful for their provoking comments and questions on various topics; My cordial thanks also go to Rismag Gordeziani and the publishing program Logos from the Tbilisi State University, for their continual support of my work.

My thanks should also go to Tecumseh Fitch, Richard Byrne, Klaus Zuberbuhler, Thomas Geissmann, Irene Pepperberg and Peter Slater for their time and advice. Special thanks to Brazilian evolutionary biologist Wladimir Alonso. I am very grateful to Zina Solovyova, the head of the big cat department of the Novosibirsk zoo, for the provided materials about liligers born in their zoo.

Although this book only had a small association with music, unlike my previous books, I want to thank the musicologist with wide scope of interests Victor Grauer and neuroartsologist Steven Brown.

I also want to thank physical anthropologists Valery Alekseev and Malkhaz Abdushelishvili. Although they passed away respectively 25 and 20 years ago, they had a profound influence in developing my interest in human evolution related topics, and I often had imagined conversations with them during writing this book.

Very special thanks go to my wife, Nino Tsitsishvili, whose critical eye and mind I trust the most, and who is the author of some of the most provocative ideas mentioned in this book. Our son Alexander, who edited my previous book, and edited parts of the new edition as well. I want to thank my dear friend Bob Segrave, wonderful representative of the altruistic human race, who had been helping me and

my Georgian colleagues with his professional editing skills for many years and edited part of this book as well. I am very grateful to my dear friend Matt Harvey, who also contributed to the editing of this book despite his busy academic schedule, and our good friend Keith Buffey, for his tireless assistance in editing the second edition of this book.

And of course, there are three more members of our family in Australia, our three cats, Socky, Gigi and Colette, who were taking plenty of my working time by only being there, and were constantly reminding me of our eternal fascination we humans have for the mystery of cat perfection. Watching cats, as you might remember, is the near perfect reason for not working, and when you are writing a book about human-cat relationship, watching them is even more justified.

And finally, once again, I want to express my deepest gratitude to Mars, the Siberian tiger, for his friendship and loyalty that profoundly affected my attitude towards cats, both big and small. If the aposematic model of human evolution proposed in this book is proven to be viable, I hope that this will lead to better treatment of our evolutionary twins and first gods of humankind – the majestic big cats.

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INDEX

Abdushelishvili, Malkhaz, 484
ability to ask questions, 330
absolute pitch in newborn babies, 196
Achilles
  as bisexual, 254
acquisition of a phonological system, 197
African apes
  drumming of, 218
African buffalo, 149, 150
African elephant, 150
aggregation
  in humans, 261
aggression
  and avoiding aggression, 239
aggressive behaviour as a warning signal, 90
aggressive response to danger, as aposematic signal, 105
aggressive scavenging, 328
Aiello, Leslie, 180, 190
Ailurophobia (fear of cats), 400
Ainus, 361
  bear cult among, 335
Alekseev, Valery, 484
Alexander the Great
  homosexuality of, 254
Allison, Peter, 228
Alonso, Wladimir, 484
altruism
  in humans, 244
  short-term and long-term consequences, 465
Anderson, Kenneth, 140, 209
Anderson, Malte, 108
Andrews, Peter, 17
Animal Assisted Therapy, 449
animal species that can throw different objects, 273
animal's reaction to loud noises, 218
apes
  humans and, 270
aposematic behaviour
  mobbing as, 198
aposematic display
  hindrance or survival strategy, 267
  importance of audio signals for, 169
aposematic index (AI), 103
  in humans, 261
aposematic model of human evolution, 139, 210
aposematic signals
  audio, 104
  awkward walking as, 227
  constant, 103
  olfactory, 104
aposematic species, 103
  bravery in, 241
aposematic strategy
  in human evolution, 346
  of survival, 238
aposematism, 101, 102
  among predators, 97
  as a strategy for peace, 95
  as a strategy to avoid physical violence, 98
  as central strategy of human survival, 270
  behavioural signals, 227
  evolutionary function of, 126
  functions of, 91
  warning display, 127
aquatic predators, 35
arboreal, 27
Arens, William, 297
Aristotle, 186
Aristoxen, 186

Asafiev, Boris, 188
asking questions
as the beginning of human intelligence, 431
Atanasoff, John, 395
attracting attention
aposematism and, 264
Audio-Visual-Olfactory Intimidating Display (AVOID), 139, 283, 304
Aum mantra, 450
avoiding predators, 33
awkward walking style
in humans, 261
Bach, Johann Sebastian, 216
bacteria
sociality in, 251
Badridze, Jason, 210, 484
Bagemihl, Bruce, 16, 249, 250
Baikov, Nikolai, 352
Balkans
singing in dissonances, 214
Bardidze, Jason, 212
Barnett, Ross, 18
Barrow, John, 190
Bartholomew, George, 35, 133
baseball, 273
Baskin, Carole, 447
Battle of Chaeronea (338 BC), 253
Battle of Leuctra (371 BC), 252
Battle of Pelusium (525BC)
lost because of cats, 385
battle of Tegyra (375 BC), 252
battle trance, 164, 203, 204, 242, 301, 342, 398, 461, 477, 478
favouring group interests, 469
parental care and origins of, 243
seven main elements of, 247
Baze, William, 353
bear, 140, 240
worship, 334
Bear Festival (Lomante), 335
Beatles, 147, 179, 206, 452
Beau Geste effect, 87, 212
beauty
aposematism and, 265
Beethoven, Ludwig van, 187, 195
beginning of agriculture, 397
behavioural warning signals, 89
being noisy, as aposematic signal, 105
being silent, as cryptic signal, 105
Bell's Theorem, 439
Benedict XVI, Pope, 392
Bentley, Gillian, 290
Benzon, William, 191
Berry, Clifford, 395
Bertram, Brian, 15, 16, 142, 324, 407, 427
Bickerton, Derek, 308
big cats, 17, 18, 19, 20, 21, 22, 23, 24, 26, 33, 35, 36, 37, 40, 41, 42, 43, 44, 45, 48, 50, 52, 54, 55, 56, 59, 60, 61, 62, 63, 84, 85, 86, 141, 164, 180, 199, 209, 211, 241, 289, 306, 314, 318, 326, 327, 328, 330, 333, 336, 337, 338, 340, 342, 349, 355, 360, 361, 394, 395, 397, 427, 472
abandoned by their owners, 447
and children, 141
and disabled humans, 320
and human evolution as a case of co-evolution, 340
and humans, 444
and small cats, 396
animal therapy with, 449
are provoked by bent or running humans, 413
as deities, 362
as first gods of humanity, 400

as gods, 324, 450, 454
as man-eaters, 405, 409, 426
as pets, 446, 447, 448, 455
as predators, 97
at the zoo and circus, 459
avoid humans on foot, 428
bicycle riding and, 234
close interaction with, 458
cross-breeds, 354
eyespots in, 288
humans and, 362, 398, 440, 476
images of, 393
in advertisements, 404
raised together with dogs, 456
theray involving, 454
tree-climbing, 24
why do we love them, 379
why they avoid humans, 427
worshipping as gods, 394
Binford, Lewis, 40, 41, 276
biophilia hypothesis, 449
bipedal locomotion, 269
bipedal threat display, 36
bipedalism, 35, 36, 38, 52, 130, 131, 132, 133, 134, 136, 137, 138, 139, 142, 143, 146, 158, 167, 274, 397
and endurance hunting, 134
and monogamy, 134
and sexual selection, 134, 136
as a means to look taller, 130
as a result of predator pressure, 141
defensive throwing of objects and, 135
ecology hypothesis, 138
enhanced vision hypotheses, 138
evolutionary function of, 152
origin from threat display, 139
origin theory shortfalls, 138
origins of, 132, 216, 276
positive and negative sides of, 131
postural feeding hypothesis, 138
provisional hypothesis, 138
thermoregulation hypothesis, 138
wading hypothesis, 138
walking hypothesis, 138
bird singing behaviour, 29
Birdsell, Joseph, 133
bisexuality, 340
bison
homosexuality and bisexuality in, 249
Blacking, John, 188
Blake, William, 177
Blood as a universal symbol, 159
blood as colouring substance, 159
Blumenschine, Robert, 306
blushing, 154, 155, 156, 158, 167
body lice, 165, 167
body odour, 329
and aposematic strategy, 292
and sexual selection, 292
as a warning signal, 88
as aposematic signal, 223, 292
in humans, 261
body painting, 161, 167, 260
as aposematic signal, 158
evolutionary function of, 156
in Neanderthals, 157
universality of, 157
body shape for visual effect, 151
bonobos, 257
and throwing objects, 273
homosexuality and bisexuality in, 249
Boomgard, Peter, 427
Braccini, Stephanie, 137
Brahms, Johannes, 401
Brain, Charles, 37, 339
Bramble, Denis, 134, 145

breastfeeding
and oxytocin, 245, 246
Brennan, Patricia, 119
bright, contrastive colours, as aposematic signal, 105
Brown, James, 189
Brown, Steven, 190, 191, 484
Bryant, Gregory, 192
Brynner, Yul, 147
Bubonic Plague
as a result of cat slaughter, 388
Bucher, Karl, 187
Buddhism, 398
buffalo, 198, 239
Buffey, Keith, 485
Burton, Reginald, 427
Bushmen, 257
Buxbaum, Martin, 366
Byrne, Peter, 233, 234, 406
Byrne, Richard, 484
Calvin, William, 37, 273, 277, 396
canines, 315
cannibalism, 15, 21, 297, 299, 301, 303
and ritual practices, 298
as a predator control strategy, 296
as expression of love and respect, 298, 335
attitudes towards, 300
disappearance of, 302
eating gods, 361
evolutionary reason for, 411
funeral, 302
genetic proof of, 302
in besieged Leningrad, 299
in human prehistory, 296
in humans and lions, 15
in Neanderthals, 297
in Wari Indians, 301
mortuary, 410
on live TV show, 299
range of opinions on, 297
reasons for, 300, 302
remnants of in our language, 298
ritualistic, 302
to avoid predation, 410
Captain Cook
attacked by stones, 275
Caputo, Philip, 427
Cardinal Richelieu
as a cat lover, 382
Carrier, David, 137
Carrington-Turner, Joshua, 411
Cartmill, Matt, 134
cat-cafe, 403
catmania, 400
cats, 14, 15, 19, 20, 24, 41, 44, 45, 46, 47, 50, 51, 52, 54, 56, 68, 82, 83, 96, 104, 120, 169, 225, 243, 318, 326, 350, 366, 367, 368, 369, 370, 379, 380, 382, 383, 386, 388, 390, 392, 393, 394, 396, 437, 447
across cultures, 382
anatomy, 429
and witches, 389
artists love, 401
as cryptic species, 225
as first human Gods, 445
as gods, 399
as pets, 444
Beau Cat story, 438
beliefs in their supernatural qualities, 432
bisexuality in, 250
cleanliness of, 97, 122, 223
connected to devil, 383
dictators hate, 400
differences between dogs and, 374

domestic, 97
etymology of the word, 386
feeling approaching human death, 433
haters, 400, 401
homing instinct, 436, 437, 439
homosexuality and bisexuality in domestic, 249
humans and, 440
in advertisements, 403
in Ancient Egypt, 384
in medieval Europe, 387
man-eating, 405
mourning the death in Egypt, 385
not mentioned in the Bible, 381
on the internet, 393
persecution of, 387
popularity of, 402
protected by law, 384
Queen Victoria and, 392
quotes about, 363
reasons for loving, 393, 444
reasons of hatred in medieval Europe, 388
religious attitudes towards, 389
resemble babies, 396
sacred, 385
shows, 392
sixth sense, 429
small and big, 456
sociality in, 329
tested for homing instinct, 436
time of domestication, 381
treated as gods in egypt, 386
ultra-sensitivity in, 433
why do we love them?, 378
worshiping Satan in the form of, 387
cats and lions
religious importance of, 386
cattle
homosexuality and bisexuality in, 249
Caucasia
singing in dissonances, 214
cave painting, 157
Centre for Compassion and Altruism Research and Education, 244
Challis, John, 37, 276
Champawat man-eater, 409
change of colours, evolutionary function of, 156
Chaplin, George, 36, 133
children sexuality, 256
chimpanzees, 36
and throwing objects, 273
homosexuality and bisexuality in, 249
China, 398
Chopin, Frederic, 401
choral singing, 20, 169, 190
as a means of military capability, 216
origins of, 195, 197
Chowgarh man-eater, 422, 441
Chuka man-eater, 409, 415, 425
Churchill, Winston, 367, 376, 479
clapping, 188
Clark, Arthur, 177
Cleave, Maureen, 452
Clinton, Bil, 251
clothes, 167
evolutionary function of, 161
use of, 260
Cocteau, Jean, 372
co-evolution, 340
of humans and big cats, 444
cognitive Rubicon, 330
Cold War as an aposematic display, 95
Colette, Sidonie, 363
collective consciousness, 398, 472
collective effervescence (Durkheim), 200

collective identity, 193, 203, 342, 471
and oxytocin, 247
colour
aposematic, 266
evolutionary function of, 152
red, evolutionary function of, 156
communicating danger without alarm signal, 172
Communion
as ritualistic cannibalism, 299
Conan Doyle, Arthur, 205
conflicts between individual and group interests, 468
confrontational scavenging, 314
Conklin, Beth, 301
constant warning signals, 139
contact calls, evolutionary function, 172
Corbett, Jim, 121, 140, 163, 209, 216, 233, 315, 321, 336, 352, 406, 407, 410, 415, 418, 421, 422, 425, 440, 443, 483
coyote eating skunks, 93
creationists about peacock's train, 118
cricket, 273
Crompton, Robin, 137
Cross, Ian, 191
crow, 198
crypsis
as survival strategy, 43, 44, 45, 53, 54, 56, 64
cryptic
and aposematic strategies, comparison, 105
change of colours, 156
da Vinci, Leonardo, 363, 429, 431, 479
dance
and entrainment, 203
dancing, 21, 164, 169, 183, 185, 200, 246, 248, 263, 292, 308
and oxytocin, 245, 246
before combat mission, 242
before the battle, 183
in military, 184
Dart, Raymond, 35, 36, 40, 57, 132, 133
on cannibalism, 297
Darwin, Annie, 177
Darwin, Charles, 34, 35, 41, 60, 68, 70, 71, 72, 73, 74, 75, 83, 91, 100, 101, 113, 114, 127, 128, 130, 132, 154, 155, 172, 177, 191, 199, 248, 258, 273, 339, 361, 373, 465, 474, 483
critique of, 127
on human defence strategy, 34
on human love, 258
on human origins, 127
on music origins, 187
on peacock, 116
on sexual selection, 100, 114, 262
on stone throwing, 275
Darwin, Erasmus, 373
Dawkins, Richard, 136, 461, 462, 471
de la Marrett, John, 133
de Saxe, Maurice, 204
deception in lions, 16
defence strategies, 33
Demirkhanian, Ara, 189
Denzau, Helmut, 414
Diamond, Barbara, 365
Dickens, Charles, 370, 379
differences between arboreal and terrestrial environments, 23
Dissanayake, Ellen, 180, 181, 191
dissonant harmonies, 199, 260
distinguishing sexual selection and aposematism produced signals, 102
distribution of singing behaviour in various environments, 28

dogs, 89, 93, 243, 373
  homosexuality and bisexuality in, 249
  quotes about, 373
dolphins
  homosexuality and bisexuality in, 249
  noise and, 219
domesticated animals are noisier than wild animals, 30
domestication of Siberian foxes, 30
Dosa, David, 433
Dreamworld, 455, 456, 457
Drone-Dissonant style (D/D Style), 214
drumming, 164, 180, 188, 194, 199
  in African apes, 192
  on external objects, 87
  to intimidate predators, 216
Du Brul, Lloyd, 134
Dugatkin, Alan, 202
dull colours, as cryptic signal, 105
Dumbadze, Nodar, 177
Dunbar, Robin, 180, 190, 192
Duncan, Isadora, 401
Dunsworth, Holly, 37, 135, 276
Durkheim, Emile, 200
Dylan, Bob, 167, 170, 173, 182, 280
dyslexia
  prevalence of, 197
Easterly, Susan, 366
Egypt, 398, 399
  cats in, 386
Ehrenreich, Barbara, 242, 445
Eickhoff, Renato, 135
Einstein, Albert, 379, 380
elephant, 128, 198, 239
  as aposematic species, 109
  homosexuality and bisexuality in, 249
Elliott, Amy-Mae, 393
Ellis, Derek, 135
Elvis Presley, 152
Eminem, 185
Engels, Donald, 387
entrainment, 169, 194, 203
  and oxytocin, 246
erecting hair as aposematic signal, 104
Etkins, William, 133
Eucharist, 160
  as ritualistic cannibalism, 362
eyebrows, 21, 263
  and eyelashes as eyespots, 289
  evolutionary function of, 289
eyelashes, 263
eyespots
  in humans, 287, 293
eyespots in peacock, 115
Falk, Cathy, 484
farming
  intensified conflict between humans and lions, 320
Feather, Sara, 438
female breasts
  as eyespots, 291
  evolutionary function of, 290
  in Bonobos, 290
  sexual selection and, 290
Fifer, Felix, 37, 135, 274, 339
Filler, Aaron, 137
finger tapping, 176
Fisher, Ronald A., 75
Fitch, Tecumseh, 137, 192, 194, 217, 218, 484
flight, fight, or freeze response, 235
Flora, Nima, 405, 484
Flora, Reis, 405, 484
flushing, 154, 155
Fonagy, Ivan, 188
Foo Fighters, 176

Foot stamping, 87
foxes
  homosexuality and bisexuality in, 249
freedom
  losing individuality and, 264
freezing
  as a survival strategy, 235
  as a warning signal, 90
  as aposematic defence, 236
  as cryptic behaviour, 236
  different reasons for, 236
  in victims of violent attacks, 235
  with fear, 235
Freud, Sigmund, 257, 363
Frolov, Boris, 189
Fromm, Erich, 449
Frump, Robert, 238
Gandhi, Indira, 337
Gardiner, William, 187
gazelle, 150
Geissmann, Thomas, 191, 484
Geist, Valerius, 134, 307
Georgia
  Dmanisi hominids from, 285
gibbons, 132, 191
  and throwing objects, 273
Gir forest
  lions in, 358
giraffes, 150
  homosexuality and bisexuality in, 249
giving birth
  and oxytocin, 245, 246
Glickman, Stephen, 311
Gnoske, Tom, 411, 427
goats
  homosexuality and bisexuality in, 249
Gordeziani, Rismag, 484
gorilla, 88
  and throwing objects, 273
  as possibly an aposematic species, 111
Gould, Stephen Jay, 370
Grauer, Victor, 193, 196, 215, 484
Great Horned Owl, 88, 93
Green, Gordon, 144
Greenhood, William, 189
Grohl, Dave, 176
Gronowicz, Antony, 389
grooming
  and oxytocin, 245, 246
ground predators, 24, 26, 56, 58, 326, 327, 328, 410
  at night, 26
  defence from, 304
group homosexual behaviour in humans and lions, 16
group selection, 461
group vocalizing, 14, 87
Guggisberg, Charles, 354, 425
Gurney, Eric, 364
Hagen, Edward, 192
Haidt, Jonathan, 200, 473
hair
  patches on human body, 261
    evolutionary function, 224
Haka, 221
Halliday, Tim, 117
Hamilton, William Donald, 243
handicap principle, 74, 100, 101, 267, 474
  critique of, 267
  peacock and, 113
Hardy, Alister, 35, 133, 136
Harrington, Fred, 210, 212
Hart, Donna, 38, 136, 269
Harvey, Chris, 425
Harvey, Matt, 485
Hattori, Yuko, 194

Hauser, Marc, 181, 192
Hawkes, Steve (Steve Sipek), 446
Heart, Donna, 339
hedgehog, 89, 238, 262
Hedges, Chris, 245
Hediger, Heini, 34
Height-Weight Ratio (HWR), 149
Heinlein, Robert A., 372
Hemingway, Ernest, 367
Hemmer, Helmut, 18
Hendrichs, Hubert, 414
Hendrix, Jimi, 147, 148
Herodotus, 385, 386
Hewes, Gordon, 133
Himalayas
  singing in dissonances, 214
Hindu-Kush
  singing in dissonances, 214
hissing as the earliest warning sound, 87
Hoeschele, Marisa, 194
Holder, Roger, 137
Holmes, Sherlock, 205
hominids, 216
  silence as a signal of danger in, 182
homosexuality, 340
  among animals, 250
  among Spartan warriors, 253
  and bisexuality, 250
  as a criminal offence, 249
  bans on, 251
  in army, 252
  in humans and lions, 16
  prevalence in human society, 256
Honing, Henkjan, 194
horses
  homosexuality and bisexuality in, 249
human, 120
human body hair, 96
  reasons of losing, 292
human body lice, 162
human head hair, 14, 21, 51, 63, 64, 68, 82, 83, 147, 148, 149, 151, 152, 158, 161, 162, 167, 181, 216, 240, 308, 342, 397, 515
  Afro style, 148
  as a visual signal, 148
  erecting is danger, 237
  evolutionary function, 147, 151
  the length of, 148
  tightly coiled, 148
human intelligence, 433
human sexuality, 248
human skin colour variations as a result of sexual selection, 101
Human/big cat evolution as co-evolution, 21
humanocentrism, 399, 479
humans
  and lions as the most widespread mammalian species in the world, 17
  as aposematic species, 127, 128, 260, 262, 291
  as eusocial species, 472
  as the only terrestrial singing species, 28
  followed lion prides, 344
humming, 15, 174, 175, 177, 180, 181, 182, 500, 501
  alone, 175
  and lullaby, 181
  as a constant background, 260
  as contact call, 180
  as human contact calls, 174
  during tests, 176
  evolutionary function of, 174
  group, 181
  in hominids and early humans, 180
  in the head, 174

innate basis for, 180
instead of clapping, 175
out of tune induces negative feelings, 175
when feeling good, 175
Hunt, Kevin, 135
hunting and scavenging
in the same species, 310
Huron, David, 192
Hutsler, Jeffrey, 192
Huxley, Aldous, 370, 374
Huxley, Thomas, 65, 94
hyena, 89, 266, 310
aardwolf, 311
and lion, 93
brown, 311
striped, 311
why humans hate, 310, 311
Hyperhidrosis (excessive sweating and facial blushing), 225
incest
as a taboo, 478
in humans and lions, 16
individual selection, 461
Indonesia
singing in dissonances, 214
instant gratification
for altruistic behaviour, 244
intersexual competition, 99
intrasexual competition, 99
Isaac, Barbara, 37, 135, 274, 275, 276, 339
Isaac, Glynn, 134
Isbell, Lynne, 135
Islam, 398
Ivanov, Viacheslav, 189
Jablonski, Nina, 36, 133, 139, 147, 149
Jarvis, Erich, 192
Jespersen, Otto, 187
Jim Corbett National Park, 337
John Paul II, Pope, 389
Johnson, Gloria, 447
Jolly, Clifford, 134
Jordania, Alexander, 484
Jordania, Joseph, 189, 193
Junger, Sebastian, 259
Jungers, William, 135
jungle sensitivity (Jim Corbett term), 443
Justus, Timothy, 192
Kala, D.C., 443
Kalee, Soulemenn, 141, 306, 420, 483
Kanzi
making stone tools, 283
Kat, Peter, 425
Kayser, Manfred, 162
Keith, Arthur, 132
Kerbis Peterhans, Julian, 411, 427
Kharlap, Miron, 188
Khergiani, Mikheil, 177
Kiknadze, Zurab, 484
Kikuchi, Yukiko, 194
Kikvadze, Zaza, 484
Kingdon, Jonathan, 136
Kinsey Report, 248, 258
Kittler, Ralf, 162
knuckle-running chimpanzee runs faster that best human athletes, 227
Ko, Kwang Hyan, 138
Kogan, Nathan, 190
Köhler, Wolfgang, 133
Kortlandt, Adriaan, 36, 37, 38, 87, 134, 139, 339
on night time defence strategies, 286
Kruuk, Hans, 310, 414
Kuliukas, Algis, 136
Kumaon, 405, 411
Kunst, Jaap, 214
La Perouse, 275

Laetoli, 17, 360
Lambeth, Susan, 137
Lang, Andrew, 365
Lawergren, Bo, 189
Lawther, Gordon, 142
Leakey, Richard, 317, 362
Led Zeppelin, 211
lemur, 89
Lennon, John, 382, 401, 452, 453
leopard, 24, 36, 150, 208, 273
  avoids humans on foot, 407
  interaction with Bushmen, 321
  man-eating, 140, 296, 321, 408, 410
Leroi-Gourhan, André, 334
Levitin, Daniel, 177, 193
Levman, Bryan, 190
Leyhausen, Paul, 350
Lieberman, Daniel, 134
Lieberman, Danniel, 145
Lindbergh, Charles, 383
lion, 17, 19, 34, 41, 43, 45, 46, 48, 49, 59, 61, 67, 82, 86, 93, 96, 112, 120, 122, 128, 140, 141, 142, 149, 163, 164, 165, 172, 198, 208, 216, 237, 238, 239, 241, 307, 310, 311, 316, 318, 319, 320, 321, 322, 324, 326, 327, 330, 348, 349, 354, 355, 359, 360, 361, 381, 386, 497, 510, 522
  and hyena interaction, 311
  and the Sun, 382, 397
  and tiger comparison, 352
  aposematic signals in male, 223
  as a national animal of India, 358
  as a religious symbol, 323
  as a social cat, 123
  as god, 323
  as scavenger, 310
  as the first god of humanity, 477
  cleanliness of, 125
  close interaction with, 454
  decline of population, 357
  defending territory in groups, 348
  differences from tiger, 356
  evolutionary reasons of sociality, 342
  expressiveness of face of, 350
  fake attack, 280
  feeding habits, 312
  hunting adult elephants, 425
  hunting in groups, 346
  images in early human art, 323
  in India, 358
  interaction with Bushmen, 320
  interaction with human ancestors, 314
  Maasai relationship, 324
  male, 266
  male, as aposematic animal, 124
  man-eating, 408, 412, 417
  morphology and behaviour changes, 346
  on menu in restaurants, 334
  on the earliest coins, 323
  population decline, 360
  preparation for hunt, 185
  raising cubs in social groups, 347
  reason for their eating habits, 313
  roar of a, 238
  scared of noise, 219
  sociality, 15, 346, 349
  sociality, origin of, 345
  three epochs of relationship with humans, 325
lion god, 323
lion mane, 14
  as aposematic signal, 124
lioness
  aposematic index, 125
lion-human relationship, 331
lion-human truce, 322

lions
and hyenas in human cultures, 309
avoid humans on foot, 407
group roaring in, 124
homosexuality and bisexuality in, 249
in the wild are afraid of humans on foot, 142
man-eaters kill mostly during the night, 419
never roar while hunting, 124
Liszt, Franz, 402
Livanov, Vasily, 205
Livingstone, Frank, 36, 52, 133, 139, 189
Livingstone, Steven, 193
Locke, John, 202
London Zoo, 175
long legs, 161, 167
evolutionary function of, 152
origin of, 143
Lorenz, Konrad, 239, 307, 350, 374
love, 248
as the force that creates both the biggest altruism and the strongest violence, 470
Lovejoy, Owen, 134
lower back pain, as a consequence of bipedalism, 131
lullaby
and humming, 181
innate basis for, 181
origins of, 181
polyphonic, 181
lynx, 93
Mache, Francois-Bernard, 191
Mackumboro, Hajee, 141, 423
magpie singing, 29
male and female voice ranges, 209
man the hunted hypothesis, 37, 40
man the hunter hypothesis, 35, 40, 461
mandrill, 156
man-eating
as a learned behaviour, 425
big cats, 424
gender difference, 415
hunting in groups, 422
in lion prides, 426
leopard in Nepal, 406
leopard kills during the night, 418
leopards, 24
leopards enter houses, 421
lions, 423, 424
lions are mostly males, 416
lions hunting in groups, 422
lions might enter houses, 420
tigers, 140, 421, 424, 427
tigers are mostly females, 415
tigers kill during the day, 418
manganese dioxide as painting substance, 161
Marcus, Gary, 193
marking territories, 89
Marler, Peter, 191
Mars, the Siberian tiger, 480
Marshall Thomas, Elizabeth, 19, 142, 318, 319, 320, 321, 322, 323, 324, 345, 349, 350, 407, 428, 458, 459, 483
Marzke, Mary, 273
mask, 167, 242
evolutionary function of, 166
universality of, 166
use of, 260
Mazak, Vratislav, 337
Mbuti pygmies, 217
McCartney, Paul, 205, 206, 452
McDermott, Josh, 181, 192
McDougal, Charles, 412, 414, 428
McGrew, W.C., 136

McHenry, Henry, 134
McKuen, Rod, 364
McNeill, William, 200
Mehrabian, Albert, 259
Meigs, Charles, 430
Melanesia
  singing in dissonances, 214
Merchant, Hugo, 194
Mercury, Freddie, 372, 401
Merker, Bjorn, 190, 191, 194
Mery, Fernand, 367, 372
Mesopotamia, 398
Milani, Myrna, 439
Miller, Geoffrey, 191, 248
Mills, Stephen, 380, 413, 427
mistaken identity
  as a reason of big cat attacks, 321, 412
Mithen, Steven, 192, 196
mobbing, 197
  audio background of, 198
models of Human evolution, 338
Mohan man-eater, 409, 440
Mohawk hairstyle, 147, 151
Molino, Jean, 191
monogamy, 340
Montaigne, 365
Morgan, Elaine, 35, 133, 136
Morley, Iain, 193, 194
Moro Reflex, 25
Morris, Desmond, 147, 149, 211, 290, 376, 388
motherese, 193
mother-infant interaction, 180
mountain lion, 140, 235
Muktesar man-eater, 409
multilevel selection theory, 463
multiregional evolution model, 215, 338
  in humans and lions, 17
Munro, Stephen, 136
muscular bonding, 200
music in war, 184
music thanatology, 177
music therapy, 177
musical worms, 176
musilanguage, 191
Nadel, Siegfried, 188
natural selection, 26, 51, 102, 103
  altruism and, 469
  avoiding aggression, 240
  individual and group selection and, 469
Nettl, Bruno, 188, 195
network model, 215
Neumann-Denzau, Gertrud, 411, 414
Newman, Ernst, 187
Newton, Isaac, 383
Niemitz, Carsten, 137
Nightingale, Florence, 370
night-time security, 328
night-time sleep
  body odour and, 261
Njombe man-eating lions, 426
North Vietnam
  singing in dissonances, 214
Norwegian lemming
  as a brave animal, 241
  as aposematic species, 108
nuclear peace, 95
nuclear weapon as an aposematic tool, 95
number four in music, 205
number of selfish humans is increasing, 471
Oakley, Kenneth, 36, 133
Olaveson, Tim, 200
olfactory signals, 63, 88
Ono, Yoko, 452
orangutans
  and throwing objects, 273

origins of human aesthetic sense
aposematism and, 265
origins of music, 21, 185, 187, 191, 192
chronological list of theories, 186
conference on the, 190
origins of singing abilities among humans, 28
Osama
man-eating lion, 141, 420
Oscar the cat, 433, 434
oxytocin, 245
Packer, Craig, 346, 347, 423, 427, 450
Panar man-eating leopard, 410, 419
Papua New Guinea
singing in dissonances, 214
Parncutt, Richard, 193
Patel, Aniruddh, 201
Pavarotti, Luciano, 209
Pavlenko, Nikolai, 350, 361, 459, 460, 483
peacock, 21, 71, 73, 74, 100, 113, 117, 118, 119, 120, 128, 153, 225, 266, 474
and sexual selection, 117
aposematic display, 115, 116
aposematic index, 115
aposematic nature of, 267
as a strongest symbol of sexual selection, 113
as aposematic species, 113, 116, 120
displaying for a pig, 116
eyespots on, 118
not afraid of a tiger, 115
train does not impress females, 118
peafowl, 113
peahen, 113
penguins
bisexuality in, 250
homosexuality and bisexuality in, 249
Pepperberg, Irene, 484
Peretz, Isabelle, 192, 194
Perlovsky, Leonid, 193
Perry, Richard, 412, 415
Petrarch and his cat, 382
Petrie, Marion, 117, 118, 119
Phelan, Jack, 443
Philodemus, 186, 190
Pieslak, Jonathan, 184
Pinker, Steven, 186, 190, 193
Pinto Syndrome
negative story is more believable, 462
Pinto, Oreste, 462
plastic masks
to avoid predators, 288
plasticity of female choice, 118
Plato, 186
Playing (or singing) in octaves, 211
Pliny the Elder, 178
Plutarch, 252
Poe, Edgar Allan, 176, 369
Polesie
singing in dissonances, 214
polygyny, 340
polyphony
distribution of, 196
in Afghanistan, 196
in Albania, 196
in Balkans, 196
in Central African Pygmies, 196
in China, 196
in Papua New Guinea, 196
in Polynesia, 196
in Tibet, 196
Pontzer, Herman, 137, 144
porcupine, 93
aposematic display, 107
as aposematic species, 104, 107
Porcupine quills

as a reason for tiger man-eating, 409
Potts, Richard, 136
power chord, 213
Pratchett, Terry, 399
praying
and oxytocin, 245
predation in human evolution, 339
predators
defence from, 262
role in human evolution, 345
types of, 96
Preetum Gheerawo, 141, 306, 483
presence of body odour
as aposematic signal, 105
Preuschoft, Holger, 136
primates
as a model of early hominid behaviour, 269
prokaryotes
sociality in, 251
pronghorn, 341
Prophet Muhammad
cats and, 381
Prost, Jack, 134
Puech, Pierre-Francoise, 136
puma, 93
Putnam, Anne, 217
Pygmies using drumming against predators, 217
Pythagoras, 186
quadrupedalism, 136
Queen Victoria
and cats, 392
Radcliffe-Brown, Alfred, 200
Raichlen, David, 137
Rameau, Jean-Philippe, 186
Recent African Model of human evolution, 17, 18, 215, 338
reclaiming the dead bodies
evolutionary function of, 294
red colour for warning display, 160
red ochre, 158, 159, 160, 161, 167
as imitation of blood, 161
Reik, Theodor, 177
religion
rhythm and, 199
religious practices, 398
removing dead human bodies
methods of, 296
Reynolds, Vernon, 135
Rhine, Joseph, 437, 438
rhino, 239
rhythm
and origin of human culture, 204
and origin of religion, 204
and poetry, 203
as a tool for defence, 202
drumming before the sense of, 218
origins of, 199
rhythmic chorusing, 169
Rice, Tim, 174, 182
Richman, Bruce, 190
Rinaldi, Andrea, 193
rising on hind legs, as aposematic signal, 105
ritualized fight, 66, 92, 99, 114, 474
as the means to avoid violence, 91
River, Diego, 299
Roach, John, 302
Robertson, Kirsty, 137
Robson, Paul, 209, 315
Rodman, Peter, 134, 137
Roederer, Juan, 189
Roughgarden, Joan, 248, 461
Rousseau, Jean-Jacques, 186, 364

Rudraprayag man-eating leopard, 410, 419, 421
running away from danger, as cryptic behaviour, 105
Rushby, George, 426
Ruxton, Graeme, 137
Sachs, Curt, 188
Sacks, Oliver, 177
Sacred Band of Thebes, 254
  against Spartan warriors, 252
  the troop of homosexuals, 252
sailfish, 156
  colour changes in, 155
Saki (Hector Hugh Munro), 364
Sanders, Carolyn, 117
Sankhala, Kailash, 413
Sarton, Eleanor Marie, 364
Sayre, Rockwell
  worst cat-hater, 401
scavenging, 146
  in Hadza, 306
  in human prehistory, 305
  of big cats as a reason for man-eating habit, 410
Schaller, George, 15, 116, 121, 142, 172, 319, 324, 350, 352, 353, 407, 427, 483
Schapiro, Steve, 137
Schroeder-Sheker, Therese, 177
Schweitzer, Albert, 371, 379
Scott, Walter, 379
secondary defence
  aposematism and, 271
Segrave, Bob, 484
selfish gene, 461, 466
Semcer, Cheryl, 334
Semmelweis, Ignaz Philipp, 430
sense of rhythm, 169, 200, 204, 207, 218, 221, 308, 398
  and collective identity, 204
  and oxytocin, 246
  as a result of genetic drift, 201
  in animals, 201
sex
  as a tool for cooperation, 248
  as means for bonding, 340
  battle trance and, 249
  homosexuality and bisexuality among animals, 249
  in humans and lions, 15
  out of bonding hypothesis, 251
  social function in humans and lions, 16
  used for social cohesion, 248
sexual arousal
  and oxytocin, 245, 247
sexual selection, 21, 70, 71, 73, 74, 75, 83, 99, 100, 101, 102, 114, 117, 118, 119, 120, 127, 134, 157, 187, 210, 263, 290, 339
  and aposematism, 99, 120, 262
  and aposematism use similar signals, 113, 474
  and peacock, 113
  stone tools and, 282
  via female choice and aposematism, 100
  via female choice, as a driving force of human evolution, 127
  via male combat, 137
sexuality
  as a sin, 256
sexuality-based bonding, 255
Shakespeare, William, 388, 393
Shamil, 183
Shapiro, Liza, 135
shared identity, 200
Sheldrake, Rupert, 437
Shipman, Pat, 135

Shostakovich, Dmitri, 401
Siberian tiger, 20, 149
silence, 169, 170
  as a signal of danger, 171, 172, 182
  avoiding during exams, 178
  for survival, 27
Sinclair, A.R.E., 135
Singh, Kesry, 228
singing, 164, 292
  before death, 177
  in dissonant harmonies, 213
  in group and oxytocin, 245
  in harmony, 212, 213
  in harmony and trance, 216
  species among aquatic animals, 28
skunk, 88, 93, 105, 225, 262, 293
  accuracy of aiming, 273
  aposematic display, 106
  as aposematic animal, 106
Skvirsky, Nikolai, 459
Slater, Peter, 29, 484
slow walking
  as warning signal, 89
  or stopping, as aposematic signal, 105
Sober, Elliot, 463
social animals, 171
social selection instead of sexual selection, 249
sociality triggered the appearance of sexual behaviour, 255
Sockol, Michael, 137
Solovyova, Zina, 354, 484
sounds in wild and domesticated cats, 30
sound-weight ratio (SWR), 208
South-West China
  singing in dissonances, 214
Spanish Flu pandemic, 410
Spartan warriors, 248, 253, 254
  defeated by a smaller opposition, 252
Spector, Phil, 220
Spencer, Herbert, 187
Sperber, Dan, 190
Sphinx, 386
spiders, 89
spitting cobras
  accuracy of aiming, 273
spotted hyena, 311
stamping, 164, 180, 188, 199
Starr, Ringo, 176
Steel, Eric, 452
stone
  as the earliest weapon, 272
  throwing, 339
stone tool industry
  beginnings of, 283
stone tools, 132
  ovesized, 282
Stoneking, Mark, 162
Stoning
  as a capital punishment, 272
stopping as a warning signal, 89
strange movements as a warning signal, 91
strawberry poison frog, 101
Stringer, Christopher, 17
strive towards uniqueness among humans
  the reason for the, 263
Stumpf, Carl, 187
stuttering
  prevalence of, 197
Sun
  as God, 397
Sundarbans man-eating tigers, 411, 413
Sussman, Robert, 38, 136, 269, 339
Sutherland, Joan, 315
swan song phenomenon, 178
sweating

as thermoregulation, 224
evolutionary function of, 224, 292
for sexual arousal, 224
in moments of danger, 88
swift movements, as cryptic signal, 105
Sylvester, Adam, 136
Szathmáry, Eörs, 308
Szendy, Peter, 177
taboo
cannibalism as a, 299
homosexuality as, 251
Taiwan
singing in dissonances, 214
Takahashi, Mariko, 117, 118, 119
talisman
the origin of, 284
Tall military head-dresses, 151
Talla-Des man-eater, 409
Talleyrand, Charles Maurice de, 259
Tanner, Nancy, 134
tattoo, 157
Taylor, Timothy, 297
teeth-drumming, 176
temporary and constant warning signals, 89
temporary aposematic signal, 104
temporary warning signals, 139
ten Cate, Carel, 194
Terra Amata site, 158
terracotta warriors, 151
terrestrial predators, 35, 138
Tevzadze, Gigi, 270, 473, 484
Thak man-eater, 409, 420, 425
Thapar, Valmik, 353
Theory of Mind (ToM), 193
theory of natural selection, 269
Thomson, William, 193
Thoreau, Henry David, 365
Thorpe, Susannah, 137
threatening movements, 180
throwing
defence and attack, 277
differences between defence from predators and for hunting, 277
historical-ethnographic account of, 274
importance in human evolution, 274
throwing objects as the means of defence, 128
use of oversized stones, 280
throwing stones
as a non-contact form of defence, 315
tiger, 20, 43, 48, 54, 68, 91, 96, 120, 140, 149, 208, 228, 237, 266, 287, 351, 354, 355, 359, 361, 362, 380, 409, 415
and lion comparison, 352
and mantra Aum, 449
aposematic signals in, 121
as a national animal of India, 358
as god, 450
as pet, 446, 447, 454
as scavenger, 411
as world's favourite animal, 402
audio signals, 122
avoids humans on foot, 358, 407, 428
body parts, 360
chase of bicycles, 412
close interaction with, 454
colours of, 266
conservation efforts, 337
decline of, 360
deflecting attack of, 164
eating habits of, 352
man-eating, 295, 407, 408, 409, 416
mating call, 450
reaction to loud noise, 221
reserves, 337
therapy, 451

Tiger Temple, 455
Tinbergen, Nikko, 439
Titon, Jeff, 174
Topsell, Edward, 389
tough skin, 315
trance
  loud singing in harmony and, 216
tree-living species become silent on the ground, 28
Trehub, Sandra, 194
Tsavo man-eating lions, 411
Tsitsishvili, Nino, 256, 484
turkey, 155, 156
Turner, Myles, 427
turtle, 89
Tuttle, Russel, 134
Twain, Mark, 176, 364, 365, 367, 375, 377, 479
unique elements of human morphology and behaviour, 269
use of intimidation
  among individual humans and among states, 240
venomous snake, 89, 91
Verhaegen, Mark, 136
Videan, Elaine, 136
Vikings
  cats and, 383
violence
  in human prehistory exaggerated, 300
visual signals in humans, 130
vocal grooming theory, 180
vultures, 313
Walker, Alan, 37, 135, 276
Wall of Sound, 220
Wallace, Alfred Russel, 12, 70, 72, 73, 74, 75, 101, 474, 483
Wallaschek, Richard, 187
Wallin, Nils, 190
Waltl, Manfred, 414, 483
Wang, Tianyan, 194
Wang, Weijie, 136
war-cry across cultures, 221
warning audio signals without voice, 87
warning colouration as aposematism, 139
warning display in human evolution, 127
watchman's song, 173
water as a three-dimensional environment, 31
Watts, David, 305
weapon
  early hominid defence, 271
Wescott, Roger, 36, 133, 188
Westenhofer, Max, 35, 133
whales
  homosexuality and bisexuality in, 249
Wheeler, Peter, 135
Whistling, evolutionary function of, 175
White, Tim, 296, 297, 302
why chimpanzees and gorillas do not sing, 30
Wickler, Wolfgang, 173
Wiggin, Tim, 185
Wilde, Oscar, 167
wildebeest, 89, 172, 238
Wilkinson, David, 137
Wilson, David, 463
Wilson, Edward, 449, 463, 472
witches
  and cats, 388
witchhunt in medieval Europe, 387
wolf, 140, 150
Wolpoff, Milford, 17
Wrangham, Richard, 134
Xenophon, 254
Yamaguchi, Nobuyuki, 18

Yavorsky, Boris, 187
Yesterday, Paul McCartney's song, 206
yodeling, 29, 215
Young, Truman, 135
Yugoslavia, 220
Zahavi, Amotz, 100, 113, 268
about peacock, 116
Zebra, 238
Zemtsovsky, Izaly, 189, 484
Zoo Lujan, 455, 457
Zuberbuhler, Klaus, 484
Zuidema, Willem, 194

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