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Edited by
Jurie van den Heever
& Chris Jones

Moral Issues in the Natural Sciences and Technologies

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AOSIS

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Peer review declaration

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Research Justification

This book reflects academically on important and relevant natural scientific disciplines, important technologies and related media to determine and communicate the moral issues and challenges within those specific fields of study, and how to deal with them morally and from a multidimensional South African context. It aims to add scientific, technological and ethical value, locally and globally, by reflecting mainly from the viewpoint of specific scholars, writing about the most pressing moral issues or challenges raised by problems within their specific field of study. It is written mainly from a qualitative methodological perspective, including autobiographical and participatory views. The co-authors present in respective chapters their research systematically and intersectionally, based on profound theoretical analysis and reasoning. Current research in the basic and implied sciences and technologies requires sound ethical practice based on a defensible moral stance. Moral norms, in our view, are deeply grounded and evolved convictions about justice and injustice, right and wrong, good and bad. It is not about rules. This scholarly book combines the insights and expertise of established South African scholars from different disciplines and backgrounds. The contributors are all deeply committed to the value and validity of science and ethical practice across the moral spectrum. Open and responsible discussions around this topic can lead to the introduction of moral guidelines and regulations to protect the rights of individuals, animals and the environment, while simultaneously facilitating the growth of scientific practice. This collected work, with its very specific and carefully selected grouping of academic fields, aims to innovatively assist in alleviating the shortage of academic publications reflecting on the moral issues in these specific fields. Its target audience includes international scholars, peers, researchers and educators with an interest in the specific fields covered in this volume. As an open access publication, this book is meant to assist in countering the high costs of Western academic publications and directly benefit scholars in Africa. We can confirm that all the chapters are based on original research and that no part of the book was plagiarised from another publication or published elsewhere.

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Chris Jones, Unit for Moral Leadership, Faculty of Theology, Stellenbosch University, Stellenbosch, South Africa.

Contents

Abbreviations and Table Appearing in the Text

List of Abbreviations

AAAI	Association for the Advancement of Artificial Intelligence
AGI	Artificial General Intelligence
AI	Artificial Intelligence
AI100	One Hundred Years of Artificial Intelligence
AMA	Artificial Moral Agent
ASI	Artificial Special Intelligence
ASSAf	Academy of Science of South Africa
ATM	Automatic Teller Machines
BREXIT	British Exit from the European Union
bt	*Bacillus thuringiensis*
CAPS	Curriculum and Assessment Policy Statement
Cas9	CRISPR-associated Nuclease 9
CDs	Congenital Disorders
CENSCOM	Centre for Science & Technology Mass Communication
CRISPR	Clustered Regularly Interspaced Short Palindromic Repeats
DIY	Do It Yourself
DNA	Deoxyribonucleic Acid
DST	Decision Support Tools
EEG	Electroencephalography
EICOS	European Initiative for Communicators of Science
ELSI	Ethical, Legal, and Social Implications
ESHG	European Society of Human Genetics
ESHRE	European Society of Human Reproduction and Embryology
EU	European Union

FAO	Food and Agriculture Organization of the United Nations
FDA	Food and Drug Administration
FLK	Funny Looking Kid
fMRI	Functional Magnetic Resonance Imaging
GDoH	Gauteng Department of Health
GE	Genetic Engineering
GINA	*Genetic Information Non-discrimination Act*
GM	Genetically Modified
GMO	Genetically Modified Organisms
HGP	Human Genome Project
ICE	Immigration and Customs Enforcement
ICT	Information and Communications Technology
IP	Intellectual Property
IRB	Institutional Review Board
IT	Information Technology
IVF	*In Vitro* Fertilisation
LSD	Lysergic Acid Diethylamide
MASA	Medical Association of South Africa
MEC	Member of Executive Council
ms	Millisecond
MIT	Massachusetts Institute of Technology
MRI	Magnetic Resonance Imaging
MSA	Middle Stone Age
NGO	Non-government Organisation
NHA	*National Health Act*
NHLS	National Health Laboratory Service
NRF	National Research Foundation
OBE	Outcome Based Education
OECD	Organisation for Economic Co-operation and Development
RNA	Ribonucleic Acid
RP	Readiness Potential
R.U.R.	Rossum's Universal Robots

SADF	South African Defence Force
SAIMR	South African Institute for Medical Research
SAMDC	South African Medical and Dental Council
SARS	Severe Acute Respiratory Syndrome
SFF	Centre for Early Sapiens Behaviour (SapienCE)
SWAPO	South West African People's Organisation
TT	Turing Test
US	United States
USA	United States of America
USDA	United States Department of Agriculture
WAC	World Archaeological Congress
WEF	World Economic Forum
WHA	World Health Assembly
WHO	World Health Organization
WWW	World Wide Web
WWF	World Wildlife Fund
YASS	Yunnan Academy of Social Sciences

List of Table

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Preface

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This book looks at different natural scientific disciplines, important technologies and related media to determine and communicate the moral issues or challenges within those specific fields of study, how to deal with them, and/or moral issues as foreseen that will be wrestled with in the near future. Therefore, the book is written mainly from the viewpoint of a specific scholar(s) writing about the (general) moral issues or challenges raised by problems within his or her (their) specific field of study.

Current research in the basic and implied sciences and technologies requires sound ethical practice based on a defensible moral stance. Moral norms in our view are not rules but deeply grounded and evolved convictions about justice and injustice, right and wrong, good and bad. This book combines the insights of established South African scholars from different disciplines and backgrounds and will challenge in certain respects conventional moral boundaries. The contributors are all deeply committed to the value and validity of science and ethical practice across the moral spectrum. Scientific and technological advancement in many fields often outpaces moral reflection and analysis. Open and responsible discussions around this topic can

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lead to the introduction of moral guidelines and regulations to protect the rights of individuals, animals and the environment, while simultaneously facilitating the growth of scientific practice. This volume, with its very specific (and carefully selected) grouping of academic fields, will assist in alleviating the shortage of academic publications reflecting on the moral issues in these specific fields. The primary aim of this book is therefore to contribute uniquely and meaningfully to an ethical approach, specifically in science and technology, although, of course, it would have been possible to include studies from many other disciplines and fields as well. The secondary aim of this book, as an open access publication, is to assist in countering the prohibitive costs of Western academic publications and directly benefit scholars in Africa and elsewhere.

This book provides a structured, multi-authored analysis of morality and ethics, ranging from its natural origins to current applicability in the chosen disciplines. Its value, according to us, lies in bringing together a broad spectrum of related research fields, and we are optimistic that the representation of collaborators from both the sciences and the humanities will add further value. Collating these insights in a single tome will provide a sound basis for advancing current knowledge and provide a reasoned foundation for future research.

One of the main benefits of this book is that it provides a solid background to and improved grasp of the importance of a rational ethical stance in current natural science and technology. We believe this study will make a substantial contribution to a better multi-, inter- and transdisciplinary view on matters relegated to ethics and morality in science and technology.

Throughout this book, we have tried to bring about a balance between issues of global interest in general, for example, artificial intelligence (AI) and genetically modified (GM) food, and issues of broad interest but with a focus on the South African scientific and cultural context like the research that is done at Blombos Cave, Border Cave, Diepkloof Rock shelter, Klasies River main site, Pinnacle Point and Sibudu Cave.

Chapter 1, written by Jurie van den Heever, a Karoo palaeontologist, and Chris Jones, an ethicist, reasons that humans are inexorably the result of millions of years of development and have consequently been extensively moulded, both physically and mentally, by evolutionary processes. Thus, the manner in which we respond to the complexity of our perceived world, including our predilection for a moral stance, as the normative basis of our existence, is contingent upon this fact. Ever since Darwin, disagreements between scientists and moral philosophers on the nature of morality have often been clouded by failure to distinguish between a biologically innate sense of morality and culturally driven moral codes. Traditionally, moral philosophers have also not been enthusiastic students of the life sciences and, other than perhaps in the occasional footnote, have not directly suggested causal explanations for our innate ethical behaviour. Biologists have subsequently stepped into the breach, and the preponderance of empirical data, generated by studies on primates, young children and adults, clearly indicates that ethical behaviour is biologically constituted. Consequently, accusations that biological explanations rely, in this regard, on just stories or transgress by way of the naturalistic fallacy can be put to rest. This begs the question whether ethics, perhaps temporarily, as suggested by some researchers, should not be claimed as a sub-discipline of biology.

In Chapter 2, the archaeologist Sarah Wurz argues that South Africa has a rich palaeoanthropological and archaeological heritage that plays a key role in the understanding of the origins of *Homo sapiens* as attested by a significant number of publications in high-impact journals. Ethical archaeology demands the discipline to move beyond expanding its scientific database to ensure ethical and equitable practice relevant to contemporary society. One of the most pressing sociopolitical issues in South Africa today is a call for the decolonisation of the curriculum and academia. Modern human origins research needs to develop strategies and partnerships to bring about such postcolonial change, a project that is fraught with contradictions and tensions. The dissemination of African achievements as illuminated by the long pre-colonial past resonates with movements that see decolonisation as celebrating this African identity and pride. On the other hand, some demand the decolonisation – that is, the complete replacement – of Western scientific knowledge. Working towards a decolonised palaeoscience practice within this contested environment requires open communication and engagement with all voices. This is best undertaken from an *Ubuntu* value system that acknowledges the interdependence of all humanity, an approach that met with success in other contested and conflicted contexts.

Chapter 3, written by Dawie van den Heever, a biomedical engineer, attends to free will, neuroscience and morality. He asks (Van den Heever 2019):

> Imagine you could rewind the entire universe to the exact state it was in at that moment right before you made the choice to start reading this chapter. With all the particles that make up the universe in the exact same position and velocity as before, could you have decided to do differently. (p. 45)

The concept of free will has been debated for over two millennia by philosophers, theologians and laymen. The debate has always been met with contention owing to the undeniable link between free will and moral agency. Today, this debate is no longer confined to the philosophy classrooms but can be addressed scientifically. And all scientific evidence points towards a deterministic world in which everything that happens, including human behaviour, is entirely caused by previous events and the laws of nature. Recent neuroscience research supports this view with empirical evidence that conscious intention to act is preceded by very specific neural activity relating to the action, that is, the brain decides to act before we are aware of it. Likewise, moral judgements emerge from a complex integration of cognitive, emotional and motivational mechanisms in the brain (Moll, De Oliveira-Souza & Zahn 2008). These, too, can be and have been studied, with interesting findings.

In Chapter 4, Dave Pepler, an eminent ecologist, argues that since pre-biblical times visionaries have realised that, given unfettered access to environmental resources, humans would rapidly deplete natural capital. The Hebraic tradition, in parallel with other ancient civilisations, later developed a narrow approach, which was based exclusively on human's, and especially kingship's, dominion and supremacy although it presented rudimentary elements of conservation thinking. It was the Roman Empire, however, that first formalised human's relationship with nature in terms of privilege, usage and access, leaving a legacy still felt today, especially in judiciary terms. In contrast, the Greeks, especially the Stoic Philosophers, reasoned that all plants and animals are for human's use. Only during – and shortly after – the middle ages did Europe begin to adopt a preservation model for nature, based on strict royal privilege, which continued well into the colonial era. With the advent of the historically recent anthropocene, ecology, as a discipline, has shifted from classic conservation to crisis management by combining conservation with biology. Only as recently as 1948 did Aldo Leopold lay the groundwork for formal natural resource management, soon to be followed by the seminal work of Rachel Carson, when *Silent Spring* was published, highlighting the global effect of worldwide chemical pollution. Currently, the discipline of ecology is grappling with issues such as the interference with wildlife, heavily managed ecosystems and, above all, with our peculiar human behaviours such as infinite greed, veganism, plastic reduction and global pollution. This chapter examines ways to build resilience to avoid distraction, denial, depression and the leading of double lives. The only escape from this moral predicament will be to plan effectively the field of direct, unmediated nature experience and, specifically, finding meaning and deepening connectedness with nature, people and self and, finally, granting the discipline of ecology international legal status.

In Chapter 5, Johan Burger, a geneticist, looks into the ethics of GM food. According to him, food is not only one of the most fundamental necessities of life but also probably the most controversial. The broader concept of 'food ethics' is an intersection of two expansive, interdisciplinary fields and aims to provide analysis and guidance for morally sound human conduct along the entire food value chain, from production to consumption. Genetically modified food ethics narrows this down to food produced using the 'unnatural practices' of recombinant DNA technology. While science prescribes how we can accurately and safely create GM food, ethics questions our motives for doing so. It pushes us beyond the comfort of scientific facts and forces us to consider the manner in which what we do is perceived by the general population, as well as how it impacts the way we act towards ourselves, our interaction with each other and with the world we live in. Genetically modified crops have now been grown commercially for more than 20 years, in many countries across the globe. Yet, concerns about GM food persist, which include potential harm to human health, potential damage to the environment, negative impact on traditional and conventional farming practices, corporate dominance and control of food supplies, and the 'unnaturalness' of the technology (Weale 2010). In this chapter, these concerns are discussed in an ethical context and contrasted against the morality of neglect, should potentially life-saving technologies be denied a world in which food security is becoming an ever-increasing problem. A newer generation of 'genome editing' technologies that largely address these concerns, at least at a technical level, will be introduced and assessed for their ability to appease the ethical and moral objections to GM food.

In Chapter 6, Himla Soodyall, another geneticist, focuses on how genetics in conjunction with societal engagement can contribute to better health outcomes for all. According to her, human genetics research has grown from the days of using classical markers, for example, blood groups and serum proteins, to the use of whole genome sequences. There are different issues linked with knowing one's blood group to knowing one's entire genomic blueprint. At the same time, DNA information has advanced our knowledge in many areas – identification of disease-causing mutations, better understanding of susceptibility to disease in the area of pharmacogenomics and so on. As knowledge of the human genome has grown, so has the expectations and challenges. Alongside the advancements in human genetics and genomic research, there have been several controversial issues that have questioned the (Centre for Genetics Education 2018):

> [*A*]pplications of genetic testing such as reproductive cloning and genetic testing for enhancement. Moral, religious and cultural beliefs underpin decision-making by individuals, couples, families and communities and may challenge such boundaries. (p. 2)

This has resulted in the introduction of several ethical guidelines and regulations to protect the rights of individuals and at the same time to allow research to progress in the advancement of science.

In Chapter 7, Anita Kleinsmidt, a medical ethicist, reasons that the advancement of biotechnology challenges moral and legal analysis. According to her, biotechnology is the use of biological processes and the genetic manipulation of microorganisms together with technology for the production of antibiotics, hormones and other treatments for health purposes. Károly Ereky, a Hungarian agricultural engineer, coined the term 'biotechnology' around 1919. Biotechnology finds application, *inter alia*, in agriculture, medicine and waste management. Examples of biotechnology in the area of human health are diagnostic test kits, vaccines, gene therapy agents, cytokines, certain antibodies and tissue-engineered products such as bone grafts. Scientific advances tend to be viewed as beneficial unless there are immediately obvious destructive effects as in the case of weapons technology. Biotechnology, on the other hand, is usually welcomed as being beneficial to humans. The main exception to this view is the genetic modification of food, which is viewed with concern by many. In this chapter, the author considers the ethical debates and concerns in the following areas of biotechnology:

- precision medicine
- animal rights in the context of transgenic animals and animals used for donor organs

- gene therapy and research ethics
- enhancement of humans
- stem cell research
- biohacking.

The ethical issues raised concern distributive justice and resource allocation, for example, do advances in pharmacogenomics and precision medicine shift resources away from much-needed health care? The ethical debates in stem cell therapy using embryonic stem cells concern well-worn debates around the destruction of human embryos. Gene therapy and human enhancement raise theoretical issues of whether we should be allowed to enhance attributes such as height and intelligence, and whether we should be researching 'therapy' that would only be available to the very wealthy. The use and creation of transgenic animals have given rise to debates around creating new species of animals, ensuring that these genes do not escape into the wild and subjugating the welfare and interests of animals involved to human interests.

In Chapter 8, Hendrik Boshoff, an engineer, and Louise du Toit, a philosopher, argue that the state-of-the-art AI technology poses unprecedented challenges to the domains of ethics (theorising morality) and morality (practical moral decision-making and behaviour). They explain the nature of these challenges by first providing an overview of the emergence of AI (and cybernetics) in science and technology since the Second World War, and in fiction since antiquity. Drawing out both parallels and differences between the fictional fantasies and fears on the one hand, and the actual growth and deployment of AI on the other hand, they make the point that it is important that AI should be evaluated realistically if we want to properly grasp the moral challenges it poses. Popular depictions of AI, especially in movies, tend to overinflate both the threats and the promises of AI, often through the use of humanoid robots that are either evil and destructive or compassionate and kind. The promise of AI is typically related to how intelligent machines may serve human life, while the threat is related to the idea that they may obtain autonomy and their own goals, and try to overthrow human domination. Hype was not limited to fiction, however; the history of AI is one of many stops and starts, of great promises and subsequent losses of faith and funding. This trajectory has had the ironic double effect that the public has an unrealistic view of what is actually technologically possible (expecting machines with full human intelligence and feelings), while at the same time underestimating the extent to which artificially intelligent machines are already acting and making decisions with far-reaching moral and other implications in our everyday lives. Because of the pervasiveness of the latter and the consistent increase in intelligent machines' autonomy, they argue that it is crucial that interdisciplinary teams work on embedding morality in intelligent systems. In the last part of their chapter, they briefly consider what this process might entail.

In Chapter 9, the challenges regarding the potential harm by Cyberspace to democracy and world stability are discussed by Basie von Solms, a well-known and highly regarded Cyberspace specialist. According to him, Cyberspace, with the risk of oversimplifying, can be seen everywhere where there is some computing device connected to another computing device via the Internet. Cyberspace, therefore, consists of all Internet-connected computing devices together with all the data and information stored on all these devices. To a large extent, this interconnectedness is maybe the main characteristic of cyberspace. Cyberspace is usually seen as the place where anyone can find any information using an Internet search engine, because of the mass of data and information available and the ease with which it can be searched. However, presently one of the biggest uses of Cyberspace is in the domain of social networks, with Facebook by far the leader with more than 2 billion users. The core idea behind a social network is for users to find friends and associates, keep in contact with such friends and share information among themselves. In this process, an unbelievable amount of data, mostly personal data of users, are stored within such social networks, and Cyberspace in general.

Because of the interconnectedness of Cyberspace, there exist massive risks that the confidentiality and privacy of such data and information can be hacked and compromised. When this happens, the compromised data can be used in unauthorised and illegal ways for a vast array of cybercrimes by terrorists, nation-state actors, cyberstalkers, cyber blackmailers and others. Such cybercrimes include theft and misuse of personal, corporate and government data; theft of intellectual property including research result formulas and design blue prints; the use of the Internet (Cyberspace) for terrorist purposes; the use of Cyberspace for nation-state to nation-state attacks; and using Cyberspace to plan and execute illegal, unethical and immoral transactions that may even cause death.

Some relevant examples are the misuse of stolen data from Facebook in 2016 to influence the democratic election process in the United States, the cyberattacks between Qatar and its neighbours, and the claimed theft by China of American fighter jet plans.

In Chapter 10, George Claassen, a science and technology journalist and professor, seriously reflects on an opaque lens distorting morality, and how the media reflect science through a 'dirty mirror'. He asks what the media's moral responsibilities are in terms of reporting news accurately, fairly and independently, thus being accountable to their readers, listeners and viewers. And what moral responsibility do journalists have regarding science news and the overwhelming presence of pseudoscientific thinking and quackery? According to him, scientists have what Bucchi (2004:108–109) identifies as an attitude or position (on the part of scientists towards journalists) as the 'diffusionist' conception (Claassen 2011):

> [/]ndubitably simplistic and idealized, which holds that scientific facts need only be transported from a specialist context to a popular one [...] On the one hand, it legitimates the social and professional role of the 'mediators' – popularizers, and scientific journalists in particular – who undoubtedly comprise the most visible and the most closely studied component of the mediation. On the other

> hand, it authorizes scientists to proclaim themselves extraneous to the process of public communication so that they may be free to criticize errors and excesses – especially in terms of distortion and sensationalism. There has thus arisen a view of the media as a 'dirty mirror' held up to science, an opaque lens unable adequately to reflect and filter scientific facts. (pp. 362–363)

This chapter investigates and scrutinises the moral responsibility journalists and the media have to expose quackery and dubious pseudoscientific practices in society, what Pigliucci (2010) calls 'nonsense on stilts'. It also addresses the question whether there is (Claassen 2011):

> [*A*] correlation between what Pouris (1991:358–359) found about South African adults' ignorance about the scientific validity of astrology (32% believed 'astrology is very scientific'), and the fact that nearly every daily and weekend newspaper and many popular magazines in the country regularly publish an astrology column. (p. 363)

Claassen (2011:363) also looks at the morality of publishing or broadcasting quackery and 'inaccurate scientific information and pseudoscience in the South African media' and the effect it might have on the public understanding of science.

The realisation of such a book is a team effort. We would like to extend a word of thanks to all our co-authors, who enthusiastically agreed to become part of this project. Thank you for your willingness, ideas, time and academic skills to reflect on this highly relevant and urgent debate within the domain of morality, science and technology.

For any book to be published, a lot of hard work is done behind the scenes. To all the members of the publishing team – for their kind and professional services – as well as the peer-reviewers for their hard work and valuable input, a word of sincere gratitude.

Chapter 1

The evolution of morality

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Social science theories claiming that morality is free of biological regulation require revision

Lieberman, Tooby and Cosmides (2003:826)

Introduction

In the traditional sense, science and ethics are considered to inhabit separate magisteria. Maienschein and Ruse (1999:1) remind us that '[...] many would agree that attempts to provide a compelling epistemic warrant for ethical theory have failed',

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and Wilson (2002:xv) pointedly refers to the '[...] uneasiness which is felt when biology is brought close to the human condition, and especially when it promises real world applications'. Consequently, moral theorists, less than eager to join the meta-theoretical search, have been supplanted by biologists and philosophers of biology taking up the challenge to naturalise ethics (Maienschein & Ruse 1999:1). This raises the important question of whether our universal sense of morality has evolved naturally or whether it functions as an adjunct to our religious and cultural convictions. To argue convincingly for a natural origin of ethics (morality) would require the elimination of non-substantial arguments or '[...] socially useful obfuscation [...]' (Dennett 1995:154) and reflection on any supporting empirical evidence, suggesting that our predisposition for a moral stance has evolved, as opposed to the presence of moral codes, which are culture dependent. Throughout history, arguments for natural ethics have been advanced by philosophers of all stripes and, in early Western tradition, Aristotle and Thomas Aquinas naturally spring to mind. Humans are, therefore, regarded not only as *Homo sapiens* but also as *Homo moralis* (Ayala 2012:169).

In *The Descent of Man, and Selection in Relation to Sex* (1871), Darwin constructed a cohesive argument for a naturalistic foundation of morality. This was the culmination of his biological work on the subject, and it controversially identified humans as evolved primates. In light of the depth and range of his life-long research on cause and effect in natural history, cryptically expressed as descent with modification, it is ludicrous to dismiss him, as has been attempted in the past, as a failed medical student. His Victorian upbringing, natural inquisitiveness, powers of observation, wide research pursuits, extensive correspondence and numerous scientific contacts, coupled with his circle of academic friendships as well as the years spent voyaging, moulded him into an intriguing package of a mild-mannered Victorian gentleman who reshaped the scientific understanding of his day, while laying the foundations of our current biology-centred worldview and ethical stance.

From his student days onwards, Darwin was an inveterate disciple of Alexander von Humboldt, the foremost German natural historian and explorer of his time and author of the multi-volume *Personal Narrative of Travels to the Equinoctial Regions of the New Continent, during the Years 1799–1804* and, subsequently, the influential discourse on science and nature, *Cosmos*. The former tomes so inspired Darwin that, during his Cambridge days, he copied out long passages and read them aloud to his friends (Richards 2003:93). Darwin persistently read Von Humboldt's texts during the *Beagle* circumnavigation, admitting in correspondence to his sister, 'I am at present fit only to read Humboldt; he like another sun illuminates everything I behold' (Browne 1995:212). In fact, Von Humboldt '[...] had taken on almost mythic proportions in Darwin's mind' (Browne 1995:416). Cut off from personal contact with his scientific circle in England, Von Humboldt featured prominently in Darwin's reading programme aboard the Beagle (Richards 2003):

> As the force of impression frequently depends on preconceived ideas, I may add that all mine were taken from the vivid descriptions in the Personal Narrative which so far exceed in merit anything I have ever read on the subject. (p. 93)

On his return to England, Darwin was acutely aware that his basic conclusions on transmutation ran directly counter to the then prevalent conviction of the fixity of species. While toiling in secret, he also realised that for his theories to gain acceptance in the broad scientific environment, he would have to produce well-argued, scientific analyses. Darwin '[...] had an exceptionally thorough acquaintance with the philosophical debates in his time over the nature and structure of scientific theories' (Gayon 2003:261). His success, therefore, in presenting his scientific insights so convincingly many years later in *On The Origin of Species* (hereafter referred to as *The Origin*) as 'one long argument' (Darwin 2008:482) as well as in his later works rested on the fact that the influential John Herschel, the foremost philosopher of science of his time, and his model of acceptable scientific practice, represented a benchmark that Darwin successfully embraced. According to Gayon (2003):

> [*T*]he model of scientific theorizing that he found in Herschel in the early 1830s was certainly of the utmost importance for his own creativity in the field of philosophical natural history. (p. 261)

In spite of Darwin's efforts at deductive theorising, the famed Herschel, among others, leaned towards the inductive approach and, when published years later, voiced reservations about the arguments in *The Origin* (Hull 2003):

> At best, it was not good enough, and certainly not as credible as the theory of creation by a designing intelligence. At worst, it was not a legitimate scientific theory at all. (p. 169)

In a letter to Darwin dated November 24, 1859, his friend, Adam Sedgewick, Woodwardian Professor of Geology at Cambridge, wrote that parts of the book were '[...] utterly false and grievously mischievous' because Darwin '[...] deserted [...] the true method of induction [...]' (Darwin 1902:216). John Stuart Mill, on the other hand, was prepared to admit that Darwin's theory was not as ridiculous as it looked, but withheld his outright support, because of religious convictions (Ruse 1979:236). As it subsequently turned out, Darwin was decisively vindicated by history.

Thus, influenced by methods of scientific practice as expounded by Herschel, and an interpretation of nature strongly influenced by Von Humboldt's world view (Gayon 2003):

> Darwin's framing ideas are almost always in a zone intermediate between 'general facts' of nature and theoretical 'hypotheses' justifiable through their consequences. His special talent was to understand this methodological approximation crucial to the success of causal theories in natural history. (p. 261)

Contrary to the opinion that Darwin saw nature as a relentless war, he had a romantic view of nature, as expounded by Von Humboldt, who subscribed to the concept of German Romanticism. Both men were long-term international travellers who extensively explored the countries they visited. They were sensitive to the atmosphere of time and place in these exotic locations and, thus, viewed nature from a different, grander perspective than their contemporaries, as is evinced by Darwin's perceptive use of the tree of life and tangled bank metaphors, the former illustrating the extensive organic relationships exhibited by nature, and the latter foreshadowing the future sub-discipline of ecology. Thus, according to Richards (1999):

> Darwin experienced the South American environment, the interconnectedness of its various aspects, the sublimity of its scenes, and the moral behaviour of its peoples – all filtered through a Humboldtian discourse on these very subjects. (p. 122)

Richards (2003) later also stated that:

> Von Humboldt, a protégé of Goethe and friend of Schelling, did not portray nature as a stuttering, passionless machine that ground out products in a rough-hewn manner, but as a cosmos of interacting organisms, a complex whose heartbeat with law-like regularity, while yet expressing aesthetic and moral values. (p. 93)

This view of nature would ultimately constitute an essential aspect of Darwin's thinking and would later surface in *The Origin,* and especially in *The Descent*. Richards also makes the important point that as Darwin's conception of nature was predominantly informed by the Romantic Movement, his theory '[...] functioned not to suck values out of nature but to recover them for a detheologized nature' (Richards 1999:114). Maienschein and Ruse (1999:6) in turn revealed that because of Darwin's view of the natural world as rich with moral values and intelligence, he does not proceed from a descriptive fact to moral value and in this way avoids committing the naturalistic fallacy. In Richards' (1999:114) judgement then, Darwin's ethics '[...] meets the usual challenges of meta-ethical analysis and recommends itself as a justified moral theory'.

Thus, from his initial musings on the species problem to his eventual triumph in *The Origin* and *The Descent*, Von Humboldt's romantic interpretation of nature was like a guiding spirit constantly hovering over Darwin's shoulder. At the very outset, this may seem as a *contradictio in terminis,* as his conception of nature has most often been regarded as quite the opposite. 'The moral theory most often ascribed to him harks back to Hobbes: ethical propositions are presumed to be merely flimflammed for efforts at self-aggrandisement' (Richards 1999:113). In the same vein, Ghiselin (1973:967), although acknowledging Darwin's view of an evolved moral sense, claims that an 'altruistic' act is merely a form of self-interest.

Discussion

The voyager returns

Upon his return from the Beagle voyage, Darwin settled in London for five years, embarking on the intellectually most productive period of his life, during which most of his main theories, including the evolution of the moral sense via the social instincts of ancestral animals, were formulated (Hodge 2003:40). Thus, from its inception, humans were part and parcel of Darwin's reasoning and convinced him '[...] that over long periods of time human mind, morals and emotions had progressively developed out of animal origins' (Richards 2003:92). Receiving scant attention in *The Origin*, human origins simmered in Darwin's mind finally coming to fruition in *The Descent.* Observing the reactions of captive primates strengthened Darwin's conviction of a common origin for the physical and mental attributes of humans and other primates. Acknowledging that the level of intellectual prowess and moral awareness achieved by humans seemed problematical, Darwin (2013) countered by stating that:

> [*E*]veryone who admits the general principle of evolution, must see that the mental powers of the higher animals, which are the same in kind as those of mankind, though so different in degree, are capable of advancement. (p. 635)

Reflecting on the moral behaviour in humans, Darwin (2013:56) concurred with other writers that of all the differences between humans and animals, 'the moral sense or conscience is by far the most important'. As he correctly viewed evolution as a ubiquitous process in nature, he was consequently obligated to formulate an explanatory argument for the evolution of morality because of the 'impossibility' to ignore it, and because, at the time, '[...] no one has approached it exclusively from the side of natural history' (Darwin 2013:56).

His subsequent scenario of moral evolution has stood the test of time. Richards (2003:93) notes that Darwin's theories on the evolution of human mentality are still mainly accepted, and with reference to morality, he '[...] produced a theory of its evolution that stands as a most plausible empirical account, and displays the range and subtlety of his thought'. Krebs (2011:10) acknowledges that although Darwin's account of the evolution of morality contains flaws, it has not been superseded since and that it 'may well provide the most useful available framework for accounting for the complexities of morality' (Krebs 2011:41).

As to the evolution of morality, Darwin argued that any animal displaying distinctive social instincts would inevitably acquire a moral sense or conscience in tandem with developing intellectual powers (Darwin 2013:57), which he outlined in four stages. He firstly suggested that these instincts would promote feelings of well-being and sympathy towards group members as well as the desire to be of service to the group as a whole. His second stage, which he regarded as the main point around which the question of morality revolves, concerns the level of development at which humans acquire the ability to distinguish between selfish urges and how an individual ought to have behaved in a specific situation, marks the first stirrings of conscience. 'This is conscience; for conscience looks backwards and judges past actions, inducing that kind of dissatisfaction, which if weak we call regret, and if severe, remorse' (Darwin 2013:70). His third premise held that, over time, an expanding linguistic ability could more easily express the norms and desires of a community and '[...] the common opinion how each member ought to act for the public good, would naturally become to a large extent the guide to action' (Darwin 2013:57). His final premise stated that our penchant for a moral stance is refined in individuals habitually conforming to the wishes and regulations of the community. Remarking at the end of the chapter (Darwin 2013):

> The moral sense perhaps affords the best and highest distinction between man and the lower animals; [...] as I have so lately endeavoured to shew [*sic*] that the social instincts – the prime principal of man's moral constitution – with [*the*] aid of active intellectual powers and

> the effects of habit, naturally lead to the golden rule, 'As ye would that men should do to you, do ye to them likewise'; and this lies at the foundation of morality. (p. 80)

Ayala (1987) comments on the universality of moral values in human cultures and notes that although some variation between cultures exists, other values, such as injunctions about stealing or killing and the directive to honour parents, may be universal. This is an important observation, as it can shed light on whether the moral sense is a natural phenomenon or whether it is merely an add-on of religion and culture. Darwin's distinction between a moral sense or conscience and moral codes or norms is, therefore, of fundamental importance when reflecting on morality in the broader context relating to, for instance, moral leadership in cultivating change (Jones 2019b).

Ayala (2012:168) responds positively to Darwin's interpretation of the human moral sense as the inevitable outcome of an elevated intellect. As intelligence has demonstrably been a selected trait during human evolution, a moral sense, although not directly selected, would indirectly benefit from the guiding hand of natural selection. Darwin pointedly distinguished between a sense of morality or conscience and the norms that guide this condition. Ayala (2012:169) deems this a crucial aspect because past failures by both scientists and philosophers to recognise and acknowledge this dissimilitude have led to disparate arguments about the origins of morality. Arguments by scientists defending a biological origin for morals most often refer to the sense of morality, the evolved predisposition to make moral judgements. Philosophers who deny the biological basis of morality derive moral tendencies from culture or religion. Because they are referring to moral codes, which vary between cultures, they consequently conclude that biology has no role in determining moral parameters.

The use of metaphors in science is well established, and Ayala (2012:170), elucidating the difference between moral conscience and codes, neatly compares the former to our natural '[...] capacity for symbolic creative language [...]', whereas the particular language (moral code) a person expresses himself or herself in is dependent on geography and culture. Thus, the need for moral values does not specify the nature of the moral value, just as the capacity for speech does not determine the language that is spoken (Ayala 2012:170).

We agree with Ayala (2012:170) that humans are ethical beings as a result of their biological nature and distinguish between moral and immoral conduct by virtue of their increased intellectual capacity, which includes self-awareness and abstract thinking. With this in mind, he points out that the moral codes or norms by which we evaluate events as either good or bad are generated by culture and not biological evolution. In human terms, then the moral sense relates to our capacity to identify some actions as morally good (right) and others as morally bad (wrong). 'Morality in this sense is the urge or predisposition to judge human actions as either right or wrong in terms of their consequences for other human beings' (Ayala 2012:171).

Given the fact that humans are moral by nature, their biology has conferred upon them three necessary prerequisites for an ethical stance. They are:

1. the ability to anticipate the consequences of one's actions
2. the ability to make value judgements
3. the ability to choose between different causes of action.

Ayala (2012:171) attributes the presence of these abilities to the result of the enhanced cognitive capacity of humans. The most fundamental of these is the ability to anticipate the consequences of one's actions, and he suggests that only when one can anticipate that pulling the trigger of a gun will release the bullet that will kill another person (Ayala & Arp 2009) can the action be judged as iniquitous. Pulling a trigger is not a moral action in itself, but it becomes so by virtue of the resultant consequences. It is, thus, closely related to the ability to realise the connection between means and ends (Ayala & Arp 2009), which in turn requires the ability to anticipate the future and form mental images of realities not yet in existence.

Being able to realise the connection between means and ends has served humanity well, as it has facilitated the development of human culture and technology. The evolution of bipedality effectively transformed the forelimbs from appendages, primarily adapted for locomotion to instruments capable of executing a wide array of tasks, ranging from precise manipulation to actions requiring a powerful grip. These adaptations went hand in hand, so to speak, with the production of increasingly complex, and thus more effective, tools, thereby increasing the reproductive fitness of the tool users. Toolmaking requires not only dexterity but also the ability to conceive the final product as a means to an end. Ayala (2009) correctly states that:

> [*N*]atural selection promoted the intellectual capacity of our bipedal ancestors because [*increasing*] intelligence facilitated the perception of tools as tools, and therefore their [*production*] and use, with the ensuing amelioration of biological survival and reproduction. (p. 17)

The historically gradual increase in cognitive capacity of our predecessors also increased the ability to connect means with their ends. The resulting technological payoff was the ability to produce increasingly complex tools, serving more remote purposes. Ayala (2012:172) reiterates that the ability to anticipate the future, an essential prerequisite for ethical behaviour, is closely associated with the developing ability to construct tools. His point is that this ability has produced the advanced technologies of modern societies and is mainly responsible for the success of humans as a biological species (Ayala 2012:172).

The second requirement for ethical behaviour is the ability to make value judgements, thus viewing certain objects or deeds as more desirable than others. If this criterion indicates that the death of an enemy is preferable to one's survival, ending his or her life can be construed as a moral action. The ability to make value judgements, therefore, relies on the capacity for abstraction and the ability to compare objects or actions with one another. The advanced intelligence required for this behaviour seems uniquely confined to humans (Ayala 2012:173).

The third condition required for ethical behaviour is the ability to choose between alternative courses of action. Executing a person can only be judged a moral act if the choice to refrain from the deed is also in the frame. Whether actions such as these involve free will is as yet a moot point. Neurological data do exist that seems to indicate that the concept of a free will is perhaps much overrated (see Ch. 3 of this volume). Ayala (2012:174) is satisfied that morality is, therefore, not a target of natural selection and that his three requirements for ethical behaviour are manifestations of advanced intellectual abilities.

Ayala (2012) convincingly argues for an evolved moral stance in humans, with the proviso that behaviours and injunctions designated as moral codes find their origin within our cultural precepts and not via biological evolution. However, moral codes, like any other cultural system, tend towards a limited lifespan if they do not conform to our biological nature because ethics can only exist in human individuals and human societies (Ayala 2012:175).

Propositions exist that attempt to justify moral codes solely from a religious perspective, although no logical connection is evident between religious faith and moral principles. Religious beliefs explain why some people are susceptible to particular ethical norms because the motivation to do so is grounded in their religious convictions. However, Ayala (2012:175) draws attention to the fact that in accepting the moral dictates of a religion, one is not rationally justifying the moral norms that one accepts. He further states that religious authors, including Christian theologians, often attempt to justify their ethics on rational foundations concerning human nature. For Ayala (2012:175), the logical justification is not derived from religious faith but from a particular worldview and is the result of philosophical analysis based on certain premises.

Most people accept the prevailing moral codes in their societies, without attempts at rational justification, for social reasons because they have learnt it from their parents, school, peers or religion. Moral codes, thus, originate through cultural evolution, a specific human variety of evolution that is more Lamarckian than Darwinian. It is faster than the biological version because it involves direction. It does not depend on the biology of inheritance but leaps horizontally without biological restraint.

Imagine that the piety, religious conviction and exemplary life of a Catholic priest so resonates with a young altar boy that the priest convinces him to follow a vocation in the church. Because of the immediate and horizontal transfer of selected moral codes from person to person in a non-biological fashion, the altar boy is doomed to eventually face biological extinction, because if he conducts himself as an authentic priest, he should leave no offspring. Viewed in a much broader context, the technological revolution has produced superbly effective means to implant a host of cultural codes in millions of brains around the world, within a single generation or less.

He is adamant, however, that in choosing which moral codes are acceptable biology alone is inadequate. This position appears overly simplified because, as Ayala (2012:178) freely admits, changes in this respect have occurred in Western Society concerning smoking, homosexuality, divorce and illegitimacy. It is in fact a truism that cultural codes often exhibit a historically fleeting existence or become modified over time. The legal and political 'systems that govern human societies, as well as belief systems held by religion, are themselves outcomes of cultural evolution, and as it has eventuated throughout human history' (Ayala 2010:n.p.), and they have constantly been subjected to change.

There exists ample evidence of once prevalent moral codes being modified or even criminalised by the application of biology and good sense. Homophobic attitudes, reflecting a myopic reading of religious texts, have been trumped by a deeper understanding of embryology in general and human developmental embryology in particular. As a result, homosexuality is now legalised in approximately 120 countries but remains unlawful in at least 80 others, while in countries like Saudi Arabia, Yemen and Iran, it still carries the death penalty (Pinker 2011:542).

The adverse and often lethal effects of smoking on the human body have been biologically determined, and in many countries, the act of smoking in selected localities is now criminalised. It can, therefore, be argued that these cultural codes have been abandoned in the light of reasonable biological arguments.

For many years, the dreaded disease, Kuru, has been prevalent in the Fore people of Papua New Guinea. Kuru is a debilitating and transmissible form of spongiform encephalopathy (Liberski 2013:472) that causes degeneration of the brain and nervous system. The Fore practised a tradition of mortuary feasting because of their conviction that if a deceased was interred, it would fall prey to worms and, left untended in the open, be devoured by maggots. It was consequently considered a far better practice if the body was consumed by the people who loved the deceased. In this way, a cultural code was established, which stipulated that ingesting the body (especially a portion of the brain) of a deceased relative constitute the ultimate form of respect for the departed. This ritual was most often observed by women and children until the Australian authorities outlawed the practice as cannibalism. Today, cannibalism remains an illegal and repugnant practice, but it was through medical research that mortuary feasting was eventually identified as the root cause of Kuru. By any manner of means this provides a strong incentive to modify dangerous and ultimately lethal cultural practices and, therefore, serves as an example of how knowledge of biological systems and processes ought to trump adverse cultural practices without resorting to legal alternatives.

In South Africa, several young men annually die or are permanently maimed during initiation rites in the bush as a result of ritual circumcisions performed by people under non-sterile conditions (Jones 2019a):

> As far as we know, 41 young boys/men have died during 2018 in initiation schools. In June last year [*2018*] the Deputy Minister of

> Cooperative Governance and Traditional Affairs, Obed Bapela, stated that since 2006 'at least 800 teens and men have had to undergo penile amputations after suffering complications related to traditional initiation'. (p. 10)

Also (Jones 2019a):

> From 2006 to 2018, 714 boys died from botched circumcisions in just the Eastern Cape. Even more shocking is that since 1994, more than 1750 initiates (of which we know) died during initiation in South Africa. (p. 10)

However, teams of volunteer urologists are always ready to perform medically sanctioned circumcisions, as well as offering reconstructive surgery for living, maimed, initiates free of charge. Some practitioners reject this service as an alternative because they view the cultural code as inviolable, thus condoning the insensate cruelty of this practice. After the 2018 incidents, a spokesperson for these practitioners acknowledged on national television that such occurrences, although tragic, cannot be avoided because the practice is of cultural significance. By claiming this practice as a cultural obligation, certain traditional practitioners wilfully ignore sound biological advice, which in turn has forced the government to step in and legislate on behalf of the future initiates for their safety and health, specifically acting against illegal initiation schools. Thus, where dehumanising moral codes are upheld in the face of rational biological explanations to the contrary, biology does and should trump moral codes.

■ Palaeontological perspectives

Tomasello (2016) presents a convincing argument on the evolution of morality, buttressed by experimental evidence from primates and young children. His stated goal is to provide an evolutionary account of the emergence of human morality, in terms of both sympathy and fairness. It is generally accepted that our early ancestors banded together in social groups approximately two million years ago. Foraging over large areas of the savannah, unable to outrun large carnivores and lacking the defensive advantages of large fangs and sharp nails, the natural solution seems to have been the formation of cooperative bonds. Tomasello (2016:40) argues that '[...] participation in certain kinds of mutualistic collaborative activities selected for individuals who were able to act together dyadically as a joint agent "we"'. This required mutual trust and a careful choice of partner. Group hunting by our last common ancestor, as evinced by the chimpanzee model, lacked these requirements. He, therefore, suggests that joint intentionality was established by a system of obligate collaborative foraging with various and robust means of partner choice and control. Tomasello (2016:159) notes that good experimental evidence shows that great apes most often act out of self-interest, but that 'human beings have evolved biologically to value others and to invest in their well-being'. Backing up these claims with supporting evidence from experiments with young children up to the age of three years, Tomasello (2016) notes that humans have become:

> [*C*]ooperatively rational in that they factor into their decision making (1) that helping partners and their compatriots whenever possible is the right thing to do, (2) that others are equally real and deserving as themselves (and this same recognition may be expected in return), and (3) that a 'we' created by social commitment makes legitimate decisions for the self and valued others, which creates legitimate obligations among persons with moral identities in moral communities. (p. 160)

In this way, Tomasello refutes the statement of Richards (1986:272) that 'evolutionary thinkers attempting to account for human mental, behavioural and, indeed, anatomical traits usually spin just-so stories, projective accounts that have more or less theoretical and empirical support'. The recent discovery of a new hominin, *Homo naledi*, in the Dinaledi Chamber of the Rising Star cave complex in South Africa (Berger et al. 2015) has sparked a controversy about the mental evolution of *Homo*. This unexpectedly small-brained hominin has been discovered deep in a nearly inaccessible chamber of the cave complex and dates to between 230 000 and 350 000 years ago. The initial find consisted of more than 1550 bones representing the remains of 15 remarkably well-preserved individuals of various ages, lacking evidence of both predation and cannibalism.

Extensive analysis of the geological history of the cave complex satisfied the investigators that the small existing entrance tunnel was in all likelihood the only access ever to the interior. Exhausting, to their own satisfaction, all other reasonable explanations for the presence of the remains, the team opted for the startling conclusion that the bodies were originally deliberately secreted by conspecifics (Dirks et al. 2016). Wary of invoking value-laden terms linked to ritual burials, they proposed a hypothesis of deliberate disposal. Additional finds of *H. naledi* material (Hawks et al. 2017), subsequently discovered in the Lesedi Chamber of the cave system, conform to the condition of the earlier finds and have added further impetus to the deliberate disposal hypothesis. However, divisive opinions exist on the geological history and the inaccessible nature of the *H. naledi* locality. Assuming that further investigations will ultimately satisfy the critics, the behaviour now tentatively ascribed to *H. naledi* would go a long way in supporting the emergent ethical behaviour in this hominin ancestor. Many non-primate, social mammals clearly express signs of distress and some form of empathy when confronted with the death of group members. Humans are strongly sympathetic to this kind of behaviour, suggesting that it stems from a common origin. With this in mind, claims about incipient ethical behaviour in *H. naledi* seem unsurprising.

It appears a given that Stone-Age hominins would also have been affected or, at least, intrigued by the death of group members. Bolton (2001:2) entertains the notion that accidents during hunting expeditions, resulting in unconsciousness and subsequent recovery, may have led to the practice of protectively secreting the dead with the hope of eventual recovery. Du Toit (2017:1) provisionally accepts the deliberate disposal hypothesis, and noting *H. naledi* probably possessed an enlarged Broca's area, compared to the australopithecines, 'suggesting the possibility of a sophisticated communication system and an enhanced way of dealing with emotion'.

Neontological perspectives

Highlighting our destructive attitudes, morally as well as physically, towards all other life forms as well as our home planet, Michael Ruse (2001:140) has defined us as: '[...] midrange primates who came down out of the trees and went into the garbage and offal business'. Such jarring comments may be just what we need to properly re-evaluate our evolutionary origins in a more nuanced way and over a broader range of disciplines in an attempt to more clearly expose the biological roots of our morality and along the way perhaps re-inventing ourselves and our relationship with the cosmos.

As a point of departure, Krebs (2011:vii) approaches morality as an evolutionary outcome and notes that, apart from biologists and neuroscientists attempting to provide a cognitive framework to explain human moral behaviour, contributors now also include the likes of psychologists, economists and political scientists. He reflects on the approach of psychologists whose attitude is (Krebs 2011):

> [*T*]o assume that the mental mechanisms featured in their preferred accounts of moral development are the only, or the most important sources of morality, and to criticize the accounts advanced by others. (p. 260)

His stated claim is that his evolutionary account of morality 'is equipped to subsume, integrate, and refine the models of moral development advanced by psychologists' (Krebs 2011:261).

Attempting to illustrate the biological antecedents of morality in modern humans, Lieberman et al. (2003) followed an empirical approach, utilising factors governing moral sentiments related to incest. They note that a much-contested debate within human biology has been whether the influence of natural selection on our ancestors is still mirrored in current human behaviour.

From Darwin onwards, evolutionary biologists have reflected positively on the role of natural selection in the origin of human morality. Alternatively, mainstream social scientists were attracted to the idea of the mind as a blank slate, thereby isolating human behaviour against any input from an evolved neural component. Lieberman et al. (2003) state that:

> On this view, our evolved neurocognitive architecture resembles a tape recorder in that it is designed to register an environmental signal (ambient culture) without introducing any content of its own. (p. 819)

In contrast, Lieberman et al. (2003:819) present an evolutionary explanation for our moral stance based on a threefold argument, contending that our neurologically 'based learning capacities include specialisations that evolved among our foraging ancestors to solve the specific adaptive problems posed by the statistical and causal structure of the ancestral world'. Because these specialisations are associated with brain circuitry involved in learning and development, they introduce evolved content, such as concepts and motivations in the mind, predisposing 'the individual to behave in ways that would have been adaptive given the recurrent statistical structure of the [ancient] world' (Lieberman et al. 2003:819). Further, Lieberman et al. (2003) state that these specialisations:

> [/]nfluence the content of cultural elements that are acquired from and transmitted to other individuals in a way that reflects, to some extent, the design and operation of these evolved problem-solving circuits. (n.p.)

They consider the only meaningful way to resolve this debate is by empirically contrasting culturally determinist predictions with data derived from specific models of adaptive specialisations and point out that moral phenomena are the ideal subject for such a test case, because many social scientists regard morality as the paradigm cultural domain, devoid of biological influence, yet encompassing behaviours, such as sexuality, altruism, infidelity, reciprocity and kin interactions, about which evolutionary biologists have presented relevant data. They, therefore, employ opposition to incest to test for '[...] the existence and functional architecture of the human kin-recognition system [...]' (Lieberman et al. 2003:820).

Westermarck (1921) proposed a groundbreaking and surprisingly modern hypothesis regarding human incest and postulated the existence of an evolved mechanism in humans which discourages incest. He proposed that children growing up together would resist incest by exhibiting sexual disinterest in or aversion to each other (Lieberman et al. 2003:820). From a genetic perspective, this makes good sense as co-socialised children are usually closely related.

Ever since Freud, social and psychological sciences have generally rejected biological explanations for incest avoidance, in other words, denying a neural capacity specifically evolved to discourage sexual activity between genetically close family members. Traditional opinions have, therefore, leaned towards the view that sexual attraction originally did exist between members of the same family, but only up to the time when external pressure in the form of prescriptive social and cultural attitudes relegated incest to the underworld of secrecy and taboo (Lieberman et al. 2003):

> Whether the prediction is that children start off endogenously neutral to the prospect of sex with close family members, or positively inclined, cultural determinists are united in believing that this initial orientation is overwritten by social signals originating outside of the conditioned individual. (p. 820)

Evolutionists, however, have suggested that the human brain possesses a kin-recognition system, evolved among our hunter-gather ancestors, which served a double function (Lieberman et al. 2003):

> (1) [*T*]o regulate the allocation of altruistic and competitive effort in accordance with the selection pressures described by inclusive fitness theory [...] and (2) to inhibit sex amongst reproductively mature close genetic relatives because children produced from such unions would be less healthy, [*and consequently more susceptible to infectious diseases*]. (p. 820)

In addition, they note that there is increasing evidence for a possible kin-recognition system operative among non-human mammals as well as many other species.

The Chinese and Taiwanese practice of a family adopting a female infant as a future bride for their male offspring offers an interesting validation for the incest model of Westermarck. Lieberman et al. (2003:820), referring to extensive published data, note:

> [*T*]hat co-rearing pairs of unrelated children as future spouses increases divorce rates and lowers fertility in subsequent marriages, which would be the observable consequence of the lowering of sexual desire predicted by the Westermarck hypothesis [...]. (p. 820)

Lieberman et al. (2003:822–825) provide empirical answers to a range of questions generated by their research. Length of co-residence is shown to correlate with degree of relatedness. Selection for a kin-recognition system that employs co-residence as a cue depends on the presence of substantial correlation between relatedness and co-residence (Lieberman et al. 2003:822–825). The length of co-residence with opposite-sex siblings also correlates with negative moral judgements about third-party sibling incest.

It turns out that co-residence better predicts the immorality of third-party sibling incest than relatedness, and extending co-residence beyond the childhood years (from 0–10 to 0–18) further contributes to viewing third-party incest as immoral.

Cultural explanations as to the origin of moral attitudes towards incest explicitly favour the presiding social and cultural environment as gatekeepers of sexual behaviour. It is taken for granted that children will automatically adopt parental convictions on the subject of sexuality or respond positively to cultural transmission through peers. However, the data produced by Lieberman et al. (2003:824–825) suggest that in these cases there is no correlation, and that '[t]aken together, these findings suggest that moral sentiments regarding incestuous acts are mediated by a different system from the one that governs culturally transmitted moral values'. The results of their study

(Lieberman et al. 2003) support the original hypothesis of Westermarck that:

> [*C*]hildhood co-residence with an opposite-sex individual predicts the strength of moral sentiments regarding third-party sibling incest. This relationship remained significant even after controlling for the effects of relatedness, sexual orientation, family composition, and parental and subject attitude towards sexual behaviour. (pp. 824–825)

The data supported the hypothesis that 'an evolved human kin-recognition system exists, and it uses the duration of co-residence (or something that [co-varies] with it) as a central cue to compute relatedness estimate for siblings' (Lieberman et al. 2003:824–825). Interestingly enough, the data revealed that for girls it is predominantly the number of years of co-residence with a boy that matters most, not whether she believes that he is her brother (Lieberman et al. 2003):

> These results cannot be easily reconciled with Freudian approaches, which implicate parent-offspring dynamics, not sibling co-residence, as the key variable creating incestuous wishes, their repression and their projection into cultural forms. More significantly, the evolutionary predicted inter-individual variations in moral attitude cannot be easily accounted for by cultural determinist theories that posit that moral attitudes in individuals are immaculately conceived from ambient cultural attitudes, through a general learning capacity. Social science theories claiming that morality is free of biological regulation require revision. If the mind is not a blank slate, then theories of culture will have to accommodate this fact. (p. 826)

It is patently evident that a wide range of disciplines are increasingly sensitised to the ubiquitous presence of the evolutionary process and its multi-levelled outcomes. A final case in point is the comprehensive research findings of Lawrence and Nohria (2002). A related but far cry from the Victorian musings of Darwin and the invisible hand of Adam Smith, they investigate human behaviour and its implications for the international business scene from an evolutionary perspective. Having abandoned their earlier reliance on the models of human behaviour, favoured by social scientists during their respective academic careers, their focus has shifted to recognise and include new data on human evolution and brain function. In their extended pursuit of a unified model of human nature, they have surveyed the research of an impressive array of evolutionary biologists, psychologists, anthropologists, economists, neuroscientists, archaeologists, palaeontologists, historians, philosophers and linguists to support and broaden their research. Their theory of human behaviour represents a fresh look at Darwinism, based on four innate but key drives (Lawrence & Nohria 2002):

1. the drive to acquire
2. the drive to bond
3. the drive to learn
4. the drive to defend. (p. 49)

They regard these drives as individually independent in that fulfilling one does not fulfil the others, although in combination they have produced a noteworthy increase in inclusive fitness among humans, and '[...] while not necessarily the only human drives, [they] are the ones that are central to a unified understanding of modern human life' (Lawrence & Nohria 2002:49).

The drive to acquire is innate in all humans. Lawrence and Nohria (2002:57) define it as the drive to seek, take, control and retain objects and personal experiences that humans value. They point out that during the course of evolution, humans have been naturally selected for this drive because of survival pressures around the basic need for food, water, shelter and sex, and, appealing as it may seem to reduce all human behaviour to the pursuit of self-interest, a cautionary note is sounded. 'Adam Smith viewed moral sentiments such as benevolence (the highest virtue) to be just as central to understanding human behaviour as the pursuit of self-interest' (Lawrence & Nohria 2002:73). Thus, as humans are also capable of unselfishness, these authors explain that acts of fairness, generosity and compassion stem from the drive to bond. This drive promotes human cooperation through attributes such as love, compassion, fairness, empathy, loyalty and respect (Lawrence & Nohria 2002:78). As this drive fosters cooperation between people, it can function as a non-zero-sum game in which all parties are winners.

Biologists now generally accept that bonding most likely evolved through natural selection and mate selection because '[t]he existence in humans of a fundamental, innate drive to bond has been demonstrated in multiple ways' (Lawrence & Nohria 2002:103). In this way, bonding has led to a genetic skill set of basic moral rules, which resonates with the life of individuals, large firms with a multitude of employees and potentially with entire populations of nation-states as well.

The drive to learn is innate in humans and can be observed literally from birth. Animals also exhibit curiosity as a mechanism for learning, but it is in the big-brained humans that it is most strongly expressed. Curiosity as a means to acquire information about the environment with regard to which food items are safe to eat, where and when to obtain them, the habits of prey animals and how to avoid danger indicate that this drive has evolved over millions of years of hominin evolution. The learning curve still grips us, even in the current technological age, and we are most often pleasantly surprised and amazed as science increasingly uncovers the mysteries of nature. Individual world views and beliefs about identity are, therefore, continually modified to cope with new and more complex explanations (Lawrence & Nohria 2002):

> Given the drive to bond, it is to be expected that people will want to share their proudly earned views of the world with their bonded friends and allies. Everyone believes their insights will be helpful so they offer them freely. (p. 116)

Eventually, these insights will be passed on from generation to generation and become part of popular culture.

The drive to defend is deeply ingrained in humans and according to Lawrence and Nohria (2002:130) may have been the first to evolve, even preceding the drive to acquire. They point out that the drive to defend interacts with the other drives but, while they are all proactive, the drive to defend is reactive.

According to Lawrence and Nohria (2002):

> The adaptive power of the four drives comes from their interplay in framing the ultimate goals of human behaviour (the what) even as innate skill sets give humans a head start on the how of behaviour. (p. 148)

Arguing from such an evolutionary background to human behaviour, these authors note that genes do not determine behaviour, but that they require the exercise of free will, albeit constrained by environmental conditions. 'They require us to make choices, over and over, in an essentially unpredictable and nondeterministic manner, choices of what to do in our search for a better life' (Lawrence & Nohria 2002:148).

Grounded in these four innate key drives, Jones (2019a) has voiced a succinct statement on human ethics:

> I believe in an integrated theory of human behaviour. A theory of leadership that is not only testable but that will also help us hopefully to do a better job of predicting certain events and outcomes. Where our moral codes are aligned and consistent with our biological nature, realistic sustainable and non-discriminatory change can be created. One of my expectations in this regard is that fears and misconceptions among people regarding gender, race, poverty and sexual orientation will be overcome in this manner, that people will be surprised in strange ways; that this model *will* help people to imagine across boundaries and cultivate an inner eye regarding the pain, brokenness and marginalisation of others in order to bring hope and show the world a new way of being human. (n.p.)

In the final analysis then, the view of life established by the mild-mannered Victorian still reaches out from the past and points the way to the future, as we continue our journey around the sun.

■ Conclusion

Morality, imbedded in our biology, is a universal feature of the human condition. Darwin's mountain of evidence, and convincing arguments, has located humans firmly, both physically and mentally, as products of evolution. His findings, subsequently refined and expanded, currently resonate with a wide range of disciplines. This raises the intriguing proposition that ethics should perhaps be claimed as a subdivision of biology, because deriving our ethical stance from a substantial biological foundation clearly reveals our current defective affiliation with nature and, uncompromisingly, suggests what it ought to be. The extensive explanatory paradigms offered by both palaeontology and neontology are rich in wide-ranging cognitive approaches and factual support that seemingly offer a far more truthful and, in some ways, transcendental exposition of our affiliation with the cosmos than the intensely myopic visions of many religious persuasions. Just as we cannot escape gravity, our biological heritage circumscribes our origins and our mentality. To truly fulfil our destiny, we need to squarely confront our position on the tree of life, not as the trunk, but as one of the minor side branches, somewhere between bestiality and mental transcendence. This will probably sensitise us to the diverse needs and desires of others hidden in the foliage, as well as the future well-being of the planet itself.

The ultimate purpose is not to negate human achievement, but if somebody refers to us as midrange primates engaged in the garbage and offal business, we need to do stocktaking on a more immediate and personal level. We are after all uniquely different from all other life forms and, therefore, share equal fellowship as *Homo sapiens,* as even the most mentally deficient person on Earth remains as fully human as Darwin himself. Within this circle, the four, innate, biologically determined drives, pertaining to humans, ought to lie at the heart of moral behaviour and moral leadership. This is the only way in which good ethical behaviour can be enhanced and ensured (Jones 2019a):

> If one enhances someone's capacity to (1) acquire the necessary resources to prosper and flourish; to (2) bond effectively because you embrace, emphasise, include, trust, respect, honour and recognise the other person for who he/she is; to (3) comprehend with knowledge not only as conveyed on rational level but also through storytelling,

narratives and different encounters, when well-researched truths, useful experience and tested information and insights are shared; and to (4) defend one another because you believe in and act according to justice without favour, fear or prejudice, people's perceptions and behaviour towards women (and men), people who belong to another race, the poor and LGBTIQ+ people, can be changed. Moral change and revolutions, in the words of Kwame Appiah from the New York University (Appiah 2010:xi–xix), still do happen. (n.p.)

Chapter 2

Modern human origins and decolonisation in South Africa

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Introduction

There is prolific research on modern human origins in South Africa, and it contributes significantly to the knowledge on the topic, placing the region in the global spotlight. Palaeontological, archaeological and genetic data on the 'earliest evidence' of the origin of *Homo sapiens* from the region have been published in high-impact journals. These publications are highly cited and earn substantial funding, but this is predominantly meant for

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academics from the northern hemisphere. Although South Africa is one of the core African regions where modern humans evolved, it would be unethical to only focus on the ever-widening and deeper exploration of modern human origins from this region. Ethical practice calls for the development of a social practice that addresses relevant matters outside the academy (cf. González-Ruibal 2018:355). In South African academia, one of the most pressing sociopolitical issues that recently came to the fore is decolonisation of the curriculum and academic practices (e.g. Constandius et al. 2018:65–85; Esterhuysen [forthcoming]; Knight 2018:1–20; Langa 2017:6–12; Le Grange 2016:1–12). Student-led movements such as the #RhodesMustFall and #FeesMustFall campaigns actively campaigned for decolonisation through protests. Decolonisation projects and campaigns are not restricted to South Africa alone. In the United Kingdom, for example, the need for decolonisation found expression in the 'Why Is my Curriculum White?', in the 'I, too, am Harvard' (and subsequently Cambridge, Oxford and elsewhere) campaigns and in the United States, in the film 'Dear White People' (Murrey 2018:1655). Such articulations of decolonialism draw from various global movements, for example, indigenous, critical and women of colour, feminist, subaltern, Pan-African, decolonial and postcolonial studies (Gosden 2012:251–266; Murrey 2018:1655).

The formation and practices of palaeosciences in South Africa are deeply entwined with colonialist, racist philosophies and governance (e.g. Dubow 2007:9–21; Esterhuysen forthcoming; Kuljian 2016). Such a legacy engenders much 'settler' feelings of guilt and hopelessness (Constandius et al. 2018:65–85). The colonialist legacy in archaeological knowledge production and practice has been discussed through postcolonial perspectives in heritage and Iron Age studies (e.g. Ndlovu 2009a:177–192, 2009b:91–93; Pikirayi 2015:531–541; Schmidt & Pikirayi 2016). There is also a discourse on the history of colonialism, and its effect on research undertaken on the periods related to australopithecine and early *Homo* development (e.g. Dubow 2007:9–21; Esterhuysen 2019, forthcoming). Modern human origins research, however, remains essentially unchanged and unaffected by the postcolonial theoretical movements and developments (Athreya & Ackermann forthcoming; Porr & Matthews 2017:1058–1068). Postcolonial perspectives provide a suitable lens to interrogate ethics in modern human origins research (Porr & Matthews 2017:1058–1068), by appraising the status quo, by addressing relations of inequality and oppression and by consciously moving towards decolonisation (Nicholas & Hollowell 2016:62).

A starting point in decolonising modern human origins research is to acknowledge and analyse how the disciplines involved, namely, palaeoanthropology, archaeology and genetics, are steeped in Western science. The main signifier used in such studies is 'modernity', from anatomical and behavioural perspectives. The concept of 'modernity' is the product of colonial and imperialist knowledge production. It was coined in the middle ages and became 'acute' within sociocultural awareness during the Renaissance. It is, thus, essentially a bourgeois idea that owes its origin to the fascination with measurable time, progress, technology and science of the time (Levitt 2011:18). Despite these Eurocentric and colonialist connotations, it is used here as a heuristic. In a similar vein, the terms 'colonial' and 'postcolonial' are imperialist in that they favour classification around periodisation in the context of foreign colonial domination. It obscures detailed changes through time, implying an unchanging past (Esterhuysen 2019; Hamilton 2018:91–116; Sesanti 2015:346–357). Dichotomising terminology, such as human and non-human, human and animal, modern and non-modern, and African and non-African (Levitt 2011:16), needs further postcolonial reflection as will be discussed in this chapter.

In spite of their colonial roots, palaeosciences provide the techniques and approaches to access a past which is devoid of any written records or oral traditions. Moreover, the rich modern human origins heritage of South Africa has created a wide-ranging 'public appetite' for the 'long past' (Hamilton 2018:93). Here, the 'long past' encompasses the pre-colonial period relating to that part of the Middle Stone Age (MSA), from 300 000 to 40 000 – 22 000 years ago, fully acknowledging the colonialist association of this periodisation. The MSA of South Africa contributes significantly to the heritage of all humanity, and this is precisely why six sites – Blombos Cave, Border Cave, Diepkloof Rock shelter, Klasies River main site, Pinnacle Point and Sibudu Cave – have been nominated for the status of a World Heritage site.[1] As will be discussed further, such heritage status is used by decolonisers for celebration and remembrance, whereas others regard it as something to be abolished because of its association with colonialist Eurocentrism. Such tensions naturally occur when decolonising practice (Munene & Schmidt 2010:323), as highlighted in this chapter. Any attempt at developing an African postcolonial study of the past must essentially address and overcome such tensions (Lane 2011:11). South Africa's rich heritage on modern human origins from palaeoanthropological, genetic and archaeological perspectives is described first, commenting on colonialist entanglements throughout. Thereafter, the role of the long past in the construction of contemporary African identity is discussed, followed by a reflection on ways to move towards ethical and equitable palaeoscience practices.

The development of 'modern humans' (*Homo sapiens*)

The anatomical traits that distinguish *H. sapiens* from other groups include a small face, tucked under a globular braincase, small brow ridges, a prominent chin and a narrow pelvis (Stringer & Galway-Witham 2018:389–390). The population history and patterns of migration of modern humans have been the subject of intense research since the inception of archaeological and palaeoanthropological disciplines. It is now thought that all humans alive today are descendants of African ancestors, as the founder populations first evolved on this continent and subsequently

1. See http://whc.unesco.org/en/tentativelists/6050/.

moved out of Africa to other regions. This 'Out of Africa' hypothesis has become the norm for academic debate on human origins. The Out of Africa theory replaced the Eurocentric view that dominated until the 1980s that modern humans developed in Europe, the origin of all things 'human', and then migrated into Africa (Athreya & Ackermann forthcoming).

There are currently at least four models that explain how populations developed within Africa prior to migrating from the continent (Henn, Steele & Weaver 2018:148–149). They vary from regarding one narrow geographical region as the origin of the first *H. sapiens* (e.g. Henn et al. 2011:5154–5162; Marean 2014: 7–40) to 'African multiregionalism' that emphasises connections between small groups over Africa (Scerri et al. 2018:582–594). Current research shows that *H. sapiens* first migrated out of Africa between 177 000 and 194 000 years ago (Hershkovitz et al. 2018:456–459), followed by many subsequent migrations (Stringer & Galway-Witham 2018:389–390). The picture of the origins of modern humans that emerges is one of a gradual development of the *H. sapiens* clade with the genetic contribution of many groups, mostly within, but also outside of, Africa (Stringer 2016). Other regions, such as Europe and Asia, also played a role in early modern human development, and groups such as Neanderthals and Denisovans contributed to the human gene pool. The narrow version of the Out of Africa hypothesis in which only the African lineage developed into modern humans ironically denies the role that other regions such as Europe and Asia played in modern human origins (Athreya & Ackermann forthcoming).

It was the genetic research by Cann, Stoneking and Wilson (1987:31–36) that indicated that African people had more genetic variability than non-Africans, which shifted the role of Africa from the 'other' to being central to the history of all humans and so the 'African Eve' was born. Genetic research initially indicated a time depth of around 200 000 years ago for the development of the 'African Eve'. The Ethiopian human fossil remains from Omo and Herto, dating to 195 000 and 160 000 years ago, respectively, did fit the expectation that *H. sapiens* developed around that time (Stringer & Galway-Witham 2017:212–214). However, the discovery of human fossils from Jebel Irhoud, Morocco, in a layer dated to around 350 000 to 280 000 years ago, pushed the origins of *H. sapiens* back by more than 150 000 years. These remains show a mixture of archaic features, especially in the shape of the brain, and modern features related to the shape of the face (Hublin et al. 2017:289). The roots of *H. sapiens*, thus, date back into the Middle Pleistocene, the period between 780 000 and 120 000 years ago. The Moroccan finds led to renewed interest in the South African Middle Pleistocene fossil finds.

The Florisbad 260 000-year-old human remains from the Bloemfontein area, known as *Homo helmei*, may be an expression of early *H. sapiens*. The cranium and partial face show a mixture of gracile and robust traits similar to the Moroccan fossils and resemble *H. sapiens* closely (Clarke 2012:44–67). Interestingly, these remains show many pathologies that illustrate that this individual suffered from diseases (Curnoe & Brink 2010:504–513) bringing home the realisation that early humans did not live a romantic care-free life. The Cradle of Humankind is internationally known for its extraordinary evidence on australopithecines and early *Homo*, but this region has been, until recently, silent on modern human origins. The recent discovery of at least 15 individuals of *H. naledi* from the Rising Star Cave system reveals that early humans frequented this area as well. The *H. naledi* individuals, with modelled ages of between 236 000 and 335 000 years ago, are unusual in that they show australopithecine type robusticity combined with modern features (Berger et al. 2015). Initially, *H. naledi* was promoted as crucial evidence for the 'birthplace of humankind', but when the dating revealed that this group was much younger and probably did not play a role in the evolution of *Homo*, it became a 'puzzling member of the human family tree' (Greshko 2017). It is thought that *H. naledi* buried their dead (but see Egeland et al. 2018:4601–4606), a controversial idea as early human burials are exceedingly rare, first occurring in South Africa at Border Cave associated with

Howiesons Poort *H. sapiens* (D'Errico & Backwell 2016:13214–13219). 'Symbolic' *H. naledi,* however, fully captured the public's imagination. A Google search reveals the remarkable effect that extensive financial backing and media attention have on elevating the public awareness of the origins of humans, in this case *H. naledi*. By comparison, very little is known about the equally significant Florisbad finds and the *substantial* body of evidence that indicates the true extent of the human fossil evidence from South Africa. *Homo sapiens* from the Late Pleistocene (130 000–11 700 years ago) occur at the coastal sites of Klasies River, Pinnacle Point, Die Kelders, Klipdrift Cave, Blombos Cave, Diepkloof Rock Shelter and beyond the Cape Fold mountains at Border Cave, Plovers Lake and Bushman rock shelter (Wurz 2018).

Genetic research is one of the most important contributors to academic and public knowledge on modern human origins and, as was the case with 'African Eve', frequently leads to the creation of new paradigms. *Homo helmei* from Florisbad is seen in a new light now that genetic evidence also indicates that human roots go further back than 200 000 years ago. The analysis of the full genome sequences from the skeletal remains of a 2000-year-old Khoisan boy from Ballito (Schlebusch et al. 2017:652–655) shows that population divergence for this group was between 250 000 and 350 000 years ago. This is interpreted as conclusive evidence that *H. sapiens* first appeared in Africa at this time (Schlebusch & Jakobsson 2018:405, but see Henn et al. 2018:153).

Such research is vital in constructing the modern human origins story from South Africa, but it is also necessary to take note of the broader sociopolitical context within which analyses are undertaken. Genetic research in the context of modern human origins is fraught with ethical challenges (Prendergast & Sawchuk 2018:803–815, see also Ch. 6). There is competition among many different research groups for access to skeletal remains curated at museums (Morris 2017:2), which needs to be ethically managed. It is also the ethical responsibility of museum personnel and analysts to treat human remains in a dignified manner, with respect for protection and preservation of long-term potential for future research (Prendergast & Sawchuk 2018:804). Guidelines do exist on the ethical handling of human remains, for example, the Vermillion Accord (WAC 1989), and the San Code of Ethics (2017), but these are often not specific enough to protect such remains. All museums need policies to control access to human remains. An example of such a policy is the Iziko Museums Human Remains policy (2005) that provides for an advisory committee that includes members of descendant and scientific communities and concerned stakeholders. Rassool (2015:146) remarks that this does not guarantee ethical practice as perhaps human remains should not be studied at all. Also, the challenge lies in identifying who descendant communities are within a non-ethnic and racist framework.

■ 'Modern' behaviour

Middle Stone Age archaeological remains consisting of stone tools, ochre, ornaments and features like hearths, dating to between 300 000 and 40 000 – 22 000 years ago, are used to develop hypotheses on the development of *modern behaviour*, 'an out-dated and theoretically flawed concept' (Wadley 2015:157), but here modern behaviour is used in its broadest sociopolitical sense (see Kissel & Fuentes 2016:222; Porr & Matthews 2017:1060), acknowledging the contested nature of this concept. South African MSA data are mostly from cave sites, many of them from the coastal regions, especially the southern Cape coast, as these areas have been targeted for investigation owing to superior preservation. Modern human behaviour and anatomy are frequently studied separately (Porr & Matthews 2017:1058–1068) owing to what is perceived as a long interval between the development of anatomical modernity, around 300 000 years ago, and 'modern' behaviour. Many archaeologists consider modern behaviour to have developed only about 100 000 years ago, although a contingent regards such behaviour as an earlier phenomenon (e.g. Deacon & Wurz 2001:55–64; Kissel & Fuentes 2016:217–244). The abundant South African

MSA record (Wadley 2015) was instrumental in changing the narrative that persisted until the eighties, that *H. sapiens* only became 'modern' when groups migrating out of Africa reached Europe and that their superior behavioural and cognitive abilities allowed them to 'conquer' the less advanced *Homo neanderthalensis* (Athreya & Ackermann forthcoming). Within this paradigm, the European Upper Palaeolithic became reified as the standard to be used for the recognition of 'modernity' *per se.* It also led to thinking about modern human behaviour in relation to 'revolutions'. Modern behaviour was seen as an Upper Palaeolithic 'package', exemplified by ornamentation, decoration, symbolic use of ochre, worked bone and blade technology. This characterisation of modern behaviour is now considered inappropriate as it is based on erroneous Eurocentric interpretations of the Middle to Upper Palaeolithic transition (Deacon 1989:547–564; McBrearty & Brooks 2000:453–563). McBrearty and Brooks (2000:492) provided more extensive, and somewhat less Eurocentric, lists of criteria involving ecological, technological, economic and social organisation and symbolic behaviours, with innovation as the underlying principle (McBrearty & Brooks 2000:534). Some of these behaviours have occurred in Africa from 300 000 years ago, the time during which *H. helmei* developed. They become more frequent through time and culminated in the Howiesons and post-Howiesons Poort, until 58 000 years ago, after which there is again a lesser intensity of modern behavioural signals. It is only after 40 000 years ago that such behaviours are again more prominently encountered in the archaeological record (Wurz 2018).

Finds from the South African MSA were instrumental in bolstering the perception that the origins of modern behaviour are not solely associated with the Upper Palaeolithic. The 77 000-year-old engraved ochre and broadly contemporaneous shell beads from Blombos Cave (Henshilwood et al. 2002:1278–1280, 2004:404) centred the search for the origins of modern behaviour in South Africa. This site also contributed the earliest ochre containers (Henshilwood et al. 2011:219–222) and drawing

(Henshilwood et al. 2018:115), thereby increasing the list of 'firsts' from South Africa. Examples of other 'firsts' published in *Nature* and *Science*, high-impact journals, include the early use of marine resources and pigment (Marean et al. 2007:905), and the early use of fire as an engineering tool at Pinnacle Point cave 13B (Brown et al. 2009:859–862) and MSA bedding construction and settlement patterns at Sibudu Cave (Wadley et al. 2011:1388–1391). These finds are widely celebrated in the media and popular culture. The media glorify the importance of such finds, thereby increasing their public significance, adding to what has been described as a 'frenzied cycle' (Wadley 2014:209) and a race to publish the 'firsts' (Athreya & Ackermann forthcoming). There are many other important finds, not published in high-impact journals that also contribute to the significance of the MSA (cf. Wadley 2014:209).

In an effort to move away from lists of criteria to characterise modern behaviour, it was suggested that symbolic thinking be used to recognise typically human behaviour (Deacon & Wurz 2001:55–64; Henshilwood & Marean 2003:627–651) and that this is recognisable in items reflecting 'storage' outside of the brain (Wadley 2003:247–250). Symbolic behaviour remains an important marker in research regarding human behaviour (e.g. Kissel & Fuentes 2016:217–244), but those approaches that link MSA archaeological material to San culture (e.g. D'Errico et al. 2012:13214–13219; Villa et al. 2012:13208–13213) have been criticised. The description of organic artefacts from the 43 000-year-old Border Cave assemblage as directly related to those of the ethnographically known southern Africa's San peoples imply that contemporary and recent San are 'living fossils, unchanged for tens of millennia – an unethical conclusion with real world political implications [...]' (Mitchell 2012:2; Wadley 2007:126). Some cognitive approaches find modernity in 'complex cognition' (Wadley 2013:63–183), cognigrams (e.g. Lombard & Haidle 2012:237–264) and cumulative culture (e.g. Marean 2015:533–556; Sterelny 2011:809–822). Most approaches agree that modernity can be recognised in artefacts associated primarily with sites dating to between 75 000 and 58 000 years ago from the Still Bay and Howiesons Poort technocomplexes (Wurz 2013). These periods are associated with items such as shell beads, engraved ochre and ostrich eggshell, formal bone tools, heating of silcrete and other raw materials. Modernity is also reflected in the hafting of stone tools using compound substances, the utilisation of plants as insecticides and in 'house-keeping' practices such as constructing bedding and the sweeping of hearths (Wadley 2015:155–226). Complex cognition can be extended to early MSA artefacts from South Africa, dating to at least 300 000 years ago. Hafted lithic points from Kathu Pan 1 for composite projectile weapons such as hand-held spears and early MSA retouched points also reflect complex cognition (Wadley 2013:63–183). Whether such evidence indicates 'language' as we know it is a complex issue that is open to debate (Klein 2017:204–221).

The identification of modern behaviour as such has been criticised as 'qualitative, essentialist, and a historical artifact of the European origins of Palaeolithic research' (Shea 2011:1). Shea (2011:11) promoted using a more geographically and temporally inclusive concept and suggested 'behavioural variability' captured through 'energetic costs, benefits, risks, and anticipated fitness consequences'. However, the conception of 'behavioural variability' is no less Eurocentric than identifying modern behaviour. Models based on optimisation of technological and extractive behaviours are deterministic, linear and teleological and not context-dependent on and sensitive to historicity (Porr 2014:257). The beliefs that optimality processes are universally applicable and that rationality dominates nature are Western science values and not necessarily applicable to the past (Porr & Matthews 2017:1058–1068). Such reductionist tendencies are also evident in research that aims to identify brain structures or genes that 'enabled' *H. sapiens* to think and behave in modern ways, separating 'us' from 'them', our ancestors (cf. Porr 2014:263).

In some modern behaviour narratives, imperialist and superiority notions typical of the European colonial expansion are apparent. In one such model, based on neo-Darwinian principles for the development of cumulative culture, Marean (2015:546) argues that 'advanced cognition, hyperprosociality, and a slavish reliance on social learning', typical of the human cultural niche, developed when symbolic capabilities allowed humans to break into the coastal foraging niche and to exploit dense and predictable resources (Marean 2016). It is hypothesised that the elevated conflict associated with the competition for these resources led to the selection of hyperprosocial behaviours. Athreya and Ackermann (forthcoming) note that in popular media Marean remarks that it was the capability of humans to become alpha predators on land and sea and to master the environment, especially through warfare and weapons in the hands of men, that led to uniquely human hyperprosociality. This suggests that humans are 'programmed' to be conflict-oriented and to 'otherise' out-group members, and that it was intellectual and technological superiority, the domain of men, that allowed us to succeed as a species.

Even though there has been critique on the essentialist logic in modern human origins research (e.g. Ingold 2000; Malafouris 2013; Porr 2014:257–264), approaches that separate humans from nature owing to the evolution of their special cognitive capabilities fixed in their genetic code still abound (Porr 2014:257–264; Porr & Matthews 2017:1058–1068). Postanthropocentric perspectives emphasise that the study of non-human animals merely to identify and demonstrate what is human is unethical and an example of 'othering' (González-Ruibal 2018:345–360). Multispecies archaeology (Birch 2018; Boyd 2017:299–316) aims to work outside the assumptions of such modernist subjectivity and the egotism of patriarchal humanistic ethics. The colonial narrative that one group of 'moderns' who were biologically and behaviourally more 'advanced' than their 'competitors' 'replaced' them and so 'conquered' the world needs to be replaced by narratives guided by approaches that value diversity and the complex interplay between cultural, biological and environmental processes (cf. Athreya & Ackermann forthcoming; Kissel & Fuentes 2016:217–244).

Modern human origins, identity and ethics

Origins research is influential in how society shapes narratives of identity (cf. Gosden 2012:251–266; Levitt 2011:12–24). For modern human origins research to be socially and politically relevant, it has to grapple with practical, philosophical and political–ethical issues (cf. González-Ruibal 2018:346) around identity construction in contemporary South Africa. Khoisan (also known as Khoesan) identity is enmeshed with the long history of South Africa. Genetic studies of Khoisan groups consistently yield the most divergent lineages, indicating a long history (Schlebusch & Jakobsson 2018:407). Whereas this generates much public discussion (e.g. Crowe 2016; Du Preez 2011; O'Reilly 2017), some Khoisan groups see the publication of their genetic data (Schuster et al. 2010:943) as 'pejorative, discriminatory and inappropriate' (Chennells & Steenkamp 2018:15), leading them to develop a San Code of Research Ethics (San Council 2017). Scientists seek out the Khoisan people, and their heritage symbolises nation-building as their rock art imagery and language are used on the South African coat of arms. Paradoxically, they are politically very much marginalised. As a recognised indigenous group (ACHPR 2006), their voice is increasingly becoming prominent in the highly contested land restitution debate in South Africa. The Platfontein San community, for example, believes that the whole of South Africa is their ancestral land (Maruyama 2018:151) and multiple public forums and activists have declared that South Africa 'belongs to the Khoisan' (Sato 2018:207).[2]

Several philosophical and political movements explicitly rely on the long history of Africa, and South Africa, to engender African pride as a means for recovering from the ills of colonialism. This complex and multifaceted subject engenders much postcolonial debate, and, therefore, I only cursorily mention

2. See also https://www.sahistory.org.za/article/khoisan-identity.

connections between some movements and how modern human origins are referred to. Proponents of pan-Africanism, for example, reflect on the 'importance of the past as a source of identity and self-confidence' by emphasising that African societies also have a rich and diverse history, just like the colonisers' countries (Lane 2011:11). The 'Afrikology' (Nabudere 2011) and 'African Renaissance' (Gutto 2006:306–323) movements emphasise the achievements of African people to liberate themselves from the dehumanisation of colonialism. Africa's position as 'cradle of humankind or the Naissance of Humanity' is commended (Gutto 2006:306; Le Grange 2016:10) as a way to reform higher education (Koma 2018:97–108). This is more than a romantic notion of a glorious past. It is a key element in formulating practical strategies for the benefit of Africa's people (cf. Sesanti 2015:347). Incorporating the notion that all humans are of common African descent and that racial divides on the basis of skin pigmentation is a sociopolitical construct with no biological basis (Crawford et al. 2017) does not only celebrate 'Africanness' (see discussions Chiumbu & Moyo 2018:136–152; Matthews 2015:112–129) but also celebrate the unity underlying the current diversity. This is by no means a universal perception. The #FeesMustFall movement revealed discontent with 'facile celebrations of decolonisation-as-diversity such as that offered by the "multicultural" and "rainbow nation" social and educational ideologies of the 1980s and 1990s' (Murrey 2018:59–75). Esterhuysen (forthcoming) furthermore discusses a teenage voice that protested 'if I am African, I am nothing', in her speech on 'our roots are speaking'. This tension between the past, African pride and the youth's discontent with this notion needs further postcolonial discussion.

Knowledge regarding modern human origins, and the long past in general, is neglected in schools and universities. In South Africa, the apartheid system and Christian National Education actively repressed interest in archaeology as history, with the aim of suppressing information on the substantial African occupation of the area prior to the occupation of the first European settlers. The long history of the region was, thus, discounted in favour of

20th-century issues (Esterhuysen 2000:159–165, forthcoming; Gutto 2006:306–323; Hamilton 2018:91–116). After the dismantling of apartheid in the 1990s, the Outcomes-Based Education (OBE) system promised to include archaeological and other information on the long past in school curricula (Esterhuysen 2012:5–13). However, with the Curriculum and Assessment Policy Statement (CAPS) (DBE 2011) that replaced it, such information was significantly reduced in the history syllabus (Ndlovu et al. 2018:2), although it received a little more attention in the Natural Sciences curricula. Ndlovu et al. (2018) note that:

> [*M*]ore than 100 000 years of human biological, social and cultural history that unfolded on the African continent are marginal to the curriculum and is dealt with in the lower grades, resulting in a curriculum that fails to treat Africa adequately as a continent with a rich past. (pp. 2–3)

The inclusion of pre-colonial archaeology is seen as vital to a deepened understanding of African History. At universities, the situation is as dismal. There are only a handful of universities where the long history of South Africa is taught, and when it is done so, it is only within small, non-history departments.

Funding is fundamental for the decolonisation of the discipline. The National Research Foundation is the main body funding palaeosciences in South Africa, and it has a strong transformation drive and aims to fund mainly black students and researchers (NRF 2020 Strategy). Such a drive needs to be complemented with a strategy to address the sociocultural challenges of learning and teaching in a diverse environment (cf. Northedge 2003:17–32). In this regard, the 'struggle for decolonisation' is ongoing, and Constandius et al. (2018:65–85) found that the need for promoting African centrality and fostering openness is widely shared. The participation of African and non-African academics is important and significant, with lecturers rather than the management taking the lead in decolonising not only various types of spaces, the curriculum and classroom but also the mind and body (Constandius et al. 2018:65–85). Lecturers are in a position of prime responsibility in universities to foster ethical principles alongside subject matter in future generations (Smith 2014:138).

Palaeosciences are ethically bound to create a more equitable archaeology and share power in knowledge production (Nicholas & Hollowell 2016:59–82; Shepherd 2003:823–844). This is one of the main challenges facing modern human origins research in South Africa as currently there are very few non-Westerners that are part of high-profile science projects or are lead authors (Athreya & Ackermann forthcoming). Most of the fieldwork research on South African MSA sites are undertaken by 'archaeological swallows' that seasonally fly in and out of the country (Wadley 2014:210), leading to another generation of colonisation of South African heritage. Also, in universities, positions in the broader field of hominin evolution are frequently filled by foreign white researchers (Esterhuysen forthcoming). Such practices do not bode well for the decolonisation and transformation project of the palaeosciences. There are some perceptions of the MSA as the 'white-man's past' (Wadley 2014:210) studied and disseminated by white intellectuals. Some of the most populist political voices call for decolonisation by doing away with Western science and 'cutting the throat' of whiteness (Esterhuysen forthcoming). In such a contested environment, decolonisation of modern human origins research can only be undertaken by listening and engaging with all voices. This is best undertaken, in my opinion, by following the *Ubuntu* value system which acknowledges the interdependence of all humanity, an approach that met with success in other contested and conflicted contexts (e.g. Lephalala 2013:51–59) and contradictory epistemologies (Assié-Lumumba 2017:1–21). *Ubuntu* is a complex, even elusive concept that mirrors multiple, ever-changing insights into African society. *Ubuntu* values include 'consensus, agreement and reconciliation, compassion, human dignity, forgiveness, transcendence and healing' – values that leaders like Tutu and Mokgoro espoused (Lephalala 2013:52). Through such perspectives, a voice can be given to marginalised groups, contributing towards building an inclusive base of palaeosciences in the country.

Conclusion

Modern human origins research in South Africa is at the forefront of global palaeosciences and regularly contributes paradigm-changing information to the discipline. The palaeosciences that engender this knowledge emerged as a result of colonial Western ideology and discourse – this is the unavoidable reality. However, palaeosciences are also central in examining pre-colonial pasts that existed before written records, the long past not accessible through oral histories. The important role such information plays in constructing unique African identities in social and political spheres demonstrates its demand. Emphasising African achievements and the typical African pre-colonial origin of all people alive today is valued as one way to move away from the country's colonial legacy. This philosophy is not shared by those who regard decolonisation as a complete separation of what is perceived as racist Western practice, of interest only to a white minority. Within the current contested environment, some voices, thus, call for the complete purging of white Western palaeoscience knowledge, whereas others are enthusiastic about engendering partnership and pride in the extremely rich long past of South Africa and its people. Adequate dissemination of the rich long past needs history curricula in school and universities to include pre-colonial information to a much greater extent. This is a challenge as the legacy of apartheid and its education system is such that a wealth of historical knowledge has been suppressed and current education and funding structures are not optimally geared to bolster further knowledge production on the long history from local perspectives. The contradictions discussed in this chapter are typical of postcolonial projects and need to be addressed by consciously developed strategies that incorporate open communication, listening and conflict resolution from an *Ubuntu* value system.

Chapter 3

The neuroscience of morality

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Introduction

Imagine you could rewind the entire universe to the exact state it was in at that moment right before you made the choice to start reading this chapter. With all the particles that make up the universe in the same position and with the same velocity as before, could you have decided to do otherwise? *The Stanford Encyclopedia of Philosophy* (Zalta 2016:n.p.) defines free will as, '[...] a philosophical term of art for a particular sort of capacity of rational agents to choose a course of action from among various alternatives'. Philosophers, theologians and non-specialists have debated the concept of free will for more than two millennia. Moreover, the undeniable link between free will and moral agency has seen this debate riddled with controversy. Today, this debate

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is no longer confined to late-night cocktail parties or the insides of philosophy classrooms. It can be addressed scientifically. Also, all scientific evidence points towards a deterministic world in which everything that happens is entirely caused by previous events and the laws of nature.

Just over 200 years ago, Pierre-Simon Laplace alluded to this with what has since become known as Laplace's demon. In a passage in his 1814 'Philosophical essay on probability', Laplace argued that the present state of the universe is an effect of the past state and the cause of the future (Kožnjak 2015:42). He continued that given an intelligence (Laplace's demon) that could comprehend all the forces of nature and all positions of particles in nature at a given instant, and given that the intelligence possesses the mental capacity, the intelligence would know the past and future exactly (Kožnjak 2015:42). This is the basis of determinism. Everything in the universe is perfectly determined and obeys the laws of nature. We do not know the positions of all particles, but we do have a very good idea of the forces of nature. We can also accurately determine the positions of particles in a specified system. In 1969, we put a man on the moon because of our understanding of the laws of nature. We build spaceships that can explore distant planets. We put aeroplanes in the sky and cars on the road. We have cell phones and computers. This can all be attributed to the fact that the universe obeys laws that we understand and can use to our advantage (or to quench our curiosity). However, what about human behaviour? According to determinism, these very same laws of nature that we use to send rockets to outer space can also account for mental processes and, thus, all voluntary actions and decisions. Thus, no thought or action can exist without a preceding cause. However, according to Plato and Aristotle, the deterministic worldview stood in conflict with concepts such as morality and responsibility that require free will (Bode et al. 2014:637).

On the other end of the spectrum lies libertarian free will. This philosophical view says that a person could have done otherwise under the same circumstances and conditions if he or she 'willed' to do so. This states that, given the same past, an agent must have alternative possibilities available to him, and the origin of his actions must lie within him (Bode et al. 2014:637; Imhof & Fangerau 2013:203). This invokes Descartes' dualism. According to Descartes (Bode et al. 2014), there exists a dualistic dichotomy between a mechanistic body and a freely acting self, a mind–body dualism, or the so-called ghost in the shell. The common perception of people is that there is a soul as the 'first mover' or 'uncaused cause', which is necessary for free will (Văcaru & Iordănescu 2015:632). The sense of free will, being the authors of our own fate, is fundamental to our identity as human beings. So, what does modern science tell us about the question of human free will?

Free will

According to Andrea Lavazza (2016:2), three conditions define free will:

1. the ability to do otherwise given everything else is equal
2. agents must be the authors of their choices, that is, agents must have control over their choices
3. the choice must be rationally motivated.

Defined as such, most would ascribe free will to all human beings by default. Commonly, people will judge an agent to have acted freely when consciousness plays a causal role in the agent's behaviour (Shepherd 2012:918). In other words, consciousness and conscious decision-making are, thus, seen as a very important part in the concept of free will. If an action was not the result of conscious will, it was not performed freely. On the other hand, when consciousness plays a causal role in decision-making and behaviour, it is felt that the agents act of their own free will and should be held morally responsible. Folk psychology tells us that conscious intentions cause movements, and therefore, the conscious intention should precede the neural instruction to initiate the movement (Batthyany 2009:2). However, in 1983, the world was shocked by the results coming out of Benjamin Libet's laboratory, providing the first neuroscientific evidence against free will (Libet et al. 1983:635–636).

Libet based his work on the 1965 discovery of the *Bereitschaftpotential*, otherwise known as the Readiness Potential (RP), by Kornhuber and Deecke (1965:1–17). The RP is a slow build-up of scalp electrical potential that starts in the prefrontal motor cortex (the supplementary motor areas and pre-supplementary motor areas) as measured through Electroencephalography (EEG) – electrodes placed on a person's scalp recording the electrical activity in the brain. The RP precedes the onset of voluntary movement and is thought to be a physiological mechanism involved in the planning, preparation and initiation of the movement (Kornhuber & Deecke 1990:14). Libet performed experiments investigating the onset of the RP in relation to the conscious intent to move. In his experiments, subjects were seated in front of a specially designed clock with a dot sweeping around it. The dot completed one revolution in just under 3 s. The subjects were instructed to relax and fix their gaze on the clock and to move their right wrist (which was their dominant hand) whenever they felt the urge to do so. They had to report the precise moment when they became aware of their decision to move their wrist by reporting the position of the dot on the clock. During the task, the onset of movement was measured with an electromyogram (which measures the electrical activity during muscle contraction), and the electrical activity of the brain was measured with an EEG. In this way, it was possible to estimate the time of conscious awareness to act and compare this with the onset of movement and the onset of the brain activity in the form of the RP (Libet et al. 1983:623–642).

The results appeared to have landed a 'striking blow to the traditional view of free will' (Lavazza 2016:n.p.). It was found that the RP, which culminated in the onset of movement, preceded the movement by 550 ms. The peculiar finding, however, was that the RP also preceded the conscious awareness of the intention to act by 350 ms. These findings, therefore, seem to show that a simple, spontaneous voluntary action like wrist movement is triggered by unconscious brain activity and that the awareness of one's own intention to perform this movement only arises at a later time (Lavazza 2016). Furthermore, the Libet-paradigm-type experiments have since been performed several times with several variations, and they all seem to confirm the findings with a sufficient degree of reliability (Lavazza 2016:3). In 2011, for instance, a similar study was done where subjects performed self-initiated finger movement at a freely chosen pace. However, in this case, the electrodes were implanted in the subject's brains while they underwent surgery to treat epilepsy. This way, they could monitor the activity of single neurons. In this setup, brain activity indicative of the upcoming movement was witnessed up to one-and-a-half seconds before subjects reported making the decision to move. With a small population of neurons, the authors could predict the impending decision to move in single trials up to 700 ms before the subject's awareness with an accuracy of 80% (Fried et al. 2011:1; Lavazza 2016). However, several methodological details of the Libet-type experiments have come under fire, especially from philosophers. It is argued that the onset of intentions cannot be accurately identified and measured on millisecond timescales and that the subjective introspective estimates of event timing are inaccurate (Bode et al. 2014:637). Furthermore, being tasked to act freely in an experiment can potentially modify the entire process and end up making it impossible or difficult to truly show free behaviour (Bode et al. 2014:637). And lastly, the assumption that the character of the 'voluntary' movements can be claimed to be acts of free will is questioned. Subjects were asked to move when they feel the 'urge' to move. An urge or desire is argued to be a passive or involuntary event and cannot be related to free will (Batthyany 2009:8; Imhof & Fangerau 2013:203–204).

In 2008, Soon et al. devised an experiment with several subtle changes addressing some of the criticism aimed at the Libet study (Soon et al. 2008:543–545). They modified the experiments to include a choice, that is, giving subjects a choice between alternative actions, something philosophers consider the core of 'free will' (Imhof & Fangerau 2013:203). Functional Magnetic Resonance Imaging (fMRI) was used to measure brain activity, while subjects were tasked to press a button with either their left or right index finger at a freely chosen pace. Again, the subjects had to report the moment of the decision, but this time by selecting a letter in a stream of letters presented to them, which updated every 500 ms. In other words, the subjects had to remember the letter that was showing on the screen at the moment they made their decision. Using statistical pattern recognition techniques, Soon et al. found that areas in the frontal cortex encoded the subject's motor decision up to 7 s before they were consciously aware of the choice. This conclusively addressed the potential inaccuracies in the short time delays as inferred by the subjects between brain activity and conscious intent. This was a significant concern and criticism in the Libet studies. Furthermore, the Soon study looked at different brain areas to find the seat of the decision-making process and not just the motor cortex that is thought to provide late-stage information of only motor planning. Thus, in this study, decisions could be predicted from brain activity in the high-level planning areas and not just the pre-motor areas. These same areas were also shown to be predictive of the abstract decision in another study by Soon et al. (2013:6217–6222). In this study, the researchers increased the complexity of the choice task by asking subjects to add or subtract two numbers from a series of numbers presented on a screen. The subjects could freely choose to add or to subtract the numbers, indicating their choice afterwards. The outcome of their choice could be decoded up to 4 s before the reported conscious moment of decision-making.

In other interesting variations of these experiments, subliminal priming is used to manipulate free choices (Ocampo 2015:4). In such priming paradigms, it is demonstrated that non-consciously perceived information can influence a subject's free choices among response alternatives. In a typical experiment, subjects are asked to make a free choice by pressing one of two buttons after the display of a visible stimulus. Crucially, however, the visible stimuli are preceded by masked primes, subliminal stimuli used to manipulate the choice. The primes are ensured to be subliminal (i.e. not consciously perceived) by displaying them for around 35 ms in-between random masking stimuli such as letters. The letters are typically displayed for longer than 75 ms to ensure they are consciously perceived with the subliminal prime hidden in-between. It has been shown that such a protocol ensures that the prime is not consciously perceived. The target then immediately follows the mask and asks the subject to make a choice. It has been shown in several versions of this experiment that subjects prefer the response congruent with the subliminal prime, and thus, it is possible to non-consciously manipulate free choices. For instance, showing a left arrow as the prime would influence the subject to press the left button when prompted to make the free choice. Brenda Ocampo also showed similar results using non-consciously triggered semantic representations in a novel classification experiment where subjects had to classify a number as being greater or less than 5 (Ocampo 2015:4–9). These experiments show how the brain can be manipulated unconsciously during free choice tasks, lending further support to the idea that consciousness plays no causal role in free choice decision-making.

Since Libet in 1983, a great deal of evidence has been piling up, indicating that many factors influence our final decisions under a wide variety of contexts, and we have no conscious access to these influencing factors during the decision-making process. This challenges the notion that 'free' equals 'conscious'. What we call voluntary actions always comprise the integration of a large number of external and internal cues from various sources and times (Bode et al. 2014:642). As Michael Gazzaniga suggests, we should see decision-making as a complex network of interactions continuously working in parallel (Smith 2011:25). One physical state of the brain inevitably gives rise to the next, suggesting that consciousness might be an epiphenomenon or a by-product of brain processing. The conscious mental states emerge from the physical activity of the brain without playing any part in its control (Mitchell 2018:574). All these studies empirically support the hypothesis that consciousness is ‘informed’ of the fact that a movement is going to occur’ (Lavazza 2016). Consciousness does not trigger our voluntary decisions; rather neural activity starts the decisional process, which culminates in the movement with consciousness of the decision only coming later (Lavazza 2016:3). You might think that you consciously decided to read this chapter today, but the decision to do so may have been made long before you were aware of it.

Yet, deciding when to press a button is far removed from deciding to pick up a book, what to eat or whether to commit a murder. As Maoz et al. (2017:3) rightly points out, most of these studies focussed on purposeless and arbitrary decisions and are thus devoid of any real-world significance. However, does the fact that the decisions are bereft of consequence mean that they have no bearing on any decisions relevant to real-life scenarios or moral judgements? We might find the answers by looking at real-life case studies in moral judgement research.

■ Case studies

On 13 September 1848, at 4:30 pm, a 25-year-old foreman, Phineas Gage, and his team of workers were clearing and levelling rocky terrain along a future railway line in Vermont, New England (Garcia-Molina 2012:371). While thumping down gunpowder in a hole drilled in the rock with a tamping iron, there was an explosion, probably caused by a spark, which resulted in the tamping iron shooting up. The iron entered the left cheek and passed through the frontal part of Phineas Gage’s skull. Phineas Gage was lucky to survive that day, but what he did not know then was that this would become arguably the most famous brain injury in history. Eight years after his death in 1860, his primary doctor, Dr John Martyn Harlow, first reported on the remarkable personality change that Gage underwent (Harlow 1868):

> His contractors, who regarded him as the most efficient and capable foreman in their employ previous to his injury, considered the change in his mind so marked that they could not give him his place again. The equilibrium or balance, so to speak, between his intellectual faculties and animal propensities, seems to have been destroyed. He is fitful, irreverent, indulging at times in the grossest profanity (which was not previously his custom), manifesting but little deference for his fellows, impatient of restraint or advice when it conflicts with his desires, at times pertinaciously obstinate, yet capricious and vacillating, devising many plans of future operation, which are no sooner arranged than they are abandoned in turn for others appearing more feasible. A child in his intellectual capacity and manifestations, he has the animal passions of a strong man. Previous to his injury, though untrained in the schools, he possessed a well-balanced mind, and was looked upon by those who knew him as a shrewd, smart business man, very energetic and persistent in executing all his plans of operation. In this regard his mind was radically changed, so decidedly that his friends and acquaintances said he was 'no longer Gage'. (pp. 13–14)

This indicates that damage to the brain can alter behaviour and even change our personality, which many might feel is the essence of who they are. It is common to feel that our personality is synonymous to an eternal and unchanging soul which defines who and what we are. However, the case of Phineas Gage gave definitive proof of the role of the frontal cortex in higher-level functioning of the brain, including our personality. Since then, there have been numerous other noteworthy cases, particularly when considering morality and moral transgressions.

One such famous case is the story of Charles Whitman, also known as the Texas Tower Sniper. One evening in the summer of 1966, Charles Whitman first drove over to his mother's apartment, killing her, before returning home where he killed his wife by stabbing her five times. The next morning, he went to the University of Texas tower armed with handguns, rifles and more than 700 rounds of ammunition. On his way up to the observation deck of the tower, he killed a receptionist and shot and killed two people on a tour. He then set up his rifle on the deck and had his pick of targets down below on the campus. He killed an additional 11 people and wounded another 31 before he was shot dead by

Austin police officers. In total, 17 people were killed on that day (Rosenwald 2016). In notes found at Whitman's home, he stated that he did not quite understand himself these days and that he was the victim of many unusual and irrational thoughts. He felt he had psychiatric disorders and he tried to find help, even talking to a doctor about his overwhelming violent impulses at one stage. He also suffered from tremendous headaches. Whitman (1966:1) asked for his life insurance policy to be donated to a mental health foundation in the hope that research could prevent further tragedies of this type. He wanted his brain to be examined to find out why he had such violent thoughts. After his death, an autopsy revealed a small brain tumour pressing against his amygdala, an area connected to emotion and aggression. Psychiatrists, neurologists, neuropathologists and forensic investigators have been debating the significance of this tumour, with some saying that the tumour probably could have contributed to his actions on that day.

Another more recent account is the case of a 40-year-old man who out of the blue developed an increasing interest in pornography, especially child pornography, and he also started soliciting prostitution at massage parlours, something he had not previously done (Burns & Swerdlow 2003:437). In the year 2000, he began making inappropriate sexual advances towards his prepubescent stepdaughter. He went to great lengths to conceal all of his newly acquired behaviour and actions because he knew they were unacceptable, but he could not resist acting on the sexual impulses. Only after his wife was informed by her daughter of his behaviour was he charged with child molestation, legally removed from his home and diagnosed with paedophilia. He was ordered to undergo a 12-step inpatient rehabilitation programme, but he was expelled after he continued to solicit sexual favours from the staff and other clients at the rehabilitation centre. The only option was sending him to jail. The evening before his sentencing, he was hospitalised after complaining of headaches. After also complaining about balance problems, a neurologic consultation was obtained, and Magnetic Resonance Imaging

(MRI) revealed an egg-sized tumour in his frontal lobes. After the tumour was surgically removed, he successfully participated in a Sexaholics Anonymous programme and appeared to have been 'cured'. He was back to normal without any of the paedophilic and other sexually inappropriate urges and desires. He was eventually allowed to return home as he was believed to no longer pose a threat to his stepdaughter. However, in October 2001, he again started complaining of persistent headaches and secretly collected pornography. A subsequent MRI revealed tumour regrowth. After the surgical removal of the tumour again, his behaviour returned to normal.

This last case is especially interesting because as one of the authors of the paper remarked, '[w]e're dealing with the neurology of morality here' (Choi 2002:1). Numerous such cases illustrate the link between brain impairment and subsequent behavioural changes. A valuable review of the neurological impairment on sexual behaviour, for instance, can be found in Baird et al. (2007). These neurological impairment or brain lesion studies strongly indicate that our actions and even our moral judgements are caused or influenced in some way by the brain. But are these just interesting and curious anecdotes? Or can similar phenomena be shown in laboratory settings?

■ In the laboratory

Modern neuroscience has used experiments and sophisticated brain imaging techniques to investigate the neural mechanisms involved in moral decision-making, and how these can be affected by brain lesions following the earlier clues alluded to in the previous section. Supported by a large number of studies, a clear picture emerges that morality and moral judgements are mediated by complex physiological and neurobiological mechanisms in which the prefrontal cortex, temporal cortex and limbic systems play a crucial role. A valuable review can be found in Moll, De Oliveira-Souza and Zahn (2008).

Morality plays a central role in human nature, and this is evident in the fact that people will engage in costly behaviour, risking material resources or physical integrity, to help or punish complete strangers based on a sense of fairness (Moll et al. 2008:161). Mental mechanisms involved in moral cognition are diverse and involve a vast number of networks distributed widely throughout the brain (Van Bavel, FeldmanHall & Mende-Siedlecki 2015:167). Both emotion and cognition play important roles in moral judgement through the activation of several limbic and prefrontal cortex systems in the brain. These include subcortical-limbic structures such as the ventral striatum, hypothalamus, amygdala and basal forebrain as well as the anterior and medial prefrontal and anterior temporal cortex (Moll et al. 2008:164). Evidence of the involvement of these structures has consistently been shown in systematic studies of brain lesions. It is evident that selective neurological impairments owing to the lesions can lead to personality changes and disturbances of moral cognition while leaving other cognitive abilities intact.

It has been shown that normal adults who suffer damage to ventromedial frontal cortices (part of the frontal cortex) develop defects in decision-making and planning. It is revealed that such patients have abnormal autonomic responses to socially meaningful stimuli, which lead to abnormal social conduct (Damasio, Tranel & Damasio 1990:81). Furthermore, such patients also show impaired rational decision-making. Damage to this part of the brain reflects in impaired social and moral behaviour even though the patients have intact social knowledge. They can explicitly indicate the behaviours considered morally appropriate by society in a given situation, yet they still behave inappropriately (Cameron et al. 2018:261–262). People showing psychopathic tendencies have also been linked with differences in this part of the brain. Psychopathy is a psychological diagnosis that is characterised by an inability to feel empathy or guilt (Fourie, Gobodo-Madikizela & Stein 2013:232). In another study, the long-term consequences of early-onset prefrontal damage was investigated. Two adults who suffered prefrontal damage before

16 months of age showed severely impaired social behaviour similar to cases when such damage occurs in adulthood. However, unlike the adult-onset patients, the two early-onset patients had defective social and moral reasoning. According to the authors of the study, this suggests that the acquisition of moral rules and complex social conventions had been impaired by the lesions (Anderson et al. 1999:1032).

Damage to other areas of the brain can also lead to impairments of moral judgement, including a host of different inappropriate behaviours. The temporal cortex has also been indicated as playing an important role in social behaviour in several studies, including studies investigating the effect of degeneration in this area because of dementia (Moll et al. 2008:164). One study describes two case studies wherein frontotemporal dementia and bilateral hippocampal sclerosis was associated with homosexual paedophilia. Both were male patients, and the abnormalities occurred late in life. The authors concluded that damage to the temporal lobes resulted in hypersexuality, but they emphasised, however, that there is still no evidence for a specific paedophilia lesion in the brain (Baird et al. 2007:1045). In other instances, the surgical removal of brain tissue in the temporal lobes owing to consistent epileptic seizures has also been linked to hypersexuality (Baird et al. 2007:1045).

It has further been shown that lesions to the limbic and paralimbic regions can result in severe impairments in moral cognition and moral conduct. Extensive lesions to limbic structures have been shown to cause periodic hypersexual and aggressive behaviour. In another case, such severe lesions were associated with the development of multiple paraphilias, including paedophilia, zoophilia and incest. Another instance is described in the literature of a male patient with limbic lesions who showed altered sexual behaviour which was characterised by ‘an obsessive and insatiable desire to touch women’s breasts’ (Baird et al. 2007:1043).

These brain areas have also been implicated in moral reasoning in normal volunteers in several experiments. In one such experiment, normal volunteers underwent an fMRI scan while instructed to make categorical judgements of right versus wrong during the presentation of short auditory statements. Some statements were purely factional without moral content, while others contained explicit moral content. Parts of the prefrontal cortex, namely, the medial frontal gyrus and sectors of the frontopolar cortex, were strongly activated when the moral statements were compared to the factual ones. Furthermore, differences in activation were also seen in parts of the temporal cortex (Moll et al. 2008:165). In another study, normal subjects were exposed to pictures with varying moral content and emotional salience, while the subjects underwent an fMRI scan. This time the subjects did not need to make any judgement, just observe the pictures. Again, the prefrontal areas were selectively activated by the moral content, prompting the authors of the study to argue that moral significance is automatically attributed to ordinary events without a subject even being tasked to make moral judgements. This is known as moral sensitivity. It is further argued that moral sensitivity allows humans to quickly and automatically apprehend the moral implications of any social situation (Moll et al. 2008:165). Another very important and valuable tool in investigating moral sensitivity and moral sentiments is the moral dilemma.

Moral dilemmas

A moral dilemma is a short story that involves a situation in which a subject is pulled in opposite directions due to moral reasons, thus resulting in a moral conflict. Both options have important moral motivations that support them, but they are conflicting (Christensen & Gomila 2012:1251). So, there is not necessarily an objective morally right answer in any situation, rather the correct course of action is probably decided by the society in which the situation presents. Moral judgements of hypothetical real-life moral dilemmas can be a very valuable tool and provide insight into the complex foundational psychological processes at play in human moral cognition. Ultimately, we can learn from these hypothetical dilemmas and shed light on real-life moral decision-making.

An example of a moral dilemma is the famous trolley dilemma that will be familiar to contemporary moral philosophers (Greene et al. 2001:2105). A runaway trolley is on a track, heading to collide with and kill five railway workers if it proceeds on its present course. The only way to save the five people is to divert the trolley onto another track, where only one worker will be killed (Thomson 1985). So, what is the correct moral action to take? Ought you to divert the trolley in order to save the five people at the expense of one (Greene 2005:344)? Most people would say yes. This is the utilitarian approach. Utilitarianism is an ethical philosophy, which states that the best action is the one that maximises utility, so in this case, sacrificing one to save five is preferable. But, consider a similar scenario known as the footbridge dilemma (Greene 2005). As before, the trolley is speeding towards the imminent death of five people. Only this time you are standing on a footbridge next to a very large stranger. The only way to save the five people is to push the stranger off the bridge and onto the tracks. His body will definitely stop the trolley from reaching the five people; however, doing this will also definitely result in the death of the stranger. Ought you to push the stranger to his death to save the five people? In this case, most people would say no. Another version of this dilemma is that of the transplanting surgeon. Ought a surgeon to kill one healthy person to save five by transplanting his or her healthy organs into the five patients each needing a separate organ? Again, for most people, this is a big no and we luckily do not see this happening in our current day and age. But from a utilitarian viewpoint, the outcome is the same as in the original trolley dilemma. You save five people at the expense of one. So why do we act differently?

Greene et al. (2001) investigated what goes on in the brain when normal subjects are confronted with such dilemmas inside an fMRI. They hypothesised that the crucial difference between the trolley dilemma and the footbridge dilemma lies in the tendency of the footbridge dilemma to engage people's emotions in a way that the trolley dilemma does not (Greene et al. 2001:2106). In the footbridge dilemma, the person is required to get 'up close and personal' with the stranger in an effort to intervene, making it a more personal moral dilemma. On the other hand, in the trolley dilemma, one is slightly removed from the action in that only a switch or lever is pulled making this a bit more impersonal. They tested this by presenting sets of personal moral dilemmas similar to the footbridge dilemma (and, thus, invoking more emotion) versus more impersonal dilemmas similar to the trolley dilemma (less emotional). These were both contrasted with non-moral dilemmas. The fMRI results clearly showed that areas commonly associated with emotional processing were more active during the personal moral dilemmas compared to the impersonal moral dilemmas and the non-moral dilemmas. This strongly indicates, logically, that the emotional processing areas in the brain have an influence on and play a role in moral judgement.

From experiments using moral dilemmas like the trolley dilemma and its variants, it has been shown that most normal people are less willing to sacrifice one life to save many if it means they have to physically harm someone compared to when they are emotionally distant from the situation. Neuroimaging studies have shown different brain areas involved in the different situations, and damage to these areas can lead to different outcomes. For instance, it was shown that damage to parts of the prefrontal cortex can lead to a more utilitarian response when confronted with these high conflicting dilemmas. In other words, these subjects tended to opt for sacrificing the one to save the many more often compared to normal controls. This again illustrates the effect of the specific brain impairment on moral judgement (Cameron et al. 2018:265; Van Bavel et al. 2015:168).

Moral dilemmas are excellent tools for investigating and understanding the role of different factors involved in moral judgement, but one has to be aware of and account for the foundational parameters (Christensen & Gomila 2012:1250). There are many parameters involved in moral dilemmas that can have an influence on the subject's response, including how the story is presented, the participant characteristics and other morally relevant elements that characterise the situation. For instance, it has been shown that something as mundane as the font type and colour used to present the dilemma can have an influence on the response (Christensen & Gomila 2012:1253). The personal relationship to the characters presented in the hypothetical story also plays a role. Are any of them directly related? Or part of the participant's in-group? What about the trade-off in the ratio of people saved versus people killed? The typical ratio is five to one, but is there a turning point? And lastly, participant characteristics definitely play a role and can influence the response. These include demographic variables like age, gender, religious inclination, political affiliation, socio-economic status, ethnic and cultural background and many other neurological predispositions (Christensen & Gomila 2012:1256–1259).

The sense of morality is because of a sophisticated integration of neural networks, including cognitive, emotional and motivational mechanisms. These complex networks are wired and constantly updated through an active process of cultural learning and environmental influences because of brain plasticity (Moll et al. 2008:161). As complex and puzzling as these interactions and mechanisms might appear, moral behaviour must have evolutionary origins. The brain has been sculpted over millions of years of evolution, with a general architecture that is genetically inscribed. However, the brain and the details of its circuitry can be modified in response to cultural and environmental influences as has been discussed above (Nestor 2018:6). Moral structure is inevitable for complex animal societies, where regulation of societal behaviour is paramount to the success of the society (Broom 2006:20). Several species, including primates and some birds, have been shown to display negative reactions to situations that are not perceived to be equitable. This implies that such traits are supported by evolution in species with the necessary mental capabilities that engage in repeated cooperative interaction (Decety & Yoder 2017:7). However, it is not only biological evolution that shapes our brains; cultural evolution also plays an important role. And this is evident in the fact that different moral systems emerge in different times and places partly owing to cultural evolution (Stewart-Williams 2015:811). The definition used by Moll et al (2008:161) for morality is 'the sets of customs and values that are embraced by a cultural group to guide social conduct'. In the past, we as humans have made tremendous errors in our sense of morality. One such example of a horrendous mistake in judgement was the apartheid regime in South Africa.

Lessons from home

South Africa presents a unique case to study morality and brain processes involved given the country's history of racial discrimination under apartheid. The constant subjugation to the racially discriminative laws and policies of the apartheid government had many adverse effects on the majority of the population, not just politically, economically and socially but also medically and psychologically (Dommisse 1986:51; Kagee & Price 1995:739). It is well documented that unfair and humiliating treatment has clear adverse effects on physical and mental health (Fourie et al. 2013:228). Unfortunately, remnants of apartheid can still be seen in South Africa today and with that, so can the psychological difficulties and poor mental health. A further consequence of apartheid is that a large proportion of the population is living under impoverished conditions which further ads to the demise in health and well-being (Fourie et al. 2013:229; Kagee & Price 1995:739). It is well-known that childhood malnutrition (an effect of poverty) results in stunted brain development and behavioural impairments.

A study by Fourie et al. (2017:881–892) investigated the brain responses of white and black individuals from the South African population who lived through the apartheid era. Subjects' brains were scanned with an fMRI while they were watching video clips showcasing in- and out-group physical and social pain. In the physical pain task, short video clips of the faces of white and black males expressing dynamic suffering were shown to the subjects. In the social pain task, short video clips were shown featuring white and black individuals in emotional distress. The distress clips were taken from the Truth and Reconciliation Commission hearings or related documents and showed victims in distress owing to either the loss of a loved one or owing to physical or sexual violence. The Truth and Reconciliation Commission was an effort by the post-apartheid government to help citizens deal with the injustices meted out to them under apartheid. It provided a platform for both victims and perpetrators of the gross human rights violations to testify about their experiences in an attempt to reconcile with the past. During the study, all subjects, regardless of race, showed significant in-group biases in activation of certain limbic and frontal cortex structures. In addition, white subjects showed increased guilt and shame to black suffering, while black subjects showed increased anger and indignation to own-race suffering. According to the study, black subjects showed apparent more in-group favouritism, whereas the white subjects showed apparently more egalitarian responses. These in-group biases are not specific to South Africa and have been illustrated elsewhere and may be more evident in countries where culturally acquired prejudices prevail (Fourie et al. 2013:235).

This shows how history and something like racial discrimination can affect brain development and neural circuitry, resulting in different brain responses and behaviour in different groups. The harsh conditions and inhumane treatment of a population affect the brain and, consequently, behaviour. Implicit racial biases that operate unconsciously and influence behaviour are present in our society (Fourie et al. 2013:233). This is something we as South Africans must always remember and be vigilant of when dealing with our fellow countrymen. We are a diverse population of people all with different backgrounds and experiences that shape our brains to respond differently in similar situations. We must learn to be more empathetic towards others, especially towards those from a different race or background. The function of empathy is not to stereotype and generalise but rather to seek the other person's distinct perspective (Fourie et al. 2013:235). We must, therefore, learn to put ourselves in others' shoes and try to understand the situation from their point of view. Empathy helps us understand how we and others are predisposed to have certain thoughts and feelings that result in specific behaviours. Neuroscience research has demonstrated that prejudiced behaviour can manifest at a neural level (Fourie et al. 2013:234). As we have argued earlier, there is no ghost in the machine calling the shots. There is only the machine, wired to respond with a particular behaviour in a particular situation owing to the many factors that exhort its influence. And in some cases, this might even lead to evilness. James Gilligan suggests that trauma during childhood can predispose people to violence (Gilligan 1997). There is probably a lot more going on and contributing to one's propensity for violence, with childhood trauma definitely playing a role in a very complex set of factors. It is certain that trauma and abuse can potentially predispose a person to become a morally evil person (Fourie et al. 2013:232). Consider the case of Eugene de Kock. He had a history of trauma, and the environment he found himself immersed in did not help. The political leaders surrounding him carved out his future as the apartheid government's chief assassin, and he ended up having a career defined by violence. He found himself in an environment conducive to evil and violence and, taking into account his history of trauma, he had no way to resist (Fourie et al. 2013:233). Did he ever have a choice?

■ Conclusion

I have tried to show that we do not have free will in the normal sense of the word. Consciousness does not play a causal role in our behaviour. It seems that consciousness is a mere epiphenomenon, a by-product of the complex processing happening in the brain. Consciousness is only aware of what the brain has decided to do after it has made the decision. The idea that consciousness can act on and affect physical structures or bodies (such as our own) implies that there must exist a fundamentally different kind of causation than usually observed in nature (Batthyany 2009:1). This would violate the law of conservation of energy, and this is not what we see. All evidence points to a deterministic world, even when concerning human behaviour. We all have different goals and purposes (although some of the basic needs are pre-wired into our nervous system) and, thus, we have different aims for our future states. This endows potential future states in the environment with different salience and values, which are in turn realised in the physical structure of the brain through adjusted synaptic weights in different neural circuits. These synaptic weights then determine how the circuit and, in turn, the person respond in any given situation. It is all controlled by the laws of nature, and no magic is needed (Mitchell 2018:575).

This is further supported by brain lesion anecdotes and studies clearly indicating that personalities and behaviour can change drastically if the brain is changed. This again indicates that our behaviour is a product of the brain and the complex processes going on at this moment inside your head. Studies have started to indicate which parts of the brain are responsible for our moral judgements and how these are easily influenced by a wide range of factors. We are complex machines made by nature and shaped by our environment. Many factors influence our behaviour in different situations and whether it is deemed moral or not is up to society. And morality is continuously progressing. As Harris (2011:179) states, 'we will embarrass our descendants, just *as* our ancestors embarrass us. This is moral progress'. Society decides *morality*. But society also plays a big role in creating its citizens. We need to strive to create *enabling* environments to foster and guide moral brain development for all citizens. And we should show empathy towards our fellow human beings in society, regardless of their *background* and their behaviour. We must acknowledge that everyone's behaviour is in part a result of their background. It has been argued that the act of activism by victims of a system (to a reasonable level) and challenging the system can have positive psychological effects and reduce stress (Kagee & Price 1995:743). So in certain situations, we should be welcoming of an act such as activism and protest. However, I also believe that we should still be held accountable for our actions even though I argue against free will. I take a compatibilist view in that I acknowledge that a person's character, motives and intentions are determined by the specific person's genes, upbringing and social interactions. Freedom here is, thus, seen as freedom from internal constraints such as addiction, obsessions, psychosis or other unwanted brain impairments (Imhof & Fangerau 2013:204).

In the near future, we will be faced with many new moral conundrums, real-life dilemmas. And we will be defined by our actions. For instance, the trolley dilemma is no longer just a hypothetical thought experiment. These are real issues we have to consider with the imminent introduction of self-driving cars on a global scale. These cars might at some stage find themselves in a situation where they are on track to kill five people, and they need to decide on a course of action. They can continue on their course or opt for another option where they swing out of the way, but in doing so kill one other person. And we need to programme these cars with the correct moral instructions. And there will be many more moral questions we will need to answer in the future. The emergence of CRISPR-Cas9, a gene-editing tool, brings with it the promise of making genome editing cheaper, easier and faster (Fernandez 2018). This technology can be used to cure genetic diseases, and the first clinical trials are already underway. However, this is just the start, and the same technology might someday be used to promote other desirable traits such as physical strength or intelligence (Hiltzik 2017). Where should the line be drawn? What is morally acceptable?

Chapter 4

Ecology and morality: Transforming the non-human into connectedness with nature

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3. The author is a practising ecologist with little or no expertise in the field of philosophy. The most proximate field in his working and teaching experience is that of nature conservation and ecology, which is marginally concerned with conservation ethics, another discipline the author has little experience and knowledge of. This chapter is, thus, a deeply personal one, based on working experience in Africa and South America, and the lessons learnt from working with people that, by Western standards, live close to the earth and to nature. The views expressed here are, thus, highly idiosyncratic.

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'... and we have to get ourselves back to the garden'

Joni Mitchell (1970)

Introduction

This chapter attempts to investigate man's relationship with nature, not only as a source of sustainability and shelter but also as a spiritual and emotional adjunct to non-material living. The relationship of man with his immediate environment is traced, in broad segments, from prehistory to the modern era. Firstly, the awakening of cognition is traced to about 70 000 years before the present, and it is shown that only with the advent of writing can we begin to discern the first attempts to establish a formalised relationship with our environment. Following the middle ages, the Romantic Movement is shown to question the fundamental nature of our relationship with the living world, and from this movement arose the first attempt to preserve nature for its own sake. At the turn of the 19th century, nations, such as Germany, Britain and the United States, became world leaders in conservation at the landscape level. Finally, this chapter attempts to show that true conservation is a historically recent human development and that, spurred by the devastating destruction of natural capital brought on by the Anthropocene, the need for a morality of ecology is brought into sharp focus. It is furthermore proposed that, for a morality of ecology to be feasible and practicable, the living world should attain international status as a legal person.

Prehistory to the middle ages

The current media obsession with the so-called 'cognitive revolution' (Brown 2009:859–862; Marean 2011:421–440, 2012: 52–59; Marean et al. 2007:905–908; Harari 2014, 2018) is highly indicative of a renewed 'Man's search for meaning' (Frankl 1946) in a world that is fast approaching an ecological apocalypse. A glance at the latest World Wide Fund for Nature's Living Planet

Report (2018) makes it evidently clear that man, now having produced the latest, and perhaps the last geological epoch, the Anthropocene, is at last beginning to grapple with the philosophical implications of a threatened existence.

With cognition came language, and much later writing, but it is only during the very last part of human development, which is about 2.4 million years old, that man began to consider his relationship with nature (Henshilwood and Marean 2003: 627–651). Before civilisation, as we know and understand it, man lived well within the carrying capacity of his immediate environment, and populations of humans and animals were regulated by simple ecological rules, for instance, density dependency (Regoeczi 2002:505–530). Hunter-gatherers roamed over large areas, following edible game species, life was short and brutal and populations of humans remained fairly constant.

The seeds of stable civilisations were geographically planted in places with constancy in crucial resources such as food and water, and it is of little wonder that later world civilisations, such as those of Egypt, India and China, were established on, or near large and perennial rivers. But these civilisations are historically recent, not much older than perhaps 7000 years. Before civilisations became established, there were other centres of consistency, such as the Olduvai Gorge, and, most importantly, sea caves on the southern coast of Africa.

Here, for the first time in human development, primitive *Homo sapiens* began to recognise the significance of the consistent availability of high-quality seafood, and combined with shelter, this geographic and ecological confluence made a sedentary and semi-permanent lifestyle possible. It is also here, for the first time in man's history, that we find signs of a mind that is beginning to think forward, into the future. And with a developed cognitive ability, that is a fairly sophisticated vocabulary, as these kinds of cognitive skills made technology transfer, and even the development of figurative and abstract art, possible. In the caves of Blombos, near Still Bay in South Africa, we find the first signs of decorative art (Jablonski 2006) and sophisticated stone tool hardening (Marean 2012:52–59). The archaeological record now clearly shows the continental and intercontinental spread of these first cognitive developments. This epoch is the so-called 'cognitive revolution', which took place between 68 000 and 70 000 years ago.

Millennia followed before the first indications of written language arose, and we have a remarkable reference and source in the famed *Epic of Gilgamesh* (George 2003), a fairly complete report on life and its metaphysical machinations. It is of crucial importance to recognise that even then there were concerns about man's ability to influence the environment negatively. When Gilgamesh defies the gods of Mesopotamia by cutting down the cedar trees (Tablets 4–6), Himbaba, a demigod, predicts drought and fire in future. Since the *Epic of Gilgamesh*, we have exact records of civilisations rising, and falling, always through the overexploitation of natural resources, where man, in his quest for development, expansion and domination, exceeded the carrying capacity of the land (Wood 1999:15).

A critical reading of the scriptures of major world religions shows that there is a tacit, and sometimes overt, injunction to harbour respect for nature. In the Buddhist *Lotus Sutra*, we find this text (Watson 1993):

> Display a heart of boundless love for all the world, In all its height and depth and broad extent, Love unrestrained without hate or enmity, Then as you stand and walk, sit or lie, until overcome by drowsiness, Devote your mind entirely to this, it is known as living here the life divine. (p. 207)

In the translation of the texts of Saint Francis of Assisi by Robinson (1903:97), we find the passage:

> Praised be you, my Lord, with all your creatures, especially My Lord Brother Sun, who brings day, and by whom you enlighten us; he shines with great splendor; of you, most high, he is the symbol. (p. 97)

In the *Atharva Veda* (Vishnam 2003), one of the seminal Hindu texts, we find the following passage:

> Supreme Lord, Let there be peace in the sky, and in the atmosphere, peace in the plant world and in the forests; Let the cosmic powers be peaceful; let there be undiluted and fulfilling peace everywhere. (p. 371)

In The *Gates of Prayer* (Central Conference of American Rabbis 1975), one of the most revered books in Judaism, we find:

> It is said: Before the world was created, the Holy One kept creating worlds and destroying them. Finally He created this one, and was satisfied. He said to Adam: 'This is the last world I shall make. I place it in your hands: hold it in trust'. (p. 102)

In his call to prayer, the native American Chief Lyons (2005) entreats:

> O Great Spirit, Whose breath gives life to the world, and whose voice is heard in the soft breeze, We need your strength and wisdom – May we walk in beauty. (n.p.)

And lastly, Lao Tzu, one of the greatest thinkers in Taoism says, '[t]hose who want to know the truth of the universe, should practice reverence for all life. This manifests as unconditional love and respect for oneself and all other beings' (Mitchell 2006:10).

This tale of development, expansion, domination and eventual downfall will certainly be repeated elsewhere in this publication, but suffice it to say, that since the rise of civilisation, ecological stability and human needs have been inextricably intertwined, hence the recently accepted ecological term, anthropomorphic.

■ The middle ages to the 1950s

This section is highly compressed in its reach as the nature of this publication does not allow lengthy analysis and discussion.

In the light of current scientific research and publications, it is patently clear that our planet has now been altered and damaged, perhaps beyond recovery (WWF 2018). The accurate measure of this progressive damage is possible as science is simply systematised knowledge, which is self-regulating, as opposed to dogma, which is unyielding and irrational. Although this ecological degradation has been known for some time (Primack 1993:136), a new interdisciplinary field of eco-phenomenology has recently become relevant (Brown & Toadvine 2003:468). I quote from Joubert (2018:3) who says that the 'eco' in 'eco-phenomenology' comes from the 'conviction that nature has value, deserves or demands a certain proper treatment from us', and furthermore, that this value of nature 'must have its roots in an experience of nature' (Brown & Toadvine 2003:156).

Phenomenology concerns itself with the world and our personal experience of the world, which has become secondary to our theoretical conception of the world, a world that has always been there (Merleau-Ponty 1956:59–70). It, therefore, gives a philosophical status to the world and is at the root of the question of why we, as modern humans, have become so alienated from the living world. At the root of this alienation is monistic religion in which man is prioritised over all living beings, which is demonstrated in the priority principles pertaining to man, widely applied in environmental ethics.

The origins of this separation of man and nature can be found in ancient Greek philosophy, particularly in the teachings of Plato, followed closely by Judaic-Christian traditions and teachings. At its core lies man's dominion over the natural world and, incidentally, the subjugation of women (Merchant 2006:513–533). Prior to this epoch, there was a shift from female to male deity worship, and this point, at about 4500 BC, marks the beginning of male-dominated society (Gaard & Gruen 1993:234–257).

Although predating the middle ages, the Roman influence on man's relationship with nature is continued to this day in terms of legal definition such as *ferae naturae*, translated as animals of wild nature, and not subject to absolute ownership. It still holds true today where should a landowner manage to sufficiently tame once free-roaming animals, these beasts will become his property. Furthermore, *res nullius*, that is, nobody's thing, pertains to *ferae naturae*, until such time the animal is captured or killed. So too does the term *foris* – still in use – refer to the wild, undeveloped countryside outside cities, towns and villages. All these terms and concepts arise from the classical Roman belief that nature existed exclusively for man's use and enjoyment.

Then, at the end of the middle ages, came the Scientific Revolution, which, in a brief timespan, led mainly by Francis Bacon, began to see nature purely in terms of cause and effect that could be 'analyzed, experimented with, and understood through reason' (Gaard & Gruen 1993:234–257). The world, thus, created saw nature as devoid of life, inert and mechanistic. Western culture was now pre-programmed to master the *Umwelt*, a legacy that continued until the 20th century.

Nature conservation, as we know it today, at least from a Western perspective, had its origins in three Western countries, namely, the United Kingdom, Germany, and later the United States of America. It is prudent to briefly examine these movements and its legacy.

Although England had vast areas set aside for the exclusive use of royalty, the foundations of modern conservation have their roots in the Romantic Period (Ditt & Rafferty 1996:1), which suggested that nature has more and deeper values than its mere utilitarian exploitation. The first attempt at the long-term preservation of natural beauty in Britain was initiated in 1886 by the establishment of the Selborne Society for the Preservation of Birds, Plants and Pleasant Places (Selborne Society 1888:8–9).

In both England and Germany, this new approach treated natural beauty as national treasures as well as crucial elements of 'National Character' and by the turn of the 19th century, the first formal organisations were founded and headed by the establishment of The National Trust for Places of Historic Interest or Natural Beauty in 1895. In 1907, the National Trust was empowered by the Parliament to declare these sites 'inalienable'. In 1912, the Society for the Promotion of Nature Reserves was founded, led by Nathaniel Charles Rothschild (Stamp 1970:18), and The National Parks Committee founded in 1929 was the governmental body responsible for evaluating and proclaiming formal conservation areas in Britain.

As in England, the Romantic Movement in Germany, at the end of the 19th century, was the catalyst for drawing attention to areas of natural beauty. Although active, with substantial support, it did not lead to direct conservation agencies being established. At the helm of this movement was the *Heimatbewegung*, but being purely scientific and antiquarian minded, it lacked the drive to establish a broader conservation ethic. At the turn of the 18th century, however, demands arose for the establishment of 'national parks', based on the North American model. Clouded by Nazi ideology of 'blood and earth', the Reich Nature Protection Law was passed in 1935. Of significance here was the differentiation between beautiful areas of the landscape and untouched areas, of which there were few in Germany. By the mid-1960s, the *Bundesanstalt für Naturschutz und Landschaftspflege* had established more than 50 such areas in the Federal Republic.

Two visionary North American thinkers, John Muir and Theodore Roosevelt (Soulé & Terborgh 1999:1), shaped modern nature conservation as we know and understand it today. Primed by the devastating results of unchecked excesses of frontier exploitation, they singlehandedly transformed the conservation and national parks landscape of the entire continent. Muir, founder of the Sierra Club (Fox 1981), through his persistent activism, was responsible for the establishment of Yosemite and Sequoia national parks and served as the inspiration for scores of others, including Roosevelt.

Even more than Muir, Roosevelt singlehandedly shaped the conservation infrastructure of the United States by establishing 150 national forests, 50 federal bird reserves, four national game reserves, five national parks and 18 national monuments. Considering the duration of his presidency, which lasted from 1901 to 1909, one is astounded at his dedication and thrift (Brands 1997). This is a remarkable achievement as the fortunes of 19th and early 20th century Americans were mostly built on the unsustainable exploitation of natural capital. Roosevelt timeously realised this and often remarked (Brands 1997):

> We have become great because of the lavish use of our resources. But the time has come to inquire seriously what will happen when our forests are gone, when the coal, the iron, the oil, and the gas are exhausted, when the soils have still further impoverished and washed into the streams, polluting the rivers, denuding the fields and obstructing navigation. (p. 38)

The early 1950s marked the watershed of our relationship with the living world, as it was only during this time that we were made aware of man's destructive behaviour through the work of Leopoldt (1949) and Carson (1962), and it is of particular importance to note that the discipline of ecology, latent until then, was maturing into a functional and effective discipline. Although Haekel coined the term ecology as early as 1866, only during the 1960s did it attain full maturity. The fledgeling concepts of the *practice* of ecological principles were established by Evelyn Hutchinson (Conniff 2016), a scientist, but reached full fruition with the publication of *Ecology: From Individuals to Ecosystems*, written by Begon, Townsend and Harper (1986). Read in concert with Primack, we now had a *pro forma* approach to responsible living and management.

The modern (current) era

The conservation conscience of the modern era is defined by four important publications and popular culture contributions. Prior to the late 1940s, the concepts of nature conservation, environmental ethics and environmental crisis management were practically unheard of, mainly because the entire planet was still largely functional at the continental and even global scale. Then, in 1949, the ecologist, forester and environmentalist Aldo Leopoldt published his seminal book, *A Sand County Almanac* (Leopoldt 1949), which was an instant classic. For the very first time in human history, the term 'land ethic' was coined, best illustrated by Leopoldt's (1949:224) often used quote, '[*a*] thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise'.

Leopoldt set the tone and approach for conservation, conservation management and utilisation of shared natural resources, which is valid till this day. Decades before the discipline of 'deep ecology' was formulated and established, Leopoldt lay the foundations for future thinkers, wherein deep ecology was regarded as the discipline that considered all life on Earth, regardless of their utilitarian use for man.

When Carson (1962) published *Silent Spring*, the public response was instantaneous and of international reach. Here, for the first time, the concept of extinction cascades, chemical persistence in the environment, chemical metabolites and global deleterious effects became evidently clear. More importantly, for the first time, the damaging role of large global chemical corporations was highlighted with meticulous and damning clarity. This publication caused an instant uproar and opposition from large chemical corporations but at the same time was instrumental in the practically immediate reversal of national and international chemical policies and brought about the establishment of the American Environmental Protection Agency. Her influence, globally, is lasting and permanent.

The publications of Leopoldt and Carson were timeous in that, again for the first time in human history, the international youth was mobilised, not only politically because of devastating international conflicts, such as in Vietnam, but specifically in terms of the environment. It is not generally realised what profound influence the pop concert Woodstock had on the youth. Filmed and televised globally, it took the genius of Joni Mitchell to have her lyric Woodstock sung by Crosby et al. (1970) to an international and receptive audience. The refrain of this lyric (Crosby et al. 1970) remains pertinent to this day:

> We are stardust
>
> We are golden
>
> And we've got to get ourselves
>
> Back to the garden (n.p.)

'Getting back to the garden' must be one of the most powerful lines in modern songwriting because of its metaphoric power to the youth, disenfranchised from the then mainstream culture of consumerism and unchecked consumption. These cannabis and LSD users, perhaps deeply enlightened by these substances, today are the captains of the industry. It is of interest to note that the therapeutic use of these substances is making a comeback in current psychology and psychiatry (Anderson et al. 2014: 969–978).

Upon the heels of this lyric, Joni Mitchell (1970) released an equally important song the next year, 'Big Yellow Taxi':

> They paved paradise
> And put up a parking lot
> With a pink hotel, a boutique
> And a swinging hot spot
> Don't it always seem to go
> That you don't know what you've got
> 'Till it's gone
> They paved paradise
> And put up a parking lot (n.p.)

'They paved paradise' resonates to this day. This modern classic has been covered by artists ever since and remains probably the most important environmental anthem ever written.

It took a number of years before the next environmental management approach was formulated and published, and in 1993, Primack (1993), incidentally born in 1950, and thus a product of the era of modern conservation philosophy, published his groundbreaking book, *Essentials of Conservation Biology*. In this work, it was realised that man, in his use and abuse of natural resources, does not have the time to study environmental degradation in such depth as to affect the appropriate immediate remedial actions. Rather, conservation biology is now seen as a crisis discipline, which attempts, through the application of current best management practices, to buffer damage and degradation until correct and appropriate actions can be taken. It takes a broad approach, combining conservation biology, climate change biology, protection of endangered species, protected area management and sustainable development into a multidisciplinary approach. What Primack has achieved is to include the general public, governments and local people in the day-to-day management of ecosystem services and biodiversity.

Morality of ecology

Up to this point in this chapter, no mention has been made of morality in terms of ecology, for the simple reason that, to the author's mind, it is a *contradictio in terminis*. In order to be or act in either a moral or an ethical fashion, it must be assumed that the conveyor of such values is human (Razz 1994). Therefore, environmental ethics lies entirely within the scope of ecology, but when it comes to morality, the issues become vague and troublesome, for in order to attain morality in ethics, ecology has to have a formal and legal identity and status, that is, that of a corporate being or 'a legal person'.

The question that now begs to be asked is whether it is philosophically and legally possible to grant any lawful status to a 'principle of conduct'? Although hypothetical in nature, there are indications that this possibility is being entertained. The recent case of an automated photograph taken by a wild primate led to a protracted legal dispute of ownership and copyright (Hutton 2016:93–103), where the court ruled that the macaque 'photographer' held no intellectual property over the image and the paper furthermore held (Hutton 2016):

> In order to focus the discussion, the paper explores these issues in the domain of law, focusing on jurisprudential understandings of how non-human animals and human beings, systems and individuals, machines and people are held to differ. (pp. 93–103)

Another recent development in this arena is the advocacy of human rights to the higher primates such as gorillas, orangutans, chimpanzees and bonobos. Bonobos are the closest living relatives of humans, with a genetic similarity of 98%. In this debate, we are, for the first time, beginning to see a confluence of ethics and morality. Yet, the problem remains; if we are to give ecology a legal status, who will represent a voiceless discipline?

Now the salient issue in the morality of ecology concept is coming to the fore – how to give voice and legal representation to the living world. The author, having no expertise or even cursory expertise in jurisprudence, is tacitly suggesting that, in order to attain a moral stance to ecology, the living world will need to have suitably qualified persons appointed, perhaps like elite judiciary systems already in place worldwide. The American Supreme Court comes to mind here as a *pro forma* structure, but in the case of ecology, obviously, the system will have to be divorced from the rapidly changing political systems. Any candidate for such appointments will firstly have to present a *curriculum vitae* showing a deep understanding of, at least, landscape ecology, and furthermore, global ecology. In fact, a candidate should be both a scientist and a naturalist, a rare commodity these days. Secondly, there would need to be proof of a measure of spirituality and ecological connection, a parameter that can only be assessed through structured interviews. What is required of suitable candidates is proof of personal connection with the living and, incidentally, the non-living world. How this personal connection can be achieved is illustrated in the following section.

■ Case studies

The following case studies are examples of the pathways that, although spontaneous and incidental, are instrumental in achieving a personal connection with the living world. They are by their nature personal as the author has little recourse to better examples. One here is reminded of the illuminating statement of

Albert Schweitzer '[t]he fundamental principle of morality is that good consists in maintaining, promoting, and enhancing life, and that destroying, injuring, and limiting life are evil' (The Albert Schweitzer Fellowship 2018).

Case study one: The Mapuche cosmology

During the mid-1990s, the author was working as a social forester in the *Nothofagus* rain forests of Chile, mainly on the Eighth Region, near the town of Temuco. The forests of this region had been nearly depleted of commercial forest species such as *Nothofagus* and *Podocarpus*, and I was part of an international team of social scientists conducting a structured social impact study. Teams were allocated to interview discreet social strata, and I was involved in the group that targeted the elderly.

While visiting a mobile sawmill in the region, I observed an elderly man observing the activities at a distance. With the help of a translator I approached him and asked whether he would be willing to be interviewed, to which he agreed. Following the *pro forma* and highly structured questions, he was obviously a lucid and willing participant, providing more in-depth data that were required by the questionnaire. Having had previous experience with the Mapuche nation, I was aware of their supremely elegant and uncomplicated cosmology and started steering the conversation in that direction, concentrating on personal and not social aspects.

I proceeded to ask him what modern technology and intrusion meant to him, as a Mapuche who has spent his entire life in the forest. His first remark was that the reigning quiet and solitude had been shattered by the intrusive sounds of modern logging equipment. This remark was highly pertinent as the Mapuche had traditionally used cattle to extract timber from the forest. His second remark was that personal isolation in the forest, for meditative purposes, was nearly impossible to attain as a network of roads and overhead aircrafts consistently shattered the quietude that reigned a mere 50–60 years ago. Streams and water are seminal elements in the Mapuche cosmology, which consist mainly of water, the sun, the wind and the moon.

Towards the end of the interview, I deviated from the standard questionnaire and asked him, attempting to probe deeper, what he thought about the entire disturbed realm, mentioning abstract elements such as rocks, mosses and fallen leaves. He responded instantly, animated and obviously excited by the subtlety and depth of the question and exclaimed, 'Senor, you know!' At that moment, I was truly earthed (Ober, Zucker & Sinatra 2010:217).

Case study two: The bee whisperer on Mount Elgon

In 1987, I was part of an international team of social foresters visiting Uganda to assess and to address a number of pressing and delicate social issues pertaining to forestry. Unlike Western classical plantation forestry, the forest industry in Uganda is largely informal, unregulated and focussed on indigenous biomes such as rain forests and open savannah, which falls mainly within the miombo biome. After some weeks of working with a tribe of Pygmies displaced from Bwindi Impenetrable Forest, we moved to Mount Elgon, an extinct volcano straddling Uganda and Tanzania. Our brief here was to address the issues and conflicts arising from water use of perennial streams among farmers on the lower slopes of the mountain. The brief was to establish a structured agreement for all users from the elevated sources, to the eventual end-users at the foot of the mountain.

On our journey up the mountain, our vehicle broke down, necessitating a one-day stopover on the side of the road. Having time at my disposal, I could now select passers-by for additional and *ad hoc* interviews. At midday, a man carrying a traditional beehive on his shoulder passed our camp and, since I am deeply interested in the production of monofloral honey, asked him for permission to interview him. He agreed readily.

Having covered all the fields of traditional honey production and management, he casually remarked that he was able to 'call' bees to an empty hive and have them move in permanently. In decades of consultation with rural communities on the sustainable use of forest products, this was the very first time that I had heard of this skill and, for a modest fee, and immersed in traditional Western scepticism, asked him to demonstrate his skill. He agreed but asked for a number of hours to gather the required forest products in order to successfully complete the ritual.

He duly appeared after 3 h, clutching a bundle of short twigs, and proceeded to build a small fire with wood from the immediate vicinity. As soon as the small fire was burning clear of smoke, he inserted the bundle of selected twigs into the flames, which caused a dense cloud of grey smoke to materialise. In concert with the smoke, he then proceeded to sing, in a monotonous drone fashion, the 'bee song'. Within 15 min, a swarm of bees arrived and settled in the tree under which the fire and smoke was coming from. He placed his primitive hive near the settled bees, and within a matter of minutes, the entire swarm moved into the hive. At this moment, I was truly earthed.

Case study three: A personal encounter with a wild gorilla

In the latter part of my career, I embarked on a venture which involved taking small groups of eco-tourists to biodiversity hotspots around the world. The most sought-after activity was the encounter with silverback gorillas in Rwanda and Uganda. On my last visit to Bwindi Impenetrable Forest in Uganda, which holds roughly half the remaining population of mountain gorillas in the world, I was allocated a wooden cottage within the rain forest as the tourist camp was fully occupied. Upon my return from a 14-h tracking excursion, I was lying on my bed, the cottage door open to the rain forest. Just before dusk, I became tacitly aware that I was being watched. Looking over my prone body, I saw an adult female mountain gorilla watching me intently through the open door. Being well aware of the strict rules of conduct which regulate contact with these animals, I slowly got up and, moving along the wall, eased out of the cottage onto a small deck. The female watched me intently while I was moving. I was constantly very much aware of the explosive power and danger posed by wild gorillas. I proceeded to the railing and then stood still. The female very slowly approached me, and when she reached my feet, lay down on her back and held my gaze steadily.

Scanning my body, she noticed a scab on my elbow. Then, lifting her hand and gently using a fingernail, she proceeded to lift and remove the scab. When she had finished she sat down, facing me, and placed her cheek on my knees. I discussed this behaviour with Professor Nina Joblonski, who assured me that this was clearly an invitation to social grooming. In that moment, I was truly humbled.

For a discipline of ecological morality to be established, the living world with all its interactions and pathways will have to be given legal status, in particular, that of a corporate, or of ‘a living person’, used in the strict judicial context here. Without such legal status and the associated powers that come with such status, we will never be able to attain a true morality of ecology. At a regional scale, there has been a legal breakthrough in 2018 when Columbia declared their Amazonian rainforest as a legal person (Moloney 2018). Should this legal status prove to be binding, it is predicted that, within the medium term, it will be rolled out to encompass the entire scope of life on Earth.

Conclusion

This author is painfully aware of his near-crippling lack of knowledge and expertise in attempting a chapter of such philosophical, ethical, ecological and moral complexity. However, a life conducted in scientific research and publication, teaching and consultation, especially in the field of sustainable utilisation of natural resources, has brought one salient point into sharp focus. Nature conservation is not an exact science but a multidisciplinary management system – above all, it is about people. It is about people cut adrift from the lost art of a life-sustaining dialogue with the living world.

The current lexicon of ecological, conservation and preservation terminology is sadly lacking in addressing the mythical and the personal in man's relationship to, and with nature, and is confined to other disciplines. This inability to enunciate is possibly one of the main drivers of man's current, and growing disconnection with ecology. There is a need for developing this new lexicon, in concert with fostering connectedness with nature. Although there may be a multitude of pathways to achieve this, earthing, as a structured and guided approach, seems to lead the way.

In terms of a morality of ecology, the Earth's critically damaged condition, exclusively attributed to man's sustained abuse of natural resources, must now commence demanding the establishment of a legal and internationally binding framework for securing legal status for ecology. Only when nature, in its full complexity, can be regarded, represented and defended in legal terms, will a true morality of ecology be possible.

'[*A*]nd we have to get ourselves back to the garden' (Crosby et al. 1970:n.p.).

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Chapter 5

We can, but should we? The ethics of genetically modified food

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Introduction

It is easy for a scientist to write about GM food. Ample data and many credible reports exist to logically argue that GM food is safe for human and animal consumption and that it does not pose major threats to our environment. Even the more philosophical concepts like the 'unnaturalness' of GM technology can be argued sensibly. All of this is easy if the writer's views are backed by scientific facts, and the writer can use scientific

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methods and evidence to argue his or her case. However, we seemingly live in a science-averse world – a world where the large majority of people do not understand, and are not interested in, scientific methods. Instead, most people (even ardent scientists) have beliefs that easily override scientific logic (and evidence) when it comes to everyday decisions, like the decision as to whether global climate change is real, or whether or not to eat GM food. Also, it is a fact that very few people are willing to change their beliefs about significant aspects of their everyday life. The wisdom of Mark Twain (Goodreads n.d.) comes to mind – he said 'it's easier to fool people than to convince them that they have been fooled'. Consider your own situation – when did you last change your mind about something significant in your life?

The technology to produce GM crops is truly well established – GM food has been produced commercially and has been part of our daily diets for more than 20 years now. In fact, the next generation of 'genome editing' technologies have recently been introduced, and the first of its food products are beginning to enter our supermarkets. These next-generation technologies largely address GM food concerns, at least at a technical level. It can, therefore, confidently be said that we can produce GM food, but the moral question remains – should we? Here I, a molecular geneticist with first-hand experience in the development of GM crops, will step away from the luxury of science and attempt to address moral and ethical issues surrounding the persistent concerns over GM food. These include potential harm to human and animal health, potential damage to the environment, negative impact on traditional and conventional farming practices, corporate dominance and control of food supplies and the 'unnaturalness' of the technology (Weale 2010). These concerns are discussed and contrasted against the morality of neglect – should developing countries, where food security is becoming an ever-increasing problem, be denied potentially life-saving first-world technologies?

The global food crisis

> Food makes philosophers of us all. Death does the same, but most of us try to avoid thinking about death. Of course, death comes only once, so we can postpone thinking about it, but choices about food come many times a day, every day. (Pence 2002:vii)

The one issue that is undisputed in the global food scenario, irrespective of your views on GM food, is that we are heading for a total disaster in terms of food production in the 21st century. Sadly, this congruence of opinion does nothing to unite the proponents and opponents of GM food. Statistics about the magnitude of the pending food crisis are abundant and varied, but none of them makes for comforting reading. The bottom line is that global staple food production (in terms of calories) will need to increase by a staggering 69% if we hope to feed the world population by the year 2050 (Ranganathan 2013).

There seems to be very little argument about the reasons for the increasing food crisis, with the explosive population growth certainly topping the list of the likely reasons. It is predicted that the world population will reach 9.6 billion in 2050, with 51% of this increase accounted for in sub-Saharan Africa (Ranganathan 2013). Combine this with statistics on the global, irreversible decrease in arable land area and a rapidly changing environment, as well as the unrelenting emergence of new crop pests and pathogens, and the picture looks pretty grim. Owing to significant contributions from modern technologies like precision agriculture, smart chemistries, soil and water optimisation, postharvest management systems, high-tech machinery and facilities, as well as marker-assisted selection and hybrid breeding, conventional crop breeding is now much faster than it was 50 years ago. The brutal reality, however, is that over the same period, the global annual rate of crop yield increase has dropped by half (Ma, Mau & Sharbel 2018). Arguments that food production is adequate because of these modern interventions are justified, as long as these arguments are limited to the geographical confines of the developed world. It is true that the developed world has very efficient agricultural systems that produce an excess of food in most years. It is equally true that poverty in most of the developing world, especially sub-Saharan Africa and parts of Asia, is such that the technologies and interventions mentioned above are simply not viable. Therefore, these technologies will still not meet the increasing food demands of the developing world in the 21st century.

The current magnitude of the problem becomes evident when one considers the 2018 Global Report on Food Crises (Food Security Information Network 2018). This report claims that an estimated 124 million people in 51 countries were facing ‘Crisis’ food insecurity or worse – meaning that at the end of 2017, they required urgent humanitarian action to save lives, protect livelihoods and reduce hunger and malnutrition, compared to 108 million people in 48 countries at the end of 2016. It states that the main reason for poverty and food insecurity in these regions is of a sociopolitical nature (protracted conflict), yet a significant contributing factor is the failure of agriculture, as a result of persistent droughts and a changing climate. In 23 (of the listed 51) countries, droughts were the major triggers of food shortages, with two-thirds of these countries in Africa, where almost 32 million people are facing acute food insecurity.

Considering these statistics, the Gregory Pence quote above becomes ironic – philosophers in these worlds are probably thinking about death as much as they do about food, many times a day, every day.

■ A brief history of genetically modified food

Of course, very solid arguments exist that genetic manipulation of food started with the domestication of plants and animals through deliberate selection around 12 000 years ago. However, for the sake of expediency, the arguments here will only consider what is generally perceived as GM food, that is, derived from crops and animals developed through recombinant DNA technology. A number of discoveries and developments in the broad field of molecular biology also represent key milestones in the development of what is generally perceived as GM food today. Among these are the discovery of DNA and its basis as the genetic material of most organisms (many viruses have RNA genomes), the elucidation of its structure and an array of techniques to manipulate DNA, which in the 1970s led to the 'cutting and pasting' of foreign DNA into a host genome – first in bacteria, but later also in crop plants (Cohen et al. 1973: 3240–3244).

The first GM plant was an experimental tobacco plant produced in 1983, using a naturally occurring plant pathogen, *Agrobacterium tumefaciens*, to introduce an antibiotic resistance gene (Bawa & Anilakumar 2016:1035–1046). The first transgenic animal was created by Rudolf Jaenisch in 1974 when he introduced Simian virus 40 DNA into a mouse embryo. In 1988, the Food and Drug Administration (FDA) in the United States approved the first food-related application for the use of GM microorganisms in the production of cheese (Los Angeles Times 1990). The first commercial food crop to appear on supermarket shelves in the mid-1990s was the 'Flavr-Savr' tomato, developed for longer shelf-life by the company, Calgene (Bruening & Lyons 2000:6–7). At this time, the first concerns about the safety of GM food also began to emerge, the most notable being the response to the results of the infamous 'Pusztai study', which reported damage to the intestines and immune systems of rats fed with GM potatoes that contained a lectin gene from the snowdrop plant (Pusztai 2002:1). In spite of this study being derided and Pusztai being dismissed from his research position at the Rowett Research Institute in Scotland, the negative sentiments created by this study considerably contributed to the commercial failure of the Flavr-Savr tomato. In spite of this setback, the development of GM crops flourished, and in 1995, Bt potato was approved for cultivation, making it the first pesticide-producing crop to be released in the United States (Lawrence Journal-World 1995). These potatoes contained a *cry* gene from the soil bacterium *Bacillus thuringiensis* (hence Bt), making them resistant to insect pests. Likewise, in 1995 Bt maize, Bt cotton, glyphosate-tolerant soybeans, virus-resistant squash, canola with modified oil composition, cotton resistant to the herbicide bromoxynil and another delayed-ripening tomato received approval for commercial release in the United States (James & Krattiger 1996:31). Another milestone was the development of golden rice in 2000 – by overexpressing β-carotene in rice, scientists, for the first time, managed to genetically modify food to increase its nutritional value (Ye et al. 2000:303–305).

The first (and the only one thus far) GM animal to be approved for commercial food use was the AquAdvantage salmon in 2015. The transgenic salmon contains a growth hormone-regulating gene from another salmon species, allowing it to grow to its full size in 18 months, as opposed to the 3 years of its non-transformed siblings (Bodnar 2010). Several other transgenic animals, including chickens, sheep, pigs and cattle, have been developed, but none for commercial use.

As will be discussed elsewhere in this chapter, one of the major objections to genetically modified organisms (GMOs), and GM food in particular, is the introduction of DNA into host organisms. In 2012, in a major breakthrough in molecular biology, Jennifer Doudna and Emmanuelle Charpentier streamlined an innate immune system of bacteria and archaea in an innovative way to create the latest of the 'genome editing' technologies (Jinek et al. 2012:816–821). Genome-encoded clustered regularly interspaced short palindromic repeats (CRISPR), along with the CRISPR-associated nuclease 9 (Cas9), have the uncanny ability to edit the genetic code of any organism with pinpoint accuracy, without necessarily introducing foreign DNA. Regrettably, this incredible advancement has been met with ignorant opposition from anti-GM lobbyists – now focussing on the process of creating genome-edited crops rather than the product thereof. In spite of this, in April 2016, a white button mushroom, modified by CRISPR to not turn brown when cut or injured, received United States Department of Agriculture (USDA) approval to bypass the conventional GM regulatory process in the United States, on the basis that the editing process did not involve the introduction of foreign DNA (Waltz 2016:293).

Discussions about the establishment of a regulatory framework for genetic engineering started at Asilomar, California, in 1975, 2 years after the first successful use of recombinant DNA technology by Cohen and Boyer (Cohen et al. 1973:3240–3244) and many years before the first GM crops were created. The aim of this meeting was to address potential biohazards resulting from recombinant DNA technology and was organised and attended by several prominent molecular biologists, including Nobel laureates like Paul Berg, James Watson, Sydney Brenner and David Baltimore. In a statement following the conference, these scientists proposed a set of guidelines for the cautious use of recombinant technology and products resulting from it (Berg et al. 1975:1981–1984). By the time that the first transgenic plants were being developed in the early 1980s, the Organisation for Economic Co-operation and Development (OECD) released a report compiled by a number of (largely European) molecular biologists about the potential biosafety hazards of releasing GMO into the environment (Bull, Holt & Lilly 1982). Since then, the basic principles for the safety assessment of GM foods have been developed in collaboration with the OECD, as well as the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO). International consensus on principles for evaluating the safety of GM food led to an OECD report, 'Safety Evaluation of Foods Derived by Modern Biotechnology – Concepts and Principles', published in 1993 (OECD 1993), which recommended that safety assessment of GM foods be conducted on a case-by-case basis, by comparing it to an existing non-GM equivalent with a long history of safe use.

In 2003, the Cartagena Protocol on Biosafety came into being with 157 member countries signatories to the protocol – South Africa included. The protocol is an international treaty that largely deals with the transfer, handling and use of GM organisms between member countries (The Biosafety Clearing-House 2019).

Over the last 20 years of commercial GM food production, radically different measures have been implemented to regulate the production, importation and consumption of GM food in different countries. In most cases, however, GM food is assessed for biosafety on a case-by-case basis, relying on the principle of ‘substantial equivalence’ to the conventional product. Countries also allow different levels of GM food ‘presence’ – some allow the commercial cultivation, others only allow commodity imports of GM food and yet others only experimental research. South Africa is one of only four countries on the African continent (the others being Egypt, Sudan and Burkina Faso) that allow commercial production of GM food and is currently the ninth-largest producer of GM crops in the world, in terms of acreage (Genewatch 2019). In South Africa, the majority of commercially produced maize, soybean and cotton are GM.

Another contentious issue is that of labelling of GM food. In 1997, the European Union (EU) first introduced laws requiring GM food to be labelled (Wikipedia n.d.). Subsequently, many countries followed suit, albeit with different interpretations and implementations of the EU regulations. In Europe, labelling is required for all food that consists of greater than 0.9% approved GMOs (Lee 2014), while in the United States and Canada the labelling of GM food is voluntary. In South Africa, two acts govern the labelling of GMOs – one dealing with health and safety aspects, while the other guarantees the consumer’s right to information. This aspect will be discussed in more detail in the section on ‘Genetically modified food – the issues’.

With the introduction of genome editing technologies (and especially CRISPR/Cas9) for the development of GM crops, an interesting scenario regarding the regulation of these arose. As before, the United States adopted a more progressive approach, with several CRISPR crops being exempted from regulation by the USDA, mainly on the premise that these crops and foods derived from them do not contain any foreign DNA and/or proteins. However, in July 2018, the EU high court in Brussels made a ruling that genome-edited crops in the EU are to be regulated in the same way as early generation GM crops (i.e. those produced by the introduction of foreign genes), to the dismay of scientists across the world (Kupferschmidt 2018:435–436).

Genetically modified food – the issues

The introduction of new technology is almost always met with scepticism by the general public and may even invoke fear of the products of such technologies. This holds true for innovations at all levels – consider the incredible progress with electronics, from real-time communication and virtual reality to autonomous self-driving vehicles. The prospects with nanotechnology are even more staggering, with AI and its integration with the human brain certainly no longer considered science fiction.

It seems, however, that it is the 'biotechnologies' that scare people the most, especially the biotechnologies used to produce GM food. In his article 'The new biotechnologies: Nirvana, or Prometheus and Frankenstein? Ethics and the Biotechnology Revolution of our time', bioethicist Anton Van Niekerk speculates 'The fact that these new technologies often operate at the genetic level, [...] has generated significant sensitivities about the moral justifiability of these technologies' and suggests that the majority of people will not perceive the new biotechnologies in the light of 'Nirvana bliss', but 'they much rather invoke the Prometheus and/or Frankenstein imagery' (Van Niekerk 2018:31–59). The latter is so aptly illustrated with the coining of the term 'Frankenfoods', widely used by anti-GM activists to describe GM food.

As one can logically expect, 20 years of commercial production and use of GM food allowed for a multitude of concerns to arise about the technology and its products. Generally, these can be roughly clustered into five sets of (ethical) concerns – they are:

1. potential harm to human and animal health
2. possible damage to the environment
3. a perceived negative impact on traditional farming practices
4. excessive corporate dominance over food supplies
5. the 'unnaturalness' of technology.

At this time, I need to reiterate an earlier comment about scientific facts versus human beliefs, and the clever Mark Twain quote (Goodreads n.d.), 'it's easier to fool people than to convince them that they have been fooled'. So, for fear of being cynical, let me refrain from expanding on this and try to understand (and hopefully explain) the persistent ethical issues that people have with GM food.

Harm to human and animal health

Surely, human (and animal) health and safety must be the most important concern when it comes to GM food. Ironically, while this issue is particularly contentious when it comes to GM food, it is hardly ever an issue with GM-derived pharmaceuticals or industrial GM applications, where similar safety considerations apply. The most commonly expressed concerns, none of which have been scientifically proven, are unwanted changes in nutritional content, as well as the development of toxic and allergenic effects in humans and animals. It is impossible to scientifically prove that any food is absolutely safe – even water, if consumed in excessive quantities, can kill you. At best, proponents of any food can demonstrate that no detrimental effects like diseases or even death have occurred over an extended period of time.

In the case of GM food, that period has exceeded 20 years now, and estimates put the number of GM meals consumed by both humans and animals over this period into trillions. Yet, during this entire period, not a single substantiated case of any detrimental effect on human or animal health has been reported. More importantly perhaps, one should look at the feed that the animals that we as humans consume, eat. Anti-GMO groups on their blogs regularly allege that animals fed GM feed develop health problems that could show up in humans as well. One typical example, 'Monsanto's GMO Feed Creates Horrific Physical Ailments in Animals' was posted on the AlterNet site (Paul 2013). The subheading states, 'New research is showing some troubling information about animals on the receiving end of industrial agriculture's big GMO experiment'. Yet, as is typical of many such blogs, it is not linked to any independent research, neither does it cite any peer-reviewed studies. However, from an ethical perspective, it is important to understand if there is any merit in these allegations, especially considering that these 'food-producing' animals consume between 70% and 90% of the global GM crop biomass (Entine 2014). The United States raises approximately 9 billion food-producing animals per year, of which more than 95% consume GM feeds. Equivalent numbers are quoted for large GM crop-producing countries like Brazil and Argentina (Entine 2014). Crude calculations put the cumulative number of GM meals for these animals over the last 20 years well into the trillions, which would suggest that if GM feed were causing any abnormalities or unusual health problems among livestock, these would have been noticed by now. Conversely, in a novel meta-study, Alison Van Eenennaam compared 29 years' worth of data on livestock productivity and health from both before and after the introduction of GM feeds. The data, which represented more than 100 billion animals (cattle, pigs and chickens), indicated no detrimental trends in either the health or the productivity of these animals after 1996 when GM feeds were first introduced (Van Eenennaam & Young 2014:4255–4278). These authors also considered the potential impact of these animals and their by-products on health, when consumed by humans, and found no differences in the nutritional profiles of animal products (meat, milk and eggs) derived from animals raised on GM feeds.

Over the years, several reports on the direct threat of GM food to humans have been published – none more sensational and controversial than the infamous 'Séralini study'. The Séralini paper was published in the Elsevier journal *Food and Chemical Toxicology* in 2012 and reported an increase in tumours in rats fed with GM maize and the herbicide glyphosate (Roundup™) (Arjó et al. 2013). The maize expressed the 5-enolpyruvylshikimate-3-phosphate synthase gene that renders plants resistant to glyphosate. The responses to this report were immediate and dramatic – the results were embraced by anti-GMO activists and used as evidence to prove that GM foods are unsafe and dangerous. On the other hand, the results were scrutinised by several scientists, who severely criticised the study – the major flaws being the Sprague-Dawley rat strain used (this strain is regularly used in cancer research because it develops tumours at a high rate over its lifetime) and the inadequate statistical support for their conclusions. In one such example, 'Plurality of opinion, scientific discourse and pseudoscience: an in-depth analysis of the Séralini et al. study claiming that Roundup™ Ready corn or the herbicide Roundup™ cause cancer in rats'(Arjó et al. 2013), the authors stated:

> We and many others have criticized the study, and in particular the manner in which the experiments were planned, implemented, analyzed, interpreted and communicated. The study appeared to sweep aside all known benchmarks of scientific good practice and, more importantly, to ignore the minimal standards of scientific and ethical conduct in particular concerning the humane treatment of experimental animals. (pp. 255–267)

These criticisms led to Elsevier retracting the article after Dr Séralini refused to withdraw the flawed article. A post-publication review of the paper by the journal found that 'the data were inconclusive, and therefore the conclusions described in the article were unreliable' (Casassus 2014).

An interesting observation, gleaned from surveys, is that while almost 90% of scientists believe GMOs and GM food are safe, only about a third of the general public share this opinion. This is in spite of more than 2000 peer-reviewed articles that have appeared in the scientific literature during the last 20 years, documenting the general safety and nutritional wholesomeness of GM foods and feeds (Nicolia et al. 2013:77–88). Moreover, about 280 scientific and technical institutions around the world, including very influential organisations like the WHO, the National Academy of Sciences, the American Association for the Advancement of Science, the FAO and the European Commission recognise the benefits of GM food and consider these safe for human and animal consumption (Norero 2017). It is, therefore, clear that in the scientific community, a very solid consensus has developed about the safety of GM food, while ignorant beliefs among the public largely remain.

One can speculate that part of the public apathy towards GM crops and foods may be the lack of (dramatic) improvements that directly benefit the consumer. Probably, this situation will be remedied in the short to medium term, as a shift in focus by the developers of GM crops occurred, to address quality and health traits. Examples of these are the elimination of allergies in nuts, enhancing nutritional value by expressing β-carotene in rice, expressing lycopene from tomatoes in pineapples and expressing the antioxidant, anthocyanin, from blueberries in tomatoes (Hefferon 2015:3895–3914).

Harm to the environment and impact on traditional farming practices

As in the case of the perceived dangers of GM crops and food to human and animal health, there are fierce arguments and protests about the apparent dangers to the environment. It is accepted that to measure the effects of any technology (or even 'natural' occurrences, such as global warming) on the environment requires far longer than the almost quarter of a century of GM crop production. And, again, it is impossible to prove an absolute negative; hence, we need to rely on events recorded to substantiate either side of the argument.

The first 'environment' argument typically raised against the use of GM technology in agriculture is that of the increased use of pesticides with GM crops. Associated concerns are the inherent 'toxicity' of these plants, especially to non-target pollinators, like bees and butterflies, as well as arguments regarding diminishing biodiversity and the development of resistance to these crops by insects and weeds.

From a purely logical perspective, arguments for the increased use of glyphosate on the range of Roundup Ready™ crops can be understood. These crops are resistant to this herbicide, so farmers can spray at higher dosages to control non-GM weeds. The reasoning behind an increase in the use of insecticides in 'B crops', however, is less obvious. These plants express one or more *cry* genes from *Bacillus thuringiensis* to render them tolerant to specific classes of insects. Common sense dictates that in this scenario, the use of insecticides will decrease – as it does according to a number of published reports (Charles 2016; Perry et al. 2016). For the use of herbicides, the picture is not so clear – data suggest that herbicide use indeed increased for GM crops, but it is still less than the increase of herbicide use for non-GM crops (Charles 2016).

Another confusing argument from the anti-GM lobby is the claim that GM-based agriculture leads to diminished biodiversity. Agriculture, by definition, is the production of selected species in a monoculture way. In a comparative study, Carpenter (2011:7–23) found that the reduction in the use of pesticides, the adoption of minimum tillage practices and the increase in yields obtained from GM crops, alleviated pressure to convert more land for agricultural use, thereby reducing the impacts of agriculture on biodiversity. While the development of resistance to certain Bt toxins cannot be denied, the same happens with commercial chemical insecticides (Tabashnik & Carriere 2017:926–935). Strategies to mitigate this in the case of GM crops are to stack several of the *cry* genes in a single transgenic plant.

Corporate dominance over food supplies

Developing GM crops is an expensive business, to the point that almost all current GM crops produced commercially have been developed by large multinational agrochemical companies. A 2011 study revealed that at that time, a GM crop took an average of 13.1 years from discovery to the field, at an average cost of US$ 136 million. Interestingly, the time associated with regulatory issues and registration is about 5.5 years, at a cost of US$ 35.1 million (Croplife International 2011). The commercial intentions of these corporations are no secret, yet there would be serious ethical concerns and justified reason to be worried if any of these multinational corporations claimed ownership over a life essential like food. And while it cannot be denied that multinational corporate control in agriculture is indeed real, GM crops are a minor component thereof.

Ironically, the corporate control of other vital life products (medicines and other pharmaceuticals) is almost absolute, yet the lack of public outcry suggests this to be acceptable. Dominance, and even monopolies, over the supply in any sector of the economy have both benefits (like economies of scale) and disadvantages (like price-fixing); however, all of these existed long before GM-based agriculture and are certainly not unique to the supply of GM food (Thompson 2017).

The unnaturalness of genetic engineering

Many definitions for a 'GMO' exist – the WHO, for instance, defines GMOs as 'organisms (i.e. plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination' (WHO 2014:n.p.). The keyword here is 'natural' (or rather 'unnatural'). I believe many philosophical discussions can be had on the meaning of this word – natural. Evidently, I am not the first to have pondered this – the concept of ‘Appeal to Nature’ in its most rudimentary form implies that all things natural are good, while the unnatural ones presumably are bad. A real-life example of this is the labelling we often see on food, where a label that uses the phrase ‘all-natural’, per definition implies that the product is wholesome, safe and environmentally friendly. In his 1903 book, *Principia Ethica*, the British philosopher G. E. Moore introduced the term ‘naturalistic fallacy’ and argued that one cannot define the concept ‘good’ in terms of some natural property, as it is a simple concept, which cannot be defined in terms of any other concept (Moore 1903). For reasons I fail to understand, the term ‘organic’ managed to capture a similar positive meaning, while ‘GM’, which on an ideological level shares many goals with organics, certainly did not. Of course, the argument about naturalness extends to a few other issues. It seems that the majority of people prefer to exclude *Homo sapiens* from their perception of nature – almost as if there is nature, and it is good. Enter humans, with their evolved capacity to interfere with this pristine naturalness, and things very quickly turn bad. This particularly became the case with the advent of recombinant DNA technology, when humans, approximately 50 years ago, learnt to ‘cut-and-paste’ DNA across traditional species boundaries, thereby fiddling with the very foundations of life. To call this type of genetic modification unnatural and conventional breeding natural is simply ludicrous. Humans have been modifying the genomes of animals and plants for at least 10 000 years. For example, the tomato originated in South America, as a small, inedible fruit with high acidity. The Aztecs started modifying the tomato genome by selecting fruit with superior size, shape, colour, taste and acidity (Eufic 2001). Without this intervention, the natural evolution of the tomato genome would probably have been much slower and with a very different outcome. The same is true for food-producing animals and most food crops. Manipulation of genes in animals and plants is therefore as old as agriculture itself – if anything, with genetic engineering the procedures have just become more precise.

In an article about the naturalness of genetically engineered foods, the bioethicist, Paul Thompson argues that the perceived unnaturalness of GM food is linked to the fact that pure, unadulterated foods have now become contaminated by the insertion of a gene that originally has not been part of that food, thus making it impure, harmful and unnatural (Thompson 2000). He also proposes that all living things, including food crops, have some kind of 'natural essence', which affords each living thing a level of moral standing that dictates how we interact with each of these. He uses the example of humans eating companion animals like dogs and cats – a practice not uncommon in certain parts, but utterly unacceptable in the Western world. While it is scientifically acceptable to eat these animals, they have a level of moral status which is lacking in food-producing animals like cattle, sheep or chickens. In the same way, some people seem to attribute a higher moral standing to crops that have been conventionally bred, compared to those that have been genetically engineered (Thompson 2000). These beliefs are deeply entrenched in these people's outlook on life and are very unlikely to be changed within their lifetime, even though it makes very little sense in scientific terms.

A major misconception about the naturalness of the gene transfer technologies is that it does not happen in nature – it certainly does and has been for aeons – without any human intervention. In fact, humans have learnt to do this from viruses and bacteria and to this day rely on these simple organisms for even the most sophisticated gene-editing technologies.

Yet another iteration of the unnaturalness debate hinges on the notion that by manipulating organisms at the level of their genetic material, humans are 'playing God'. This phrase would suggest that religions would principally oppose the technology. Interestingly, this is not always the case – mainstream religions have largely come out with carefully worded neutral (or even positive) opinions. For instance, the Social Doctrine of the Catholic Church declares that (Pontifical Council for Justice and Peace 2004):

> Modern biotechnologies have powerful social, economic and political impact locally, nationally and internationally. They need to be evaluated according to the ethical criteria that must always guide human activities and relations in the social, economic and political spheres. Above all the criteria of justice and solidarity must be taken into account. (n.p.)

I cannot imagine any scientist involved in the development or regulation of GM crops having issues with this statement. It seems, therefore, that the phrase 'playing God' does not have real religious connotations but is merely a popular slogan (equivalent to 'Frankenfoods') that has become popular among anti-GM activists.

■ Moral dilemma or moral imperative?

Consequentialism is an ethical theory that judges whether or not something is good by what its consequences are. A consequentialist ethical framework for GM food, therefore, suggests that we should consider whether planting GM crops and harvesting GM produce from these will bring about more good or more harm. Probably, by now, readers of this chapter need no more convincing that the advantages and potential of GM food by far outweighs potential disadvantages – at least from a scientific point of view. Remarkably, this does little to quell concerns or to convince most people to reconsider their opinion on this topic. Therefore, perhaps the case of golden rice deserves some further discussion. Golden rice is one of the first biofortified crops and was genetically engineered to express increased levels of β-carotene, a precursor of vitamin A, which is an essential nutritional requirement for humans, especially during childhood. The WHO estimates that about 250 million pre-school children in underdeveloped parts of Asia and Africa suffer from vitamin A deficiency, which often leads to irreversible blindness, and that about 2.7 million children die annually because of this deficiency (Humphrey, West & Sommer 1992:225–232).

At the time, golden rice became a symbol for the vision that genetically engineered crops can be a means to improve the lives of the poor. Initial criticism of insufficient β-carotene levels in golden rice was addressed by the release of golden rice 2 in 2005, in which β-carotene levels were increased 23-fold (Paine et al. 2005:482–487). In 2012, a study in China showed that a single bowl of golden rice could supply around 60% of a child's daily requirement of vitamin A (Tang et al. 2012:658–664). Sadly, this study was tainted when the scientists involved failed to obtain the obligatory parental consent for the children used in the study. This omission was pounced on by Greenpeace in China, calling the study an ethical scandal and prompting the Chinese government to severely punish the Chinese scientists on the research team, by dismissing them from their positions. While I am not advocating a disregard for ethical clearance in scientific experimentation, the fact that these children were used without the consent of their parents, in feeding trials that compared golden rice to conventional rice, of course, could in no way have skewed the experimentation or invalidated the findings of the study. Among the arguments listed by opponents of golden rice is the availability of sufficient cheaper sources of vitamin A (like supplement programmes that are currently in place). They question the motives of the scientists involved with the development of golden rice because of the latter's links with biotech companies, and they even question the yellow colour of golden rice, which could be a social and cultural obstacle to acceptance.

I wish to use the case of golden rice to illustrate my point about the (im)morality of neglect. Here, we have a compelling case of very obvious benefits of a GM crop that has been biofortified to potentially save significant numbers of lives, predominantly the lives of children. Does the fact that vitamin A deficiency is not a problem in the developed world relieve the moral obligation to provide a life-saving technology, with a proven safety record, to underdeveloped parts of the world where it can save lives? At a philosophical level, what is the difference between shipping hundreds of tonnes of maize as part of a food aid programme to sub-Saharan countries where famine is life-threatening, and making a life-saving technology that is extremely simple to implement, available to countries in southern Asia, where vitamin A deficiency is ubiquitous? Confounding and aggravating this are instances of governments of countries in dire need of food relief refusing such aid because it involved GM food. A classic example in this regard is the refusal of the Zambian government in 2002 to accept GM food aid while nearly three million of its citizens were facing severe famine (BBC News 2002). Efforts to ensure wider adoption of GM crops, especially in African and Asian countries who are still averse to the technology, could make significant differences to the food supply in areas where current (and future) climate regimes require crops that can grow in arid and saline soils and tolerate extreme temperatures.

Despite opposition, the Golden Rice Project is gradually 'growing' and currently has 16 national rice research institutions in its fold, including one in South Africa. Support in the form of blessing from the Pope and the 2015 'Patents for Humanity' award is contributing significantly to the acceptance of this product.

As with governments, and I am not disputing the sovereignty of governments regarding their policies on GM food, there will always be a (significant) segment of the population whose beliefs about GM food are so entrenched that they are not going to be persuaded to change their beliefs just because of compelling scientific arguments and theories. According to Thompson (2017), 'society has a moral and ethical responsibility to make sure that these people aren't forced by the marketplace to eat foods that they are opposed to'. This raises the issue of choice, which, in turn, raises the issue of labelling GM food.

On the face of it, the issue of labelling seems quite simple – stick on a GM label and move on. This will allow the general public to make an informed choice about their food – a straightforward democratic principle. However, in real life, the issue of GM food labelling is fraught with ambiguities and complexities, making this aspect of GM food as contentious as any other. The regulatory frameworks for GM food labelling can be broadly classified into voluntary or mandatory and vary in different countries and regions. Typically, with voluntary labelling, only GM foods that differ substantially in composition, nutritional value or allergenicity, compared to their conventional counterparts, are required to be labelled. Mandatory labelling normally has two categories; the first requires that food products, which contain GM content that exceeds a certain threshold level, must be labelled. The second category requires that only certain designated products, which are GM, need to be labelled (Centre for Food Safety 2017).

As stated earlier, in South Africa, the labelling of GMOs (and GM food) is regulated by two independent acts – the first prescribes compulsory labelling of GM food where these differ substantially from existing food in terms of their composition and nutritional value. However, as ‘substantial equivalence’ is an important prerequisite in the development of all GM foods thus far, this regulation has never been activated and thus no GM foods currently on the market are labelled under this Act. The more recent *Consumer Protection Act* states that all GM foods must be labelled, in order to protect the consumer’s right to information, thus allowing for informed choices to be made. From a philosophical perspective, one can argue that as the *Consumer Protection Act* regulations prescribe the labelling of GM food irrespective of the fact that it may be substantially equivalent (i.e. not distinguishable) to a non-GM counterpart, this can be considered a value-system-based distinction, similar to religion-based labels such as ‘Halal’ and ‘Kosher’ or ethics-based labels such as ‘free-range’ or ‘organic’ (Gouws & Groenewald 2015). Unlike these religion- and ethics-based choice systems, which are maintained and funded by relevant interest groups for the benefit of their own constituencies, the *Consumer Protection Act* prescribes mandatory legislative regulations that impact all consumers.

The primary obstacle in implementing such a simple labelling regime is cost. The law would enforce the testing of all possible

GM-containing products, with considerable cost implications to bring these products on the market, and which would ultimately translate into significant price increases to the consumer. In South Africa, where approximately 87% of locally produced maize and all commodity imports are GM, the direct cost increase to the consumer is estimated at between 9% and 12% (Gouws & Groenewald 2015). Considering that maize is a basic food, the implication is that the poor majority of the population will carry the costs of maintaining an essentially value-system-based choice of a minority. The second problem is that these GM labels can be used to promote unfair discrimination under the pretext of 'consumer choice'. The reasoning here is that anti-GM lobbying over many years created such a negative image of GM food that irrespective of the 'official stamp of approval' that such a label should signify (as all GM products have to pass a rigorous biosafety risk assessment), the very same label will be easily recognisable, thus making unfair discrimination much easier (Gouws & Groenewald 2015).

In essence, the concept of labelling GM food, or any other food for that matter, is not objectionable. All foods are currently labelled, not only to advertise their benefits and virtues but also to inform the consumer of their composition, nutritional value and to warn about possible allergenicity. No ethical arguments can be brought against the inclusion of GM labelling, as it is happening already in most countries selling GM food. The practical implementation of a more transparent and cheaper GM labelling system is what is required.

■ The future of genetically modified food

It would be a shame if after considering so many issues and concerns in the murky world of GM food, one does not peek into the proverbial crystal ball and risk an opinion about what the future holds. Let me immediately apologise for basing my optimism about the future of GM food on recent scientific and technical advances, and not so much on potential ethical solutions to current and possible future issues.

All arguments in this chapter thus far were based on what I would like to call second-generation genetic engineering, that is, the deliberate transfer of functional genetic elements between organisms in order to introduce a desirable genetic trait into the host organism. This form of genetic modification, more accurately known as recombinant DNA technology, differs from first-generation genetic modification, which is restricted to the random transfer of uncontrolled numbers of genes through conventional breeding techniques, in that it could transcend species boundaries. However, the process to introduce foreign genes into plants, for instance, cannot control the number of copies of the gene-of-interest being inserted into the host genome, nor the position in the host genome where the gene-of-interest will be inserted. This probably led to the derogatory description of genetic engineering as being an 'inexact science'.

During the early 1990s, in my first research position, I was tasked to develop virus-resistant potatoes. Being young and enthusiastic (maybe even arrogant), I decided on a 'dual-resistance' approach and designed a construct containing genetic elements of the two important potato viruses at that time – potato virus Y and potato leafroll virus. The 'dual-resistance' construct was transformed into a local potato cultivar, and plantlets regenerated and hardened-off. Of course, the proof of the pudding is in the eating, or in this case in screening for resistance, so one year later we had enough material to start greenhouse trials. Results were fantastic; we could show very high levels of resistance, almost immunity – and my science career was made! Until we harvested the tubers for proper field trials the next season and discovered that the tuber morphology was severely compromised – to the extent that the shape of these potatoes very much resembled that of sweet potatoes. I was devastated, and when the funders immediately shelved the project, I was seriously contemplating a career as a second-hand car salesman. So, what is the moral of this story? I am not sure myself, but it did teach me the meaning of the word 'Frankenfoods' – first-hand!

The exciting developments in technology I referred to above is what I call third-generation genetic engineering, or more formally, 'genome editing' – and specifically CRISPR/Cas9 genome editing. Apart from the technical brilliance of the technology (which I explained earlier), the excitement from an ideological perspective is that CRISPR technology addresses many of the ethical issues levelled at current GM technology. These include the 'inexact science' nature of the previous technology – CRISPR can, with pinpoint precision, edit single nucleotides in the host organism. But by far the most important improvement is that genome editing can now be done without the introduction of foreign DNA or proteins. This single feature eliminates all arguments about 'messing with nature' or 'playing God' (or even gene escape), because cross-species gene transfer does not take place. Creating mutations this way is far more controlled and precise than by inducing random mutations using hazardous chemicals or irradiation – practices which have never been accused of 'messing with nature' or 'playing God'. Another objection that becomes obsolete is that of the expression of antibiotics or other marker proteins in the host, thus eliminating fears of toxicity or allergenicity. The latest notion by anti-GM activists alleges that the process of making GMOs is objectionable in itself, irrespective of what the final genetic make-up of the final product is. This is very disappointing and reminds me of the Bill Gates poop water debacle a few years ago (Gates 2015). In this case, the fact that the water is as pure as water can be, is immaterial. The process of how the water came to be, that is, wastewater from a sewerage plant, is all that counts. In a fascinating article on this, Paul Rozin and colleagues state (Konnikova 2015):

> The problem isn't making the recycled water but getting people to drink it, and it's a problem that isn't going to be solved by engineers. It will be solved by psychologists. (n.p.)

They further argue that 'when it comes to naturalness, content is far less important than process' and that a 'natural substance can easily be rendered unnatural by passing through an unnatural-seeming transformation, even one as innocuous as boiling or pasteurization' (Konnikova 2015). This certainly seems to be the case for GM food. Let us end on a positive note – I firmly believe that the new generation of genome-edited food products will be so amazing that people will look past the process of producing these and see and appreciate the products for what they are.

Conclusion

Here, I argued the case of GM food. In doing so, I tried to cover most of the concerns that normal citizens (in their capacity as largely uninformed individuals) have, but also those of anti-GM activists (who are certainly not uninformed). For a scientist, ethical issues often are difficult to deal with, probably because the safety of scientific process and fact is not there for protection. For this reason, it was not too difficult to address ethical issues about possible harm to humans and animals, potential detrimental effects to the environment and farming practices or even the threat of corporate dominance over our food supplies. For all these concerns, ample credible literature exists to either prove or disprove both sides of the argument. Much more ambiguous is the issue of the unnaturalness of GM technology and its products. Ironically, these also seem to be by far the most troublesome for the majority of people. Of course, all of this very much hinges on one's perception of naturalness, especially whether one believes naturalness by definition implies 'good' and unnaturalness implies 'bad'. Fear of the unknown and resisting change seem to be two intrinsic features of human nature. So, it is hardly surprising that the genetic modification of food crops by 'unnatural methods' results in the categorical rejection of these foods by many consumers. Terms like 'Frankenfoods' are cleverly exploited by anti-GM activists to perpetuate these fears among uninformed consumers, who are as scared of drinking genetically decaffeinated coffee, as I am of the concept of singularity (the latter obviously as the result of ignorance on my part).

I guess it is clear that I am a strong proponent of GM technology and that I truly believe that the positive consequences far exceed possible negative ones. I am comforted in my beliefs when I learn that a sincere attempt to alleviate the very real problem of vitamin A deficiency in parts of the world where few of us ever will visit is blessed by the Pope and awarded the '2015 Patents for Humanity' award. I feel justified with my assessment of this technology and its achievements and future potential, when I hear that in 2016, 5591 scientists, including 110 Nobel laureates, signed a letter against Greenpeace's opposition to GMOs, and in support of GMOs, and I feel a bit neglected as I did not get an opportunity to be a signatory to this. Like most other scientists in this field that I have encountered in my career, I believe there is a need to consider new technologies that are developed for the production of food and to carefully scrutinise the food products produced using these, on a case-by-case basis. Moreover, most of us feel a responsibility to educate the public in a non-patronising way about such technologies so that their decisions about these issues no longer are based on fear. I have no doubt that these technologies will play an essential role to ensure sustainable food production towards the middle of this century and beyond.

Chapter 6

The changing landscape of human genetics and genomics: A personal journey of enlightenment spanning three decades

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Introduction

When I joined the Division of Human Genetics in 1987, the department was jointly affiliated with the South African Institute for Medical Research (SAIMR), now the National Health Laboratory Service (NHLS), and the University of the Witwatersrand (Wits). Professor Trefor Jenkins was the head of the department at that time, and it was under his leadership, mentorship and guidance that my career was shaped. Armed with a master's degree in biotechnology from Wits, with no other formal education in genetics or human genetics, I was thrown in at the deep end of having to make use of tools in molecular biology to track the inheritance of disease in families with known histories of single-gene disorders. This was at the beginning of the DNA era in the department, with the transition having already been made by my predecessors who had previously made use of classical genetic markers found in blood components like plasma, serum and red blood cells, excluding DNA, to examine the genetic variation in human populations.

I was part of that generation of human geneticists in the country who introduced genetic testing services involving DNA analysis to the public. In the late 1980s, when we did not have much knowledge on which genes caused the disease, we used linked genetic markers (genetic markers in close proximity to the gene) to track the inheritance of disease traits in families. For this analysis, we collected DNA from both parents and their affected child to track the allele (position in a gene on a chromosome) associated with the disease. Often, we would have to test a few genetic markers around the region where the disease was thought to be located to make a diagnosis.

With the official launch of the international Human Genome Project (HGP) in 1990, several advancements in understanding knowledge of disease aetiology were realised, including the mapping of diseases to specific regions of the genome. With this came information of mutations and a deluge of information on the geographic distribution of genetic variation. This, together with technological advances and the introduction of more direct methods of detecting mutations (changes in DNA), improved our laboratory methods to more robustly screen for disease-causing mutations and in making a diagnosis of inherited disorders. One of the goals of the HGP was to address the ethical, legal and social issues that were brought about by the project. This resulted in the launch of the Ethical, Legal and Social Implications (ELSI) programme, which was to receive 5% of the annual budget allocated to address the ELSI arising from the project. Currently, ELSI issues feature prominently in all aspects of research on human subjects and in the health sector as well as in other societal issues.

The first draft sequence of the complete human genome was published on 15 February 2001 (International Human Genome Sequencing Consortium 2001:860–914; Venter et al. 2001:1304–1351). Two years later, in April 2003, the human genome sequence was fully released to celebrate the 50th anniversary of the DNA (International Human Genome Sequencing Consortium 2004: 931–945). Information gleaned from the understanding of the human genome has resulted in an explosion in knowledge of human genetics, and several new technologies have been developed, for example, gene therapy, genetic engineering, stem cell therapy, cloning, prenatal diagnosis, pre-implantation diagnosis and gene editing, for therapeutic applications in humans (De Wert et al. 2018:1–5; Handyside 2018:F75–F79).

Being an active scientist in the field of human population genetics, several personal experiences or incidences in my career have intersected with issues on morality, ethics, legal issues, religion and science. I share some of these scenarios to reflect on the nexus of science and societal issues.

Handling of blood specimens to prenatal diagnosis

A few months after joining the department in 1987, I was invited to attend the 2nd conference hosted by the Southern African

Society for Human Genetics in Johannesburg. It was my first conference, and it was overwhelming, yet thrilling, to be among established geneticists and other scientists from around the country. Many of them were clinical or medical professionals, and presentations were mostly of a clinical nature with disturbing pictures (at least to me) of clinical features of phenotypes of patients with inherited genetic disorders. There was also a presentation by a cytogeneticist who had recently travelled abroad to learn the technique of separating foetal tissue obtained from a sample of chorionic villi from the maternal tissue. A short video clip was shown to demonstrate how the sample of chorionic villus tissue was obtained. Being squeamish in nature, these visuals were too much for me to handle, and I just closed my eyes or looked away. However, not long after attending this meeting and being introduced into the clinical outcomes of inherited genetic disorders, I was tasked with having to extract DNA from tissue samples other than from blood.

This was the first conflict I had with my religious indoctrination and cultural upbringing and my new-found scientific world. As a laboratory-based scientist at the time, with undergraduate and postgraduate training in the fields of microbiology, biochemistry and biotechnology, nothing had prepared me for the hard reality of having to deal with these personal conflicts while having to execute my duties as a scientist. Termination of pregnancy was perceived to be wrong in keeping with my Hindu religious views. I was nauseated when I touched a foetus and had to dissect a tissue sample for DNA extraction. I also had a problem handling tubes that still had warm blood collected from patients. I would only proceed with handling these samples after they were refrigerated and cooled to prepare myself mentally to process them. My moral well-being was further challenged when a close relative told me that I 'did the work of the devil by interfering with God's creation' and that 'if we prayed and overcame the devil, that faith would cure these diseases'.

Like me, I am sure many scientists enter the workplace or find themselves in situations where personal views on what is *perceived* as right or wrong, moral or immoral, ethical or unethical create conflict in how they act. The World Medical Association defines ethics as 'the study of morality – careful and systematic reflection on and analysis of moral decisions and behaviour, whether past, present or future' (Williams 2009:n.p.). Using this definition, Moodley (2011:3) states that 'morality refers to the value dimension of human decision making and behaviour'. When discussing morality, words such as 'rights', 'responsibilities', 'virtues', 'good' and 'bad', 'right' and 'wrong', 'just' and 'unjust' are frequently used. Ethics 'is a matter of knowing what the right thing is to do, while morality is a matter of doing the right thing' (Moodley 2011:3).

So, how did I cope with my personal dilemma? The turning point in my career came one afternoon as I worked in the darkroom, processing the last step of a prenatal diagnostic test for cystic fibrosis. Cystic fibrosis is a progressive, debilitating genetic disease that presents when an offspring inherits a defective gene from each parent. This results in (College Focus for CF n.d.):

> [*A*] thick, sticky build-up of mucus in the lungs, pancreas, and other organs. In the lungs, the mucus clogs the airways and traps bacteria leading to infections, extensive lung damage, and eventually, respiratory failure. In the pancreas, the mucus prevents the release of digestive enzymes that allow the body to break down food and absorb vital nutrients. (n.p.)

In this case, a family in which both parents were carriers (i.e. each parent had one normal chromosome and one affected chromosome) for cystic fibrosis with one affected child requested prenatal diagnosis for a subsequent pregnancy.

From the profile of the affected child (diagnosed from our preliminary genetic studies), it was possible to track how the disease was transmitted in this family. After genetic counselling, the family opted for prenatal genetic testing from chorionic villus sampling that is usually done between 9 and 12 weeks of pregnancy. I had successfully extracted the sample when it came to the laboratory and completed the other steps in the diagnostic test. Two weeks later, the autoradiograph that was being developed in the darkroom would reveal the fate of the unborn foetus. After the development stage, the autoradiograph was then rinsed in water before the fixing stage. I could not contain my anxiety to know the outcome of the result and held up the autoradiograph against the safety light to infer the outcome. The foetus had inherited the same alleles as the affected child, which meant that it had inherited the defective genes from both parents. In other words, the child was going to be born with the disease. I was overcome with guilt, as I felt that my involvement in the diagnosis could potentially contribute to a termination of pregnancy! At this stage, abortion was not legalised in South Africa, but under certain circumstances related to health, it was approved.

As I wrote up the report for this case, I felt emancipated by the power of evidence-based science. There was no magic or voodoo associated with genetic inheritance. We inherit our genetic traits from our parents, packaged in the gametes contributed by each parent at the time of conception. The evidence was clear from the results. The stories I was indoctrinated on from family elders around 'sins of the fathers' – punishment from God for having done something wrong in the past was commonly used whenever things went wrong. Finally, the short course that we learnt at school on Mendelian inheritance, and what I was learning from my job, started to grow on me. I had no formal training in evolution either, as it was considered against the principles of the lecturer who was meant to teach that course in Zoology. Instead, we were referred to the chapter in the prescribed textbook for reading on our own. This was the world of evidence-based science. That was the catalyst of my own growth and journey that helped me shape my thinking as a scientist.

The responsibility of scientists and being a responsible scientist

I was very privileged to have had the opportunity to work with Professor Trefor Jenkins. In addition, to be a colleague and my mentor, he was a role model to us all with respect to issues in medical ethics, responsibilities as scientists and how to be responsible scientists. Moreover, he challenged me to think out of the box and was instrumental in my acculturation around the *human* elements of human genetics. I witnessed first-hand how he engaged clients during a genetic counselling session.

As part of our induction into the department, we were invited to attend a counselling session to understand the clinical activities within the department. With the informed consent of the client, I sat in with Professor Jenkins as he counselled a woman who had travelled overnight on a bus from Durban to see him following a referral. I recall the session as being very teary. The mother, exhausted from the bus trip with a child of about 10 or 11 months of age, and who then had to find her way from the Greyhound bus terminal near the Johannesburg Station to the Transvaal Memorial Hospital in Parktown, and then waited for her appointment, was puffy-eyed and sniffled as she described her child's condition to Jenkins. The child was restless, and red in the face from crying, and still cried. The mother had seen several doctors in Durban who could not diagnose the problem with her child until one doctor recommended to her that she should see Jenkins. After asking the mother questions and examining the crying baby, Jenkins calmly pacified the child and spoke caringly to the mother. I cannot recall the specific details of this session, because for the most part, I had tears rolling down my cheeks from feeling the anguish of the mother.

The child had dysmorphic features, possibly the result of a genetic condition, that doctors commonly referred to as 'funny looking kid' or FLK, and I recall the post-counselling session among the counsellors and clinicians. It bothered me at the time that doctors could use the term 'FLK' among themselves to describe a clinical condition. What is worse, some doctors tell parents that their child has FLK, almost as if it stands for a disease. One mother wrote, in a blog entitled 'Life with Elise' (Ashley n.d.:n.p.), when the doctor responded to her question about what FLK stood for, 'Did that just happen? Did he just say that? [...] Was he letting me in on backroom slang used by doctors, nurses, teachers and therapists about kiddos with brain injuries?' This mother's distress about the insensitivity in the use of the term in reference to such patients highlights the growing need to cultivate a culture of care, respect and sensitivity to others who are different to us.

It is the moral and ethical thing to do.

Many of us are aware of the brutality surrounding the untimely death of Steve Biko while in police custody. Few of us remember the details surrounding the case of the five doctors – Frances Ames, Edward Barker, Trefor Jenkins, Leslie Robertson and Phillip Tobias, who were responsible for successfully obtaining a Supreme Court ruling to force the South African Medical and Dental Council (SAMDC) to re-open the case against the Biko doctors in 1985. Over the years, I have heard first-hand the stories about this case from Professor Jenkins and sat in on lectures and discussions on medical ethics by him at the NHLS and Wits in which the Biko case was discussed. In the paper, 'The Steve Biko affair: a case study in medical ethics', the authors bring to attention the conflict between 'knowing what the morally correct course of action is and doing what one ought to do' (McLean & Jenkins 2003:77–95).

Following interrogation in detention by the security police in Port Elizabeth under Section 6 of the *Terrorism Act of 1967*, Dr Ivor Lang, the district surgeon, and Dr Benjamin Tucker, the chief district surgeon in Port Elizabeth (Moodley & Kling 2015):

> [*F*]ailed to examine Biko adequately, did not attempt to elicit even a basic history from him, and did not provide adequate care or treatment. Instead they acquiesced to the instructions of the security police, neglecting to place the best interests of their patient above all other considerations. (p. 968)

This unprofessional conduct (Moodley & Kling 2015):

> [*M*]ay be explained by the conflict of the doctors caught in a classical 'dual-loyalty' situation, one in which their duty to their patient, Steve Biko, conflicted with their (perceived) duty to the state. (p. 968)

In fact, Dr Tucker subsequently admitted (Moodley & Kling 2015):

> I had become too closely identified with the interest of the organs of the State, especially the police force, with which I dealt practically on a daily basis [...] I have come to realise that a medical practitioner's primary consideration is the well-being of his patient [...].
>
> The duty of the doctors involved in Steve Biko's case was clear, but performing that duty was difficult. They had become so accustomed to working with the security police and regarding the detainees as dangerous terrorists rather than patients that they had disengaged from the duties and the responsibilities of their profession. (p. 968)

What was the role of the Medical Association of South Africa (MASA) and the South SAMDC, the latter being the (Moodley & Kling 2015):

> [*R*]egulatory body controlling the medical and dental professions, at the time Bike was imprisoned [*?*] Surprisingly, neither MASA nor SAMDC supported charges of misconduct or unethical conduct against the doctors involved in the Biko case. [...]
>
> These professional organizations were derelict in their duty to uphold professional standards because they too allowed state security issues to subvert the profession's responsibilities and ethical obligations to its patients. (p. 969)

Through the actions (or lack thereof) of MASA and the SAMDC, the whole organised medical profession became implicated in that wrongdoing (Pityana 1991, cited by Moodley & Kling 2015:966–972). It was only through the responsible actions of Drs Frances Ames, Edward Barker, Trefor Jenkins, Leslie Robertson and Phillip Tobias that the unethical conduct of Dr Lang (who 'was found guilty of improper conduct and received a caution and a reprimand') and Dr Tucker (who 'was found guilty of improper and disgraceful conduct and was later struck from the medical roll') was exposed (Moodley & Kling 2015:969).

Rights to health care: How are we fairing in our new democracy?

Steve Biko's case, during apartheid, highlighted how, in some instances, the medical profession failed society. Many other cases, like those linked to Dr Wouter Basson (nicknamed

'Dr Death'), as described in articles on Project Coast (Gould & Folb 2002:77–91), have also been profiled following the Truth and Reconciliation Commission (SAHA 1998).

How has the health sector faired with respect to serving the citizens of South Africa during our post-apartheid democracy? Section 7(2) of the South African Constitution (Department of Justice and Constitutional Development 1996) specifically states that the State is required to 'respect, protect, promote and fulfil the rights in the Bill of Rights'. In relation to health care services, this means that the government must (Ferlito & Dhai 2018):

> Respect the right of access to health care services by not unfairly or unreasonably getting in the way of people accessing existing health care services, whether in the public or private sector; protect the right by developing and implementing a comprehensive legal framework to stop people who get in the way of the existing access of others; promote the right by creating a legal framework so that individuals are able to realise their rights on their own; fulfil the right by creating the necessary conditions for people to access health care, by providing positive assistance, benefits and actual health care services. (pp. 155–156)

In particular, Section 27(2) says that 'government must take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation' of the right (Ferlito & Dhai 2018:156).

However, in the 'Life Esidimeni Disaster: The Makgoba Report' (Makgoba 2017), Professor Malegapura Makgoba, in his capacity as the health ombudsman who was appointed by the current National Minister of Health (Dr Aaron Motsoeledi) to investigate the circumstances surrounding the deaths of mentally ill patients in Gauteng, provided *prima facie* evidence in support of human rights violations. Part of the report is provided under an emotionally fuelled heading 'No guns: 94+ dead and still counting' (Makgoba 2017). This report highlights how, despite the Constitution and several laws that are supposed to protect South African citizens, the lives of patients with mental health problems were compromised as a result of the decision taken by the former Member of the Executive Council (MEC) for health and social development of Gauteng Province, Ms Qedani Mahlangu, to terminate the contract between the Department of Health and Life Esidimeni in October 2015. The consequence of this decision was that around 2000 patients, who were receiving highly specialised chronic psychiatric care, were to be moved out of Life Esidimeni Hospitals to families, non-governmental organisations (NGOs) and other psychiatric hospitals. This, it is claimed, was done to reduce medical costs as part of the National Mental Health Policy Framework and Strategic Plan 2013–2020 (Health-E News 2012) on deinstitutionalisation.

Despite the international, regional and national legal instruments of protection, more than 140 mentally ill patients died under suspicious, unlawful and unjust circumstances (Ferlito & Dhai 2018:155–156; Makgoba 2017). In the 'Life Esidimeni Case Fact Sheet', Section 27 states that several attempts were made by civil society organisations, family members and professional associations to stop the Gauteng Department of Health (GDoH) from removing patients from Life Esidimeni Hospitals as the alternate options could not provide the care required to accommodate these patients (Health-E News 2012). Despite expert witnesses and evidence presented before the courts on why the patients should not be transferred, the Johannesburg High Court ruled in favour of the GDoH, who in their defence claimed that they had assessed the patients and that they no longer required professional care (Ferlito & Dhai 2018:155–156; Health-E News 2012). A second application to the courts to stop the dismissal of patients was also ignored because of 'lack of urgency'. With the backing of the legal system, the MEC terminated the contract with Life Esidimeni Hospitals. In sum, our legal system and health care system failed in acting morally and ethically even though the factual evidence was available to inform a better outcome with respect to the lives lost as a result of the lack of action in upholding human rights.

There are many other examples of how the health care system fails the citizens. Even with the publication of the National Guidelines for the Care and Prevention of the Most Common

Genetic Disorders, Birth Defects and Disabilities (South African National Department of Health 2004), congenital disorders (CDs) are still not a priority and the required resources are still lacking in South Africa to prevent and care for those affected (Malherbe, Christianson & Aldous 2015:186–188). It is estimated that approximately one in 15 live births in South Africa is affected by a CD. Of these, 80.5% can be attributed to genetic or partial genetic causes, while the remaining 19.5% are caused by teratogens. About a third of the cases of CD can be diagnosed at birth, and it is expected that over 18 000 cases ought to be reported annually in South Africa (Venter et al. 1995:1304–1351). However, after reviewing and modelling for the epidemiology of CDs in South Africa, Malherbe et al. (2015:1304–1351) conclude that the prevalence of CDs is under-reported by about 88% in South Africa (Kromberg & Krause 2013):

> About 90% of the 7.6 million babies with severe genetic conditions or malformations worldwide were born in low- or middle-income countries like South Africa. Furthermore, haemoglobinopathies alone comprise a health burden similar in scale to that of communicable and other major diseases, particularly in sub-Saharan Africa. (n.p.)

'Many inherited disorders can now be prevented, and the burden of genetic diseases ameliorated with appropriate programmes' (Kromberg & Krause 2013:958). In 2010, the World Health Organisation's World Health Assembly (WHA) prioritised services for care and prevention of CDs, particularly in low- to middle-income countries, by passing Resolution WHA63.17 (WHO 2010), and recommended that (Kromberg & Krause 2013):

> [*T*]hese services should be promoted and offered as an integral part of basic health care. It is therefore unethical not to provide them as part of a comprehensive health care programme. (p. 958)

■ One small edit for human, one giant edit for humankind?

On 26 November 2018, the world was rocked by the startling announcement that Prof. He Jiankui, a Chinese scientist, had impregnated a woman with embryos that had been edited to disable the genetic pathway HIV uses to infect cells (Cyranoski & Ledford 2018). Speaking at the Human Genome Editing Summit on 28 November 2018 (Brant 2018):

> [*A*]t the University of Hong Kong for the first time about his work since the uproar, […] Jiankui said [*that*] he was 'proud' of altering the genes of twin girls so they could not contract HIV. […] He revealed that the twin girls – known as 'Lulu' and 'Nana' – were 'born normal and healthy', adding that there were plans to monitor the twins over the next 18 years. (n.p.)

According to the BBC News report (Brant 2018):

> [*Jiankui*] explained that eight couples – comprised of HIV-positive fathers and HIV-negative mothers – had signed up voluntarily for the experiment; one couple later dropped out. Prof He also said that the study had been submitted to a scientific journal for review, though he did not name the journal […] Professor He's university – the Southern University of Science and Technology in Shenzhen – said it was unaware of the research project and would launch an investigation. It said [*Prof.*] He had been on unpaid leave since February. (n.p.)

Many countries, including China, have laws that prevent the use of genome editing in embryos, a technique commonly referred to as human germline gene editing, for assisted reproduction in humans (Brant 2018). Scientists are permitted to do gene-editing research on 'discarded *in-vitro* fertilised embryos, as long as they are destroyed immediately afterwards and not used to make a baby' (Brant 2018:n.p.). China, like many other countries, 'allows *in-vitro* human embryonic stem cell research for a maximum period of 14 days', but the experiment carried out by Jiankui is prohibited under Chinese laws (Brant 2018).

While not new per se, gene editing has become a popular topic primarily because of the novel tool called CRISPR-Cas9. In the 1980s, 'scientists [observed] a DNA sequence in bacteria that would be repeated over and over with a unique sequence of repeats. They named this "clustered regularly [interspersed] short [palindromic] repeats"' (CRISPR) (Fenech 2018:n.p.). Soon it was discovered 'that the unique sequences between the CRISPR matched DNA of viruses that attack bacteria' (Fenech 2018:n.p.). The protein Cas, which is considered the molecular scissors of

CRISPR, would use the DNA to identify the virus and cut it away (Fenech 2018:151; Zhang 2015). The Cas protein currently used in the CRISPR technique is known as Cas9, and the full name of the technique used is the CRISPR-Cas9 system. During the editing process, 'CRISPR holds the DNA sequences that tell Cas9 which portion of the DNA sequence to cut off' (Fenech 2018:152).

Using the CRISPR-Cas9 system, it is possible to change multiple genes at one time; in other words, 'instead of waiting for the next generation to be born to edit more genes, scientists are able to change multiple areas of the DNA within the same embryo' (Fenech 2018:153). The difficulty with this technology, emphasised by many who critique the use of the technique for gene editing in human embryos, is that while it is possible to control the specific DNA sequence to be eliminated and/or replaced, many other events could also occur. It has been demonstrated that Cas9 can cut the incorrect area, called an 'off-target' cut, which can lead to mutations (Fenech 2018). In fact, reports ranging from 0.1% to over 60% of off-target mutations have been recorded. According to Fenech (2018):

> There is no way to track whether the germline modification will introduce more changes further down the generational line. There is a possibility that an irreversible change or disease can be created. Children who were healthy at birth could develop serious health issues later in life. There is simply no way to know at this time. (p. 153)

On the contrary, somatic cell gene editing may prove to be a game-changer for (De Wert et al. 2018):

> [*A*] whole range of serious hereditary disorders, especially Mendelian ones [*and*] in the treatment of cancer and infectious [*disease. Of the*] over 5000 Mendelian diseases identified, treatment is [*only*] available for a small [*number*] of these. (n.p.)

Several studies to date have shown promise for the use of CRISPR-Cas9 technology in the future treatment of Duchenne muscular dystrophy (Bengtsson et al. 2017:14454; Nelson et al. 2016), haemophilia B (Singh et al. 2018:1241–1254), beta-thalassaemia (Liang et al. 2017:811–822) and cancer (Castillo 2016:178–180; Rupp et al. 2017:737).

Reconceptualising harms and benefits in the genomic age

The era of targeted genetic testing primarily for severe, highly penetrant conditions has given way to the new era of expansive testing with the advent of next-generation sequencing technology. 'Genomic sequencing provides the potential benefit of a wealth of information' (Prince & Berkman 2018:n.p.), but at the same time raises questions of risks and benefits. Usually, when researchers assess potential harms of genetic information, a primary concern is its risk of causing psychosocial harm. In the early days of the ELSI era, the scientific community was concerned that negative (i.e. unfortunate) genetic information would lead to research subjects or patients to experience adverse psychological effects like depression and anxiety (Prince & Berkman 2018: 419–428). Given the hereditary nature of genetic information, there were also serious concerns about the risk of stigmatisation and the social impact that the findings could have on relationships with relatives.

'Genomic sequencing provides the potential benefit of a wealth of information, but also has the potential to alter how we [conceptualise] risks' (Prince & Berkman 2018:n.p.). In addition to the harm caused of psychosocial risk, there have also been claims of economic harm related to issues like discrimination in health insurance, where insurers would deny coverage or charge higher premiums for people with a higher risk of disease (Prince & Berkmam 2018:419–428). There were also concerns about discrimination in the long-term care, disability and life insurance industries as well as employment discrimination (Rothstein 2008:174-178).

Why then does genetic testing raise the alarm bells when we more readily accept other forms of medical information? It would seem that genetic information is seen as special 'because it was predictive rather than diagnostic' (Roche & Annas 2001:392), and because it could have an impact on family members as well as the proband (Prince & Berkmam 2018:419–428). Furthermore, genetic information is perceived as being an 'immutable part of one's self, unlike behaviourally or environmentally mediated health traits', hence treated differently from other kinds of medical information.

In their review of the literature on ELSI-related issues around psychosocial harms spanning two decades, Prince and Berkmam (2018:419–428) argue that the 'ELSI discourse remains fixed on speculative informational harms' and ask whether this focus remains justified. Fear of discrimination is often cited as why people forgo potentially beneficial testing. Despite this concern, 'there is a clear gap between fears of informational harms and actual evidence of economic or psychosocial harms'. A number of studies showed that patients actually reported substantial benefit rather than anxiety after learning about neurodegenerative conditions like Huntington's disease and Alzheimer's disease, where there is no available treatment at present, and that the long-term distress is similar to that of non-carriers (Paulsen et al. 2013:2–28). In fact, specific vulnerable populations who might be at risk for psychological risks, such as children and high-risk minority groups, were also minimally adversely impacted by genetic testing (Prince & Berkmam 2018:419–428).

With respect to genetic discrimination, the literature suggests that there is a lack of evidence to suggest that genetic discrimination represents a pervasive social problem, although the fear of genetic discrimination is pervasive in society (Joly, Feze & Simard 2013:25). It appears that 'people evaluating genetic risks are increasingly open to the notion that genetic research can be a minimal risk activity' (Prince & Berkmam 2018:419–428). In one survey of genetic researchers and Institutional Review Board (IRB) professionals, it was found that a majority of all respondents were not concerned about the prospect of harm associated with participating in genetic research, although IRB professionals were more concerned on average (Edwards et al. 2012:236). This diversity of opinions is also reflected in IRB guideline and policy, with some institutions and commentators arguing that genetic studies are generally minimal risk, while others suggest they are more than minimal risk (Wendler & Rid 2015:11–15). As the field continues to evolve, the gap between fears of informational risks and actual evidence of widespread harms suggests that we should be cautious about continuing to be unduly concerned about theoretical harms (Prince & Berkmam 2018:419–428). The worry is that by ignoring existing evidence and focussing on 'looking for psychosocial harms associated with genetic testing' (Prince & Berkmam 2018:419–428), we run the risk of creating a 'culture of risk-aversion in which patients may be opting out of potentially beneficial diagnostic and treatment regimes' (Prince & Berkmam 2018:419–428).

Against this background, what is the situation in South Africa with respect to ELSI issues in human genetics and genomics? The Academy of Science of South Africa (ASSAf) conducted a consensus study on the topic, and the findings, with recommendations for policy-makers, were published in 2018 (ASSAf 2018). The study reported that the current legislation dealing with genetics and genomics is very limited and that 'The National Department of Health (DoH) oversees implementation of the *National Health Act* (NHA) (No 61 of 2003) and its Regulations' (ASSAf 2018). Chapter 3 of the NHA mandates the Director-General to make provision for genetic services, 'The Director-General must issue and promote adherence to, norms and standards on health matters, including – genetic services' (s 21[b][vii]). Chapter 8 of the NHA deals with blood and blood products, assisted reproductive technology, cell-based therapy, transplantation, tissue banks and forensic medicine/pathology. Chapter 8 includes a section on reproductive and therapeutic cloning (s 57[1][a] as well as [6][a] and [b]) which states that manipulation of human genetic material from gametes, zygotes and embryos for purposes of reproductive cloning is prohibited. *The Criminal Law (Forensic Procedures) Amendment Act* (No 37 of 2013) and its subsequent Forensic DNA Regulations of 2015 (Government Gazette 38561 of 13 March 2015, Government Notice R 207) only address the collection, use, storage and destruction of DNA samples in forensics. The Medicines Control Council guidelines (August 2012) refer to GM material, including recombinant DNA technology in the section on biological medicines. The report highlights that apart from the regulatory measures mentioned above, no specific legislation on genetics and genomics exists in South Africa. Thus, critical and highly topical fields of practice and research such as gene editing and gene therapy remain unregulated.

Balancing the potential health benefits and the diverse moral values of a society can be a tremendous challenge (Caulfield, Knowles & Meslin 2004:414–417). Most people would agree that 'the law often reflects public morality, [and on] what is ethical ought to be permitted and what is unethical ought to be prohibited' (Caulfield et al. 2004:414–417).

■ How can we end the exploitation of vulnerable communities?

During my career, I have been privileged to work among various communities in the sub-Saharan African region. I have conducted fieldwork in South Africa, elsewhere in Africa, Madagascar and the Maldives. All of my research projects have been approved by the Human Research Ethics Committee (Medical) at Wits, and research permits for conducting research in other countries were also obtained prior to commencement of research.

Fieldwork has been one of the most humbling experiences in my career. These experiences and the mentorship of Professor Jenkins have taught me respect, humility, patience, tolerance, empathy and many other humanitarian qualities. My first experience in the field was in September 1992 when I accompanied a colleague to Schmidtsdrift, about 100 km north of Kimberley in the Northern Cape Province, to work with the San community there. This community consisted of !Xun and Khwe soldiers and their descendants, who following the independence of Namibia in March 1990 were settled in a tent town near Schmidtsdrift. These soldiers were part of the 31/201 Battalion at

Omega and 203 Battalion in Bushmanland, which served actively in counter-insurgency operations during the Border War (Van Wyk 2014:133–151). The San soldiers were recruited by the South African Defence Force (SADF) to assist them as trackers against the active military wing of SWAPO during the war that stretched over a long period, from 1966 to 1989.

Although we successfully collected blood samples, with informed consent from the soldiers at this tent camp, I have previously written about my discomfort about freedom of choice of the participants under these conditions (Soodyall 2003: 200–215). Do military individuals have freedom of choice when asked by a superior officer to participate in an activity? Although we went through the process of discussing our planned research and asked for voluntary participation, was the participation of the subjects voluntary?

There are now very strict ethical guidelines concerning informed consent of subjects for research and health-related activities. However, many questions still exist as to how well the complexities of the scientific jargon are understood by participants prior to consenting to participate. Over the years as I have grown into an independent researcher and became responsible for the activities involved in research on the genetic prehistory of the peoples of Africa, I was very conscientious as to how I engaged with individuals who were invited to participate in my research and ensured active community engagement of science both for the research and in public engagement of science.

In the ASSAf (2018) consensus study on *Human Genetics and Genomics in South Africa: Ethical, Legal and Social Implications*, Recommendation 8 comments on ELSI issues related to communities, families and vulnerable and marginalised individuals. It states the following:

> (a) When working with small, identifiable groups that may already be socially or politically marginalised, researchers must include in the community engagement process a discussion on the manner in which

> the research process and outcomes will be managed to mitigate potential harm to the community, e.g. unintended perceptions of stigma. (b) Researchers investigating certain conditions, phenotypes or behaviours must also include in the community engagement process a discussion on the manner in which the research process and outcomes will be managed to mitigate potential harm to the community. (n.p.)

On the issues of 'race' and discrimination

In a country where the (Soodyall & Reagon 2017):

> [*L*]ived experience of people is inextricably bound with social categorisation, particularly 'race', and its association with power, inequality, discrimination, poverty and injustice, there is a pressing need to build a cohesive society which underscores redress and reconciliation. (pp. 16–18)

Discrimination on the grounds of race, gender, sex, pregnancy, marital status, ethnic or social origin, colour, sexual orientation, age, disability, religion, conscience, belief, culture, language and birth is prohibited in the Constitution of South Africa (Department of Justice and Constitutional Development 1996:Section 9).

Soodyall and Reagon (2017) highlighted that:

> [*E*]ven as we move deeper into our democracy, many South Africans still battle to construct a sense of belonging, especially when issues around 'race' continues to be dominant in public discourse. For many, the meaning of 'race' refers to morphological characteristics such as skin colour, facial features, hair texture, etc. (pp. 16–18)

While science has confirmed that patterns of human variation exist, it has also provided ample evidence that there is no biological or genetic basis for 'race' and that it is socially constructed (Soodyall & Reagon 2017:16–18).

Sir Francis Galton introduced the concept of 'eugenics' in 1869, the term he used to mean 'well-born'. Galton (in Naicker 2012) advanced the idea:

> [*T*]hat biologically inherited leadership qualities determined the social status of the British ruling class. The notion of 'inferior types', European superiority and the need to control human heredity became the preoccupation of eugenicists. (n.p.)

By the early 19th century, the study of eugenics provided a pseudoscientific brand of racism which advanced the belief that difference in phenotype, intelligence and the ability to achieve was genetically determined. Racial mixing was seen as a social crime and was prohibited because the offspring of mixed marriages would supposedly transmit 'impure' blood into the 'white race' and if allowed to continue would eventually rob the 'white race' of its hereditary 'purity' (Naicker 2012; Soodyall & Reagon 2017:16–18).

In South Africa, the eugenics movement was promoted by Harold Fantham after the First World War. 'His main claim was that the greatest threat facing white South Africans was the deterioration of the "white race"' (Dubow 1995; Naicker 2012:n.p.). 'Fantham believed that heredity was the basis of good progeny' (Naicker 2012:n.p.) and, even among the white community, people with hereditary defects ought to be segregated. The medical profession in the early twentieth century was concerned about the escalation of 'feeble-mindedness' among white people and maintained that this was because of racial mixing. The debate centred around the 'preservation of white "purity", white superiority and white dominance' and racism (Lewin 1969; Naicker 2012:n.p.). While South Africa did not practise forced sterilisation as in the case of the United States, some European countries and elsewhere, it was these ideals of white supremacy that advanced the formal apartheid era, 1948–1994, even though such practices were well entrenched in the country prior to its legislation in 1948 (Soodyall & Reagon 2017:16–18).

Biological information has shown that about 85% of differences at the genetic level exist within populations and that less than 10% of the variation distinguishes traits that are commonly associated with ‘race’. There is no ‘race’ gene that is present in all members of one group and not in another. Instead, what is common is that all alleles (copies) of genes are found in most groups, but at different frequencies. Evolutionary processes like selection have been the major driving force in allowing our species to adapt to changes in the environment that have contributed to producing differences in physical appearances, often associated with ‘race’ (Soodyall & Reagon 2017:16–18).

As a society, we need to move away from being fixated on ‘race’, and we need to be more accepting of difference.

Conclusion

ELSI issues have grown alongside the HGP and researchers continue to explore topics on how to think about the risks and benefits associated with the explosion of genetic information. In the future, more individuals will choose to have their genomes sequenced, and this will contribute to the range of benefits and risks observed across the population. The changing landscape will challenge us to reassess how we weigh and communicate the potential risks and benefits of genomic research. Better communication channels between researchers, policy-makers and the public would have to be introduced to facilitate the growth of science but with sensitivity to societal issues.

In an inequitable society, where wide gaps already exist between the rich and the poor with respect to access to basic needs such as health, education and living conditions, the scientific community ought to play a more active role in ensuring that there is better advocacy for ethics and morality in science. The research community should engage with the general public to explain complex issues and attempt to quell their anxieties and fears. While we do that, we should also bring evidence-based science to intersect with societal issues to debunk racism and advocate for tolerance and respect.

I have been privileged to have shaped my career in human genetics in the era when so much has happened so quickly. I have watched as the field grew internationally and as we played catch-up with the rest of the world. We are living in exciting times, and my advice to our growing cadre of young scientists is that as we launch into the world of the technological-driven era, we need to ensure that we are firmly grounded on the issues of morality, ethics and values in science.

Chapter 7

Biotechnology and ethical controversies

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Introduction

Biotechnology is the use of biological processes and the genetic manipulation of microorganisms together with technology for the production of antibiotics, hormones and other medicines. Károly Ereky, a Hungarian agricultural engineer, coined the term 'biotechnology' around 1919. Biotechnology finds application, inter alia, in agriculture, medicine and waste management. Examples of biotechnology in the arena of human health are diagnostic test kits, vaccines, gene therapy agents, cytokines, certain antibodies and tissue-engineered products such as bone grafts (Afzal et al. 2016:309).

Biotechnology is advancing at a rate that far outpaces movements in ethical and legal analysis. Scientific advances tend

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to be viewed as beneficial unless there are immediately obvious destructive effects as in the case of weapons technology. Biotechnology, on the other hand, is usually welcomed as being beneficial to humans. The main exception to this view is the genetic modification of food, which is viewed with concern by many. In this chapter, we will consider the ethical debates and concerns in the following areas of biotechnology:

- precision medicine
- animal rights in the context of transgenic animals and animals used for donor organs
- gene editing
- enhancement of humans
- stem cell research
- biohacking.

The ethical issues raised concern distributive justice and resource allocation, for example, do advances in pharmacogenomics and precision medicine shift resources away from much-needed health care? The ethical debates in stem cell therapy using embryonic stem cells concern well-worn debates around the destruction of human embryos. Gene editing and human enhancement raise theoretical issues of whether we should be allowed to enhance traits such as height and intelligence, and whether we should be researching ‘therapy’ that would only be available to the very wealthy, with the risk of off-target effects.

The use and creation of transgenic animals have given rise to debates around creating new kinds of animals, ensuring that these genes do not escape into the wild and subjugate the welfare and interests of the animals involved to human interests and preferences.

■ Precision medicine

Precision medicine is the targeting, at a genetic level, of diagnosis or treatment to the patient or group of patients. Examples of the application of precision medicine in disease and treatment include drugs targeted at specific sub-groups of cystic fibrosis, chemotherapy specifically targeted at certain cancer genes and pharmacogenomics where drugs are 'designed' for patients' genetic make-up (Ashley 2017:2120).

In 2015, in the United States, President Obama together with the National Institutes of Health launched a precision medicine initiative now known as 'All of Us'[4] to focus on developing targeted cures for diseases and to research personalised healthcare. Genomics England, in their precision medicine initiative, has sequenced 100 000 genomes from National Health Service patients with rare diseases, their families and from patients with cancer.[5] The South African Medical Research Council has launched a Precision and Genomic Medicine Research Unit to conduct research in the field of genomic science.[6]

The ethical concerns around precision medicine are:

1. concerns around the sharing of sensitive patient data across databases
2. vast amounts of data which could potentially be correlated to health outcomes over time
3. incidental findings in genetic testing
4. questions about what information is to be relayed back to the patient or sample donor
5. questioning whether there is a right not to know that one is a carrier of an inherited disease-causing mutation.

One of the ethical difficulties presented by genome sequencing as part of data gathering is that the testing yields masses of data that cannot yet be correlated to diseases or to predispositions to diseases. Genetic variants of unknown significance might in the future be interpreted and understood when the analysis and interpretation of these variants have progressed, which is inevitable. What then is the responsibility of the researcher and

4. See https://allofus.nih.gov.

5. See https://www.genomicsengland.co.uk.

6. See http://www.mrc.ac.za/extramural-research-units/precision-and-genomic-medicine.

clinical geneticist with regard to re-contacting patients and sample donors, including re-contacting and counselling potentially affected family members (Fiore & Goodman 2015:86)? Similarly, the current ethical debates in clinical genetics around incidental findings will be present in precision medicine, given the enormous amounts of genomic data generated. Incidental findings are test results that were not anticipated when the sample was taken. These findings may relate, inter alia, to misattributed paternity, consanguinity, unknown adoption or unanticipated hereditary conditions which may or may not be treatable. The patient should be warned in advance that testing may yield surprises. Questions arise as to the type of informed consent required, given the many unknown factors; does the patient want to be contacted with all results, with disease-causing variants only, with mutations that will affect family members, with treatable illnesses only, excluding incidental findings related to paternity or adoption, and so on. A further complexity is that as medicine advances, illnesses may move from one of the above categories to another (Roche & Berg 2015:174). Roche and Berg (2015:172) note that for a patient to opt out at different levels of disclosure requires understanding by the patient of the implications of what he or she is refusing. Genetic counselling is therefore important to promote the patient's understanding of the types of results possible and to facilitate informed decision-making about the return of test results.

The question then arises as to whether there is a right not to know. This is especially relevant when dealing with genetic information that has implications for affected family members, and even more so when the test results have important implications for future generations, reproduction choices and preventative surgery for cancers with high-risk genetic mutations such as certain breast cancers. The right not to know about potential future illnesses is concerned with respect for patient autonomy. The difficulty, of course, is that the autonomy of possibly affected family members who might have wished to be tested is at the same time obstructed as the right not to know of the original patient is respected. The vast amount of data generated by genomic research and even by testing in the clinical genetics setting does not lend itself to detailed discussion with the patient of every type of possible finding or to a checkbox approach to preferences about what may be disclosed (Berkman & Hull 2014). In the diagnostic paradigm, it is possible that patient preference may change over time and that there may be implications for family and offspring which will raise questions about traditional views of patient confidentiality (Dockrill 2019). The right not to know should be approached with caution and certainly overridden if there are legal ramifications.

Data sharing in precision medicine

The All of Us precision medicine project will require participant consent to share data across a number of databases in addition to consent for ongoing access to medical records. The amount of data generated in the biomedical context is staggering. Ethical concerns arising in the context of big data revolve around informed consent, the privacy of information, ownership of data (especially after aggregation of data sets), and the divide between well-resourced institutes which have the capacity to store and analyse big data and those who do not (Mittelstadt & Floridi 2016:339). The most-debated issue with informed consent in this context is the difficulty of predicting possible secondary uses of data, especially secondary uses not anticipated at the time of obtaining consent. The obvious problem is that of consenting in advance to unknown secondary use of one's data, for example, by completely different researchers. Currently, most researchers obtain broad consent from participants, that is, the consent covers unknown future use of the data as long as the research is carried out with the approval of an accredited research ethics committee or IRB. In South Africa, data privacy will be governed by the *Protection of Personal Information Act* when this statute comes into effect.

Direct-to-consumer genetics companies offer private individuals ancestry testing and information about predispositions to certain diseases including complex diseases. However, these predispositions may not be clinically significant. If the consumer opts in, and most consumers do, the genetic data are shared with research companies and with drug companies involved in drug development. 23andMe has the largest database of samples, around 5 million, and has entered into a deal with GlaxoSmithKline on drug research and development. While customers of consumer genetic testing view the end-product as their test results, in fact, their DNA is the commodity for trade (Rutherford 2018). Controls on direct-to-consumer testing are being relaxed with respect to the number of disorders that can be tested.

■ Animals and biotechnology

Animals have been used to pursue human interests since the time they were domesticated. These interests include 'work', for example, in agriculture, as pets, for food, for clothing and in research to test products such as vaccines and to test surgical procedures such as organ donations. The ethical debates for and against the use of animals are ongoing and are often accompanied by violent protests. Proponents of using animals for scientific research point out the benefits to humans – the development of medical and scientific knowledge and the alleviation of human suffering resulting from antibiotics, medicines, vaccines and surgical procedures tested on animals (Nuffield Council on Bioethics 2005:184).

Opposition to animal research is based on various ethical bases. In some instances, it is based on arguments that human and animal biological processes are different and that most animal research is not subjected to systematic review and, therefore, the 'design, quality and relevance' of the results from research on animals cannot reliably be extrapolated to humans (Pound & Bracken 2014:348). This is a highly contentious viewpoint discussed in detail elsewhere (Shanks, Greek & Greek 2009:18).

Ethical arguments against animal use in research also point to the pain and suffering involved in experimentation, which does not benefit the animals themselves and which they would not consent to if they were able to communicate. These arguments are based on the 'might is *not* right' position, that is, just because humans are able to physically subdue and inflict pain on animals who are unable to communicate their unwillingness to suffer for human interests, is not in itself an ethically defensible basis for the practice (Singer 1990:Ch 5 & 6). If a being is sentient – that is, it has the ability to feel pain and suffer – it is, in ethical terms, deserving of moral regard and has an interest in not suffering, i.e. it does not want to suffer (Greek & Greek 2010:15). The position is that a high degree of intelligence does not confer the right to exploit sentient, non-human animals.

The use of biotechnology to alter animal characteristics can be considered from both utilitarian and deontological ethical perspectives. The utilitarian perspective considers the act from the point of view of whether the animal is capable of sentience, experiencing pain and suffering and, thus, worthy of moral regard. The deontological analysis considers this from the point of view of our duties towards non-human beings and the scope of these duties.

Transgenic animals

Transgenic animals are bred for research. They contain genetic material from different species or are bred with deliberate mutations that might predispose them to certain diseases in order to develop treatments or cures for those diseases. It may be possible in the future to breed transgenic animals as organ donors for humans and, thus, eliminate the shortage of human donor organs. An anti-thrombin drug called ATryn has been produced using GM goats, with no observed ill-effects on the goats (Choi 2006). There are questions regarding the legal status of these animals and organisms, for example, whether one should be able to patent a transgenic animal. Interestingly, given that human genes have been spliced into animals, we must ask, what is the moral status of these animals? At what stage of the human–animal mixture, do we blur the line between humans and animals (Regalado 2016)? There is currently a ban in the United States on the government funding such research, but the research is in fact taking place with alternative funding, for example, studies on 'growing human organs inside pigs and sheep' using human stem cells injected into animal embryos (Regalado 2016). Human–animal chimeras already exist, but they were injected with human tissue after being born, as opposed to being injected with human stem cells while still in an embryonic stage. Research funders and ethicists are concerned about the development of human–animal chimeras that have cognitive states of a higher order, approximating human intelligence. This is a very remote eventuality, but the speed at which genetic research is developing has removed any complacency about remote eventualities. The questions raised in the section above on inflicting pain and suffering on animals for human benefit are relevant to transgenic animals as well. Likewise, there are concerns about treating sentient, non-human beings as a means to serve human ends.

Human enhancement

Human enhancement is defined by Bess (2010:641) as 'an intervention designed to modify a person's traits, adding qualities or capabilities that would not otherwise have been expected to characterize that person'.

Gene editing

Gene therapy is the treatment of genetic disease by inserting a healthy copy of a defective gene, inactivating a mutated gene or inserting a new gene into the body.[7] Gene editing, a type of gene therapy, has the potential to alleviate the suffering caused

7. See https://ghr.nlm.nih.gov/primer/therapy/genetherapy.

by genetic diseases. Human enhancement through gene editing has long been debated by philosophers on a purely theoretical basis. These debates came into sharp focus when it was widely reported in international news in December 2018 that a scientist in China claimed – without providing any proof – to have edited human embryos, to render the foetuses immune to HIV infection (New York Times 2018). There are no scholarly publications on the procedure, and it was carried out without institutional ethics review as is required. At the time of writing, there was no proof that this was any more than a pompous claim by the scientist. Independent genetic testing of the children and their parents would have to be carried out to verify his claim. Of course, no ethics review committee would have approved an experiment of questionable safety with high risks to viable human foetuses for the benefit of possible immunity to a treatable illness. At the time of writing, the scientist was suspended from Shenzen University and was under investigation.

Gene therapy of babies after birth to correct genetic defects is not viewed as controversial. For example, children born without immune systems who would otherwise have to live in complete isolation have been successfully treated with gene therapy (Menon et al*.* 2015:367).

Gene editing has been carried out on human embryos since 2015 when embryos unusable for *In Vitro* Fertilisation (IVF) were used in the research. These embryos, until the unauthorised experiment at Shenzen University in December 2018, were routinely destroyed after the experiment. At the time of gene editing of the first human embryo, there was an outcry and a call from scientists and research funders for these experiments to be stopped (Lanphier et al*.* 2015:410). Their concerns were mainly related to safety and the possibility of creating unpredictable changes which would be passed down to future generations or which might only be detected in future offspring. The first research into germline editing produced off-target effects, that is, unanticipated changes (Liang et al. 2015), but in the intervening time, laboratory techniques have improved greatly. The standard ethical research principles limiting harm and risk of unsafe research dictate that the research can only be carried out on humans when known harmful mutations are not anticipated. The usual observation holds for good scientific development racing far ahead of ethical and policy decision-making.

Non-therapeutic human enhancement

The ethical debates in human enhancement focus on a theoretical situation where the enhancements are not related to illness and disease but to qualities or traits like height, eye colour, intelligence, homosexuality, and so on. This difference between genetic enhancement to cure illness versus a cosmetic enhancement is known as the therapy/enhancement distinction. This non-therapeutic human enhancement aimed at changing physical characteristics or intelligence is, of course, open to accusations of being akin to a programme of eugenics and being an indulgence that only the wealthy will be able to afford, thus exacerbating inequality.

Bioethicists are concerned about the possibility of gene editing being used for non-therapeutic enhancement and the creation of 'designer babies'. The counterargument to this is that it would be unethical to halt research into a technique such as gene editing which could save so many people from what could be curable genetic birth defects and even chronic illnesses (Savulescu 2015:89). The logical course of action is rather to regulate the use of gene editing.

Germline gene editing

Germline cells are those that pass on genetic material to the offspring of the organism. The Hinxton Group Consensus Statement on genome editing technologies and human germline genetic modification (Chan et al. 2015:43) does not regard germline editing as morally impermissible *per se*. The ethical debates and questions raised by gene editing prompted a group of eminent scientists, policy-makers, ethicists and journal editors to come together and discuss the ethical challenges involved and to publish a consensus statement from a reputable interdisciplinary group. The aim of the Hinxton Group is 'to inform ongoing debates and provide useful guidance' (Chan et al. 2015:n.p.). The Hinxton Group emphasises the importance of engagement rather than taking intractable positions, and they also emphasise the need for well-considered regulatory frameworks and governance in this area of research.

Transhumanists

Transhumanists are proponents of biotechnological enhancements of the human body and brain using technological advancements such as bionic limbs and neuro-enhancements. The aim is to improve the human by enhancing physical and mental capabilities (Bess 2010:653). In this context, bioethicists ask questions such as whether disabled people would have a duty to enhance themselves, who decides what the norm is to which humans should be enhanced, should the deaf be allowed to select deaf embryos for implantation and is moral enhancement desirable if it were possible?

Is it ethical to select for disability

In the United States, a deaf couple was allowed to choose a deaf sperm donor with five generations of deafness in his family. The couple did not view deafness as a disability and wanted a child who would be part of the Deaf culture and who would communicate with them in sign language (which they did not regard as inferior to other languages) and who would identify with the parents as closely as possible (Spriggs 2002:283). The couple's arguments were that they regard themselves as a minority group – not disabled. They likened themselves to women and people of colour who experience discrimination and are allowed to prefer children like themselves, despite these children being likely to experience societal harm in the future (Anstey 2002:287). However, there is no doubt that a deaf child has fewer choices and faces difficulties in a predominantly hearing world. To deliberately limit the child's communication options to that of a minority group is questionable. Similar debates exist in relation to dwarfism and selecting embryos for dwarfism (Baruch 2008:245). Deaf people who have accepted their deafness and are integrated into Deaf culture feel pressured to choose cochlear implants that can assist them in hearing sounds – as Sandberg states, 'enforcing cultural norms of normality or desirability' (2011:73). The ethical principle of personal autonomy and the right not to enhance oneself is at play here. This personal choice for an autonomous adult is, of course, to be distinguished from imposing one's preference and choosing a disabled embryo which will grow into a disabled child negotiating an 'abled' world. Some ethicists ask, if there is a duty to enhance, remove disabilities and bear the best children that we can reproduce – is this not akin to eugenics? Agar (2008:6) responds that there is no duty to enhance and remove disability but rather an extension of reproductive freedom to bear children with the best characteristics that one can have. The charge of increasing inequality by providing non-therapeutic enhancements affordable only to a fortunate few remains a concern.

In South Africa, cochlear implants for certain types of deafness are very costly and not covered by state health care. There is minimal access except to wealthier families, in the private sector or those with access to crowdfunding.

■ Stem cell research

Stem cells, also known as 'master cells', are undifferentiated cells in the blastocyst stage of cells before they reproduce to form differentiated cells for the different organs and tissues in the body. Embryonic stem cells are totipotent – they have the potential to become any cell in the body. This pluripotency holds great promise for replacement of cells in the human body lost to disease or injury. Adult stem cells are not pluripotent and hence not as useful. Though, there is evidence that the addition of specific signalling molecules can make them more widely 'potent'.

The ethical debates in stem cell research are similar to those used against termination of pregnancy, that is, reasons based on the moral status of the embryo, respect for human life even at an early stage of development and 'commodification of human life' (Sandel 2004:208).

These arguments are also raised in debates around the destruction of embryos in gene-editing research. Human embryos used in gene-editing research are not 'bred' for research but are unsuitable for IVF implantation or left over from IVF procedures and would be destroyed anyway. Devolder (2005:368) holds that there is no moral difference between embryos created for research and those left over from IVF procedures. Opponents to Devolder's viewpoint highlight the need to respect human embryos and not to exploit and use them as merely a means to an end.

Biohacking

Scientists and clinicians who undertake health-related research are governed by rigorous laws and international guidelines on research ethics and good clinical practice. Research ethics oversight is also implemented at the institutional level to regulate practice at universities and research institutes. Many countries have a layer of oversight at the national level as well, with National Health Research Ethics Committees that usually fall under the auspices of the country's Ministry of Health, as is the case in South Africa.

In the meantime, however, there are individuals and groups who carry out biological experiments at laboratories set up in their homes and operate outside of the legal framework. It is now feasible to purchase DNA fragments from online vendors.

The costs of genetic sequencing and of using gene-editing technology like CRISPR-Cas9 have fallen dramatically. In the past, genome sequencing could only be carried out by large, well-resourced research institutes. It is now possible to purchase DNA for around 0.1 US cents per base pair (Nash 2010:7). These individuals who conduct scientific experiments with tissue samples in their homes are known colloquially as 'biohackers'. Biohacking groups, also called 'community scientists', have in some instances organised themselves and one group, DIYbio[8], a proponent of responsible, safe Do it Yourself (DIY) biologists, publishes a regular newsletter and organises annual international meetings. This group also organised an international congress in 2011 to develop their own code of ethics, proposing practices that are safe, responsible, respectful, accountable and for peaceful purposes. The rationale, shared by many mainstream scientists, is to make biological products accessible, easy to engineer and open-source (Bennett et al. 2009:1110). Some biohackers are also involved in synthetic biology, for example, enhancing their limbs with implants that glow in the dark. Medical practitioners who have come across patients with these implanted devices are unsure as to whether they are compatible with MRI and diathermy, whether they affect wound healing or whether they might increase the risk of post-operative infection (Shinde & Meller-Herbert 2017:909). There is, thus, a need for engagement between biohackers and mainstream researchers.

Mainstream scientists, including virologists, are concerned about the ease with which one could theoretically create a lethal virus with DNA fragments purchased online. Institutional laboratories have security systems and security protocols in place to deal with dangerous biological events. The lack of regulatory oversight of biohackers and the failure of governments to monitor and control their activities could lead to the creation of deadly viruses and bacteria and their release and proliferation in society. This area of biotechnology practice currently operating

8. See http://www.diybio.org.

outside research ethics frameworks is a serious and potentially dangerous regulatory lacuna and requires an external system for evaluating risks and dangers. Biohackers contend that their experiments are aimed at the good of society and humankind and are conducted for peace. On the whole, this is so, but the lack of predictability in scientific experimentation coupled with the high degree of trust required from society that the experimentation will always be properly secured and used for peaceful means is a cause for concern, given the possible consequences should a malicious biohacker create a lethal virus or should a benign experimenter not properly secure the home laboratory. Regulators are concerned with safeguards in the event of 'high-impact, low probability' events such as tsunamis or the SARS virus, but there is an imperative to include informal bioengineering in the threat analysis (Bennett et al. 2009:1111).

■ Conclusion

Biotechnological research has in the recent past operated under strict ethical and scientific oversight and governance. This ethical framework arose as a result of appalling breaches of respect for human and animal rights in the past. We are now at a stage where scientific practices such as biohacking and illegal human gene editing are taking place outside of standard ethical and policy frameworks. Ethical debates on human enhancement, which seemed purely theoretical in the recent past, are now more immediate and urgent.

Chapter 8

The threat and promise of artificial morality

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Introduction

Alan Turing published a paper on 'computing machinery and intelligence' in the journal *Mind* (Turing 1950):

> I propose to consider the question, 'Can machines think?' This should begin with definitions of the meaning of the terms 'machine' and 'think'. The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. (p. 433)

He then describes an 'imitation game' and goes on to formulate what has come to be called the *Turing Test* of machine intelligence.

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Instead of grappling with definitions, he effectively substitutes an operational question: Can a machine *act* in a way that cannot be distinguished from the way a thinker acts? Pylyshyn (1986) writes:

> Turing argued that a machine would qualify as intelligent if it could [...] fool a human observer with whom it could communicate only through a teletype so that the observer could not discriminate between it and another person. (p. 53)

This may seem to anchor AI in deception, but Stevan Harnad (1992) rightly responds:

> It is important to understand that the Turing Test (TT) is not, nor was it intended to be, a trick; how well one can fool someone is not a measure of scientific progress. The TT is an empirical criterion: It sets AI's empirical goal to be to generate human-scale performance capacity. This goal will be met when the candidate's performance is totally indistinguishable from a human's. Until then, the TT simply represents what it is that AI must endeavor eventually to accomplish scientifically. (n.p.)

The term *artificial intelligence* itself was coined later when John McCarthy, Marvin Minsky, Nathaniel Rochester and Claude Shannon jointly proposed the 'Dartmouth summer research project on Artificial Intelligence' (McCarthy et al. 1955) as 'a 2-month, 10-man study':

> The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. (p. 1)

This project may be regarded as the founding of AI as a field (within the discipline of computer science) with the aim of creating machines that can simulate human intelligence. The participants were mostly drawn from mathematics and engineering and also included Herbert Simon, Allen Newell and Arthur Samuel. Minsky went on to co-found the AI Laboratory at Massachusetts Institute of Technology (MIT), McCarthy developed the LISP programming language, Samuel pioneered machine learning with a program that played checkers, and Newell and Simon taught and conducted research related to AI at CMU.

An ancient dream

The idea of imbuing artefacts with life and intelligence is, of course, much older than the study of AI. Stories about automatons go back to the ancient Greek myths (Atsma n.d):

> [*The automatones*] were animate, metal statues of animal, men and monsters crafted by the divine smith Hephaistos (Hephaestus) and the Athenian craftsman Daidalos (Daedalus). The best of them could think and feel like men. (n.p.)

Hephaistos reputedly fashioned Talos out of bronze to guard the island Krete for its queen Europa and made Pandora out of clay, allegedly to punish the men created by Prometheus. He also sculpted many other automatons, including horses breathing fire, the eagle that tortured Prometheus, animated tripods bringing food to the Olympian gods and two golden maidens who served Hephaistos in his household[9] (Atsma n.d.).

But small statues with perceived magical powers to do work for humans in the next world had already been placed in Egyptian tombs by about 2000 BCE. These figurines, made from stone, wood, porcelain and so on, are called *shabti* or *ushabti*. They are 'the most numerous type of artifact to survive from ancient Egypt (besides scarabs)' (Mark 2012). Their function was clear from the inscriptions found on their bodies and on funeral papyri (Wallis Budge [1899] 1985):

> O thou, *shabti* figure [...] if I be called [...] to do any work whatsoever of the labours which are to be done in the underworld [...] let the judgement fall upon thee instead of upon me always, in the matter of sowing the fields, of filling the water-courses with water, and of bringing the sands of the east [*to*] the west.
>
> [*The shabti figure answereth*,] Verily, I am here [*and will come*] whithersoever thou biddest me. (pp. 53–54)

9. See the 1987 comic sci-fi movie *Spaceballs* for a faithful visual rendition.

Also, the *terracotta army* discovered in 1974 in the mausoleum of Emperor Qin Shi Huang Di, the builder of the Great Wall of China, comprises thousands of life-sized figures of soldiers, chariots and horses (China Internet Information Center 2003). It is difficult to escape the impression that the army, buried with the emperor in 206 BCE, is not merely decorative or demonstrative of past power but intended to protect him and fight for him in the afterlife as well. The dream of making animate machines or artefacts that can replace human labour is thus age-old, and in these ancient renditions of such creatures, we see them faithfully serving their masters.

The theme of artificial bodies brought to life recurs in tales as different as those of *Pygmalion* (in ancient Greek mythology as well as in Shaw [1913] 2003), *Frankenstein; Or, The Modern Prometheus* (Shelley [1818] 2018), and *The Adventures of Pinocchio* (Collodi [1883] 2011), but here we start to see an emerging and enduring concern that the creatures will escape from the control of their creators and run amok. As soon as Pinocchio's feet are chiselled, he first kicks Geppetto on the nose, then runs away from home. Possibly also the nature of the dream starts to change, with creators of such artefacts aiming to substitute not just labour but also other aspects of humanity, especially emotional bonds. For example, Geppetto finds a son in Pinocchio, and Pygmalion falls in love with his sculpture. Like the old Egyptians, the ballad 'The Sorcerer's Apprentice'[10] (Goethe 1870) articulates the wish for relief from chores, but the story ends with a warning about the unintended consequences of releasing powerful forces beyond one's control to achieve this aim. A common theme throughout these stories seems to be the risky human hubris displayed in imitation of the gods' creation of humans.

Our closest equivalent for *automaton* or *ushabti* today is probably the *robot*. The word entered the English language through the Czech author Karel Čapek's play 'R.U.R.' (Rossum's

10. 'Der Zauberlehrling' by Goethe was in turn inspired by a tale by Lucian, written *c*. 140 CE, called 'Philopseudes' or 'Lover of lies'.

Universal Robots) of 1920. The robots[11] in the play are quite different from our present understanding of the term; they are made from a synthetic substance similar to living matter, but chemically different. Their bodies are optimised for work; otherwise, they live and think much like humans. Initially, they serve their human masters, but eventually they kill all humans in a robot rebellion (Čapek [1920] 2001). In light of the two devastating World Wars, it is not surprising that the fear of losing control of destructive technology becomes so pronounced in 20th-century fiction.

By the middle of the 20th century, many types of labour had been mechanised. Yet, the dream remained of liberating humans from all drudgery, even in office and care work, and thus, the dream of replicating the functionality of the human body in a tireless yet docile, machine. Between 1940 and 1950, Isaac Asimov's science fiction short stories later compiled as *I, Robot* (1950) appeared in American magazines, featuring among others a robot child-minder called Robbie. Robbie is closer to the popular imagination around robots; he has glowing red eyes and a metal body. He does not feel any physical pain when his charge, the 8-year-old Gloria, hits him, but strangely, in spite of his muteness and metal composition, he seems to experience and express the full range of human emotions, including misery about Gloria's taunting, stubborn resistance and finally forgiveness (1950:4–17).

Artificial Intelligence and cybernetics

In the meantime, on a less fictional front, two research fields developed around the middle of the century, recalling the ancient dreams about machine servants, namely, AI (already referred to) and cybernetics. Along with the development of digital computers, the practical aims shifted away from replicating the ability to do physical labour to simulating intelligence and implementing goal-seeking behaviour. Norbert Wiener's book *Cybernetics: Or control and communication in the animal and the*

11. The Czech word 'robota' means labour.

machine (Wiener 1948) introduced the field of cybernetics. It had obvious applications to modern robotics, but it took an approach distinct from AI when the latter emerged in 1955. According to Paul Pangaro (1990):

> Artificial Intelligence and Cybernetics are widely misunderstood to be the same thing. However, they differ in many dimensions. For example, [*AI*] grew from a desire to make computers smart, whether smart like humans or just smart in some other way. Cybernetics grew from a desire to understand and build systems that can achieve goals, whether complex human goals or just goals like maintaining the temperature of a room under changing conditions. But behind the differences between each domain ('smart' computers versus 'goal-directed' systems) are even deeper underlying conceptual differences […] For example, AI […] presumes that value lies in understanding 'the world as it is' – which presumes that knowing the world is both possible and necessary. Cybernetics […] holds that it is only necessary and only possible to be coupled to the world sufficiently to achieve goals, that is, to gain feedback in order to correct actions to achieve a goal. Thus, while both fields must have clear and inter-consistent concepts such as representation, memory, reality, and epistemology […], there are more differences than similarities. (n.p.)

The difference between the two fields is relevant to our discussion later on, with AI following a more realist epistemological approach and cybernetics following a more constructivist approach. At risk of oversimplification, one might say that AI initially followed the epistemological approach typical of modern science, criticised by Richard Rorty (1979) in his book, *Philosophy and the Mirror of Nature*. According to Rorty, modern scientific thinking is founded upon the mistaken idea that the human mind is a mirror-like reflection, or a one-to-one isomorphic representation, of the 'outside' world 'inside' the mind. Similar to Rorty, cyberneticists had a different view of the nature of intelligence, whether animal or artificial. The epistemological vision underlying cybernetics might be closer to what Turing had in mind when he placed the emphasis of his test less on whether machines can in fact think and more on whether they can effectively act like thinkers in the world. The latter is also the approach that we favour.

Warren McCulloch, Arturo Rosenblueth and John von Neumann also made early contributions to cybernetics, before the field was even named. In addition to mathematicians, these founders notably included physiologists and psychologists. Early work on *connectionism,* which includes what is now called (*artificial) neural networks*, was done by cyberneticists. Based on an understanding of the nervous systems of animals and humans, networks of simple neuron-like elements were used to study the working of perception and recognition.

The Dartmouth AI proposal notably included ‘neuron nets’ among its seven topics. Although at least two cyberneticists (McCulloch and Ross Ashby, who later wrote *An introduction to cybernetics* [Ashby 1956]) visited the project, AI research in the years following the Dartmouth project diverged from cybernetics and became focussed on explicit symbol manipulation. This is in line with the strong focus on language as expressed in the early definition of AI quoted above and might be compared to the dramatic ‘linguistic turn’ in philosophy and the birth of analytic philosophy during the course of the 20th century. The book *Perceptrons* published by the AI researchers Minsky and Papert (1969) moreover generated controversy, as it was seen as emphasising the limitations of the neural approach and discouraging research in that direction.

AI and cybernetics always overlapped to some extent, and their adherents competed for funding and students. Artificial intelligence seemed to have won the initial struggle and it achieved early successes with demonstration programmes based on the symbolic approach, for example, one playing tic-tac-toe and the ELIZA[12] conversational system named after Bernard Shaw’s character in *Pygmalion* (Weizenbaum 1966). Another AI success was the natural language understanding programme created at MIT for dialogue with a virtual robot called SHRDLU

12. ELIZA was intended, ironically, to demonstrate superficiality in conversation, but was perceived by many as human-like.

(Winograd 1971:261). Cybernetics did not attract as much attention as AI, but nevertheless found applications in many fields, like biology, economics and political science, in addition to contributing to machine intelligence.

While the founders of AI grasped the interdisciplinary character of their field, they underestimated its complexity. Their optimistic promises led to the disappointment and impatience of their funders when they could either not deliver on time or at all. The first so-called AI winter followed a critical report compiled by AI outsider James Lighthill (1973), for the British Science Research Council. Since then, AI has gone through a number of cycles from enthusiasm to disappointment, making sporadic progress and also appropriating every promising approach, including connectionism, earlier associated exclusively with cybernetics. The result is that AI has now become a blanket term for a broad range of different technologies and approaches, like expert systems, pattern recognition, machine learning, genetic algorithms, neural networks and so on. Artificial intelligence has effectively 'swallowed' cybernetics, but one may wonder whether researchers have taken sufficient account of their contrasting points of departure in terms of epistemology, that is, their underlying theories of knowledge and intelligence.

Popular milestones of AI include computers beating the human world champions in checkers (in 1962), chess (in 1997) and Go (in 2017). The renewed shock that many people experienced on each of these occasions highlights a peculiar human sensitivity to being surpassed in certain mental tasks. We do not feel insulted when machines are stronger or faster than us (thus, outperform us on a physical level; after all, other animals have been doing this forever), nor even when they can do data storage, retrieval and calculation much better than us. But we do feel threatened by a machine that seems smarter than the smartest human, even if it is in a highly specialised dimension such as chess.

Somewhat related to this is the so-called AI effect. It describes a form of habituation, where problems already solved through machine intelligence no longer ‘count’ as approaching AI because their application has become routine and pervasive. One example is the experience of having one’s credit card blocked when travelling internationally. The ‘decision’ to block transactions is made by an automated system using pattern recognition and rule-based processing, and contact with a ‘real human’ is usually required to lift the block. Most readers would be familiar with this phenomenon and may agree with the designers of their banks’ cybersecurity that such an automatic block and its accompanying inconvenience is preferable, on a simple cost–benefit analysis, over a system that will not recognise such anomalies. But in becoming routine, the application of machine learning has lost both its exciting novelty and its perceived threat, and we no longer readily recognise it as part of AI, which is imagined to always be cutting edge.

By projecting the advent of ‘real’ AI into the future, we tend to underestimate the extent to which machines are already constantly making decisions that affect our lives. In response to this deflation in the concept, the term ‘artificial *general* intelligence’ (AGI) is increasingly used to denote the holy grail of human-like abilities, like understanding, judgement and knowledge transfer between domains.

Predictions were made repeatedly throughout the 20th century that superhuman intelligence was on the horizon; once machines reached the critical stage where they could improve themselves and design other machines, the positive feedback would lead to vast progress. Ray Kurzweil is an exponent of this type of optimism, as his book titles (*The Age of Intelligent Machines* [1990], *The Age of Spiritual Machines* [1999] and *The Singularity Is Near* [2005]) show. He found it ‘reasonable to estimate that a $1000 personal computer will match the computing speed and capacity of the human brain by around the year 2020’ (Kurzweil 1999:79) and believed that ‘a functional simulation of human intelligence that passes the Turing Test […] will take place by 2029’ (Kurzweil 2005:139). However, ‘the extraordinary expansion contemplated for the Singularity, in which human intelligence is multiplied by billions, won’t take place until the mid-2040s’ (Kurzweil 2005:179).

His projections have been criticised by many, including Microsoft co-founder Paul Allen, who states (2011):

> Kurzweil's reasoning rests on the Law of Accelerating Returns and its siblings, but these are not physical laws. They are assertions about how past rates of scientific and technical progress can predict the future rate. Therefore, like other attempts to forecast the future from the past, these 'laws' will work until they don't. (n.p.)

Human responses to machine intelligence

Some researchers give their AI systems proper names, like Watson (IBM), Siri (Apple) and Alexa (amazon.com). Names seem appropriate when we talk to systems and when they respond with speech and even facial expressions. However, this practice may be misleading. The existing technology does not make it likely that we will see truly human-like or AGI machines in the near future as Kurzweil predicted.

Nevertheless, our connection with humanoid machines that at least seem to respond appropriately to our affective nature is the stuff of many flights of the imagination, and something we will have to contend with as machine intelligence becomes more pervasive. In the 2013 sci-fi movie, *Her*, the protagonist, Theodore, falls in love with an AI operating system, Samantha. The story tracks his increasing emotional attachment to 'her', eventually leading to a somewhat predictable breakup. It ends with the suggestion that Samantha has helped Theodore to reconnect with real people in an authentic way, even as it leaves one wondering whether he would have chosen this over his relationship with 'her'.

Similarly, in Asimov's short story about the robot child-minder, Robbie, in *I, Robot* (1950), the young girl Gloria grows more emotionally attached to Robbie than to her real parents, with the result that Gloria's mother grows so jealous that she gets rid of Robbie, to Gloria's great distress. As with the AI character HAL in the movie *2001: A Space Odyssey*, in these two stories the machines seem to excel in skills of human connection and emotional sensitivity and in the process turn out to be the 'most human' of all the characters. Often, the development of authentic, machine-internally generated emotions (R.U.R., Samantha and HAL) and moral sensitivity (Pinocchio) is represented as the final stage of 'becoming human'. Thus, along with the common human fear that machine intelligence might become more refined and more autonomous, there is clearly also a fascination with the potential benefits of forming emotional bonds with intelligent machines, together with the promise that humans might thereby become more, rather than less, human.

There is, of course, also a vivid imagination around 'evil' AIs portrayed, for example, in *Robocop*, *Terminator* and *The Matrix*. In all these films, virtual or machine intelligence had obtained a degree of autonomy that made it fully independent of its human creators and humans collectively come under threat. These fears are also not without real-life counterparts, even though also here, as in the fictional 'good' AGIs, the stories depict scenarios that are highly unlikely given the state of current technology.

This does not, however, mean that existing AI systems cannot wreak catastrophic damage. For example, there are many military applications of AI, including a whole range of remote-control through to almost completely autonomous killing machines (Wallach & Allen 2009:20). An open letter by the Future of Life Institute (2015) advocating a total ban on AI weapons was signed by Stephen Hawking, Elon Musk, Steve Wozniak and more than 3000 AI and robotics researchers. The letter compares the proposed ban with those on chemical and biological weapons and states (Future of Life Institute 2015):

> Starting a military AI arms race is a bad idea, and should be prevented by a ban on offensive autonomous weapons beyond meaningful human control. (n.p.)

The real threats described in this proposed ban, threats to human life that are already built into, and operative in, existing military and other forms of AI, tend to be obscured and overshadowed by exaggerated and unrealistic fears associated with fictional depictions of armed humanoid AGIs such as *Robocop*.

The success of the current wave of AI that gave us self-driving cars, machine translators, and smart speakers[13] may seem like fundamental breakthroughs, adding to the hype around AI. Yet, the technology in all of these cases derives from three main sources:

1. machine learning algorithms from the 1980s
2. the cumulative effect of Moore's 'law' on silicon processing power over decades
3. the more recent availability of large data sets for training AI models.

With the possible exception of 'deep learning', no significant new invention was necessary to enable them.

One important aspect of AI systems based on sophisticated artificial neural networks is that their 'thinking' or 'reasoning' is opaque. Neither the machine nor its trainer can explain how any particular result is achieved. It can be ascribed to the training data, and the model may be retrained to compensate for biases in the data, but the result cannot be directly interrogated or analysed. When its success rate is better than human performance, this can often be tolerated, but inexplicable and sometimes gross errors and malfunctions remain worrisome, especially in critical applications.

This contrasts with the earlier *expert systems*, which are based on two subsystems, a knowledge base and an inference engine, and where it may, in fact, be possible to show how a conclusion has been reached. Work on expert systems started at Stanford around 1965 and, 20 years later, they were successfully applied to many tasks, including diagnosis, prediction and control. Despite these early successes, the approach of expert systems did not generalise to problems requiring common sense and contextual knowledge, like speech recognition and machine vision. Expert systems are still routinely used as components in many systems,

13. A main feature of smart speakers is ironically their *listening* function, but more honestly calling them 'listeners' rather than 'speakers' would likely be disturbing to potential consumers.

but they have been largely eclipsed by machine learning and neural networks.

It is important to emphasise that none of the current systems – artificial neural networks, machine learning, expert systems, and so on – qualifies as AGI. The ability of each can perhaps be called ‘artificial *special* intelligence’ (ASI) because it is so narrow. Not that special intelligence is undesirable; there is evidence that the human brain is constituted by a ‘society’ of specialised components or agents (Minsky 1986). And human intelligence, which serves as the prime model for AI, has been claimed to have multiple different dimensions (Gardner [1983] 2011). It may, therefore, help to start referring to artificial *intelligences* in the plural. Perhaps, general intelligence can only be built using interacting parts, each with a different specialised intelligence.

Our sense that the sci-fi promise and threat of fully autonomous, runaway AI is nowhere near, is widely shared among scientists. The Association for the Advancement of Artificial Intelligence (AAAI) initiated a year-long study of long-term AI futures in 2008. This led to the ‘One hundred year study of artificial intelligence (AI100)’ project, housed at Stanford University. In his ‘Reflections and framing’ regarding the project in 2014, Eric Horvitz lists 18 topics of interest. Under ‘Loss of control of AI systems’, he states (Horvitz 2014):

> Concerns about the loss of control of AI systems should be addressed via study, dialog, and communication. Anxieties need to be addressed even if they are unwarranted. Studies could reduce anxieties by showing the infeasibility of concerning outcomes or by providing guidance on proactive efforts and policies to reduce the likelihood of the feared outcomes. (n.p.)

The first AI100 study panel of 17 AI practitioners published a report titled ‘Artificial Intelligence and life in 2030’ (Stone et al. 2016). They selected eight salient domains for study, namely, ‘transportation, service robots, health care, education, low-resource communities, public safety and security, employment and workplace, and entertainment’ (Stone et al. 2016:4). The summary concludes (Stone et al. 2016, [*author’s added emphasis*]):

> Contrary to the more fantastic predictions for AI in the popular press, the Study Panel found no cause for concern that AI is an imminent threat to humankind. *No machines with self-sustaining long-term goals and intent have been developed, nor are they likely to be developed in the near future.* Instead, increasingly useful applications of AI, with potentially profound positive impacts on our society and economy are likely to emerge between now and 2030, the period this report considers. At the same time, many of these developments will spur disruptions in how human labor is augmented or replaced by AI, creating new challenges for the economy and society more broadly. (pp. 4–5)

With this sober outlook about the possible benefits that specialised AIs in general hold for human society in the present and near future, provided that the attendant social disruptions such as resulting job losses can be properly managed, we now turn to focus more closely on the question of AI and morality.

■ Artificial morality

The social implications of the already pervasive and growing use of specialised AIs have been highlighted recently by public failures, like the Uber self-driving car killing a pedestrian in Arizona (T.S. 2018), an Amazon automated recruiting tool with gender bias (Dastin 2018), and a Chinese facial recognition system which framed as a jaywalker a woman whose face it detected in the middle of the road - on a bus ad (Tao 2018). These examples give a sense of how diverse AI applications have become, and correspondingly, how varied also the consequences of their failures. The 2018 end of year report released by the AI Now Institute at New York University lists further examples of 'cascading' and far-reaching AI moral failures and scandals that emerged during the year (AI Now Institute 2018):

> From Facebook potentially inciting ethnic cleansing in Myanmar, to Cambridge Analytica seeking to manipulate [*US and UK*] elections, to Google building a secret censored search engine for the Chinese, to anger over Microsoft contracts with ICE [*US Immigration and Customs Enforcement*], to multiple worker uprisings over conditions in Amazon's algorithmically managed warehouses – the headlines haven't stopped. And these are just a few examples among hundreds. (n.p.)

The prominent position of the mentioned IT mega-corporations in many of these scandals is noteworthy. They represent unprecedented concentrations of capital in the hands of a small number of internationals often characterised by strongly monopolistic tendencies and weak external oversight, such as taxation and other control mechanisms. Furthermore, never before did anyone have access to the amount of data and processing capacity that they have, nor their technological power and sophistication, especially in the field of AI. Their mere existence, combining unparalleled computing power, data and money, with poor oversight, thus presents our world with enormous new challenges. As reflected in the AI100 study report referred to above, the potential of such great power to enhance human existence is clear. At the same time, we face unequalled dangers. Threats of destructive use of these huge concentrations of power come, firstly, from badly intentioned actors gaining illegal access from outside; secondly, from questionable and opaque internal corporate decision-making; and thirdly, from the possibility of technical failure and human error. The moral challenge presented by AI is, therefore, multifaceted.

The European forum AI4People (n.d.) responded to this challenge by creating ‘a common public space for laying out the founding principles, policies and practices on which to build a “good AI society”’. The AI Now Institute at New York University in its turn has identified *accountability* as the core question; who is to be held responsible when AI systems harm us? The AIs themselves are obviously not accountable (yet), and it is not straightforwardly easy to say which specific persons associated with the systems should be held accountable for the harms inflicted by them. This is because human agency gets dispersed through space and time, mediated and automated through the use of AI, and not every situation facing an AI might be foreseeable. Engineering decisions often become untraceable, and multiple levels of ownership, operation, maintenance, outsourcing, deployment and supervision work to further disperse, distribute and dilute individual human accountability.

In an attempt to strengthen accountability within the AI sector, the AI Now Institute recommends an array of far-reaching reforms including:

1. sector and domain-specific governmental agencies to oversee and monitor AI safety in application
2. new approaches to internal governance structures in the AI industry itself
3. waiving of any legal claims which protect trade and corporate secrecy in the case of AI used in the public sector[14]
4. protection by technology companies of their own – often quite vociferous (see e.g. Conger 2018) – workers' organising, whistle-blowing and conscientious objection
5. mechanisms to ensure community participation and legal redress for workers and communities adversely affected by AI
6. stringent regulation for facial and affect recognition.

In line with our earlier argument about the gap between what AI seems to promise and what it in fact delivers, the report also recommends (7) that AI advertising be held strictly to the standard 'truth-in-advertising' legislation.[15] And finally, it recommends, interestingly, (8) that AI training programmes at universities should be expanded beyond their current narrow location in engineering and computer science faculties and into the humanities and social science faculties. We may add that engineering and computer science students of AI should be educated in ethics. Either way, the disciplinary scope and orientation of the field must return to its interdisciplinary origins to include physiologists, psychologists, ethicists and others,

14. These regulations are proposed in order to offset or mediate the 'black box' effect of AI systems which means that their findings or decisions cannot be directly interrogated, as we have discussed in relation to artificial neural networks. See also Doshi-Velez and Kortz (2017), for a discussion on how to hold AI systems accountable by demanding explanations.

15. Wallach and Allen (2009:45) point to the well-established human tendency to attribute anthropocentric characteristics to anything they perceive as animate including moving triangles, dolls, human-like robots and animals and suggest that there exists a real danger that humans may wrongly impute full-blown moral agency to AI systems with human-like features such as voice. Thus, 'anyone who puts matters of life and death in the hands of computers has failed to understand the limits of current technology' (Wallach & Allen 2009:45).

because technology is always embedded in social contexts and is being shaped by and in turn influences relations of power and domination. AI specialists should be trained to reflect on the social and political contexts in which technology operates.

A dimension of AI and morality that the above report arguably underplays is the extent to which decision-making with moral implications has already been transferred to automated processes of AI. In other words, increasingly, we remove AI systems from direct human supervision, even if such systems can impact hugely, even catastrophically, on human well-being. For example, global computer networks already evaluate and accept or reject millions of financial transactions per minute (Wallach & Allen 2009:3), usually doing so more reliably than humans. Sophisticated software systems manage power grids in many countries. Furthermore (Wallach & Allen 2009):

> [*H*]uman activity is being facilitated, monitored, and [*analysed*] by computer chips in every conceivable device, from automobiles to garbage cans, and by software [*'bots'*] in every conceivable virtual environment, from web surfing to online shopping. (p. 3)

Another salient example of AI moral decision-making is the introduction of self-driving cars, which recalls the dilemma known in some circles as the 'trolley problem' (Foot 1967), where a time-constrained choice is forced between two or more bad outcomes resulting from having to deal with a runaway trolley. When faced with an inevitable accident, should an autonomous vehicle act to protect its passengers or to minimise the number of lives lost? What about a choice between saving either an old person or a young one? (An MIT Moral Machine survey found that people's preferences on this vary by culture; see Vincent 2018.) On a different level, the question emerges how much and which information do we want such an AI system to have about the individuals involved when choosing between lives? The further question of who is morally and legally liable when such an accident occurs, the manufacturer of the vehicle and its control system, or the owner setting it in motion, is interesting, which is an example of dispersed or diffused moral responsibility, but not our current focus.

Here we ask instead about the moral decisions that we increasingly transfer onto AI systems. Can we induce morality into computing machines, and if so, what kind of morality will that be? Will machines be better or worse moral agents than humans? The general ambivalence we feel towards machine agency, visible since ancient times, again appears here – on the one hand we might see machine morality as very promising, because it will likely remove the subjectivity, prejudice and contingency that we readily associate with human moral agency (see Lerner et al. [2015], on how emotions can act as a bias in decision-making). On the pessimistic side, we might be concerned that precisely because machines lack emotional and embodied involvement in the moral situations they evaluate and might lack flexibility and fine-tuned discretion, they might miss crucial clues and make harmful mistakes in the process (see Damasio & Damasio 2000). Or, in a different vein, machines may learn to replicate existing human prejudice – we have seen this happen with the Amazon automated recruiting tool referred to earlier. The tool was trained through machine learning using the CVs of all applicants to Amazon over the previous 10 years, and it consequently reproduced the gender bias that existed within that database itself.

Similarly, when decision-support systems are created to assist judges with sentencing, based on a full suite of parallel cases, the clear danger exists that past patterns of gender and racial bias in sentencing might be built into such systems. At worst, we then get a machine morality persisting in the all-too-human prejudices of the past and reinforcing them with new authority because of its supposed greater neutrality. Again, on the optimistic side of the AI argument, a decision-support system might conceivably be retrained to reduce bias as soon as bias is detected, whereas it might be considerably more challenging to both reliably detect and 'retrain' a biased human judge.[16]

16. Some theorists are moreover concerned that such decision-support tools (DSTs) might lead to legal and medical professionals abdicating their own responsibility and critical thinking

There is a further benefit in AIs which is not strictly replicable in humans. One of the advantages of centralising the data in a learning system is that the result of learning by, for example, a single self-driving vehicle in a specific situation can immediately be made available to all the other vehicles running the same system. The way in which machine learning can thus be made accumulative across instances has some parallels in humans gaining knowledge, but it is fundamentally different from humans gaining skills.

The idea of an artificial moral agent (AMA) was introduced by Wendell Wallach and Colin Allen (2009) in their book *Moral Machines: Teaching Robots Right from Wrong*. They make the point that autonomy and moral sensitivity are mutually independent and that a machine could be designed to have either in varying degrees. For example, a decision-support system has low autonomy but may display high moral sophistication (Wallach & Allen 2009:32) – on the other hand, a highly autonomous AI system may be morally blind.

Because of the tendency to make machines more and more autonomous, that is, capable of acting without direct human supervision, the need for priming their behaviour with an eye to morality in their decision-making, that is, of getting them to act as if they were not only autonomous and efficient but also *moral* agents, is becoming more pressing by the day. This means that such systems must be induced to act responsibly in real and virtual world environments (Wallach & Allen 2009:17), even under unforeseen circumstances. Eckersley (2018:10) calls this ideal an 'aligned AI', referring to AIs that are aligned with human moral values.

(footnote 16 continues...)
(Friedman and Kahn in Wallach & Allen 2009:40). Clearly, that would be undesirable. At the same time, however, DSTs that apart from an impressive database also have the ability to take a range of salient ethical aspects of the situation into account, might become invaluable supports to professionals facing complex moral dilemmas (Wallach & Allen 2009:42).

Wallach and Allen (2009:10) distinguish different levels of morality; 'operational morality' in machines is where the machine's 'morality' is completely in the hands of its designer. Even a simple tool such as a pair of scissors with rounded ends to the blades might be said to contain 'operational morality' in so far as it is designed to minimise the risk of human injury. An example of operational immorality is the phenomenon of 'planned obsolescence' (Packard 1960:53), where consumer products are designed in such a way that their useful life is artificially limited. At the other end of the morality spectrum on Wallach and Allen's model, there is 'full moral agency', a category unlikely to be realised in machines soon. The domain of 'functional morality' (identifying, assessing and responding to moral challenges) they define as lying between mere operational and full moral agency. This functional morality is their focus, because this is where the current challenges regarding the designing of machine morality lie.

They are concerned that we are increasing machine autonomy and technical sophistication, without simultaneously increasing the moral sensitivity of the machine's decision-making processes (Wallach & Allen 2009:26). According to the abstract of their book by the American Psychological Association (2016), they argue that:

> [*E*]ven if full moral agency for machines is a long way off, it is already necessary to start building a kind of functional morality, in which artificial moral agents have some basic ethical sensitivity. (n.p.)

Not only is this a future need to ensure that machines' moral expertise keeps up with the levels of their technical expertise and autonomy, it is also a current need because of how pervasive machine agency has already become. We need to become more proficient in designing ethical concerns into artificial systems.

Wallach and Allen (2009:6) thus consider the 'technological issues involved in making computers themselves into explicit moral reasoners', and they recognise that these are not purely technological questions that might be approached by engineers alone. Because a number of difficult meta-ethical questions arise as soon as we ask how to start 'teaching robots right from wrong' (Wallach & Allen:xi), the field of artificial morality or 'aligned AI', will require interdisciplinary work involving scholars from fields ranging across philosophical ethics, philosophy of mind, evolutionary ethics, neuropsychology, developmental psychology and so on. In this, their thinking is in line with what we listed as the eighth recommendation of the AI Now Institute's report above, which calls for AI training and research to be returned to its initial strong inter-disciplinarity. Moreover, we agree with Wallach and Allen's (2009:11) expectation that once we start to seriously grapple with the question of how to teach machines moral decision-making, that is, when we start with 'the exercise of thinking through the way moral decisions are made with the granularity necessary to begin implementing similar faculties into (ro)bots', we will soon discover that it becomes an 'exercise in [human] self-understanding', that is, one that will productively feed back into the other fundamental disciplines.

AI systems will likely become much more pervasive as well as autonomous within the foreseeable future, and we are already affected by and interacting almost daily with AMAs. And as Wallach and Allen (2009:39) rightly argue, 'systems and devices [...] embody values whether or not humans intend or want them to'. This is echoed by Mike Loukides (2019), O'Reilly Media's vice president of content strategy, who says:

> We are surrounded by systems that make [*automated*] ethical decisions: systems approving loans, trading stocks, forwarding news articles, recommending jail sentences, and much more. They act for us or against us, but almost always without our consent or even our knowledge. (n.p.)

Clearly, if left to market forces alone, those are the values that will dominate decision-making processes in AI systems. Thus, the real question becomes whether AMAs are good or bad moral agents, and how well their decision-making fits in ('aligns') with human moral principles, virtues and frameworks. Wallach and Allen foresee that as AMAs increase their capacity to act as if they were moral agents (recall the TT), that is, ‘to assess multiple options and consider different evaluative perspectives’ on any given matter, that the human moral ecology itself is also likely to change through AMA presence and feedback (Wallach & Allen 2009:62). They are likely to be better than humans in some respects and worse than us in other respects and bound to make mistakes as they learn to act within moral parameters.

An area where machine morality has already become pertinent is the increase of semi-automated and remote-controlled weapon systems in war zones. During 2004 and 2005, numerous news outlets reported that the US Military had deployed robots (the remote-operated ‘Talon’ robot) armed with M240 and M249 machine guns ‘to wage war against insurgents in Iraq’ (BBC, quoted in Wallach & Allen 2009:47). Equipping such robots with the ability to accurately discriminate between friendly and enemy soldiers, but also between soldiers and civilians, and even between fighting enemies and enemies trying to surrender, or to correctly identify prisoners of war, are actions with military utility, but obviously also with far-reaching moral and legal implications. On a first level, designers of these military robots must ensure that their systems act within the limits of acceptable behaviour, but on a second level, we might need to consider how to incorporate into more intelligent systems the ability to autonomously assess the morally significant aspects of their own decision-making (Wallach & Allen 2009:26).

If one accepts the reasoning of Wallach and Allen up to this point, then the philosophically interesting question opens up of which ethical approach would serve us best when we try to equip AMAs with good ethics. Ethicists usually distinguish between rule-based (deontological) ethical theories, consequentialist (utilitarian) ethical theories and virtue ethical theories. They are generally also aware of multiple problems attached to each one of these approaches in human moral deliberation, and this is no less true when thinking about how to embed them in AMAs.

Asimov famously introduced the problem with his 'Laws of Robotics' (Asimov 1950):

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey the orders given to it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws. (p. 26)

Ethical rules, principles and obligations (deontological approach) look deceptively simple, as if one can simply embed them in a system, and all an AMA has to do is 'to compute whether its actions are allowed by the rules' (Wallach & Allen 2009:83). Already with his narrative explorations, however, Asimov himself illustrates that these apparently common-sense, universal rules will soon prove insufficient. Consider a robot which attempts to interfere in a medical operation assuming it to be a situation in which a human being is threatened with serious harm. Or think of a situation where two humans simultaneously give a robot conflicting orders, or the whole range of trolley problems in which a robot has to weigh up saving one human life over another, or two lives instead of one other and so on. Also, these rules will not be helpful for war robots to follow, unless we restrict their war usage purely to non-offensive operations such as locating and defusing landmines. We will moreover likely consider very different rules for a robot who works as a caregiver to children, than for one who is used in war.

Wallach and Allen discuss both rule-based ethics and utilitarianism (outcome-oriented) as 'top–down' approaches where a single principle or a handful of rules is supposed to guide all actions. Problems associated with consequentialist, cost–benefit approaches, in spite of computers' superior calculation capacity, are also obvious, for example, how should computers attribute relative weight to different outcomes, that is, which 'currency' should they use when calculating different likely outcomes? Should harmful and beneficial outcomes be restricted to individual humans or should moral machines incorporate concerns about individual animals, the environment, infrastructure, future lives, the AIs themselves, and so on? Linked to this question about the scope of the calculations involved, how far into the future should moral machines attempt to calculate the effects of their decisions?

Under bottom–up approaches to ethics learning, Wallach and Allen locate the third broad set of ethical theories, namely virtue ethics. This approach is associated with trial-and-error, cumulative learning on a case-by-case basis, learning through mistakes, and something more akin to inductive reasoning, where performance is repeatedly incrementally enhanced in the absence of a unifying theory or centralised intelligence (Wallach & Allen 2009:80). If general principles or abstract ideas are to play a role here, it is a limited one in that they merely indicate a task for the system but refrain from providing the method. This is the kind of model that we would also suggest should be worked out in more detail within interdisciplinary teams working on moral machines, including scholars of Aristotle's virtue ethics, as well as developmental psychologists, engineers and others. We contend that this type of combination of bottom–up and top–down approaches will come closer to developing AI systems that behave like moral agents than when moral 'rules' or principles are embedded in them, with the assumption that a mere calculation will provide the best moral outcome. A crucial aspect of good moral agents is that they regard moral decisions not as flowing seamlessly from calculations, but rather as entailing levels of complexity that can never be fully resolved, but only reckoned with, inside concrete situations of moral decision-making and action.

In this regard, Eckersley (2018) investigates a mathematical approach to moral (and economic) decision-making. He notes that ethicists had proven 'impossibility' theorems for the case where there are independent, multidimensional objectives that cannot be reduced to each other. These theorems imply that no satisfactory objective function exists that can be used to guide machine learning in such a case. Instead, he (Eckersley 2018) proposes the use of 'uncertain' objectives and shows that the impossibility theorems can be transformed into uncertainty theorems. The advantage of this approach is that it offers a way out of a key dilemma (Eckersley 2018):

> Many of the concerns in the literature about the difficulty of aligning hypothetical future AGI systems to human values are motivated by the risk of 'instrumental convergence' of those systems – the adoption of sub-goals that are dis-empowering of humans and other agents […]. The crux of the instrumental convergence problem is that given almost any very specific objective, the chance that other agents (e.g., humans, corporations, governments, or other AI systems) will use their agency to work against the first agent's objective is high, and it may therefore be rational to take steps or adopt a sub-goal to remove those actors' agency.
>
> We believe that the emergence of instrumental sub-goals is deeply connected to moral certainty. Agents that are not completely sure of the right thing to do (which we believe is an accurate summary of the state of knowledge about ethics, both because of normative impossibility and uncertainty theorems, and the practical difficulty of predicting the consequences of actions) are much more likely to tolerate the agency of others, than agents that are completely sure that they know the best way for events to unfold. (p. 10)

Ironically, then, machines' superior capacity for exact calculation may be of little benefit when it comes to imbuing them with moral sensibility. For that, they will have to become less like machines and more like humans, with all the uncertainty and error, and incremental learning, and the need for regular retraining of their moral sensibilities that humans also require.

■ Conclusion

We argued in this chapter that the state-of-the-art of AI technology poses unprecedented challenges to the domains of ethics (theorising morality) and morality (practical moral decision-making and behaviour). We explained the nature of these challenges by first providing an overview of the emergence of AI (and cybernetics) in science and technology since the Second World War, and in fiction since antiquity. Drawing out both parallels and differences between the fictional fantasies and fears on the one hand, and the actual growth and deployment of AI on the other, we made the point that it is important that AI should be evaluated realistically if we want to properly grasp the moral challenges it increasingly poses. Popular depictions of AI, especially in movies, tend to overinflate both the threats and the promises of AI, often through the portrayal of humanoid robots that are either evil and destructive or compassionate and kind. Hype is not limited to fiction, however; the history of AI is one of many stops and starts, of great promises, and subsequent losses of faith and funding. This trajectory has had the ironic double effect that the public has an unrealistic view of what is actually technologically possible (expecting machines with full human intelligence and feelings), while at the same time underestimating the extent to which artificially intelligent machines are already acting and making decisions with far-reaching moral and other implications in our everyday lives. Because of the pervasiveness of the latter and the consistent increase in intelligent machines' autonomy, we argued that it is crucial that interdisciplinary teams work on embedding morality in intelligent systems. Finally, we highlighted the connection between morality and uncertainty.

Chapter 9

Can Cyberspace potentially harm democracy and world stability?

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Introduction

There can be no doubt that the Internet, which forms the technical infrastructure of cyberspace, has changed the lives of everyone on this planet – and that in a little more than 20 years. Cyber-based applications like social networks, email, instant messaging and search engines are used by most people in the world and are the new norm.

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According to Pappas (2016):

> The Internet is a busy place. Every second, approximately 6000 tweets are tweeted; more than 40000 Google queries are searched; and more than 2 million emails are sent. (n.p.)

The social network Facebook alone has more than 2 billion users, of which 1 billion are regular daily users, and there are more than 4 billion smartphones in the world, all making use of cyberspace.

In two decades, cyberspace has become a phenomenon that affects most people in the world and is having an immense impact and influence on the whole world. Some people are very positive about cyberspace, while others (including the author of this chapter) are becoming more cynical by the day. Many claimed over the last 20 years that the Internet could benefit humanity in many ways.

Nicolas Negroponte stated in 1997 that the 'Internet is (the) way to world peace', predicting that 'the Internet would do no less than bring world peace by breaking down national borders' (Reuters 1997). As recently as 2015, Mark Zuckerberg, the CEO of Facebook, also stated that 'Internet access can help bring world peace' (Torres 2015).

With expectations like the above fuelled by Negroponte and Zuckerberg, it seems rather shocking that the 2018 Global Risk Report of the World Economic Forum (WEF) (2018) rates cyber attacks as the third-highest global risk in 2018, with data fraud and data theft ranked as number four. The top two risks are extreme weather events and natural disasters. This comprehensive report (WEF 2018), therefore, indicates that 50% of the top four risks in the world in 2018 are related to the Internet and cyberspace. This puts the optimistic views about world peace mentioned above in a slightly different light.

Other voices, even from unexpected quarters, are also being voiced. Sir Tim Berners-Lee, the creator of the World Wide Web (WWW), has admitted that his brainchild has 'evolved into an engine of inequity and division, swayed by powerful forces who use it for their own agendas' (Bridge 2018). Even Facebook has recently acknowledged that 'the widespread use of social media can be harmful to democracy' (AFP 2018).

The purpose of this chapter is to investigate how this seemingly indispensable concept of cyberspace (the Internet, WWW) is being misused and is becoming the platform to negatively influence the concepts of democracy, world peace, privacy and world stability. This chapter will discuss a number of areas where the negative side of cyberspace has already caused big worries and problems.

It is structured as follows, starting with some technical background to position the rest of the chapter, followed by a discussion of a number of areas where the negative side of cyberspace has already caused big worries and problems and has already started to negatively impact democracy, world stability and the normal way of life of billions of people.

Some technical background

Defining a few concepts

As background to the different sections in this chapter, some concepts have to be defined. For the concepts defined in this section, many definitions do exist, and many different definitions can be provided from existing literature.

However, the definitions provided below are mostly based on the personal experience of the author of the relevant concept over many years and may therefore be criticised by the 'purists'. Nevertheless, the purpose is to make concepts as understandable as possible and is specifically directed at the non-technologists.

The Internet

In its simplest form, the Internet can be visualised as millions of computers and computing devices connected via millions of computer networks. Such computers include big enterprise-type computers, desktop computers, laptops, tablets, smartphones and many more. The Internet can, therefore, be seen as purely a technical infrastructure on which more advanced applications can be built.

☐ The World Wide Web

On every computer and device connected to the Internet, there may be databases containing data, information and software. In its simplest form, the WWW is a collection of all these databases and thereby a collection of all the data, information and software in these databases, connected via the Internet infrastructure. The WWW is built on the underlying Internet infrastructure. The WWW can be divided into different 'types', for example:

1. The Surface Web, which most people know as the WWW. This part of the WWW is directly accessible and can be reached using search engines like Google, without any login process.
2. The Deep Web, which is not indexed by search engines and a login process is usually required, for example, to access an e-commerce site where payment takes place and an identification is needed.
3. The Dark Web, which can only be accessed using specialised software, which ensures complete privacy of transactions.

☐ Websites

A website can be seen as a 'place' or location in the WWW, which contains data and which can be accessed from any place via the Internet. The data on a website are organised into web pages. Websites can, therefore, be seen as the places on the WWW that a person or a system can access to retrieve information or to add information. Not all data and information in the WWW need to be accessible to everyone, as access control can restrict access to only those authorised to do so.

Search Engines

A search engine is a software that can be used by a user to search through the WWW to find web pages matching a specific 'search criterion' entered by the user. Google may be the most well-known search engine at the moment.

Cyberspace

Again, with the risk of oversimplifying, cyberspace can be seen as a combination of the Internet and the WWW. This means that cyberspace is present wherever computing devices are interconnected. This interconnectedness is probably the main characteristic of cyberspace.

Governance of cyberspace

There is no central control or governance over cyberspace, and no single body can decide on its own as to how cyberspace should be managed. Cyberspace governance is an issue which is causing a lot of disagreement between nations, but the emphasis seems to be on open and free cyberspace for all.

Social networks are cyberspace platforms that allow users to share information, photos and much more. One of the biggest such social networks is Facebook, which supposedly has more than 2 billion users. Users store large amounts of personal information on these platforms, expecting the platform to protect the privacy of their data.

Critical infrastructures are environments that are critical to the functioning of a country or business, for example, bridges, roads and airports, but also systems responsible for electricity and water supply. When such environments are controlled using computers, networks and cyberspace, they are referred to as *critical information infrastructures.*

With this background, a few important characteristics of cyberspace are investigated.

Some characteristics of cyberspace – Size and interconnectivity

There are many important aspects of cyberspace that can be emphasised, but this section will concentrate on only two of those, namely Aspect 1: The size of cyberspace in terms of the data and information stored in cyberspace and Aspect 2: The interconnectivity of cyberspace.

The coexistence of these two aspects makes cyberspace immensely valuable in terms of its practical use, but it is also precisely these two aspects of cyberspace that pose a massive risk for mankind. These two aspects and its coexistence will now be briefly discussed.

Aspect 1: The size of cyberspace in terms of the data and information

According to estimates, there were at least 4.66 billion web pages online as of mid-March 2016 (Pappas 2016). This estimation, however, only covers the Surface Web. It is estimated that the Surface Web makes up only 4% of the whole WWW. The Deep Web makes up the remaining 96% (Deepwebadmin 2016).

Combining the Surface Web and the Deep Web, and accepting that most web sites potentially provide access to databases that can each potentially contain millions of data records, the total amount of data stored in cyberspace is staggering and most probably impossible to determine.

Aspect 2: The interconnectivity of cyberspace

This aspect allows users to access information on anything or anyone without having any idea as to the location of the relevant person or data. This, therefore, allows for the sending of an email to a recipient without the faintest idea on the location of the recipient. The interconnectedness of cyberspace can also allow users to access information on other users or stored data without revealing their identity, that is, the identity of a sender can be made anonymous so that the receiver does not necessarily know who sent the message, or from which part of the world the message originated.

The coexistence of aspects 1 and 2 – A potentially deadly cocktail

The immense size of the cyberspace, coupled with its interconnectedness, can be misused to perform unauthorised and unacceptable actions which can have far-reaching, harmful and unexpected consequences in all areas of human existence. This aspect is reflected in the title of this chapter – 'Can cyberspace potentially harm democracy and world stability?'

Having provided some background information, the rest of this chapter will concentrate on examples of how disturbing situations can arise, eventually figuring out that the answer to the title of the chapter is a resounding 'Yes'.

The examples will address the following areas:

- social networks
- fake news and data misuse
- hacking of personal, corporate and government data
- intellectual property (IP) and university research
- education
- cyber warfare and cyber espionage
- terrorist activities
- economic cybercrime
- biometrics and personal privacy
- the Internet of Things.

Social networks

Among the applications in cyberspace which have taken the world by storm are the so-called social networks. The basic purpose of a social network is to let people communicate with each other and share information of all sorts. Different social networks offer different services, such as exchanging messages and photos, writing online blogs, providing online chat rooms and much more. The growth and use of social networks worldwide progressed at a frantic pace. Of the different social platforms, Facebook is the most coveted, with more than 2 billion registered users, of whom about a billion are online in cyberspace on a daily basis. The interconnectivity of cyberspace makes this communication and sharing possible.

These social networks of all forms and types slurp up user data and information at alarming rates. Social networks not only collect the data supplied by users directly but also buy user data from data brokers and many other available places. In this way, social networks create extensive profiles of users to such an extent that they correlate data to make assumptions about the user's behaviour, preferences and actions. In many cases, these user profiles are again sold to companies and advertisers to target their advertisements based on such user profiles. It can be concluded that a social network like Facebook often has a more complete profile and view of a user than the user will ever imagine.

Because of this knowledge and insight into users' personal data, preferences and potential choices, social networks can be misused in many ways creating large risks. Firstly, users' data can be misused by the social network itself in many unauthorised ways, and secondly, the network's databases containing this private data can be hacked and used in other unauthorised ways. In March 2018, news headlines were dominated by the Cambridge Analytica/Facebook matter (Cadwalladr 2018), where it was claimed that data from 87 million Facebook clients were acquired by the company Cambridge Analytica and eventually manipulated to influence the US national election of 2016. Reuters (2018a) reported that:

> The suspended chief executive of Cambridge Analytica said in a secretly recorded video [...] that his UK-based political consultancy's online campaign played a decisive role in U.S. President Donald Trump's 2016 election victory. (n.p.)

Claims are also surfacing that the same players, using the same techniques, were involved in the British referendum to leave the EU (known as BREXIT) and even in the Kenyan elections (2017), potentially influencing the outcome of these events. It is also claimed that Russia had been involved in some way, as Cambridge Analytica apparently had discussions with Russian agents too.

For the American elections (2016), the modus operandi was to study the acquired Facebook profiles of potential US voters. Using sophisticated computer algorithms, implementing aspects of AI and machine learning, it was possible to create some sort of psychometric profiles of such voters. Based on these profiles, these voters were then targeted with focussed advertisements and fake news stories to influence their voting decisions. Many aspects of the cyberspace environment were involved in this case example. Firstly, there were billions of private and confidential user (voter) data records that were stored in cyberspace by Facebook. As stated, 87 million of these records were compromised and misused. Secondly, after the necessary profiles of potential voters were created, fake news and targeted advertisements were sent via cyberspace to influence these users. Therefore, the masses of users' data stored in social networks, together with advanced programming techniques, were combined with fake news and targeted marketing, which formed a toxic mix.

Using the same ingredients, similar toxic mixes can be constructed to influence many other situations and eventually become a threat to the core of democracy. Of course, such actions directly challenge the morality and ethical actions of such social networks. In the so-called Arab Spring a few years ago, many of the big protests were organised and coordinated using social networks. Looking back at these events, Hempel (2016) mentions how:

> Five years ago this week, massive protests toppled Egyptian President Hosni Mubarak, marking the height of the Arab Spring. Empowered by access to social media sites like Twitter, YouTube and Facebook, protesters organized across the Middle East, starting

> in December 2010 in Tunisia, and gathered together to speak out against oppression, inspiring hope for a better, more democratic future. (n.p.)

The fear that social media is creating dangerous risks to world stability is growing internationally. 'While social media provides myriad benefits, the advances in connectivity [...] may come at the expense of the state and the world's stability' (Wharton 2014). Facebook itself has acknowledged that the widespread use of social media 'can be harmful to democracy' (AFP 2018).

As mentioned above, fake news is a problem growing at an alarming rate. The interconnectedness of cyberspace provides a perfect environment for spreading fake news. This aspect will now be investigated.

Fake news and data misuse

The discussion above already gave an idea of the risk and impact of fake news and data misuse. This is emphasised by the following quote (Waterson 2018):

> Democracy at risk due to fake news and data misuse. Democracy is at risk unless the government and regulators take urgent action to combat a growing crisis of data manipulation, disinformation and so-called fake news. (p. 1)

The BBC states 'Fake news: Too important to ignore' (Rajan 2017). The risk is not necessarily in the fake news itself – fake news had been around probably since the beginning of time. The risk and problem lies in the speed with which such fake news can be spread via social networks. Large numbers of people have 50 million or more followers on some social networks, meaning that one statement made by such person instantly reaches millions and millions of people. Even worse, such a person's account can be hacked and his or her digital identity stolen by a cybercriminal. This criminal can now reach the millions of followers of the original owner with one message, potentially spreading fake news at an alarming rate.

A study by MIT has shown that fake news spread up to six times faster that true news. This should be a matter of serious concern to all involved with peace, democracy and true values because the negative consequences of fake news can potentially impact on world events and undermine democracy (Coldewey 2018; Ghosh 2018). Fake news can have a serious negative impact on world events – it can even precipitate such negative events. This is facilitated by the interconnectedness of cyberspace.

The masses of all types of data and information stored in cyberspace create massive risks related to the unauthorised access and hacking of such information and data. Some of these matters will be addressed in the 'Hacking of personal, corporate and government data' section.

Hacking of personal, corporate and government data

Never in the history of mankind have a few big private companies accumulated and controlled so much information and data as they do today through cyberspace. Such companies are information keepers and have become so rich and powerful that their financial muscle alone is more than that of many countries. Such accumulated data and information belong to individuals, corporates and governments. These masses of information and data do have the potential to be seriously misused – not only by the information keepers themselves but also by cybercriminals who hack into these vast pools of data and information. If these masses of data and information are compromised on a large scale and a consistent basis, it can seriously impact peace, democracy and human rights and lead to a less stable world.

Such compromised information do happen, and data hacks are basically not news anymore – every week brings its own list of data hacks of personal, corporate and government data. It was reported that in 2016, more than 4 billion data records were leaked (Weisbaum 2017). In October 2018, Facebook reported the biggest leak in its history – more than 50 million records with personal details of its users were leaked (Heaven 2018).

Many people, including the author of this chapter, are of the opinion that the concept of privacy of data, and specifically personal data, is something that does not exist anymore. It is not possible to secure cyberspace, and therefore, data stored in cyberspace will just become more vulnerable. This situation will only get worse with the growth of the Internet of Things (Sungard 2018).

One serious concern is that computer systems are getting bigger and more complex, and this could lead to more compromises. The codebase of many such systems is now becoming so vast that it is impossible to properly test the code, and making changes is a very risky venture. According to statistics, the code base of Facebook comprises 60 million lines of code. Humanly, it is impossible to ensure correctness and integrity in such a complex system. The risk of data and information being compromised will just grow in the future.

Traditionally, access to sensitive information and data had been managed and controlled by simple passwords which had in time become much more unsafe than in the initial years of the Internet. Better techniques to manage access to such data had been developed over time. One of the leading techniques presently is biometrics, which leverages the unique characteristics of a person, like a fingerprint, to control access.

Biometrics and personal privacy

Biometrics is the discipline of using a person's unique characteristics to identify them. The best-known example is the use of fingerprints to identify people – mostly in criminal cases. Other well-known forms of biometrics include facial and voice recognition. Biometric information is collected from many points – surveillance cameras in cities and fingerprint access to buildings and housing complexes is the norm these days.

Such surveillance cameras can track a person's movement around a city or other locations, and all the data are captured and stored in cyberspace.

Computer algorithms have now become so powerful that newly developed equipment can scan a crowd and recognise a specific person based on a facial copy of that specific person taken previously (Wang 2018). Facebook has facial recognition facilities that can recognise a person in a group photo, and even add the person's name to the photo without the knowledge or consent of the owner of the photo. Banks are moving towards using fingerprints at Automatic Teller Machines (ATMs) to try to prevent fraud, and some new smartphones use facial recognition for sign-in purposes.

In this way, masses of personal biometric data of people are captured and stored. Such data can, of course, be retrieved and used again by governments for whatever reason, but these databases can also be hacked, and these personal data can be used for criminal purposes. The big risk with biometrics is that if a password is compromised, it can be changed. However, if a person's fingerprint or facial parameters or any other biometric characteristic is compromised, it cannot be replaced or changed – a person has only one left thumb, and when compromised, the person has lost a piece of his identity which cannot be changed.

The privacy of people is, therefore, constantly challenged by these masses of personal biometric data. The growing mass of personal biometric data in cyberspace is of serious concern, as it can be grossly misused if not well protected, which is in principle not possible. This creates serious risks, specifically to democracy.

The previous two sections, namely, 'Hacking of personal, corporate and government data' and 'Biometrics and personal privacy' investigated the compromise of data and information from a more general viewpoint. The next section, 'Intellectual property and university research' will specifically concentrate on the compromise of IP and University research data.

Intellectual property and university research

Any research, whether it is in the private or public domain, costs money, and results should be closely protected for many reasons, including for competitive reasons, potential financial benefits, national security and much more. The same holds for research results, which has moved to the design and testing phase, be it a new drug, a new weapon system, a new form of electronic communication or some new invention, resulting in valuable IP.

Cybercriminals are also very aware of the strategic and financial value of such IP and as outputs are in electronic form in computer databases, such IP becomes a target in cyberspace. Companies and countries can employ hackers to compromise systems and steal the IP, using among others, the approach of cyber espionage. This aspect is discussed in more detail later (Gelinne et al. 2017; Kraus 2018:1):

> While hacks targeting credit card information, consumer health information and other personal information still attract the most media attention, Intellectual Property (IP) theft is emerging as another risk weighing heavily on corporate decision makers.
>
> It's a business leader's nightmare – the stomach-churning realization that a corporate network breach has occurred, and that valuable intellectual assets are now in unknown hands. Because the information exists in the form of data rather than, say, manila folders in file cabinets, a breach might remain undiscovered for weeks or months. (p. 1)

Recently, there was an increase in cyberattacks on university networks in an attempt to access research results of staff of a specific university. Universities are internationally warned to take special cyber protection measures to ensure such results are not stolen (Hamilton 2017). The theft of all forms of IP can seriously impact democracy and world stability.

Cybercrime is presently seen as one of the most lucrative ways of illegally making money. It is an immensely lucrative way of stealing money, and some recent examples will be discussed in the 'Economic cybercrime' section.

Economic cybercrime

In an oversimplified form, cybercrime can be seen as any form of unauthorised action performed using cyberspace. This, therefore, includes crimes like hacking into databases and stealing money and information and misusing the information for unauthorised purposes. Two examples are used to show how money can either be directly stolen from a large corporation, or customer data can be stolen which can then be sold to be misused for financial gain.

The direct theft of US$ 81 million from a bank in Bangladesh

In this case, the cybercriminals hacked the bank's systems directly and got away with US$ 81 million (Zetter 2016):

> [*T*]he hacks in this case targeted the banks themselves and focused on subverting their SWIFT accounts, the international money transfer system that banks use to move billions of dollars daily between themselves. (n.p.)

This is just one example of cases where millions, even billions, of dollars are stolen from financial institutions and clients, resulting in big losses for the relevant stakeholders.

The Target hack

According to Reuters (2018b):

> In one of the biggest data breaches to hit a U.S. retailer, Target had reported that hackers stole data from up to 40 million credit and debit cards of shoppers who had visited its stores during the 2013 holiday season. (n.p.)

Many of the stolen data were offered for sale by cybercriminals, and customers lost large amounts of money. Severe governance problems arose for the management of the company, and some were fired while others resigned. Investors are taking legal action against the company in the form of class actions, which are legal approaches involving all the complainants together in one legal case.

Using cyberspace to steal money directly from companies or from individuals is becoming the norm. Presently, all international trading is done via cyberspace, and huge amounts of money are daily flowing via networks. This is a perfect scenario for cybercriminals to loot. Economic cybercrime is growing into a serious risk, which can impact negatively on world stability.

So far, the discussion was mainly focussed on information, data and unauthorised access and compromise of such information and data. Cyberspace, however, has a much more direct influence on humanity, specifically on school learners, as indicated in the 'Education' section.

■ Education

A growing body of research results indicates that the exposure of school learners to cyberspace is impacting on their development in many ways. Exposure only to mobile phones, tablets and more such devices has a negative impact on their intellectual and physical development. Furthermore, addiction to social networks causes depression and social and emotional problems (The Fix 2018). Also, there are medical reviews stating that the mental development of children is negatively impacted by too much 'screen time' – the term used for looking at the screens of mobile phones, tablets, watching TV and even screens involved in teaching. A recent article discusses 'How too much screen time affects kids' bodies and brains' (Walton 2018).

A book by two veteran school teachers documents their experience on how unrestricted use of phones, tablets, computers and TVs has impacted the intelligence of learners. 'Veteran teachers Joe Clement and Matt Miles have seen first-hand how damaging technology overuse and misuse has been to our kids' (Clement & Miles 2018).

Furthermore, school learners, pre-teens and teenagers are most often not mature enough to realise the risks of cyberspace and fall victims to cyberbullying, cyberstalking and exchanging explicit photos. These types of research are extremely worrying, as it will take at least 5 or 10 years to gauge the real impact of the overuse and overexposure to these screens. Unrestricted and uncontrolled screen exposure can impact a whole generation of learners and eventually have a serious impact on democracy and world stability.

The sections above mostly concentrated on aspects related to data and information of many sorts. The section on 'Cyberwarfare, cyber espionage and terrorist activities' investigates some extremely serious potential risks to democracy and world stability.

Cyberwarfare, cyber espionage and terrorist activities

In December 2015, someone sabotaged the electricity supply of a number of power stations in Ukraine (Bezhan 2016), resulting in hundreds of thousands of homes, including hospitals, being without electricity, causing a national crisis. Precisely who the attacker was is still unclear, but the attack was executed by planting malicious software (it is software which performs unauthorised actions) in the computer systems of the power stations, causing the systems to switch off or misbehave. Many commentators described this as a 'doomsday' scenario providing a good example of where full-scale cyber warfare can eventually go (Georgetown 2018):

> [*T*]he most disruptive and potentially destructive types of cyberattacks (are) those that target critical national infrastructure (power grids, air traffic control systems, banking networks, etc.), which may qualify as armed attacks or acts of war under international law. Such acts are characterized as cyber warfare when perpetrated by state actors, and cyber terrorism when perpetrated by non-state actors. (n.p.)

Cyberwarfare during times of war is, therefore, a fact and can be expected. The ‘doomsday’ scenario is, however, the case where such cyberattacks are perpetrated in peacetime. ‘Cyberattacks should normally be expected during times of war. Of far more concern though is the emerging norm in favour of conducting cyberattacks during peacetime’ (Hanson 2015; Osawa 2013).

The reality is that such cyberattacks need not necessarily be perpetrated by state actors alone; they can also be orchestrated by non-state actors like terrorist groups, criminal syndicates and more. This increases the concept of a cyberwar between state actors to a much more complex situation – in most cases, it is extremely difficult to determine who such non-state actors are, and how to prove their involvement.

Again, this situation is a direct consequence of the fact that most, if not all, data and information, stored electronically, can potentially be accessed (hacked) because of the interconnectedness of cyberspace.

According to Paganini (2017):

> Cyber espionage [*and*] Cyber spying is now becoming more sophisticated and widespread both on the international and domestic stages. Cyber [*criminals*] can attack you from any place in the world at any time if you don’t secure your computer properly. (n.p.)

Software for such spying is freely available, and some can even be installed on a modern smartphone. This can result in a victim being constantly tracked and spied on without the victim having the faintest idea as to what is happening.

An interesting review of the 10 biggest cyber-espionage cases that affected companies, governments and even nations is reported by Paganini (2017). One of the complaints raised at the WEF referred to above was the use of cyberspace and specifically social networks for terrorist activities. As Yunos and Hafidz (n.d.) point out:

> Terrorist groups may use [*the*] Internet as the medium for hostile activities such as hacking, spreading negative propaganda and

> promoting extreme activities. They may also use the Internet for the purpose of intergroup communication and inter-networked grouping. (n.p.)

It is not only the visible social networks that are misused, but many activities take place on the Dark Web, which is basically anonymous and not easily accessible (Townsend 2018):

> Terrorists and extremists are creating growing numbers of safe havens on the 'dark net' to plot future attacks, raise funds and recruit new followers, new research reveals.
>
> Terrorist organisations and individuals are evading security services and intelligence agencies by 'hiding in the shadows' of the darknet, using encrypted messaging services, to communicate, and anonymous crypto currencies such as bitcoin to generate funds. (n.p.)

If ever there was a toxic cyberspace mix that can seriously impact world stability and democracy, then it must be the risk of using cyberspace for cyberwarfare, cyber espionage and cyberterrorism. This may be one of the main reasons why Sir Tim Berners-Lee, the creator of the WWW, stated that 'I created a monster [...]' (Bridge 2018). Cyberwarfare, cyber espionage and terrorist activities may presently be the biggest risk to world stability and democracy coming from cyberspace.

The last aspect to be discussed in this chapter is the concept of the Internet of Things. If not well controlled, this may result in even more serious risks.

The Internet of Things

As mentioned above, interconnectivity is one of the main characteristics of cyberspace. This characteristic had led to the development of sensors of all sorts which are capable of collecting all sorts of data and which can be connected to cyberspace. Such sensors are built into devices, cars and even people. These 'extra dimension' of the Internet, and therefore, cyberspace, is referred to as the Internet of Things. Estimates are that by 2025 there may be up to 75 billion such sensors connected to the Internet. These sensors will collect data and transfer the data via cyberspace to the backend databases. Many of these sensors will collect personal data, for example, medical and fitness-related sensors. Pacemakers can be connected to cyberspace so that the patient's doctor can monitor the heart activities. Already in 2013, the doctors of ex-US Vice President Dick Cheney disconnected his pacemaker from cyberspace to prevent a possible assassination attempt (Vaas, 2013 p1).

Insulin pumps can be life-saving but can also be hacked. 'Attackers exploit flaws in insulin pump systems to deliver dangerous insulin doses' (Constantin 2016). Fitness devices collect data on fitness levels, heart rates and many more. As we have seen above, any data sent in cyberspace can be hacked, meaning that such data can be compromised and misused. The Internet of Things has many benefits, but just as many risks to personal privacy and world stability. This chapter is concluded with a brief evaluation of the moral issues resulting from the discussions in previous sections.

■ Moral issues resulting from the discussion above

In evaluating all the areas discussed above, and there are many more which had not been covered, it is realistic to come to the conclusion that cyberspace can (and is doing so already) cause serious harm to democracy, world stability and the human race in general. The discussions above have not even taken into account the massive influences of AI and machine learning.

The author of this chapter is of the opinion that many of the cyberspace-based systems developed today are morally unacceptable and very close to the abyss that such systems should not be developed at all. Cyberspace, and specifically the misuse of cyberspace, is turning into a monster which, if not managed and regulated strictly, can seriously harm mankind. Maybe, Tim Berners-Lee, inventor of the WWW, is absolutely correct when he states, ‘I created a monster’ (Bridge 2018).

Based on the discussions in this chapter, and also from the author’s viewpoint, the answer to the title of the chapter, ‘Can cyberspace potentially harm democracy and world stability?’ is an unequivocal ‘YES’!

Chapter 10

Science, morality and the media: Complicity in spreading pseudoscience, or watchdog of the public?

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Introduction

The role of the media in society has been extensively studied over the past century. As part of the *Four Theories of the Press*, Siebert, Peterson and Schramm (1956) formulated the social responsibility concept of the media. The social responsibility paradigm, as Nordenstreng (1997, [*author's added emphasis*])

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calls it, was first proposed by the Hutchins Commission, as follows:

> [*T*]hat freedom of expression was not an inalienable natural right but an earned *moral right, with obligations beyond self-interest* [...] Thus news becomes an agent of community formation, the goal of reporting being active citizenship, instead of abundant information. (p. 108)

The Hutchins Commission, set up in 1942, was officially known as the Commission of the Freedom of the Press, and its fifth recommendation was that 'agencies of mass communication accept the responsibility of common carriers of information and discussion' and this 'became the basis of the concept of social responsibility' (Rantanen 2017:3465). Rantanen (2017:3465) observes that the commission 'indirectly introduces here, in the form of social responsibility theory, the role of the press as a kind of a public sphere'.

The concept of the media as a 'public sphere' was first introduced by Habermas in 1961 as a (Gastrow 2014):

> [*N*]otional space for debate that could be contested by public institutions as well as by individuals in their capacity as citizens exercising their abilities for deliberation and contestation over public matters media as a public. (p. 16)

As Habermas (1989) formulates it:

> The bourgeois public sphere may be conceived above all as the sphere of private people come together as a public; they soon claimed the public sphere regulated from above against the public authorities themselves, to engage them in a debate over the general rules governing relations in the basically privatized but publicly relevant sphere of commodity exchange and social labour. (p. 305)

In this public sphere, the media's social responsibility is to report news according to a set of ethical guidelines that are fairly standard in countries where freedom of expression and the media's important role in democracy is recognised. This chapter will use the Code of Ethics of Africa's largest media company, Naspers, and its subsidiary Media24, as well as that of the South African Press Council as a means of measuring the way the media report on science – and subsequently, the concomitant moral responsibility reflected in the reporting.

Media24's Code of Ethics rests on four pillars, namely, to report the news as accurately, truthfully and fairly as possible; to minimise harm; to act independently; and to be accountable (Claassen 2017). The South African Press Council's Code of Ethics is grounded on the same ethical principles, and the first article emphasises this broadly, '[t]he media shall take care to report news truthfully, accurately and fairly' (South African Press Council 2018).

Moral responsibility and journalists' reporting

What are the moral responsibilities of the media in reporting the news accurately, fairly, independently and, thus, being accountable to their readers, listeners and viewers? Furthermore, what moral responsibility do journalists have regarding science news and the overwhelming presence of pseudoscientific thinking and quackery, as often reflected in news reports and advertising?

These questions must be seen in the context of Bucchi's identification of the relationship between scientists and journalists. Scientists have what Bucchi (2004:108–109) identifies as an attitude or position (on the part of scientists towards journalists) as the 'diffusionist' conception (Claassen 2011):

> [/]ndubitably simplistic and idealized, which holds that scientific facts need only be transported from a specialist context to a popular one [...] On the one hand, it legitimates the social and professional role of the 'mediators' – popularizers, and scientific journalists in particular – who undoubtedly comprise the most visible and the most closely studied component of the mediation. On the other hand, it authorizes scientists to proclaim themselves extraneous to the process of public communication so that they may be free to criticize errors and excesses – especially in terms of distortion and sensationalism. There has thus arisen a view of the media as a 'dirty mirror' held up to science, an opaque lens unable adequately to reflect and filter scientific facts. (pp. 362–363)

When it comes to morality and science journalism, as well as journalism in general, applying ethics is not only to make a choice between right and wrong, but 'developing a range of acceptable actions and choosing from among them' (Black, Steele & Barney 1999:51). In one of the sections below, ethical essentials science journalists need to apply when reporting on science are set out.

This chapter will investigate and scrutinise the moral responsibility of journalists and the media to expose quackery and dubious pseudoscientific practices in society, what Pigliucci (2010) calls 'nonsense on stilts'. It will also address the question of whether there is (Claassen 2011):

> [*A*] correlation between what Pouris (1991:358–359) found about South African adults' ignorance about the scientific validity of astrology (32% believed 'astrology is very scientific'), and the fact that nearly every daily and weekend newspaper and many popular magazines in the country regularly publish an astrology column. (p. 363)

The chapter will also look at the morality of publishing or broadcasting quackery and inaccurate scientific information and pseudoscience in the South African media and the effect it might have on the public understanding of science.

Pigliucci (2010) quotes the 19th-century British scientist Thomas Henry Huxley on the moral duty of everyone in society to make a distinction between science and non-science:

> The foundation of morality is to [...] give up pretending to believe that for which there is no evidence, and repeating unintelligible propositions about this beyond the possibilities of knowledge. (p. 1)

Pigliucci (2010:1) emphasises the dangers inherent in accepting pseudoscience, that to accept 'pseudoscientific untruths or conversely rejecting scientific truths, has consequences for us all, psychological, financial, and in terms of quality of life. Indeed [...] pseudoscience can literally kill people'.

Pigliucci and Boudry (2013) point out the difficulty in distinguishing science from pseudoscience or non-science, the so-called demarcation problem, contesting Laudan's (1983) view of the demise of the demarcation problem. As quacks and pseudoscientists are master mimics at dressing their pseudoscientific claims in a scientific cloak, fooling and confusing the public, it remains an ever-growing challenge for laypeople to make sense of the validity of claims.

This paradox between the 'coexistence of progress in human knowledge with the persistence of certain ideas that are either false or questionable' (Bronner 2011:2) is part of the challenge journalists regularly face reporting on science.

Another illustration of the intermixed world – although most of the time because of a lack of knowledge about the scientific methods and evidence-based science among the public – of science and pseudoscience, Ruse (2013) analyses the Gaia Hypothesis and why it was so strongly rejected by scientists, mostly evolutionary biologists, but widely accepted by members of the public.

As Retief (2002:4) points out, media ethics is not 'an exercise for the elite. In fact, *everything* that a journalist does has ethical dimensions, to a lesser or greater degree'. This also applies to reporting on science. Retief's (2004, [*emphasis in original*]) words have even more salience when it comes to the public's understanding of science, especially health and climate science:

> [*E*]verything a journalist writes or says, or neglects to write or to say, in some or other way has an *influence* on people. And influences can be good or bad. (p. 4)

Fairness and balance in journalism – And the need for evidence

A standard and required aspect of the ethical codes of conduct of media organisations is the question of fairness and balance in reporting. In legal and ethical terms, the *audi alteram partem* (or *audiatur et altera pars*) principle is a *sine qua non* to ensure fair journalism, that not only one side is reported on, but as far as possible, the other side also. Thus, the concept of 'let the other side be heard'. The South African Press Council's (2018) code states in Section 1:

> [*T*]he media shall take care to report news truthfully, accurately and fairly; present news in context and in a balanced manner, without any intentional or negligent departure from the facts whether by distortion, exaggeration or misrepresentation, material omissions, or summarization. (n.p.)

More will be said why this moral principle should be applied differently in science journalism than in other fields of journalism.

A number of essentials: What every science journalist should know about science

Understanding the difference between textbook science and frontier science

Bauer (1992:37) makes the distinction between textbook science and frontier science. '*Textbook science* is the settled scientific knowledge on which (in Natural Sciences) one can build one's own work' (Dube 2013:305) (e.g. Einstein's Theories of General and Special Relativity, Darwin's Theory of Evolution, Mendel's Laws of Heredity, Clausius' Second Law of Thermodynamics, the theory that HIV leads to AIDS).

In contrast, '*frontier science* is science as it is actually being conducted. Its results have just been obtained, [and these results] are uncertain and [often] unconfirmed' (Claassen in Le Roux 2013:34) (e.g. trying to get vaccines and cures for HIV/AIDS, Ebola, Alzheimer's, Parkinson's, genetic diseases, discovery of fossils, new planets, supernovae, weather patterns).

The media mostly are not interested in reporting on textbook science (mainly because it is not news anymore) but rather concentrate on frontier science with its new developments, often using a term like 'breakthrough' indiscriminately without taking into consideration that scientists themselves usually try to avoid the hype around research findings.

Furthermore, a former director of the European Initiative for Communicators of Science (EICOS) at the Max Planck Institute, Bernhardt Adelmann-Grill, and his colleagues (Adelmann-Grill, Waksman & Kreutzberg 1995) set out this difference:

> In textbook science an expert is easily identified. Someone who claims that there is a reasonable probability that an apple may fall from the bottom to the top is immediately known as a non-expert. But if we are interested in the effects of electronic smog it is difficult indeed to know who is an expert and who is not [...] Citizens are not much interested in textbook science but in frontier science [...] Unfortunately, public decision making with respect to new technologies is not about textbook science but always about frontier science. And decisions cannot be postponed until present frontier science has matured into textbook science [...] Scientists are intensely involved in frontier science because their emotions, their careers, their whole life depend on what they are doing. This entices many scientists to sell textbook science when they are actually talking about frontier science. (n.p.)

The question of balance, fairness and evidence

One of the basic tenets of fair and sound journalism is that the *audi alteram partem* rule (let the other side be heard) must always be applied in reporting. That entails that as many sides of an issue should be given and that as far as possible, any report should be balanced and fair towards all parties. The Hutchins Commission referred to earlier investigated the press in the United States and aspects of fairness, slant and sensation in reporting. In its report in 1947, the commission set out five basic services the media should provide (Altschull 1990):

- The media should give an accurate and comprehensive account of the day's news.
- The media must provide a forum for the exchange of comment. That means the media establish a platform where vigorous debate can take place.
- The media should provide a means of projecting group opinions and attitudes to one another.

- The media should utilise a method of presenting and clarifying the goals and values of society.
- The media should set up a way of reaching every member of society. (p. 283)

The *audi alteram partem* principle means journalists should always be fair and apply the rule that the other side must be heard, the so-called balance-principle. This is reflected in the ethical codes of conduct of most media organisations in democratic societies, for example, in the code of the South African Press Council (Sects. 1.1, 1.2 and 1.8).

This moral principle though is not an absolute rule when applied to science reporting. Here, evidence becomes a vital aspect of reporting, where journalists should (Cohn 1989):

> [*B*]orrow from science [*to*] tell the facts, or the probable facts, from the chaff, [*and*] try to judge all possible claims of fact by the same methods and rules of evidence that scientists use to derive some reasonable guidance in scores of unsettled issues. (p. 12)

Oreskes and Conway (2011) elaborate on the paradox Bronner (2011:2) pointed out and referred to above, and how the matter of evidence is often neglected or even ignored by journalists:

> Science has grown more than exponentially since the 1600s, but the basic idea has remained the same: scientific ideas must be supported by evidence, and subject to acceptance or rejected […] The he said/she said framework of modern journalism ignores this reality. We think that if someone disagrees, we should give that someone due consideration. We think it's only fair. What we don't understand is that in many cases, that person has already received due consideration in the halls of science […] Many of the claims of our contrarians had already been vetted in the halls of science and failed to pass the test of peer review. (pp. 269–270)

Journalists often do not understand the scientific method (Blum 2001:ix; Claassen 2011:358; Knudson 2006:viii; Nelkin 1995:31–32; Oreskes & Conway 2011:214) and the principle inherent to trustworthy scientific claims. To get the evidence for studies, scientists follow an elaborate process, a scientific sequence containing the following elements (Verma 2005):

- observations and search for data
- hypothesis to explain observations
- experiments to test hypothesis
- formulation of theory
- experimental confirmation/rejection of theory
- mathematical or empirical confirmation of theory into scientific law
- use of scientific law to predict behaviour of nature. (p. 202)

The American philosopher John Dewey (1920:32) summarised the search for evidence that 'Scientific principles and laws do not lie on the surface of nature. They are hidden, and must be wrested from nature by an active and elaborate technique of enquiry'. Similarly, Rensberger (2002, [*author's added emphasis*]) links the need for evidence to its trustworthiness:

> Science demands evidence, and some forms of evidence are worth more than others are. A scientist's authority should command attention but, in the absence of evidence, not belief [...] Balanced coverage of science does not mean giving equal weight to both sides of an argument. It means *apportioning weight according to the balance of evidence.* (n.p.)

Science reporters have the moral obligation to weigh all the evidence, the veracity of claims made by pseudoscientists and put them on a scale of evidence, for example, the age of the Earth (4.57 billion years) and the universe (13.8 billion years) versus the Young Earth theorists (6000 to 10 000 years old); the theory of evolution versus creationism and intelligent design theory; and Big Bang theory versus Steady State theory. More seriously, claims made by alternative medicine practitioners that their treatment can, for example, heal cancer, or any other disease, should be treated with circumspection by journalists (Warraich 2018):

> While misinformation has been the object of great attention in politics, medical misinformation might have an even greater body count. As is true with fake news in general, medical lies tend to spread further truths on the internet – and they have very real repercussions. (n.p.)

Understanding risks and benefits

Rensberger (2002) emphasises a phenomenon often misunderstood by society and journalists, that nearly:

> [*A*]ll new technologies pose risks along with benefits. Thus 'safe and effective', whether applied to drugs or new devices or processes, are always relative terms. It is irrational to ask whether something is safe or not. Nothing is 100 percent safe. Policy decisions involving science must balance risks and benefits. (n.p.)

Examples are the compulsory inclusion of pamphlets in medicine packaging, warning users about the possible side-effects. This relates to the Swiss scientist, Paracelsus (1493–1541), whose Paracelsus Principle is still widely accepted, '[a]ll substances are poisons; there is none that is not a poison. The right dose differentiates a poison from a remedy', paraphrased by scientist John Timbrell (2005:3), '[t]here are no safe drugs, only safe ways of using them'.

One of the most vehement debates in the public sphere (Habermas 1989) is the often aggressive discussion about the safety of GM foods. Here, journalists are often caught between activists who resist GM organisms and food strongly and who try their best to sway public opinion via the media, and scientists whose voices that there is little evidence that genetic modification of food is dangerous, are drowned (Dawkins 2000; Lore, Imungi & Mubuu 2012; Lukanda 2019; Omeje 2019; Ruse & Castle 2002). For science journalists, the challenge is to weigh the evidence of GM-science and biotechnology and report accordingly.

Again, the moral obligation for journalists is to point out and emphasise to readers that nothing is 100% safe, to give a balanced view of the scientific evidence and possible harm.

Accentuating the positive and ignoring the negative

It is vitally important that journalists and science communicators achieve a balance between the positive results of research findings being announced and the negative aspects, the latter often hidden away in the conclusions or discussions section in peer-reviewed articles. Lieberman (2001) emphasises the moral pitfalls between the positive and negative emphasis of scientific stories:

> Perhaps because so much medical news is manufactured by commercial interests trying to sell a product [...] many stories carry a positive twist. In their haste to report any new medical achievement, many news outlets either ignore the negative or slip it in at the end of a story that already has been framed as a positive report. What's worse, is omitting the negative altogether, even when good scientific evidence shows that a treatment is not effective. (n.p.)

Lieberman (2005) continues about the moral obligation the news media have as watchdogs over the interests of the public, to report medical research correctly, as the:

> [*P*]ress too often is caught up in the same drug-industry marketing web that also ensnares doctors, academic researchers, even the FDA, leaving the public without a reliable watchdog [...] today a drug can move almost instantaneously from medical research to miracle cure through news media that too often seem more interested in hype and hope than in critically appraising new drugs on behalf of the public. The problem has grown dramatically in recent years as direct-to-consumer advertising has increased, delivering ever-higher ad revenues to the nation's media. (n.p.)

Regarding how the internet has changed science journalism, Trench (2007:137) emphasises that the 'job of the journalist is simplification without distortion, and therein lies the specific expertise of the science journalist'.

Anecdotes are not reliable data

In advertising, personal stories by patients or sufferers of illnesses are often applied with anecdotes and quotes, ignoring that a test, treatment or technology cannot scientifically be applied to everyone. Any anecdote testifying to the value a treatment or technology may hold must also be balanced with the opposite testimony of one in which it is pointed out that the treatment or technology was not beneficial. Journalists reporting on science have a moral obligation to point out that anecdotes can be dangerous because they are mostly selective and taken out of context without the negative aspects being emphasised. Levi (2000) warns that:

> Journalists' predilection for anecdotes is not a problem if they use such narrative devices judiciously. Anecdotes breathe life into medical stories, create empathy, and help the audience understand an individual patient's situation. Although single cases may *illustrate* the effects of a treatment, anecdotes should never be portrayed as *evidence* [...] For science journalists who want to be their readers' advocates, it is crucial to be sceptical of anecdotes. (p. 63)

Gina Kolata, a science reporter of *the New York Times,* refers to the emphasis reporters place on anecdotes as the 'tyranny of the anecdote' (Levi 2000:63). The economist Roger Brinner points out that the 'plural of anecdote is not data' (Brinner n.d.), a warning that journalists should always remember.

Always use the primary source first

One of the most iniquitous aspects destroying journalists' credibility regarding science reporting is the fact that many journalists report on science from a secondary source, mostly the news releases by universities and research institutions. The reliance on news releases by journalists often distorts findings, and exaggeration 'in news is strongly associated with exaggeration in press releases' (Sumner et al. 2014). Thus (Sumner et al. 2014):

> [*The*] framing of health related information in the national and international media, and the way in which audiences decode it, has complex and potentially powerful impacts on healthcare utilisation and other health related behaviour in many countries. The media also demonstrably influences the behaviour of scientists and doctors. Such impacts may often be beneficial, but misleading messages can have adverse effects (even if these effects may be difficult to predict and prove because the responses of audiences are complex and multiply determined). This problem is not restricted to rare dramatic cases such as vaccination scares; the cumulative effect of everyday misreporting can confuse and erode public trust in science and medicine, with detrimental consequences. (n.p.)

Journalists and science communicators should always read the peer-reviewed study first, then secondary sources. 'Ignoring the holistic picture and failing to recognize the conclusions and weaknesses of scientific studies' (Sherman 2015:n.p.) is a serious flaw in many newsrooms. Reporters must read the conclusions at the end of a study first. They should be aware of phrases such as 'the preliminary results', or 'further research has to be conducted' or 'the uncertainty of these findings'. They should ask questions about the size of the survey and sample of patients, was it a double-blind study, the risks, the possibility of chance influencing the results and other possible red flags in evidence. As Rensberger (2002) points out, '[n]ews organizations usually invest too much importance in a scientific development and not nearly enough in the broader trends'. Science journalists should look at context given by other studies and use trustworthy science databases such as EurekAlert,[17] Medline,[18] AlphaGalileo,[19] PubMed,[20] SciDev.Net,[21] Africa Science News,[22] Publicize,[23] Science Daily,[24] Nature News[25] and Science in Africa.[26]

Science works with uncertainty

One of the most common characteristics of science is that its results are always open to further scrutiny. Rensberger (2002)

17. See http://www.eurekalert.org.

18. See https://www.nlm.nih.gov/bsd/pmresources.html.

19. See http://www.alphagalileo.org.

20. See http://www.ncbi.nlm.nih.gov/pubmed.

21. See http://www.scidev.net.

22. See http://www.africasciencenews.org.

23. See http://www.publicize.com.

24. See http://www.sciencedaily.com.

25. See http://www.nature.com/news.

26. See http://www.scienceinafrica.com.

emphasises '[u]ncertainty is a sign of honest science and reveals a need for further research before reaching a conclusion. Cutting-edge science is highly uncertain and often flat-out wrong'.

This uncertainty and the way the media tend to ignore it is further underlined by the American physicist Harvey Brooks (cited by Cohn 1989):

> Too much of the science reporting in the press (blurs) what we're sure of and what we're not very sure of and what is inconclusive. The notion of tentativeness tends to drop out of much reporting. (p. 8)

Friedman, Dunwoody and Rogers (1999) also analysed the role of scientific controversies, which often lead to distorted media coverage because journalists fail to recognise the uncertainty of scientific findings. 'Because of the mass media's pervasiveness, how they construct scientific uncertainty can often have significant effects'. Various studies (Collins 1987; Fahnestock 1986; Hornig 1990; Singer & Endreny 1993; Tankard & Ryan 1974; Weiss & Singer 1988) have shown that the media's coverage of science tends to 'transform provisional findings into certain findings' (Stocking 1999:25). Nelkin (1995:31–32) points out that the media often promote scientific findings 'as the cutting edge of history, the frontier that will transform our lives', without journalists highlighting and emphasising the uncertainty of those findings. In a study analysing the public images and perceptions of science between 1910 and 1955, LaFollette (1990) found that scientific findings were reflected in the media as a certainty rather than an uncertainty.

Furthermore, a former editor of the *New England Journal of Medicine,* Arnold Relman, warned reporters (Cohn 1989):

> [*Y*]ou, the reporter, must realize – and must help the public understand – that we are almost always dealing with an element of uncertainty. Most scientific information is of a probable nature, and we are only talking about probabilities, not certainty. What we are concluding is the best we can do, our best opinion at the moment, and things may be updated in the future. (p. 9)

Beware of conflict of interest

Journalists' independence forms an important part of their work ethic and is clearly stipulated in most codes of conduct. The South African Press Council's (2018) code emphasises this in Section 2, stating that the media shall:

> 2.1 not allow commercial, political, personal or other non-professional considerations to influence reporting and avoid conflicts of interest as well as practices that could lead readers to doubt the media's independence and professionalism
> 2.2 not accept any benefit which may influence coverage
> 2.3 indicate clearly when an outside organisation has contributed to the cost of newsgathering
> 2.4 keep editorial material clearly distinct from advertising and sponsored events. (n.p.)

The independence of scientists to conduct any study without a conflict of interest should, therefore, be easily related to by journalists as independence in reporting news is also an important part of the profession's code of conduct. Such a conflict of interest may affect the credibility of scientific findings. Journalists should always ask, who funded the study? Were all the results published, and was the research registered, or maybe even abandoned? If so, why?

Goldacre (2012:321–322) defines a conflict of interest as 'when you have some kind of financial, personal, or ideological involvement that an outsider might reasonably think could affect your reasoning'. Financial interests can have a direct influence and bias on results, for example, as a study by Stelfox et al. (1998) shows:

> [*A*]uthors who supported the use of calcium-channel antagonists were significantly more likely than neutral or critical authors to have financial relationships with manufacturers of calcium-channel antagonists [...] Supportive authors were also more likely than neutral or critical authors to have financial relationships with any pharmaceutical manufacturer, irrespective of the product. (p. 101)

Avoid offering misleading or harmful tips not based on sufficient scientific evidence

Journalists often fail their moral obligation of being accurate in their reporting on science when, because of the nature of news presentation, the news is often summarised by publishing lists of tips on scientific or other subjects. It has the advantage that it simplifies science news by giving short pointers to, for example, health matters. Yet, journalists must ensure that these tips are based on scientific facts, not on pseudoscientific marketing or misinterpretation by not reading the full findings or corpus of research. They should study and research databases such as Eurekalert!, PubMed or other credible websites given above to scrutinise the whole range of research on a topic. Short tips and lists should never be based on a single study and should always mention if there is a controversy about findings and conflicting results.

The difference between science and pseudoscience

Journalists should make sure that they know the difference between science and pseudoscience. The science philosopher Karl Popper (1992) explains the difference between a *scientific* and a *metaphysical theory* in that the former can be refuted or falsified, while it is not possible in the latter. In this way, it is possible to distinguish between *scientific* and *pseudoscientific* claims on the basis of the *testability* thereof. If a claim, for example, intelligent design, cannot be subjected to testing, it is pseudoscience and not science. Because it is not possible to test if there is a creating godhead, such a claim cannot be founded in rational thinking and therefore is unscientific. According to Popper, the expansion of metals when they are heated is a good scientific theory, not because all tests of the theory up until now have proven it to be valid, but because only one observation that metal does not expand when heated will prove the theory false.

The physicist Robert Park (2000, [*author's added emphasis*]) puts it in a different way, stating that two rules determine the success and credibility of science, distinguishing it from pseudoscience and quackery:

- Expose new ideas and results to *independent testing* and *replication* by other scientists
- Abandon or modify accepted facts or theories in the light of more complete or reliable experimental evidence (p. 39).

The British evolutionary scientist Richard Dawkins (1998) shines the light on the overwhelming presence of pseudoscience in society today:

> Astrology books outsell astronomy. Television beats a path to the door of second rate conjurors masquerading as psychics and clairvoyants. Cult leaders mine the millennium and find rich seams of gullibility: Heaven's Gate, Waco, poison gas in the Tokyo underground. (n.p.)

Distinguishing between science and pseudoscience and the way the media report on claims by quacks, charlatans and pseudoscientists should be guided by reporters' ethical codes. These clearly state that news should be reported accurately, truthfully and fairly. Accurate news reporting should never mislead, should not distort the truth of scientific findings and should not propagate alternative claims that are not based on any scientific evidence. Coker (2001:n.p.) makes the distinction between science and pseudoscience in Table 10.1.

■ Conclusion

It is clear from the guidelines and discussion above that the media's ethical codes guiding the daily reporting of news, whether it is about politics, the arts, finance, sport, entertainment and science and technology, make it obligatory for journalists to report news in an ethical, moral way. The scientific methods and procedures leading to credible and evidence-based findings that

TABLE 10.1: Coker's distinction between science and pseudoscience.

Science	**Pseudoscience**
Their findings are expressed primarily through scientific journals that are peer-reviewed and maintain rigorous standards for honesty and accuracy.	The literature is aimed at the general public. There is no review, no standards, no pre-publication verification, no demand for accuracy and precision.
Reproducible results are demanded; experiments must be precisely described so that they can be duplicated exactly or improved upon.	Results cannot be reproduced or verified. Studies, if any, are always so vaguely described that one cannot figure out what was done or how it was done.
Failures are searched for and studied closely because incorrect theories can often make correct predictions by accident, but no correct theory will ever make incorrect predictions.	Failures are ignored, excused, hidden, lied about, discounted, explained away, rationalised, forgotten, avoided at all costs.
As time goes on, more and more is learnt about the physical processes under study.	No physical phenomena or processes are ever found or studied. No progress is made; nothing concrete is learnt.
Convinces by appeal to the evidence, by arguments based upon logical and/or mathematical reasoning, by making the best case the data permit. When new evidence contradicts old ideas, they are abandoned.	Convinces by appeal to faith and belief. Pseudoscience has a strong quasi-religious element: it tries to convert, not to convince. You are to believe in spite of the facts, not because of them. The original idea is never abandoned, whatever the evidence.
Does not advocate or market unproven practices or products.	Generally earns some or all of his living by selling questionable products (such as books, courses and dietary supplements) and/or pseudoscientific services (such as horoscopes, character readings, spirit messages and predictions).

Source: Coker (2001:n.p.)

the public can trust are often circumvented by charlatans, quacks and pseudoscientists who use marketing methods and devious claims not based on peer-reviewed science to sell products and ideas to a gullible public. Quackery in the health field is specifically dangerous and basically immoral, often fraudulent. Journalists, by providing quacks and charlatans a platform, give oxygen and sustain health claims that can endanger the public's lives in four ways (Offit 2013:241–252):

- 'by recommending against conventional therapies that are helpful' (p. 241)
- 'by promoting potentially harmful therapies without adequate warning' (p. 244)

- ‘by draining patients’ bank accounts’ (p. 246)
- ‘by promoting magical thinking, which, sadly, is everywhere you look’ (p. 250).

Furthermore, Singh and Ernst (2008:265–279) point out how the methods of quacks and certain catch-words they use can easily fool smart people, also journalists, to believe fallacies such as the ‘natural’ fallacy, the ‘traditional’ fallacy and the ‘holistic’ fallacy. These quacks are often ‘quick to criticize science’ but are ‘equally keen to use science to it [*sic*] own advantage whenever it is convenient’. Singh and Ernst (2008) show how these therapists rely on flawed arguments and ‘faulty notions to promote themselves’, using fallacies falling into three broad categories:

1. the ‘Scientific explanation’ fallacy (pp. 273–274)
2. the ‘Scientific gadget’ fallacy (pp. 274–275)
3. the ‘Scientific clinical trial’ fallacy (p. 275).

Journalists cannot and should not become complicit in spreading pseudoscience. The ethical journalistic principle of fairness and balance, as pointed out above, often leads to the views of denialists (on topics as wide as evolution, climate change, tobacco smoking, cancer and other health treatments) being touted in the media and treated as scientific controversies. Thus, ‘professional deniers’ get ‘equal status – and equal time and newsprint space’ (Oreskes & Conway 2011:214).

A final word on the moral obligation of the media not to be complicit in spreading pseudoscience comes from Pigliucci (2010):

> If the news media are to play a truly informative role with the public they should present more than just a collection of allegedly equally valid ideas; they should also do the hard work of investigating them, to help the public filter the few golden nuggets from the ocean of nonsense that will otherwise bury any intelligent social discourse. (p. 91)

It is the social responsibility of the media, therefore, to morally act in the interest of the public, to be the watchdog of society guarding against pseudoscience that can mislead and harm.

As Retief (2002:5) emphasises, the media's enormous influence makes it vitally important that 'journalism be practised in an accountable and responsible way'. When journalists neglect their moral duty to act responsibly, the following can happen, and in each case, it has a direct bearing on the way they report on science:

- unnecessary harm is done to people
- the media lose credibility
- this weakens the media's vital role as watchdog
- the well-being of democracy suffers.

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Preface

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This collected work reflects, in a multidimensional fashion, on moral issues that arise in scientific and technological work. It resembles the South African heritage and circumstances of the authors. Let me state unequivocally that this is a very professionally conceived and completed project. That it is multidimensional is a given.

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This scholarly work covers various fields in the natural sciences (neuroscience, genetics, biotechnology, and ecology), technology (artificial intelligence, cyberspace), human sciences (anthropology, archaeology) and media (journalism, advertising and reporting on scientific research). It reflects on ethical matters and challenges presented by these disciplines. The central issue is the scientific question as to the origin of ethics and how it applies in science. Two distinct lines of thought are presented, the one being that morality is biologically innate to humans; the second line of thought is that morality is culturally or religiously transmitted from one generation to the next. This book illustrates how scientists are challenged with ethical considerations in their everyday existence.

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