Human Constitutive Technicity: The Evolutionary Turn in the Philosophy of Technology

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Abstract

In this research, I aim to enquire into the human relation to technology from an evolutionary perspective. To that end, I will elaborate on insights by two major contemporary thinkers, the German philosopher Peter Sloterdijk and the French philosopher Bernard Stiegler. I will argue that both develop a fully-fledged philosophy of technology—although they are usually not recognized as philosophers of technology proper—and I will show the convergence and mutual complementarity of their respective approaches. I will highlight how Sloterdijk's and Stiegler's stances critically diverge from contemporary philosophy of technology—the so-called empirical turn—and corroborate their claims through recourse to insights coming from twentieth-century philosophical anthropology, Science and Technology Studies (STS) and contemporary evolutionary biology, especially the Extended Evolutionary Synthesis (EES). Starting from this conceptual framework, I will submit the idea of human constitutive technicity, i.e., technology belongs to what Jacques Derrida would call the conditions of possibility and impossibility of our lifeform. According to this perspective, human technicity is constitutive, insofar as, first, we could neither survive nor have evolved as we are now without our relation to artefacts. Secondly, technology can also deprive us of our humanity, by altering our lifeform to the point that it could not be considered human anymore or by provoking the actual extinction of the lifeform it has, in turn, contributed to producing. Thirdly, we can develop self-representations, i.e., accounts of what we think it means to be humans, including through scientific practice, only thanks to and based on specific technologies. Fourthly, developments in our technical system may also inhibit our capability to think and, therefore, reflectively think about ourselves. Hence, with this research I set out to underscore the importance of a critical reflection about technology in order to understand the human condition.

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To Bernard Stiegler, in memoriam

PHILOSOPHY OF TECHNOLOGY, PHILOSOPHICAL ANTHROPOLOGY AND EVOLUTIONARY BIOLOGY: TECHNICITY IN SLOTERDIJK AND STIEGLER

1 Preface

Humans have always been tinkering with artefacts. However, nowadays the feeling arises that our relation to technology has entered a critical phase. On the one side, technoscientific development enables us to achieve otherwise seemingly unreachable goals, such as worldwide real-time connection, highly automated machinery replacing biological workforce, studying and exploring outer space. We seem increasingly surrounded by a multitude of instruments, devices and apparatuses mediating and partaking in our daily activities, from taken-for-granted, routine tasks, such as preparing a meal, to exceptional and unforeseen events, such as open-heart surgery, for instance. On the other, advances in the design, employment and regulation of the most recent technologies challenge our self-representation, i.e., what we think it means to be humans, by intruding into the most intimate dimensions of our existence and thereby perturbing its operational and conceptual margins. One could think of artificial intelligence increasingly reproducing human cognitive capabilities, biotechnology implanting artificial components into our bodies or industrial pollution leading to global environmental degradation, just to name a few examples.

Starting from the mid-nineteenth century, these converging circumstances have inspired and promoted the articulation of multifarious philosophies of technology, i.e., the critical reflection on the function, meaning and politics of artefacts, their modes of employment and our conception of them. Nowadays, the philosophy of technology is a well-established research field, fruitfully dialoguing with approaches as different as engineering, artificial intelligence (AI) and applied ethics in order to help us better understand our relation to technical objects. On the one hand, the philosophy of technology seeks to enquire into how concrete technologies influence our existence and how we should handle their usage. On the other, it sets out to investigate what we mean by technology in general and which are its core features.

In this thesis, I aim to contribute to the scholarship in the philosophy of technology and enrich the debate by drawing our attention to two key figures, the German philosopher Peter Sloterdijk and the French philosopher Bernard Stiegler. These two major contemporary thinkers are usually not regarded as philosophers of technology proper. However, as I set out to show throughout this research, both elaborate a fully-fledged philosophy of technology and devote discerning analyses to the study of artefacts. Furthermore, as I will argue in what follows, their respective philosophies of technology exhibit substantial convergence at major points, thereby outlining what I wish to define

as an evolutionarily informed theory of human constitutive technicity. The insights brought about by the critical combination of Sloterdijk's and Stiegler's philosophies will enable me to emphasize how their approach significantly diverges from the mainstream theoretical framework in contemporary philosophy of technology in at least two regards.

First, Sloterdijk and Stiegler advocate for a constitutive role of artefacts in determining our lifeform. According to this viewpoint, humans could not exist without their relation to technology—or possibly more exactly: "technics", a rather obsolete English word translating the German *Technik* and the French *technique*. Moreover, humans could not have evolved as they are now if it were not for the usage, production and transmission of artefacts. Finally, we would not be able to conceive of ourselves as humans, enquire into our origin and make sense of it without the employment of a vast technoscientific apparatus. Thus, our biology, cognition and behaviour are shaped by our relation to all sorts of tools, instruments, devices and machines, ontogenetically as well as phylogenetically, individually as well as collectively. Secondly, Sloterdijk and Stiegler elaborate their theory of human constitutive technicity starting from a reconstruction of human evolutionary origin. They contend that the relationship between humans and artefacts should be investigated starting from the genesis of this relationship, i.e., by enquiring into how technics and the human lifeform coevolve and mutually influence one another.

Hence, the approach I aim to articulate throughout this research, starting from my interpretation of the key insights of Sloterdijk's and Stiegler's philosophies, on the one side, aims to engage in a critical dialogue with contemporary philosophy of technology. I will highlight how this subject area can be enhanced by amending some of its core tenets based on an appreciation of the evolutionary dimension of human constitutive technicity. On the other, this research seeks to set up a fruitful exchange between philosophy and scientific practice, especially evolutionary biology and palaeoanthropology. I will point out how philosophy may benefit from the findings and models coming from evolutionary sciences while concurrently retaining its critical supervision concerning the undue hypostatization of scientific facts as incontrovertible truths.

2 Outline

In the wake of Sloterdijk's and Stiegler's insights, I aim to outline a refined conception of human constitutive technicity from the viewpoint of a genealogical reconstruction of anthropogenesis, that is the process of human evolution. In this Introduction, I will highlight the conceptual landscape starting from which this research originates. First, I will sketch out contemporary philosophy of technology's main features, locate Sloterdijk's and Stiegler's approaches within this debate and underscore how their insights may help us improve the current understanding of human technicity. Secondly, I will turn to philosophical anthropology and Martin Heidegger's philosophy to emphasize

how these philosophical traditions may provide us with a conceptualization of human technicity which is somewhat closer to Sloterdijk's and Stiegler's understandings compared to contemporary philosophy of technology. Concurrently, I will highlight their theoretical limitations and submit that some of their most relevant inconsistencies can be amended by establishing a more proactive relation to scientific practice. Thirdly, I will outline some of the main tenets of contemporary evolutionary biology and point out how recent developments in this field of study may enable us to better understand the role played by technics in human evolution, thereby corroborating Sloterdijk's and Stiegler's insights.

In Chapter 1, I will elaborate on a philosophical conceptualization of technics based on the theory of human constitutive technicity. First, I will differentiate the understanding of technics I aim to submit throughout this research from the traditional conception which regards it as an expression of human sociocultural activities, as opposed to natural processes. Through recourse to the analyses carried out by authors such as Philippe Descola, Bruno Latour and Jason Moore, I will show how the nature-culture/society binary is a historical construct contingent on the modern western episteme (Michel Foucault), i.e., a way of organizing experience rather than a configuration of reality independent of human operations. Secondly, by introducing Yuk Hui's concept of cosmotechnics, I will emphasize how technics contributes to constituting this episteme, thereby submitting a processual understanding of human technical practices as the historical articulation of our worldview and behaviour.

In Chapter 2, I will outline the major concepts of Stiegler's philosophy of technology. First, I will introduce his general organology, i.e., the study of the human lifeform as the intertwinement of biological organs, artefacts and social organizations, highlighting how the relationships between these three elements should be regarded as mutually constitutive. Secondly, I will emphasize Stiegler's understanding of human evolution as the supplementation of biology with technics, which he terms exosomatization, i.e., the progressive de-functionalization and subsequent re-functionalization of biological organs by artificial organs. I will further articulate these claims by introducing Arnold Gehlen's concept of unburdening and, by doing so, I will also criticize some widespread misunderstandings in conceptualizing human evolution. Thirdly, I will discuss Stiegler's pharmacology, i.e., the idea that technics always operates as a both toxic and curative power, inhibiting as well as enhancing our faculties—a conception Stiegler derives from Jacques Derrida's notion of *pharmakon*. Fourthly, I will elaborate on the concept of epiphylogenesis, through which Stiegler aims to conceptualize human evolution as the cumulative intertwinement of genetic, somatic and artefactual memory. By outlining Stiegler's critical appropriation of core ideas by Edmund Husserl, Martin Heidegger and Gilbert Simondon, I will show how he conceives of artefacts as

mnestic supports transgenerationally transmitting experience. To conclude, I will corroborate Stiegler's claims with findings coming from evolutionary anthropology.

In Chapter 3, I will discuss Sloterdijk's understanding of anthropogenesis as a technical process, highlighting how technics has altered the selection pressures yielding our current biology. First, by referring to niche construction theory in evolutionary biology, I will emphasize how organisms actively construct their environment and thereby bequeath altered selection pressures to their offspring, influencing their evolutionary trajectory. Secondly, I will further develop these insights by outlining Sloterdijk's spherology, i.e., his understanding of the human condition as the creation of inner spaces insulating those who produce them from the external environment. Thirdly, I will scrutinize Sloterdijk's idea of human evolution as the outcome of self-domestication, which aims to thematize how anthropogenesis occurs as the supplementation of "natural" selection with the adaptation to a self-constructed, artificial environment. Fourthly, I will discuss his concept of anthropotechnics, i.e., the technical practices humans employ to render themselves suitable for surviving according to their autogenous living conditions. By doing so, I will argue that anthropogenesis occurs as the selection of those traits which better fit in with the norms governing the environment which we have, in turn, contributed to creating.

In Chapter 4, I will focus on the evolutionary emergence of our advanced plasticity, which is required to construct, maintain and transmit the artificial environment yielding anthropogenesis. I will refer to insights coming from psychoanalysis, social anthropology, evolutionary psychology and neuroscience in order to emphasize how human striding bipedalism, immaturity at birth and behavioural plasticity coevolve and mutually constrain one another. First, through recourse to Richard Wrangham's work, I will highlight the evolutionary correlation between bipedalism and the adoption of a cooked food diet. Secondly, by emphasizing the biological, psychological and ontological relevance of human birth, I will show how the emergence and stabilization of bipedalism condition the human birthing process which, in turn, influences our brain development. By referring to Sloterdijk's philosophy of birth, I will highlight that humans are born underdeveloped and immature and, consequently, need to rely on extrauterine gestation, i.e., the reproduction of uterine-like living conditions outside the maternal womb. By introducing the concepts of human neoteny and neuroplasticity, I will underscore how technics plays a pivotal role in enabling and driving this evolutionary trajectory. Fourthly, I will expound on this biotechnical condition as both cause and effect of our advanced proclivity to social learning and cooperation.

In Chapter 5, I will articulate the pharmacology underlying human advanced plasticity. First, through recourse to scholarship in ethology I will emphasize how technical practices in human and nonhuman animals can be differentiated without considering technics as an exclusively human feature. I will thereby scrutinize how Thomas Macho, Jacques Derrida and Giorgio Agamben

understand the anthropological difference, i.e., the risks implied by the attempts to distinguish the human from the nonhuman lifeform. Secondly, I will turn to Stiegler's interpretation of Jacques Derrida's notion of *différance*, thereby showing how Stiegler conceives of technics as the emergence of a new process within life without concurrently opposing "the human" to "the animal" as hypostatized categories. Thirdly, I will underscore how technical practices, which constitute our lifeform, may also dismantle our humanity, disbanding what they have contributed to producing. By referring to insights by Georges Canguilhem and Lambros Malafouris, I will point out that the plastic character of both individuals and their environment must be preserved, for humans to flourish.

In Chapter 6, I will interpret the human immune system as a bio-socio-technical organ(ization). First, I will reconstruct the historical origins of the concept of immunity, discussing the mutual influence of its biomedical, legal and biopolitical occurrences. By referring to scholarship in biology, I will underscore how the immune system should be regarded as an organ mediating the relation of an organism to its environment by discriminating between benign and harmful encounters. Secondly, I will emphasize the relevance of immunity for contemporary philosophy, especially relative to Roberto Esposito's and Jacques Derrida's respective approaches. Thirdly, I will discuss Sloterdijk's general immunology, i.e., his conception of human communities as held together and managed by an extended immune system, which supplements biological processes with technical practices and social performances. This organological understanding of human immunity, in turn, will enable me to highlight the pharmacological character of Sloterdijk's thinking. Specifically, I will focus on how knowledge, especially scientific practice, exhibits a both immune and autoimmune dimension, insofar as it not only helps us make sense of the world but also jeopardizes our self-representation by debunking the illusory, reassuring character of our current beliefs.

In Chapter 7, I will discuss how technics constitutes not only our conditions of existence but also our conditions of thinkability. On the one hand, our capability to account for our origin may only emerge thanks to our relation to artefacts. On the other, this reconstruction changes based on the available instruments. First, I will discuss Stiegler's concept of mnemotechnics, i.e., artefacts produced to thematically store memory, and amend it by introducing the notion of cultural techniques, i.e., technologies enabling us to perform their self-representation. I will submit that we may evolve the capability to represent ourselves as humans and thereby recognize ourselves in our ancestors thanks to these artefacts. Secondly, I will outline the main features of genealogy, that is the methodology of analysis underlying this research, and emphasize how it is adopted by both Sloterdijk and Stiegler in order to enquire into our evolutionary origin. Thirdly, through recourse to research in the philosophy of science, Science and Technology Studies (STS) and postphenomenology, I will underscore how scientific phenomena also manifest themselves through perspectival biases, as highlighted by genealogy, and how technics plays a pivotal role in their manifestation, both enabling

and constraining it. Thus, in my research I aim to adopt a scientific pluralism, where scientific knowledge is regarded as composed of different "sciences", each endowed with peculiar, historical and sometimes competing methodologies and frames of reference, rather than as a single "Science" pretending to provide us with an all-encompassing, holistic and ultimate knowledge about the world. From this perspective, the philosophical scrutiny of scientific findings and theories should help us appreciate and contextualize the truth value of each scientific approach without hypostatizing it as an incontrovertible given.

3 Origins of the Philosophy of Technology

The philosophy of technology is a prominent and growing subfield in the philosophical world. However, the reflection on the function, meaning and politics of artefacts is somehow underrepresented in the history of western thought. While already Plato and Aristotle dealt with *tékhnē*, mostly conceived of as a way of knowing and doing (Chappell, 2012), the philosophy of technology as an autonomous discipline only emerged starting from the nineteenth century. The increasing pervasiveness of technological development brought about by the second industrial revolution fostered the interest in "technology" as the study, classification and formalization of the individual technologies and their related modes of construction and employment. This condition enabled, in turn, the establishment of "philosophy of technology" as a critical reflection on the relationship between humans and their artefacts, as exemplified by German philosopher Ernst Kapp's seminal book *Elements of a Philosophy of Technology* (1877, 2018).[1]

During the twentieth century, technics became an increasingly significant concern for philosophy, concomitantly with the massive advances in technological innovation covering nearly every aspect of our existence—from medicine to warfare, from communication to agriculture, from education to entertainment and so on. Thus, the philosophy of technology gradually constituted itself as a relatively independent subdiscipline and nowadays the "question concerning technology" represents a major field of enquiry within philosophical speculation, featuring research programmes as different as posthumanism, cultural studies, the analytic philosophy of the extended mind and engineering ethics, just to name a few examples (Cressman, 2022).

As pointed out by the US philosopher of technology Carl Mitcham (1985), a tension between two major approaches crosses the history of this field of study. On the one hand, the philosophy of technology as a discipline proper is initially developed by engineers who critically reflect on technics, taking an optimistic stance towards technoscientific development and privileging the empirical analysis of concrete technologies in their studies. These authors traditionally focus on topics such as

[1] Here and below, in case of double references, the first one refers to the French or German original and the second one to its English translation.

the difference between industrial and craft production, the classification of tools and machinery and the promises of a technocratic society. On the other, in the wake of these works, philosophers proper also start to thematically deal with technics, taking on the humanistic tradition which has always engaged with questions concerning techniques, artefacts and machines. These scholars usually scrutinize issues such as the impact of industrial technology on our individual and collective existence or the distinction between technological and biological processes. The humanistic tendency is generally more abstract and speculative in its study of technics and adopts a more critical and pessimistic attitude towards the most recent outcomes of technoscientific development.

Mitcham argues that, by enquiring into the relationship between technics and the human lifeform, the engineeringly oriented approach typically employs an unproblematic understanding of what it means to be humans, which is taken for granted as common-sensical and obvious. Conversely, the philosophically oriented approach usually adopts a superficial and non-specialistic conception of technics, merely deemed to alienate and dehumanize people, and consequently advocates for "the defense of the human as larger and more extensive than the technological" (Mitcham, 1985, p. 78). Hence, a philosophy of technology proper and up with the times should benefit from both the specialistic and empirical insights coming from engineering and the discerning analyses concerning the human condition coming from philosophy. As I set out to show throughout this research, indeed, neither what is technics nor what it means to be humans should be taken for granted in a study aiming to enquire into their relationship: the two terms should rather work to mutually explain one another. Moreover, it is important to note that, while Mitcham is referring to the origins of the philosophy of technology in the Nineteenth century in his analyses, in the Twentieth century this scenario is further complicated by the emergence of an "ontological" tradition in the philosophy of technology, exemplified by authors such as Walter Benjamin, Martin Heidegger and Ernst Jünger.

4 The Classical Philosophy of Technology

Historiography usually distinguishes two main phases in the history of twentieth-century philosophy of technology (Achterhuis, 2001; Brey, 2010; Franssen et al., 2016; Kroes & Meijers, 2000). The first phase, roughly ranging from the twenties to the eighties, is referred to as the "classical" philosophy of technology, featuring thinkers such as Jacques Ellul, Arnold Gehlen, Martin Heidegger, Ivan Illich, Hans Jonas, Herbert Marcuse and Lewis Mumford and approaches as different as theology, phenomenology, existentialism, hermeneutics, critical theory and postmodernism. These philosophers submit that technics is the core issue of our epoch and, therefore, should not be understood as mere applied natural science—as is the case with the older, engineeringly oriented version of the discipline outlined above.

The classical philosophers of technology maintain that technics is a systemic phenomenon, to be conceived of more as a lifeform than as an instrument or a cultural expression. Moreover, their approaches emphasize how modern technics represents a radical novelty compared to preindustrial epochs and societies and submit that it has become something harmful to humanity and should be consequently overcome. They thereby express a reaction against the Enlightenment optimistic ideals of technoscientific progress as something leading to better living conditions and increased human mastery over nature. Indeed, twentieth-century industrial societies reveal how many of their ills are due to technics itself—as exemplified by global warfare, the atomic threat, environmental degradation and the impoverishment of living conditions under consumerist regimes. Thus, the classical philosophers of technology hold that modern technics subjugates humans, rather than emancipating them, and that it does not enhance our control over the world, but has rather acquired an autonomous, uncontrollable developmental pattern, where processes of automation, rationalization and uniformization worsen our living conditions rather than improving them.

German philosopher Martin Heidegger's approach is usually considered exemplary of the classical philosophy of technology, especially concerning his later writings. In his seminal essay "The Question Concerning Technology" (Heidegger, 2000, pp. 7–36, 1977b, pp. 3–35), for instance, Heidegger states that we should reject those anthropological-instrumental definitions of technics that conceive of it as a human activity or a means for an end. The essence of technics, he argues, does not concern whether we enthusiastically accept or fearfully refuse it. Nonetheless, it should not be defined as something neutral, which can be employed for good or evil purposes according to the aims of its users. Hence, "technology", i.e., the individual, systemically interrelated technologies, "is not equivalent to the essence of technology. […] Likewise, the essence of technology is by no means anything technological" (Heidegger, 2000, p. 7, 1977b, p. 4), i.e., it cannot be explained by investigating the function and design of the individual technologies. The question is not the mode of employment of the particular artefacts but rather the general conception of technics prevailing nowadays.

According to Heidegger, modern technics manifests itself as *Gestell*, that is a mode of bringing forth conceiving of beings as *Bestand*, i.e., as "standing reserve", an indefinitely available and fully calculable supply. As a way of unveiling beings from their latency and as historical configuration of the event of Being, modern technics is not fully dependent on human will. The interplay of veiling and unveiling beings from the latency of Being, which Heidegger also calls truth, rather belongs to the destiny of Being itself. However, modern technics as *Gestell* jeopardizes the possibility for humans of relating to the essence of Being in an originary and authentic way and, therefore, should be overcome in favour of a more intimate and meditative relation to the world (Harman, 2010).

Starting from this cursory and surely inexhaustive outline of Heidegger's philosophy of technology, we can appreciate how his reflection stereotypically exhibits the characteristics of the classical approach, which has been thoroughly criticized, for instance, by the Dutch philosopher of technology Peter-Paul Verbeek in his book *What Things Do* (2005, pp. 47–95). First, Heidegger holds that technics is fundamentally a philosophical issue that should not be merely understood as a means or as an expression of human praxis. Secondly, the question of technics is deemed to concern neither the modes of production and employment of the individual technologies nor the scientific knowledge managing them. Thirdly, technics is understood as a systemic phenomenon, where all kinds of technologies are grouped together and equated by their sharing a common "essence". Fourthly, modern technics is conceived of in strongly pessimistic terms and is deemed to alienate and disrupt our relation to the world, considered more originary than and otherwise independent of it. Fifthly, some kind of autonomous agency leading towards increasing pervasiveness and control is attributed to the global technical system. Thus, as pointed out by the US philosopher of technology Andrew Feenberg (2000), the main problem with Heidegger's philosophy of technology and the related approaches lies in their essentialism, i.e., the pretension to separate some alleged essence of technics from its constitutive sociocultural embeddedness.

5 The Empirical Turn

Starting from around the eighties, the classical philosophy of technology is not the dominant approach in the field anymore and new ways of thinking about technics originate out of discontent with the traditional stance's shortcomings. Contemporary philosophers of technology are inspired by the emergence of interdisciplinary subject areas such as Science and Technology Studies (STS), which aim to analyse the mutual influence of technoscientific development and changes in our sociocultural organization; or applied ethics, which scrutinizes the moral and political implications of the design, production and usage of specific apparatuses. These scholars submit that the classical approaches conceive of technics, first, in one-sidedly negative and pessimistic terms; secondly, as something overly deterministic and autonomous in its development; thirdly, as too general and abstract a phenomenon. According to Philip Brey (2010), this approach would not only prevent us from advancing constructive propositions regarding the development of our technical system but also neglects the study of the concrete, individual technologies, which exhibit peculiar dynamics and should be handled relatively autonomously.

Hence, contemporary philosophy of technology—defined as an "empirical turn" in the field after Hans Achterhuis's (2001) introduction to a collection of essays on the US philosophy of technology—understands technological development as contextual, socially embedded and contingent. The empirical turn's constructivist approach aims to investigate "the concrete empirical manifestations of

different technologies" (Achterhuis, 2001, p. 3) rather than enquiring into their "transcendental" conditions of possibility. Technics is not anymore understood as a unitarian, monolithic phenomenon, but rather as a multifarious category consisting of different, individual technologies, to be investigated separately and according to their sociocultural context of belonging. As stated by Achterhuis, "the classical philosophers of technology occupied themselves more with the historical and transcendental conditions that made modern technology possible than with the real changes accompanying the development of a technological culture" (Achterhuis, 2001, p. 3). Moreover, given that they claim that there is no inner, teleologically oriented and autonomous force driving technoscientific development, supporters of the empirical turn usually agree that contemporary technological culture should be pursued and accepted, rather than longing for the return to a prior state of innocence towards technics.

The empirical turn is, therefore, a reaction against the classical approach, aiming to turn upside down some of its main tenets, analogously to how the classical approach emerged as a reaction against the Enlightenment and engineering beginnings of the discipline, some of the core concepts of which are now restored and revamped. First, the philosophy of technology goes from optimism to pessimism to optimism again towards technoscientific development, which is now considered contingent, socially embedded and ultimately dependent on human will rather than deterministic, autonomous and alienating. Secondly, the discipline shifts from being attentive to concrete, individual technologies and the sciences designing them to an abstract understanding of technics "in general and as such" and then back again to the first conception, where the analysis of the differences between the various kinds of technologies is prioritized over a unitary definition of technics.

One could compare, for instance, Lewis Mumford's (1966) analysis of so-called megamachines—technobureaucratic organizations where humans are employed as the components of a standardizing machinery, such as in Cold War nuclear powers—to Don Ihde's (1990) hopes for a multicultural society based on technological transfer and hybridization induced by globalization. Or one could contrast Martin Heidegger's (2000, pp. 7–36, 1977b, pp. 3–35) understanding of technics as a transhistorical phenomenon endowed with a nontechnological essence with Peter-Paul Verbeek's (2011) exclusive interest in a few twentieth-century, scientifically advanced industrial technologies.

Finally, while there is also continuity between the classical and the empirical approaches to the study of technology, the empirical turn's most recent developments lead the discipline possibly even further away from the classical philosophies of technology. Starting from the nineties, an engineeringly oriented philosophy of technology (re)emerges, devoted not so much to studying the effects of (concrete and individual) technologies on society as to analysing the developments of technical devices regardless of their relation to the sociocultural context where they are invented, produced and employed. As pointed out by Peter Kroes and Anthonie Meijers (2000), this tendency,

which focuses almost exclusively on the actual functioning of modern technics—here understood as the process of construction and design of devices and machines—is, therefore, more descriptive than prescriptive and refrains from any grand claim about what technics is or should be.

While the empirical turn's focus on the concrete materiality of experience and in-depth analysis of individual technologies are usually positively appraised, criticisms have also been raised against this approach's general aims. Agostino Cera (2020), for instance, argues that, while Heideggerian essentialism should be rightly dismissed in the philosophy of technology, the empirical turn risks neglecting the question of technics altogether, insofar as philosophy is here increasingly understood as an engineering-like problem-solving activity, without any consideration for an understanding of technics as an epochal phenomenon shaping our conditions of existence.

Furthermore, as Dominic Smith (2015) claims, according to the empirical turn, one should abandon transcendental arguments in the study of technology—empirical refers here to the objects of experience, while transcendental denotes the conditions according to which this experience becomes possible. However, Smith argues, these conditions should not necessarily be hypostatized as transcendent, unalterable or autonomous—as is the case, for instance, with the Kantian perspective. They may also be regarded as concrete, historical and heterogeneous. Thus, the philosophy of technology should not forfeit the consideration of the transcendental dimension of technics but rather balance off the study of empirical technologies by the appreciation of how technology renders this and other human activities possible.

Finally, Pieter Lemmens (2021) acknowledges that the empirical turn is right in pointing out that concrete technologies are not fully determined by their transcendental conditions of possibility and display no inner teleology towards increasing perfectibility. However, Lemmens also submits that the question of the relationship between the empirical and the transcendental should not be completely dismissed in the philosophy of technology, as is the case with the empirical turn, but rather re-elaborated to show how individual, concrete technologies exhibit some independency in their development but are also constrained by the general tendency of the global technical system, which increasingly tends towards functional standardization and homologation. The attention to the individual technologies, Lemmens (2017) argues, should not distract us from trying to conceptualize the general tendencies of the contemporary technical system, especially concerning its capability to globally and pervasively format and rearrange behaviours and experience.

6 Sloterdijk and Stiegler

Despite the multiplicity of approaches stemming from the empirical turn in the philosophy of technology, Sloterdijk and Stiegler are scarcely mentioned among the scholars in the field—as exemplified, for instance, by the entry "philosophy of technology" in the Stanford Encyclopedia of

Philosophy,[2] where their names do not even appear. Perhaps surprisingly, none of these two thinkers is usually considered a philosopher of technology proper, let alone identified with a particular approach or school of thought. Thus, although both widely engage with the question of technics from a philosophical standpoint, they seem to linger at the margins of this debate. However, as I aim to show throughout this research, both Sloterdijk and Stiegler provide us with major contributions to a philosophical elucidation of technics. Indeed, I think that their approaches may help us explore different, possibly more radical and sophisticated ways to think about technics and its relation to the human lifeform than those elaborated by mainstream philosophy of technology.

Peter Sloterdijk was born in Karlsruhe, Germany, in 1947, earned his PhD at the University of Hamburg in 1976 and since the eighties represents a major figure in the philosophical debate in German-speaking countries and worldwide. He has published extensively and on a wide range of topics, spanning from cultural studies to philosophical anthropology, from media theory to global history, from the history of religions to aesthetics. Characterized by a literary, erudite and boldly unsystematic style of writing, his works are devoted to understanding the historical roots of our present condition, with special reference to the role played by technologies in shaping our lifeways. Sloterdijk conceives of the human lifeform as the production of inner spaces of coexistence, which he calls spheres, capable of insulating those who create them from the threats coming from the outside or, as he would put it, immunizing us from external stressors. These anthropogenetic processes, Sloterdijk argues, are technically constituted by what he calls anthropotechnics, i.e., the iterative adoption of technical practices in order to mould our biology, ranging from body painting to plastic surgery and from rites of passage to social insurance, for instance.

Critical commentaries and biobibliographical introductions to his thought testify to Sloterdijk's intellectual resonance and have been published in several languages, ranging from monographs (Bonaiuti, 2019; Consoli, 2017; Couture, 2015; de Conciliis, 2023; Heinrichs, 2011; Lucci, 2011; 2014b; Michaud, 2011; Noll, 1993; Rocca, 2008; van Tuinen, 2006) to edited volumes (Elden, 2012; Grillmeyer et al., 2015; Jongen et al., 2006; Kallscheuer, 1987; Pavanini, 2020; Schinkel & Noordegraaf-Eelens, 2011; Weibel, 2019), journal special issues (Couture, 2007; Roney & Rossi, 2021; Urválek & Brázda, 2017; Various Authors, 2007; 2009b; 2012) and glossaries (Dobeneck, 2006; Lucci, 2014a). While Sloterdijk usually presents himself more as a public intellectual than as a philosopher proper, leaving no school of thought or real students behind him and thereby lingering at the margins of academia, his figure is often at the centre of heated public debates, especially in the German-speaking world. For instance, while he was highlighting how human communities historically achieve social cohesion by subjecting their members to birth control policies and training

[2] See https://plato.stanford.edu/entries/technology/, last accessed 5 December 2023.

systems, which may sometimes resemble the breeding procedures exerted on domesticates, representatives of the Frankfurt School in social theory and critical philosophy have rather ill-fatedly accused him of promoting a eugenicist politics revolving around genetic engineering (Nennen, 2003). More recently, he has provocatively advocated for a shift from tax liability to voluntary taxation, depicting the modern nation-states as parasitic organizations frustrating human noblest tendencies towards disinterested spending (Rehmann & Wagner, 2010).

Bernard Stiegler, born in Villebon-sur-Yvette, France, in 1952, and died in Épineuil-le-Fleuriel, France, in 2020, is also a major representative of contemporary "continental" philosophy. Despite having started as an outsider in the philosophical world—similarly to Sloterdijk but for radically different reasons—Stiegler earned his PhD at the School for Advanced Studies in the Social Sciences (EHESS) in 1993 under the supervision of Jacques Derrida, one of the most influential twentieth-century French philosophers and the founder of deconstruction. Stiegler published a massive number of books, mostly devoted to enquiring into the relationship between the economic, political and existential state of crisis of the global, industrial world, on the one side, and technologies, especially digital, on the other. According to Stiegler, the human condition should be conceived of as the cumulative intertwinement of biological organs, artefacts and social organizations. This perspective, which he calls organological, prompts him to appreciate the role played by technics in human evolution, through the process of what he terms epiphylogenesis, i.e., the supplementation of somatic and genetic memory with exteriorized mnestic supports. Starting from this viewpoint, Stiegler sets out to understand technics pharmacologically, as he would put it, that is relative to its capability to both constitute our faculties and deprive us of them, a curative and enhancing as well as toxic and inhibiting power.

This research let him gain momentum in the philosophical stage, as is testified by the vast number of publications devoted to expounding on his work, ranging from monographs (Abbinnett, 2019; Jugnon, 2022; Turner, 2023) to edited volumes (J. P. N. Bradley & Kennedy, 2021; Dillet & Jugnon, 2013; Howells & Moore, 2013) and journal special issues (Bishop, 2022; J. P. N. Bradley, 2022; De Boever, 2015; J. Gilbert & Roberts, 2013; Various Authors, 2006; 2009a; 2010; 2020; Vignola & Baranzoni, 2016). Notably, Stiegler was not only a prominent figure in the philosophical and intellectual debate in France and worldwide but also the initiator of a vast array of organizations, such as the lobby group Association of the Friends of the Thunberg Generation–Ars Industrialis (AAGT–AI)[3] and the research centre Institute for Research and Innovation (IRI),[4] which aim to experiment and apply the main tenets of his philosophy to concrete and local realities.

[3] See https://generation-thunberg.org/accueil, last accessed 5 December 2023.
[4] See https://www.iri.centrepompidou.fr, last accessed 5 December 2023.

What is Sloterdijk's and Stiegler's relation to the philosophy of technology? The latter is a traditionally established field of study in Germany and Sloterdijk intersects this tradition as a promoter of a contemporary reappraisal of twentieth-century philosophical anthropology. Things are quite different regarding Stiegler, insofar as the philosophy of technology still struggles to affirm itself as an autonomous research field in France (Parrochia, 2009). This may partially explain the relatively small attention devoted to Stiegler by this particular research community. In their review, however, Sacha Loeve and his collaborators (2018) submit a more nuanced interpretation. A French philosophy of technology strictly speaking would have not hitherto emerged mainly because contemporary French philosophers have always been thematically dealing with technics, albeit trying to understand it as an all-encompassing, epochal phenomenon, rather than mostly enquiring into individual, concrete technologies.

In some way, the empirical turn in the philosophy of technology would have not established itself in France, where the classical approach has remained majoritarian. Hence, a widespread tendency to equate the question of technics more or less explicitly with a most general metaphysical questioning would have prevented French scholars from focusing on the actual specificities of the different technologies composing our world. If we accept this construal, then Stiegler rightly belongs to the French tradition of philosophy of technology, insofar as his reflection about technics, as I will discuss in Chapter 5, stems from a critical appropriation of the main tenets of deconstruction, deemed not to devote enough attention to the role played by artefacts in constituting our lifeform.

7 Preliminary Confrontations

Sloterdijk and Stiegler engaged in a public debate at Radboud University, Nijmegen, the Netherlands, on the 27th of June 2016.[5] The topic of this encounter was the stakes of the Anthropocene, i.e., the current epoch as characterized by a global environmental and political crisis elicited by the human industrial overexploitation of the planet. However, despite exchanging insightful views, the two thinkers did not seem willing or able to elaborate a common ground of thought and a joint programme of action, so that no real follow-up ever occurred.

Some cursory attempts to engage with Sloterdijk's thought can be found in Stiegler's work. For instance, Stiegler (2008c, pp. 71–79, 2010c, pp. 36–40) criticizes Sloterdijk for overly relying on the potential of sociocultural apparatuses to train and domesticate humans' most destructive drives, whereas, according to Stiegler (2008a, pp. 117–121), total domestication would rather result in an inhuman lifeform. Elsewhere, Stiegler (2016, pp. 195–198, 2019, pp. 130–131) reproaches Sloterdijk for neglecting the question of what he calls the arche-protention (i.e., human mortality) and not

[5] See https://www.youtube.com/watch?v=ETHOqqKluC4, last accessed 5 December 2023.

developing a pharmacology, i.e., only considering technics in its positive and enhancing dimensions (Stiegler, 2018c, pp. 103–114). Whether these criticisms really hold when assessed from a perspective thoroughly engaging with Sloterdijk's philosophy is debatable. At any rate, they do not seem to flow into a systematic criticism of his thought.

In the wake of the Nijmegen debate, a few authors have tried to develop a critical comparison between Sloterdijk's and Stiegler's respective philosophies, highlighting their differences and commonalities. Antonio Lucci (2016), for instance, points out that Sloterdijk's thought lacks political propositions proper because of its tendency to atomistic solipsism, insofar as he downplays the potential for collective action in favour of a focus on an individual, quasi-heroic dimension. According to Lucci, while Stiegler develops his discourse about the Anthropocene as a criticism of the current, capitalist socioeconomic system, Sloterdijk emphasizes the ecumenical and impersonal dimension of the ecological crisis, advocating quite vaguely for a novel form of technics to help us avoid the looming catastrophe.

From a different perspective, Pieter Lemmens and Yuk Hui (2017a) highlight how both Sloterdijk and Stiegler understand the Anthropocene as the ultimate crisis of the human lifeform inasmuch as it is a technical lifeform, crafting political as well as technological responses to this challenge and conceiving of globalization as the artificialization of the whole biosphere, atmosphere and geosphere. Moreover, Lemmens and Hui (2017b) argue, both Sloterdijk and Stiegler significantly reinterpret Heidegger's thinking of technics in an empirical fashion, insofar as they regard the possibility of overcoming the ongoing crisis as lying not in a move away from technics in general but rather in a shift within the social organization of the extant technical system. Furthermore, the authors underscore the differences between the two thinkers' philosophical and anthropological sources and contrast the reserved, conservative and aristocratic elan of Sloterdijk's thought with the engaged, progressivist and communitarian spirit of Stiegler's philosophy, as well as the emphasis on space and natality of the former with the importance of time and mortality for the latter.

However, despite the insightful claims provided by these studies, a coming together of Sloterdijk's and Stiegler's philosophies has yet to be systematically undertaken. Throughout this research, I aim to fill in this hermeneutical gap by emphasizing their respective approaches' convergence and mutual complementarity. Their philosophies, despite substantial differences in style, methodology and core polemical targets, seem to me to be compatible in at least two major instances, which may enable us to also highlight their common difference from the perspective elaborated by the empirical turn in the philosophy of technology. These two main points, to which I will now turn, are their radical conceptualization of human constitutive technicity and their genealogical emphasis on the technical dimension of anthropogenesis.

8 Human Constitutive Technicity

What do I mean by human constitutive technicity? This phrase, which I derive from the French expression *technique anthropologiquement constitutive* (TAC), comes from the paper "Representations" (2002) by Véronique Havelange and her collaborators, where it is advanced that technics is constitutive of the human lifeform, i.e., what we call humans could not exist, evolve or survive without their relation to technologies. As I aim to show throughout this research, adopting the paradigm of human constitutive technicity amounts to accounting for our conditions of existence starting from how artefacts shape our behaviour, ecology, cognition, morphology and metabolism. Thus, the major goal of this research is, first, to translate this conceptual claim into a refined reconstruction of the moulding effects of technics on our biology. Secondly, to draw out the main consequences of this perspective for the conceptualization of the human lifeform both as a technical lifeform and as the lifeform that we ourselves are as the performers of this conceptualization.

Both Stiegler (2004, pp. 14–15, 2017c, pp. 31–32) and Sloterdijk endorse and elaborate on this conception, as exemplified by the latter's concept of anthropotechnics, which I will discuss in Chapter 3:

> the expression "anthropotechnics," in the context of the work undertaken here, stands for a clearly outlined theorem of historical anthropology: according to this theorem, "the human being" is from the ground up a product and can only be understood—within the limits of our knowledge to this point—by analytically pursuing his methods and relations of production (Sloterdijk, 2001b, p. 152, 2016a, p. 95).

The human lifeform should be considered the outcome of a production process that is both exerted by technologies and understood through technologies. However, as pointed out by Stiegler, "even if technics is *constitutive* of the anthropological and, in this sense, man is a prosthetic living being, he is not *only* technical"[6] (Stiegler, 2003a, p. 72, my translation). Stating that humans are technical beings does not mean that we are nonbiological organisms fully made of technical artefacts, but rather that our biology is constitutively interrelated with our technologies, which coevolve and mutually influence one another. Hence, the question is not whether humans and technics are initially different or not and how they may subsequently relate, but rather how biological and technical dynamics intertwine in order to produce what we call the human lifeform.

By speaking about technics as a constitutive condition, I wish to draw our attention to the insights developed by Derrida in texts such as "Signature Event Context" (1972b, pp. 367–393, 1982, pp.

[6] "Même si la technique est *constitutive* de l'anthropologique et, en ce sens, l'homme est un être vivant prothétique, il n'est pas *seulement* technique".

309–330). According to Derrida, the conditions of possibility of a phenomenon should be also understood as its conditions of impossibility, i.e., what enables the emergence/conception of a phenomenon is also what may impede the emergence/conception of that phenomenon. As I will discuss in Chapter 5, human technicity being constitutive means that technics is both what constitutes us as humans and enables us to represent ourselves as such and what may always deprive us of our humanity and hinder its conceptualization.

This dismantling may occur, first, by altering our lifeform to the point that it could not be regarded as human anymore. For instance, if human cloning technology will establish itself, one could debate whether cloned humans should be regarded as humans in the same sense as us or not. Secondly, technics may cause the actual extinction of the lifeform it has evolutionarily contributed to originating. This may be the case, for instance, with world-wide nuclear conflicts or environmental catastrophes induced by the industrial overexploitation of the planetary ecosystem. Thirdly, developments in our technical system may impede our capability to think and, therefore, to represent ourselves as humans. A case could be made, for instance, that the uncontrolled implementation of market-oriented algorithmic technologies in the fields of education and research may lead to the automation and reprogramming of cognition to the point of thwarting the long-term, large-scale development required to exert higher-order cognitive functions.

Starting from this perspective, Stiegler (2018a, pp. 17–19, 1998b, pp. ix–xi) submits that the analysis of the relationship between humans and artefacts is the fundamental task of contemporary thinking. Stiegler regards technics as the unthought of philosophy, i.e., the latter has always neglected the former, downplaying its significance for our lifeform and considering it an optional, inessential and ultimately insignificant add-on to a supposedly more originary human "essence". However, by doing so, philosophy has traditionally not only forgotten what actually lies at the core of our humanity but also ignored the question of its own, techno-logical conditions of possibility and impossibility, which are themselves technical through and through (Stiegler, 2008c, pp. 195–204, 2010c, pp. 107–112). This dynamic is evident, for instance, if we consider the technique of alphabetic writing, which perturbs philosophical reflection since Plato and which contemporary thinking should render explicit at the very same time when our capability to reflect critically on our lifeform is jeopardized by the current development of the global technical system (Stiegler, 2004, pp. 30–35, 2017c, pp. 39–42).

Crucially, the assumption of human constitutive technicity by Sloterdijk and Stiegler is structurally accompanied by their focus on the technical dimension of human evolution. If we are technical organisms, it means that technics constitutes us as these organisms, i.e., renders us humans. And if we assume, concordantly with biology's state of the art, that humans, as much as all other organisms, find their origin in an evolutionary process, abiding by the Darwinian dynamics of natural selection, this assumption means that technics renders us humans also and most importantly in an evolutionary

sense, i.e., technics plays a major role in the evolutionary process which gradually renders some prehuman animals what we now define as humans. Thus, Sloterdijk and Stiegler investigate how anthropogenesis occurs thanks to our evolving relation to technologies and how technics enables us to become the kind of organisms that we are now.

As I aim to show throughout this research, this assumption is relevant for at least two major reasons. First, the introduction of technics into an evolutionary explicative framework prompts us to rethink the main tenets of traditional evolutionary biology, which often neglects the impact on the genotype of a population of phenotypic individual changes, such as the creation of an artefact (Lemmens, 2009). Secondly, this viewpoint prompts us to consider how technics also plays a fundamental role in the constitution of evolutionary biology as the science studying human evolution, insofar as this discipline is itself a human activity and is, therefore, technically structured (Di Martino, 2017, pp. 83–124).

9 Postphenomenology

How do these two main tenets of the approach I aim to develop throughout this research in the wake of Sloterdijk's and Stiegler's insights intersect with the conceptual core of the empirical turn in the philosophy of technology? I will elaborate on this comparison by focusing on a particular strain of the empirical turn, namely postphenomenology, because it is among the most prominent approaches in the field and best exemplifies the empirical turn's main tenets.

In the nineties, postphenomenology emerged out of US philosopher of technology Don Ihde's work on human-technology relations. While the connection between phenomenology and postphenomenology is substantial but also unclear (Mykhailov & Liberati, 2023), Ihde's original approach is explicitly inspired by Science and Technology Studies and US pragmatism, aiming to combine empirical and philosophical methodologies. First, one of postphenomenology's main aims is to overcome two symmetric pitfalls in the philosophy of technology, famously denounced by the political theorist Langdon Winner (1980) as the social construction of technology and technological determinism respectively. According to the social construction of technology, artefacts would be "neutral", i.e., they would have no intrinsic political value and their impact on society would depend solely on the use that is made of them. According to technological determinism, technologies would follow an autonomous developmental pattern that influences society but is by no means influenced by it in return.

Secondly, the postphenomenological endeavour sets out to amend the instrumental-anthropological downplaying of technics exerted by traditional phenomenology while concurrently reappraising the analysis of concrete technologies neglected by the classical approach in the philosophy of technology, merging conceptual and normative instances with empirical case studies

(Rosenberger & Verbeek, 2015). According to Ihde, the "naive objectivist account" (Ihde, 1990, p. 97) should be dismissed in the analysis of technologies. The latter should not be regarded only or primarily as already constituted objects bearing properties which could be studied by already constituted observers, but should be rather conceived of as what constitutes the very correlation between subject and object—which Ihde calls intentionality—by mediating the human relation to the world. Thirdly, in the wake of the empirical turn, postphenomenology prompts us to conceive of technics as something not necessarily performing alienation on the human condition, but more generally and multifariously mediating our relation to the world.

These aims are aptly conveyed by postphenomenology's key concept of multistability, i.e., "the idea that any technology can be put to multiple purposes and can be meaningful in different ways to different users" (Rosenberger & Verbeek, 2015, p. 25). For instance, an umbrella is usually used as a means to protect oneself from the rain or the sun, but can also serve as a rudimentary weapon, if needed. Less prosaically, a totem pole operating as a devotional device in one culture may become the object of a museum exhibition in another. While the concept of multistability initially comes from Ihde's analyses of perception, without specific reference to artefacts, it is subsequently employed to define the very (non)essence of technics:

> a technological object, whatever else it is, *becomes* what it "is" through its uses. This is not to say that the *technical* properties of objects are irrelevant, but it is to say that such properties in use become part of the human-technology relativity. Nor is it to deny that there is a specific type of history to the development of technical properties (Ihde, 1990, p. 90).

Everything can be a technology, objects becoming technologies by being utilized by humans. While different artefacts can be used for the same purpose, the same artefact can serve different aims. And when a technology from a given society is re-employed in another, it somehow becomes a different technology, because its sociocultural context contributes to rendering it a technology in general as well as that technology in particular.

According to Ihde (1990, pp. 144–151), through the notion of multistability postphenomenology aims to conceive of artefacts as nonneutral, i.e., they significantly shape our experience and mould our relation to the world, without, however, deterministically influencing our behaviour through and through. While a technology can exert different functions, it cannot exert every possible function and the functions it can exert are constrained by environmental, individual and historical factors (de Boer, 2021a). Hence, technologies are always context-dependent and materially situated.

Postphenomenologists endorse the idea that the human subjects and the worldly objects mutually constitute one another through the originary mediation provided by technologies (Verbeek, 2015). As pointed out by Verbeek, contrary to traditional phenomenology,

> the postphenomenological approach makes it possible to move beyond the modernist subject-object dichotomy in two distinct ways. First of all, Ihde shows the necessity of thinking in terms of *human-technology associations* rather than approaching human subjects and technological objects as separate entities. […] Second, human-world relationships should not be seen as relations between preexisting subjects who perceive and act upon a preexisting world of objects, but rather as sites where both the objectivity of the world and the subjectivity of those who are experiencing it and existing in it are *constituted* […]. What the world "is" and what subjects "are" arise from the interplay between humans and reality […]. Postphenomenology closes the gap between subject and object not by linking subject and object via the bridge of intentionality but by claiming that they actually constitute each other (Verbeek, 2011, pp. 15–16).

From Verbeek's (2005, pp. 111–113) viewpoint, which radicalizes the postphenomenological approach initiated by Ihde, technologies both produce and connect the subjective (human) pole and the objective (nonhuman) pole of reality, framing the spectrum of their interrelations. While this is a relevant advance compared to the traditional phenomenological perspective, I think that it is a rather different claim from human constitutive technicity, although it is not necessarily incompatible with it. Indeed, while postphenomenology investigates how technologies constitute the human relation to the world, Sloterdijk and Stiegler emphasize how humans and technologies mutually constitute one another. More precisely, the paradigm of human constitutive technicity holds that humans may only exist as humans by virtue of their relation to technologies, which in turn they contribute to producing.

The difference here seems to lie more in the focus of enquiry than in the ontological claims undergirding it. For instance, starting from the postphenomenological perspective, an artefact such as a book would be understood as what mediates the human relation to the world by providing its readers with a new vantage on reality. Our relation to the world is mediated by the use we make of that book and this relationship is constituted so that our experience is structured by the characteristics of that particular book. Supporters of human constitutive technicity would not deny this claim. However, they would add that, across generations, we have evolved into a community heavily relying on literacy for its survival and accordingly changed our neural networks thanks to the selective advantages provided by the use of those books our community has, in turn, produced. More generally, while postphenomenology would study, e.g., how microwaves have changed our dietary habits and relation to food, an enquiry centred around the paradigm of human constitutive technicity would investigate

how shifting to a cooking food diet has evolutionarily modified our digestive system and consequently rearranged our biology and social structure.

Thus, I think that human constitutive technicity lies somehow in between the classical philosophy of technology and the empirical turn. As argued by Verbeek (2005), the classical approach studies technology exclusively starting from its conditions of possibility, i.e., it addresses not so much technology itself as what renders it possible—usually identified with some form of calculative rationality or some underlying industrial sociocultural structure—and reduces the whole of technology to these conditions. Conversely, Verbeek claims, the empirical approach aims to study individual artefacts in their concrete manifestations, enquiring into how they mediate our relation to the world, shaping it without fully determining it. The approach I aim to develop throughout this research does not aim to study technology starting from its conditions of possibility but rather seeks to understand technology—in the concrete instantiations of its individual artefacts—as the conditions of (im)possibility of the human lifeform. Empirical technologies, therefore, are not investigated starting from their "transcendental" conditions of possibility, but rather represent the empirical-transcendental conditions for the emergence of the lifeform which, in turn, contributes to producing them.

10 We Have Always Been Cyborgs

At first sight, while postphenomenologists do not seem to openly deny human constitutive technicity, they do not explicitly affirm it either. I think that the reason why this particular question is not tackled in the postphenomenological literature is that this approach lacks the methodological emphasis on human evolution exhibited by Sloterdijk and Stiegler. Authors such as Verbeek regard technology quite narrowly as "the specifically modern, 'science-based' technological devices of the sort that began to emerge in the last century" (Verbeek, 2005, p. 3), without fleshing out the specificity of these devices any further and without considering how they would even nowadays still obtain alongside other, "older" forms of technology.

Conversely, if one attempts to reconstruct the emergence of the human lifeform as a technical lifeform, one should necessarily also deal with the question of the genesis of its constitution, i.e., enquire into how the relationship between humans and technologies originates. Merely affirming that technologies constitute both human subjectivity and the objectivity of the world amounts to lingering within an atemporal and non-evolutionistic framework, where humans are supposed to have always been as they are now and technologies to have always existed, re-constituting our relation to the world each time again, but without transgenerationally modifying, in turn, what is constituted by this relation.

More precisely, I contend that this apparent lack of thematization is actually the result of an implicit refusal of the paradigm of human constitutive technicity by postphenomenology. I will tackle this issue by drawing our attention to two exemplary discussions of human technicity in the postphenomenological literature, elaborated by Ihde and Verbeek respectively.

10.1 Ihde

As argued by Ihde in his seminal book *Technology and the Lifeworld* (1990), technics, i.e., "human action employing artifacts to attain some result within the environment" (Ihde, 1990, p. 12), historically and geographically pervades every human community:

> could humans live *without* technologies? Clearly, in any empirical or historical sense, they in fact do not. There are no known peoples, now or in historic or even prehistoric times, who have not possessed technologies in some minimal sense, yet we might still want to say that they could live so as an imaginative limit-possibility. […] We should from the beginning, however, be aware of the imaginative and even quasi-mythic quality of such an exercise (Ihde, 1990, p. 11).

Humans without technologies, Ihde argues, may only be conceived of as a thought experiment, a liminal and fantastic intellectual operation. Thus, even if humans without technologies do not actually exist, one could still somehow think of them:

> it might be possible for humans to live non-technologically as a kind of abstract possibility—but only on the condition that the environment be that of a garden, isolated, protected, and stable. […] But there is no such empirical-historical human form of life because, long before our remembering, humans moved from all gardens to inherit the Earth (Ihde, 1990, p. 13).

It is unclear and perhaps quite puzzling why Ihde decides to conceive of pre-technical human life starting from the mythical setting of a Garden of Eden rather than from the scientific setting of the African Pliocene, for instance. Anyway, his aim is to exert a sort of eidetic variation in the phenomenological style around the human lifeform, representing it without technics.

I think that this attempt is problematic for at least two major reasons. First, when Ihde (1990, pp. 11–20) speaks about the humans inhabiting this fantastic, pre-technical garden, he describes them as featuring some traits, such as language use or kinship structures, whose independence from technics is debatable to say the least, as I will discuss in Chapter 3. Moreover, according to Ihde (1990, pp. 157–161), pre-technical humans would eat, for instance, fish and nuts—but how would they catch the fish? And how would they crack the nuts open? Hence, I submit that Ihde's description of the pre-

technical world, contrary to what it sets out to achieve, inadvertently features at least some (indirect) instances of technics, thereby invalidating his own thought experiment.

Secondly, I contend that the epistemic premises upon which Ihde's thought experiment is based are incorrect. The aim of eidetic variation, as famously theorized by the Austrian philosopher and founder of phenomenology Edmund Husserl (1968, pp. 72–87, 1977, pp. 53–65), is to highlight the constant and invariant traits of a phenomenon. Thus, if we imagine humans without technologies, their essential features should remain the same as if we imagine humans with technologies—as imagining faces with, e.g., blue, black or brown irises should enable us to detect some of the basal qualities of the human eye. However, as it will become apparent throughout this research, humans would look and behave very differently without the moulding effects exerted by their technologies during their evolution. Not only our hands or jaw, for instance, would assume a significantly different shape if abstraction were made from their evolutionary interrelation with technologies, but the very survival of these imaginary humans would be compromised for several reasons, all pointing to the fact that we cannot live without technologies—not even in a quasi-paradisiac environment devoid of predators, harsh weathers, illnesses etc., as the one described by Ihde.

For instance, as cogently argued by the anthropologist Richard Wrangham (2009, pp. 15–36), humans could not survive on a diet exclusively based on raw, that is unprocessed food, contrary to what is implied by Ihde's thought experiment. Hence, from my perspective, not only are the humans without technologies imagined by Ihde not really imagined without technologies, but humans without technologies would be unimaginable in the phenomenological sense, i.e., eliminating technologies from our representation of humans through the means of eidetic variation would alter the invariant traits of our lifeform to the point that what we would imagine could not be considered "humans" anymore.

10.2 Verbeek

In his book *Moralizing Technology* (2011), Verbeek, while making reference to both Sloterdijk and Stiegler without really engaging with their positions, expands on the four forms of human-technology relations initially described by Ihde and submits that a fifth form should be singled out, which he calls cyborg relations. According to Ihde (1990, pp. 72–123), there are four kinds of human-technology relations. First, embodiment relations, where technologies mediate and transform our sensory perception of the world, thereby retreating in the background of our experience and becoming perceptually quasi-transparent (e.g., telephones, microscopes etc.). Secondly, hermeneutic relations, where technologies are the object of our perception and semantically inform us about some feature of the world, to which they refer (e.g., wristwatches, thermometers etc.). Thirdly, alterity relations, where technologies become the focus of our attention in a way similar to how we relate to other

humans, while the rest of the world shifts in the background (e.g., smartphones, consoles etc.). Fourthly, background relations, where technologies contribute to constructing our environment while concurrently remaining unnoticed (e.g., ventilation systems, antitheft alarms etc.).

While embodiment relations represent the combination of human and technological intentionality, cyborg relations, Verbeek (2011, pp. 139–152) argues, are a modification of embodiment relations, where a distinction between human and technological intentionality cannot be drawn anymore. They thereby constitute a new kind of entity, which Verbeek calls hybrid intentionality, exemplified by psychopharmacological drugs, biotechnologies and neural implants. Verbeek interprets this condition as the outcome of contemporary technoscientific development, which enables the concrete incorporation of technologies into our biology leading to physical alterations of our body and cognition:

> technological development has reached a stage in which technology has started to interfere explicitly with the nature of human beings. Intentionality used to be one of these concepts which belonged to the realm of the exclusively human, but by now it has become clear that it needs to be extended to the realm of technology—and to the realm of human-technology amalgam (Verbeek, 2008, p. 394).

Verbeek maintains that, although we interrelate with technologies continuously and multifariously, there is something "exclusively human", such as intentionality, that technologies do not influence, let alone constitute. However, so goes his argument, some of the most recent technologies break even with this last boundary of pristine human "nature" and finally render us fully "cyborgs".

Verbeek diverges from Ihde's (1990, pp. 112–115) approach in this regard, insofar as for the latter those technologies which cannot be experientially distinguished from their human users—Ihde makes the example of medical drugs, among others—would cease to be technologies altogether for the purpose of his analysis. Anyway, from my perspective, the above claims show how Verbeek, similarly to Ihde, does not endorse the paradigm of human constitutive technicity.

Indeed, if we are evolutionarily constituted as humans by our relation to technics, i.e., if our biology is the outcome of the production, usage and transmission of artefacts across generations, it would make no sense to claim that, because of some new technoscientific development, however unprecedented and disruptive, something that was formerly uncontaminated by technicity has now become technically mediated. Furthermore, Verbeek does not clarify what the difference would be between, say, a modern psychopharmacological drug and a traditional medicinal infusion or between a modern nanotechnological implant and a traditional tattoo, relative to their capability to alter our

psychophysical constitution to the point that it is impossible to tell apart the human and the technological components anymore.

Thus, contrary to Ihde and Verbeek, as well as postphenomenology in general, when Sloterdijk and Stiegler speak of human life as technical through and through, they regard it as the originary conditions of (im)possibility of the human lifeform and not as the acquisition of a later, localized stage of technoscientific development. And I think that, despite some hesitations (Ihde & Malafouris, 2019), the refusal of the paradigm of human constitutive technicity exerted by postphenomenologists is due to their lack of thematization of the question of anthropogenesis, which is never posed, let alone answered in their works. Conversely, as I aim to show throughout this research, if we set out to enquire into the origin of our lifeform consistently with contemporary evolutionary biology, we must consider the role played by technics in driving our evolution.

10.3 Haraway

When Verbeek develops his argument, he makes reference to US philosopher Donna Haraway's well-known paper "A Cyborg Manifesto" (1991, pp. 149–181), where the figure of the cyborg is introduced in order to conceptualize our contemporary condition from a minoritarian, resistant and emancipatory perspective. According to Haraway, thinking of ourselves as cyborgs enables us to dissolve the binary oppositions characterizing western metaphysics in general and capitalist modernity in particular, together with the axiological unbalance structurally accompanying them (e.g., nature versus culture, woman versus man, primitive versus civilized etc.). Verbeek takes this stance as exemplary of the ontological shift in our "nature" performed by contemporary technologies.

However, Haraway does not claim that we have actually become cyborgs, i.e., new types of organisms, but rather that a conceptual shift in our self-representation is underway. While this reconceptualization of the human lifeform is indeed promoted by the blurring of the traditional metaphysical distinctions operated by contemporary technoscientific development, this shift is happening on a cognitive and political plane and not in the sense that these devices would actually transform our humanity into something completely different. Stating that we should think of ourselves as cyborgs does not mean that we are all actual cyborgs or that we have become biotechnical hybrids starting from something "purely" biological. It rather signifies that the contemporary condition enables us to elaborate an emancipatory politics starting from a revision of our self-representation aiming to integrate into the core of our humanity what was formerly excluded as inessential or irrelevant. As pointed out by the Italian philosopher Roberto Esposito,

> in the dichotomous model that has long opposed the world of things to the world of persons, during the era of its decline, a crack appears to be showing. The more our technological objects,

> with the know-how that has made them serviceable, embody a sort of subjective life, the less we can squash them into an exclusively servile function. At the same time, through the use of biotechnologies, people who at one time appeared as individual monads may now house inside themselves elements that come from other bodies and even inorganic materials. The human body has thus become the flow channel and the operator […] of a relation that is less and less reducible to a binary logic (Esposito, 2015, pp. 3–4).

The perturbing performances of some of the most recent technologies prompt us to reconsider the traditional opposition between (subjective) mind and (objective) matter. Retrospectively, we have always been cyborgs, in the sense of organisms constitutively relating to technics in order to survive and thrive, but we are only starting to realize it nowadays. Sloterdijk, inspired by German philosopher Gotthard Günther's (2002) analyses concerning the logic and ontology of artefacts, claims that "with the idea of really existing memories and self-organizing systems the metaphysical distinction between nature and culture becomes untenable, because both sides of the difference only present regional states of information and its processing" (Sloterdijk, 2001b, p. 219, 2016a, p. 138). Hence, contemporary technoscientific development does not qualitatively alter the human lifeform, which is already constitutively dependent on technics for its existence, but prompts and possibly even forces us to revise the traditional interpretive frameworks articulating our understanding of what it means to be humans.

11 Heidegger's Being-in-the-World

Human constitutive technicity exhibits what I wish to define as a twofold dimension, i.e., technics not only amounts to the conditions of (im)possibility of our existence but also consists in the conditions of (im)possibility of our thinkability. As I will further discuss in Chapter 7, without our relation to artefacts, not only would we be unable to survive as humans but we could not represent ourselves as humans either. Consequently, not only is human evolution enabled and constrained by technical practices, but also the study of this evolution can only obtain thanks to these activities. When speaking about human technicity, the empirical turn seems to neglect this condition.

Indeed, as argued by Jochem Zwier and his collaborators (2016), the dismissal of the ontological question concerning the essence of technology prevents the empirical turn from enquiring into its own questioning behaviour, contrary to Heidegger's phenomenological approach, for instance. Since the latter represents one of Sloterdijk's and Stiegler's main philosophical sources, I will now elaborate on Heidegger's thought and critically combine it with another of Sloterdijk's main intellectual influences, namely philosophical anthropology—an approach developed starting from the first half of the twentieth century, canonically featuring German philosophers such as Max Scheler, Helmuth

Plessner and Arnold Gehlen and typically combining philosophical insights with scientific analyses. By doing so, first, I will underscore how these conceptual traditions enable us to thematize our capability to question ourselves relative to our condition and thereby investigate our own questioning behaviour, contrary to the empirical turn in the philosophy of technology. Secondly, I will highlight how they tackle the question regarding the evolutionary dimension of human technicity, posing but failing to answer it. However, it is important to note that my reading of Heidegger's philosophy represents no more than a heterodox interpretation of his existential analytic as a philosophical anthropology, which a strictly Heideggerian approach would surely not accept. Concurrently, I wish to point out that a thorough scrutiny of Heidegger's ontology of technology falls outside the scope of this research.

Heidegger understands the capability to question ourselves, thereby elaborating self-representations and accounting for our condition, as an implication of what he terms our being-in-the-world in his book *Being and Time* (1977a, 2010), his 1927 lecture course *The Basic Problems of Phenomenology* (1975, 1982) and his 1929–1930 lecture course *The Fundamental Concepts of Metaphysics* (1983, 1995). According to Heidegger (1977a, pp. 15–20, 2010, pp. 10–13), the questioning of the meaning of Being is the most general question, which is implicitly presupposed in every other question and, therefore, should be addressed first and foremost. Everyone already has a sort of preliminary, nonthematic comprehension of Being—otherwise, the question of Being could not be posed at all.

However, Heidegger argues, in order to pose this question thematically, i.e., rigorously and explicitly leading to authentic understanding, it is incumbent upon us to first enquire into the ontological constitution of that peculiar kind of being inherently possessing the capability to question Being, i.e., human existence, which he calls *Dasein*. This existential analytic, through which Heidegger outlines *Dasein*'s ontological structure, is preliminary to the thematization of the question of Being, insofar as *Dasein* is "already caught up in all comprehending questioning" (Heidegger, 1983, p. 31, 1995, p. 21), i.e., always intimately concerned with their own Being about their questioning behaviour:

> Dasein is a being that does not simply occur among other beings. Rather it is ontically distinguished by the fact that in its being this being *is* concerned *about* its very being. Thus it is constitutive of the being of Dasein to have, in its very being, a relation of being to this being. […] Dasein understands itself in its being in some way and with some explicitness. It is proper to this being that it be disclosed to itself with and through its being. *Understanding of being is itself a determination of being of Dasein* (Heidegger, 1977a, p. 16, 2010, p. 11).

In order to enquire into Being, the most general and consequently the most fundamental, all-encompassing question, we should first understand our own ontological structure. Indeed, it is through us that the question of Being can be posed, as well as any other question, which the question of Being implies and presupposes. This question always concerns us, always challenges our own behaviour and understanding, constituting us as the questioning beings. And since *Dasein* always exists in a world of other beings, Heidegger submits that the existential analytic should also feature the investigation of the ontological structure of the world.

Yet what does Heidegger mean by world? It is neither a container where all beings would collect nor the whole of these beings. *Dasein*'s condition of being-in-the-world is not about being contained in a space with other beings, it is rather what renders space and relationality in general possible. The world is defined as "*manifestness of beings as such as a whole*" (Heidegger, 1983, p. 412, 1995, p. 284). First, it constitutes what enables *Dasein* to relate to beings—and, therefore, also to themselves, insofar as *Dasein* is also a being. Only because being-in-the-world ontologically pertains to their constitution is *Dasein* "open" to the other beings, i.e., they can access and relate to them. The latter, in turn, can only manifest themselves to *Dasein* as beings in and from that world.

Secondly, being-in-the-world means that beings manifest themselves to *Dasein* as beings, i.e., in their difference from the event of Being which enables, articulates and performs their manifestation. *Dasein*'s worldly condition amounts to their capability to grasp what Heidegger, in his essay "The Onto-Theo-Logical Constitution of Metaphysics" (Heidegger, 2006, pp. 51–79, 1969, pp. 42–74), terms the ontological difference, i.e., the difference between beings and the event of Being, understanding the structural dependence of beings on Being while concurrently not hypostatizing Being as a being among the other beings or as the whole of these beings.

Hence, the world consists in *Dasein*'s originary receptiveness to the ontological event that renders beings manifest in their Being. As contended by Heidegger (1977a, pp. 71–120, 2010, pp. 53–88), beings manifest themselves to *Dasein* first and foremost as ready-to-hand, i.e., as means for something, and always within and starting from a complex of means and ends mutually referring to each other, ultimately referring to the whole of beings. Importantly, for means Heidegger primarily intends technical objects and it is when a means turns out defective, unsuitable or absent that the complex of means and ends to which it belongs becomes apparent and comes out from the latency of its habitually unnoticed, taken-for-granted functioning. When the complex of beings proves ineffective and malfunctioning, the world may emerge, shaking *Dasein* out of their well-established, routine relation to beings and confronting them with the event of Being as what renders manifestation in general possible.

The event of Being provides the whole of beings with consistency and enables them to present themselves to *Dasein* as a consistent whole. Thus, according to Heidegger, the basic question of

metaphysics interrogates beings as a whole, i.e., on the one side, all beings, on the other, beings as beings in general. The existential analytic, in turn, enquires into what renders this metaphysical questioning possible, investigating our capability to question in the broadest and deepest sense. By doing so, it also scrutinizes the conditions of its own possibility, insofar as *Dasein* themselves belongs to the worldly complex of beings (McNeill, 1992).

Heidegger's analyses enable us to conceptualize our essential belonging to a mutually referring complex of instruments, showing how the thematization of this condition always concerns and appeals to our own existence, which is capable of distinguishing between the given (beings) and what renders its manifestation possible (Being), while concurrently appreciating their structural interdependence. However, I think that Heidegger's approach should leave us unsatisfied, insofar as it presents at least two major issues when confronted with the theory of human constitutive technicity.

First, Heidegger denies technical objects any chance to contribute to constituting *Dasein*'s ontological structure. Although the world may manifest itself to *Dasein* through their encounter with the defective instrument, this understanding of technics remains overly instrumental and precludes the possibility of conceiving of artefacts as what not only reveals but also enables and supports *Dasein*'s being-in-the-world. Heidegger asserts that technical instruments are ontologically different from the other beings, insofar as they "belong to world". They thereby represent a fourth, perhaps underdeveloped ontological thesis, together with those of the stone being worldless, the animal being poor in world and *Dasein* being world-forming, which I will review in Chapter 2:

> they are neither simply worldless, like the stone, nor are they ever poor in world. Yet presumably we must say that equipment, articles of use in the broadest sense, are worldless, yet as worldless *belong to world* [weltzugehörig]. In general this means that all equipment […] is what it is and in the way that it is only insofar as it is a *product* of human activity. And this implies that such production of equipment is only possible on the basis of what we have called *world-formation* (Heidegger, 1983, p. 313, 1995, p. 213).

This special ontological status is only attributed to instruments because they belong to *Dasein*'s world. As human products, they differ from "natural" beings, but only insofar as they structurally depend on human existence in order to come into the world, contrary to the other beings. This conception is anthropocentric because technics is understood merely as the outcome of some human faculty (i.e., being-in-the-world), which is supposed to render it possible without being conditioned by it in return.

Secondly, Heidegger's existential analytic precludes any possibility of enquiring into the origin of *Dasein*'s being-in-the-world, i.e., investigating how this condition may be produced and occur.

According to Heidegger (1983, pp. 265–267, 1995, pp. 178–180), the question of the becoming-human of the animal can only be posed subsequently to having conceptualized the respective essences of "the human" and "the animal", i.e., the anthropological difference. Anthropogenesis, therefore, is only deemed investigable starting from the thematization of the essential difference supposed to oppose humans to "the animal" in general, thereby falling prey to anthropocentric essentialism, which I will criticize in Chapter 5.

I rather aim to investigate the human condition starting from an evolutionary perspective, i.e., reconstructing the transformation occurring between two distinguished, albeit interrelated lifeforms. This approach prompts us to regard human being-in-the-world not as an inexplicable originary situation, but rather as the outcome of a process starting from pre-worldly and pre-human conditions. However, this methodology would be unacceptable from Heidegger's viewpoint because of his notorious hostility towards the sciences, especially biology and anthropology, deemed unable to provide any authentic ontological explanation of the human condition. Since Heidegger aprioristically refuses the conceptual framework elaborated by evolutionary sciences, he ignores the paradigmatic shift in the understanding of our lifeform provided by these disciplines.

In Heidegger's philosophy, sciences are initially despised as regional ontologies, i.e., forms of knowledge unaware of the ontological status of their objects of enquiry, and subsequently identified with the fulfilling of western metaphysics as the forgetting of Being. In *Being and Time* (1977a, pp. 61–67, 2010, pp. 44–49), Heidegger maintains that psychological, biological and anthropological sciences pretend to enquire into human essence, but do not succeed, because they uncritically assume an ontic concept of what humans are without posing the ontological question of their relation to Being. Conversely, philosophy as the question of the Being of beings would constitute the precondition of scientific practice and frame its object of investigation, without, in turn, having to rely on its findings. Otherwise, sciences would remain caught up in an outdated, metaphysical questioning.

As Heidegger submits in his essay "Phenomenology and Theology" (1976, pp. 45–78, 1998, pp. 39–62), "philosophy, as the free questioning of purely self-reliant Dasein, does of its essence have the task of directing all other […] positive sciences with respect to their ontological foundation" (Heidegger, 1976, p. 65, 1998, p. 53). Since "positive" sciences deal with beings starting from an implicit understanding of their object of enquiry, philosophy should provide them with direction and orientation, unveiling the Being of the beings they study. Hence, from Heidegger's perspective, sciences are subordinated to philosophy and the latter has nothing to learn from them, while the former should receive from it their foundation.

Moreover, as stated by Heidegger in his essay "Letter on Humanism" (1976, pp. 313–364, 1998, pp. 239–276), "every determination of the essence of the human being that already presupposes an interpretation of beings without asking about the truth of being, whether knowingly or not, is

metaphysical" (Heidegger, 1976, p. 321, 1998, p. 245). For instance, western anthropology traditionally conceives of the human lifeform as *animal rationale*, that is an animal endowed with some special quality (e.g., linguistic reasoning) that distinguishes it from the other animals. By doing so, the human essence is missed and reduced to that of the animal—something completely different. Accordingly, *Dasein*'s mode of existence is conceived of as present-to-hand, without considering their openness to Being and, therefore, their existential condition. Since human faculties "are again inexplicitly and 'self-evidently' taken as something 'given' whose 'being' is not a matter of question, the anthropological problematic remains undetermined in its decisive ontological foundation" (Heidegger, 1977a, p. 66, 2010, p. 48).

According to Heidegger, relying on the sciences in order to investigate the human mode of existence would be out of the question. Indeed, every set of scientific findings provided by, for instance, ethnology, "already moves in certain preliminary concepts and interpretations of human being in general, beginning with the initial 'collection' of its materials, its findings and elaborations" (Heidegger, 1977a, p. 68, 2010, p. 50). Heidegger understands the scientific attitude as the neglect of our worldly condition, i.e., as underestimating how every questioning, interpretation and investigation of beings already presupposes our being-in-the-world, that is our originary openness to the event of Being as what renders beings manifest to us and frames them within a factical and historical understanding of truth. Thus, starting from scientific findings in order to reconstruct our openness to Being would be nonsensical, insofar as the latter is what provides us with the possibility of elaborating scientific knowledge in the first place.

Notably, Heidegger's criticism of anthropology also encompasses philosophical anthropology: "philosophy in the age of completed metaphysics is anthropology […]. Whether or not one says 'philosophical' anthropology makes no difference" (Heidegger, 2000, p. 85, 1973, p. 99). Criticisms of Heidegger's approach, in turn, have also been raised from philosophical anthropology's perspective (M. Russo, 2002). However, Heidegger's stance gauged more consensus, as testified by its reappraisal and appropriation by the French philosophers Jean-Luc Nancy and Philippe Lacoue-Labarthe (1981), who vindicate their relation to Heidegger against "the almost unchallenged domination of anthropology"[7] (Lacoue-Labarthe & Nancy, 1981, p. 14, my translation) and defend this approach's political significance against the threats of scientific determinism and totalitarian biologism.

[7] "La domination quasiment sans partage de l'anthropologie".

12 Philosophical Anthropology's World-Openness

I think that Heidegger's approach should be nuanced and critically revised, rendering a transdisciplinary dialogue between the sciences and philosophy possible and fruitful while concurrently retaining its methodological precautions against the undue hypostatization of scientific findings as incontrovertible truths. Hence, I now aim to review how a reappraisal of philosophical anthropology may lead us in that direction. Despite Heidegger's animosity towards this approach, indeed, I think that his conception of the human condition as being-in-the-world may culminate in something not that far from what Scheler (1991, 2009) and Gehlen (1950, 1988) in his wake call world-openness (*Weltoffenheit*)—not to forget Plessner's (1965, pp. 288–346, 2019, pp. 267–321) quite analogous concept of eccentric positionality.

Both Heidegger and these three main representatives of traditional philosophical anthropology are inspired by biologist Jakob von Uexküll's (1934, 2010, pp. 41–145) seminal analyses of the concept of environment (*Umwelt*), while remaining unsatisfied with their applicability to the human condition nevertheless. They argue that while nonhuman animals are supposed to be bound to an environment, that is a system of fixed stimuli and responses, humans would be open to the world, i.e., capable of determining their own existence while making abstraction from the present contingencies (Cykowski, 2015).

This conception has even older origins and dates back at least to the German philosopher Johann Gottfried Herder. As maintained in Herder's book *Treatise on the Origin of Language* (1967, pp. 1–154, 2002, pp. 65–164), animal behaviour would be fully determined by instincts, conceived of as tailored responses to univocally determined environmental occurrences. According to Herder (1967, pp. 22–26, 2002, pp. 77–81), humans would lack this instinctive equipment and, therefore, need to rely on their cultural and linguistic capabilities in order to orient themselves and survive in the world:

> *the sensitivity, abilities, and drives to art of the animals increase in strength and intensity in inverse proportion to the size and diversity of their circle of efficacy*. […] The human being has no such uniform and narrow sphere where only a single sort of work awaits him; a world of occupations and destinies surrounds him. His senses and organization are not sharpened for a single thing; he has senses for everything and hence naturally for each particular thing weaker and duller senses. His forces of soul are distributed over the world; no direction of his representations on a single thing; hence *no drive to art, no skill for art* (Herder, 1967, p. 24, 2002, p. 79).

On the one hand, humans would lack direct, biological adaptation to their environment, having to rely on subsidiary, artificial faculties in order to cope with this otherwise desperate situation. On the other,

the absence of a rigidly determined environmental relation would render them freer, more plastic and eventually capable of self-determination, contrary to nonhuman animals' alleged stubborn obtusity and quasi-automaticity.

Herder's philosophical conception was believed to find scientific support in von Uexküll's analyses—at least concerning animals' occlusion to perceptual stimuli alien to their preformatted horizon of environmental relevance. Afterwards, it was revamped by Scheler's (1991, pp. 36–49, 2009, pp. 25–35) understanding of human world-openness as our capability to make abstraction from the surrounding, immediate conditions in order to objectify phenomena and conceive of them as such, i.e., universalizing their meaning while exceeding the animal environmental limitation to concrete, singular instantiations. Eventually, it is fully developed by Gehlen, who argues that humans are open to the world precisely because they lack the animal adaptation to the environment:

> the lack of physical specialization, his vulnerability, as well as his astonishing lack of true instincts together form a coherent whole which is manifested in his "world-openness" (Scheler) or, what amounts to the same thing, in his lack of ties to a specific environment (Gehlen, 1950, p. 34, 1988, p. 27).

Humans would lack instincts, i.e., univocally determined responses to specific environmental stimuli, as well as specializations, i.e., morphological arrangements developed to fulfil precisely one and the same goal. This condition, Gehlen (1950, pp. 29–40, 1988, pp. 24–31) argues, would lead to the overburdening of our perceptual, limbic and behavioural faculties. Humans would experience structural overstimulation because, on the one side, they can be chronically triggered by multifarious, nonspecific phenomena. On the other, everything occurring to them is potentially perceived as relevant, eliciting nonstandard, unforeseeable and potentially uncontrollable reactions.

The positive flipside of world-openness, Gehlen claims, means that "the perceivable is clearly not limited to what is necessary for basic survival" (Gehlen, 1950, p. 34, 1988, p. 27). If everything is potentially relevant for humans, potentially frightening, paralyzing or perturbing, everything is also potentially irrelevant and meaningless. As I will further discuss in Chapter 2, thanks to their cultural practices, humans become able to make abstraction from their present concerns, repressing, delaying and diverting some stimuli while focusing on others, letting the institutional procedures themselves put in place channel and organize their energies. Therein would lie the anthropological difference: "whereas an animal is subject to the pressures of an immediate situation and changes in that situation, man is able to draw back and establish distance" (Gehlen, 1950, p. 41, 1988, p. 33). Gehlen submits that humans, thanks to technics, become able to control their potentially dangerous lack of instinctual mechanisms, entrusting their institutions with the task of absolving their biological functions at their

place. Furthermore, since humans are potentially concerned by everything and not necessarily concerned by anything, they gain the freedom to devote their attention to what they want, acquiring self-determination and doing without preconfigured biological patterns.

Leaving aside the important differences in emphasis and methodology, concerning the question of the human worldly condition I think that there may be a convergence between Heidegger's approach and the stances typical of philosophical anthropology. Humans are open to the world, i.e., they are not bound to predetermined behavioural patterns and are, therefore, able to abstract themselves from the contingencies of the immediate present to appreciate phenomena as such, that is in consideration of the event of their manifestation within an ecology of interconnected possibilities, always available for further transformations and modifications. Thus, we are capable of distinguishing between what manifests itself in our world and what renders this manifestation possible. However, I contend that the concept of human world-openness introduced by philosophical anthropology should also leave us unsatisfied, insofar as it presents at least two major issues when confronted with the theory of human constitutive technicity.

First, the concept of instinct, on which this construal depends, is far from straightforward. As pointed out by the anthropologist Gregory Bateson (1987, pp. 48–69), while commenting on scholarship in biology, for instance, instincts should be understood as an explanatory principle, i.e., a social convention between scientists meant to provide context to phenomena whose explanation remains unclear. Claiming that nonhuman animals are driven by instincts while humans are not, therefore, is contentious and does not provide real insights into our behaviour. According to Bateson, if we regard as instinctive those hardwired and mostly noncognitive behaviours not requiring learning to be developed, we should concede that also humans have instincts and very important ones, such as breathing. Moreover, we should acknowledge that even in nonhuman animals it is extremely difficult to precisely determine the difference between innate mechanisms and developmental outcomes, because of the impossibility of answering crucial questions such as whether learning itself should be conceived of as instinctual or acquired, i.e., whether learning to learn is an instinctive predisposition or should be learned in turn and so on.

13 Miserabilism

Secondly, despite its emphasis on the artificiality inherent to the human lifeform, philosophical anthropology largely relies on an erroneous understanding of our relation to technics. I will now outline and criticize this conceptual tradition, which Sloterdijk (1993, p. 56) terms miserabilism (*Miserabilismus*), i.e., the conception of humans as deficient beings, that is organisms lacking any means of biological adaptation and consequently forced to rely on technics in order to survive.

As reviewed by the German philosopher Odo Marquard (2000, pp. 11–29), miserabilism draws back to ancient, pre-evolutionistic understandings of humanity, crossing the history of advanced civilizations and especially that of the western one. This conception bears great influence on the Christian worldview of human existence and subsequently undergoes several metamorphoses concerning its secularization and reformulation by many historical and philosophical anthropologies. The term miserabilism groups all those conceptions which regard humans as degenerated, disgraced and disobedient creatures, helplessly prone to existential, political and moral failure. If humans are not able to carry on their life "on their own", miserabilism consequently calls for the intervention of "external" supports devoted to channelling, sustaining and leading their existence, such as transcendent intervention or political disciplining.

In this sense, miserabilism denounces the constitutive need for technical supplementation, but it does so while hypostatizing human deficiency as an originary given, which cannot be accounted for except through mythological narratives of the fall. The Christian doctrine of the original sin is an eminent example of this conception, revealingly interconnected with a metaphysics of origin which doubles human genesis into divine creation, on the one side, and the expulsion from the Garden of Eden, on the other. The second, accidental origin occurs to corrupt the first, originary origin, while actually accounting for our present condition as a subsequent and yet somehow necessary degeneration from the originary state of grace, transcendently projected back to an atemporal past, before "humanity" proper would arise.

The work of Herder in the eighteenth century represents the first attempt to secularize this worldview, elaborating the paradigm of its modern configuration: "culture" would occur in order to supplement "nature". As Herder argues in *Treatise on the Origin of Language* (1967, pp. 1–154, 2002, pp. 65–164), humans would lack any natural, that is biological means of adaptation to their environment and, therefore, need culture, i.e., complexes of traditions, institutions and norms, in order to survive. According to Herder,

> considered as a naked, instinctless animal, the human being is the most miserable of beings. Here there is no obscure, innate drive which pulls him into his element and into his circle of efficacy, to his means of subsistence and to his work (Herder, 1967, p. 93, 2002, p. 127).

Technics would emerge in order to cope with biological deficiencies, supplementing the human lack of innate adaptive mechanisms. The German philosopher Friedrich Wilhelm Nietzsche also represents a turning point in the miserabilist paradigm's conceptual itinerary, albeit occupying a rather ambiguous position within the debate. On the one hand, he claims that "the human being is the *as yet undetermined animal*" (Nietzsche, 1988c, p. 81, 2014, p. 61): "for humankind is sicker, more

uncertain, more changing, more indeterminate than any other animal, there is no doubt of this—he is *the* sick animal" (Nietzsche, 1988c, p. 367, 2014, p. 310). Nietzsche depicts humans as chronically ill organisms, who pervert and deflate their originary, affirmative vital drives into crippled and degenerate lifeways, such as the ascetic ideals.

On the other, Nietzsche states that "the proclivity to luxury goes to the depths of a person: it reveals that superfluity and immoderation are the water in which his soul most likes to swim" (Nietzsche, 1988d, p. 253, 2011, p. 215). By emphasizing the anthropological relevance of luxuriating superfluousness, Nietzsche submits an anthropology of excess and unlimited spending. He thereby acknowledges the constitutive character of pampering for the human condition and advocates for the positive affirmation of vital values, for instance, in his book *Thus Spoke Zarathustra* (1988a, 2006).

In the twentieth century, the miserabilist understanding also pervades Scheler's approach, as expounded in his essay "On the Idea of Man" (1919, pp. 273–312, 1978). Tool use, language, symbolic behaviour and cognition are understood by Scheler as "biologically a disease" (Scheler, 1919, p. 297, 1978, p. 193):

> only on the basis of the lack of specific organic and functional "adaptations" to the environment, as we find them among man's nearest relations, could a fundamental condition of optional and mobile adaptation, i.e., the basic conditions for understanding and choice, speech and making of tools, develop among men (Scheler, 1919, p. 307, 1978, p. 196).

This argument is pretty much the same as Herder's one: humans would lack the adaptation to the environment proper of the other animals and would consequently need to rely on nonbiological, artificial practices in order to survive and flourish. Not even Plessner deviates significantly from this pattern. Indeed, although he highlights human "natural artificiality", i.e., the fundamental role played by culture in supporting our existence, Plessner (1965, pp. 309–321, 2019, pp. 287–298) submits that the human lifeform would only resort to technical practices because "he wants to *compensate* for the dividedness of his own form of life" (Plessner, 1965, p. 311, 2019, p. 289, my emphasis).

Tellingly, Herder represents one of Gehlen's (1950, pp. 79–93, 1988, pp. 65–76) major sources of inspiration, as the latter finally incorporates the miserabilist account into an evolutionary framework. However, when miserabilism undergoes evolutionistic restyling, its fallacy becomes so apparent that even one of his main supporters cannot help but continuously hesitate between its strong affirmation and a more nuanced defence of human cultural uniqueness, while submitting different, revised versions of his anthropology throughout his intellectual itinerary (Lucci, 2010). On the one side, Gehlen maintains that "there is not at all a pre-culturally comprehensible human nature" (Gehlen, 1956, p. 119, my translation), i.e., there is no second, doubled origin and human technicity is

constitutive, unburdening manipulation of biological drives and environmental features. On the other, Gehlen (1950, pp. 3–17, 1988, pp. 3–13) famously conceives of the human lifeform as a deficient being (*Mängelwesen*), that is an unaccomplished, maladapted animal:

> in terms of morphology, man is, in contrast to all other higher mammals, primarily characterized by deficiencies, which, in an exact, biological sense, qualify as lack of adaptation, lack of specialization, primitive states, and failure to develop, and which are therefore essentially negative features (Gehlen, 1950, p. 31, 1988, p. 26).

Basically, Gehlen's narrative is at least as ancient as the myth reported by Plato in his dialogue *Protagoras* (1997, pp. 746–790). Contrary to the other animals, which are equipped with fangs, horns, big size, high speed, thick fur etc., as well as with innate, hardwired systems of adaptive responses to environmental stimuli, humans would lack any means of adaptation and capabilities to survive in the "natural" environment. In order to cope with this desperate condition, humans are supposed to have resorted to culture, i.e., complexes of artefacts together with their rules of usage, and thereby having arranged an artificial environment and body enabling them to carry on their existence.

The bacteriologist Paul Alsberg, whose philosophy of technology I will discuss in Chapter 2, elaborates one of the first thematic criticisms of miserabilism. Alsberg (1975, pp. 46–47) claims that while animals adapt to their environment through their bodies, humans lack this adaptive bodily organization. Human ancestors, as animals, are bodily adapted too, until a novel evolutionary process sets in. This new dynamic, "bodily switching off by means of artificial instruments"[8] (Alsberg, 1975, p. 49, my translation), amounting to "extrabodily adaptation"[9] (Alsberg, 1975, p. 49, my translation), constitutes human adaptation to the environment through technics, which replaces our ancestors' bodies in the process of adaptation, keeping humans adapted to their environment—as the other organisms also are—but differently, i.e., by means of artificial, extrabodily instruments. These technical practices, in turn, retroact on the human psychophysical constitution and take the place of its adaptive functions.

Inspired by Alsberg's insights, Sloterdijk (2004, pp. 674–676, 2016b, pp. 630–632) is among the most radical critics of the miserabilist understanding of the human condition, which he aims to overcome through a theory of human originary pampering, as I will discuss in Chapter 3. Sloterdijk (2004, pp. 699–711, 2016b, pp. 651–662) contends that, after the increase in comfort in modern western societies, the miserabilist ideology needs to become extreme to remain compelling. This approach, championed by Gehlen, now inscribes lack at the core of the human condition, rendering

[8] "Körperausschaltung mittels künstlicher Werkzeuge".
[9] "Außerkörperlichen Anpassung".

it “a constitutional or bio-cultural *a priori* neediness on the part of *homo sapiens*” (Sloterdijk, 2004, p. 701, 2016b, p. 652), rather than understanding it as a circumstantial situation due to socioeconomic parameters. Gehlen,

> by speaking of *homo sapiens* as a deficient being, […] presupposes a history of the weakening of humans, or rather their precursors, which—according to his own assumptions—can no longer be reproduced as mere natural history. […] In this picture, […] it remains entirely unclear how a creature is supposed to have acquired its initial deficiencies by natural evolution. It is impossible to derive such a dramatic dowry of deprivations from a natural history of humanity’s precursors. Left to its own devices, nature knows no successful handing-down of maladjustments or fatal weaknesses […]. It is extremely far-fetched to characterize the primal scene of anthropogenesis as the appearance of a creature unfit for life that—only just placed into its surroundings—immediately had to withdraw into the protective shell of a prosthetic cultural armor in order to compensate for its own biological impossibility. […] In other words, *homo sapiens* is not a deficient being that compensates for its poverty through culture, but rather a luxury being that was adequately secured by its proto-cultural skills to survive and occasionally prosper in the face of all dangers (Sloterdijk, 2004, pp. 704–706, 2016b, pp. 655–657).

Miserabilism’s contradictory untenability should now become evident. First, it is evolutionarily implausible: not only would it be hard to account for the emergence of such widespread and pervasive maladjustments, but above all organisms with this chronic condition would be likely to go extinct in the first place, before any other evolutionary solution or environmental change could set in.

Secondly, while attempting to answer the question of the origin of technics, which would occur as a survival strategy to cope with a biological maladaptation, miserabilism interprets these alleged deficiencies all too negatively, downplaying the crucial role the non-specialization of organic functions plays as plasticity, i.e., the capability to adjust one’s behaviour according to environmental interactions and, therefore, adopt culturally transmitted lifeways throughout ontogeny—as pointed out by the zoologist Adolf Portmann (1970, pp. 200–209) with reference to Gehlen’s anthropology. As argued by the ethologist Konrad Lorenz (1965, pp. 201–254, 1971, pp. 196–245), humans are “specialists in non-specialization” (Lorenz, 1965, p. 234, 1971, p. 227): we display advanced plasticity leading to flexible, interchangeable behaviours, but this predominant non-specialization is itself a form of specialization, i.e., a particular evolutionary pattern elicited by our sociocultural organization.

Thirdly, these deficiencies would only be ostensible: the bodily and behavioural maladjustments would be balanced off by the overdevelopment of the mind. Otherwise, no organism would be able to survive in such a hostile environment and concurrently thrive to the point of inventing technics from scratch. This perspective, in sum, risks inadvertently reproducing the old, worn-out dualism between both mind and body—devoting to spiritual intelligence the task of coping with bodily misfunctions through the means of technics—and history and nature—opposing human everchanging and modifiable sociocultural features to their biological, immutable foundations.

Understanding humans as deficient beings mistakes phylogeny for ontogeny. Our ancestors are adapted to their environment, which becomes increasingly artificial as they become increasingly human, technics actively modifying their biological constitution. Human offspring's helplessness and immaturity are indeed the outcome of this artificialization and their maladjustments are only ostensible. They should be rather understood as adaptations to their technical environment, which is precisely what evolutionarily shapes them in this way, as I will review in Chapter 3.

Miserabilism's pervasiveness is perhaps best appreciable when considering that it is uncritically resubmitted, in an almost unaltered fashion, even by contemporary approaches to the philosophy of technology. The Italian philosopher Paolo Virno (2009), for instance, aiming to criticize the current socioeconomic system, advocates on this basis for increased democratization and the emancipation of minorities—rather than for disciplinary institutions dictating collective behaviour, as is the case with Gehlen. And still, according to Virno, human alleged deficiencies would be biological, innate invariants, culture should cope with but will never be able to alter. Furthermore, from yet another political perspective, where neoliberal consumerism is praised as the only valuable goal for contemporary humans, the Italian philosopher Maurizio Ferraris (2021) submits the very same construal:

> for hundreds of thousands of years the human being, despite having hands, remained only a naked ape. The change took place when the hand finally grasped a stick. […] The human animal needs supplements to make up for its deficiencies, and that is why humans have technology and technology has humans […], because technology is precisely the set of tools or weapons with which the human animal has equipped itself to make up for its shortcomings (Ferraris, 2021, pp. 16–17).

Miserabilism represents one of the most refined configurations of the metaphysics of origin, which I will further scrutinize in Chapter 2. Technics, as a second origin, is not understood as an accidental addition to humanity, but rather as what substantially characterizes it. However, lack, as a first origin, is contradictorily deemed to account for the emergence of technical behaviour, it is the origin of the

origin, projected back in an absolute, "natural" past, disregarding how technics (the "second" origin) produces the human biological constitution (the "first" origin), transforming it throughout anthropogenesis.

Thus, starting from this perspective, I contend that it is possible to recontextualize Heidegger's insights into *Dasein*'s being-in-the-world within an updated evolutionary framework through the mediation of philosophical anthropology, which traditionally exhibits a privileged relation to the question of human evolution (Lysemose, 2012). Building on Heidegger's existential analytic has major relevance for this research because it enables us to appreciate how every investigation of our condition necessarily also implies enquiring into our own questioning behaviour, which is a major feature of the genealogical methodology of analysis I am adopting throughout this research, as I will discuss in Chapter 7.

In order to corroborate these claims, however, a confrontation between contemporary evolutionary biology and the philosophy of technology becomes compelling. Only by constantly referring to the state of the art of these disciplines, I believe, is it possible to cogently argue in favour of the technical constitution of our lifeform. I thereby aim to further develop the approach initiated by studies such as those carried out by Sylvia Blad (2010) and Gerald Moore (2017a) concerning the philosophies of Sloterdijk and Stiegler respectively.

14 Evolutionary Biology

As much as every other science, biology is an evolving discipline, whose tenets change over time and which exhibits inner controversies and a plurality of viewpoints. Scholars in the field usually submit the following periodization: since the forties, the so-called Modern Synthesis (MS), which is defined by the combination of Darwinian natural selection, Mendelian inheritance and population genetics, has been the dominant paradigm in evolutionary biology. This is the case despite the existence of alternative approaches and the very concept of the Modern Synthesis being a retrospective reconstruction elaborated by contemporary biologists and philosophers of biology, rather than a unitarian and self-declared paradigm.

Even before the Modern Synthesis established itself, indeed, alternative views were proposed, such as psychologist James Baldwin's (1896) insights regarding the transmission of acquired characteristics (the so-called Baldwin Effect) or biologist Conrad Waddington's (1942) theory of canalization of development, which emphasize how phenotypic variations in individuals may lead to heritable genotypic changes in the population. Moreover, the Modern Synthesis itself evolves across decades, thereby incorporating new experimental findings, which nevertheless are not seen to challenge its underlying tenets, so that nowadays it is still the dominant paradigm in its field of study.

I will now outline some of Modern Synthesis's core concepts, acknowledging nonetheless that this cannot be more than a simplification and stereotyping of a more complex scenario.

As pointed out by Philippe Huneman and Denis Walsh (2017), the Modern Synthesis emerges out of the reappraisal of some core Darwinian insights initially neglected by the early reception of the theory of evolution between the end of the nineteenth century and the beginning of the twentieth century:

> according to modern synthesis thinking the component processes of evolution—inheritance, development, innovation, and adaptive population change—are discrete and quasi-autonomous. They are discrete in the sense that each has its own proprietary cause. Inheritance is simply the transmission from parent to offspring of replicated materials. Development is the implementation of a program, or at least a set of flexible recipes, that exerts control over the phenotype. Novel evolutionary variants arise ultimately from random changes introduced into the genetic code. And adaptive population change is the change in the relative frequency of replicated entities under the influence of natural selection, mediated by the environment. The component processes of evolution are quasi autonomous in the sense that each operates more or less independently of the others. The process of inheritance is unaffected by the processes that introduce an adaptive bias to form, and by the process of development. Organisms do not inherit what would be advantageous for them to inherit, instead, for better or worse, they get the traits their parents donate to them at conception […]. Novel evolutionary characters (i.e., mutations) are unbiased by the adaptive demands of the organisms in which they first occur. They are said to occur at random. Neither of the processes of inheritance or development introduces evolutionary changes to biological form. The structure of the inherited material is completely unaffected by the downstream developmental processes that turn programs into organisms. What arises anew in development cannot be genuinely inherited. […] Adaptive evolutionary change is the sole province of natural selection (Huneman & Walsh, 2017, pp. 2–3).

According to the Modern Synthesis, each of the component dynamics of evolution has a different cause and acts independently of the others. Furthermore, genes are the units of inheritance and development, insofar as only they can be replicated and passed on from parents to offspring and encode the information for phenotypic formation. Evolutionary novelty, therefore, only emerges in an organism from genetic mutation and recombination and evolutionary change in a population, exerted by natural selection alone, is only registered if it is a change in gene frequency.

Starting from this outline, we can appreciate some of Modern Synthesis's tenets. First, gradualism, i.e., evolution only occurs slowly and over very long timespans. Secondly, gene-centrism, i.e., genes are the main drivers of evolutionary change. Thirdly, externalism, i.e., evolution occurs as the selection by the environment of the most adapted phenotypes, without the organisms being able to actively contribute to their evolutionary trajectory in return. As pointed out by the evolutionary biologist Kevin Laland and his collaborators, according to the Modern Synthesis,

> (i) evolutionarily significant phenotypic variation arises from genetic mutations that occur at a low rate independently of the strength and direction of natural selection; (ii) most favourable mutations have small phenotypic effects, which results in gradual phenotypic change; (iii) inheritance is genetic; (iv) natural selection is the sole explanation for adaptation; and (v) macro-evolution is the result of accumulation of differences that arise through micro-evolutionary processes (Laland et al., 2015, p. 2).

More generally, as highlighted by Massimo Pigliucci and Gerd Müller (2010), the Modern Synthesis exhibits an emphasis on genes as the individual units of selection; on evolution as solely led by competition; and as life as determined by preformatted genetic programmes uninfluenced by environmental or developmental factors. Among other disciplines, molecular biology plays a major role in the establishment of the Modern Synthesis, providing it with core ideas such as the operational conception of DNA, genes as uninfluenced by development and the clear-cut distinction between genotype and phenotype. Concurrently, other fields of study such as embryology, developmental biology and ecology are not integrated into Modern Synthesis's conceptual programme and, therefore, their findings are neglected.

15 The Extended Evolutionary Synthesis

Already in the eighties, the biologist Stephen Jay Gould (1982) called for a revision of evolutionary biology, deemed to be overly reductionist in its account of the dynamics of evolution and, therefore, unable to explain relevant evolutionary phenomena, such as heterochrony. Gould's work is mainly devoted to revising and updating traditional evolutionary theory by submitting and elaborating alternative dynamics. For instance, Gould (1991) proposes the concept of exaptation to explain how an otherwise maladaptive trait may become evolutionarily indifferent once it does not undergo negative selection anymore and can subsequently be co-opted for other, novel purposes. Feathers, for instance, initially emerge as a means to heat regulation and display and are only afterwards employed in bird flight.

In the last decades, many scholars advocate for a radical revision and expansion of the theory of evolution and call for a shift from the Modern Synthesis to an Extended Evolutionary Synthesis (EES), i.e., a new scientific paradigm able to accommodate the most recent experimental findings into a coherent theoretical framework, thereby composing a more complex and nuanced scenario for understanding evolution (Laland et al., 2015). The most important challenges presented by the Extended Evolutionary Synthesis to the Modern Synthesis include, first, broadening the concept of inheritance beyond genes alone and acknowledging the existence of other forms of inheritance such as epigenetic, environmental and cultural inheritance. Secondly, reappraising the significance of development as a constraint to evolution and a source of inheritable adaptation. Thirdly, not conceiving anymore of natural selection as the only cause of adaptive evolutionary change, because organisms proactively contribute to their evolution and fitness through their behaviour (Huneman & Walsh, 2017; Laland et al., 2015; Pigliucci & Müller, 2010). Importantly, while many of these ideas are already present in the Modern Synthesis and even in Darwinism prior to it, the evolutionary relevance of these dynamics is usually unacknowledged until recent times.

The revision of evolutionary biology advocated by supporters of the Extended Evolutionary Synthesis is triggered by observations coming, first, from evolutionary developmental biology (evo-devo), insofar as this discipline regards phenotypic variation as potentially biased by developmental processes. Secondly, from the study of neural and developmental plasticity, insofar as an organism's capability to modify its phenotype and behaviour according to its interactions with the environment is regarded as not only the outcome but also the cause of phenotypic evolution. Thirdly, from an inclusive conception of inheritance, insofar as parental effects and social transmission enable organisms to pass on traits not only from parents to offspring and through reproduction and gene replication alone, as previously believed. Fourthly, from niche construction theory, insofar as environmental modification by the organisms is regarded as non-random and the ensuing ecological inheritance is deemed to be evolutionarily relevant.

In sum, the Extended Evolutionary Synthesis advocates for a central evolutionary role for the organisms in actively contributing to their own evolutionary trajectory and affirms that mutation and selection are not the only or primary drivers of evolution. Notably, as argued by Scott Gilbert and David Epel (2015, pp. 403–420), the most recent developments in evolutionary biology challenge our current conception of life and, in turn, prompt us to rethink our current ontology, epistemology and ethics. Concurrently, twentieth-century philosophies such as dialectical materialism, phenomenology and process philosophy bear influence on the ongoing restructuration of evolutionary biology's paradigm, testifying to the coevolution and mutual complementarity of biological and philosophical approaches.

However, as argued by Douglas Futuyma (2017), the need for a radical revision of evolutionary biology advocated by the Extended Evolutionary Synthesis may not exhibit enough empirical and theoretical grounds, insofar as the most important insights vindicated by this conceptual paradigm would already be substantially present in and taken into account by the Modern Synthesis. From this perspective, the main tenets of evolutionary biology would undergo constant update and accommodation of new insights but would not require a thorough and sudden transformation and emendation.

16 The Evolutionary Turn

Either way, the conceptual paradigm submitted by the Extended Evolutionary Synthesis in order to understand evolution in general also applies to the study of human evolution in particular. For instance, the conceptual apparatus developed by the Modern Synthesis is not suitable for adequately enquiring into the evolution of our species, insofar as it downplays processes, such as niche construction, which nevertheless play a major role in anthropogenesis (Kissel & Fuentes, 2021). Conversely, the Extended Evolutionary Synthesis, with its emphasis on the evolutionary relevance of phenomena such as developmental plasticity, provides us with a scientific toolkit suitable for satisfactorily investigating our evolutionary origin (Antón & Kuzawa, 2017). As pointed out by the French philosopher Edgar Morin, human evolution cannot be accounted for through gene mutation and natural selection alone, insofar as it rather amounts to "a complex and multidimensional morphogenesis resulting from genetic, ecological, cerebral, social and cultural interferences"[10] (E. Morin, 1979, p. 65, my translation).

A reference to dating and terminology may here be useful. The family of Hominids, to which humans as well as the other great apes (orangutans, gorillas, chimpanzees and bonobos) belong, separated from the order of Primates around 18 million years ago, while the tribe of Hominins, our proper lineage, separated from this family around 6–7 million years ago. The genus Homo, in turn, separated from the other Hominins around 2.8 million years ago, as documented by the fossil record found in Ledi-Geraru, Ethiopia (Villmoare et al., 2015). Although many genera of Hominins and species of Homo existed, ours is the only one that survives nowadays. The species Homo erectus spread from Africa across the world between 1.8 and 1.3 million years ago, while our direct ancestor—although interbreeding between different species of Homo occurred—is the species Homo sapiens (also known as anatomically modern humans), which emerged around 300 thousand years ago and shortly afterwards spread across the world from Africa.

[10] "Une morphogenèse complexe et multidimensionnelle résultant des interférences génétiques, écologiques, cérébrales, sociales et culturelles".

This categorization should be confronted with data concerning the evolutionary emergence of stone tool manufacture by Hominins, whose earliest secure evidence is presently dated as around 3.3 million years ago in West Turkana, Kenya (Harmand et al., 2015). Technical behaviour could have begun even earlier, possibly initially as simple tool use and subsequently as tool manufacture proper, also because tools not made of stone, such as leather or wood instruments, for instance, are less likely to survive as fossil records, while also representing an easier material to manipulate than stone. Moreover, simple, unsophisticated tools such as bare stones cannot be accurately identified as artefacts by palaeontological research, because they may be easily confused with trivial prehistoric stones, their usage only being inferable thanks to the marks they may have left on other fossilized items. Finally, the most ancient stone tools may go unnoticed by paleontological research because they occur in very low densities. Hence, not only the lithic industry predates the genesis of Homo but technical behaviour could also hark back to the origin of Hominins themselves, at least in embryonic form.

Thus, the evolution of the usage, production and transmission of artefacts substantially interrelates with the evolution of our lineage (Ambrose, 2001). Throughout this research, I aim to reconstruct the role played by technics in anthropogenesis by benefiting from the conceptual apparatus developed by the Extended Evolutionary Synthesis, with special reference to three major dynamics, which should enable me to underscore the evolutionary significance of technics. First, the concept of cultural niche construction prompts us to consider how humans modify their environment through sociocultural practices, thereby contributing to altering their selection pressures. Secondly, the notion of neuroplasticity enables us to conceive of humans as organisms constantly modifying their behaviour and morphology through their interactions with the environment, thereby learning and transmitting skills and knowhow relevant to their survival. Thirdly, the idea of nongenetic transgenerational inheritance paves the way to an understanding of the evolutionarily relevant transmission of traits through sociocultural means.

CHAPTER 1

THE HISTORICAL CONTINGENCY OF THE NATURE-CULTURE/SOCIETY BINARY AND THE TECHNICAL CONSTITUTION OF THE MODERN WESTERN EPISTEME

The conceptual landscape outlined above conjoins insights coming from the philosophy of technology, philosophical anthropology and evolutionary biology in order to introduce Sloterdijk's and Stiegler's understanding of human constitutive technicity. In this chapter, I will apply this approach to elaborate a refined conceptualization of technics. First, I will combine Sloterdijk's and Stiegler's understanding with the analyses developed by authors such as Philippe Descola, Bruno Latour and Jason Moore in order to differentiate my conception of technics from the traditional stance that regards it as an expression of human sociocultural activity, conceived of, in turn, as opposed to natural processes. I will show how the nature-culture/society binary, upon which this understanding rests, far from describing some alleged repartition of reality independent of human practices, is rather a historical, intrinsically paradoxical organization of experience contingent on western modernity. Secondly, thanks to Yuk Hui's concept of cosmotechnics, I will argue that this episteme—in Michel Foucault's sense—is structured by technical operations and that it permeates our common-sensical understanding of the world as well as our scientific practice and socioeconomic system, which the processual understanding of technics developed through these analyses sets out to revise. Hence, by referring to insights coming from scientific fields such as human geography and cultural anthropology, I will criticize the traditional philosophical understanding that regards nature and culture/society as two distinct ontological domains and debunk the axiological priority typically assigned to the latter.

1.1 The Episteme of Western Modernity

Claiming that biology and technics constitutively interrelate relative to the human lifeform begs the question regarding how, in the first place, we should conceive of biology and technics respectively. According to the interpretive framework I aim to submit throughout this research, we should not understand them as two separate and autonomous domains of reality that would subsequently somehow need to relate. As stated in the Introduction, we should not start by taking their inherited meaning for granted in order to understand their relationship, but rather enquire into their relationship in order to elucidate their mutual definition.

Thus, I set out to investigate the relationship between biology and technics starting from a criticism of how these concepts have been traditionally expounded, i.e., as nature, on the one side, and culture or society, on the other. The following analyses aim to highlight that, first, nature and culture/society

should be understood as complementary concepts, i.e., they only hold validity and produce effects through their mutual definition. Secondly, they are historical, i.e., they only emerge and perform meaning in a certain epoch and region, that is western modernity. Thirdly, the logic of their articulation is irreducibly paradoxical, insofar as they only work by unduly and arbitrarily separating what is actually one and the same, thereby exhibiting conceptual tensions which may only be resolved through the adoption of a different interpretive framework.

The relationship between nature and culture/society can be considered a fundamental element of what we may call, following the French philosopher Michel Foucault, the western modern episteme. According to Foucault, who develops this concept in his book *The Order of Things* (1966, 1989), epistemes are "fundamental modes of knowledge" (Foucault, 1966, p. 265, 1989, p. 275), i.e., the conceptual and behavioural schemata prevalent in a given epoch and region. Epistemes are made of what Foucault (1971, 1981) calls discourses, that is what holds "the power to constitute domains of objects, in respect of which one can affirm or deny true or false propositions" (Foucault, 1971, pp. 71–72, 1981, p. 73), thereby determining realms of legitimacy and illegitimacy, mutating over time and supported by institutions, rituals and habits. These sets of lifeways and worldviews constitute the framework within and according to which particular forms of knowledge and systems of enunciation may emerge and hold validity and, more generally, what implicitly undergirds our understanding of reality:

> what I am attempting to bring to light is the epistemological field, the *episteme* in which knowledge, envisaged apart from all criteria having reference to its rational value or to its objective forms, grounds its positivity and thereby manifests a history which is not that of its growing perfection, but rather that of its conditions of possibility; in this account, what should appear are those configurations within the space of knowledge which have given rise to the diverse forms of empirical science (Foucault, 1966, p. 13, 1989, pp. xxiii–xxiv).

Epistemes determine the limits and potentialities of knowledge in a given historical context. Foucault's enquiry aims to reconstruct their tenets and render their constitution explicit—differently from the individuals directly experiencing them, who are mostly unaware of their thinking's background presuppositions. We interpret the world according to our episteme, for instance, by assigning values to some beings and ignoring others or by partitioning reality into different domains supposed to abide by different rules of functioning. Our episteme represents the set of conditions determining how we structure our experience and account for our knowledge.

According to Esposito (2012a, pp. 88–111), the traditional opposition between nature and culture/society, despite its paradoxical untenability, is constitutive of our episteme. This conception

emerged out of the articulation of Hellenic philosophy, Roman law and Christian doctrine and still pervades the hegemonic, globalized understanding of the contemporary world. As Esposito argues in his books *Third Person* (2012b) and *Persons and Things* (2015), the western tradition organizes reality as subdivided into two main domains, namely what he terms persons (i.e., immaterial, spontaneous intellects), on the one hand, and what he calls things (i.e., inert, passive materials), on the other.

This split, Esposito argues, is also reproduced within humans themselves, insofar as each of us is deemed to have both person and thing components, embodying an ineliminable fracture between rational faculties (soul) and biological processes (body), with the former traditionally supposed to rule over the latter. Esposito outlines how this functional opposition is axiomatically charged and functionally unbalanced in favour of persons, which are supposed to dominate, control and exploit things.

1.1.1 Descola

In his book *Beyond Nature and Culture* (2005, 2013), the anthropologist Philippe Descola, inspired by Foucault's analyses, attempts to comparatively reconstruct different epistemes, contrasting western modernity's interpretation of reality with other conceptions of the world. Descola (2005, pp. 72–113, 2013, pp. 32–56) highlights that there are many ways of organizing our understanding of the environment and the relationships between the beings inhabiting it. For instance, some communities attribute the status of human subjects to what western modernity rather classifies as nonhuman animals or regard what western modernity usually considers inert beings as endowed with living faculties.

Hence, according to Descola (2005, pp. 169–203, 2013, pp. 91–111), practical and cognitive schemata of experience determine how humans understand and inhabit the world. These schemata are multiple and yet not infinite and may combine with each other and transform themselves multifariously. They vary geographically and historically, are apprehended and yet deeply rooted in our cognitive setup and influence and mould our behaviour. Although we are mostly unaware of them, we can utilize and take advantage of them nonetheless. The predominant schemata in a community determine what Descola calls its ontology, i.e., how its members classify and attribute value to beings.

Descola sketches out four main ontologies historically organizing our understanding of reality, which he calls animism, totemism, analogism and naturalism. The latter is peculiar to and predominant in western modernity, where it has originated from analogism through a series of polarizing radicalizations, starting from the sixteenth century in Europe and gradually becoming institutionalized as the dominant epistemic paradigm in the contemporary, globalized world. Analogism, indeed, is characterized by the impossibility of exactly differentiating between what

belongs to the interiority of a being and what belongs to its exteriority. Conversely, naturalism regards all beings as sharing the same exteriority, i.e., their physical, material constitution, while being differentiated by their interiority, understood as immaterial, abstract faculties only manifesting themselves through exteriority.

In naturalism, humans are usually deemed to have an interiority, while the other beings would not have one. Descola (2005, pp. 302–350, 2013, pp. 172–200) points out that this conception, rather consistent at first sight, is actually paradoxical. First, according to this episteme, interiority should concurrently account for both what distinguishes all humans from all the other beings (i.e., all and only humans have culture/society) and what differentiates a human group from the others (i.e., each community has a different culture/society). Secondly, interiority, as it is conceived of by naturalism, that is as ineffable, intelligent soul, spirit, mind etc., is hardly extendable to all beings, such as mountains or rivers, for instance, because of their apparent lack of "internal" states, while exteriority, understood as amorphous, indeterminate matter, can hardly account for all our faculties because of its complete lack of specificity. Thus, all the different versions of naturalism tend to deny any reality to either nature or culture/society, advocating for either a reductionist and physicalist explanation for all phenomena or the absolute relativity and unfathomability of "external" nature.

1.1.2 Latour

Based on Descola's analyses, we may appreciate how, first, the understanding of nature as passive, irreflective matter opposed and complementary to culture/society as spontaneous, intelligent spirit is contingent on the episteme of western modernity. Secondly, it is necessarily doomed to give rise to irresolvable tensions because of its own paradoxical structure. I will now turn to French philosopher Bruno Latour's thinking in order to outline our episteme's contradictory character, since he provides us with a refined interpretive framework for understanding the relationship between natural beings, which he calls nonhumans, on the one side, and sociocultural beings, which he terms humans, on the other, in western modernity.

According to Latour, while these two concepts have traditionally been understood as separate yet somehow interrelating realities, we should not attempt to ground a connection between two distinct entities, but rather set out to investigate their historically rooted co-belonging. In his book *We Have Never Been Modern* (1991, 1993), Latour enquires into the origin of western modernity's worldview and advances that this episteme is characterized by a paradoxical project, working as long as it concurrently denies its own reality and based on a supposedly clear-cut distinction between nature and culture/society.

Latour (1999, pp. 21–85, 2004, pp. 9–52) maintains that nature is produced through sociocultural practices—such as science, for instance, whose objects are constructed through networks of

laboratories, research institutions, experimental toolkits and so on. Concurrently, Latour (1990) also argues that culture/society is produced through natural practices, since social relations, for instance, only occur as mediated and structured by complexes of nonhuman entities—such as signs, machinery, communication technologies and so on. However, Latour (2015, pp. 15–56, 2017, pp. 7–40) claims, in this episteme natural sciences are deemed to faithfully represent nature, conceived of as an external, independent entity, readily available to be measured and tested, without any human, that is sociocultural influence bore on their experimental processes and outcomes. Concurrently, he argues, sociology holds that the relations among humans are unimpacted by nonhuman apparatuses, which are rather conceived of as ultimately superfluous add-ons, whose mediation does not affect the relations they embody to any extent:

> the word "modern" designates two sets of entirely different practices which must remain distinct if they are to remain effective but have recently begun to be confused. The first set of practices, by "translation", creates mixtures between entirely new types of beings, hybrids of nature and culture. The second, by "purification", creates two entirely distinct ontological zones; that of human beings on the one hand; that of nonhumans on the other. Without the first set, the practices of purification would be fruitless or pointless. Without the second, the work of translation would be slowed down, limited, or even ruled out. […] So long as we consider these two practices of translation and purification separately, we are truly modern—that is, we willingly subscribe to the project of critical purification, even though that project is developed only through the proliferation of hybrids down below. As soon as we direct our attention simultaneously to the work of purification and the work of hybridization, we immediately stop being wholly modern, […] because we become retrospectively aware that the two sets of practices have always already been at work in the historical period that is ending. […] The more we forbid ourselves to conceive of hybrids, the more possible their interbreeding becomes—such is the paradox of the moderns, which the exceptional situation in which we find ourselves today allows us finally to grasp (Latour, 1991, pp. 20–22, 1993, pp. 10–12, trans. mod.).

Our episteme performs what Latour terms translation, i.e., the production of so-called hybrids, that is entities not ascribable to nature (nonhumans) or culture/society (humans) alone, but rather concurrently belonging to both. Some of these entities occasionally come to the fore explicitly as hybrids, perturbing the modern order with their seemingly unresolvable admixture of human and nonhuman traits—climate change and COVID-19 being two eminent examples, among many others. Concurrently, our episteme also exerts what Latour terms purification, i.e., the separation of what belongs to nature from what belongs to culture/society, accurately and univocally assigning each

entity to one of these two domains and denying importance to what seems recalcitrant not to fall right in between them.

Moreover, Latour argues, western modernity denies the existence of the process of translation, while only explicitly acknowledging the process of purification. According to this narrative, this episteme is characterized as the accomplished and effective separation of what was formerly unduly confused, i.e., humans and nonhumans—as it believes to be the case with the other epistemes. However, it is precisely thanks to the denial of the process of translation (i.e., the production of hybrids) that these hybrid entities may massively proliferate in our world. Since attention is not paid to their production, their development is not regulated, administered and collectively taken into account. Latour aims to unveil the paradoxical logic inherent to the episteme of western modernity by giving due consideration to both the process of purification and the process of translation, thereby contrasting the uncontrolled proliferation of hybrids and proposing an alternative narrative.

Indeed, Latour (1991, pp. 104–108, 1993, pp. 76–79) regards purification as a particular instance of translation. Nature and culture/society, nonhumans and humans, are not two separate, ultimately unbridgeable realms, only locally and partially, if not erroneously, combining into hybrids. If understood under western modernity's categories, every entity consists of a mixture of natural and sociocultural elements. This does not mean, however, that the contamination between nonhumans and humans is unavoidable, but rather that the separation of entities into natural and sociocultural elements (i.e., the process of purification) is a secondary operation aiming to arbitrarily divide what is initially united. The process of translation is originary, insofar as it consists in the production of entities that can only subsequently and relatively be ascribed to the respective domains of nature and culture/society.

Admittedly, the word "hybrid" may be misleading here, insofar as it reflects the conception of reality as initially split into two separate domains, only derivatively, occasionally and temporarily combining, purported by the episteme of western modernity. However, what is really derivative is this episteme's logic, whence its discomfort when it is found that no entity actually manifests itself as purely natural or sociocultural. Nature and culture/society should be regarded not as separate domains of reality but rather as two relative and ultimately inexistent vanishing points of the process of production of hybrids. Translation is a relation constituting its own poles (i.e., nature and culture/society), which consequently only exist and hold meaning within this relation.

Hence, Latour (2005) argues, we should concurrently deconstruct the respective notions of nature and culture/society, thereby showing how these two concepts are not independent, autonomous realities, but rather represent two complementary sides of the same worldview, that is the modern western episteme, and only work through their mutual exclusion and opposition. According to Latour (2012, 2013), every community differently determines what belongs to nature and what belongs to

culture/society, as well as what "nature" and "culture" or "society" are supposed to be, framing and classifying the world according to its particular interpretive schemata.

We should discard cultural relativism, i.e., the paradigm according to which there would only be one nature, differently interpreted by different cultures (i.e., historical human groups), together with particular universalism, which is a special case of the former, where it is assumed that only western modernity would faithfully represent nature "as it truly is". As observed by Latour (1991, pp. 139–144, 1993, pp. 103–106), this special vantage on reality is only apparent, insofar as the episteme of western modernity also produces—albeit without acknowledging it—the concept of nature against which the repartitions of reality exerted by the other "cultures" are assessed. Rather than one single nature and many different cultures/societies, among which only the western one would have privileged access to the truth about nature, there are multiple nature-culture/society couplings, each community repartitioning beings differently.

1.1.3 Moore

The paradoxical logic inherent to the episteme of western modernity is also cogently expounded by the environmental historian Jason Moore in his theory of the Capitalocene, as he develops it starting from his book *Capitalism in the Web of Life* (2015). In the last two decades, the term Anthropocene has come to the spotlight of both general and scientific attention as a keyword to define the current epoch. Succeeding to the geological era of the Holocene, the Anthropocene's name refers to "the human" (*anthropos* in Hellenic) as the major cause of environmental change, eminently expressed by global warming and the related disruptions. However, Moore observes that the term Anthropocene is misleading and overly indeterminate because, first, it obfuscates the intersectional differences subsisting between individual humans, such as class, gender, race etc. Secondly, it deflects our attention from the real cause of the current ecological crisis, which, Moore argues, should not be identified with "humanity as an undifferentiated whole" (J. W. Moore, 2015, p. 173), but rather with a particular way of interpreting and inhabiting the world, i.e., capitalism. He proposes, therefore, the term Capitalocene to denote "the historical era shaped by the endless accumulation of capital" (J. W. Moore, 2017, p. 596), framing the essence of our epoch as an ongoing environmental catastrophe provoked by capitalist overexploitation.

According to Moore, capitalism originated in Europe starting from the second half of the fifteenth century and not with the second industrial revolution occurring in the mid-nineteenth century, as it is usually believed, and is thereby coincident with the rise of the episteme of western modernity. Furthermore, it should not be reduced to changes in economics alone, but is rather "*a way of organizing nature*" (J. W. Moore, 2015, p. 14), "a new pattern of environment-making" (J. W. Moore, 2015, p. 175), a "situated and multispecies world-ecology of capital, power and re/production" (J. W.

Moore, 2017, p. 609), involving a paradigm shift in how the westerners conceive of and organize the world. The rise of capitalism entails social, intellectual and technological changes: "the capitalist revolution, far from a narrowly economic process, was an epochal shift in the ways of earth-moving […], state-making, mechanization and symbolic praxis" (J. W. Moore, 2017, p. 605).

Moore observes that, while "value shifted from land productivity under conditions of seigneurial power to labor productivity under the hegemony of the modern world market" (J. W. Moore, 2017, p. 610), terrestrial globalization was pursued as the mapping and conquest of lands and seas. Contributing to the rise of capitalism, "alongside new technologies, there was a new *technics*—a new repertoire of science, power and machinery" (J. W. Moore, 2017, p. 610), i.e., a "crystallization of tools and power, knowledge and production" (J. W. Moore, 2015, p. 188), particularly concerning spatiotemporal localization, discretization and calculus techniques, contributing to eliciting a thorough reorganization of what is valued and what is not.

Hence, Moore claims, the current crisis is the direct outcome—and not a by-product—of centuries of exploitation and dominion, thereby highlighting the limits of a system structurally living beyond its possibilities. Moore maintains that capitalism is based on what he calls Green Arithmetic, i.e., the originary separation of "humanity" (i.e., culture/society) from "nature", together with the performative belief that these two entities summed up would amount to the whole of reality. These two concepts, humanity and nature, should be understood as neither concrete entities nor pure speculations, but rather as historical interpretations of reality bearing actual influence on our practices nevertheless. Moore observes that the traditional narrative of the Anthropocene prolongs Green Arithmetic's tenets because it claims that humanity is now a geological force, i.e., it influences nature, which is thereby conceived of as initially separate from it.

Thus, "the whole thrust of capitalist civilization develops the premise that we inhabit something called Society, and act upon something called Nature" (J. W. Moore, 2017, p. 600): Green Arithmetic provides capitalism with the conceptual means to pursue endless dispossession and accumulation. Indeed, if nature is conceived of as something external to and independent of culture/society, one may feel free to indefinitely exploit and dominate it, uncritically subserving it to their purposes: "capitalism's governing conceit is that it may do with Nature as it pleases, that Nature is external and may be coded, quantified, and rationalized to serve economic growth, social development, or some other higher good" (J. W. Moore, 2015, p. 14). Consequently, when the capitalist project encounters obstacles to its proceeding, they are depicted as "natural limits" and overcome accordingly, that is violently and indiscriminately.

These observations lead Moore to submit the concept of cheapening, which he likens to Heidegger's abovementioned notion of *Bestand* (J. W. Moore, 2016). Under capitalist conditions, "nature" is always Cheap Nature, i.e., something meant to provide free work/energy, that is "work in

a broadly biophysical sense" (J. W. Moore, 2018, p. 242), composing an indefinitely available and exploitable, inert and passive supply. According to this episteme, everything that can undergo cheapening may count as nature, regardless of it being geological forces, nonhuman organisms or people, as exemplified by the fact that most humans in the capitalist system are completely or mostly ascribed to the side of nature rather than humanity—such as women, slaves, indigenous and colonized people etc. As contended by Moore, "this Cheapening is twofold. One is a price moment: to reduce the costs of working for capital, directly and indirectly. Another is ethico-political: […] to treat as unworthy of dignity and respect" (J. W. Moore, 2017, p. 600), through violence, oppression and exploitation of both humans and nonhumans.

Capitalism's logic not only regards nature as cheap but also actively works to constantly produce Cheap Natures, i.e., strives to render everything exploitable completely or almost completely for free and on-demand. Since the rate of profit structurally tends to diminish, the costs of production need to decrease accordingly for the system to keep on working: "the problem is that such exclusions must grow faster than the mass of accumulating capital. New frontiers must be appropriated, lest the problem of surplus capital intensify" (J. W. Moore, 2018, p. 266). Moore submits that, in order to survive and thrive, capitalism needs to incessantly and increasingly produce and consequently exploit Cheap Natures, benefiting from the free work/energy they provide—the whole system would collapse without this disproportionality.

Cheapening amounts to a general reassignment of values where some performances are considered labour proper (i.e., sociocultural labour) and are thereby recognized (some) value, while others are not, thereby becoming invisible (i.e., natural labour). From this perspective, Moore contends that capitalism works through both accumulation by capitalization, i.e., organizing re/production and exchange within the cash nexus, and accumulation by appropriation, i.e., organizing re/production outside the cash nexus and sustaining it with a constant flow of materials, energies, capabilities and bodies. The latter are not accounted for as valuable and are, therefore, fed into the system without any recognition or compensation: "vigorous accumulation depends on the existence—and the active production—of human and extra-human natures whose costs of reproduction are kept 'off the books'" (J. W. Moore, 2017, p. 606). While the paid work of some humans constitutes the pivot of capitalist production, the unpaid work of the other humans and all nonhumans constitutes the conditions of reproduction of this production. Thus, work/energy involves not only waged work but also the "work" of biosocial reproduction, for instance, and the "work" of nonhumans.

Hence, capitalism cannot help but lead to the ecological crisis, insofar as it has to increasingly produce and exploit Cheap Natures in order to keep on pursuing indefinite accumulation and avoid structural breakdown. Moore aims to overcome the hegemony of the capitalist organization of reality by submitting that there is no clear-cut, essential distinction between nature and culture/society. We

are rather all part of the "web of life", an ecological intertwinement of humans and nonhumans—the latter structurally contributing to every human endeavour, including capitalism. From this viewpoint, humans being a geological force is no novelty, since we have always contributed to constructing our environment, to which we also inherently belong. The Capitalocene rather marks a shift in the way reality has been conceived of and organized by the capitalist logic, i.e., the separation of culture/society from nature and the consequent exploitation of this divide to endlessly accumulate capital.

I maintain that the analyses carried out by Descola, Latour and Moore exhibit substantial convergence on at least two major points. First, they show how the concepts of nature and culture/society exhibit oppositive complementarity, historical relativity and irreducible inconsistency, thereby contributing to producing the episteme of western modernity. Secondly, they draw our attention to how the articulation of these concepts, despite their inner contradictions, holds validity even nowadays and pervades our common-sensical understanding of the world (Descola) as well as conception of science (Latour) and socioeconomic practice (Moore). We may now be able to peek beyond the horizon of this episteme because of the rearrangement of our living conditions brought about by contemporary technoscientific development and the related unsettling of our current systems of value. Nonetheless, the nature-culture/society binary is still the overarching understanding of the globalized world, framing our experience and accounts of reality.

1.2 Cosmotechnics

In light of the analyses carried out above, I now aim to elucidate the role played by technics in the constitution of epistemes and especially that of western modernity. Technics should not be uncritically identified with culture/society, because it is rather what enables and organizes the episteme to which the concept of culture/society constitutively belongs. Hence, I think that Hong Kong philosopher of technology Yuk Hui's concept of cosmotechnics, elaborated in his book *The Question Concerning Technology in China* (2016), may help us understand how technics structures the system of knowledge based on which we interpret the world and assign value to beings.

In the wake of Stiegler's (2018a; 1998b, 2009c, 2010d) and palaeoanthropologist André Leroi-Gourhan's (1964, 1965; 2018) analyses, Hui regards technics as an anthropologically universal phenomenon constituting the human lifeform. He broadly understands it as the "skills for making artificial products" (Hui, 2016, p. 8), thereby referring to "the general category of all forms of making and practice" (Hui, 2016, p. 4). However, Hui (2016, pp. 9–10) argues, albeit equally concerning all humans, technics is perceived and reflected upon differently in different communities, thereby acquiring diverse meanings and developmental pathways.

For instance, in "The Question Concerning Technology" (2000, pp. 7–36, 1977b, pp. 3–35), Heidegger distinguishes between the Hellenic conception of technics as *poiesis*, i.e., production broadly understood, the process of bringing something forth into existence, and modern technics as *Gestell*, i.e., an all-encompassing grip on the whole of beings aiming to frame and exploit it as *Bestand*, that is standing, indefinitely available and fully calculable reserve. Starting from this perspective, Heidegger claims that "technology is a way of revealing" (Heidegger, 2000, p. 13, 1977b, p. 12), i.e., *poiesis* as well as *Gestell* are modes of unveiling, that is historical manifestations and modulations of the event of Being. Technics articulates how we make sense of reality and, since it manifests itself differently in different historical epochs, our understanding of our worldly condition will vary accordingly.

However, Hui (2016, pp. 3–5) argues, Heidegger's differentiation remains internal to the western understanding of technics, thereby abiding by a widespread tendency in the history of philosophy to assume that there is only one explanation for, function and kind of technics. This conception, in turn, supports the contemporary, hegemonic understanding of technics as homologating *Gestell*, which Hui (2016, pp. 20–22) identifies with western modernity's conceptualization of the relationship between nature and culture/society discussed by Latour, the naturalist ontology outlined by Descola and the capitalist socioeconomic system analysed by Moore.

Thus, without denying historical validity and hermeneutic relevance to Heidegger's understanding, Hui denounces its ethnocentrism when it is considered the only possible conception of technics. In order to counter this tendency, Hui submits the concept of cosmotechnics: "technics is always *cosmo*technics", i.e., "the unification between the cosmic order and the moral order through technical activities" (Hui, 2016, p. 19). The development of a group's technical system is not only influenced by factual constraints, such as ecogeographical factors or the availability of some particular material. It is also shaped by that group's cosmology, i.e., its understanding of the world, determining which technical solutions that community regards as acceptable and which not. Technical change, in turn, influences the way we understand and inhabit the world, moulding our cognition based on the different technologies we adopt:

> the experience of technics is related to and partially conditioned by cosmology—and it is precisely in this sense that we insist on the importance of a *cosmotechnics*. Technical apparatuses function somatically as extensions of organs—and, as prostheses, are *somatically and functionally* universal, and yet they are not necessarily *cosmologically* universal. That is to say, in so far as technics is both driven by and constrained by cosmological thinking, it acquires different meanings, beyond its somatic functionalities alone. […] Yet even if we agree with Leroi-Gourhan in seeing the exteriorisation of memory as a general technical tendency, this

> does not yet allow us to explain why and how each culture exteriorises at a different pace and with a different direction; that is, it does not explain how exteriorisation is determined by certain conditions—not only biological and geographical but also social, cultural and metaphysical (Hui, 2016, pp. 217–218).

Technics—or more precisely, its epochal and regional configurations—play a major role in structuring how we make sense of the world, leading us to adopt some ways of classifying beings and the relationships between them and reject others, thereby undergirding what Descola calls our ontology. Thanks to Hui's concept of cosmotechnics we may appreciate how our worldviews are influenced and constrained by the available artefacts and coevolve with them. We may or may not assign value to some entity or process based on how our technical system frames our experience and moulds our behaviour, thereby structuring our community as well as our understanding of it. For instance, one can appreciate how the introduction of alphabetic writing in Ancient Greece contributed to the Athenian conception of democracy as based on publicly available, written laws. Or how the unregimented circulation of deepfakes nowadays enhances people's mistrust in statements by politicians, thereby unsettling the current conception of public truth.

Hui (2016, pp. 23–24) criticizes Descola for using the term "practice" instead of technics, because, while he rightly tries to overcome the opposition between nature and culture/society, he thereby also risks obfuscating the question of cosmotechnics and technics in general (Hui, 2017a). Moreover, in his theory of technical change, Descola (2005, pp. 655–662, 2013, pp. 386–390) emphasizes how modifications in our practical and cognitive schemata of experience lead us to accept or discard given technological developments. Conversely, Hui (2017b) prioritizes the symmetrical idea that an ontology, in order to be adopted by a community, should first and foremost be compatible with its current technical system. Arguably, the truth in this regard lies somewhere in between Descola's and Hui's stances, insofar as technics influences our behaviour without fully determining it, as discussed in the Introduction relative to postphenomenology's criticism of both the social determination of technology and technological determinism.

An even more pressing criticism of Descola's approach is raised by the anthropologist Eduardo Viveiros de Castro in his book *Cannibal Metaphysics* (2014). According to Viveiros de Castro (2014, pp. 39–48), who is other than that rather concordant with Descola's project, cultural anthropology should not limit itself to the criticism of how our modern, western, civilized conceptual schemata influence how we understand other communities. It should also acknowledge the extent to which how the members of these communities inhabit and understand the world may influence anthropological research in return, thereby transforming our epistemic framework and behaviour.

This perspective leads Viveiros de Castro to observe that "its design makes it impossible for Descola's system to not predominantly express one of the four ontologies he identifies" (Viveiros de Castro, 2014, p. 83). If Descola's ontologies are pervasive, deeply rooted cognitive schemata framing our worldview through and through, this condition also applies to the anthropologist sketching out this classification, as they should necessarily subscribe to one of these four ontological options. And if this is so, then one should expect that the classification would be influenced by the epistemic framework of the ontology to which the anthropologist belongs, reflecting it in its methodology and outcomes. Indeed, Viveiros de Castro (2014, pp. 81–84) argues, the very idea of a classification and subdivision of human experience into four complementary ontologies arguably stems from and depends on a particular ontological understanding of the world, namely Descola's one.

I think that an analogous criticism can be applied to Hui's approach. One could argue that the cosmotechnical pluralism he advocates for, i.e., the acknowledgement of the different ways technics is conceived of historically, is necessarily developed starting from a particular epistemic position, structured and enabled by a particular cosmotechnics, whose characteristics will influence how Hui's project is outlined. Furthermore, the tension underlying Hui's discourse between technics as an anthropologically universal phenomenon, on the one side, and the multiplicity of locally determined cosmotechnics, on the other, risks falling prey to a criticism analogous to the one raised by Latour against cultural relativism. One could advance that Hui understands "technics" in general to be shared by all humans, however differently they interpret it, as much as cultural relativism conceives of "nature" in general as being the same for everyone, although its interpretation would vary culturally. This position, if not explicitly acknowledged, is problematic, insofar as the conception of technics supposedly shared by everyone would actually stem from the cosmotechnics of a particular community and, therefore, reflect its epistemic biases, dictating the standard against which the other cosmotechnics are evaluated.

This criticism, in turn, resembles the one raised by the Italian philosopher Enzo Melandri (1967) against Foucault's archaeological approach, which is contrasted with Husserl's phenomenology and Heidegger's existential analytic. According to Melandri (1970), the problem with Foucault's methodology is that the episteme starting from which the reconstructive enquiry is carried out is not made explicit and cannot be rendered explicit within Foucault's own conceptual apparatus, which thereby renders the limits of his structuralism evident. Melandri submits that the epistemic presuppositions of the archaeological method should be rearticulated by expounding the interpretive tenets of Foucault's own episteme.

Thus, every community frames its experience of the world differently, valuing some practices over others and organizing the beings composing its environment according to its peculiar understanding. In this sense, it may be helpful to recall French philosopher Jacques Rancière's (2000, 2004b)

conception of the political as a conflict and a decision over what is visible and what is invisible and over whose voices should be heard and whose should be silenced in a given group (Rancière, 2004a, pp. 223–254, 2010, pp. 27–44). Moreover, the constitution of a community's worldview, in turn, depends on the available technical system and on how that community's technologies help it make sense of its place in the world. Although these ways of organizing experience may be accurately described, the organization of experience of the one carrying out the description will forcefully bear some influence on the descriptive process itself. While this condition is unavoidable and does not necessarily invalidate the outcome of the reconstructive operation, it risks inadvertently biassing it if not explicitly acknowledged. In order to avoid this pitfall relative to the reconstruction of anthropogenesis, in Chapter 7 I will highlight the genealogical perspectivity of the one carrying out the reconstructive process and discuss its epistemological implications.

1.3 Technics as Process

Based on the analyses carried out above, I submit that one should adopt a processual rather than substantial conception of technics. The latter is not so much a set of entities as a form of practice, which contributes to constructing our understanding of the world and organizing the beings inhabiting it. Although every community produces, utilizes and transmits artefacts, the latter vary geographically and historically, thereby differentiating that community's interpretation of reality from that of the others. And although these interpretations may boil down to a set of combining structures, each of them exhibits a different understanding of what should count as "natural" and what as "social" or "cultural", i.e., a different conception of what values should be assigned to what beings and according to which criteria.

This condition is evident, I believe, if we draw our attention, for instance, to how some humans may be considered "natural" beings by western modernity's capitalist episteme or how some nonhuman animals may be considered "sociocultural" beings by some Amerindian indigenous people's epistemes. Importantly, it is not only the way according to which beings are partitioned that varies but also the understanding of these partitions—for instance, the understanding of "nature" as indefinitely available and exploitable supply seems peculiar to the capitalist episteme alone.

Sloterdijk's stance points in that direction. While Latour (2009b, 2009a) highlights the convergence between his and Sloterdijk's approaches, the latter argues, regarding humans, that "one of the oldest […] errors of reasoning is that they insist on viewing nature as an outside force; in reality, the relevant nature has always already been incorporated into the inside of the anthropic hothouse" (Sloterdijk, 2004, p. 493, 2016b, p. 459). Nature and culture/society do not exist "as such", but only as ways of organizing the world by inscribing certain entities into the spectrum of what is technically administered, produced and transmitted or excluding them from it.

Stiegler's observations also display this construal. First, according to him, "the objects of the world in general are *always* technical objects, even when they are natural: they are only worldly objects to the extent that they are inscribed in a circuit within a technical system which functionally integrates them" (Stiegler, 2013a, p. 320, 2015b, p. 120). Artefacts only manifest themselves as elements of a technical system dovetailing with the biological organs and social organizations composing the organological collective, to which I will turn in Chapter 2. It is its relation to this bio-socio-technical system, rather than some alleged intrinsic property, that confers to an object its artificiality.

Secondly, Stiegler submits that artefacts "are only active […] on the condition that they are practised" (Stiegler, 2013a, p. 302, 2015b, p. 107) through rituals, ceremonies, apprenticeships etc. Technologies should not be separated by their techniques of usage and their technical status does not depend on their inner qualities but rather on how they interrelate with the complex of practices structuring a community's rules of living. Thirdly, Stiegler focuses on "the tertiary retentions of which technical objects originarily consist (*inasmuch as they are epiphylogenetic*)" (Stiegler, 2013a, p. 111, 2014, p. 69, trans. mod., my emphasis). Tertiary retentions, i.e., artefacts as mnestic supports, acquire their technical condition not as such, but insofar as they partake in epiphylogenesis, i.e., life pursued by technical means, as I will discuss in Chapter 2. From this perspective, artefacts should be conceived of as artefacts based on and starting from their impact on our developmental and evolutionary trajectory.

Thus, there are no natural or sociocultural beings in general, nature and culture/society being modes of organization of experience rather than domains of reality. Nevertheless, they are productive of real effects on our cognition and behaviour. Technics constrains how each community frames its worldview and arranges the institutions administering the relationships between its members starting from a particular understanding of what should be valued and what should not and how value should be produced and assessed. As the French philosopher of technology Gilbert Simondon insightfully claims,

> the essential artificiality of an object resides in the fact that man must intervene to maintain the existence of this object by protecting it against the natural world, giving it a status of existence that stands apart. Artificiality is not a characteristic denoting the fabricated origin of the object in opposition to spontaneous production in nature: artificiality is that which is internal to man's artificializing action, whether this action intervenes on a natural object or on an entirely fabricated one (Simondon, 1958, pp. 56–57, 2016, p. 49).

Human practices render something "technical", in the sense I wish to attribute to this term, regardless of the domain of reality to which the latter is ascribed by a particular episteme. Technics manifests

itself as the production, usage and transmission of artefacts, which in turn influence our worldview and behaviour. Concurrently, as I aim to show throughout this research, artefacts also render us humans, i.e., they produce, modify and sustain our lifeform.

Inspired by Simondon's viewpoint, Stiegler defines artefacts as "*organized inorganic matter*" (Stiegler, 2018a, p. 74, 1998b, p. 49). According to Stiegler (2018a, pp. 71–74, 1998b, pp. 46–49), while living beings (such as animals, plants etc.) are organic, organized matter and non-living beings (such as stones, gasses etc.) are inorganic, unorganized matter, technical objects (such as tools, machines etc.) are halfway between them, inorganic and yet organized matter, evolving according to its own dynamics, an interstitial and irreducible third between physics and biology. One may object that technical objects are not necessarily made of inorganic matter, citing wood or leather instruments, for instance, and that also "physical" matter exhibits forms of organization, as is the case with crystals, analysed by Simondon in his book *Individuation in Light of Notions of Form and Information* (2005, pp. 85–92, 2020, pp. 77–87).

However, I think that the emphasis in Stiegler's discourse should lie in the process of organization rather than in its outcome, because artefacts do not spontaneously self-organize (as living and non-living beings are supposed to do), do not self-constitute, but are rather produced by something else, which they nonetheless contribute to producing in return. As I will discuss in Chapter 2, according to Stiegler (2013a, pp. 243–247, 2015b, pp. 62–65), living matter organizes non-living matter, which thereby becomes technical matter and reorganizes living matter in return through progressive de-functionalization and re-functionalization.

1.4 Malm's Hybridism

In order to further clarify my point, I will now contrast the approach discussed above with the stance defended by the Swedish philosopher Andreas Malm in his book *The Progress of This Storm* (2018). I aim to show that Malm's understanding is symmetrically opposed to the view I am submitting through the works of Haraway, Esposito, Descola, Latour and Moore. I chose Malm's work as exemplary of a widespread worldview, first, in virtue of its recent release date, refined conceptualizations and major influence on the current debate. Secondly, because it explicitly develops a criticism of Latour's and Moore's philosophies—the latter conceived of as derivative of the former (Malm, 2018, pp. 177–185). Thirdly, because while advocating for a clear-cut and ultimately unbridgeable distinction between nature and culture/society is usually associated with traditional, conservative metaphysics ultimately justifying the *status quo* of capitalist exploitation, Malm develops a thorough criticism of capitalism and defends the nature-society/culture divide precisely in order to overcome this socioeconomic system and face up against the ongoing ecological crisis—analogously to what Moore and the others set out to do.

Malm submits that the current ecological crisis, identified with global warming, is due to "the birth and perpetual expansion of the fossil economy" (Malm, 2018, p. 16) driven by capitalism. Thus, in order to overcome this crisis, which jeopardizes human existence all over the planet, the climate has to be stabilized through the complete dismissal of fossil fuels extraction and consumption. This crisis, Malm (2018, pp. 11–18) argues, challenges our current understanding of the relationship between nature and culture/society, calling for its critical reassessment. Malm (2018, pp. 21–28) defines nature as what is independent of human activity, i.e., is not a human product, on the one hand, and constitutes the necessary precondition of every human activity, on the other. Reciprocally, culture/society is defined as what, not being natural, is the outcome of our historical practices:

> if it is social, then it has arisen through relations between humans as they have changed over time, and then it can also, in principle, be dismantled by their actions; if it is natural, it is not a humanly created product but rather a set of forces and causal powers independent of their agency, and hence it cannot be so disassembled (Malm, 2018, p. 60).

Malm holds this definition and the distinction it implies to be valid everywhere and every time. Irrespective of the different, historical understandings of what nature and culture/society are about, he contends that "as a matter of course, *conceptions* of nature are culturally determined, but the referent is not thereby similarly constituted" (Malm, 2018, p. 26). According to this approach, we can think of nature differently around the world, but nature "out there" is the same for everyone, only differently interpreted among different communities. Malm (2018, pp. 59–63) relies on the analytic philosophy of mind in order to submit that nature and culture/society are composed of the same "matter" but have different "properties". They can, therefore, interrelate while concurrently remaining distinguishable. And since nature is understood as the precondition of culture/society, "social properties ultimately depend on natural properties, but not the other way around" (Malm, 2018, p. 65). Malm resorts to this argument in order to contend that we should clearly pinpoint who is to be held responsible for the ongoing crisis and what we should do in order to stop them, instead of uncritically redistributing agency and responsibility among different human and nonhuman entities.

Malm identifies Latour as the most radical and influential proponent of the idea according to which nature and culture/society are historical and relative concepts and elaborates a harsh and tenacious criticism of his work, regarded as "mysticism and unabashed fetishism" (Malm, 2018, p. 147). As highlighted by Malm (2018, pp. 44–47), Latour thinks that nature and culture/society should not and cannot be distinguished because they have always been the same thing or, more precisely, two aspects of the same phenomenon, that is the episteme of western modernity. Quite surprisingly, however,

right after having singled out Latour's approach and having labelled as hybridism the theories inspired by it, Malm submits a substantially different interpretation of Latour's work and claims that hybridism contends that "*because natural and social phenomena have become compounds, the two cannot be differentiated* by any other means than violence" (Malm, 2018, p. 47). The current technoscientific development would amount to the irretrievable combination of natural with sociocultural components, thereby impeding every attempt to exactly distinguish between the two.

As I have shown above, this is not at all Latour's position, as even Malm should be aware of, if attention is paid to the first steps of his construal. However, the latter interpretation quickly takes over in his account and Latour's "hybridism" is erroneously expounded as purporting the accomplished end of the difference between nature and culture/society, rather than their originary and situated co-belonging. Starting from this peculiar interpretation, Malm develops his criticism:

> *only by postulating nature and society as categories located a universe apart does their combination warrant their collapse*. Only with an implicit conception of them as more *substantially unlike each other* than any other two things can one conclude that their admixture, in contradistinction to so many humdrum alloys, disproves their existence (Malm, 2018, p. 49).

In his latest book, dedicated to Latour's memory, Sloterdijk (2023, pp. 69–79) defends his colleague's approach by outlining limitations and inconsistencies in Malm's political proposition. And I think that Malm's argument also exhibits a double fallacy on the epistemological plane. First, Malm erroneously interprets Latour's philosophy, submitting that the latter purports the accomplished conjunction of formerly separate nature and culture/society, whereas, as we have seen above, Latour aims to conceive of nature and culture/society as two interdependent and co-originary terms of the same relation, which constitutes them as the operators of a performative interpretation of reality. Secondly, Malm uncompellingly defends a version of the old, worn-out dualism between nature and culture/society. He thereby abides by what Latour terms particular universalism, i.e., the idea according to which there is only one nature, shared by all humans, which is differently interpreted among different cultures, although the "real" interpretation is only one, i.e., our modern western conception of nature as something independent of our actions while concurrently sustaining them and making them possible.

Paradoxically, Malm ends up defending the epistemic position he actually sets out to criticize, i.e., naturalism in Descola's sense. His approach is deeply albeit inadvertently ethnocentric in its understanding of the relationship between nature and culture/society, consequently falling prey to Descola's and Hui's criticisms outlined above. Furthermore, I think one may liken his conception of nature with what Heidegger calls *Bestand* and Moore terms Cheap Nature—and insightfully, the latter

is aware that Malm's criticism of capitalism submits exactly what the concept of Capitalocene sets out to confute, that is the nature-culture/society binary (J. W. Moore, 2018, p. 240). Indeed, Malm understands nature as what is both independent of our activities and constitutes their unavoidable background, i.e., what renders our existence possible without requiring our intervention for itself to exist.

CHAPTER 2

ORGANOLOGY, EXOSOMATIZATION, PHARMACOLOGY AND EPIPHYLOGENESIS: THE SUPPLEMENTATION OF BIOLOGY WITH TECHNICS

Starting from the processual understanding of technics as the organization of human experience and behaviour, discussed above, in this chapter I will review the core concepts of Stiegler's philosophy of technology. First, I will outline his general organology, i.e., the study of the human lifeform as the intertwinement of biological organs, artefacts and social organizations. Through recourse to the philosophy of Gilbert Simondon and the Extended Evolutionary Synthesis (EES) in evolutionary biology, I will highlight how the relationships between these three elements should be regarded as mutually constitutive. Secondly, I will underscore how Stiegler conceives of anthropogenesis as the supplementation of biology with technics, i.e., the progressive de-functionalization and re-functionalization of biological organs by artefacts, which reinvent organic functions, exapted for novel purposes—a process he calls exosomatization. I will corroborate Stiegler's claims through recourse to philosophical anthropology and especially Arnold Gehlen's concept of unburdening. By doing so, I will also debunk some widespread misunderstandings in the conceptualization of human evolution, such as privileging cognitive over bodily development.

Thirdly, I will discuss how Stiegler appropriates Derrida's theory of writing in order to develop his pharmacology, i.e., the idea that technics always operates as a both toxic and curative power, inhibiting some possibilities of subjectivation and development and encouraging others. Fourthly, I will expound on Stiegler's concept of epiphylogenesis, which aims to conceptualize anthropogenesis as the intertwinement of genetic, somatic and artefactual memory, thereby highlighting the cumulative character of human cultural evolution. I will clarify this approach by outlining Stiegler's critical interpretation of the work of Edmund Husserl, Martin Heidegger and Gilbert Simondon, which Stiegler employs in order to show how our individual consciousness is constituted by its transgenerational relation to past consciousnesses via the inheritance of artefacts, conceived of as mnestic supports. Lastly, I will buttress Stiegler's stance by reviewing scientific literature regarding cultural evolution. Thus, making recourse to cultural evolution theories in biology will enable me to criticize the traditional philosophical-anthropological perspective (e.g., Rousseau) which conceives of brain-based cognition as the originary driver of anthropogenesis.

2.1 General Organology

Stiegler labels as general organology his approach to the question of technics. The phrase comes from the French philosopher Georges Canguilhem who, in his essay "Machine and Organism" (1965, pp.

101–127, 2008, pp. 75–97), states that "general organology" (Canguilhem, 1965, p. 101, 2008, p. 174) should be the name of a science to come, inspired by French philosopher Henri Bergson's (1907, 2005) thought and devoted to studying the relationship between machines and organisms by understanding the construction of machines as an organic function. Thus, Canguilhem (1965, p. 125, 2008, p. 174) sets out to inscribe the study of machines into a broader ecological paradigm, conceiving of technics as a lifeform, produced by and interrelating with other organismal phenomena.

The project of a general organology is also pursued by one of Canguilhem's disciples, Simondon who, in his book *On the Mode of Existence of Technical Objects* (1958, 2016), draws an analogy between the elements composing technical objects and the organs composing living bodies, asserting that "it would in this sense be possible to define a general organology, studying technical objects at the level of the element, and which would belong to technology, together with mechanology, which would study complete technical individuals" (Simondon, 1958, pp. 80–81, 2016, p. 66). While organology is devoted to studying the relationship between the technical elements composing a technical individual (i.e., a machine), mechanology should investigate the relationship between technical individuals and their environment. Together, these two disciplines would compose "technology" as the general study of technical objects.

In his two-book series *Symbolic Misery*, composed of *The Hyperindustrial Epoch* (2013a, pp. 11–152, 2014) and *The Catastrophe of the Sensible* (2013a, pp. 157–398, 2015b), Stiegler elaborates on Canguilhem's and Simondon's insights and reinterprets the concept of organology. According to Stiegler (2013a, p. 343, 2015b, pp. 135–136), Simondon's understanding is too limited: general organology proper should rather be what the latter calls mechanology and also concern biological organisms. This approach should study the human lifeform as the articulations of "the body with its physiological organization; artificial organs (technologies, objects, tools, instruments, artworks); and social organizations resulting from the articulation of artefacts and bodies" (Stiegler, 2013a, p. 18, 2014, p. 5), i.e., the transformations of the way we collectively feel and experience reality (Stiegler, 2013a, pp. 13–20, 2014, pp. 1–6). Hence, general organology functionally binds together three elements: endosomatic, that is biological organs; exosomatic, that is artificial organs (i.e., artefacts); and social organizations, that is the norms regulating the intertwinements of endosomatic and exosomatic organs, such as educational regimes, legal systems, ritual conventions, scientific methodologies etc.

From this perspective, biological organs, artefacts and social organizations coevolve relative to the human lifeform. The interrelations between these three elements, investigated by general organology, compose the minimum grade of complexity necessary for the human lifeform to both emerge and be understood. As I will discuss in Chapter 7, this is a genealogical approach linking our conditions of existence with our conditions of thinkability. Humans, Stiegler (2013a, pp. 320–327, 2015b, pp. 119–

124) claims, are not only general organology's "objects", insofar as this approach sets out to understand the human condition, but also its "subjects", insofar as this knowledge is performed by socially interrelated and technically equipped human organisms.

2.2 Transductive Relation, Reciprocal Causation and Feedback Loops

General organology conceives of the relationship between biological organs, artefacts and social organizations as transductive. The term transduction, coming from physics and cellular biology, usually denotes the process of converting a physical or biochemical signal into another. Simondon, however, reinterprets the concept and broadens its scope:

> by transduction we mean a physical, biological, mental, or social operation through which an activity propagates incrementally within a domain by basing this propagation on a structuration of the domain operated from one region to another: each structural region serves as a principle and model, as an initiator for constituting the following region, such that a modification thereby extends progressively throughout this structuring operation. […] The extreme terms attained by the transductive operation do not exist before this operation (Simondon, 2005, pp. 32–33, 2020, pp. 13–14).

Simondon (2005, pp. 32–34, 2020, pp. 13–16) regards as transductive those operations comprehensively restructuring the system within which they act. The elements of this system are produced by this structuration and mutually modify one another each time a new operation occurs. Thus, the terms of a transductive relation do not exist prior to, independently of or outside that relation. Transduction "is exerted across and through a field of forces that modifies the whole system in terms of the individual and the individual in terms of the whole system" (Simondon, 2005, p. 143, 2020, p. 152). A modification provoked by an individual propagates through the system, altering it while reshaping that individual in return.

Stiegler takes on Simondon's conception and states that a transductive relation is "a relationship which constitutes its own elements, where one element cannot exist without the other—where the elements are co-constituents" (Stiegler, 2018a, p. 316, 2009c, p. 2, trans. mod.). Hence, in order to understand the human lifeform, general organology sets out to study the relations between endosomatic organs, artefacts and social organizations by conceiving of these relations as transductive, that is mutually constitutive. According to Stiegler (2018a, p. 321, 2009c, pp. 6–7), these elements are the products of their ongoing interaction with one another and, therefore, are not pregiven entities existing prior to their relating, but rather open-ended and impermanent trajectories.

Consequently, the causation linking together the organological components within their transductive relation is not unidirectional—where a cause A produces an effect B, which produces, in turn, an effect C and so on, without causes being conditioned by their effects in return. We are rather dealing with so-called reciprocal causation, which "simply means that process A is a cause of process B and, subsequently, process B is a cause of process A, with this feedback potentially repeated in causal chains" (Laland et al., 2015, p. 6). While A produces B, the latter, by its emergence, strengthens and modifies the performance of the former, thereby transforming it. Reciprocal causation prompts us to think of causes and effects as complementary sides of the same phenomenon, mutually constituting one another and co-belonging. They operate within a system where the elements coevolve, ruling out the possibility of identifying an originary, uncaused cause that would subsequently elicit everything else.

Supporters of the Extended Evolutionary Synthesis also advocate for adopting an interpretive framework based on reciprocal causation in order to understand evolution, contrary to the Modern Synthesis, where although reciprocal causation is acknowledged to occur in some particular instances, it is not considered a major evolutionary dynamic (Svensson, 2018). Indeed, Modern Synthesis's strong externalism leads its supporters to conceive of a weaker or negligible role of the organisms in constructing their environment and thereby shaping their evolution and development. Furthermore, it regards genes and populations rather than organisms as the main units of selection, downplaying, therefore, the relevance of individual behaviour and experience to evolution (Baedke et al., 2021). As submitted by Andrew Buskell, reciprocal causation is

> a kind of causal relationship, one where two processes exert a mutual influence on one another […]: two causal processes are reciprocally linked insofar as they are coupled processes where the state of one is a function of the other (and vice versa). On this understanding, reciprocal causal processes contrast with *unidirectional* ones—causal relationships where mutual influences are negligible or non-existent (Buskell, 2019, p. 268).

Laland and his collaborators (2011) trace this unidirectional understanding of causation back to evolutionary biologist Ernst Mayr's (1961) distinction between proximate causes (i.e., relating to ontogeny) and ultimate causes (i.e., relating to phylogeny) in biology: "a proximate cause is an immediate, mechanical influence on a trait […]. Ultimate causes are historical explanations; these explain why an organism has one trait rather than another, often in terms of natural selection" (Laland et al., 2011, p. 1512). According to Mayr, only ultimate causes would have evolutionary relevance. The authors, however, contend that this construal should be overturned: reciprocal causation is the most general and perhaps universal phenomenon in evolutionary biology, while unidirectional

causation is nothing but one special occurrence of it, where the causal feedback, albeit present, is so weak that it can be considered evolutionarily negligible.

In evolutionary theory's progressive timeframe, adopting a reciprocal conception of causation amounts to understanding the emergence of phenomena as the outcome of "positive feedback loops" (Sterelny, 2012, p. 20). According to the Australian philosopher Kim Sterelny (2012), indeed, complexes of accidental, imperceptible changes in the relationship a group of organisms establishes with its environment, if proved adaptive, may increase in frequency and intensity. They may gradually become stabilized within the group's lifeway and grow in importance to the point of actually making a difference in its chances of survival, driving selection and acquiring evolutionary momentum.

Adopting this perspective on causation enables Sterelny to discard those accounts of human evolution relying on a singular, breakthrough phenomenon to explain the whole of our morphological, ecological and behavioural features: "the story of hominin evolution is not the story of the evolution of specialized, innately structured modules. Nor is it a story of a key innovation and its consequences. […] There is no master adaptation whose origin explains the rest" (Sterelny, 2012, p. 20). This would be the case, for instance, with palaeoanthropologist Ian Tattersall's (2012, pp. 199–206) hypothesis for the evolutionary emergence of symbolic behaviour, which he exclusively derives from a (hitherto unidentified) genetic variation. As I will discuss in Chapter 5, human evolutionary origin should not be understood as a unique, circumscribable event able to account for everything that follows from it—e.g., a key environmental change or genetic mutation. Anthropogenesis is rather about "a sequence of minimal, incremental changes" (Sterelny, 2012, p. 25) yielding alterations in the relationship between hominin populations and their environment. According to Sloterdijk, the human lifeform

> is the product of a production that is not itself a human being and was not intentionally undertaken by human beings. The human being was not yet what he would become before he became it. Thus it is a matter of describing the anthropogenetic mechanism and making clear that it proceeds in an unequivocally pre-human and non-human manner, and that under no circumstances may it be confused with the effects of a producer-subject, neither a divine one nor a human one (Sloterdijk, 2001b, pp. 167–168, 2016a, p. 106).

We should understand anthropogenesis as the outcome of a production process. However, we should also be mindful that this process is unintentional and nonteleological. What needs to be explained, namely the human lifeform, should be accounted for in its fully-fledged deployment without concurrently presupposing that its fundamental characteristics already obtain in its prehuman ancestors. Reciprocal causation, therefore, enables us to conceptualize the emergence of novel traits

out of the interrelation of pre-existing dynamics. Importantly, technics plays a major role in the feedback loops structuring anthropogenesis, as illustrated by Sterelny's example concerning lithic technology:

> the initial shift to a stone-tool-based lifestyle may well have depended on preexisting mechanisms of adaptive plasticity, preexisting potentials for manual dexterity, and preexisting foraging patterns. But once established, the new lifestyle will select for genetic variants that enable these new skills to be acquired with high reliability and low cost (Sterelny, 2012, p. 33).

There are several cognitive, morphological and sociocultural preconditions for the lithic industry to emerge. None of them would necessarily lead to its emergence on its own, nor would they be univocally linked to a lifeway based on it. Occurring together, however, these preconditions let this opportunity manifest itself—initially fragmentally and occasionally, then systemically and pervasively. And once it becomes entrenched within the group's ecology, it will in turn constitute a precondition for future innovations. Knapping stones may well have debilitating costs in terms of injured fingers and defective tools, for instance, but a widespread habit of stone knapping will favour those individuals who prove more effective at carrying it out, consequently benefiting from enhanced chances to reproduce and pass on their genes.

Thus, lithic technology shifts from being the emergent and accidental outcome of formerly unrelated preconditions to a fundamental component of hominin populations' lifeway, selecting, in turn, for those traits which prove more suitable for supporting and enhancing it, thereby increasing its pervasiveness and consequently selective influence and so on. Sterelny maintains that "this feedback dynamic […] has structured hominin evolution" (Sterelny, 2012, p. 3): humans are the outcome of the retroaction exerted by their own techniques and technologies. Convergently, Sloterdijk states that the human lifeform "was able to first form itself only under the retroactive effect of spontaneous proto-technologies" (Sloterdijk, 2001b, p. 153, 2016a, p. 96), gradually cumulating to the point of restructuring our relation to the world and influencing our evolution.

Hence, general organology understands the human lifeform as the interrelation of biological organs, artefacts and social organizations. These three components do not exist or can be thought of separately or independently, but rather mutually constitute one another through their transductive relation. Modifications in this relation occur through (positive or negative) feedback loops. Different conditions mutually influence and modify one another, increasing or decreasing the selective relevance of a trait to the point of its emergence or disappearance. The altered trait, in turn, will exert causal influence over the other conditions, modifying and restructuring them.

2.3 Unburdening Exosomatization

I will now turn to discuss how the transductive relation binding together biological organs, artefacts and social organizations manifests itself throughout anthropogenesis as the progressive de-functionalization and subsequent re-functionalization of organic faculties. When investigating human technical behaviour, indeed, we should regard the production and utilization of instruments, on the one hand, and the reproduction and transmission of their rules of usage, on the other, as two complementary, ultimately inseparable aspects of the same phenomenon. As maintained by Leroi-Gourhan, "technics is both gesture and tool" (Leroi-Gourhan, 1964, p. 164, 2018, p. 114, trans. mod.) and "the tool only really exists is in the gesture which makes it technically effective" (Leroi-Gourhan, 1965, p. 35, 2018, p. 237, trans. mod.). Technics is about the production, maintenance and transmission of tools, instruments and artefacts, their utilization according to norms, rules and rituals and the transgenerational reproduction and transmission of these operational concatenations.

Consequently, technical behaviour should rely on the inscription of these operations on mnestic supports securing their persistence: "the operational synergy of tool and gesture presupposes the existence of a memory in which the behavior program is stored" (Leroi-Gourhan, 1965, p. 36, 2018, p. 237). This memory, in turn, is also constituted by artefacts, which thereby retain the knowledge necessary for their management. This perspective is also defended by Gehlen:

> the movement of cutting and the associated instrument form *one* connection. […] The designed and (one-sidedly) characterized instrument, device or material symbol has a sort of triggering effect on the likewise determined habit of action, in the sense that the visible and constantly lying object keeps a ready-made habit, so to speak, at the threshold of execution, in the starting phase[11] (Gehlen, 1956, p. 24, my translation).

Instruments crystallize memory into reactivable supports available for further interventions. Reciprocally, they channel and organize behaviours according to their structure, inhibiting some possibilities of engagement and prompting others. They thereby shape human experience, both cognitively and materially.

From this perspective, artefacts, even the simplest ones, such as palaeolithic chipped flintstones, guard in their structure, shape and texture the complex of operations that made their production possible, their history. Moreover, their concrete design advances and channels their possibilities of

[11] "Die Bewegung des Schneidens und das dazugehörige Werkzeug bilden *einen* Zusammenhang. […] Das gestaltete und (vereinseitigt) charakterisierte Werkzeug, Gerät oder Sachsymbol hat eine Art Auslöserwirkung auf die ebenso bestimmte Handlungsgewohnheit doch in dem Sinne, daß der sichtbar und dauernd daliegende Gegenstand eine bereitgestellte Gewohnheit sozusagen an der Vollzugsschwelle, im Ansatzzustand festhält".

usage, the uses and applications to which they may be devoted, their future destinations. Artefacts are affordances in psychologist James Gibson's (1977) sense, i.e., combinations of environmental properties converging with their perception by the organisms, subsisting as materialized possibilities of interaction, subjectivation and behavioural modification. Reciprocally, technical objects always need the information coming from their sociocultural context of belonging (i.e., their episteme) in order to operate as technical objects. Even stone tools, for instance, require expertise and experience in order to be produced and handled properly and this knowledge needs to be socially transmitted among individuals in order to endure across generations. As efficaciously stated by Étienne Bimbenet,

> the technical object is not only made by human hands; it imposes on these hands a succession of artificial gestures; it prescribes the mode of its usage. […] Submitting the body to its intrinsic mobility, the instrument instructs and moulds us, as much as the other way around[12] (Bimbenet, 2017, p. 264, my translation).

The archaeologist Lambros Malafouris also highlights the mutual influence and correlation characterizing the anatomical, cognitive and artefactual components of instrumental behaviour: "the tool guides the grip, the grip shapes the hand, the hand makes the tool, and engaging the tool shapes the mind" (Malafouris, 2013, p. 174). More generally, artefacts are always employed according to certain norms and conventions, which determine their functions in a community and render them technical objects for that community.

If the transmission of information breaks down, the adoption of an instrument may become impossible, its meaning and functioning incomprehensible. Notably, inscribing this knowledge and these rituals into artefacts, in turn, alters the fidelity and reliability of transmission, which becomes partially independent of the biological existence of the individuals utilizing them, as I will discuss below. I submit, therefore, that artefacts embody the structural coupling of interrelated technologies (tools, instruments, devices, apparatuses, machines etc.) and techniques (habits, norms, rituals, conventions, beliefs, rules, skills, knowhow etc.).

Leroi-Gourhan terms the process of production, utilization and transmission of artefacts exteriorization, i.e., the detachment of organic functions from the body and their bestowal on exosomatic media eliciting socialization and distancing from environmental pressures. In the three published volumes of his book series *Technics and Time, The Fault of Epimetheus* (2018a, pp. 17–311, 1998b), *Disorientation* (2018a, pp. 315–581, 2009c) and *Cinematic Time and the Question of*

[12] "L'objet technique n'est pas seulement fait de main d'homme ; il impose à cette main une succession de gestes artificiels ; il prescrit le mode de son utilisation. […] Soumettant le corps à sa mobilité intrinsèque, l'instrument nous éduque et nous façonne, autant que l'inverse".

Malaise (2018a, pp. 589–842, 2010d), Stiegler adopts Leroi-Gourhan's terminology and defines technics as the exteriorization of life outside itself, that is in the other-than-life: "as a 'process of exteriorization,' technics is the pursuit of life by means other than life" (Stiegler, 2018a, p. 38, 1998b, p. 17). In his later works, Stiegler prefers the term exosomatization, i.e., the production of artificial (exosomatic) organs, to refer to the same phenomenon, thereby adopting a terminology derived from insights by the biophysicist Alfred Lotka (1945) and the economist Nicholas Georgescu-Roegen (1977).

The logic of the process of exosomatization is paradoxical, insofar as there is no interiority (e.g., soul, spirit, mind etc.) which would subsequently exteriorize itself; rather, one should "speak of an exteriorization without a preceding interior: the interior is constituted in exteriorization. […] The interior and the exterior are the same thing […], since man (the interior) is essentially defined by the tool (the exterior)" (Stiegler, 2018a, pp. 170–171, 1998b, pp. 141–142). Biology and technics mutually constitute one another in the process of anthropogenesis, co-belonging as two interpenetrating articulations of the same event, their relation being transductive. As stated by Stiegler, "technics […] is the invention of the human. As object as well as subject. Technics inventing the human, the human inventing technics. Technics as inventive as well as invented" (Stiegler, 2018a, p. 166, 1998b, p. 137, trans. mod.). Humans produce technics and technics produces them in turn, with none of the terms of this relation having ontological or chronological priority over the other.

Consequently, from Stiegler's (2004, pp. 54–55, 2017c, pp. 54–55) viewpoint, exteriorization always coincides with some form of interiorization: while crafting, using and relating to artefacts, the human psychophysical constitution is accordingly reorganized and interiority is produced. For instance, as Stiegler argues regarding the lithic industry,

> the stereotype is as much the result as the condition of its production, both the support of the memory of operational sequences that produces it, conserving the trace of past epigenetic events that accumulate as lessons of experience, and the result of the transmission of these operational sequences by the very existence of the product as an archetype (Stiegler, 2018a, p. 207, 1998b, p. 177).

According to Stiegler (2015a, pp. 46–48, 2017a, pp. 21–22), artefacts, as socialized exosomatic organs, engender the relative dis-automation of extant biological mechanisms, detaching them from univocally determined targets and reinvesting these drives into new forms of desire, shared and technically mediated. This process substantially differs from the unidirectional understanding of causation discussed above: the produced and the producer continually imply one another and exchange their functions—what is caused causes in return what causes it and vice versa.

Stiegler's concept of exosomatization, I think, is well complemented by Gehlen's notion of unburdening, i.e., "the transition from performances closer to the body to higher, freer, more intellectual ones"[13] (Gehlen, 1956, p. 258, my translation) through technics. Gehlen states that humans need to produce artefacts and arrange them in institutions in order to cope with their plastic, undetermined drives, which chronically exceed their fulfilment into univocal targets: "the same institutions that humans let emerge among themselves in their thoughts and actions become independent of them and turn into a power that establishes, in turn, its own laws right into their hearts"[14] (Gehlen, 1956, pp. 6–7, my translation), training and disciplining them. Hence, exosomatization is understandable as unburdening from direct environmental, social and metabolic pressures thanks to exosomatic supports, which constitute the means to delegate, procrastinate and redirect impelling and chronic needs, rendering their satisfaction instrumentally mediated and collectively administered.

As contended by Latour (1994), techniques, as programmes of action inscribed into tools, enable us to shift the execution of an action in time and space, so that the individual aiming to perform that action may not be present anymore but the action can be carried out nonetheless. Latour (2008) calls this operation a process of transcription, i.e., transferring programmes of action to more durable supports, not implying that "the direction always goes from soft bodies to hard machines, but simply that it goes from a provisional, less reliable one to a longer-lasting, more faithful one" (Latour, 2008, p. 176). Through exosomatization, memory is transferred to extrabodily supports, thereby unburdening our bodies from the task of carrying and preserving it—although, in order to be activated and thereby operate as memory, exosomatic mnestic supports always require the organological interaction with biological organs embedded in social organizations.

Thus, in order to understand technical behaviour attention should be drawn to the twofold dimension of its manifestation, cogently expressed by the convergence between Stiegler's and Gehlen's approaches. On the one side, artefacts perform a bodily function through extrabodily means (exosomatization). On the other, this biological function, once bestowed on an artefact, is consequently rearranged (unburdening). This approach aims to debunk the conceptions of human technicity conceiving of technics as the simple prolongation of biological functions into nonbiological means, without neither these functions nor the organs absolving them being modified in return.

This insight, I believe, becomes evident if attention is drawn to the difference between two seminal philosophies of technology, developed between the end of the nineteenth century and the beginning

[13] "Des Übergangs von leibnäheren in höhere, freiere, intellektuellere Vollzüge".
[14] "Dieselben Einrichtungen also, die die Menschen in ihrem Denken und Handeln untereinander hervorgehen lassen, verselbständigen sich ihnen zu einer Macht, die ihre eigenen Gesetze wiederum bis in ihr Herz hinein geltend macht".

of the twentieth century by Kapp (1877, 2018) and Alsberg (1975) respectively. According to Kapp, "the first tools appear as extending, strengthening, and intensifying the human being's bodily organs" (Kapp, 1877, p. 42, 2018, p. 36). The production of artefacts would amount to the extension of somatic functions into exosomatic media, which intensify our biological features thanks to the properties of inorganic matter. For instance, a hammer would perform the same task as a fist, but better, benefiting from a more appropriate shape, texture and design. Kapp contends that this phenomenon consists in "an organ projection, or the mechanical reconstruction of an organic form" (Kapp, 1877, p. 42, 2018, p. 36), i.e., the extroversion of psychophysical contents as the transformation of exosomatic matter according to biological criteria, prosecuting life into the other-than-life.

Alsberg (1975, pp. 51–52) criticizes Kapp's understanding of human technicity, claiming that technics does not represent an organic extension but rather an organic replacement: "the artificial instrument 'replaces' the natural bodily equipment. What was gained in terms of artificial means of adaptation, however, was lost, to the same extent, in terms of physical qualities, as a result of lower strain on the body"[15] (Alsberg, 1975, p. 48, my translation). Transferring biological functions to nonbiological supports entails the rearrangement of the biological organs which formerly performed these functions, which are de-functionalized as supports of these functions and re-functionalized as supports of the artefacts now exerting these functions in their place. The hand that operates a hammer is not the same "hand" that exerts the hammer-like function of the fist: some of its percussive strength has to get lost in favour of the increased dexterity necessary to manipulate the instrument. Unburdening exosomatization, i.e., the bestowal of biological functions on artificial supports, engenders the rearrangement of the human bodies, which give up on some of their biological functions by entrusting their complexes of techniques and technologies with the task of absolving these functions in their place. This functional transfer, in turn, is necessary in order to develop bodies able to support, perform and produce artefacts.

Technics as unburdening exosomatization is also a collectivizing process, which gathers a community around the task of managing complexes of operational chains according to collectively established norms. On the one hand, the increasing complexity of artefacts requires the cooperation of different individual knowhow for their production and utilization. On the other, exteriorizing an organic process always involves its collectivization, as this process becomes available for usage, appropriation and reconfiguration by other individuals. Reciprocally, since many individuals partake in the establishment of the same techniques and technologies, they all also undergo their moulding effects, abiding by the same conditions of use and reproduction. In this sense, exosomatization

[15] "Das künstliche Werkzeug setzte sich 'an die Stelle' der natürlichen Körperausrüstung. Was aber an künstlichen Anpassungsmitteln gewonnen wurde, ging in gleichem Maß, infolge geringerer Beanspruchung des Körpers, an körperlichen Qualitäten verloren".

engenders the collectivization of experience and the definition of a community whose members are concerned with the same, shared norms. Concurrently, as more groupmates partake in the construction of the same devices, the latter will retain each one's individual experience, thereby constituting collective memories and procedures.

2.4 Hylomorphism

From this perspective, the production, usage and transmission of artefacts should not be conceived of as the mere prosecution into nonbiological means of formerly biologically absolved functions—even if it is advanced that these functions are altered by the process of exosomatization, as is the case with Kapp's account outlined above. On the one side, organic functions are transformed by technical behaviour, which not only magnifies some of their features and reduces others, as also observed by Ihde (1990, p. 49), but may also engender novel and unprecedented functionalities, encouraging some practices and inhibiting others, as contended by Verbeek (2005, pp. 168–171), thereby articulating which affordances are foregrounded and which fade in the background (Kiran, 2015). On the other, the organs formerly exerting these functions are also transformed (i.e., exapted) by the process of exosomatization, insofar as they lose some features and acquire others, based on which of their functions are bestowed to artefacts. Hence, through unburdening exosomatization biological organs and artificial organs (i.e., artefacts) coevolve, mutually transform one another and engender new and/or altered biotechnical functionalities.

I think that these observations should enable us to debunk the so-called hylomorphic conception of technics, i.e., the understanding of technical behaviour as the imposition of a pre-existing form to an amorphous matter. This approach is evident in Leroi-Gourhan's (1964, pp. 161–166, 2018, pp. 112–116) case, which debatably contends that the linguistic and instrumental behaviour of the other great apes is qualitatively different from that of humans and ultimately does not constitute a process of exteriorization, because it would only manifest itself in response to external stimuli and fade away alongside them. Conversely, human technical production would pre-exist the actual stimuli and survive their disappearance.

Leroi-Gourhan is left with the question of technogenesis, i.e., the origin of technical behaviour, which he attributes to humans alone, and hypothesizes a gradual transition in order to account for its emergence. At the early stages of anthropogenesis, Leroi-Gourhan argues, techno-linguistic behaviour would almost completely abide by mechanical constraints and follow strictly biological evolutionary patterns. Tools would be "a real anatomical consequence" (Leroi-Gourhan, 1964, p. 129, 2018, p. 90, trans. mod.), "a real 'secretion' of the […] body and brain" (Leroi-Gourhan, 1964, p. 132, 2018, p. 91, trans. mod.) and technical behaviour would be "a direct emanation of species behavior" (Leroi-Gourhan, 1964, p. 140, 2018, p. 97), presenting high stereotypy and minimal

variation. As “artificial organs” (Leroi-Gourhan, 1964, p. 132, 2018, p. 91), instruments are expected to evolve at the same pace as biological organs and yet retain the whole potential for the technological and symbolical civilization they will elicit, somehow halfway between zoology (there is no technics) and anthropology (technics is constitutive). The system of feedback loops this condition engenders would gradually emancipate technological development from biological evolution, letting it gain autonomy and ultimately take over anthropogenesis.

The anthropologist Tim Ingold (2013) criticizes Leroi-Gourhan’s stance by maintaining that technical activity, which he calls “making”, should be rather understood as a dynamic process of recursive interrelations between materials and forces, both organic and inorganic, human and nonhuman, embedded with immanent, emergent intentionality. Artefacts are always incomplete entities in perpetual becoming, the provisional outcome of compromises between heterogeneous tendencies: “making, then, is a process of correspondence: not the imposition of preconceived form on raw material substance, but the drawing out or bringing forth of potentials immanent in a world of becoming” (Ingold, 2013, p. 31). Ingold criticizes the hylomorphic paradigm, debunking this long-lasting understanding of technics as the imposition of pregiven forms to inert and homogeneous materials by detached, intentional agents, who fulfil preconceived projects.

Ingold (2013, pp. 36–37) contends that, since Leroi-Gourhan unwittingly abides by this conception, he is called to contradictorily account for both the mechanical stereotypy of technical production and the spontaneous intelligence of its design. Thus, according to Ingold, adopting the hylomorphic paradigm prevents an actual understanding of technical behaviour. For instance,

> the form of the handaxe is constrained neither by cognition nor by biomechanics but by the developmental potentials inherent in the field of forces established by way of the lifelong engagement of practitioners with their lithic materials, and cutting across the interface between them (Ingold, 2013, p. 44).

Artefacts, analogously to biological organs, evolve according to their own dynamics and retain the marks of their interrelations with the environment sedimented in their structure. They influence biological evolution as much as they are influenced by it and their evolutionary trajectory should be understood as the provisional outcome of the compromise between these different tensions.

Human hands exemplify Ingold’s (2013, pp. 109–124) conception of making as constant flowing, the inscription and incorporation of rhythmical patterns. They should not be understood as remote devices controlled by the brain and executing commands according to the information provided to them by it. Thanks to their specialized as much as versatile anatomy, which combines the capabilities to perceive, express, transform and respond, hands are mnestic supports as well as intentional agents.

Hands, tools and the capability to produce, use and transmit these tools coevolve, as already noted in the eighteenth century by the German philosopher Friedrich Engels in his essay "The Part Played by Labour in the Transition from Ape to Man" (1962, 1987):

> the hand is not only the organ of labour, *it is also the product of labour*. Only by labour, by adaptation to ever new operations, through the inheritance of muscles, ligaments, and, over longer periods of time, bones that had undergone special development and the ever-renewed employment of this inherited finesse in new, more and more complicated operations, have given the human hand the high degree of perfection (Engels, 1962, pp. 445–446, 1987, pp. 453–454).

Starting from a different philosophical approach, this viewpoint is also submitted by the German philosopher Oswald Spengler in his book *Man and Technics* (1931, 1932):

> not only must man's hand, gait, and posture have come into existence together, but […] *hand and tool* also. […] As the implements took form from the shape of the hand, so also the *hand from the shape of the tool*. It is meaningless to attempt to divide the two chronologically. It is impossible that the formed hand was active, even for a short time, without the implement (Spengler, 1931, pp. 28–29, 1932, pp. 37–38).

The operational and conceptual schemata presiding over their singular instantiations and regulating their potential for replication do not exist as autonomous mental states, detached from their concrete performance, that is the production of an instrument. They emerge in the flowing interrelation with multiple materials and forces and crystallize into those artefacts which, as materialized memory available for multiple reactivations, they retroactively render producible.

I think that these insights are relevant in order to avoid a naïve understanding of the evolutionary relationship between technics and the human lifeform, where humans are supposed to have always been biologically as they are now, only having invented technics at some point in their evolutionary trajectory, without this "invention" having modified their biology to any extent. This is the case, for instance, with Malm's (2018) approach, according to which culture/society "has emerged from nature—more immediately, from the biological bodies of members of our species" (Malm, 2018, p. 70), human biology thereby represented as already suitable for and conducive to technical life, before and independently of its appearance.

2.5 Cerebralism

A related, widespread pitfall one should also avoid in order to adequately understand anthropogenesis as a technical process is cerebralism, i.e., presupposing the emergence of highly developed brains which would subsequently enable hominin populations to create their instruments, languages and social organizations. Since the eighteenth century, this conception is traditionally exemplified by the Swiss philosopher Jean-Jacques Rousseau in his essay "Discourse on the Origin and Foundations of Inequality among Men" (1780, pp. 1–176, 1992, pp. 3–95), where he argues that human advanced cognitive capabilities would originate culture and society. Convergently, the German philosopher Immanuel Kant, in his book *Anthropology from a Pragmatic Point of View* (1923, pp. 55–654, 2006), submits that the morphology of our hands and their capability to technically manipulate reality would be due to our enhanced and yet originary rationality. More recently, this understanding is also contended by the US philosopher of technology Lewis Mumford:

> to compensate for his extremely primitive working gear, early man had a much more important asset that widened his whole technical horizon: he had far richer biological equipment than any other animals, a body not specialized for any single activity but, precisely because of its extraordinary plasticity, more effective in using a larger portion of both his external environment and his internal psychosomatic resources. Through man's overdeveloped and incessantly active brain, he had more mental energy to tap than he needed for survival at a purely animal level (Mumford, 1966, p. 306).

According to Mumford, our enhanced plasticity and cognitive skills would engender and improve our technical system. First, I contend that this construal is untenable because it contradicts the basic principles of physiology and anatomy. Indeed, as maintained by Leroi-Gourhan (1964, pp. 19–20, 2018, pp. 9–10), the increase in the size of the cranium and consequently of the brain follows from the mechanical changes in morphology due to the shift to the upright position and concerning the relation between jaw, backbone and braincase. Leroi-Gourhan (1964, pp. 124–128, 2018, pp. 86–89) claims that striding bipedalism, on the one side, allows for the liberation of the hands from their locomotory duties, thereby enabling instrumental manipulation as the configuration of an organ devoted to touching, holding, grasping, carrying etc. On the other, it frees the head and jaw from their prehensive tasks, permitting the emergence of a refined phonatory apparatus suitable for articulating sounds and developing vocal communication. Language use, in turn, requires the coevolution of the mechanical possibility of articulating sounds and the cognitive possibility of thinking symbolically. Hence, the emergence of our cognitive capabilities is the effect rather than the cause of our technical behaviour and the related anatomical changes.

Secondly, as pointed out by Stiegler (2018a, pp. 127–162, 1998b, pp. 100–133), who extensively comments on Rousseau's insights, this empirical misconception is symptomatic of a conceptual pitfall, which typically manifests itself when the emergence of humanity is accounted for by some transcendent principle not further understandable within our epistemic framework—such as the divine intervention submitted by creationism, for instance. Rousseau famously seeks to "separate what is original from what is artificial in the present Nature of man, and to know correctly a state which no longer exists, which perhaps never existed, which probably never will exist" (Rousseau, 1780, p. 33, 1992, p. 13), i.e., envisioning an enigmatic "state of nature" before modern civilization, halfway between humanity and animality.

However, these primaeval humans, which may also remind us of the "humans without technologies" imagined by Ihde, discussed in the Introduction, fulfil a contradictory position within Rousseau's discourse. On the one hand, they are represented as anatomically analogous to contemporary humans: "I shall suppose him to have been formed from all time as I see him today: walking on two feet, using his hands as we do ours" (Rousseau, 1780, pp. 47–48, 1992, p. 20). On the other, they are imagined as devoid of any form of instrumental behaviour and cultural tradition, deemed unnecessary for their survival: "the first man who made himself clothing or a Dwelling, in doing so gave himself things that were hardly necessary, since he had done without them since then" (Rousseau, 1780, pp. 55–56, 1992, p. 25).

This condition is not only empirically but also conceptually impossible. On the one side, human hands and the upright position, for instance, are precisely the results of evolutionarily relevant technical behaviour, as I will review in Chapter 4. On the other, as Stiegler points out, this conceptualization doubles the origin, thereby rendering evident its contradictory untenability. There is a first, transcendent origin, which is supposed to account for the extant human psychophysical configuration. A second, empirical origin then sets in in order to explain the emergence of civilization, that is technics. However, the second origin actually accounts for the alleged originary origin, i.e., technics accounts for anthropogenesis—albeit in hindsight. From this perspective, the second origin is disregarded as an accident supplementing the first origin, which actually never takes place, if not within the supplemental structure of technics itself.

Thus, if we assume an evolutionary perspective on the origin of the human lifeform, anthropogenesis has to be accountable according to the state of the art of scientific knowledge and based on factual, describable circumstances. Moreover, if we assume that technical behaviour plays a pivotal role in this process, first, we should discard those explanations of the origin relying on transcendent, hypostatized factors which would subsequently account for every human feature (e.g., an immortal soul or a universal reason). Secondly, we should reject those accounts which only regard

technics as adding itself to the accomplished human constitution without providing any alteration to our psychophysical and ecological setup.

Starting from this perspective, Stiegler submits the concept of default of origin: "there will have been nothing at the origin but the fault, a fault that is nothing but the de-fault of origin or the origin as de-fault" (Stiegler, 2018a, p. 218, 1998b, p. 188). There is no such a thing as a "simple" or "pure" origin, which would subsequently unfold all its implications. The origin is rather always lacking, always differentially retreating, precisely because, as technics, it is always already there, always occurring before our understanding and constituting the possibility of this understanding. The human lifeform is produced retrospectively, in a feedback mechanism questioning any empirical-transcendental divide, as I will discuss in Chapter 5.

2.6 Pharmacology

Despite these methodological precautions, Stiegler's jargon of the supplement, which he adopts from Derrida in order to conceive of anthropogenesis as the supplementation of biology with technics, perhaps inadvertently introduces a suspicion of miserabilism in Stiegler's account of human evolution, likely beyond and against his own intentions (Di Martino, 2019a). On the one hand, Stiegler (2003b, p. 50, 2009a, p. 34) carefully distinguishes between lack and default, submitting that the former represents an erroneous, moralistically connotated interpretation of the latter. On the other, while perhaps overly relying on Leroi-Gourhan's (1964, 1965; 2018) insights, Stiegler (2003a, p. 64) seems to quite surprisingly conflate them:

> hominization is immediately engaged with and as the technicization of life, inasmuch as the biological organs of the technical living being are not sufficient to guarantee its survival, and inasmuch as, in order to survive, this new form of life must *invent artificial organs that in return "organologize" its cerebral organ* (Stiegler, 2015a, p. 286, 2017a, p. 160).

Technics here seems to set in only subsequently, taking evolutionary advantage of an otherwise unbearable, "purely" biological condition, without constituting it in turn. As I will discuss in Chapter 5, Derrida's notion of supplement is concerned with a criticism of the metaphysics of pure presence, where the origin of a phenomenon, rather than being conceived of as a retrospective, performative construction, is hypostatized as an autonomous entity, a pregiven, uncaused cause. Indeed, as clearly stated by Derrida himself, "the strange structure of the supplement appears here: a possibility produces by delay that to which it is said to be added" (Derrida, 1967, p. 99, 2010, p. 75). Supplementing is not about filling in some supposedly originary lack, since, this being the case, absence would be hypostatized in place of presence and we would still linger within metaphysical

thinking. The logic of the supplement rather conceptualizes the impossibility of determining the ontological, chronological and epistemological priority of one term of a relation over the other—although its semantics may lead one to suppose the contrary.

Stiegler builds on Derrida's notion to conceptualize how endosomatic and exosomatic organs coevolve. As pointed out by Gerald Moore's (2017a) interpretation of Stiegler's understanding of anthropogenesis, first, the employment of an artefact de-functionalizes an organic function and subsequently re-functionalizes the organ formerly exerting that function, which is thereby exapted for other functionalities. Secondly, biological evolution is supplemented with technical evolution. As I will further elucidate in Chapter 3, the process of biological mutation, inheritance and selection obtaining in the relationship between the members of a species and their environment intertwines with the process of so-called artificial selection occurring between hominin populations and their increasingly artificialized surroundings.

Hence, I think that the suspicion of miserabilism in Stiegler's account of human technicity may be definitively ruled out if attention is drawn to his concept of pharmacology. As discussed by Derrida in his essay "Plato's Pharmacy" (1972a, pp. 69–197, 1981, pp. 63–171), the Hellenic word *pharmakon* expresses the logic of the supplement. Signifying both remedy and poison, it originally refers to medicinal and magical draughts. Subsequently, its meaning is extended by Plato in his dialogue *Phaedrus* (1997, pp. 506–556) to conceptualize the ambiguous character of writing relative to memory. According to Derrida, *pharmaka* are "both remedy and poison, […] refusing to submit their ambivalence to analysis" (Derrida, 1972a, pp. 78–79, 1981, p. 70), and their effects may be "alternately or simultaneously […] beneficent or maleficent" (Derrida, 1972a, p. 78, 1981, p. 70).

This condition is evident in the case of writing. While bestowing our memory on exosomatic, artificial supports, we enlarge it. Concurrently, we also reduce it, because what is bestowed on writing is also stripped from our "inner", neuro-somatic memory, expropriated from our intimacy and transferred to the detachable, collectivized domain of artefacts. Negatively understood, as Plato does, "contrary to life, writing—or, if you will, the *pharmakon*—can only *displace* or even *aggravate* the ill […]: under pretext of supplementing memory, writing makes one even more forgetful; far from increasing knowledge, it diminishes it" (Derrida, 1972a, p. 113, 1981, p. 100). Writing strengthens *hypomnesis* (recollection) at the expense of *anamnesis* (living memory). However, as argued by Derrida, the *pharmakon* is never purely negative: (alphabetic) writing, as a historical instance of the metalogic Derrida calls arche-writing, actually consists in the most general structure of Being, always ambiguous, irreducible, both producing and amounting to indefinite deferrals and differentiations of the given.

In his book *What Makes Life Worth Living* (2010a, 2013b), Stiegler appropriates Derrida's notion of *pharmakon*, stating that all artefacts are *pharmaka*, technics, as an articulation of the logic of the

supplement, being inherently pharmacological. The complex of human artificial organs, as interrelated techniques and technologies, socialized in a community,

> is at once what *enables* care to be taken and that *of which* care must be taken—in the sense that it is necessary *to pay attention to it*: its power is *curative to the immeasurable extent* [*dans* la mesure et la démesure] that it is also *destructive* (Stiegler, 2010a, p. 16, 2013b, p. 4, trans. mod.).

Consequently, pharmacology is "a discourse on the *pharmakon* understood *in the same gesture* in its curative and toxic dimensions" (Stiegler, 2010a, p. 16, 2013b, p. 4). According to the pharmacological understanding of technics, the latter is what should be taken care of by a community, i.e., what both needs care and provokes concern, insofar as, on the one side, only through their technical behaviour, socialized within institutions, are humans able to survive and thrive. On the other, technical change always triggers a suspension of the extant behavioural patterns and shared lifeways, requiring and provoking their modification. The rearrangement of the living conditions peculiar to a given epoch and region, elicited by technological development, may be either actively pursued, appropriated and collectively determined or passively undergone, inadvertently withstood and accepted. While in the first case this condition engenders a comprehensive and coherent reconfiguration of the modes of individual and collective existence, in the second case it provokes social fragmentation and unaware behavioural automation, eventually leading to cultural breakdown. This pharmacological duplicity amounts to the difference between adopting and adapting to an environment, as I will review in Chapter 5.

Thus, pharmacology depicts anthropogenesis as an evolutionary trajectory heading towards increasing artificialization. The human lifeform, Stiegler argues,

> *is constantly* and *has forever* been challenged and called into question by a technicity that is *itself perpetually new* and which, from the moment of its default of origin, this being has continued to develop in order to compensate for the perverse, secondary effects of its primordial technicity. These effects are *always already there before it* (Stiegler, 2010a, p. 228, 2013b, pp. 113–114, trans. mod.).

Technical apparatuses evolve and, by doing so, rearrange the psychophysical and behavioural constitution of hominin populations, letting them evolve in turn. Exosomatization, however, is always pharmacological. On the one hand, our techniques and technologies enable us to expand, refine, intensify, multiply and redirect our organic functions, disclosing new possibilities of subjectivation,

shared lifeways and organizations of survival. On the other, exteriorizing amounts to delegating to artificial devices what was formerly performed by biological organs, which has two main, interwoven consequences.

First, artefacts, since they are socialized, entail the rearrangement of the complex of tasks and duties devoted to their production, maintenance and utilization. They relatively belong to the community rather than the single individual, their responsibility is up to everyone and no one, the decisions concerning their acquisition, reproduction and regimentation should be the object of shared practices of concern and care. Secondly, exosomatization as unburdening bestowal of organic functions on artefacts engenders the reconfiguration of the biological organs which formerly performed these functions. From supports of organic functions, these organs become supports of the artificial organs exerting these functions in their place—but not without their contribution—becoming, therefore, supports of supports, losing some capabilities and acquiring others, towards an increasingly mediated relation to environmental stimuli and pressures.

Hence, Stiegler's pharmacological approach highlights how the process of exosomatization is unavoidably meant to increase: "technics constantly compensates for a *default of being* […] by *constantly bringing about a new default—always greater*, always more complex and *always less manageable* than the one that preceded it" (Stiegler, 2010a, p. 32, 2013b, p. 15). The exosomatization of organic functions onto accordingly reorganized artificial supports, on the one side, increasingly rearranges human biological constitution, heading towards extended artificialization and, therefore, increased dependence on artefacts, moulding hominin populations as organisms only able to survive and flourish in their self-constructed, artificial environment, i.e., their complexes of institutionally coded techniques and technologies.

On the other, this process also engenders the need for the increased socialization of these technically mediated life functions. Becoming more complex and pervasive, technical devices not only require increasingly numerous and different expertise for their management but also extend their effects to increasingly vast and diverse biological functions, calling for the participation of virtually the whole community in the establishment of their rules of usage, i.e., the norms presiding over what is deemed acceptable to do with them and what is not. Recursively, this decisional process is also technically mediated and configured according to the techniques and technologies available to that community.

Consequently, there is no originary, "purely" biological lack technics would subsequently supplement—not even in a quasi-instantaneous, quasi-simultaneous *après-coup*. Technics itself rather produces this alleged lack, carving human biological constitution towards increasing dependence on technologies. New artificial organs, in turn, call for increased exosomatization, because the dis-automated biological functions bestowed on them should now be explicitly

considered, collectively managed and taken care of through the production of further (curative) artificial organs. The new artefacts should cope not only with the unavoidable (toxic) side effects in terms of social disruption and upheaval engendered by the former innovations but also with the unavoidable complexification of the community's living conditions they elicit, i.e., the multiplication of the dynamics that should be actively taken into account while coherently organizing shared lifeways.

Thus, as highlighted by Stiegler (2015a, pp. 266–267, 2017a, p. 292) and as I will further discuss in Chapter 5, the pharmacological approach to human constitutive technicity prompts us to consider that technics is both what constitutes humans and what may always deprive them of their humanity, the sense of this deprivation being structurally twofold. On the one hand, it consists in the ineliminable possibility of social breakdown provoked by disruptive technical change when not adequately taken care of. On the other, it amounts to the standing reorganization of the extant organic functions through their bestowal on artefacts.

2.7 Consciousness, Historicity, Individuation

The last major concept of Stiegler's philosophy of technology I aim to discuss is what he terms epiphylogenesis. This notion enables him to conceptualize the cumulative dimension of human cultural evolution, highlighting the role played by artefacts in the transmission of memory and, therefore, the inheritance of past experience. Stiegler submits that our individual consciousness, which structures our behaviour and worldview, is produced by its interrelation with the individual consciousnesses of our peers—including those who lived before us—and that this transgenerational relationship is enabled by technics and, therefore, depends on the available technical system, which operates as accumulator and transmitter of exteriorized experience.

Stiegler elaborates on this conception by critically appropriating insights by three thinkers whose influence is among the most prominent within his oeuvre, namely Husserl, Heidegger and Simondon. Via Husserl's phenomenology, Stiegler shows how the individual consciousness is constituted by its relation to exosomatic mnestic supports. Via Heidegger's existential analytic, he underscores how the individual assumption of a collective heritage is enabled by the inheritance of artefacts from past generations. Via Simondon's theory of individuation, he submits that the reciprocal constitution of individual and collective identity depends, in turn, on the available technical system. Hence, I will now turn to Stiegler's interpretation of these three philosophies and then outline his concept of epiphylogenesis.

2.7.1 Husserl

In his book *On the Phenomenology of the Consciousness of Internal Time* (1966, 1991), Husserl deals with what he considers "the most difficult of all phenomenological problems, the problem of the analysis of time" (Husserl, 1966, p. 276, 1991, p. 286). What he calls temporal objects are those phenomenological givens "to whose constitutive content temporal extension also belongs" (Husserl, 1966, p. 221, 1991, p. 228)—regardless of whether they constantly mutate or persist unmodified. Temporal objects are apprehended by the phenomenological consciousness as fluxes of now-moments, each of which subsequently presents a now-trait, starting from the first instance of its appearing and consequent elapsing. Each now-moment of a temporal object retains its former ones within it, not as present anymore, but as just-passed, thereby rendering the feeling of succession and constituting the temporal object as enchainment of retained perceptions, gradually fading away.

Through these primary memories (i.e., perceptions with the now-trait), also termed retentions by Husserl, the feeling of succession starting from the given of perception is constituted. However, only the moment which is each time carrying the now-trait is originally perceived, while the former now-moments are apprehended by consciousness as retentions, gradually becoming less evident, i.e., less present to consciousness. If the previous moments of, say, the perception of a dance would not be retained in its subsequent moments, consciousness would not grasp this object as a whole, i.e., as a unitary phenomenon with inner variations, but only as the single instances of its elapsing. This condition is particularly evident in the case of a melody or a song, exerting heuristic value in order to enquire into the nature of consciousness. Indeed, the latter also has a temporal status, occurring as constant elapsing and flowing of enchained lived experience, and since consciousness is always consciousness of something because of its intentional structure, Stiegler agrees with Husserl in claiming that "to account for the structure of the temporal object's flux is to account for the structure of the stream of consciousness of which it is the object" (Stiegler, 2018a, p. 607, 2010d, p. 14).

Contrary to his mentor, the Austrian philosopher Franz Brentano, Husserl contends that time consciousness does not depend on phantasy, but solely on perception (Tănăsescu, 2021). According to Husserl's (1966, pp. 15–19, 1991, pp. 16–20) interpretation, for Brentano phantasy would act productively, attributing the trait of being-past to the incoming perceptions, thereby rendering the feeling of succession, that is phenomenological time. Hence, succession and mutation would not be rooted in perception, but would rather be the products of phantasy. By doing so, however, Brentano does not distinguish between the perception of succession and the recollection of a past succession or its imagination not directly linked to present perception. Time perception, Husserl argues, would thereby depend solely on phantasy and what is past would be phenomenologically inexistent. Indeed, recollection is not immune from the suspicion of absolute scepticism, i.e., the idea that external reality is nothing but a mental projection. However, through phenomenological reduction, as theorized by

Husserl, we may gain certainty about time perception, as long as we maintain that retention is grounded on perception: "the consciousness of time does not originate from phantasy in the sense of pictorial consciousness [*Bildlichkeit*], but purely from perception" (Husserl, 1966, p. 209, 1991, p. 216). Since recollection is grounded by Brentano on phantasy instead, it does not necessarily entail the reality of what it recalls.

Thus, secondary memory, which Husserl also calls recollection, should be regarded as structurally separate from and independent of retention. From Husserl's perspective, every past content that is (re)presented to the phenomenological consciousness must have been perceived before, differently from the simple phantasy of objects that have never been perceived. Recollections have their temporality as well, which manifests itself as enchained primary retentions and protentions. Indeed, both primary memory and secondary memory entail a futural component, i.e., protentions and expectations respectively. The originary impression of a content into consciousness, i.e., perception, produces the now-consciousness and continuously becomes retention, i.e., something that is now but refers to the past that has just elapsed. Hence, retentions constantly become retentions of retentions, gradually fading away from consciousness, continuously modifying themselves into other retentions. Contrary to retentions, recollections do not depend on perception but rather on phantasy. They make the past (as enchained retentions and protentions) present as past, (re)presenting the past (as past) to consciousness.

According to Husserl (1966, pp. 33–34, 1991, pp. 34–36), recollections should also be separated by what he calls image-consciousness, i.e., the perception of a semantically relevant image, such as a painting or a statue. Perceiving an image consists in intending something that is not present in perception (i.e., the referent of the image) through something that is present in perception (i.e., the image itself). Recollection, instead, renders present within consciousness as past (i.e., with the past-trait) something that was actually present in perception before.

Derrida develops a criticism of the main tenets of Husserl's phenomenology. First, in his introduction to Husserl's essay *Origin of Geometry* (1962, 1978), Derrida submits that Husserl unduly opposes perception and imagination, failing to conceptualize what the former calls retentional finitude, i.e., the finite character of (living) memory, which cannot retain everything that is perceived and is, therefore, constitutively oblivious. As claimed by Husserl, in his analyses "the limitation of the temporal field is not taken into consideration […]. No ending of retention is foreseen there, and *idealiter* a consciousness is probably even possible in which everything remains preserved retentionally" (Husserl, 1966, p. 31, 1991, p. 32). Conversely, according to Derrida, "the retentional power of living consciousness is finite" (Derrida, 1962, p. 45, 1978, p. 50), i.e., an infinite retentional capability does not obtain, not only empirically but also "ideally", that is as a heuristic hypothesis.

Secondly, Husserl advocates for "the *a priori* necessity that a corresponding perception, or a corresponding primal impression, precede the retention" (Husserl, 1966, p. 33, 1991, p. 35), i.e., recollection must always be grounded on an actual perception. Conversely, Derrida, in his book *Voice and Phenomenon* (1967, 2010), submits that the originary presence of the now-moment is always already haunted by an absence working through it and de-voiding it of its plenitude and self-reference, empirically as well as in its formal structure:

> the phenomenological originality that Husserl wants thus to respect leads him to posit an absolute heterogeneity between perception or originary presentation […] and re-presentation or representative re-production […]. Memory, the image, the sign are re-presentations in this sense. […] This heterogeneity constitutes the whole possibility of phenomenology which makes sense only if a pure and originary presentation is possible and original (Derrida, 1967, pp. 49–50, 2010, pp. 38–39).

Thus, according to Derrida (1972a, p. 155, 1981, p. 135), Husserl's phenomenology remains within the tradition of the metaphysics of presence, albeit hinting at its conceptual limits, his opposition between primary and secondary memory corresponding to Plato's opposition between anamnesis and hypomnesis, precluding the latter to conceptualize the pharmacological character of writing, as discussed above. Derrida maintains that what is regarded as originally separate and independent in Husserl's phenomenology, i.e., the originary present and the represented absent, rather structurally intertwines and co-belongs through the logic of the supplement. Presence, the absolute givenness of one's own experience to one's own consciousness, is never originary but rather continuously deferred, haunted and supplemented.

Stiegler endorses Derrida's criticism of Husserl's phenomenology but also aims to amend it. According to Stiegler (2006, 2009d), Derrida, while rightly criticizing Husserl's opposition between primary memory (which Stiegler renames primary retentions) and secondary memory (which Stiegler renames secondary retentions), unduly effaces every distinction between them. Instead, Stiegler (2018a, pp. 519–581, 2009c, pp. 188–243) argues, although primary memory and secondary memory should not be opposed, they should be distinguished nonetheless. Failing to conceptualize this distinction ultimately leads Derrida to miss the question of what Stiegler calls tertiary retentions (also termed *souvenir tertiaire* in the first two volumes of *Technics and Time*), i.e., technics as transgenerational, exteriorized transmission of memory.

By tertiary retentions, Stiegler means materially embedded, exteriorized experience contributing to constituting consciousness. These are gestures, habits and attitudes sedimented onto extrabodily devices, that is technics, insofar as the latter represents the processual exosomatization of life

practices onto accordingly reorganized supports. Furthermore, tertiary retentions, since they consist in affordances of interactions with the past, are always also protentions, invitations to engage with materialized possibilities of subjectivation and invention of alternatives. They are concurrently "an artificial support for memory and imagination" (Stiegler, 2013a, p. 219, 2015b, p. 45).

Hence, according to Stiegler, who refers to the constitutively finite character of memory underscored by Derrida, primary retentions are always also selections, insofar as what will be perceived is framed and conditioned by what has been perceived. Memory is not only a repository but also a filter providing the criteria according to which experience is retained: "a primary selection is the repetition of a secondary retention in what is primarily retained from what has happened" (Stiegler, 2013a, p. 86, 2014, p. 53). Consequently, perception and imagination are not two separate and independent functions of consciousness, but rather structurally intertwine and co-belong. Secondary retentions are also selections since past memories condition the flow of experience, i.e., which contents will be retained and which ignored. Finally, tertiary retentions are also selections as well, since they represent what is retained from the past at the expense of the constant flow of living experience.

Thus, memory being finite and, therefore, unable to retain everything that occurs, I select what to retain from the incoming experience based on my past experience, insofar as my life history determines the horizon of my concerns and interests regarding what will happen: "retentional finitude imposes selection at the very heart of an anticipation that is already memorization qua forgetting" (Stiegler, 2018a, p. 568, 2009c, pp. 231–232). My individual life history constrains the spectrum of my expectations, thereby constructing my reception of the future. This condition becomes clearly observable when repeatedly perceiving a temporal object which can be reproduced with the highest fidelity and exactitude, e.g., a record on a gramophone or a projector. Every new perception will slightly differ from the previous ones, although the recording apparatus always plays (virtually) the same performance. The retention of the previous perceptions (i.e., secondary retentions/protentions as selections), sedimented in (biological) memory, influences and organizes the subsequent ones (i.e., primary retentions/protentions as selections), letting consciousness experience each time a different content. According to Stiegler, the possibility of repeatedly perceiving a temporal object thanks to a given means of reproduction is not accidental but rather represents a constitutive feature of (human) memory, i.e., tertiary retentions/protentions as selections.

This tertiary memory, Stiegler argues, best corresponds with Husserl's concept of image-consciousness, i.e., the experience arising when observing an image, such as a painting or a photo, where perception and imagination intertwine through the mediation of the artefactual imaginative support. However, since ultimately Husserl does not admit a constitutive role for imagination and even less for the exteriorized support, aiming to ground memory and, therefore, the temporality of

consciousness on the originary perception of experience alone, he thereby fails to see its technicity. Admittedly, Husserl (1954, pp. 365–386, 1970, pp. 353–378) partially revises his position in the later stages of his work, dealing with the question of the origin of geometry and envisaging how writing enables the transmission and reactivation of (scientific) knowledge.

Stiegler radicalizes Derrida's stance, according to which "traditional sedimentation in the communal world of culture will have the function of going beyond the retentional finitude of individual consciousness" (Derrida, 1962, p. 45, 1978, p. 50, trans. mod.). Stiegler regards the inscription of mnestic contents into exosomatic media as a constitutive feature of human consciousness, which is thereby (re)produced by its interrelation with artefacts. The structural deficiency of biological memory calls for its supplementation with technics, "a compensation that not only acts as a support when it 'flinches' but that establishes it in its originary possibility" (Stiegler, 2018a, p. 555, 1998b, p. 220). Retention, selection and anticipation are bound together by our memory's originary technicity, pharmacologically understood as the standing deferring as well as increasing of what can be forgotten.

These insights can be buttressed by scholarship in evolutionary psychology. As argued by the evolutionary psychologist Thomas Suddendorf (2013, pp. 89–111), based on observed cognitive dysfunctions elicited by damages occurred in specific brain areas, memory is usually subdivided into three different dimensions: procedural memory, i.e., knowhow; semantic memory, i.e., information; and episodic memory, i.e., recollection. Notably, episodic memory is regarded as far from all-encompassing but rather structurally forgetful. Hence, on the one hand, humans need to rely on exosomatic mnestic supports. On the other, recollection always also entails phantasy as the introduction of fictional elements aiming to render our narratives consistent. Moreover, recollection and foresight are structurally interlinked on a neural as well as cognitive plane and, therefore, coevolve. According to Suddendorf, while nonhuman animals exhibit procedural and semantic memory, they do not display episodic memory and foresight. Nevertheless, the experiments carried out by Nicholas Mulcahy and Joseph Call (2006) show how captive bonobos and orangutans exhibit behavioural signs of future planning, which, therefore, may not be a uniquely human cognitive feature.

2.7.2 Heidegger

From Stiegler's perspective, individual consciousness only occurs as the interrelation of primary, secondary and tertiary memory (i.e., tertiary retentions/protentions as selections), which all together contribute to retaining, storing and reactivating knowledge, knowhow and desires. New experience is selected according to what I retain from the past. Concurrently, exteriorized memory, once conveniently reactivated, enables me to recall, repeat and reinterpret this experience. Crucially,

tertiary memory also includes experience individuals did not live personally but rather inherited from their cultural tradition and thereby always implies a collective dimension.

In order to investigate how individual experience can propagate both collectively and transgenerationally through technics, I should now leave Husserl's phenomenology aside and turn to Stiegler's interpretation of Heidegger's philosophy. Indeed, the question of inheritance lies at the core of Heidegger's *Being and Time* (1977a, pp. 27–36, 2010, pp. 19–25):

> in its factical being Dasein always is how and "what" it already was. Whether explicitly or not, it *is* its past. […] In its manner of existing at any given time, and thus also with the understanding of being that belongs to it, Dasein grows into a customary interpretation of itself and grows up on that interpretation. It understands itself initially in terms of this interpretation and, within a certain range, constantly does so. This understanding discloses the possibilities of its being and regulates them. Its own past—and that always means that of its "generation"—does not *follow after* Dasein but rather always already goes ahead of it (Heidegger, 1977a, p. 27, 2010, p. 19).

However, according to Heidegger, *Dasein* tends to interpret themselves starting from the impersonally acquired, shared tradition of their epoch, which does not disclose an authentic comprehension but rather covers and distorts it, to the point of compromising the possibility of accessing our own ontological constitution. Heidegger (1977a, pp. 492–533, 2010, pp. 355–383) expands on this topic when introducing the concept of historicity:

> the resoluteness in which Dasein comes back to itself discloses the actual factical possibilities of authentic existing *in terms of the heritage* which that resoluteness takes over as thrown. Resolute coming back to thrownness involves *handing oneself over* to traditional possibilities (Heidegger, 1977a, p. 507, 2010, p. 365).

In order to assume their authentic historicity, *Dasein* has to acquire their transmitted legacy based on the anticipating decision of their being-towards-death, i.e., the possibility of being as a whole through the experience of one's own finitude.

Historicity, Heidegger argues, represents *Dasein*'s access to the temporality of Being, which discloses their world in its historical structure. However, alongside *Dasein*, there is a kind of beings termed world-historical which also have a historical structure. As Heidegger highlights in *The Basic Problems of Phenomenology* (1975, pp. 231–242, 1982, pp. 162–170), world-historical beings, differently from "natural" beings, are essentially intraworldly, i.e., they do not acquire their

intraworldly character only because they are disclosed to *Dasein*'s world. As products of *Dasein*'s activity, the world-historical beings "*are* only or, more exactly, arise only and come into being only *as* intraworldly […], even the most primitive tool" (Heidegger, 1975, p. 241, 1982, p. 169). Nonetheless, despite representing "*possible* 'material' for the concrete disclosure of Dasein that has-been-there" (Heidegger, 1977a, p. 520, 2010, p. 374), world-historical beings are historical only secondarily, i.e., thanks to their intraworldly character—they can only subsist in the historical world, but the temporality of the latter depends on *Dasein*'s disclosure to Being alone. In their everyday condition, *Dasein* first and foremost encounters these beings and only when they retreat is *Dasein* able to grasp their worldly constitution, which is nevertheless the condition for these beings to appear and relate to *Dasein* in the first place.

Indeed, according to Heidegger, the temporal opening provided by Being to *Dasein* cannot be grounded on the ontic dimension and thereby overdetermines every possible relation to beings: "since the Dasein is being-in-the-world and the basic constitution of the Dasein lies in temporality, *commerce with intraworldly beings is grounded in a specific temporality of being-in-the-world*" (Heidegger, 1975, p. 413, 1982, p. 291). This condition applies even more so to the historical understanding of the world and "since factical Dasein is absorbed and entangled in what it takes care of, it initially understands its history as world history" (Heidegger, 1977a, p. 514, 2010, p. 370), i.e., starting from the beings ready-to-hand. In Heidegger's view, this intraworldly condition pertains to inauthenticity and cannot grant access to *Dasein*'s ontological constitution. Hence, analogously to what has been discussed in the Introduction concerning instruments as "belonging to world", whose ontic status is regarded by Heidegger as precluding them from partaking in the ontological constitution of *Dasein*'s world, the authentic-inauthentic divide excludes the world-historical beings from the constitution of *Dasein*'s existential structure.

Interpreting Heidegger's considerations, Stiegler (2018a, pp. 273–311, 1998b, pp. 239–276) highlights their ambiguity regarding artefacts, which are on the verge of contributing to *Dasein*'s ontological constitution but are eventually rejected due to existential analytic's overly instrumental conceptualization of technologies. According to Stiegler, Heidegger conceives of instruments as mere means of calculation, i.e., what supports *Dasein*'s retreat into preoccupation aiming to determine the indeterminable event of their own death, and fails to see that this attempt at calculating is grounded on the impossibility of ultimately determining everything. Pharmacologically, technics provides us with the means of calculation as well as representing the source of incalculability as the fallibility of memory and, therefore, anticipation.

Heidegger aims to overcome his mentor Husserl's fixation on present perception, inscribing the assumption of the non-lived past into the constitution of present existence. However, similarly to Husserl, he does not acknowledge a constitutive role for technics as the exosomatization of memory

and experience. Stiegler's criticism of Heidegger, therefore, consists in the overturning of the latter's main ontological tenet, that is the impossibility of grounding *Dasein*'s existential constitution on the ontic domain of intraworldly beings. According to Stiegler, technics is what effectively gives access to the non-lived past *Dasein* inherits and has to seize. Tertiary memory, such as monuments, letters or paintings, enable the reception of experience not belonging to *Dasein*'s individual history, since it is collectively inherited and transgenerationally transmitted.

From Stiegler's perspective, world-historical beings frame our temporal constitution: "the relation to time […] is always already determined by its techno-logical, historial conditions, *effects* of an originary techno-logical condition" (Stiegler, 2018a, p. 269, 1998b, p. 236). Human identity is constitutively engaged in the process of adopting a tradition. This adoption is conditioned by the available technical system of encoding and recording which not only relates us to a shared past but also allows for its further development, that is its individuation:

> the past that I have not lived is nevertheless *my* past *through my tertiary retentions*, i.e., through the *things* which constitute the world from which I come, which preceded me and which support the memory whose inscription I neither lived nor produced, but which I have to interpret—and starting from these interpretations, *as* these interpretations, I produce, in turn, inscriptions[16] (Stiegler, 2018b, p. 18, my translation).

In order to fully outline this dynamic, I will now tackle Simondon's theory of individuation and review how Stiegler both assumes and criticizes it by reinscribing technics at its core.

2.7.3 Simondon

According to Simondon (2005, pp. 23–36, 2020, pp. 1–17), who devotes *Individuation in Light of Notions of Form and Information* to the concept of individuation, the genesis of beings has traditionally been investigated starting from a hypostatized, standalone notion of individuality, postulating some principle of individuation preceding and constituting it. This conception abides by the hylomorphic paradigm, where a pregiven form is imposed on an inert matter to mould and individuate it. Simondon rather aims to enquire into individuation as a process, i.e., by focusing on the operation of individuation producing the individual as its partial and relative outcome, and claims

[16] "Le passé que je n'ai pas vécu est cependant *mon* passé *à travers mes rétentions tertiaires*, c'est-à-dire à travers les *choses* qui constituent le monde d'où je viens, qui m'ont précédé, et qui supportent la mémoire dont je n'ai ni vécu ni produit l'inscription, mais que j'ai à interpréter—et à partir de ces interprétations, *comme* ces interprétations, je produis des inscriptions à mon tour".

> that the principle of individuation is not an isolated reality, that it is not localized within itself, and that it does not preexist the individual like an already individualized embryo of the individual; […] the principle of individuation, in the strict sense of the term, is the complete system in which the genesis of the individual takes place; […] moreover, this system outlasts itself within the living individual as a milieu associated with the individual in which individuation continues to take place (Simondon, 2005, p. 63, 2020, p. 51).

From Simondon's perspective, there is a preindividual reality from which the individual may emerge and that is not exhausted by it but rather remains available for further individuations. Furthermore, the outcome of the process of individuation is not the individual alone, but rather the mutually constitutive coupling of the individual and its environment. In order to pursue individuation, an entity has to be in metastable equilibrium, i.e., a state where its energetic potentials are not completely resolved, but rather are available for further reconfigurations. These operations, in turn, are triggered by the exigence to rearrange and resolve the tensions constituting the metastability of this state.

Stable equilibrium amounts to the exhaustion of all potentials and, therefore, energetic death, that is the impossibility of pursuing any other operation without the input of energy external to the system—this is the case with physical individuation, i.e., the individuation of non-living beings. Disequilibrium, instead, represents the impossibility of resolving the tensions of the system in its extant configuration and, therefore, calls for a new regime of individuation in order to avoid breakdown. Once the supersaturated condition of energetic excess peculiar to metastable equilibrium becomes unstable, it triggers a new individuation or even a whole new regime of individuation. This is the case with vital individuation, as living organisms, differently from non-living beings, not only keep on individuating themselves throughout their lives but are also able to pursue individuation beyond themselves through reproduction, constituting the preindividual field for further individuations.

In the case of humans, Simondon argues, the process of vital individuation decouples into two processes mutually constituting one another and constantly referring to each other, namely psychic and collective individuation. The single, psychic individual can only perform individuation by exceeding themselves and partaking in the collective dimension composed of the other psychic individuals. Reciprocally, the human collective only individuates itself through the conjoining and interrelating individuations of its individual components. Taken together, psychic and collective individuation constitute the transindividual, i.e., the constant, reciprocal individuation of the members of a group. These individuals are in a transductive relation,

> a relationship that does not relate individuals by means of their constituted individuality separating them from one another, nor by means of what is identical in every human subject, […] but by means of this weight of pre-individual reality, this weight of nature that is preserved with the individual being, and which contains potentials and virtualities (Simondon, 1958, p. 336, 2016, p. 253).

Stiegler (2018a, pp. 697–702, 2010d, pp. 93–98) endorses the main tenets of Simondon's theory of individuation, praising his methodological stance in conceptualizing genesis in processual terms, against substantialism and in favour of a thinking of becoming. However, Stiegler (1998c) also criticizes Simondon for not having drawn all the consequences from his position, especially relative to the relationship between his theory of individuation and the analyses developed in *On the Mode of Existence of Technical Objects* (1958, 2016).

Indeed, despite some hesitation, for instance when he states that "in the individual's relation to other individuals and to nature *or technical beings*, the individual is invested in a transductive relation" (Simondon, 2005, p. 455, 2020, p. 704, my emphasis), Simondon seems not to endorse the paradigm of human constitutive technicity and does not include technics (i.e., artefacts as exteriorized memory) in the preindividual field of psychic and collective individuation. In Simondon's view, technics would only emerge subsequently to anthropogenesis, in order to solve the tensions in the process of individuation generated by a previous, so-called magical phase, "the primitive and original phase" (Simondon, 1958, p. 216, 2016, p. 169), a mode of existence regarded as "pre-technical and pre-religious" (Simondon, 1958, p. 216, 2016, p. 169). Moreover, according to Simondon (1958, pp. 170–178, 2016, pp. 183–190), technics would only manifest itself concomitantly with another, separate mode of existence, namely religion. Finally, Simondon (1958, pp. 70–82, 2016, pp. 71–81) seems to postulate an act of spontaneous invention at the origin of each technical lineage, without considering the retroaction technical objects exert on their producers as what triggers the capability to imagine and anticipate.

From Stiegler's perspective, not only psychic and collective individuation co-belong, but also technical individuation partakes in this process: "technical individuation can be accomplished only to the extent that it generates psychic individuations themselves formative of collective individuations" (Stiegler, 2015a, p. 286, 2017a, p. 160). Psychic, collective and technical individuation coevolve in a transductive relation enabling the emergence of the human lifeform. Technical individuation, Stiegler (2013a, pp. 82–84, 2014, pp. 50–51) argues, occurring alongside anthropogenesis and eliciting the decoupling of vital individuation into psychic and collective individuation, constitutes the preindividual milieu only starting from which individuation can be

pursued. The preindividual field represents the tertiary memory individuals have to adopt in order to inherit their non-lived past and pursue their individuation further.

2.8 Epiphylogenesis

Stiegler (2017b) contends that inheriting a shared, non-lived past, i.e., adopting the system of habits and beliefs transmitted by a tradition and thereby individuating and developing it further, is only possible thanks to the transgenerational transmission of collective experience performed by technics, which he terms epiphylogenesis. Contrary to biological organs, artefacts are detachable organs, as Stiegler (2008a, pp. 30–31) points out in the wake of Simondon's (1958, pp. 65–70, 2016, pp. 67–71) and Leroi-Gourhan's (1965, pp. 35–36, 2018, pp. 237–238) insights. They subsist independently of the individuals who produced them, surviving their biological death and being re-employable by others. Other individuals may acquire, adopt and modify them, thereby inheriting the techniques of usage and production inscribed into their structure, trails of those who made and used them, and transmitting, in turn, this materialized knowledge to posterity, pursuing the process of psychic-collective-technical (trans)individuation further.

One may object that biological organs may also be detached, survive their owners' death and be passed on to others, as is the case with a transplanted kidney or a scalp, for instance—although this may only occur provided that these biological organs are inscribed into a complex of technologies providing for their "artificialization" and enabling their detachability. Reciprocally, artificial organs are not always properly detachable, like tattoos, whose eradication from their bearers would amount to their destruction, or pacemakers, whose removal would most likely elicit their owners' death. However, consistently with the processual understanding of technics outlined in Chapter 1, I think that the emphasis here should lie in the process of exosomatization rather than in its outcome. The appropriation or dispossession of an artefact amounts more to the loss or acquisition of a function than to the physical displacement of an object. For instance, while a visually impaired person can remove their eyeglasses without incurring sudden death, in the present stage of technoscientific development that would immediately transform their relation to the world to the point that it is no longer the same as it was when that person was wearing them.

Hence, in the case of humans, according to Stiegler (2018a, pp. 163–171, 1998b, pp. 134–142), three different kinds of memory should be singled out: genetic, i.e., phylogenetic memory, which is shared by the species and embedded in each individual, transmitted through biological reproduction. Somatic (especially neural), which Stiegler terms "epigenetic" memory (with reference to its traditional signification as what relates to developmental processes and not to its contemporary meaning as the stable transmission of mutations in gene expression not involving changes in DNA), which develops during ontogeny and is peculiar to each different individual. And technical, so-called

epiphylogenetic memory, composed of the techniques and technologies available to a given community and inherited as tertiary retentions:

> the living animal is a capacity for reproduction through the articulation of two memories that do not communicate with each other […]. If acquired characteristics cannot be inherited, it is because the individual animal's memory is erased at the moment of its death […]. But technics opens the possibility of transmitting individual experience beyond the individual's life […]. Inheriting and adopting a tool means inheriting a part of the experience of the one(s) who bequeathed it: it is to adopt this experience, to make it part of one's own past even if one did not live it oneself, except, somehow, through retroactive delegation (Stiegler, 2018a, p. 821, 2010d, p. 206, trans. mod.).

Stiegler maintains that epigenetic memory, that is the experience acquired throughout ontogeny, cannot influence genetic memory and gets lost when its bearers die. Epiphylogenetic memory, however, supplements this condition and renders the transgenerational transmission of acquired characteristics possible by adopting artefacts from past generations. Tertiary retentions, therefore, amount to the means of epiphylogenesis because they compose the artificial environment evolutionarily moulding our biology, as I will argue in Chapter 3. The inherited artefacts represent a pool of shared, exosomatic experience, insofar as somatic memory is exteriorized onto technical objects and survives the death of those who produced them. Consequently, this experience is transmitted and reproduced alongside genetic memory, influencing it.

Thus, throughout anthropogenesis, genetic and epiphylogenetic memory coevolve and mutually influence one another. Hominin populations' instruments and skills transform alongside their psychophysical and genetic setup. Technological development is initially largely conditioned by biological evolution, then gradually becomes more relevant and eventually overdetermines our evolutionary trajectory. According to Stiegler (2018a, pp. 390–391, 2009c, pp. 70–71), however, with the stabilization, in Homo sapiens, of the process of corticalization, i.e., the transfer of neural functions from primitive brain areas to the brain cortex, genetic evolution would cease and technological development would become the only mechanism providing alteration and novelty. The coevolutionary process would be transferred to the coupling "between the technical system and other social systems" (Stiegler, 2013a, p. 350, 2015b, p. 141), in a dynamic of subsequent misalignments and adjustments yielding transformation. Stiegler adopts this conception from Leroi-Gourhan (1964, pp. 184–187, 2018, pp. 130–132), who advances that cultural differentiation would only start with the end of biological evolution.

I think that Stiegler's understanding of epiphylogenesis as the intertwinement of genetic, somatic and technical memory, despite its insightfulness and substantial correctness, should be nuanced. First, as reviewed by Edith Heard and Robert Martienssen (2014), transgenerational epigenetic inheritance actually occurs in plants and at least some animals. This account does not abide by a pure Lamarckian conception of the biological transmission of acquired characteristics, as the adaptive function of these mutations in gene expressions unaffecting DNA and the role played by the environment in these processes are unclear and perhaps unlikely. However, the relationship between genetic programming and developmental experience may not be one of complete incommunicability, contrary to Stiegler's view.

Michael Haworth (2016), for instance, goes so far as to claim that these scientific findings jeopardize the validity of Stiegler's conception of epiphylogenesis as a novel process within biological evolution enabling the transgenerational inheritance of developmentally acquired experience through technics. However, I contend that this is not the case, because transgenerational epigenetic inheritance has not been hitherto observed in mammals, let alone in humans. Moreover, what matters from Stiegler's perspective is that technological development, once it becomes systemic and cumulative, substantially influences the process of speciation, producing a lifeform constitutively interrelating with technics for its survival—a circumstance that none of the studies reviewed by Haworth seems to mention.

Secondly, Stiegler's understanding of human genetic evolution as ceasing concomitantly with accomplished corticalization does not hold. As discussed by Frederick Simoons (1970), for instance, culturally driven genetic selection and mutation still take place until relatively recent times. The most well-known example is lactose intolerance. After weaning, some individuals are still tolerant to lactose, while others cease to be so. Lactose tolerance is genetically inherited and, since it represents a deviation from the evolutionary trend in mammals, there must have been positive selection for the mutant gene encoding the production of lactase, i.e., the enzyme we need to digest milk sugar (lactose). This condition depends on the emergence of communities that largely rely on the consumption of milk and dairy products, where the individuals presenting the mutation are likely to be fitter and more competitive, consequently having more chances to reproduce and pass on their (mutated) genes. The production and consumption of milk, in turn, depends on the adoption of milking and farming, a likely consequence of breeding, which occurred no more than 10 thousand years ago—long after corticalization and the emergence of Homo sapiens.

Hence, while Stiegler is right in emphasizing that "the coupling […] living matter/inert matter" (Stiegler, 1998c, p. 142, 2018a, p. 171) constitutes a "double plasticity" (Stiegler, 2018a, p. 171, 1998b, p. 142), as I will further discuss in Chapter 5, this condition does not cease to obtain concomitantly with accomplished corticalization. Stiegler seems to nuance his view when he notes

that human genetic evolution only ceases "*relative to technical objects' rhythm of evolution*"[17] (Stiegler, 1998a, p. 190, my translation), implying that the question would be one of speed. From this perspective, technological development tends to become so fast that biological evolution may turn out irrelevant when it cannot keep pace anymore with technical change and the social transformations it yields. Nowadays, the potentially disruptive impact of the implementation of new technologies is dealt not so much with mutations in the human genome as with the general rearrangement of the organological milieu into which these technologies are introduced—although the former may still occur and prove effective in some particular instances.

2.9 Cumulative Cultural Evolution

Let me now conclude these remarks by corroborating Stiegler's analyses with insights coming from the scientific literature regarding cultural transmission. Sterelny's (2012) approach focuses on the relevance of social learning and cooperation in anthropogenesis. Specifically, human sociocultural practices are regarded as "epistemic niche construction" (Sterelny, 2012, p. 145): "the distinctive character of human social life depends on the accumulation, preservation, and transgenerational transmission of cognitive capital" (Sterelny, 2012, p. 65). Human minds, Sterelny (2010) argues, are not so much extended into artefacts as they are scaffolded through them because the whole human environment and not only some of its features are cognitively engineered towards the systematic transmission and sharing of knowledge. Cooperation occurs between brains through the mediation of artefacts but, most importantly, Sterelny remarks that these brains may well be those of individuals from previous generations, whose exteriorized experience survive their biological death and is retained into socially embedded, cognitive devices.

The developmental psychologist Michael Tomasello (2014) emphasizes the cumulative character of human cultural traditions in comparison to those of the other great apes. Admittedly, it has been inferred that the manufacture of complex-shaped stepped pandanus tools by New Caledonian crows, for instance, displays diversification and cumulative evolution (G. R. Hunt & Gray, 2003), thereby rendering debatable Tomasello's claim that cumulative cultural evolution pertains to humans alone. Either way, according to Tomasello, the human potential for cumulative cultural evolution derives from our propensity for collaboration, while the social organization of the other great apes revolves more around competition. The latter have the capability to invent new behavioural patterns but subsequently fail in accurately transmitting them to other individuals and eventually to their offspring. Consequently, their cultural behaviours mostly rely on inventiveness from scratch and occasional emulation. Conversely, Tomasello regards what he calls shared intentionality as the bedrock of human

[17] "*Relativement au rythme d'évolution des objets techniques*".

cultural traditions, insofar as the propensity for sharing information, thematically imitating and teaching and learning are considered humans' evolutionary assets, decentring our individualities towards increased interaction and cooperation.

According to Tomasello, this condition triggers the so-called ratchet effect: "cumulative cultural evolution takes place when the inventions in a cultural group are passed on with such fidelity that they remain stable in the group until a new and improved invention comes along" (Tomasello, 2014, p. 121). When observing a behaviour, humans, including children, pay more attention to its process than to its outcome, relying on social learning for most of their activities. By doing so, inventions can be faithfully transmitted transgenerationally while concurrently being susceptible to further alterations and enhancements:

> one generation does things in a certain way, and the next generation then does them in that same way—except that perhaps they add some modification or improvement. The generation after that then learns the modified or improved version, which then persists across generations until further changes are made (Tennie et al., 2009, p. 2405).

According to this approach, cumulative cultural evolution would depend on social learning alone, with little mention being made of artefacts if not as the outcome of cultural behaviour. Social learning and advanced cooperation, in turn, are depicted as an adaptive response to novel ecological challenges, such as struggles with foraging or competition between groups. They are "biological adaptations that come into existence as they are used during ontogeny to collaborate and communicate with others" (Tomasello, 2014, p. 146). Nevertheless, Tomasello and his collaborators seem to show some awareness of the transgenerational significance of instruments, for instance, when they observe that

> when individuals use the cultural artefacts and practices invented by others before them they are, in a sense, collaborating indirectly with those others—so that any improvements they make are owing to a kind of indirect collaboration, as they build on the products of previous inventors (Tennie et al., 2009, p. 2411).

Not only instruments but also immaterial cultural objects such as concepts or words enable individuals to transgenerationally collaborate with their departed peers, who left trails of their behaviour through their tools and devices, taken on by their community and transmitted to newcomers. The latter are thereby allowed not to start from scratch in their endeavours and concurrently implement changes which, if proved effective, may be adopted by their community and

transmitted in turn. As observed by Sloterdijk, “symbolic ordering systems disburden all human young of the insoluble problem (at least on the individual level) of having to create the experiences and discoveries of their ancestors over again all by themselves” (Sloterdijk, 2016c, p. 49, 2018, p. 27).

Hence, we may appreciate how, first, cultural traditions are a special case of the nongenetic transmission of traits. Secondly, they rely on social learning and cooperation among groupmates, are also displayed by at least some nonhuman animals and do not necessarily depend on the production of artefacts. Thirdly, for cultural traditions to become cumulative and thereby acquire evolutionary momentum, the usage, production and transmission of technologies as mnestic supports seem required, insofar as they enable their users to relate to the knowledge and experience coming from previous generations and progressively build on it also in the absence of the actual individuals who developed that information.

CHAPTER 3

NICHE CONSTRUCTION, ARTIFICIAL SELECTION AND ANTHROPOTECHNICS: ANTHROPOGENESIS AS TECHNICAL ADAPTATION TO SELF-CONSTRUCTED ENVIRONMENTS

In this chapter, I will render operative the core concepts of Stiegler's philosophy of technology, outlined above, by discussing Sloterdijk's understanding of human evolution as a technical process, highlighting how technics alters the selection pressures yielding anthropogenesis. First, I will turn to niche construction theory in evolutionary biology, reviewing how organisms proactively produce their environment and thereby modify the selection pressures their descendants will inherit, influencing their evolution. Secondly, I will show how these insights corroborate Sloterdijk's spherology, i.e., the study of the human lifeform as the production of interior spaces of coexistence dampening down external stressors and replacing them with autogenous selection pressures.

Thirdly, by referring to Sloterdijk's idea of anthropogenesis as the outcome of self-domestication and Stiegler's analogous concept of artificial selection, I will discuss how throughout human evolution the increasing employment, production and transmission of techniques and technologies transform the relationship between hominin populations and their environment, supplementing the processes of environmental selection and genetic mutation with the functional rearrangements elicited by the couplings between endosomatic and exosomatic organs. Fourthly, I will introduce Sloterdijk's anthropotechnology, i.e., the study of the iterative, subjectivizing practices humans put in place in order to mould their plastic biology through technics and render themselves suitable for living in their self-produced, artificial environment. I will thereby submit that anthropogenesis occurs as the selection of those traits which better fit in with the norms governing the environment hominin populations, in turn, contribute to creating. By referring to niche construction theory in evolutionary biology, I will be able to appreciate the interactive relationship between humans and their environment, thereby emphasizing the evolutionary role of developmental processes, contrary to an understanding of evolution as only based on genetic recombination and natural selection, where technics would play no role.

3.1 Cultural Niche Construction

Niche construction theory represents a prominent field of enquiry in contemporary evolutionary biology (Odling-Smee et al., 2003). As discussed in the Introduction, the Extended Evolutionary Synthesis submits that evolution cannot be explained by genetic inheritance alone, i.e., by the transmission of the parents' combined genotypes to their offspring, with transformation only being elicited through genetic mutation and environmental selection. The organisms' relation to their

environment amounts not only to the passive adaptation to the selection pressures exerted by this milieu but also to the active modification of its characters. All organisms provide habitats and resources to themselves and other organisms through their activities, thereby influencing the flow of matter, energy and information between them and their surroundings. They contribute to producing their own environment (i.e., niche) through their continuous metabolic exchanges and interrelations with their milieu—as is apparent in the case of beaver dams or ant nests, for instance. The main feature of niche construction, therefore, is not so much the modification of the environment by the organisms as the modification of the relation between the organisms and their environment (Laland et al., 2007).

The construction of niches influences, in turn, the development of the organisms inhabiting them and of their offspring, since the modified environment will present new, altered selection pressures and developmental possibilities. These changes evolutionarily affect the genotypes of the organisms inhabiting the constructed environment, because those traits which better fit in with the altered living conditions will be favoured and passed on to the next generation. Ecological inheritance, therefore, constitutes the inheritance of the environmental selection pressures which have been modified by the operations of ancestor organisms on the shared environment, i.e., by their processes of niche construction. Differently to genetic inheritance, ecological inheritance is not transmitted by sexual reproduction, implying that it is exerted by multiple organisms on multiple organisms throughout their whole lifespans—involving, therefore, also genetically unrelated individuals—while genetic inheritance only concerns the parents and their offspring and takes place all at once (Odling-Smee, 2007).

The relationship between the organisms and their environment is a process of co-constitution, the organisms constructing their environment and the latter selecting which organisms may better survive and thrive in it. Hence, environments should not be considered mere ecogeographical containers (e.g., the savannah, the forest, the steppe etc.) harbouring different organisms independently of these organisms' life processes. As shown by von Uexküll (1934, 2010, pp. 41–145), the environment represents the coupling between, on the one hand, the system of relevant stimuli, affordances, possibilities of interaction surrounding an organism; on the other, its perceptual dispositions, receptors, instances of engagement. It is a field of ecologically structured relations, constituting an organism's living conditions, that is the complex of what is perceived as relevant for its survival. Consequently, an organism's environment also consists of other organisms and every organism not only inhabits an environment but also constitutes the environment of other organisms.

However, even if human niches exhibit the same ecological relativity as those of the other organisms, their evolutionary relevance seems outstanding and human niche construction, insofar as it is performed through sociocultural practices, is considered "exceptionally potent" (Laland &

Brown, 2006, p. 96). As maintained by Laland and his collaborators (2001), human technical activities, operating as niche construction, i.e., by modifying the sources of environmental selection, influence genetic evolution, driving speciation:

> if hominids have evolved more in response to self-constructed selection pressures than other mammals and less in response to selection pressures that stem from independent factors in their environment, then hominid populations may have become increasingly divorced from local ecological pressures (Laland et al., 2001, p. 32).

Anthropogenesis, therefore, is characterized by the convergence of niche construction and gene-culture coevolution. Human niches are artificially produced, i.e., they arise as systems of socially coded behaviours transmitted through collectively constructed artefacts, buffering the selection pressures coming from the "natural" environment (Laland et al., 2010).

Since selection coming from niche construction tends to override selection coming from other environmental sources and cultural niche construction operates at faster rates than genetic evolution, "our cultural capacities, and our cultural niche constructing activities, apparently reinforce each other. Trans-generational cultural niche construction modifies environments in ways that favour ever-more culture, causing cultural niche construction to become ever-more powerful" (Laland et al., 2007, p. 59). This condition leads to positive feedback loops, as hominin populations tend to increasingly respond to the alteration of the selection pressures brought about by their niche construction with further niche construction, which thereby takes over their evolutionary trajectory. Through sociocultural practices, an artificial environment arises around hominin populations. Their complexes of artificial organs increasingly pervade every aspect of their existence, reorganizing it through and through, as biological functions are increasingly bestowed on technics for their accomplishment.

3.2 Spherology

Sloterdijk's approach also contends a constructivist perspective on human biology. His concept of spheres, analogously to niches, aims to thematize how humans inhabit their self-constructed environment, which shapes and supports their lifeform in return (Latina, 2013). In his three-book series *Spheres*, composed of *Bubbles* (1998b, 2011b), *Globes* (1999, 2014c) and *Foams* (2004, 2016b), Sloterdijk (1998b, pp. 336–345, 2011b, pp. 333–342) investigates human spatiality by combining ontological analyses with anthropological insights, aiming to make up for the underdevelopment of the existential concept of space provided by Heidegger in *Being and Time* (1977a, pp. 135–151, 2010, pp. 99–110). The space we inhabit, Sloterdijk (2001b, pp. 172–173, 2016a, p. 109) argues, should not be understood through the concepts of trivial, physical or

geometrical space. Humans rather deal with plastic dimensions of cohabitation, shared interiorities constantly relating to their outside, constituting

> the place that humans create in order to have somewhere they can appear as those who they are. […] The sphere is the interior, disclosed, shared realm inhabited by humans—in so far as they succeed in becoming humans. Because living always means building spheres, […] humans are the beings that establish globes and look out into horizons. Living in spheres means creating the dimension in which humans can be contained. Spheres are immune-systemically effective space creations for ecstatic beings that are operated upon by the outside (Sloterdijk, 1998b, p. 28, 2011b, p. 28).

Spheres denote an inner, endogenous tension creating the living conditions where humans can thrive. They are multipolar spaces of coexistence structuring our experience as constant interdependence and relatedness. Humans "flourish only in the greenhouse of their autogenous atmosphere" (Sloterdijk, 1998b, p. 46, 2011b, p. 46): their activities resonate by framing dimensions of mutual influences between bodies, moods and artefacts, producing altered living conditions, which retroact on their producers, determining their mode of existence. According to Sloterdijk, only thanks to the alteration of the environmental selection pressures performed through the construction of new, artificial environments via socially shared practices of unburdening exosomatization could humans evolve: "if 'there is' [*'es'... 'gibt'*] the human being, then that is so only because a technology has brought him forth from out of pre-humanity" (Sloterdijk, 2001b, p. 225, 2016a, p. 142, trans. mod.).

In his essay "The Domestication of Being" (2001b, pp. 142–234, 2016a, pp. 89–148), Sloterdijk further elaborates on his spherology by pursuing a reconstruction of the process of anthropogenesis willing to take into account both Heidegger's legacy and the most recent insights coming from palaeoanthropology, evolutionary biology and psychology. The stake here is to secularize and substantialize Heidegger's meditation on what he calls the *Lichtung*—a later name for our being-in-the-world—while concurrently retaining his critical supervision regarding scientistic objectivism (van Tuinen, 2011). Sloterdijk thereby aims to develop an interpretation of Heidegger's ontology from the perspective of philosophical anthropology, thereby reconsidering him as an unintentional and peculiar representative of this approach (Dirakis, 2014).

Sloterdijk (1999, pp. 85–96, 2014c, pp. 82–91) adopts Heidegger's conception of the human condition as being-in-the-world, reviewed in the Introduction, but also criticizes it because he deems Heidegger's concept of world to lack the dimension of enclosure, in favour of pure and total openness. As I will argue below, humans may only emerge within their self-constructed, insulating environment. Pharmacologically, this artificial environment is both constructible and destructible.

Appreciating this condition enables hominin populations to conceive of the increasingly artificial character of their environment as something that should be taken care of, that is thematically created, administered and reproduced. Hominin populations gradually become receptive to the idea that even their world, i.e., the all-encompassing horizon constituting the conditions of manifestation of the phenomena to which they relate, insofar as it is artificially produced, analogously to these phenomena, is itself the impermanent and provisory outcome of a process of manifestation that could have well happened differently, is always susceptible to being altered and can possibly collapse.

From this perspective, the world as the most general conditions of (im)possibility of manifestation is not understood as an originary given—as is the case with Heidegger's original conceptualization—but rather as something that needs to be produced in turn. Sloterdijk (2001b, pp. 203–206, 2016a, pp. 128–129) understands human openness to the event of Being as our capability to appreciate phenomena starting from their conditions of manifestation, conceiving of the surrounding circumstances as structurally open to the occurrence of the unknown, making evident the excess of presence, i.e., the inextinguishable possibility of novel manifestations and chances to invent alternatives. This originary openness, Sloterdijk argues, is interdependent on an equally originary enclosure within well-protected, technically managed interiors. Only by distancing themselves from direct, immediate environmental pressures, indeed, can hominin populations become capable of carelessly thriving, experimenting and learning in a pampered environment, adopting an unburdened, that is detached, mediated and somehow "meditative" confrontation with their environmental affordances.

Sloterdijk (2001b, pp. 160–165, 2016a, pp. 100–104) maintains that without this amendment Heidegger's concept of world would amount to a mere reversal of von Uexküll's (1934, 2010, pp. 41–145) conception of the animal environment—likewise unduly understood excessively in terms of stubborn encapsulation within quasi-automatic, univocally determined behavioural patterns—while denying to human niches their character of protected enclosure. In order to avoid this undue opposition between the human world and the animal environment, Sloterdijk (2001b, pp. 172–175, 2016a, pp. 109–111) resorts to the concept of sphere, which he deems suitable for thematizing the interdependence of openness and enclosure, thereby framing the structural co-belonging of exteriority and interiority relative to the human condition (Jongen, 2008).

This operation can only be carried out by "thinking with Heidegger against Heidegger" (Sloterdijk, 2001b, p. 154, 2016a, p. 96), i.e., through a critical reassessment of Heidegger's main intuitions, investigating the factical, empirical origin of our ontological capability to project ourselves beyond the contingency of what is ready-to-hand and towards the ecstatic becoming of temporality. Thus, Sloterdijk's appropriation of Heidegger's insights consists in an attempt to reconstruct the ontic, that is technical origin of the *Lichtung* while concurrently retaining its ontological priority (M.-E. Morin,

2011). In Sloterdijk's words, the *Lichtung* "is not to be thought without its technogenic provenance" (Sloterdijk, 2001b, p. 224, 2016a, p. 142). First, Sloterdijk does not regard our being-in-the-world as an originary, inexplicable condition, as Heidegger does, but rather sets out to reconstruct its emergence and account for its constitution. Secondly, he aims to carry out this reconstruction thanks to scientific findings and models, thereby relying on ontic phenomena in order to explain our ontological condition, contrary to Heidegger, who rules out the possibility that positive sciences could contribute to elucidating human existence to any extent.

Thus, human spheres are artificial environments, technically constructed through complexes of socially coded techniques and technologies. Cultures undergo mutation and selection over time, exhibiting evolutionary mechanisms which are distinct from the evolution of biological species, although some analogies can still be observed (Mesoudi et al., 2004). Hence, by changing over time, cultural niches influence the evolution of those organisms bearing, producing and transmitting cultural traits, letting their evolution shift away from "pure" biological patterns. Importantly, technics driving anthropogenesis always manifests itself as a system, that is as sets of interdependent techniques and technologies, rather than as isolated, standalone behaviours.

Indeed, according to Leroi-Gourhan (1971; 1973), who reviews a vast amount of ethnographic data, the introduction of new techniques and technologies into a group may be enacted by individual or collective acts of invention, imitation or permutation. Nonetheless, in order to be effective, it has to comply with the group's technical environment, i.e., the complex of its interconnected techniques and technologies, that the new elements will partially transform. Moreover, as submitted by the historian of technology Bertrand Gille (1978, 1986), the technical system must remain consistent with the complex of socioeconomic norms, habits and beliefs peculiar to that group, which is in turn influenced by its ecogeographical surroundings as well as by its relation to other groups. Technological development occurs as a systemic process, i.e., the constant rearrangement of interdependent dynamics, inscribed, in turn, into sociocultural and ecological environments mutually influencing one another and requiring inner coherence in order to develop.

Analogously to Leroi-Gourhan's and Gille's approaches, the analyses carried out by Simondon (2014, pp. 27–129) provide us with the means to understand the systemic dimension of technical change. According to Simondon (1958, pp. 61–65, 2016, pp. 63–66), technical objects never exist as absolute and autonomous entities, but rather always articulate themselves according to their both geographical and technical environment, i.e., the extant ecological conditions and the complex of the other technical objects respectively. Technicity only emerges as practiced interconnectedness:

> technicity is a mode of being that can only fully and permanently exist in a network, both temporally and spatially. […] An object is only technical if it operates in relation to other

> objects […]; in itself and as an object, it only has virtual characters of technicity, which are actualized in its active relation to the whole system[18] (Simondon, 2014, p. 82, my translation).

Through human mediation, technical objects contribute to producing their own associated environment, featuring both artefactual and geographical dynamics. They not only adapt to the extant circumstances but also transform them, arranging different techniques and technologies into coherent socioecological systems. Simondon terms this process concretization: "adaptation-concretization is a process that conditions the birth of a milieu rather than being conditioned by an already given milieu" (Simondon, 1958, p. 68, 2016, p. 58). Technological development is not only determined by pregiven environmental conditions but also contributes to their establishment. And as the anthropologist Timothy Taylor (2010) puts it, technics always emerges as entailment, i.e., systems of interconnected technical practices determining a community's living conditions: "overall, technology produces the environments within which fitness is ultimately judged, regardless of nature" (Taylor, 2010, p. 186).

3.3 Originary Pampering

Hence, if all organisms participate in constructing their environment, thereby contributing to determining the evolution of their species through ecological inheritance in the form of altered environmental pressures, human evolution seems especially characterized by this phenomenon, insofar as human niches are engineered through "cultural" practices. These activities organize an artificial environment, composed of interconnected techniques and technologies, which gradually replaces the so-called natural environment during anthropogenesis. However, what is the specificity of human niche-constructing activities? I will try to answer this question through recourse to Sloterdijk's analyses.

The main consequence of cultural niche construction is that environmental pressures are dampened down. Thanks to their culturally engineered niches, hominin populations are increasingly less prone to threats coming from their "natural" environment. For instance, the harshness of weathers and cold are attenuated by manufacturing clothes and shelters. Attacks from enemies and predators are kept away by the management of fireplaces and the throwing of projectiles, to which the encounter with aggressors is delegated. Wounds and diseases are taken care of through drugs and medications. Famines and shortages are prevented through storage and processed food. Correspondingly, rigid, hardwired mechanisms of response to fixed, univocally determined stimuli undergo negative

[18] "La technicité est un mode d'être ne pouvant exister pleinement et de façon permanente qu'en réseau, aussi bien de façon temporelle que de façon spatiale. […] Un objet n'est technique que s'il opère en relation avec d'autres objets […]; en lui-même et comme objet, il ne possède que des caractères virtuels de technicité qui s'actualisent dans le rapport actif à l'ensemble du système".

selection. Concurrently, since the stake of survival is increasingly bestowed on artefacts, which require being explicitly taken in charge collectively for the reorganization of shared lifeways around their production, maintenance and transmission, there is positive selection for enhanced plasticity, flexibility and behavioural versatility.

According to the sociologist Dieter Claessens (1993), anthropogenesis occurs as a process of technically mediated distancing "from old nature", i.e., "from the reality immediately pressing on bodily adaptation"[19] (Claessens, 1970, p. 166, my translation). Here it is not so much "nature" that is modified as "the real relation to compelling nature and its interpretation"[20] (Claessens, 1970, p. 190, my translation). The relationship between hominin populations and their environment is altered, technics supplementing biology and inscribing itself at the core of human existence. As observed by Sloterdijk, "the displacement of the incipient human group relates not to its natural habitat, the grassy African landscape, but to its own conventionally animal way of being-in in the natural milieu" (Sloterdijk, 2004, p. 493, 2016b, p. 459). The artificialization of the environment amounts not so much to a transformation of hominin populations' surroundings as to a thorough modification of their living conditions.

Claessens (1970, pp. 81–98) aims to bring together Alsberg's (1975) insights with the analyses carried out by the evolutionary biologist Hugh Miller (1963) on "domestic insulation from external conditions" (H. Miller, 1963, p. 143). Miller maintains that human evolution takes place as the withdrawal of the geneflow from environmental selection because the group, organized around inner criteria of mating and rules of breeding, becomes the ultimate instance of selection:

> through their efficient nurture of progeny, human populations secure their repeated regeneration not by fitting individuals to meet external conditions but by removing them from these; for here the effective environment of the group has come to be nothing else than the group itself, inasmuch as each grown generation in its turn provides the environment of the new generation that rises to replace it (H. Miller, 1963, p. 72).

Insulation, Claessens (1993, pp. 60–92) argues, is performed through technical distancing from environmental stressors, archetypically exemplified by the throwing of stones against predators in order to keep them at a distance, which replaces escaping as a way to deal with aggressors (Sloterdijk, 2014a, pp. 426–449, 2017b, pp. 265–279): "keeping at a distance through the use of instruments is

[19] "Von alter Natur", i.e., "von der unmittelbar auf körperliche Anpassung drängenden Realität".
[20] "Das reale Verhältnis zur zwingenden Natur und deren Interpretation".

the insulation technique of the human being, which actually makes them human in the first place"[21] (Claessens, 1993, p. 132, my translation). This condition leads to the production of an "artificial inner climate"[22] (Claessens, 1970, p. 95, my translation), i.e., an artefactual environment where altered, endogenous selection pressures prevail.

Throughout anthropogenesis, hominin populations construct their own ecology, an artificial environment organized around shared complexes of techniques and technologies. This environment replaces the former, "natural"—in the sense of prehuman—environment, dampening down its selection pressures, which are attenuated, kept at a distance and minimized. Genetic variation becomes less relevant for fitness, insofar as the information necessary for survival is increasingly transmitted through socially embedded artefacts rather than genes. This condition amounts to what Claessens and Sloterdijk in his wake term originary pampering (*Verwöhnung*), an evolutionary "luxury" where individuals and groups retreat from environmental selection. As Claessens puts it, "the creation of a luxuriant inner climate is integral part of the definition of insulation"[23] (Claessens, 1993, p. 231, my translation).

Phylogenetically, this pampered condition consists in the increased tolerance developed by hominin populations towards genetic variation, allowing for the flourishing of characteristics not presenting immediate adaptive functions. These traits may subsequently undergo culturally driven positive selection and be exapted in order to support technical practices. In turn, the selected traits will be those that better fit in with the artificial environment, granting its endurance. Ontogenetically, evolutionary pampering amounts to the possibility for individuals of not being constantly and directly concerned with their daily survival, devoting time and energies to playing, learning and experimenting. The endeavours they are thereby able to carry out may turn out useful in the long term and in an indirect fashion, contributing to the creation and transmission of novel arrangements of the artificial environment by coping with less immediate and more abstract concerns—such as the reflection about the meaning and function of this artificial environment, exemplified by this research itself.

This pampered condition is indispensable for giving birth to underdeveloped offspring requiring enduring and complex nurture. As stated by Sloterdijk, "all luxury begins with the license to be immature and with the retention and enjoyment of an infantile past" (Sloterdijk, 2001b, p. 193, 2016a, p. 122). As I will discuss in Chapter 4, human offspring's helplessness and immaturity at birth are the flipside of our enhanced developmental plasticity, i.e., the capability to extensively mould our

[21] "Das Auf-Distanz-Halten durch Werkzeuggebrauch ist *die* Insulationstechnik des Menschen, die ihn zum Menschen eigentlich ja erst macht".
[22] "Künstliches Innenklima".
[23] "Die Entstehung eines luxurierendem Innenklimas ist Definitionsbestandteil von Insulation".

cognition and behaviour based on our interactions with the (postnatal) environment. Humans' long-lasting, dangerous rearing process may only occur in an insulated, well-protected environment, whose conditions of existence are established and secured through technical practices. Reciprocally, human plasticity, thereby supported, is necessary to adopt highly differentiated technologies and learn a wide range of techniques, inheriting the complex of socially coded behaviours structuring human niches. The human pampered condition is originary—its biological exceptionality always retreating in the background—and actually represents the norm among humans:

> we have always lived in a space station of pampering, but usually we don't notice because part of the character of pampering is that it naturalizes itself at every stage and declares itself to be self-evident. Pampering is relegated to the background as self-evident and becomes irrelevant (Sloterdijk & Macho, 2013, p. 146, 2016, p. 85).

In this sense, human artificial environment becomes "natural", insofar as it represents the only ecology where humans may survive and thrive, their fundamental living conditions. As pointed out by Sloterdijk, "the best way for luxury to protect itself is by denying that it is luxury; it always presents itself as covering only the minimum requirements" (Sloterdijk, 2004, p. 690, 2016b, p. 643), starting from which novel levels of pampering can be achieved.

3.4 Artificial Selection

The pampered condition defining the human artificial environment does not amount to a suspension of selection, but rather to its transformation. First, selection pressures are still exerted on the individuals composing the insulated groups because the artificial environment represents a set of shared behavioural norms, which should be respected, enforced and upheld in order to grant collective survival. Only those traits which better fit in with these complexes of mutual obligations and enable their bearers to take advantage of them will be positively selected and, therefore, passed on to the next generation. Secondly, since human niches are culturally constructed, hominin populations must now take care of the production, maintenance and transmission of their own conditions of existence, coping with environmental stressors operating on the collective level, such as aggressions from other groups, ecological catastrophes and autogenous cultural breakdowns. Sloterdijk shows awareness of this pharmacological duplicity:

> precisely because humanly risky bodies were, on the basis of group-incubator technology that is stable and successful over the long term, able to afford taking features of their fetal and early childhood pasts along with them into the present, they had to learn to tend, in an increasingly

> explicit manner, their own incubators—to use another kind of terminology: their "laws." Pampering compels provision, provision stabilizes pampering (Sloterdijk, 2001b, p. 192, 2016a, p. 121).

The artificialization of the environment equates with the constant concern for its endurance. As Sloterdijk observes, "all luxury comes from the others keeping watch"[24] (Sloterdijk, 1993, p. 335, my translation): in order to give to some individuals—foremost to children—the possibility of carefreely thriving and experimenting in a pampered, protected environment, the other individuals must proactively engage in safeguarding the existence of this environment. Pampering institutions, therefore, are also disciplining apparatuses managing pedagogy, division of labour and social hierarchy, for the artificial environment to acquire consistency and stability. Pharmacologically, the human propensity for plastic inventiveness and creativity also consists in the selection for flexible, docile and submissive phenotypes, as discussed by Sloterdijk in his essay "Rules for the Human Park" (2001b, pp. 302–337, 2016a, pp. 193–216).

Thus, as submitted by Gerald Moore (2017a), who elaborates on Stiegler's insights, so-called artificial selection supplements natural selection in the process of anthropogenesis. The latter does not cease with human evolution, contrary to what sometimes Stiegler seems to submit, e.g., when he states that "exosomatization is the exit from natural selection"[25] (Stiegler, 2018b, p. 96, my translation). Selection for the most viable genetic variants and the consequent rearrangement of the human genotype still takes place. However, genetic variation becomes increasingly less relevant and the transformation of human biology is increasingly enacted by technical means. According to Stiegler, artificial selection amounts to

> the selection of mutations exerted at the cortical level in the context of a relation to the original milieu, mediated by the technical apparatus constituting the system of defense and predation and informing simultaneously the process of individual adaptation and the evolution of the entire species (Stiegler, 2018a, p. 206, 1998b, p. 176).

Technics becomes the main driver of our evolution, determining and constraining both the species's transformation and the single individuals' conditions of existence, integrating biology into technics because organic alterations now also occur through technical change. Exosomatization retroacts on the organisms performing it via feedback loops:

[24] "Aller Luxus kommt aus dem Wachen der anderen".
[25] "L'exosomatisation est la sortie de la sélection naturelle".

> with the process of exteriorization, the "selection pressure" concentrates on humankind's capabilities to manufacture or practice the artificial organs which concretize this exteriorization and, in this context, one cannot speak anymore of "natural selection" in the strict sense of the term: it is about an artificial selection where art, i.e., technics, and arts and crafts in the broad sense become the first question[26] (Stiegler, 2008b, p. 22, my translation).

The process of exosomatization, i.e., the production of artificial organs and the consequent rearrangement of biological organs and the norms presiding over their intertwinement, takes over human evolution. First, artificial selection means that genetic evolution is driven by our technical practices, insofar as the artificialized environment selects for those traits which better fit in with its living conditions, culture leading to genetic change. Secondly, thanks to human enhanced developmental plasticity, technical change may also rearrange human phenotypes bypassing genetic change, because our ways of experiencing and inhabiting the world are constantly reorganized based on which complexes of techniques and technologies are each time adopted, mutating so fast that they increasingly override genetic selection. Thirdly, technics becomes both the agent of selection—biological characteristics may only survive and thrive when they comply with the extant technical system—and the agent of mutation—our artefacts evolve over time, providing us with new ways to frame experience, interpret and act upon the world. Fourthly, technics becomes both the subject of selection—each technical system may only welcome and enable certain technical devices, behavioural arrangements and worldviews—and the object of selection—new techniques and technologies may only be incorporated into a community when they fit in with its current technical system.

Fifthly, artificial selection is not only the cause, but also the effect of human biology and, therefore, is only understandable according to an interpretative framework based on reciprocal causation. On the one side, the pampered living conditions prevailing within human niches favour the emergence of helpless offspring, which is protected from direct confrontation with immediate environmental stressors and requires enduring and energy-demanding nurture in order to survive. On the other, our long-lasting developmental rates and consequent behavioural plasticity and proneness to learn provide us with the means to adopt articulated complexes of techniques and technologies, interiorizing their rules of usage, patterns of production and systems of transmission. Reciprocally, the human helpless condition at birth calls for relying on technical practices in order to secure survival

[26] "Avec le processus d'extériorisation, la 'pression de sélection' se concentre sur les capacités du genre humain à fabriquer ou à pratiquer les organes artificiels qui concrétisent cette extériorisation et, en cela, on ne peut plus parler stricto sensu de 'sélection naturelle' : il s'agit d'une sélection artificielle où l'art, c'est-à-dire la technique, et les arts et les métiers au sens large deviennent la première question".

and effective nurture, the enclosed protection granted by an inner, artificial environment. And increasingly relying on technics in order to rear our offspring leads to the intensification of the pervasiveness of the technical system, favouring artificial selection for increased developmental plasticity. Importantly, we should always be wary of miserabilism and keep in mind that technics is originary and constitutive of humanity: it is the quest for luxury and not a response to lack which determines our increasing technicity.

3.5 Self-Domestication

I think that this construal of anthropogenesis converges with the hypothesis of human self-domestication, that is a rationale of human evolution which understands it as a process mirroring in its proceedings and outcomes the condition occurring to domesticates, such as reduction in size, gracilization and decreased aggressivity (Lorenz, 1965, pp. 114–200, 1971, pp. 115–195). According to Helen Leach (2003), four stages of domestication can be singled out. First, the coevolution of humans and domesticates performs the mutual, unintended modification of physiology and behaviour through shared living in an enclosed environment. Secondly, breeding and agriculture in view of the preservation of favoured types exert the unintended selection of animal and plant characteristics. Thirdly, domestication proper, starting from around 300 years ago, features the intentional selection of types in view of increased robustness and productivity. Fourthly, nowadays domestication is also achieved through genetic manipulation.

Leach (2007) submits that synanthropic, which she also calls unconscious selection amounts to organisms adapting themselves to novel, anthropic environments. Since it is unintentional and nonteleological, it occurs spontaneously as mutualism, commensalism or contramensalism, i.e., ecological interactions between organisms from different species which are respectively beneficial for both, beneficial for one and neutral for the other or beneficial for one and detrimental for the other species. Unconscious selection may only obtain provided that the human environment supplies shelter, protection from predators and access to food, with sedentarism also playing an important role. This condition may lead to operational selection, i.e., the unintended genetic change coming from adaptation to farming and gardening techniques across generations. From this perspective, humans are a special case of synanthropic selection, insofar as they adapt to their own, artificial environment. Unconscious selection, therefore, is different from both "natural" selection (i.e., regular evolution) and intentional selection for preferred characteristics and species (i.e., domestication proper).

This understanding of human evolution, which Suddendorf aptly terms "auto-artificial selection" (Suddendorf, 2013, p. 281), is also endorsed by Sloterdijk, who claims that "humans are pets that have domesticated themselves in the incubators of early cultures" (Sloterdijk, 2009b). According to Sloterdijk, insulation from external selection pressures through the artificialization of the

environment leads to an autogenous incubator-effect providing the pampered living conditions yielding anthropogenesis:

> successive generations that follow a trend toward domestication are not governed by the normal evolutionary pressure of a purely natural environment. They benefit from a special climate that has been created half naturally and half culturally, in which it is not necessarily those who are optimally adapted for external nature who survive but rather the specimens that do well in internal conditions (Sloterdijk, 2016c, p. 47, 2018, p. 26).

Auto-artificial selection performs the supplementation of natural selection with autogenous artificial selection, dampening down the effects of the former in favour of the establishment of endogenous selection pressures. Importantly, throughout anthropogenesis this artificial self-domestication occurs unintentionally and is not goal-directed, so that we deal with "a breeding without breeder, thus a biocultural drift without subjects" (Sloterdijk, 2001b, p. 327, 2016a, p. 210). As I will discuss in Chapter 7, the insulation provided by these artificial spheres operates as what Sloterdijk defines as an enlarged, bio-socio-technical immune system, organologically supplementing biological performances with technical practices and social procedures.

Admittedly, criticisms have been raised against the understanding of human evolution as the outcome of self-domestication. For instance, as reviewed by Dor Shilton and his collaborators (2020), even if many similarities between humans and domesticates actually subsist, morphologically, developmentally and behaviourally, these shared characteristics may be better explicable as the convergence of evolutionary patterns (e.g., the enclosure in a protected environment or a cooked food diet) with different origins, rather than as analogous evolutionary trajectories. Moreover, many important differences between humans and domesticates also subsist (Francis, 2015, pp. 296–297). Thus, I contend that the hypothesis of human self-domestication should be complemented with the theory of artificial selection outlined above in order to adequately account for anthropogenesis.

3.6 Anthropotechnology

In order to better clarify the relationship between phylogeny and ontogeny relative to the account of anthropogenesis I aim to outline throughout this research, I will now discuss how technics shapes human psychophysical constitution through multiple, pervading moulding procedures, which Sloterdijk terms anthropotechnics: "the concept of anthropotechnics designates nothing but that no *Homo sapiens* has yet fallen from the sky, that this creature is therefore attained only by means of technogenic effects, which react to their own evolutionary drift" (Sloterdijk, 2017a, pp. 216–217,

2020a, p. 137). Anthropotechnics defines those technically mediated practices shaping and constraining individual and collective morphology and behaviour.

In "The Domestication of Being" (2001b, pp. 142–234, 2016a, pp. 89–148), Sloterdijk distinguishes between anthropotechnics and anthropogenetic technics, which I interpret as the two, complementary sides of (auto-)artificial selection. On the one hand, anthropogenetic technics consists in the evolutionary mechanisms which actually perform anthropogenesis, i.e., select for the most viable genetic variants concerning enhanced plasticity and proneness to adopt, produce and transmit complexes of techniques and technologies. Impersonal, unpremeditated and nonteleological, these mechanisms are enacted by the reciprocal causation obtaining between hominin populations and the artificial niches they build around them, exerting mutation on the transgenerational level. On the other, anthropotechnics refers to the self-forming practices performed by hominin populations in order to subjectivize themselves and render themselves suitable for living in the artificial environment these practices recursively produce, maintain and transmit. They rely on our enhanced plasticity, thereby eliciting phenotypic modification during ontogeny. Hence, they may become intentional and goal-directed, providing humans with some degree of agency over their evolutionary trajectory:

> in order to cope with the self-endangerments that increase for sapiens-beings from their unique biological position, they have produced an inventory of procedures for the formation of the self, which we discuss today under the general term "culture" […]. To the culturally effective techniques for forming the human being belong symbolic institutions such as languages, origin narratives, rules regarding marriage, logics concerning kinship, educational techniques, the normalization of gender roles and age-based roles, not least preparations for war as well as the calendar and the division of labor […]. It is these ways of ordering and formative powers that characterize anthropotechnics in the proper sense of the word. Primary anthropotechnics compensate for and elaborate on human plasticity, which emerged from the de-definition of the living being called "the human" in greenhouse-evolution. […] Yet it goes without saying that these procedures would have never sufficed to produce the human being as such: they presuppose an educable human essence but they do not engender it. The more primitive anthropogenetic technics that triggered autodomestication must have predated them (Sloterdijk, 2001b, pp. 201–202, 2016a, pp. 126–127, trans. mod.).

I think that these two processes are actually complementary. Anthropotechnics is necessary, first, to preserve the pampered conditions where the human offspring can thrive, i.e., enduring and securing our artificial environment. Secondly, it is required to cope with the drawbacks of our developmental plasticity, such as our exacerbated receptiveness to multiple, undetermined stimuli:

> naturally, for the nascent human beings, certain side effects and personal risks in their evolution of luxury do not remain hidden: they see themselves compelled to put themselves in relation to their heightened physical and emotional vulnerability, to their motivational lability, to their endogenous unrest caused by unbound drive-surpluses, to their group-dynamic excitability, and all the way up to the unleashing of paranoid, orgiastic, and self-destructive violence. Thus do conventions become necessary for the reduction of the risks of coexistence belonging to living beings in the incubator (Sloterdijk, 2001b, pp. 200–201, 2016a, p. 126).

Anthropotechnics consists in the complexes of shared behaviours humans must adopt and transmit in order to condition their subjectivities and thereby render their shared existence possible under given behavioural norms. As Sloterdijk argues in his book *You Must Change Your Life* (2009a, 2012b), expanding on the seminal insights developed by Nietzsche in the third treatise of his book *On the Genealogy of Morality* (1988c, pp. 339–412, 2014, pp. 286–349), the human anthropotechnical constitution should be understood through a positive reconsideration and generalization of the category of ascesis.

According to Nietzsche, ascetic ideals, "one of the broadest and longest facts there is" (Nietzsche, 1988c, p. 362, 2014, p. 306), are a pervasive phenomenon throughout human history. Although they often manifest themselves as hostility and ressentiment against a positive affirmation of life, they also contribute to its preservation and propagation, insofar as they still consist in the establishment of a mode of existence, however sick, corrupted and deformed it may be. As contended by Sloterdijk (2009a, pp. 52–68, 2012b, pp. 29–39), the ascetic practices initially analysed by Nietzsche do not primarily and mainly denote operations of individual self-mortification: "asceticism in the fundamental sense does not reject the will; it is, on the contrary, an expression of a strong pooling of will, an energetic summary of all partial drives in a single ray of will" (Sloterdijk, 1989a, p. 188, 2020b, pp. 84–85). Those who perform asceses enact a transformation of their own psychophysical constitution out of the repetition of sequences of exercises.

Thus, the phenomenon of ascesis, "i.e., autoplastic training"[27] (Sloterdijk, 2019, p. 156, my translation), manifests itself in multiple ways, ranging across epochs and regions, concerning innumerable sets of disciplines and constituting a fundamental anthropological category:

> man genuinely produces man […] through his life in forms of exercise. Exercise is defined here as any operation that provides or improves the actor's qualification for the next performance of

[27] "C'est-à-dire le training autoplastique".

> the same operation, whether it is declared as exercise or not (Sloterdijk, 2009a, pp. 13–14, 2012b, p. 4, trans. mod.).

According to Sloterdijk, "in every performance of exercising, an action is carried out in such a way that its present execution co-conditions its later execution" (Sloterdijk, 2010, p. 19, 2012a, p. 8, trans. mod.). From this perspective, human plasticity amounts to the unavoidable task of moulding one's own subjectivity through the repetition of behavioural patterns: "the subject itself is nothing other than the carrier of its own exercise sequences—on the passive side an aggregate of individuated habitus effects, and on the active a centre of competencies that plays on the keyboard of callable dispositions" (Sloterdijk, 2009a, p. 377, 2012b, p. 242). Pharmacologically, exercises may lead to homologation, submission and automation as well as individualization, enhancement and dis-automation. Regardless of their particular aims, directions and specificities, they all perform the shaping of subjectivity, thereby enacting

> the basic anthropotechnic law: the autoplastic repercussions of all actions and movements on the actor. Working places the worker in the world and marks them with the stamp of their own acts by the short route of an exercising self-shaping. No activity evades the principle of retroactive influence on the operator—and whatever affects past states also affects future ones (Sloterdijk, 2009a, p. 501, trans. mod.).

By combining Sloterdijk's anthropotechnology with Stiegler's understanding of the couplings between endosomatic and exosomatic organs as progressive de-functionalization and subsequent re-functionalization of organic functions exapted by artefacts, discussed in Chapter 2, I submit that adopting an anthropotechnics amounts to the dis-automation of the extant psychophysical and behavioural mechanisms and the re-automation of our biology according to the new sequences of exercises. Importantly, the former automatisms may also be nothing but the outcome of a former anthropotechnics, human ontogeny occurring as functional bio-socio-technical shifts based on the adoption of different self-forming techniques.

As maintained by the cultural scientist Thomas Macho (2011, pp. 431–459), while commenting on Sloterdijk's insights, anthropotechnology retains its explicative potential for the emergence and stabilization of group synchronization and social cohesion as long as anthropotechnics is interpreted foremost as a collective rather than individual practice. Communities transmit and endure the behavioural patterns necessary for the construction of their artificial environment by submitting themselves to shared norms. These habits are inscribed into the individuals' plastic neural and

behavioural constitution through the repetition of rituals, norms and conventions, thereby acquiring stability and predictability.

Indeed, as contended by the anthropologist Francesco Remotti (2013, pp. 4–59), for a community to render its members suitable for living according to its self-produced living conditions, on the one side, the unaware, continuous shaping through the everyday gestures which align us with the behavioural standards of our sociocultural context is required. On the other, the specific, intentional production of given models of humanity through devoted rituals, such as rites of passage and initiations, must also obtain. Individuals undergo these procedures which, in turn, render them properly "human", i.e., members of a community characterized by shared behaviours and beliefs. This process, Remotti (2010) argues, features both positive and negative selection: some developmental possibilities are each time enhanced and others eliminated, training and taming always co-belonging. Consequently, anthropotechnics is always also a matter of power, involving who decides who should be moulded, how and according to which models as well as who may challenge these decisions.

3.6.1 Techniques of the Body

I think that Sloterdijk's perspective may be best understood if reference is made to the analyses carried out by the anthropologist Marcel Mauss in his essay "Techniques of the Body" (1950, pp. 363–386, 1973). This phenomenon refers to "the ways in which from society to society men traditionally know how to use their bodies" (Mauss, 1950, p. 365, 1973, p. 70, trans. mod.). Techniques of the body are learned habits, concerning every facet of human existence, constitutively interrelating biological, psychological and social dimensions. Highly differentiated within and among communities, they rely on social authority for their transmission. The way we walk, eat or have sex, for instance, is the outcome of explicitly or implicitly learned behavioural codes, which mould our psychophysical constitution according to given sociocultural standards: "man's first and most natural technical object, and at the same time technical means, is his body" (Mauss, 1950, p. 372, 1973, p. 75). According to Mauss, techniques of the body are not necessarily governed by the use of artefacts, human bodies themselves being the support of technical activities.

As observed by Bruno Karsenti (1998), an analogy can be drawn between Mauss's (1950, pp. 363–386, 1973) techniques of the body and Leroi-Gourhan's (1964, 1965; 2018) understanding of technics as exteriorization, discussed in Chapter 2, which may enable us to understand "technicity without technologies" starting from Mauss's perspective. The body, according to Karsenti, is conceived of by Mauss as a mnestic support, where operational chains and behavioural patterns can be inscribed, similarly to how biological memory is exteriorized onto artefacts in Leroi-Gourhan's account. For the human body to be re-functionalized as a potential support for mnestic inscriptions, however,

advanced plasticity has to be attained, thereby requiring the technical supplementation of our birthing and rearing practices, which I will scrutinize in Chapter 4. Thus, as is the case with Sloterdijk's understanding of the relationship between anthropogenetic technics and anthropotechnics outlined above, Mauss's techniques of the body as developmental mechanisms are only conceivable provided that auto-artificial selection operates on the phylogenetic level, rendering our biology increasingly plastic.

3.6.2 Techniques of the Self

Hence, technics shapes subjective identity. As extensively investigated by Foucault in his 1981–1982 lecture course *The Hermeneutics of the Subject* (2001, 2005), for instance, the processes of subjectivation in late antiquity structurally depend on what he terms techniques of the self, i.e., complexes of practices such as reading, writing, praying and meditating, devoted to triggering a transformation in the subject, from their present state of dejection to the good life—whose definition may sensibly vary across epochs, ranging from political mastery to mystic enlightenment. Techniques of the self concern the "actions exercised on the self by the self, actions by which one takes responsibility for oneself and by which one changes, purifies, transforms, and transfigures oneself" (Foucault, 2001, pp. 12–13, 2005, p. 11), relating to instruments according to specifically learned techniques. While exercising, individuals become subjects, i.e., they are subjectivized by the practices they perform.

The techniques of the self described by Foucault only deal with the empowering of individual subjectivity. However, as Foucault (2001, pp. 45–47, 2005, pp. 45–48) also acknowledges, these kinds of anthropotechnics obtain before and independently of their first theorization by Plato in his dialogue *Alcibiades* (1997, pp. 557–595) and present a vast, largely forgotten prehistory. This conception is also maintained by the French philosopher Pierre Hadot (1987, pp. 29–31, 1995, pp. 89–90), who carries out analogous analyses regarding those practices aiming at producing "a transformation of one's vision of the world and a metamorphosis of one's personality" (Hadot, 1987, p. 14, 1995, p. 21) in late antiquity.

As reviewed by Macho (2000b, 2021), indeed, individual subjectivity is a relatively late product of human history and inherently depends on forms of anthropotechnics such as those analysed by Foucault and Hadot, complemented by other exercises, such as controlled breathing or ascetic privations. Individual consciousness, Macho argues, historically emerges through the experience of solitude deriving from retreating from or being abandoned by one's own community. Individuals become able to establish a relation to themselves thanks to the mediating and transformative effects of their artefacts, thereby supplementing their former community and recreating a new "social" environment.

Thus, Sloterdijk's anthropotechnology emphasizes the biological, operational and corporeal dimensions latent in Foucault's insights (Liggieri, 2014). Sloterdijk (2014b, pp. 222–242) points out that subjectivation initially involves the standardization and synchronization of behaviours rather than their individualization and the conquest of autonomy. Ancient cultures should be understood as systems of behavioural reproduction, where groups have priority over their members and individual initiatives are precluded or banned. The elders' subjectivity is faithfully and forcefully repeated over the youngers, among individuals and across generations. According to Sloterdijk (2009a, pp. 189–191, 2012b, pp. 119–121), this obsession with homologation and fidelity, in turn, is due to the fact that the technologies of reproduction and transmission of memory available to these communities are already overloaded with the task of replicating the given and can hardly stand further transformative cumulations of knowledge. Consequently, early techniques of the self are collective rather than individual practices and individuality initially pertains to groups rather than individuals.

Hence, Sloterdijk's anthropotechnology enables us to appreciate how auto-artificial selection is actually performed. Subjectivizing exercises, such as military training, etiquette, specific diets and so on, render the individuals suitable for living in their community. The latter's rules of life, indeed, should be explicitly taught and learned at each generation, since they rely on socially coded behavioural patterns, enacted and transmitted through artefacts. Individuals are thereby moulded so that, thanks to their behaviour, they can, in turn, endure the production, maintenance and transmission of their artificial environment. Selection, therefore, takes place in order to preserve those behaviours that better fit in with the living conditions of this environment, favouring those taking advantage of them and thwarting those endangering them.

CHAPTER 4

IMMATURITY AND PLASTICITY: THE COEVOLUTION OF BIOLOGY, TECHNICAL PRACTICES AND SOCIAL ORGANIZATION

As argued above, anthropogenesis occurs as the auto-artificial selection exerted by the technical environment hominin populations, in turn, contribute to producing. In this chapter, I will discuss how we have evolved the neural and, consequently, behavioural plasticity which is required to learn and adopt the wide range of techniques and technologies composing this artificial environment. Through recourse to findings coming from psychoanalysis, social anthropology, evolutionary psychology and neuroscience I will investigate how there has been positive selection for human plasticity despite its flipside being an increased immaturity and helplessness at birth. I will argue that some of our most relevant characteristics, such as striding bipedalism, socialized birthing and rearing processes and enhanced neural and cognitive development, are evolutionarily interlinked and mutually constrain one another through the increasing adoption of technical practices by hominin populations.

First, by referring to Richard Wrangham's work, I will submit that human bipedalism depends on the adoption of food processing techniques by our ancestors. Secondly, I will underscore the biological, psychological and ontological significance of the event of human birth, especially concerning the subjectivizing experience occurring during gestation. Thirdly, I will highlight the interconnection between these two phenomena by showing how the adoption of the upright posture conditions our birthing process which, in turn, influences our brain development. By drawing on Sloterdijk's insights, I will enquire into why humans are born underdeveloped and immature and, therefore, need to rely on extrauterine gestation, i.e., the production of uterine-like living conditions during the first months of extrauterine life. Thus, by outlining the phenomena of human neoteny and neuroplasticity, I will point out the feedback loops occurring between the evolution of our morphology and cognition, on the one side, and our increasing dependence on technics, on the other. Fourthly, I will emphasize how this biotechnical condition is organologically intertwined with our advanced proclivity to social learning and cooperation. Making recourse to these scientific insights will enable me to reassess the relevance of birth, infancy and motherhood for a philosophical-anthropological understanding of the human condition and criticize the traditional, death-, adulthood- and male-centred understanding prevailing, for instance, in Heidegger's existential analytic.

4.1 Inaugurating Anthropogenesis

The question of bipedalism holds a central position in most accounts of anthropogenesis and, therefore, can serve as a privileged starting point for this enquiry. According to Leroi-Gourhan (1964,

1965; 2018), for instance, permanently assuming an upright posture paves the way for the series of morphological changes leading hominin populations towards our extant morphology. Specifically, bipedalism frees the upper limbs from locomotory duties, thereby rendering the hands available for manipulative purposes. Moreover, it frees the mouth from prehensive tasks, thereby rendering weaker jaws adaptive and, therefore, conducive to vocal communication. Finally, smaller jaws enable an increase in braincase volume, thereby fostering encephalization, i.e., the increase in brain size and complexity compared to body size.

Leroi-Gourhan regards the assumption of bipedalism as the inaugural event of anthropogenesis, the first major change eliciting everything else (Johnson, 2011). However, he does not provide any account for the emergence and stabilization of the upright posture itself. Notably, sometimes this idea is also uncritically assumed by philosophers. Exemplarily, Derrida, possibly inspired by Leroi-Gourhan's analyses, claims that "the criterion in force, the distinctive trait, is inseparable from the experience of holding oneself upright, of uprightness as erection in general in the process of hominization […] distinguishing the human from other mammals" (Derrida, 2006, p. 90, 2008, p. 61). Analogously to Leroi-Gourhan's case, no explanation is provided by Derrida for the evolutionary emergence of human bipedalism.

I do not wish to deny the fundamental role bipedalism plays in anthropogenesis. However, we should also keep in mind, for instance, Sterelny's abovementioned suspicion of those monolithic explanations aiming to derive all human characteristics from a single modification. Moreover, assuming that technics is constitutive of the human lifeform suggests that the emergence of our condition should be conceived of as the organological outcome of the feedback loops intertwining biological organs, artefacts and social organizations. Hence, we should not understand it as the result of a single cause unidirectionally accounting for everything that follows from it.

As highlighted by Stiegler, "elevation, or the upright stance, […] is conditioned by technical and prosthetic human becoming" (Stiegler, 2013a, p. 326, 2015b, pp. 123–124). Bipedalism and artificialization occur concomitantly throughout anthropogenesis and mutually influence one another, driving our evolutionary trajectory towards the increasing stability and unavoidability of our upright posture and the increasing pervasiveness of techniques and technologies in our behaviour and ecology. In order to test this hypothesis, I will now turn to scholarship in evolutionary anthropology and focus on one major theory of the emergence of bipedalism, developed by Wrangham in his book *Catching Fire* (2009).

4.2 Striding Bipedalism

Bipedalism, i.e., locomotion using the two rear limbs, pertains to many different animal species. However, so-called alternate foot or striding bipedalism is a locomotory strategy unique to humans

as well as our main and preferred way to ambulate. During hominin evolution, bipedalism is likely to evolve in stages, from facultative or part-time bipedalism—as in gibbons and orangutans, for instance—to postural bipedalism—i.e., upright posture as foraging or feeding attitude, for instance, but not as main locomotory adaptation—and finally to striding bipedalism, emerging around 4 to 2.9 million years ago and proving particularly energetically efficient for walking and endurance running, eventually stabilizing in its fully-fledged, modern form in Homo erectus around 2 million years ago.

This complex adaptation is likely triggered by many different causes, gradually acquiring importance in our lifeway and eventually entailing a thorough restructuration of our morphology. Among the currently most accredited causes for the emergence of bipedalism, we find carrying, insofar as bipedalism frees the upper limbs from locomotory tasks and, therefore, renders transporting items more effective; vigilance, insofar as it enables individuals to overwatch their surroundings more efficiently while standing on their rear limbs; display, insofar as it increases the individuals' apparent size and enables them to also use objects while performing display; and foraging, insofar as acquiring food while transitioning among different low branches may result in a successful feeding adaptation (Videan & McGrew, 2002).

According to Kevin Hunt (2015), who submits the postural feeding hypothesis to explain the emergence of our upright posture, hominin populations evolve bipedalism starting from a foraging behaviour based on grasping fruits from short trees, low branches and the ground, elevating on their rear limbs in order to reach up from the ground or stand on smaller, flexible branches—which would be too weak to sustain unassisted bipedalism or sitting postures—while clinging with their upper limbs to other branches to gain balance. This adaptation, Hunt argues, is initially effective for both arboreal and terrestrial lifestyles and, once the trees are abandoned for good, the remaining adaptations to arboreal locomotion may gradually disappear.

It has been observed that human bipedalism emerges starting from an arboreal environment, likely representing an adaptation to hand-assisted locomotion on flexible branches. This locomotory strategy provides hominin populations with increased stability, efficiency, safety and balance, while concurrently leaving one hand available for grasping purposes—as orangutans, the most arboreal as well as bipedal among the other great apes, also seem to do. Furthermore, the comparison with orangutans enables researchers to submit that vertical rather than horizontal locomotion is more efficient in an arboreal environment and that the capability to reach otherwise inaccessible branches confers selective advantages (Thorpe et al., 2007).

Thus, human bipedalism—which, incidentally, evolves independently of chimpanzees' and gorillas' knucklewalking—is likely to emerge while exploiting an arboreal behaviour retained from the great apes' common ancestor. Moreover, comparative functional neurophysiological experiments (especially cortical somatotopy) suggest that human striding bipedalism (feet) and manual dexterity

(hands) evolve at least partly independently, contrary to what is usually believed. Human hands may evolve with only minor modifications from a largely retained ancestral form, similar to the one presented by Old World monkeys (Hashimoto et al., 2013).

As observed by Kwang Ko (2015), Hunt's postural feeding hypothesis may help us clarify the origin of our remote ancestors' postural bipedalism. However, it does not provide us with many insights into why partially bipedal Hominins evolve to walk as modern humans, thereby acquiring striding bipedalism. Ko maintains that this transition is explained by the liberation of the hands for carrying and instrumental purposes, insofar as the possibility of constantly relying on the upper limbs for manipulation provides a selective advantage offsetting the disadvantages of bipedalism—such as a weaker spine, slower speed, the impossibility of constantly dwelling on trees and the overall loss of the arboreal lifestyle. Hence, by adopting this updated version of Hunt's postural feeding hypothesis, we can make sense of how the capability of limited tool use in an arboreal environment is exapted for extensive tool use and production once striding bipedalism emerges. By doing so, it becomes possible to connect the evolution of bipedalism as a major feature of anthropogenesis with technical behaviour and the production of artefacts, without concurrently assuming the former to be the uncaused cause of the latter, as is the case with Leroi-Gourhan's account evoked above.

4.3 The Cooking Hypothesis

I can now introduce Wrangham's argument to further elucidate the relation between technics and the emergence of bipedalism. According to Wrangham (2009, pp. 39–44), cooking triggers anthropogenesis: adopting a diet based on cooked food yields the series of morphological, ecological, behavioural and cognitive changes leading to the human lifeform. Wrangham develops his thesis by expanding on research carried out by Leslie Aiello and Peter Wheeler (1995). The latter observe that brains are highly expensive organs in terms of energetic demand: the bigger the brain, the more energy is needed to aliment it. Since humans exhibit substantial encephalization, the authors submit that the energy needed to fuel our otherwise too big and consequently energy-demanding brain is obtained by a reduction in size and energy expenditure of another organic tissue, namely the gut.

This trade-off enables hominin populations to develop bigger brains without needing to excessively increase their basal metabolic rate, i.e., their average energetic demand. And yet, what does enable, in turn, the reduction in gut size? Aiello and Wheeler maintain that it is provoked by a change in diet towards more energetic food, such as meat, which is partially the case also with the other great apes. However, Wrangham suggests that it is the adoption of a diet based on varied, cooked aliments, rather than raw meat, that actually yields this transition.

Indeed, while the main shortcoming of a cooked food diet is developing the inability to digest raw food, Wrangham (2009, pp. 79–81) observes that the benefits of eating cooked food are many. First,

there is a developmental advantage, insofar as cooked food is easier to digest, softer, lower in fibres and more calorically dense than raw food, providing, therefore, more energy. Furthermore, cooking enables us to eliminate parasites from food, preserves it for a longer time before it gets spoiled and renders edible some organic tissues which would be undigestible if consumed raw. Secondly, there is an evolutionary advantage, insofar as cooked food requires smaller guts to be digested—the human stomach and especially the colon weighing approximately 60% less compared to what is expected of a similar-sized Primate.

Cooked food, Wrangham (2009, pp. 138–146) argues, can be digested more quickly and with a lower energetic expenditure because of the increased tenderness, starch gelatinization and protein denaturation brought about by most cooking techniques. This way of processing food also entails disadvantages, such as energy losses because of dripping while cooking, the production of some indigestible, toxic protein compounds and reduced vitaminic import. However, the latter are outweighed by the advantages and particularly by the increased energetic intake, which directly selects for enhanced evolutionary fitness and competitiveness, especially concerning reproductive success.

Thus, eating cooked food entails lower metabolic digestion costs, thereby increasing energetic efficiency. Moreover, a cooked food diet selects for smaller mouths and teeth as well as weaker jaws, paving the way to vocal communication and encephalization. Finally, eating cooked food results in consistently reduced chewing and food processing time overall, also considering how long the stomach takes to empty itself before it can be filled up again. A cooked food diet thereby increases not only our average caloric intake rate but also the amount of re-employable free time. Complementarily, fire increases the available time at night, on top of being a defence against predators and a source of heat.

According to Wrangham (2009, pp. 85–90), our relation to fire arguably starts accidentally. Subsequently, hominin populations learn to control fire, then figure out how to ignite it and eventually become able to cook. Nonetheless, Wrangham stresses that human biology is produced by a cooked food diet and not vice versa. This evolutionary trajectory begins when cooking transitions from episodic to systemic behaviour, which implies the ability to properly control fire. However, it is difficult to paleontologically locate the origin of controlled fire use by Hominins, whose earliest secure evidence to date harks back to around 1 million years ago at Wonderwerk Cave, South Africa (Berna et al., 2012). Wrangham, therefore, proposes that we assess the onset of fire use indirectly, i.e., starting from those morphological changes appearing in Hominins which are arguably due to the stable adoption of a cooked food diet. This approach enables him to hypothesize a substantially earlier onset for fire use and control, that is concurrently with the emergence of Homo erectus around 2 million years ago.

This inferred evidence leads Wrangham (2009, pp. 98–103) to establish a link between the stabilization of striding bipedalism in Homo erectus and the adoption of a cooked food diet. He claims that the capability to cook meat and roots renders the food to be found on trees less essential to survival, while fire allows hominin populations to sleep safely on the ground at night. In the evolutionary scenario depicted by the postural feeding hypothesis, where Hominins carry a partly terrestrial, partly arboreal lifestyle, increasingly adopting the upright posture to forage fruits among low trees and flexible branches, hominin populations spend most of their time in a bipedal posture but still rely on regularly dwelling on trees especially at night, because they are overly vulnerable to predators while asleep on the ground. The adoption of a cooked food diet and fire control renders feeding on trees unnecessary, on the one hand, and staying on the ground overnight less dangerous, on the other, removing the two main rationales to retain a partially arboreal lifestyle and thereby leading to striding bipedalism.

Hence, Wrangham connects the emergence of bipedalism proper in Homo erectus with technological development, especially the adoption of cooking techniques. Importantly, cooking as a technical practice should not be reduced to a set of instruments and procedures but rather involves a thorough rearrangement of hominin populations' ecology and behaviour. It is not about an individual innovation unidirectionally causing the emergence of our lifeform. It is rather the reorganization of our lifeway induced by a modification in our feeding and foraging habits, built on pre-existing potentials for tool use and bipedalism, which selects for those traits which, in turn, prove better suitable for sustaining and developing this modification, thereby rearranging our morphology and cognition as adapted to a cooked food diet.

The emergence and stabilization of the upright posture in hominin populations, therefore, transform their lifeway towards increased reliance and dependence on technical practices, which alter their biology in return. However, the implications of striding bipedalism are not exhausted by these modifications in our digestive system, feeding habits and social ecology. There are other, equally important correlations between technics, bipedalism and anthropogenesis. As I aim to show below, the adoption of the upright posture also entails substantial changes in human birthing, rearing and developmental processes, which in turn significantly transform our brain, cognition and behaviour. Thus, I will now tackle the question of our immaturity and plasticity at birth, i.e., why we are born underdeveloped and dependent on enhanced parental care and concurrently display advanced neuroplasticity, i.e., the capability to alter our cognitive and behavioural constitution based on our interactions with the environment.

4.4 Existential Analytic from Mortality to Natality

Human birth seems a rather enigmatic phenomenon. By investigating its complexity and highlighting its importance, I aim to show that it is an event where ontological and biological dimensions intersect and mutually determine one another. In Sloterdijk's words, "coming-into-the-world is the philosophical formula for a biological event charged with an ontological character" (Sloterdijk, 2001a, p. 174, 2011a, p. 175). I thereby set out to discuss how a focus on human birth and its consequences may grant us a comprehensive vantage on human technicity.

In *Being and Time* (1977a, 2010), Heidegger draws our attention to the phenomenon of death as the fundamental event characterizing human existence. According to Heidegger (1977a, pp. 314–354, 2010, pp. 227–255), *Dasein* should regard themselves as being-towards-death in order to be as a whole, i.e., grasping their own existence in its totality despite their factical, originary dispersion among the intraworldly beings. While facing the possibility of their own death as the constitutive possibility of the impossibility of every mode of ontic existence, *Dasein* is shacked out of their thrownness into the world and confronts their being-in-the-world itself.

Hence, according to Heidegger (1977a, pp. 244–253, 2010, pp. 178–184), our existence is ontologically determined by our mortality and this condition manifests itself to *Dasein* through the fundamental mood of anxiety (*Angst*), which conveys the upsetting experience of our finitude, notably to be distinguished from the mood of fear (*Furcht*), which Heidegger (1977a, pp. 186–189, 2010, pp. 136–138) rather relates to the confrontation with determinate, intraworldly beings. Anxiety refers to our being-in-the-world, i.e., our opening to the event of Being, and thereby renders fear possible, since the potentially frightening encounter with intraworldly beings presupposes *Dasein*'s originary openness to the world, that is the condition of manifestation of the whole of beings.

In the mood of anxiety, *Dasein* experiences isolation and detachment from the complex of beings composing their world, realizing that the possibility of their manifestation depends on their finite temporality, which determines their mortal existence. Being-towards-death, therefore, recalls *Dasein* from their ontic dispersion by rendering evident the relativity of our worldly conditionings, i.e., our factical possibilities of existence, and thereby enabling them to fix upon those particular possibilities which are most their own, that is more authentic. However, Heidegger (1977a, pp. 492–499, 2010, pp. 355–360) argues, death is not the only fundamental existential phenomenon. Birth also pertains to the ontological domain:

> death is, after all, only the "end" of Dasein, and formally speaking, it is just *one* of the ends that embraces the totality of Dasein. But the other "end" is the "beginning," "birth." Only the being "between" birth and death presents the whole we are looking for. Accordingly, the previous orientation of our analytic would remain "one-sided," despite all its tendencies toward a

> consideration of *existing* being-whole and in spite of the genuineness with which authentic and inauthentic being-toward-death have been explicated. Dasein has been our theme only as to how it exists, more or less, "forward" and leaves everything that has been "behind" (Heidegger, 1977a, p. 493, 2010, p. 356).

Birth represents the ontological condition of every ontic possibility of existence, i.e., our being-in-the-world as what renders the encounter with the intraworldly beings possible first and foremost. After all, we are mortal because we are born and birth determines our finitude as much as death. Despite these claims, however, Heidegger does not elaborate on birth as an ontological phenomenon. Consequently, this feature of his existential analytic remains underdeveloped.

One of Heidegger's disciples, the German philosopher Hannah Arendt (1958), aims to fill in this theoretical gap by emphasizing how a "one-sided" focus on death, insofar as it privileges isolation and detachment over relatedness and interdependence, would ultimately preclude philosophical meditation from investigating the intersubjective, political dimension of existence. However, as argued by Alison Stone (2019, pp. 35–43), even if Arendt is the first who introduces the concept of natality into philosophy, her insights linger between an appraisal of our natal condition proper, human political capability to undertake novel actions and our singular uniqueness as individuals who are born. Thus, Arendt's approach is quite unhelpful to an enquiry into birth as an existential phenomenon. Furthermore, according to Peg Birmingham (2002), Arendt's interpretation of Heidegger's existential analytic should be nuanced, insofar as the latter's thinking of thrownness would actually represent a thinking of birth, albeit implicitly. This interpretation emphasizes that it is by being born that *Dasein* is thrown into a world of predetermined modes of existence, an ecology of possibilities determining the whereabouts of their historical subjectivation.

Either way, in Heidegger's philosophy, it is the experience of being-towards-death, i.e., the anticipation of our unavoidable although indeterminable end, rather than a meditation on birth, which ultimately grants *Dasein* the possibility of grasping their existential condition, thereby overdetermining the disclosure of its ontological structure. As contended by Macho (1987, pp. 98–115), while commenting on Heidegger's insights, being-towards-death conveys an experience of radicalization of individuality, where even the existential feature of being-with ceases to be a constitutive component of our being-in-the-world. While confronting their own death, Macho argues, *Dasein* strives towards liberation from all dependencies and ontic constraints, thereby rendering evident that originary dependence which cannot be overcome, namely the dependence on the mother one is born from and from the complex of inherited possibilities of subjectivation this condition entails. From this perspective, Heidegger's underestimation of the ontological significance of birth

amounts to an actual neglect of this phenomenon, which calls for a reinterpretation of the main tenets of his existential analytic in light of an ontological theory of birth.

4.5 Philosophies of Birth

According to the Swiss philosopher Hans Saner (1979), who elaborates on Arendt's insights into human natality and whose intuitions are revamped by Sloterdijk (1988), philosophy in general has neglected birth and infancy, privileging death and adulthood when enquiring into the human condition—despite the pivotal role these phenomena play in our cultural production and social organization. Philosophy's forgetting of birth, Saner (1979, pp. 12–13) argues, may be due to several reasons, such as the long-lasting taboos concerning procreation in western civilization; its overarching patriarchy obfuscating the feminine; the metaphysical and then Christian misappraisal of sexuality and corporeality; or a general fixation on death and dying, often conceived of as liberations from a disgraced and cursed existence. Saner contends that this neglect is "a hermeneutic arbitrariness, […] an anthropological and logical scandal"[28] (Saner, 1979, pp. 15–16, my translation) and, therefore, should be dealt with an in-depth reflection on birth as an existential event.

A reappraisal of the philosophical and anthropological relevance of the phenomenon of birth is also carried out by Stone (2019). Philosophy, she argues, has traditionally failed to account for birth and natality while one-sidedly focusing on death and mortality, emphasizing the (male) autonomy of individual, atomized subjects over traits such as dependency, relationality, situatedness, contingency and vulnerability. By doing so, the western tradition has stressed the relevance of a second, sociocultural "birth" over birth proper, thereby devaluating women's role as mere supports for gestating babies. Nonetheless, as claimed by Stone (2019, pp. 25–54), our natality influences the structure of our existence in intersecting and multifarious ways. Specifically, attention is drawn to the threefold meaning of natality, which should be taken into account all together when enquiring into human birth. Being natal amounts to, first, starting one own's finite life at a given time; secondly, coming into the world in a unique bodily, historical, geographical and social situation; thirdly, actually exiting from the womb and coming into the world.

Furthermore, as Stone (2019, pp. 55–58) points out, although traditionally we come into the world from the maternal womb, nowadays technologically assisted pregnancies, surrogate pregnancies, adoptions and pregnancies from trans fathers also obtain. It is important, therefore, to emphasize the historical role played by female bodies in carrying out gestation, while concurrently not overlooking that also other kinds of "bodies" may exert this task. Birth can be conceived of in the narrow sense of the exit from the womb; in the broader sense of the whole process of conception, gestation and

[28] "Eine hermeneutische Willkür, […] ein anthropologischer und logischer Skandal".

birth proper; or even including early rearing. Postnatal care is also traditionally performed by mothers, but not only by them. And the womb someone is coming from is not necessarily a biological one or the one of their own mother. Thus, one should speak of gestators and caregivers, rather than mothers and allomothers.

Moreover, as Sloterdijk warns us, broadly elaborating on these topics especially in the first volume of *Spheres, Bubbles* (1998b, 2011b), when dealing with these delicate and intimate issues, we should take care of adopting a perspective which enquires into the fields of the maternal, the uterine and the natal without falling prey to either objectifying scientism or holistic mysticism. Sloterdijk (1998b, pp. 307–308, 2011b, pp. 301–302) labels this methodological approach as negative gynaecology. Convergently with the major instances of women's studies, this methodology operates at the crossroads of phenomenological analysis, psychoanalytical investigation and historical reconstruction (de Conciliis, 2020). As pointed out by the feminist theorist Judith Butler (1989), while criticizing French philosopher Julia Kristeva's (1977, pp. 409–436, 1980, pp. 237–270) conception of motherhood, indeed, we should attentively avoid those naturalistic explanations which, after all, inadvertently abide by the current, hegemonic sociocultural discourse. Maternity and the maternal body are sociocultural productions, insofar as they are shaped deep into their most intimate biology by historical systems of subjectivation and power relations.

4.6 Intrauterine Subjectivation

Hence, human birth is a complex phenomenon and in order to unpack it we should consider that although birth is usually understood as the beginning of individual existence, subjectivation already takes place during gestation. The research carried out by the otolaryngologist Alfred Tomatis (1993) and reappraised by Sloterdijk (1998b, pp. 487–531, 2011b, pp. 477–520), for instance, cogently shows that during their nine-month intrauterine lifespan the foetus is receptive to the voice of their mother. Regardless of whether this voice comes from the biological mother or an ersatz mother figure or whether it is semantically structured and/or intentionally directed to the foetus or not, it is effective as long as it resonates within the foetus's perceptual domain. Human auditory capabilities develop early in ontogeny, starting from the second month of gestation, and the reception of the maternal voice, experienced by osseous transmission, is positively selected against other intrauterine sounds, such as maternal digestion or heartbeat.

This auditory experience is retained by the foetus and stored as "sensory-motor responses"[29] (Tomatis, 1993, p. 23, my translation) into particular patterns of cellular organization, thereby constituting "a deep, cellular, undistributed, undeveloped and consequently unanalysed pre-

[29] "Réponses sensori-motrices".

memory"[30] (Tomatis, 1993, p. 169, my translation), which is subsequently transmitted to the developing nervous system. Foetuses seem to react through motor responses to particular frequencies connected with the human voice and, in case of traumatic development, this experience can be reactivated postnatally through specific therapeutic techniques of listening. According to Tomatis (1993, pp. 166–170), during gestation, the foetus experiences the intrauterine environment and subjectivizes while interacting with their own body, the uterine walls and the umbilical cord—which is not innervated and, therefore, may be perceived as an extrabodily reality. Starting from this perspective, Tomatis (1993, pp. 236–240) infers that the conditions through which gestation in general is carried out and the inputs coming from the mother's voice in particular influence and determine human subsequent, extrauterine development.

Macho (1993) also provides us with insights into the phenomenon of intrauterine subjectivation. He criticizes the Freudian theory of ontogeny, deemed to ignore some significant subjectivizing experience occurring before those singled out by the neurologist and founder of psychoanalysis Sigmund Freud in his work "Three Essays on the Theory of Sexuality" (1942, pp. 29–145, 1953, pp. 130–243), which take place during infancy and are characterized by the relation to an object (oral, anal and phallic). According to Macho, such neglected, earlier experience does not deal with object relations, but rather with media. There is a foetal phase of placental blood communication; a vocal-auditive phase through vibration and resonance of the amniotic fluid; and a breathing phase of inspired and expired air, taking place right after birth.

Thus, according to Sloterdijk and consistently with the state of the art of prenatal and perinatal psychology, intrauterine subjectivation occurs and the foetus experiences resistances, affordances and possibilities of interaction with their intrauterine environment (Evertz, 2021). These medial instances are not aptly understandable in terms of subject-object relations. In order to conceptualize them, elaborating on Macho's insights, Sloterdijk (1998b, pp. 287–291, 2011b, pp. 280–284) introduces the term nobject (*Nobjekt*), i.e., "spherically surrounding co-circumstances envisaged by a non-facing self, namely the fetal pre-subject, in the mode of non-confrontational presence as original creatures of closeness in the literal sense" (Sloterdijk, 1998b, p. 300, 2011b, p. 294, trans. mod.). They consist in medial entities eschewing objectification, i.e., they cannot be properly represented as standing still in front of a detached observer. In the intrauterine world, there are no objectifiable, autonomous realities, but only relations, exchanges and confrontations, through which the foetus's emerging subjectivity and their capability to conceive of other entities as external realities are produced. Nobjects

[30] "Une pré-mémoire profonde, cellulaire, non distribuée, non développée et par là non analysée".

> never separate the subject from its environment, nor do they place it in confrontation with something that is present in concrete form or faces it as a state of affairs; rather, they integrate it into an encompassing situation and take it up into a space of relationships with two or more locations, where the ego side only represents one pole (Sloterdijk, 1998b, p. 551, 2011b, p. 541).

Uterine subjectivity refers to a complex of cointegrated dynamics, which englobe the foetus into a field of mutually determining relations rather than separating them from their environment. The subject, Sloterdijk (1998b, pp. 297–305, 2011b, pp. 291–299) argues, is nothing but one of the polarizations of a multifarious relational field. Hence, according to Sloterdijk (1998b, pp. 347–401, 2011b, pp. 343–396), the intrauterine, placental environment constitutes the developing subject's first shared world. Since this originary ecology of possibilities coemerges with the individual (or individuals, in case of multiple pregnancy) inhabiting it, the two phenomena should be considered an integrated, mutually constituting whole, rather than two separate realities which may eventually conjoin. Spherologically, under intrauterine living conditions, one can only speak of "subjects" and "objects" in a broad sense, as the outcomes of analytical categorizations, whereas the sole actual reality is the inseparable foetus-placenta dyad.

Notably, the placenta, "a transient extracorporeal organ", "arguably the most important […] of the body" (Burton & Fowden, 2015, p. 1), is an organ of the foetus and not of the mother. It plays a pivotal role in gestation, for instance, by protecting the foetus from maternal stress hormones, which may otherwise provoke reduced cell proliferation and growth restriction in the foetus (Burton & Fowden, 2015). Thus, one may liken the human placenta to a sort of liminal entity between biological and artificial organs, insofar as it is organic as biological organs but also detachable and extrabodily as artefacts, thereby hinting at its foundational role in the constitutive interrelation between biology and technics relative to the human lifeform. As pointed out by Sloterdijk (1998b, pp. 402–417, 2011b, pp. 397–412), after its postnatal disposal, multifariously dealt with across cultures, the placenta still accompanies the individual throughout their development in the form of psychic remnants and somatic marks, starting from the navel.

4.7 Negative Gynaecology

Giving due relevance to intrauterine subjectivation should prompt us to consider the event of birth from a novel perspective. From the new-born's viewpoint, indeed, birth not only represents the beginning of extrauterine existence but also the termination of intrauterine life. In this sense, it should not be understood as a pure commencement, but rather as a radical shift within already ongoing living conditions: from the immersion into the amniotic fluid to that into air; from the elementary

assumption of oxygen to breathing proper; from standing nutrition to the periodical ingestion of food; from uniform warmth to cold and differences in temperature; from darkness to light and the interchange of light and darkness; from mutism to vocal communication; from enclosed undifferentiation to the relation to a world of objects and so on (Saner, 1979, pp. 24–25).

We do not retain an episodic memory of our own birth and this is another of its fundamental features. As contended by Sloterdijk (1988, pp. 35–38), everyone has been through it, it belongs to everyone's intimate life history, but no one was properly "there", no one lived it as a self-conscious experience. We come into the world by being inserted into an ecology of factical, predetermined possibilities of subjectivation, which we have to inherit and adopt to be able to not only partake in this shared world but also reconstruct the beginning of our existence in this world, i.e., producing an account justifying and contextualizing our origin. Thus, being born and coming into the world should be distinguished:

> the physical birth of a human is the opposite of a coming-into-the-world; it is the dropping out from all that is "familiar," a plunge into the uncanny, finding yourself exposed in a frightening location. This is true in three ways. First, for the human child, being born means bidding farewell to its intra-uterine life, which is probably the only stage of its reception in the world that has a truly hidden, homey character […]. Second, coming into the world means arriving in uncertainty—because for humans more than any other beings, the world is something that does not get defined from the outset, that is not a foregone conclusion, but something that has to be determined and established. […] And, third, for humans, giving birth always means getting there way too early and finding oneself in a state that is absolutely unsuitable for a successful arrival in reality, a state of total disorientation, helplessness, and embarrassment (Sloterdijk, 1989a, pp. 174–176, 2020b, pp. 66–67).

Sloterdijk regards birth as a phenomenon that, if considered in merely biological terms, would not suffice to account for the full deployment of our faculties. In order to come into the world, i.e., becoming proactively integrated into its organological collective of biological organs, artefacts and social organizations, intrauterine subjectivation is not enough and must be supplemented with extrauterine subjectivation. The new-born's arrival in the shared world has to be complemented by a countermovement of welcoming and acceptance by the organisms and organizations composing this world, which have to engage with the task of equipping the newcomer with the means to survive in their new environment and eventually integrate themselves into it to the point of becoming in turn capable of providing others with similar performances.

According to Sloterdijk (1998b, pp. 419–465, 2011b, pp. 413–457), the usually close resemblance of the first extrauterine environment, the mother, to the former, intrauterine living conditions, provides that quantum of continuity that prevents human birth from being a complete catastrophe. However, this resemblance can neither be complete nor last forever, gradually decreasing and leading the infant into enlarged and more complex relational systems. Birth constitutes the necessary disappearance of the first shared world, that is the foetus-placenta dyad, which should be consequently rebuilt and replaced with other media, driving individual ontogeny. Since individuals are structurally dual entities, Sloterdijk (2001b, pp. 207–210, 2016a, pp. 130–132) argues, the breakdown of the first sphere of coexistence triggers a process of expansion and transfer where exteriority is englobed into a new interior, which is in turn reconstructed according to the former experience of interiority. In order to be effective, this process should occur neither too slowly, as the individual would risk remaining encapsulated in their earlier developmental stages, nor too quickly, as they would risk refusing to open to richer environments because of too early intrusions into their intimate sphere.

Hence, we should not underestimate the existential, psychological and biological importance of the event of human birth. Notably, in his book *Inhibitions, Symptoms and Anxiety* (1948, pp. 113–205, 1959, pp. 87–172), Freud (1948, pp. 120–121, 1959, pp. 93–94) cursorily associates birth with the originary experience of anxiety (*Angst*), connected with a physiological feeling of narrowness and suffocation. Elaborating on Freud's insights, one of his disciples, the psychoanalyst Otto Rank (1924, 1993), submits that since birth is a risky, dangerous and potentially painful event, it is repressed and removed from conscious experience, influencing postnatal development with significant repercussions for the unconscious. According to Rank, human existence would represent the struggle to overcome this trauma in order to restore the originary libido constituted by the bond between the foetus and their intrauterine environment, postnatally turned into libido towards the mother and her surrogates, so that "*every pleasure has as its final aim the re-establishment of the intrauterine primal pleasure*" (Rank, 1924, p. 20, 1993, p. 17).

From this perspective, the intrauterine bond would be the prototype of libido, an archetypal experience of pleasure, "asexual but libidinal" (Rank, 1924, p. 36, 1993, p. 36), which is lost forever at birth and, therefore, constantly craved for (Sloterdijk, 1998b, pp. 212–216, 2011b, pp. 208–212). Birth is regarded by Rank (1924, pp. 22–24, 1993, pp. 19–22) as the first developmental trauma, followed by the trauma of weaning and only later by the genital, highly symbolized trauma of castration. As is the case with Macho's criticism of Freud's stages of subjectivation, the series of developmental traumas theorized by Freudian psychoanalytic theory also presents a nobjectual, medial prehistory.

However, while dealing with these approaches, one should be wary of not overestimating the foetus's (let alone the embryo's) capability to retain memories of their intrauterine life and possibly long for its restoration. Intrauterine experience and the very event of birth are unlikely to reach a conscious mnestic form in the later developmental stages, remaining anchored to the quasi-automated somatosensory and motor layers of subjectivation. Hence, differently from Tomatis's (1993, pp. 161–166) and Rank's (1924, pp. 183–187, 1993, pp. 192–198) stances, accordingly criticized by Stone (2019, pp. 161–167) and postulating that intrauterine life would constitute a sort of archetypal unconscious shared by virtually all humans because of the relative similarity of our intrauterine life histories, I rather aim to address the question of human birth from a developmental perspective. The medial shift it entails, insofar as it constitutes a radical, unavoidable change in everyone's living conditions, has to be coped with through an extensive rearrangement of both the new-born's environment and the psychophysical equipment devoted to relating to it.

From Sloterdijk's perspective, humans are "amphibious" organisms that structurally switch from one medium (amniotic fluid) to another (air) during their ontogeny and, therefore, need to modify their relation to the world accordingly (ten Bos, 2009). Thus, in order to properly understand the new-born's installation in their novel, extrauterine environment, the living conditions of their former, placental environment should be taken into account, insofar as extrauterine existence represents the new-born's effort to adapt to these novel living conditions while concurrently transferring and rearranging their former relation to the world.

4.8 The Obstetrical Dilemma

In light of the analyses carried out above, some questions may arise, such as why is human birth such a traumatic event? And why are humans so needy of care and attention once they are born? In order to submit an answer, let me now investigate these issues from an evolutionary viewpoint, i.e., assessing how our particular birthing condition may emerge throughout anthropogenesis.

In his seminal research, Portmann (1969, pp. 27–38, 1990, pp. 19–31) borrows from ornithology the distinction between altricial (*Nesthocker*) and precocial (*Nestflüchter*) animals and applies it to mammals in order to highlight how humans would represent a special case within this classification. Altricial mammals, such as mice and cats, have low specialized morphologies and low developed brains, are reproductively characterized by short gestation periods and give birth to a numerous litter, underdeveloped and highly dependent on parental care at birth (e.g., they have no hair; their sensory organs are not working; they have to rely on external sources for thermoregulation). Conversely, precocial mammals, such as elephants and bears, are more specialized and have more developed brains, exhibit long gestation periods and give birth to few offspring per pregnancy, highly developed and autonomous at birth. While humans are precocial in some ways, presenting sizeable

morphological complexity and brain development as well as a low offspring rate, they are altricial in others, being extremely underdeveloped and dependent on parental care at birth.

The key to understanding this apparent paradox is the length of human gestation, which is rather shorter than one would expect from a precocial mammal when compared to human size and morphological complexity. According to Portmann (1969, pp. 57–61, 1990, pp. 50–54), humans would need a 21-month gestation in order to attain the degree of development expected by a similar mammal at birth, a maturity that human offspring indeed reaches around one year after birth. Portmann, therefore, conceives of human birth as "a kind of 'physiological,' or normalized, early birth" (Portmann, 1969, p. 58, 1990, p. 52). If we regard human gestation as lasting twenty-one months instead of nine, this condition fits in well with the precocial scheme: at around one year of age, human infants are relatively well-developed and autonomous. Hence, humans are defined as "secondarily altricial" (Portmann, 1969, p. 65, 1990, p. 38) because to correctly understand our ontogeny one should assume that the second and longer part of our gestation occurs outside the uterus, after birth has taken place.

Yet why does human intrauterine gestation not last longer? Portmann (1945) contends that since humans are cultural organisms, they need to carry out a considerable amount of their gestation period outside the maternal womb in order to apprehend the knowledge and skills necessary to effectively integrate themselves into their sociocultural context, acquiring bipedalism, instrumental behaviour and language. However, Portmann's account should not leave us satisfied, insofar as it postulates a sort of inner teleology driving evolution and disregards the importance of the biomechanical constraints human birthing entails.

Bipedalism, for instance, should not be considered an acquired characteristic, but rather a genetically determined anatomical feature that is positively selected during evolution already starting from Hominins and entails major physiological rearrangements. Specifically, bipedalism seems strictly correlated with the question of human birthing by what is usually referred to as the "obstetrical dilemma" (Washburn, 1960, p. 74). The biomechanical shift to bipedal locomotion involves a morphological change in the pelvic girdle, which is constrained in both size and shape, so that new-borns are compelled to perform risky rotations while passing through the pelvic canal, rendering birthing a potentially dangerous process. Furthermore, because of the particular anatomy of the pelvic outlet, which faces backwards, human new-borns come into the world in a position that prevents their mothers from guiding them out of the canal and, therefore, complicates giving birth alone, thereby rendering birthing a social phenomenon from the outset (Rosenberg & Trevathan, 1995).

Notably, the naturalist and founder of evolutionary theory Charles Darwin already suggested a correlation between bipedalism and tool use relative to anthropogenesis in his book *The Descent of Man, and Selection in Relation to Sex* (1877, pp. 47–60). And the obstetrical dilemma, first theorized

by the anthropologist Sherwood Washburn in his paper "Tools and Human Evolution" (1960), aims to overturn the traditional view according to which hominin populations would evolve their biology towards increased encephalization and consequently become capable of tool use. According to Washburn, facultative and postural bipedalism enables incipient tool use, whose evolutionary advantages select for striding bipedalism, in turn leading to more pervasive tool use and so on. Concurrently, bipedalism implies narrower pelvises constraining brain size at birth, while propension for tool use selects for larger brains. Thus, human infants are born underdeveloped, thereby benefiting from postnatal brain growth, and this condition is possible because, thanks to tool use, bipedalism and encephalization, advanced parental care can be provided.

Let me now elaborate on Washburn's argument in detail. As discussed above, the adaptive advantages of bipedalism are many—long distances can be covered walking; hands become free to manipulate; the jaw consequently becomes free from the task of food prehension; the alteration of the position of lungs and diaphragm allows for breath control, which is a prerequisite to articulated vocal communication, etc.—so one may expect that there are positive selection pressures to acquire permanent bipedal locomotion. However, our adaptation to bipedalism risks clashing with another fundamental human feature, namely encephalization. Since bigger brains are likely to mean more intelligence, it is evident that also encephalization exhibits many adaptive advantages and, therefore, may undergo positive selection pressures like bipedalism.

Hence, the human birthing process seems to be caught between two antagonistic positive selection pressures, for bipedalism and encephalization respectively. As a trade-off to accommodate both adaptations, first, birthing becomes a delicate issue, potentially dangerous for both the foetus and the mother. Secondly, human infants come into the world extremely immature and underdeveloped, thereby calling for substantial parental care. Moreover, because of this combination of bipedalism and encephalization, human new-borns are not only underdeveloped and dependent on parental care at birth but also extremely fragile, as a huge cranium plus a weak spine means that infants can hardly move during their first weeks of postnatal life and cannot walk properly until around one year of age (Taylor, 2010, p. 188). According to Taylor (2010, p. 123), who insightfully claims that "the central paradox of our existence is that we are the product of the artifice that we ourselves brought into the world" (Taylor, 2010, p. 69), technics in general and techniques and technologies of baby-carrying in particular help hominin populations cope with their offspring's locomotory hindrances and in turn enable human intelligence, enhanced thanks to encephalization, to further innovate and improve these technical arrangements.

From this perspective, the human birthing process can be considered the compromise between bipedalism and encephalization. Our birth is so risky and we are born so immature because we stay in the maternal womb as long as possible, before our brains grow so big that it would become

mechanically impossible for them to pass through the pelvic canal. This condition enables us to have bigger brains but also renders us extremely underdeveloped and helpless at birth. Concurrently, substantial brain growth takes place postnatally so that the morphological changes due to bipedal locomotion do not prevent our brains from growing bigger, as I will discuss below.

However, criticisms have been raised against this understanding of human evolution, notably from feminist anthropology's viewpoint. As contended by Dana Walrath (2006), for instance, our ideas concerning the relationship between birthing, sexual dimorphism and human evolution risk inadvertently adopting biases belonging to our contemporary sociocultural background and thereby legitimizing them through their integration into our "natural", that is evolutionary history. Specifically, these biases usually reproduce gendered discriminatory practices determined by modern western patriarchy. From this perspective, the obstetrical dilemma, in Washburn's traditional formulation, dictates that the human birthing process is complicated, dangerous and painful and women are depicted as distressed bodies needy of help from (male) society in order to successfully carry out reproduction, while men are conceived of as models of perfected bipedalism, never attainable by women, who are, therefore, defined through a defective comparison with men.

Human birthing, Walrath argues, is not necessarily problematic, as is testified by birthing practices alien to western modernity, and birthing difficulties may be largely due to the gendered medicalization of reproduction characterizing that sociocultural context. Hence, the role played by the obstetrical dilemma in anthropogenesis should be dealt with extra care in order to avoid the risk of reproducing in human ontogeny a gendered version of the miserabilist account of the human condition discussed relative to human phylogeny in the Introduction. As submitted by Walrath,

> each of these paleoanthropological solutions to the obstetrical dilemma ultimately reinforces the notion of flawed female reproductive biology. Culture, in the form of birth attendants for vulnerable mothers and babies, steps in to rescue females and their young from the danger imposed by their biology (Walrath, 2006, p. 62).

Furthermore, recent research in the mechanics and energetics of human locomotion suggests that the size of women's pelvises may not negatively interfere with their locomotory capabilities. These studies also submit that even broader pelvises would not hinder locomotion, thereby revising the obstetrical dilemma. However, constraints to human gestation length are deemed to persist nonetheless, insofar as they are metabolic rather than locomotory, as is the case with the other mammals. Since gestation is metabolically burdensome, there are limits to its length and to the foetus's size according to their energy demands and human maximum sustained metabolic rate is rapidly attained during gestation, which is the most energy-demanding task in humans. Human

gestation, therefore, is likely to be constrained within its extant length by both anatomic and metabolic factors (Dunsworth et al., 2012).

4.9 Neoteny

I have reviewed above the constraints that bipedalism and encephalization may pose to the evolution of the human birthing process. Let me now discuss how human brains could grow so big despite these anatomic and metabolic hindrances. Traditionally, this issue has been related to the question of human neoteny.

The neoteny hypothesis has initially been submitted in order to account for the whole human morphology rather than for some particular characteristic. Moreover, much of the confusion around this issue comes from the slightly different meanings attributed to this term over the years as well as the number of alternative terms proposed to describe related, although somewhat different phenomena. The talk has often been not only about neoteny, but also about paedomorphosis, juvenilization, foetalization, proterogenesis and so on. Some of these terms have been adopted in a sense which is partially different from the one that is assigned to them by contemporary scholarship in biology, while others have been simply dismissed. Currently, these phenomena are all considered instances of heterochrony, i.e., the difference in the onset, rate or duration of some developmental process of an organism compared with other organisms or its ancestors. Paedomorphosis is a type of heterochrony and amounts to the manifestation in the adult form of an organism of features that are confined to the juvenile or foetal stages in its ancestors. Neoteny, in turn, is one of the processes through which paedomorphosis may be attained and designates the delayed onset, slower rate or prolongation of the development of some features of an organism.

The zoologist Julius Kollmann (1885) introduced the concept of neoteny in evolutionary biology at the end of the nineteenth century relative to amphibians. Kollmann (1905) also noticed the morphological resemblance between young humans and young chimpanzees, hypothesizing that human evolution may proceed as the progressive retention of juvenile forms into the adult stages. However, to acquire its contemporary import the concept had to wait until the anatomist Lodewijk Bolk (1926) presented anthropogenesis as the outcome of developmental retardation and foetalization. According to Bolk, humans would exhibit several so-called primary characteristics that the other great apes would also have but then lose during ontogeny. These features would represent "foetal states or conditions that have become permanent"[31] (Bolk, 1926, p. 7, my translation) through a process Bolk terms foetalization. These characteristics would belong to the juvenile stages of some ancestor common to humans and the other great apes and would have been retained into adulthood

[31] "Permanent gewordene, fetale Zustände oder Verhältnisse".

throughout anthropogenesis as the result of an evolutionary "*retardation of development*"[32] (Bolk, 1926, p. 10, my translation). As the developmental pace gets slower, Bolk argues, some juvenile, foetal features would be maintained throughout ontogeny and then stabilized in adulthood, determining the morphology peculiar to humans. This shift in our evolutionary trajectory would be due, in turn, to an unspecified alteration of the endocrine system.

Afterwards, the palaeontologist Otto Schindewolf (1972) also partook in the debate, submitting the partially alternative concept of proterogenesis. Schindewolf contended that during early, embryonic developmental stages new features could spontaneously arise and subsequently be retained into adulthood. The supposed similarity between the juvenile forms of humans and those of the other great apes would be due to an exceptional regressive phenomenon presented by the latter. The novel characteristics, that they evolutionarily share with humans and that appear in their early developmental stages, would subsequently disappear in favour of the permanence of the older ones. Notably, Schindewolf's hypothesis is symmetrical to Bolk's one, who assumed that the retained juvenile features would belong to some ancestor common to humans and the other great apes, thereby not representing an evolutionary novelty, but rather a sort of archaism.

Schindewolf aimed to set up an explanatory framework opposed to the so-called recapitulation theory (also known as palingenesis or biogenetic law), the original contribution provided by the biologist Ernst Haeckel (1866) to his reading of Darwinian theory. The recapitulation hypothesis states that a species's phylogeny would be somehow repeated, on an individual scale, in ontogeny, i.e., the early developmental stages of an individual's morphology would retrace the early evolutionary stages of its lineage. This insight may prove useful for better understanding the vicissitudes of the neoteny hypothesis, since these theories revolving around human juvenile characteristics have been developed in order to contrast the recapitulation hypothesis's hegemony in evolutionary biology, as is the case with Schindewolf, according to whom the early developmental stages would exhibit newer rather than older evolutionary features.

Another, important example of this tradition is represented by the zoologist Walter Garstang (1922), who crafted the concept of paedomorphosis—which he understood as the retention of juvenile and especially larval traits into adulthood and sexual maturity—precisely in order to refute Haeckel's approach, showing that evolutionary changes occur in the early stages of development, which is, therefore, quite the opposite of a repetition of ancestral features. However, Haeckel's stance gauged more consensus at the time and neoteny was regarded as playing a minor role, if any, in evolution in general and anthropogenesis in particular. Moreover, as pointed out by the anthropologist Ashley Montagu (1955), another important supporter of the neoteny hypothesis, although this phenomenon

[32] "*Retardation der Entwicklung*".

can be appreciated consistently with the main tenets of Darwinian evolutionary theory, its adaptive role in human evolution risks remaining unclear. Only after the breakdown of the recapitulation theory, which proved untenable in most of its aspects—although recapitulative instances may be appreciated in some special cases—could the idea of properly integrating neoteny into the novel context of evolutionary biology be considered (Gould, 1977, pp. 352–355).

In contemporary evolutionary biology, Gould (1977, pp. 353–404) is one of the major supporters of the key role of neoteny in anthropogenesis. However, according to Gould, some substantial amendments to the traditional neoteny hypothesis should be made in order to incorporate this phenomenon into a scientifically reliable account of human evolution. First, contrary to Bolk's understanding, the prolongation of growth rates is not necessarily linked with the retention of juvenile proportions and these two phenomena may also occur independently. Secondly, retaining juvenile features into adulthood does not imply, as Bolk suggested, that they should necessarily belong to some ancestor. Thirdly, human juvenile characteristics do not have much in common with the other great apes' morphologies, which rather follow an autonomous evolutionary trajectory. Fourthly, a neotenic tendency obtains in Primates in general, thereby not representing a uniquely human feature. Fifthly, not all human characteristics are paedomorphic, let alone neotenic, but this should not prevent us from enquiring into the pivotal role this phenomenon plays in anthropogenesis.

However, criticisms have been raised against Gould's stance. According to Brian Shea (1989), for instance, although some human features seem indeed neotenic, such as neuromuscular development or the attainment of sexual maturity (Francis, 2015, pp. 270–272), human evolution is mostly not characterized by neoteny, this view being the result of a series of conceptual and ideological misunderstandings piled up during this debate's history. In order to better assess the importance of the role played by neoteny in anthropogenesis, I will focus, therefore, on one single set of phenomena, namely those pertaining to encephalization, rather than interpreting neoteny as a quite obscure and overly general evolutionary tendency.

Notably, when enquiring into the phenomenon of encephalization, the evolution of brain growth, i.e., its increase in size, should be distinguished from that of brain organization, i.e., the transformations occurring to processes such as neurogenesis, synaptogenesis and myelination as well as the differences in the allocation of functional areas in the brain. Thus, there are different ways to compare brains, such as overall brain size or the rate between brain size and body size. Furthermore, the capabilities of a brain also depend on its organization, such as the rate of neurons between different brain areas, the overall number of cells or the number of connections between neurons (Suddendorf, 2013, pp. 34–38).

For instance, Leah McKinney (2000) claims that the evolution of human brain size is indeed characterized by heterochrony, however, not by paedomorphosis, but rather by its opposite, that is

acceleration, i.e., higher growth rates. Nevertheless, McKinney argues, if attention is drawn to brain organization, rather than brain size, humans may well undergo neoteny, presenting delayed life history patterns and events which result in more complex neuronal patterns. As pointed out by Enrique Bufill and his collaborators (2011), while reviewing recent research in neurodevelopmental anatomy, humans display neuronal neoteny, insofar as our brains are not only bigger than those of the other great apes but also differently organized relative to an enhanced degree of neuroplasticity. Hence, neoteny could play an important role in encephalization, thereby contributing to the evolution of our brains and consequently cognitive skills.

4.10 Neuroplasticity

I will now link the question of human neoteny with that of neuroplasticity and, therefore, behavioural plasticity, i.e., the capability of our brain to be shaped by our interactions with the environment and, therefore, our capability to learn and acquire new habits and knowledge throughout ontogeny. As cogently shown by Steven Leigh (2004), indeed, there is a positive correlation between cognition and brain growth patterns in mammals. Among Primates, the latter vary sensibly, especially depending on whether brain growth mostly takes place prenatally or postnatally, outlining different life history strategies (e.g., precociality versus altriciality).

Human brains are around three times bigger than those of the other great apes, our closest living relatives, and of our most recent common ancestors with them. Nonetheless, they are smaller at birth relative to their adult size (around 27%) compared with chimpanzees' brains (around 36%) and actually the smallest among Primates. While humans' and chimpanzees' postnatal brain growth durations are not substantially different (adult brain size is attained at around 5 and 5–6 years of age respectively), however, in the first eighteen months of postnatal life human brain growth rates are considerably higher than those of chimpanzees, brain growth occurring at foetal-like rates. Specifically, during anthropogenesis, some aspects of brain maturation shift from prenatal to postnatal development, such as the myelination of limbic, striatal and neocortical structures (Sherwood & Gómez-Robles, 2017). Consequently, brain size differences between humans and the other great apes are mostly the outcome of growth rate differences and not growth duration differences.

Concurrently, humans present substantial neuroplasticity. As reviewed by Chet Sherwood and Aida Gómez-Robles (2017), our brains are not only powerful relative to their computing power in elaborating information, but also plastic, insofar as our possibly unique cognitive abilities are mostly developed thanks to environmental interactions: "brain plasticity refers to the way synaptic connections, axon fiber pathways, and the mapping of the cerebral cortex can change during the lifespan in response to the environment and experience" (Sherwood & Gómez-Robles, 2017, p. 401).

Brain areas associated with higher-order cognitive processes, such as the neocortex and especially the prefrontal cortex, grow around three times bigger and exhibit more individual variation and less genetic heritability in their organization than those of the other great apes. These are not only the areas phylogenetically undergoing greater expansion but also those with later ontogenetic development, thereby benefiting from enhanced and longer-lasting exposition to the environment.

Moreover, throughout anthropogenesis, human brains undergo extensive cortical and subcortical reorganization. Since postnatal brain development almost exclusively relies on interactions with the environment and its organisms; since developing neurons are more plastic than adult neurons; and since neuronal maturation in humans is delayed compared with that of the other great apes, human cognitive maturation is also delayed. On the one side, this condition enables humans to absorb a greater amount of information from their sociocultural environment. On the other, it determines our cognitive immaturity at birth (Semendeferi & Hanson, 2016).

Indeed, as the research carried out by Mehmet Somel and his collaborators (2009) shows, humans exhibit neuronal neoteny. Around 48% of human age-related genes in the prefrontal cortex is expressed with a different timing from those of chimpanzees. Specifically, during the postnatal maturation of the human prefrontal cortex, there is a neotenic shift in gene expression, so that the expression profiles of adult humans may resemble those of juvenile chimpanzees. This phenomenon does not affect the whole transcriptome, but only some genes related to neuronal development. Somel and his collaborators suggest that this condition may be linked with the development of our particular cognitive skills because the delayed maturation of grey matter in the human prefrontal cortex may prolong the length of neuronal plasticity and, therefore, enhance our capability to learn from the environment.

Furthermore, as contended by Zdravko Petanjek and his collaborators (2011), in the prefrontal cortex synapses are initially overproduced, then stabilize and finally get selectively eliminated, this mechanism providing developmental differentiation among neuronal connections. In humans, synaptic pruning, i.e., the overproduction and subsequent elimination of dendritic spines on pyramidal neurons, reaches its peak in infancy and starts decreasing after adolescence, but extends well beyond adolescence and puberty and is prolonged into the third decade of life, thereby lasting longer compared with that of the other great apes. During anthropogenesis, therefore, reorganization of synaptic circuitry occurs at the both anatomical and functional level, with neuronal plasticity lasting longer and humans becoming consequently more receptive to environmental information.

Finally, human neuroplasticity can also be appreciated relative to the process of myelination, i.e., the formation of myelin sheaths around axons in the nervous system. As pointed out by Daniel Miller and his collaborators (2012), myelination “is important in establishing connectivity in the growing brain by facilitating rapid and synchronized information transfer across neuronal systems, which is

essential to higher-order cognitive functions" (D. J. Miller et al., 2012, p. 16480), and increases with age in both humans and chimpanzees, partially differently according to different brain areas but uniformly overall. However, neocortical myelination in humans works differently from that in chimpanzees, resulting prolonged and delayed and, therefore, neotenic. Humans are born with fewer myelinated axons (almost 0%) compared with chimpanzees (around 20%) and myelination is prolonged well beyond adolescence and puberty, until the third decade of life at least. As contended by Miller and his collaborators, this phenomenon is pivotal to the ontogeny of human cognition, insofar as it enables us to develop greater neuronal and, therefore, behavioural plasticity by being more receptive to the information coming from the environment.

Let me now sum up the main results of the studies reviewed above. Humans are neuronally and, therefore, behaviourally neotenic. On the one hand, our cognitive equipment is extremely immature and underdeveloped at birth, rendering human infants helpless and needy of extensive parental care. On the other, this immaturity represents the drawback of our enhanced plasticity, insofar as it allows our brains to develop and mature while interacting with the extrauterine environment, thereby acquiring relevant knowledge, habits and knowhow. Since human encephalization is the outcome of higher postnatal brain growth rates, rather than longer postnatal brain growth duration, compared with that of the other great apes and our direct ancestors, some scholars contend that, although the evolution of human brain organization indeed exhibits neotenic tendencies, the evolution of human brain size is due to higher rather than slower growth rates, thereby representing the opposite phenomenon of neoteny, namely acceleration.

However, if we regard, as Portmann (1969, 1990) suggests, the first months of human extrauterine life as the prolongation of intrauterine gestation outside the uterus, together with the related persistence of intrauterine brain growth rates postnatally, human early infancy brain growth rates should not be compared with the postnatal brain growth rates of the other great apes (which do not undergo extrauterine gestation), but rather with their prenatal brain growth rates, thereby presenting no substantial heterochrony, let alone acceleration. From this perspective, in humans intrauterine brain growth rates are extended postnatally and gestation is prolonged because intrauterine gestation is supplemented with extrauterine gestation, representing an instance of neoteny and thereby doing some justice to Gould's (1977, pp. 352–404) original argument.

Interestingly, in Stiegler's (2008c, p. 177, 2010c, p. 97; 2018a, p. 344, 2009c, pp. 27–28; 2013a, pp. 26–27, 2014, pp. 10–11; 2018c, p. 207) work we find cursory references to the question of neoteny, which he seems to equate with the biological side of human technicity (Levivier, 2012). However, this concept remains largely underdeveloped in his philosophy, possibly because, first, Stiegler inherits it from Simondon (2005, pp. 148–153, 2020, pp. 158–164), whose use of the term is quite idiosyncratic, insofar as he conceives of neoteny as a sort of general developmental tendency

common to every organism. Secondly, Stiegler may also be influenced by Leroi-Gourhan's (1964, pp. 177–182, 2018, pp. 124–128) hasty refusal of this hypothesis.

Admittedly, Stiegler's underestimation of the question of neoteny and, therefore, human birth risks obfuscating his understanding of the recursive dynamic subsisting between technicity and plasticity. According to Stiegler, "the appearance of these tools, an actual nonliving yet vital memory, organized but inorganic matter, essential to the definition of the human organism, *supposes*, as the vector and accumulator of past epigeneses, *a singular epigenetic plasticity of the cerebral structure*" (Stiegler, 2018a, p. 206, 1998b, pp. 176–177, trans. mod., my emphasis). I think that this statement is correct but incomplete. Enhanced neuroplasticity is indeed a precondition of advanced technical behaviour, insofar as the latter requires the capability to learn the rules of production and usage of artefacts. However, technical behaviour is also, in turn, a precondition of (neotenic) neuroplasticity, insofar as extrauterine gestation can only be carried out provided that an artificial, uterine-like environment is predisposed and advanced techniques and technologies of caregiving and rearing are provided. As pointed out by Ian James (2013), Stiegler's underestimation of the question of neuroplasticity may hint at a more general neglect of the brain in his organology.

4.11 Extrauterine Gestation

The question of neoteny, developed by evolutionary biology, thanks to the mediation of Portmann's work gains momentum in the philosophical debate and is discussed by some important representatives of twentieth-century philosophical anthropology and by Gehlen (1950, pp. 95–148, 1988, pp. 79–116) especially. This intellectual tradition leads us to Sloterdijk (2001b, pp. 175–211, 2016a, pp. 111–133), who broadly elaborates on Portmann's work and endorses the hypothesis of human neoteny.

According to Portmann, the first year of extrauterine life should be regarded as the prolongation of intrauterine gestation outside the uterus, that is extrauterine gestation. From this perspective, the new-born's environment is a "social uterus"[33] (Portmann, 1970, p. 195, my translation), i.e., a complex of dynamics recreating intrauterine living conditions postnatally in order to cope with the new-born's cognitive, behavioural and physiological immaturity. Building on Portmann's insights, Claessens (1978) further develops this conception:

> now the uterus becomes a social space again, which means nothing other than part of the protective function that the maternal inner space had taken on is now relocated *to the outside*,

[33] "Sozialer Uterus".

which would not be possible if such an outer space had not been created beforehand[34] (Claessens, 1993, p. 61, my translation).

The human extrauterine environment, Claessens (1993, pp. 156–157) argues, works as a sort of incubator (*Brutofen*), insofar as, on the one side, it seeks to reproduce intrauterine living conditions within an extrauterine environment. On the other, it has to be artificially primed, produced and regulated in order to do so.

As stated by Sloterdijk, who expands on Claessens's analyses, "every society is a uterotechnic project" (Sloterdijk, 1999, p. 205, 2014c, p. 194): human new-borns' immaturity calls for the production of an artificial environment supplementing biological, intrauterine performances with artificial, extrauterine means. Since human birth seems to occur too early in ontogeny, gestation, in order not to be truncated, is technically prolonged, so that it actually never really ends, the human environment increasingly resembling a climatized, protected indoor space, extending its uterine performances into adulthood and sexual maturity, thereby reinforcing and expanding our neotenic tendency. Thus, this artificial, uterine-like environment is not only the product of human technical behaviour but also what produces the human lifeform in return.

As I have shown in Chapter 3, the auto-artificial selection operated by our technical environment evolutionarily shapes the human condition, rendering hominin populations suitable for living within enclosed, technically protected interiors. Keeping in mind that immaturity is the flipside of plasticity, we may now appreciate how a dynamic of positive, self-reinforcing feedback loops presides over this evolutionary tendency. The new-borns' immaturity calls for para-uterine performances, consisting in techniques and technologies of rearing, caring, feeding etc. These performances need to be each time produced and managed by the members of the new-borns' community, i.e., the mechanisms managing their functioning need to be socially learned and transmitted. The individuals presenting a higher degree of neuroplasticity will prove more suitable for learning increasingly complex sets of habits, procedures and knowhow, resulting, therefore, more adapted to their self-constructed, artificial environment. Since increased plasticity is positively selected, this phenomenon also entails an increase in developmental immaturity. The latter, in turn, calls for further complexification of the social uterus because more immature new-borns will require more advanced parental care. And this condition amounts to higher degrees of information to be learned by the members of the new-borns' community (and by the new-borns themselves, once they grow older), thereby selecting for increased degrees of plasticity and, therefore, increased immaturity at birth and so on.

[34] "Jetzt wird der Uterus wieder ein sozialer Raum, was ja nicht anderes bedeutet, als daß ein Teil der Schutzfunktion, den der mütterliche Innenraum übernommen hatte, nun wieder *nach außen* verlagert wird, *was nicht möglich wäre, wenn ein solcher Außenraum nicht vorher geschaffen wurde*".

As David Bjorklund (1997) points out, human infants' immaturity is usually regarded as maladaptive, insofar as our sensorimotor and cognitive abilities are less effective when not fully developed and many of our faculties change or are abandoned during ontogeny to give way to more efficient ones. However, some abilities due to developmental immaturity may also be considered adaptive, not only because they pave the way to further adaptations but also because they are adaptive as such, i.e., they represent adaptations to the infants' environment and, therefore, are positively selected during anthropogenesis. These observations lead Bjorklund to suggest that our long-lasting developmental immaturity may be adaptive altogether, insofar as it allows for extensive and in-depth social learning.

For instance, as submitted by the psychoanalyst John Bowlby (1958), during their first year of extrauterine existence human infants develop so-called attachment behaviour towards their mothers or mother figures, i.e., they seek to capture and monopolize maternal attention through actions such as sucking, clinging, eye-following, crying and smiling. According to Bowlby, attachment behaviour has an adaptive function and, therefore, is positively selected during anthropogenesis, insofar as the individuals who successfully manage to secure parental care will have more chances to reach sexual maturity and consequently reproduce. Thus, biology and technics interrelate throughout anthropogenesis, to the point that, developmentally, humans may be considered biologically prepared for adopting sociocultural practices, which in turn evolutionarily produce this propensity (Suddendorf, 2013, pp. 224–229).

4.12 Transitional Objects and Transitional Phenomena

In light of the above, let me now scrutinize the technicity of extrauterine gestation in more detail. The research carried out by the psychoanalyst Donald Winnicott (2012) highlights how infants, after mostly interacting with their limbs during their first months of extrauterine life, start interrelating with some particular (technical) object, typically something soft, warm and manipulable, such as a piece of blanket or a stuffed animal, which usually becomes especially important to them. Winnicott terms these artefacts transitional objects and transitional phenomena the practices accompanying them—such as mannerisms, lullabies etc. These complexes of manipulations, interchanges and gestures of care represent an "intermediate area of experience" (Winnicott, 2012, p. 2) between the infant's bodily proprioception and their relation to the shared world and their function is to provide the infant with a supply of security and comfort during the delicate developmental transition from being a new-born to late infancy and then adulthood.

As Winnicott acknowledges, these transitional objects and transitional phenomena are a "defence against anxiety" (Winnicott, 2012, p. 5) and a source of non-erotic libido. The latter, however, is not simply directed towards the biological mother or the mother as a person, but rather to "the whole

technique of mothering" (Winnicott, 2012, p. 15), that is "any benevolent and protective psychic power" (Stiegler, 2010a, p. 11, 2013b, p. 134), as Stiegler puts it. Ultimately, mothering here refers to something more originary, "more important" (Winnicott, 2012, p. 9) than the actual mother, representing an "almost inseparable part of the infant" (Winnicott, 2012, p. 9), standing for "the object of the first relationship" (Winnicott, 2012, p. 12), which Winnicott, following traditional, Freudian psychoanalytic theory, tends to identify with the maternal breast.

However, considering what I have outlined above concerning our intrauterine, nobjectual developmental stages, one should rather maintain that transitional objects and the transitional phenomena embodying them refer to intrauterine life, i.e., the relationship the foetus establishes with the placenta, the umbilical cord and the amniotic fluid. These transitional instances, suspended between the individual body and external reality, constitute the medial background of the first subjectivizing experience and reproduce the intrauterine, pre-erotic libido, which gets lost after birth. Hence, while relating to their transitional objects, infants become able to restore and maintain a connection with that lost world and, by doing so and provided that the maternal care is "good-enough" (Winnicott, 2012, p. 13), they become able to render the postnatal transition less traumatic and keep the natal anxiety at bay.

The transitional structure of early infancy is especially evident in the case of the maternal voice, which already plays a pivotal role, as I have reviewed above, in the intrauterine developmental phase. The maternal voice is the only element of the intrauterine world that persists postnatally and survives the catastrophe of birth. In this sense, according to Sloterdijk, "as a form of acoustic umbilical cord, it offers a replacement for the lost actual umbilical connection" (Sloterdijk, 1998b, p. 303, 2011b, p. 297). Cutting the umbilical cord and, therefore, losing the placenta, Sloterdijk (1998b, pp. 398–401, 2011b, pp. 393–396) claims, constitutes a form of castration and thereby represents not only a trauma, but also the chance of an opening, rendering further, more enlarged developmental stages available and enabling the new-born to welcome the shared, extrauterine world. Nevertheless, to be effective, umbilical castration should be balanced off by the extrauterine persistence of a bond recalling intrauterine life: "the physical umbilical bond must indeed have a successor to ensure that unbound life too will remain under the sign of attachment" (Sloterdijk, 1998b, p. 399, 2011b, p. 394). According to Sloterdijk (1998b, pp. 141–209, 2011b, pp. 139–205), this bond becomes mutual postnatally, because the infant is now also able to articulate sounds, and it is further strengthened by the establishment of a visual bond, i.e., the creation of an interpersonal space of contemplation and communion between the infant and their mother.

Thus, Sloterdijk argues, "the intrauterine double life, along with its continuation in the postnatal mother-child field, provides the model for all expansions of the integral situation" (Sloterdijk, 1999, pp. 209–210, 2014c, p. 199). The originary, placental environment and its first supplementations

represent a reservoir of experience of safety, belonging and wellbeing which may be subsequently projected onto enlarged contexts in order to render them liveable. As shown by the experiments carried out by Anthony DeCasper and William Fifer (1980), for instance, three-day-old new-borns, even if only limitedly exposed to maternal contact, are capable of distinguishing their mothers' voice among different human female voices and display an active preference for their mothers' voice over the others. DeCasper and Fifer contend that this finding provides us with insights into the establishment of the infant-mother bonding and hypothesize that the intrauterine auditory experience may play a role in structuring this postnatal behaviour.

Sloterdijk also emphasizes the importance of early infancy transitional operations, i.e., the complex of maternal care and their substitutes, which "stands for the entire effort of converting the child to the belief that it is advantageous for it to be born" (Sloterdijk, 1998b, p. 400, 2011b, p. 395), i.e., transforming the trauma of losing the intrauterine comfort into a positive attitude towards partaking in the extrauterine, shared world. From this perspective, thanks to a successful, well-disposed sociocultural apparatus "the panic of world loss would be transformed into the ecstasy of coming into the world" (Sloterdijk, 1989a, p. 101, 2020b, p. 156). The traumatic character of birth is converted into the ecstatic potential of the opening to an intersubjective world. To put it in Winnicott's terms, a good developmental outcome depends on the provision of effective transitional objects and transitional phenomena during early infancy, insofar as maternal and sociocultural care can provide the new-born with the feeling that "life is worth living" (Winnicott, 2012, p. 87).

As contended by Stiegler (2010a, pp. 11–17, 2013b, pp. 1–5), who broadly elaborates on Winnicott's analyses, transitional objects constitute the prototype of every subsequent therapeutic or empoisoning relation, based on how mothers take care of their infants through them. In this sense, they are the "first" technical objects and, given their technical detachability, they will elicit subsequent supplementations throughout ontogeny. As Winnicott emphasizes, "cultural experience", that is "inherited tradition" (Winnicott, 2012, p. 133), represents the prolongation into adulthood's sociocultural world of early infancy individual transitional objects and transitional phenomena, i.e., the upkeep and reproduction of the transgenerational bond. As discussed in Chapter 2, "there is a dependence here on some kind of recording method" (Winnicott, 2012, p. 133): transgenerational informational transmission is as technically determined as developmental rearing.

4.13 Allomaternal Cooperation

As Sloterdijk points out, these references to mothers and motherhood should not be understood as exclusively concerning the actual, biological individual, but rather the complexes of sociocultural dynamics providing maternal performances: "the mother must not be conceived first as a person, but as a site, a form of vase, an immunitary spatial structure—and as a space of resonance, a voice"

(Sloterdijk, 2001a, p. 166, 2011a, pp. 166–167). This is even more so from the new-born's perspective, according to which the mother represents virtually their whole extrauterine environment. Human birthing and rearing being structurally sociocultural phenomena, we always deal with joint and interdependent performances of both maternal and allomaternal functions, which are "all those parenting acts of animating, providing for and investing in progeny that can be separated from the biological mothers and transferred to third persons or institutions […]. Civilizing shows that within certain boundaries, motherhood constitutes a prostheticizable service" (Sloterdijk, 2004, pp. 753–754, 2016b, p. 702). Sloterdijk conceives of the maternal as an impersonal, medial process exceeding the biological dimension of individuation and thereby cutting across the traditional distinctions between genders and social roles (von Samsonow, 2009).

In order to further clarify this point, it may be helpful to refer to the cooperative breeding hypothesis advanced by the anthropologist Sarah Hrdy (2007) and reappraised by Sloterdijk (2004, pp. 748–767, 2016b, pp. 697–714). According to Hrdy, cooperative breeding is an evolutionary strategy playing a key role in anthropogenesis. Human infants are extremely costly, given their slow developmental maturation as well as human low parturition rates and short interbirth intervals, so that new-borns usually come into the world while their older siblings are not fully autonomous yet. This condition calls for the adoption of allomothers, i.e., groupmates other than the biological mother (not necessarily kin) who help her rear her offspring—provided that this does not invalidate their own chances of survival and reproduction—thereby rendering human breeding a structurally collective process. Reciprocally, human breeding also becomes cooperative because the mothers' commitment in taking care of their offspring becomes heavily dependent on the sociocultural, that is allomaternal commitment in supporting their endeavour in return.

These insights should enable us to operate a perspectival shift from the new-born's perspective to the viewpoint of their groupmates, who are called to the task of arranging and predisposing care and rearing for them. The most evident outcome of this evolutionary tendency is perhaps our proclivity to teach and learn because in humans much information crucial to proactively integrate oneself into one own's community is transmitted by explicit pedagogy. Humans are evolutionarily adapted to receive (as infants) and transmit (as adults) knowledge through teaching (Csibra & Gergely, 2006). Furthermore, throughout human evolution, there is a positive correlation between social learning proclivity and absolute brain size, thereby suggesting that encephalization and our prowess to transmit and retain information from our sociocultural context may coevolve by mutually supporting and enhancing one another (Street et al., 2017).

As discussed by Sterelny in his book *The Evolved Apprentice* (2012), a shift towards cooperative foraging in Hominins may elicit the implementation of transgenerational social learning. The evolutionary emergence of the latter, Sterelny argues, builds on extant mimicry and individual trial-

and-error mechanisms, combining them with an increased prowess by young individuals to extract and retain information from what the adults do and say, together with increased tolerance and communicativeness by the adults towards the presence of young people around them, whose infancy is increasingly prolonged, as discussed above. Hominin populations are rearranged around the management, optimization and maintenance of this novel, collaborative lifeway leading to advanced plasticity, readiness to learn and collaboration, enhancing procedural and episodic memory as well as a theory of mind.

Sterelny's hypothesis, based on the positive feedback loops occurring between cooperative foraging and collaborative learning, fits in well with the remarks on human cognition elaborated by Tomasello in his book *A Natural History of Human Thinking* (2014). Following a shift towards cooperation in their foraging mode, hominin populations can develop what Tomasello terms joint intentionality, lying the evolutionary foundations for more complex cognitive abilities and social organizations. According to Tomasello, cooperation is pivotal to understanding anthropogenesis because it conjoins phenomena such as breeding procedures, foraging habits, social learning and tool manufacture, restructuring them into an integrated whole. The need for further cooperation calls for an increase in group size, which in turn enables further functional specialization among groupmates, complexifying the sociocultural environment and, therefore, requiring increased learning and teaching skills and so on.

Hence, starting from the question of neoteny, we become able to link technics and human biology within an evolutionary framework (Dubois, 2020a; 2020b). And as I have shown in Chapter 3, the intergenerational flow of information from parents to offspring becomes transgenerational, persisting through multiple generations, thanks to the encoding of our habits, knowhow and beliefs into artefacts. Social learning thereby gains evolutionary momentum, allowing for anthropogenesis to occur.

CHAPTER 5

FROM THE ANTHROPOLOGICAL DIFFERENCE TO *DIFFÉRANCE* AND METAPLASTICITY: CONDITIONS OF (IM)POSSIBILITY

Human advanced plasticity is both cause and effect of the production of an artificial environment insulating hominin populations from external stressors, as discussed above. In this chapter, I will underscore the pharmacological dimension underlying this process, insofar as technics not only constitutes us as humans but may also deprive us of our humanity. First, by differentiating the paradigm of human constitutive technicity from the theory of originary technicity and by referring to scholarship in ethology concerning tool use and cultural traditions in nonhuman animals, I will emphasize how human and nonhuman technics may be tentatively distinguished. Secondly, I will discuss Thomas Macho's, Jacques Derrida's and Giorgio Agamben's conceptions of the anthropological difference in order to highlight the conceptual pitfalls entailed by the attempts to oppose the human to the animal lifeform based on their technicity.

Thirdly, I will critically scrutinize Stiegler's appropriation of Jacques Derrida's notion of *différance*, on which Stiegler builds in order to conceptualize the anthropological difference. I will thereby show how Stiegler understands the emergence of technics as the articulation of a new lifeform without unduly opposing "the human" as an abstract category to an equally hypostatized conception of "the animal" in general. Fourthly, I will elaborate on this understanding of technics as our conditions of (im)possibility by emphasizing how our technical practices may lead to the depletion and deprivation of our own humanity, impeding the process of epiphylogenetic evolution they have, in turn, triggered. By discussing insights by Georges Canguilhem and Lambros Malafouris, I will point out that both the behavioural plasticity of individuals and the cultural plasticity of the environment are required, for the human lifeform to survive and flourish, and that technics may always disrupt and inhibit this process. These insights coming from comparative ethology and cognitive archaeology will enable me to appreciate some peculiar characteristics of the human lifeform without regarding it as ontologically separate from the other organisms, as is often the case with the traditional philosophical-anthropological understanding (e.g., Scheler, Heidegger).

5.1 Originary Technicity

In order to enquire into the relationship between technics and the human lifeform from an evolutionary perspective, as this research sets out to do, it is incumbent upon us to enquire into the origin of this relationship. Stating that technics enables the emergence of the human lifeform leaves unanswered the question of technogenesis, i.e., what enables the emergence of technical behaviour in

general. One possible strategy to address this issue is the theory of originary technicity, i.e., the idea that life in general is somehow technical from the outset.

This conceptual paradigm, as reviewed by Arthur Bradley (2011), conceives of technicity as the originary structure of all forms of life. Technics is inscribed at the core of life itself and characterizes it as life, i.e., the conditions of (im)possibility of the living as something constitutively relating to the non-living—generally meaning both the inorganic and the dead—and, therefore, ultimately indiscernible from it. According to Bradley, the theory of originary technicity is initiated by the German philosopher Karl Marx in the mid-nineteenth century and is reappraised by several thinkers during the twentieth century, such as Nancy (1992, 2008).

As highlighted by Canguilhem, who is one of the most radical thinkers of originary technicity, although rather ignored by Bradley's overview, in his essay "Machine and Organism" (1965, pp. 101–127, 2008, pp. 75–97), "by considering technique to be a universal biological phenomenon and no longer only an intellectual operation of man, one is led […] to inscribe the mechanical within the organic" (Canguilhem, 1965, pp. 126–127, 2008, p. 96). If technics, Canguilhem argues, is conceived of as a general biological phenomenon, i.e., the construction of mechanisms by other mechanisms, one should not try to understand organisms starting from machines—as western traditional metaphysics has done at least since French philosopher René Descartes's oeuvre in the seventeenth century—because both operate abiding by the same functional automaticity and relative teleology, technics being an organic function and organisms always being technical. According to this perspective, the question of technogenesis is equated with that of the origin of life.

Although I acknowledge this approach's hermeneutical fruitfulness, I also maintain that it is different from—although not necessarily incompatible with—the one I set out to discuss throughout this research. Submitting that human life is evolutionarily and developmentally structured by its relation to artefacts and that it could neither emerge nor be conceived of without it is quite a different claim than to contend that life in general is never "pure", that is self-referentially centred, but rather structurally relates to its other, always haunted by alterity and never acquiring autonomous givenness. From this viewpoint, the deconstructive operation brought about by the theory of originary technicity provides us with no insights into the specificity of technics—which is not the same thing as "originary technicity" but rather represents a particular form of alterity—and its impact on a particular evolutionary trajectory, namely the human lineage.

5.2 Nonhuman Animal Technics

An alternative strategy to tackle the question of technogenesis is attributing technics to humans alone or to the evolutionary lineage leading to Homo sapiens alone, claiming that these two interrelating phenomena, technics and the human lifeform, have mutually originated one another via reciprocal

causation. However, based on the available scholarship in ethology, this does not seem to be the case. For instance, according to Vicki Bentley-Condit and Edwin Smith (2010), who review a vast amount of ethological literature, tool use and tool manufacture are widely spread and highly differentiated among many nonhuman animal species, especially birds and apes.

However, Bentley-Condit and Smith also acknowledge that their definition of tool use, i.e., controlling an external object in order to alter the physical properties of the environment or mediate the informational flow between the organism and the environment, is deemed to remain problematic, if not arbitrary or anthropocentric, given the considerable quantity of borderline cases and the controversial difference between simple tool use and tool manufacture proper. Moreover, from their perspective, the question of the transmission of tool-based behaviour remains blurred, since it is not always clear whether such behaviour is acquired through learning from other groupmates or is the outcome of individual, episodic acts of invention.

If we shift the focus of analysis from tool use to the transmission of cultural behaviour, similar problems arise. First, the very definition of cultural traditions is not straightforward. Miriam Haidle and her collaborators (2015), for instance, identify cultural behaviour with any instance of individual behaviour conditioned by interactions between groupmates and not directly dependent on genetic inheritance or external environmental modifications. They elaborate a refined, multi-layered concept of culture, ranging from forage-oriented group dynamics in bird colonies to human symbolic and technological production. From this viewpoint, cultural behaviour as "socially-derived homogeneity" (Haidle et al., 2015, p. 54) obtains in virtually all animals.

Starting from a different perspective, Eva Jablonka and Marion Lamb (2006) focus on the evolutionary potential of cultural transmission. Linguistic and symbolic communication, they argue, should be understood as particular instances of nongenetic inheritance. Genetic inheritance, that is the transmission of the parents' combined genes to their offspring, is always accompanied by epigenetic inheritance, i.e., the transference of membranes, metabolic cycles and other molecular marks in the cell. The transmission of these markers does not alter the genetic structure proper. However, it influences the expression of some genes, eliciting stable phenotypic variations in the individuals across generations. Both genetic and epigenetic inheritance obtain since the first lifeforms, while other nongenetic inheritance systems appear later in evolution. What Jablonka and Lamb call behavioural transmission, for instance, is enabled by the emergence of the nervous system, which in turn allows for social learning and eventually symbolic transmission through language in humans.

Secondly, as reviewed by Andrew Whiten (2019), many nonhuman animal species, including birds, apes and cetaceans, develop group-specific cultural traditions, combining behavioural transmission with social learning. However, the usage and production of tools are not considered

constitutive of cultural traditions by Whiten's approach, only representing one of their possible outcomes. Similarly, Hal Whitehead and his collaborators (2019) contend that many species exhibit cultural behaviours which influence their genetic evolution, eliciting cumulative cultural evolution and even leading to speciation. They understand cultural traditions as the outcome of social learning alone, i.e., "learning that is facilitated by observation of, or interaction with, another animal or its products" (Whitehead et al., 2019, p. 3), regardless of the role of artefacts.

The difference between human and nonhuman animal behaviour seems to be better understandable when these two phenomena, tool use and social learning, are considered together. This dynamic has been investigated by the experiments carried out by Katherine Nagell and her collaborators (1993), for instance, where human children appear more attentive to the process of demonstrative learning, faithfully reproduced, than the chimpanzees confronted with the same tasks, who focus more on the general outcome of these instrumental behaviours.

5.3 The Anthropological Difference

Thus, we should acknowledge that (at least some) nonhuman animals display (at least some kind of) technical behaviour. However, this observation begs the question regarding the distinction between human and nonhuman animal technics, which articulates the anthropological difference based on our technicity. I think that the following two considerations may help us differentiate between the two, without concurrently opposing the human to the nonhuman lifeform.

First, hominin populations' technical behaviour becomes so pervasive and indispensable for their survival that it influences their process of speciation, actually rendering us humans, as this research aims to show. This is not to aprioristically deny that this condition may also apply to other animals, but compelling evidence in this regard seems to be currently scant. Secondly, as I will further discuss in Chapter 7, technics constitutes not only our conditions of existence but also our conditions of thinkability. Thanks to our current technical apparatus, for instance, we are able to reconstruct our evolutionary trajectory and account for our lifeform as a technical lifeform, while this genealogical behaviour does not seem to obtain in the case of nonhuman animals.

The question of the anthropological difference, however, is further complicated by the fact that humans are not only among its objects—insofar as they can be differentiated from nonhuman animals based on their technicity—but also its subjects, insofar as the operations aiming to highlight this difference are performed by (technically equipped) humans. As pointed out by Macho (2013c), the ensuing human exceptionalism may unfold either as praise of humans as the most (or only) intelligent or moral animals or as their condemnation as the most (or only) maladapted or decadent animals. Either way, the positive question concerning what humans are always implies the negative question

concerning what humans are not, i.e., defining the human lifeform requires defining what distinguishes it from the other lifeforms.

The margins of this distinction, Macho (2000a) argues, shift and rearrange across epochs and regions. Specifically, our conception of what it means to be a nonhuman animal varies according to how we relate to a specific animal or set of animals. Animals as sacrificial victims, for instance, are understood differently from animals as domesticated pets or animals as mass-produced meat supply. Until relatively recent times, the distinction between human and nonhuman animals in continental Europe was far from clear-cut and many features subsequently regarded as exclusively human were also attributed to other animals. For instance, from the thirteenth to the eighteenth century, the criminal prosecution and execution of animals were common practice. These trials concerned both secular and ecclesiastical law, were integrated into the sociocultural structure of their times and were exerted according to the relevant juridical standards and procedures, analogously to human trials (Cohen, 1986).

Moreover, as highlighted by Derrida in his book *The Animal That Therefore I Am* (2006, 2008) and by the Italian philosopher Giorgio Agamben in his book *The Open* (2004)—while both commenting on Heidegger's well-known passages from *The Fundamental Concepts of Metaphysics* (1983, pp. 251–532, 1995, pp. 169–366)—every attempt to attribute to humans something that would separate them from the other organisms risks falling prey to untenable metaphysical contradictions. According to Heidegger, "the stone (material object) is *worldless*; […] the animal is *poor in world*; […] man is *world-forming*" (Heidegger, 1983, p. 263, 1995, p. 177). These three ontological theses aim to thematize the different ways these three kinds of beings may relate to Being. Inanimate beings, insofar as they are worldless, would lack any possible openness to the event of Being which the worldly condition is supposed to disclose. Conversely, human existence as *Dasein*, insofar as it is world-forming, would be able to relate to beings "as such", i.e., with reference to the ontological difference between the event of Being and what this event renders manifest, that is the beings populating a world. Nonhuman animals, insofar as they are poor in world, seem to assume a quite enigmatic position within this interpretive framework. Heidegger contends that they would indeed possess a sort of relation to beings but concurrently lack the capability to grasp their event as such, captured as they are within their environmental complexes of stimulus-response couplings, instead of dwelling in a world, as *Dasein* would.

As maintained by Derrida (2006, 2008), Heidegger's stance is representative of a long-lasting and well-established tradition, cutting across the history of western civilization, which identifies what is peculiar to humans as what differentiates them from the other animals, crafting a concept of animality in order to oppose it to some supposedly unique human faculty, such as language, culture, mind or technics, which all other animals would lack. By doing so, animality is strategically disregarded as

impoverished humanity. Specifically, talking about "the animal" in general is deeply misleading, insofar as it unduly groups under a single, abstract determination the multiplicity of lifeways composing an extremely diverse set of organisms:

> beyond the edge of the *so-called* human, […] rather than "The Animal" or "Animal Life" there is already a heterogeneous multiplicity of the living, or more precisely […], a multiplicity of organizations of relations between living and dead […]. These relations are at once intertwined and abyssal, and they […] do not leave room for any simple exteriority of one term with respect to another. It follows that one will never have the right to take animals to be the species of a kind that would be named The Animal, or animal in general (Derrida, 2006, p. 53, 2008, p. 31).

Humans should be conceived of as one kind of animal among other animals, presenting many, more or less significant differences with many of them in many regards. Consequently, humans are unique just as each other species is, insofar as they represent the unique outcome of an evolutionary pattern constituted by complexes of dynamics already extant in life. I think that this stance is corroborated by biology's state of the art, as while supposedly unique human faculties are increasingly also attributed to nonhuman animals, the fundamental elements of these faculties are increasingly explicated as depending on biological, that is "merely" animal factors (Bimbenet, 2017, pp. 9–36).

Finally, according to Agamben (2004), the anthropological difference not only separates humans from the other animals but also crosses through humans themselves, opposing what would be really "human" in us to what we would share with the other organisms:

> the division of life into vegetal and relational, organic and animal, animal and human, […] passes first of all as a mobile border within living man, and without this intimate caesura the very decision of what is human and what is not would probably not be possible. It is possible to oppose man to other living things, and at the same time to organize the complex […] economy of relations between men and animals, only because something like an animal life has been separated within man, only because his distance and proximity to the animal have been measured and recognized first of all in the closest and most intimate place (Agamben, 2004, pp. 15–16).

According to Agamben, this ontological separation is always accompanied by an axiological polarization in favour of "the human", whose oppositive relation to "the animal" not only engenders our sometimes patronizing, often dominating behaviour towards the other organisms but also differentiates, within the human lifeform itself, between what should be enhanced and preserved and

what should be tamed and neutralized—within single individuals, as training and pedagogy, as well as among groups, as biopolitics and thanatopolitics. In this sense, the anthropological difference is not so much a theoretical consideration or a scientific conundrum as "a fundamental metaphysico-political operation in which alone something like 'man' can be decided upon and produced" (Agamben, 2004, p. 21). Hence, when enquiring into human specificity, one should be aware of the strategic function the anthropological difference has hitherto fulfilled as a discriminatory apparatus and pay attention to its unavoidable political bearings.

5.4 Technics and *différance*

In light of the analyses carried out above, let me now scrutinize Stiegler's original approach to the question of the anthropological difference, which flows from his confrontation with Derrida's thought. Stiegler submits that the emergence of the process of exosomatization marks an articulation within the history of life in general, which he understands, following Derrida, as *différance*. I will now briefly review the notion of *différance*, in order to investigate Stiegler's critical appropriation of it.

As discussed by Derrida in his essay "Différance" (1972b, pp. 1–29, 1982, pp. 3–27), this rather enigmatic term simultaneously refers to deferral in time and differentiation in space, constituting the originary interplay of time and space, the becoming-space of time (spatialization) as well as the becoming-time of space (temporalization). *Différance* is a name for the indefinite production of actual differences and, therefore, should not be hypostatized as something existing before or independently of its individual instantiations. This strategic notion aims to deconstruct the oppositions engendered by the originary neglecting of its dynamic by western metaphysical tradition (e.g., matter versus form, signified versus signifier, evil versus good etc.), ultimately questioning its conception of Being as pure presence.

In his book *Of Grammatology* (1976, 1997), Derrida expands on the notion of *différance*—also called *grammè*, trace, supplement or arche-writing—and relates it to the question of the origin, i.e., the structural impossibility of a "pure" origin, that is origin as a single, describable event which would account for everything that, proceeding from it, it produces: "the trace is not only the disappearance of origin—[…]it means that the origin did not even disappear, that it was never constituted except reciprocally by a nonorigin, the trace, which thus becomes the origin of the origin" (Derrida, 1976, p. 90, 1997, p. 61). What originates the origin should not be hypostatized as an origin itself. The latter is rather constituted retrospectively by the indefinite deferral and differentiation of an originary event which has actually never occurred. Since the givenness of presence is always haunted by absence, devoid of plenitude and self-referential autonomy, the origin only manifests itself by default, that is by its retreat.

As maintained by Martin Hägglund (2011), *différance* is a metatheoretical notion whose domain of operativity equates with the whole of beings. Thus, while it should not be restricted to what is living alone, it enables us to also account for the history of life in general consistently with Darwinian evolutionary biology, if we understand life as the differential replication and selection of characteristics. According to Derrida, "mark, gramma [*le gramme*], trace, and différance refer differentially to all living things, all the relations between living and nonliving" (Derrida, 2006, p. 144, 2008, p. 104). However, while commenting on Leroi-Gourhan's (1964, 1965; 2018) insights, Derrida (1976, pp. 124–128, 1997, pp. 83–86) points out that anthropogenesis represents

> a stage or an articulation in the history of life—of what I have called differance—as the history of the *grammè*. […] It is an emergence that makes the *grammè* appear *as such* (that is to say according to a new structure of nonpresence) (Derrida, 1976, p. 125, 1997, p. 84).

On the one hand, *différance* concerns life in general, with humans representing just one stage of this process, as all other organisms do. On the other, the human lifeform corresponds with the emergence of the *grammè* (i.e., *différance*) "as such". Yet what does "as such" mean here? Stiegler's interpretation of Derrida's thinking of *différance* amounts to an attempt to answer this question. On the one side, according to Stiegler, anthropogenesis is a technical process. On the other, according to Derrida, it equates with a new articulation of *différance*. Stiegler, therefore, submits that what originates this new articulation is precisely the emergence of technics or, more exactly, the emergence of a lifeform structurally interrelating with technics in order to survive and thrive.

Hence, Stiegler (2018a, pp. 163–171, 1998b, pp. 134–142), while commenting on Derrida's considerations, submits that anthropogenesis consists in a "rupture in différance" (Stiegler, 1998b, p. 138, 2018a, p. 167), "a double différance" (Stiegler, 2018a, p. 180, 1998b, p. 151), a "différance of différance" (Stiegler, 2018a, p. 208, 1998b, p. 178), whose momentum would have been underestimated by Derrida, who has not developed a history of the supplement to complement its logic by reconstructing the different stages of the articulation of the *grammè*. This doubling of *différance*, Stiegler argues, equates with the emergence of technics and amounts to the possibility of self-consciously thematizing *différance* as the history of life in general, insofar as the latter is conceivable only starting from a particular organization of the living, that is human life as technical life.

While dealing with Derrida's thinking of technics, Stiegler (2001) submits that, on the one hand, the general logic of *différance* renders the particular logic of anthropogenesis possible, insofar as biological memory is supplemented with nonbiological devices, mnestic traces reproduced into different supports and thereby transformed, as discussed in Chapter 2. On the other, *différance* as

such, i.e., the general metalogic of the whole of beings, can only be conceived of starting from that particular articulation of the *grammè* that renders this self-thematization possible. *Différance* is not reducible to technics. However, technical life amounts to that articulation of *différance* that enables us to properly access and experience *différance* in general through that concrete instantiation of *différance* represented by this particular discourse about *différance*. It is "*the condition of the possibility and impossibility of having access to the gramme 'as such'*" (Stiegler, 2001, p. 251), technics framing every human experience, including that of *différance* and its logic.

Insightfully, what Markus Gabriel (2011, pp. vii–xxxii) calls transcendental ontology, aiming to combine the respective legacies of Kantian transcendental philosophy and German idealism, sets out to enquire into how the world (i.e., the whole of beings) becomes reflectively self-intelligible through us (beings of a peculiar kind), i.e., how the world relates to itself. As argued by Gabriel, we are part of the world and our thoughts about the world are also part of it. Thus, through the operations of human consciousness, the world as such may become the object of a transcendental (self-)reflection while concurrently empirically remaining within itself. In my view, Stiegler's approach seeks to highlight how technics plays a pivotal role in this process of reflective mediation.

Indeed, since his early paper "What Is Missing" (1995), Stiegler identifies this problematic as the question of what he calls the a-transcendental. The paradigm of human constitutive technicity, Stiegler argues, implies that technics, which is usually included in the empirical domain, i.e., the object of experience, is constitutive of (human) experience. Hence, it should be regarded as belonging to the transcendental domain, i.e., what conditions experience, while concurrently remaining empirical, that is concretely and individually experientable as the techniques and technologies composing a historical episteme. From this perspective, the empirical-transcendental divide is invalidated and, therefore, should be dismissed. However, according to Stiegler, the separation between facts and rights, i.e., a nonfactual criterion deciding over what is factual, traditionally embodied and purported by the question of the transcendental, should be preserved nonetheless and reformulated in terms of a-transcendentality. Stiegler's philosophy

> submits that the question concerning the support is irreducible and tries to think elementary supplementarity per se, before any particular support. However, it experiences the impossibility of reducing its *own* thought support (the writing in which this *text* is woven). In order to attempt to think in general the conditions of access to the past imposed by the elementary supplementarity, it has itself to think the conditions under which it has access to the past of this

> question, to what, in the past, has prepared it without ever having formulated it as such. This is why it is indeed an a-transcendental concept[35] (Stiegler, 1995, p. 277, my translation).

In order to conceive of what grants us access to experience in general, we should first conceive of what grants us access to the particular experience of this operation itself. This a-transcendental condition of experience through technics is defined by Stiegler as the "hermeneutic privilege" of epiphylogenesis:

> I posit that it is *starting* from the *epiphylogenetic* trace, the trace that appears with *technical life*, that it is possible for us to discern the trace that constitutes life *in general*, and to access it, and not the other way around: this is a phenomenologico existential standpoint in the strict sense, *which makes conditions of appearance conditions of what appears* […]. To be able to access the trace that does not emerge from epiphylogenesis, […] it is necessary to *start* from epiphylogenesis, on the *basis* of epiphylogenesis […]. Therefore, the trace *before* epiphylogenesis presents itself to us only *through* epiphylogenesis (Stiegler, 2020, p. 86).

Anthropogenesis marks a change—and yet one among many others—in the process of individuation of life in general. However, Stiegler (2020) argues, first, we can reconstruct our own origin and conceptualize the history of life in general as the logic of *différance* only starting from our present condition, i.e., the relativity of our situated perspective, articulated by a given stage of technoscientific development, as I will argue in Chapter 7. Secondly, it is possible to conceive of *différance* as such, i.e., thematizing it and rendering it the object of a philosophical, political or scientific discourse—without, obviously, reducing *différance* to this discourse—only through technologies, i.e., through the mediation of cognitively embedded artefacts cumulatively triggering, sustaining and driving epiphylogenesis.

Hence, Stiegler wittingly diverges from Derrida's stance, which becomes evident in a dialogue between them, where Derrida reproaches Stiegler for identifying technics with what constitutes intelligibility, i.e., the explicit thematization of the conditions of (im)possibility of a phenomenon,

[35] "Pose que la question du support est irréductible, et tente de penser la supplémentarité élémentaire pour elle-même, avant tout support particulier. Mais il fait l'expérience de l'impossibilité de réduire son *propre* support de pensée (l'écriture dans laquelle ce *texte* s'est tramé). Pour tenter de penser en général les conditions d'accès au passé qui impose la supplémentarité élémentaire, il doit lui-même penser les conditions dans lesquelles il accède au passé de cette question, à ce qui, dans le passé, l'a préparée sans l'avoir jamais formulée comme telle. C'est en cela qu'il s'agit bien d'un concept atranscendantal".

while demanding to investigate its specificity nevertheless. According to Derrida, this recursive operation is structurally aporetic:

> the origin of sense makes no sense. This is not a negative or nihilistic statement. That which bears intelligibility, that which increases intelligibility, is not intelligible—by definition, by virtue of its topological structure. From this standpoint, technics is not intelligible. This does not mean that it is a source of irrationality, that it is irrational or that it is obscure. It means only that it does not belong, by definition, by virtue of its situation, to the field of what it makes possible. Hence a machine is, in essence, not intelligible. No matter what, even if it makes possible the deployment or transmission or production of meaning, in itself, as machine, it makes no sense. […] That which constitutes sense is senseless. This is a general structure. The origin of reason and of the history of reason is not rational. […] Whoever asks a question about the origin of meaning, the origin of reason, the origin of the law, the origin of humanity, and with a view to asking this particular question, must turn toward whatever bounds the very thing he is questioning: the condition of the question does not yet belong to the field of what it questions. The question does not belong to the field of the questioned (Derrida & Stiegler, 1996, pp. 121–122, 2002, pp. 108–109).

While, on that occasion, Stiegler laconically retorts that technics "*constitutes sense if it participates in its construction*" (Derrida & Stiegler, 1996, p. 121, 2002, p. 109), his approach's general aim should become clearer in light of the above. Technics grants us access to the overarching horizon of intelligibility (i.e., *différance* "as such"), without this "general structure" being reducible to technics in general, let alone to some individual artefact in particular. Concurrently, since we construct and employ concrete technologies all the time, through our practices we also gain insights into their specificity, each of them moulding our experience and framing a historically situated horizon of intelligibility. Analogously, in his discerning criticism of Derridean deconstruction, the German philosopher Christoph Türcke (2005, pp. 153–197) urges us to distinguish between the constitutively logocentric character of rationality, i.e., its unavoidable self-referentiality, from logocentrism itself, that is the metaphysical hypostatization of rationality as the transcendent fundament of Being.

5.5 Deconstructive Criticisms

Stiegler's interpretation of Derrida's notion of *différance* has raised some criticisms among commentators, which I will now scrutinize. While Richard Beardsworth (1995), Ian James (2010) and Ben Turner (2016) regard his stance as ultimately convergent and somehow compatible with Derrida's insights, Ben Roberts (2005), for instance, contends that Stiegler unduly identifies what

Derrida calls the non-living in general with (human) technics in particular. The latter, Roberts argues, would rather only be one possible manifestation of the articulation of the living onto the non-living composing *différance*. Accounting for human specificity and the doubling of *différance* it implies would be nonsensical, insofar as for Derrida the differential relation between the living and the non-living is constitutive of life itself, which is always confronted with metabolic and environmental processes regarding what is other-than-life—starting from air-breathing, for instance.

These remarks are shared by Tracy Colony (2011), who also submits that by doing so Stiegler underestimates how animal life is finite and aporetically relating to alterity as much as human life is, thereby committing himself to the metaphysical anthropocentrism of human exceptionality discussed above. Furthermore, Francesco Vitale (2020), in a similar fashion, maintains that Stiegler, instead of inscribing technics into life itself, as Derrida does, refers to it in order to account for human specificity. Moreover, his conception of animal life would disregard Derrida's methodological precautions, insofar as "the animal" as an undifferentiated whole would be opposed to humanity and conceived of as purely homogeneous automaticity. From a Derridean perspective, Vitale argues, *différance* differs from itself at each stage of the living, producing a different articulation for every species, rather than a single rupture concerning humans alone.

Finally, Geoffrey Bennington (1996) criticizes Stiegler for committing to a sort of positivism of *différance*, whose logic would have to abide by factual constraints. He submits that "the possibility of the 'appearing as such' of the gramme is built into the description of the trace quite independently of the factual history of the emergence of mankind or any other species" (Bennington, 1996, pp. 189–190), i.e., the movement of *différance* cannot be influenced by empirical events. Bennington conceives of *différance* as a transcendental metalogic of Being, articulating empirical becoming without being impacted by the latter to any extent.

In light of these criticisms, I should concede that Stiegler's conception of animal life seems rather ambiguous. While acknowledging that we should not oppose the human to the nonhuman lifeform, Stiegler (2020) maintains that a distinction should be made nonetheless in order to understand the specificity of technical life. Thus, while there is indeed no such a thing as "pure life", life always aporetically relating to its other and articulating itself at each organismal stage according to the ever-changing structure of *différance*, for Stiegler artefacts represent a particular form of alterity and, therefore, a new articulation of the *grammè*.

This assumption is consistent with the approach purported by Derrida, who claims, relative to the relationship between the human and the animal lifeform, that "everything I'll say will consist, certainly not in effacing the limit, but in multiplying its figures, in complicating, thickening, delinearizing, folding, and dividing the line precisely by making it increase and multiply" (Derrida, 2006, p. 51, 2008, p. 29). The aim of deconstruction is not to erase all possible differences between

humans and the other animals but rather to avoid understanding these differences as absolute binaries, hypostatizing humanity as what would define itself as opposed to a likewise hypostatized conception of "the animal" in general. Stiegler thinks that Derrida fails to properly articulate this distinction because he does not give due consideration to technics as what, by marking a new stage of *différance*, produces the human lifeform.

However, by doing so, Stiegler sometimes stresses the uniqueness of the human relation to technics, maintaining that nonhuman life would abide by "an economy of the instincts, which control animal behaviour with the rigour of automatism" (Stiegler, 2015a, pp. 47–48, 2017a, p. 22), thereby risking falling prey to Derrida's (2006, pp. 125–126, 2008, pp. 89–90) criticism of those metaphysical conceptions which understand animal life as strictly determined by (genetic) programmes. Furthermore, according to Stiegler, organisms would usually lose the acquisitions of their lived experience once they die and only genetic memory would be kept and transmitted across generations, while humans, "contrary to what occurs in the strictly biological space" (Stiegler, 2018a, p. 188, 1998b, p. 159, trans. mod.), would be able to retain their lived experience into exosomatic technical objects and transmit it transgenerationally. As argued in Chapter 2, technics represents a third form of memory that enables the mutual influence of genetic and somatic memory. Quite problematically, however, Stiegler maintains that humans, in this regard, would be "a unique life form" (Stiegler, 2013a, p. 60, 2014, p. 33) compared to the other animals.

Moreover, even when Stiegler admits that other animals may also behave technically, the distinction between the human lifeform and the others in this regard is nevertheless preserved: "of course, animal life can have exosomatic dimensions that are accommodations to the milieu. But we refer to exosomatization only when endosomatic organogenesis becomes dependent on exosomatic organogenesis, which, conversely, becomes independent of the biological conditions of endosomatic organogenesis" (Stiegler, 2018c, p. 313). However, the latter condition seems hardly appliable even to humans alone, insofar as technical organization coevolves with biological organization, rather than proceeding fully regardless of it. Finally, even when accepting to also attribute technics to some nonhuman animals, such as the other great apes, Stiegler (2004, pp. 47–49, 2017c, p. 51) seems only to include them in his conception of humanity as technical life, thereby lingering in the metaphysical apparatus which understands animality as what, by opposing humanity, eventually defines it.

Despite the conceptual ambiguities outlined above and even if sometimes Stiegler seems to exhibit an overly narrow conception of nonhuman animal technicity, I think that his core argument concerns not so much a defence of human exceptionalism relative to our technicity as an attempt to thoroughly problematize the category of "the human". Indeed, Stiegler contends that "the issue is not that of 'the human' but of the process of which it serves as the transmitter" (Stiegler, 2018a, p. 495, 2009c, p. 255). Other animals may well adopt artefacts and transgenerationally transmit the acquisitions of their

lived experience, although seemingly to a lesser extent and with a lower impact on their process of speciation than humans.

According to Stiegler (2018a, p. 488, 2009c, pp. 161–162), "the human" does not exist. Only "humans" exist, each of them provided with the capability to disseminate their conception of what it means to be humans, transmitting it to others and potentially universalizing it. Thus, Stiegler (2020) conceives of humans not as hypostatized entities, but rather as the name for local instances of cumulatively evolving de-functionalization and re-functionalization of endosomatic and exosomatic organs. The question here is not so much that of the definition of humans as a (biological) species as that of the general process of transmission of experience through technics. Rather than conceiving of technics as a means to determine human specificity, Stiegler is concerned with understanding technics in general as what enables a new articulation of the living onto the non-living, i.e., a new lifeform as a new stage of *différance*.

5.6 Adoption and Normativity

In light of the analyses carried out above, we may appreciate how Stiegler, by appropriating Derrida's thinking of *différance,* aims to conceive of technics as our conditions of (im)possibility. One the one hand, technics renders us humans, i.e., it allows for the transgenerational transmission of cumulating acquired characteristics—rather than identifying a special kind of entity as separate from the others based on its technicity. One the other, it enables us to conceive of ourselves as such, that is thematically reflecting on this process. Concurrently, technics is also what may always deprive us of our humanity, i.e., impeding the process of epiphylogenesis as well as the possibility of representing it. Let me now flesh out this pharmacological duplicity from an evolutionary perspective, consistently with the aim of this research.

As submitted by Stephen Jay Gould and Richard Lewontin (1979), the Modern Synthesis of evolutionary biology traditionally exhibits a pervasive and often implicit adherence to what they call the adaptationist programme. This conceptual paradigm advocates for natural selection as being virtually the only factor in evolution, while other dynamics are ignored or dismissed as irrelevant. Organisms are regarded as atomized and dissected sets of characteristics, each of which would be the direct result of a selective operation aiming at the most suitable solution for survival and reproduction. They are considered the outcome of an optimization process where trade-offs occur between the adaptive characteristics and those characteristics whose evolution is constrained by the evolution of the former. As contended by Gould and Lewontin, however, "one must not confuse the fact that a structure is used in some way […] with the primary evolutionary reason for its existence and conformation" (Gould & Lewontin, 1979, p. 587). The current function of a trait is not necessarily

what originated it, while the adaptationist narrative regards everything as adaptive and every trait as designed to compete for the purpose of maximal adaptation.

Moreover, as reviewed in Chapter 3, this understanding of evolution as exclusively limited to genetic adaptation to environmental pressures, coming from Neo-Darwinism, is also contested by niche construction theory, which highlights how organisms modify their environment and thereby bestow altered selection pressures on their offspring. However, the contemporary, neoliberal socioeconomic system, as contended by French philosopher and Stiegler's daughter Barbara Stiegler (2019, 2022), still refers to Neo-Darwinism and the Modern Synthesis in order to naturalize its own ideology, submitting that humans must adapt to their sociocultural environment, such as the labour market, developing flexibility and resilience to change, or else perish. Finally, as argued by Gerald Moore (2013), even French "poststructuralist" theory risks inadvertently endorsing this narrative, stating that the only alternative to capitalism is resisting its power, rather than inventing alternative lifeways. Confuting the adaptationist paradigm in evolutionary biology, therefore, amounts to also debunking the scientific groundlessness of the prevailing socioeconomic ideology.

Canguilhem (1965, pp. 155–169, 2008, pp. 121–133), for instance, while enquiring into the distinction between healthy and pathological states, submits the concept of biological normativity, i.e., the organisms' capability to establish vital norms through their activities. Organisms and their environment, Canguilhem (1972, 1991) argues, are never "normal" as such, but only relative to their mutual relation, where new norms express modifications in this relation. The so-called anomalous organisms exceed their norm, i.e., exhibit altered characteristics compared to their conspecifics' statistical mean. If their anomalous traits reduce their chances of survival and reproduction, they are abnormal, that is pathological individuals. They relate to their environment in more limited, restricted, constrained ways than their conspecifics and may either perish or achieve no more than mere survival, as opposed to flourishing in a state of healthful normativity. However, if their anomalous characteristics (i.e., their altered ways of relating to the environment) enhance, rather than reduce, their chances of survival and reproduction, they will gradually replace their conspecifics by establishing new norms, that is becoming normative.

Health, from this perspective, represents "the possibility of transcending the norm, which defines the momentary normal, the possibility of tolerating infractions of the habitual norm and instituting new norms in new situations. […] Health is a margin of tolerance for the inconstancies of the environment" (Canguilhem, 1972, p. 130, 1991, pp. 196–197). Being healthy amounts to being capable of enduring environmental perturbations and restoring altered living conditions, thereby being able to survive and thrive in different environments. Canguilhem's concept of health, therefore, is different from Modern Synthesis's and Neo-Darwinism's concept of fitness outlined above and life is understood as "not only subject to the environment but also as an institution of its own

environment" (Canguilhem, 1972, p. 155, 1991, p. 227). Being healthy, that is normative, not only consists in being able to withstand unpredictable environmental perturbations. It also amounts to actively constructing one's own environment, establishing and propagating new ways to organize it.

According to Canguilhem, "organic vitality flourishes in man in the form of technical plasticity" (Canguilhem, 1972, p. 133, 1991, p. 201). Humans perform their normativity not so much through the modification of their biological organs as by transforming the "social organs, that is, the collective technical means" (Canguilhem, 1972, p. 190, 1991, p. 255). Hence, anthropogenesis does not take place as random genetic mutations thriving or perishing according to whether they fit in with the extant environmental pressures or not—fitness only occurring retrospectively and regardless of ontogenetically acquired characteristics. Human life is rather technical engineering of one's own environment, technics constituting the agent of both mutation and selection, as discussed in Chapter 3. From niche construction theory's viewpoint, although all organisms experience a sort of adaptive lag between their phenotype and the extant selection pressures—since responses to environmental changes are hardly instantaneous—this evolutionary mismatch is constantly bridged, precisely thanks to the organisms' niche-constructing activities (Laland & Brown, 2006).

Pharmacologically, however, niche construction may also lead to the depletion of the environment, thereby triggering negative fitness. In the case of humans, single individuals as well as whole communities may undertake activities leading to the impoverishment and weakening of their artificial niches, thereby jeopardizing their insulating performances. Stiegler (2018a, pp. 788–790, 2010d, pp. 176–177) understands this condition as the reversion of adoption into adaptation. Adopting techniques and technologies means participating in the construction of our own environment, modifying ourselves while modifying its selection pressures in return by inventing new uses and configurations for these devices. Likewise, adopting our community's technical system amounts to interiorizing the complex of shared behavioural patterns presiding over its functioning, rearranging our biological setup through the production of new artefacts and social organizations.

The process of adoption, thusly understood, may only occur if two conditions are satisfied. First, the artificial environment should provide its inhabitants with the means to endure and transmit their plasticity, that is their capability to rearrange their psychophysical constitution while constructing their own living conditions in return. Secondly, it should include them in the organizational apparatuses presiding over the articulation of its living conditions, letting them contribute to establishing and modifying them. Otherwise, if plasticity is impeded and the possibility of influencing shared behavioural norms is precluded, individuals can only adapt to their artefactual niches, i.e., either manage to cope with the extant environmental stressors or perish.

Adaptation, therefore, far from being an originary evolutionary dynamic, is rather the degeneration of adoption, leading to what Stiegler terms proletarianization, i.e., the loss of knowhow, knowledge

and motivations in the transindividual transmissional chain. According to Stiegler, "proletarianization is what constitutes an exteriorization without return, that is, without interiorization in return" (Stiegler, 2015a, p. 57, 2017a, p. 28). Proletarianization occurs when organic functions are exteriorized onto artefacts without the corresponding possibility for those who perform exosomatization of transforming themselves accordingly. Individuals are proletarianized once they are deprived of the means to proactively adopt the complex of behavioural patterns, information and beliefs structuring their organological collective. Whole communities may become proletarianized if the apparatuses presiding over the transmission, production and maintenance of their artefacts and their rules of usage cease working successfully, possibly leading to cultural breakdown and civilizational collapse.

Thus, proletarianization amounts to the uncontrolled disinhibition of the individuals, who cannot help but abide by the prevailing stimuli of their technical environment. Their desires are broken down into disconnected drives, i.e., their protentional horizons, organologically constituted, are disbanded into short-term, highly automated expectations of basic, survival-oriented rewards. In Canguilhem's terminology, we may say that adapting is interiorizing a vital norm, without the possibility of being normative in return, i.e., performing exosomatization and thereby modifying the environment in which that norm has been established.

5.7 Metaplasticity

I will conclude these remarks by introducing the concept of metaplasticity, thereby further elucidating the pharmacological dimension of technics as our conditions of (im)possibility. Material Engagement Theory (MET), the approach developed by Malafouris in his book *How Things Shape the Mind* (2013), investigates the origin and evolution of human cognition, agency and intentionality as an emergent process enacted in "*the zone in which brains, bodies, and things conflate, mutually catalyzing and constituting one another*" (Malafouris, 2013, p. 5). By doing so, Malafouris (2019) includes material culture in the activity of the "mind" and aims to overcome both mind-body dualism and the privileging of the brain as the sole location of thought, traditionally contended by cognitivism, for instance.

The term metaplasticity comes from neuroscience but is reinterpreted by Malafouris (2013, pp. 45–50) to conceptualize "the fact that we have a plastic mind which is embedded and inextricably enfolded with a plastic culture" (Malafouris, 2013, p. 46), i.e., "ever-increasing extra-neural projective flexibility that allows for environmentally and culturally derived changes in the structure and functional architecture of our brain" (Malafouris, 2013, p. 241). Human evolution is the outcome of a double plasticity. On the one hand, neurophysiological, developmental plasticity, i.e., the capability to substantially acquire information during ontogeny and modify one's behaviour

accordingly. On the other, cultural plasticity, i.e., the possibility of thematically altering our artificial environment through auto-artificial selection. Technics binds these two conditions together because techniques and technologies are what both enables the transgenerational transmission of acquired knowledge and composes an interactive, constructed environment. Adoption occurs as the constant, recursive interplay between plastic individuals and their plastic environment, granting the former the possibility of familiarizing themselves with the living conditions of the latter as well as contributing to modifying these norms in return.

Stiegler's pharmacology, outlined in Chapter 2, highlights that precisely because this double plasticity represents the conditions of (im)possibility of the adoption of the artificial environment characterizing anthropogenesis it may always reverse into its opposite and render this environment unliveable. Both cultural and neural plasticity can be impeded—learning may become impossible and institutions unalterable—breaking the transmissional process and jeopardizing individual and collective existence. In such cases, adoption turns into adaptation: individuals are completely submitted to their environmental pressures and the technical environment, not taken care of anymore, collapses. As discussed in Chapter 3, insulated, plastic individuals in an insulating, plastic environment may only produce and sustain one another provided that the former are explicitly concerned by the management of the environment which, in turn, protects them.

Hence, for the human lifeform to survive and flourish, both neuroplasticity and cultural plasticity are required, i.e., plastic brains and behaviours should relate to a plastic artificial environment, both being capable of mutually influencing one another and, therefore, coevolving. Anthropogenesis as a technical process amounts to the evolutionary emergence of the conditions which render metaplasticity possible. However, given that technics, pharmacologically, both constitutes the human lifeform and may deprive it of its humanity, disruptive alterations in a community's technical system may impede the development of neural plasticity, cultural plasticity or even both, thereby jeopardizing the existence of the very individuals who produce the artefacts endangering them. For instance, long-term, continuative exposure to screens (e.g., smartphones, tablets etc.) may engender cognitive developmental disorders in young children. Analogously, highly automated, computer-based decisional processes, such as those in place in the worldwide stock exchange, may undercut the individuals' capability to avoid finance-induced economic crises.

The paradigm of human constitutive technicity, therefore, prompts us to appreciate the selective performance exerted by technics throughout our evolution. While some characteristics are enhanced and preserved by our self-constructed environment, others are thwarted and inhibited. The flipside of the insulating, pampering performance of our artificial niches amounts to the need to exclude from the organological collective what does not fit in with its rules of living. As I will now turn to discuss, this bio-socio-technical dynamic is aptly expressed by Sloterdijk's general immunology.

CHAPTER 6

THE IMMUNE SYSTEM AS THE BIO-SOCIO-TECHNICAL ORGANIZATION OF SURVIVAL

As shown above, understanding technics as our conditions of (im)possibility allows us to appreciate how our artificial environment not only protects us from external stressors but also selects which instances can survive and replicate based on its endogenous selection pressures, thwarting what endangers its maintenance. In this chapter, I will articulate this phenomenon by expounding on the human immune system as a bio-socio-technical organ(ization). First, I will reconstruct the origins of the concept of immunity, highlighting the historical intersections between its biomedical, legal and biopolitical occurrences. Based on biology's state of the art, I will interpret the immune system as a complex organ which mediates the relationship between an organism and its surroundings, discriminating between what is regarded as beneficial and, consequently, incorporated, and what is regarded as harmful and, therefore, excluded or eliminated.

Secondly, I will scrutinize how immunity has become an important topic for contemporary philosophy, especially relative to Roberto Esposito's and Jacques Derrida's approaches, underscoring the mutual complementarity of scientific and philosophical conceptions of immunity. Thirdly, I will turn to Sloterdijk's general immunology, i.e., his understanding of human communities as held together and regulated by an extended conception of the immune system, which supplements biological dynamics with technological and social performances. This organological conception of human immunity, in turn, will enable me to emphasize the pharmacological dimension underlying Sloterdijk's thinking. Specifically, I will focus on how knowledge, especially scientific practice, features a both immune and autoimmune character, insofar as it not only helps us navigate the difficulties of our existence but may also render us more insecure about our self-representation, i.e., what we think it means to be humans in a historical episteme. Hence, by referring to debates in contemporary immunology I will be able to criticize the traditional understanding of humans as independent, "monadic" individuals, emphasizing the role of cooperation and dynamic cointegration in the process of anthropogenesis.

6.1 The Rise of Biomedical Immunology

As discussed by Inge Mutsaers (2016, pp. 23–41), the notion of immunity is significantly older than immunology as a biomedical subdiscipline. It originated as a juridical concept in Ancient Rome, where the Latin word *immunus* characterized an individual who was permanently or temporarily exempted from the obligations (*munera*) normally constraining and binding together the members of their group. Immunity subsequently took on a biopolitical meaning starting from European

modernity's contractarianism, where ideas of obligation and exemption expressed by the Roman use of the term were interlinked with notions of host and defence, insofar as the nation-state was deemed to protect (i.e., immunize) its individual members from both external enemies and internal conspiracies.

Starting from the nineteenth century, immunity as a biological concept emerged and rapidly gained momentum. Hence, Mutsaers argues, while contemporary reflections about immunity usually adopt this notion starting from its clinical and epidemiological background, its whole conceptual scope should be taken into account when elaborating on a philosophy of immunity. The concept of immunity, coming from law and politics, subsequently influenced the development of medicine and biology, where it became a pivotal notion and, from this privileged position, held sway, in return, over current political and philosophical debates about the understanding and management of human societies.

Furthermore, the immune system as an organ proper has been conceptualized only relatively recently in the history of biomedical science. As critically reconstructed by the US philosopher Alfred Tauber in his book *Immunity* (2017), immunology as a subdiscipline of medical biology was initially concerned with an idea of the biological individual as an autonomous entity, defined as separate from and independent of its environment and whose identity had to be preserved and protected against the attack of external pathogens. Thus, Tauber (2017, pp. 23–56) argues, the questions of immunity and identity were initially connected through the discourses and practices of epidemiological research about infectious diseases. By challenging our ideas about immunity, we also challenge, therefore, our ideas about selfhood and identity.

Starting from the second half of the nineteenth century, traditional immunology emerged as a clinical science mostly concerned with therapeutic success against transmissible diseases. The immune system was conceptualized as a defence mechanism protecting the organism from other organisms by attempting to neutralize them. Starting from the second half of the twentieth century, this rather simplistic understanding was complicated by the discovery of autoimmune diseases. According to this novel vantage, initially formalized by the virologist Frank Macfarlane Burnet (1959), the immune "self" was conceptualized as what is recognized as internal to the organism by its immune system, while the immune "nonself" was understood as what is not recognized as internal to the organism by its immune system. The latter was deemed to ignore the self (i.e., what belongs to the organism) and attack the nonself (i.e., what does not belong to the organism). Autoimmune pathologies were regarded as malfunctions of the immune system, which does not recognize as internal to the organism something which nonetheless rightly belongs to it and thereby attempts to eliminate it.

Nowadays, clonal selection theory, the approach inspired by Burnet's intuitions, is the dominant model in immunology. Nevertheless, it is now believed that the immune self, i.e., the information provided to the immune system concerning what is internal to its organism, is not genetically predetermined, as previously hypothesized, but rather develops during the organism's embryonic phase. The immune system is supposed to learn to recognize as self those entities which it encounters during the early gestation period, subsequently ignoring them while attacking the nonself (i.e., everything else), thereby preserving organismal identity.

However, as discussed by Tauber (2017, pp. 163–189), alternatives to this dominant view have also been proposed. The zoologist Élie Metchnikoff (1901, 1905), for instance, conceived of the immune system as regulating organismal identity by ecologically mediating the interchanges between the individual and its environment. This conception of identity was not fixed but rather constantly changing via internal and external challenges. Starting from the seventies, the immunologist Niels Jerne (1974) pursued a deconstruction of the concept of immune identity, further elaborated by the French philosopher Thomas Pradeu (2019). This view hypothesizes that the immune system operates as a network of dynamics with neither agency nor self proper, insofar as only what is internal (self) is really recognized by the immune system, while what is external (nonself) is only indirectly perceived as a potential disruption of the routine functioning of the network, which the immune system consequently attempts to restore. Hence, according to Tauber, the dominant conception of immunology is currently shifting towards an ecological paradigm:

> immunity is that process which "negotiates" the traffic of potentially beneficial against noxious encounters on a reactive spectrum of tolerance and rejection. Accordingly, immunity is not restricted to some preestablished self/other discrimination but, rather, functions as an information processing system in an ever-challenging environment, and from such information immune responsiveness is regulated. With such a dynamic perspective, defining that which must be identified as benign or dangerous over the life span of the organism becomes immunity's cardinal feature. And because the immune spectrum forms a continuum of reactivity, shifting in time and space, a stable dichotomous construction of agency that has dominated immunology no longer suffices to model immunity (Tauber, 2017, p. 16).

First, the immune system is regarded by Tauber as mediating both harmful and benign encounters with the environment—not merely as neutralizing pathogens. Secondly, it is deemed to assess whether something is harmful or benign based on the context of the encounter and not starting from some predefined criterion. The immune system, thusly understood, regulates the exchanges between the organism and its environment, thereby administering its everchanging, symbiotic and relational

identity, rather than defending a predetermined "self" against its "others". Organismal identity is maintained through its constant exchange with external phenomena, both harmful and benign, which transform the organism through the mediation of the immune system. Thus, the latter should be conceived of as a cognitive-like function processing information because it establishes and maintains the relationship between the organism and its environment by first recognizing external inputs and then multifariously reacting to them. For instance, apart from attempting to neutralize external pathogens, the immune system also routinely works by scavenging effete cells, controlling possible malignancies and mediating the intake of nontoxic substances and benign microbes.

As brilliantly expressed by Tauber, "as immunology developed, the self/nonself dichotomy became the central theoretical scaffolding of the discipline" (Tauber, 2017, p. 2). However, increasing evidence from experimental biology nowadays prompts us to believe that "the functional difference that determines recognition of the foreign results from an aggregate of quantitative affinity difference, the context in which the antigen is seen, and the degree of interruption in network dynamics induced by such an antigen" (Tauber, 2017, p. 78). Immunity is not about the defence of a predetermined self, but rather about establishing and upkeeping this everchanging self throughout development. Immunology deals more with how the organism's identity is maintained through constant change rather than with how to preserve the distinction between self and nonself.

6.2 Immunity and Symbiosis

By adopting Tauber's perspective, we may appreciate how the concept of symbiosis becomes increasingly relevant to understanding how the immune system works. As shown by the seminal research carried out by the biologist Lynn Margulis (1991), symbiosis is a fundamental evolutionary and developmental dynamic. Margulis maintains that organisms should be regarded as holobionts, i.e., symbiotic complexes of different organisms from different species physically and functionally associated throughout their life histories. The appreciation of this neglected phenomenon, in turn, disrupts the central tenets of several subfields of traditional biology, including the self-nonself distinction pivotal to immunology.

As pointed out by Scott Gilbert and his collaborators (2012), biology traditionally focuses on the study of individuals, conceived of as autonomous entities competing with each other and thereby constituting the units of selection—initially understood as organisms, then as cells and lastly as genes. Thanks to the insights developed, starting from the second half of the nineteenth century, by the ecological approaches to biology, however, the idea of organic systems integrating different individuals into an environment starts questioning this view. Nowadays, the all-pervasiveness of symbiosis in life is increasingly acknowledged, thereby challenging the current conceptions of biological individuality.

Gilbert and his collaborators contend that biological individuality does not hold anatomically, insofar as animals can only live thanks to their interactions with complexes of bacterial symbionts, for instance. It does not hold developmentally, insofar as the ontogenesis of some organs is triggered by the interrelations of the host organism with its microbial symbionts. Specifically, in mammals the microbes colonize the guts as soon as the amnion breaks and develop concomitantly with postnatal parental interactions. Conceiving of organisms as autonomous individuals does not hold physiologically either, insofar as our metabolism and life processes co-constitute through multispecies relations. It does not hold genetically, insofar as microbial symbionts form a second kind of genetic inheritance since they are not passed on through the combination of the parents' genomes during reproduction but are rather acquired by mammals during the crossing of the maternal reproductive tract at birth and early postnatal parental interactions. Hence, every holobiont has multiple genomes that all together contribute to selective fitness. Not even evolutionarily can we be conceived of as individuals, insofar as the unit of selection should be considered the whole holobiont and not the single organisms composing it. The host and its microbial symbionts reciprocally contribute to enhancing their fitness and managing their physiology, surviving and thriving only thanks to their cooperation.

Finally, the ecological approach grounded on a symbiotic conception of the organism prompts us to reject the idea of biological individuality also immunologically, insofar as our immune system is partly produced and activated by the symbiotic microbiome. The immune system plays a major role in administering the different components of the holobiont and holding them together as a functional whole. Reciprocally, immune processes are also fundamental to the development of symbioses because the inter-organismal immune system mediates the relationship between the different organisms composing the holobiont, welcoming some and excluding others and learning throughout its development to operate according to varying degrees of recognition and tolerance.

From this viewpoint, we may appreciate how the traditional idea of the immune self is biased because it inadvertently reproduces the old conception of the individual as an autonomous agent eminently purported by western metaphysics. This traditional approach is reductionist, insofar as it conceives of organisms starting from a pathological attitude seeking to defend the attacked individual from external diseases, thereby presupposing the self-nonself distinction as an originary given. As summarized by Tauber, "symbiosis fundamentally revises the conception of the immune system from its earlier unifocus on host defense to one in which the promotion of cooperative relationships is fostered" (Tauber, 2017, p. 104).

6.3 Immunology Beyond Biology

This overview of the metamorphoses of the conception of the immune system should not only enable us to appreciate the transformations this concept undergoes concomitantly with the development of immunology but also prompt us to consider the mutual influence of biological and sociological understandings of immunity. As submitted by David Napier (2012), biomedical debates in immunology often overlook that the concept of biological identity hinges upon an understanding of the self as a predefined, persistent and autonomous entity. These accounts submit that the self must preserve its identity by defending itself from the attacks carried out by the nonself, which the immune system should recognize and consequently eliminate. This conception of individual identity, Napier argues, is historically determined and belongs to western metaphysical thinking, while actual immune responses are more complex and nuanced, thereby resisting the attempts to frame them within this traditional understanding. Hence, research in immunology may help us reconsider our culturally inherited definition of selfhood, possibly bringing it closer to conceptions coming from other, non-western cultures, where encounters and exchanges with the nonself are regarded as constitutive to a processual and everchanging definition of the self.

Thus, the biomedical immunological discourse, developed by modern western science, often inadvertently and uncritically reproduces older metaphysical conceptions of selfhood and identity. Moreover, as maintained by Emily Martin (1990), immunology reiterates in its theoretical structure, in both scholarly and popular accounts, the extant social differences and hierarchies of gender, class and race. Specifically, Martin points out that immune reactions are usually depicted as wars between friendly defenders (self) against hostile aggressors (nonself). Another common metaphor is that of the body as a police state administered by the immune system. Immunology grounds its distinction between self and nonself on the need for the self to ward off, control and destroy the nonself, reproducing in biomedical terms the ideology of the nation-state whose boundaries must be defended against foreign invaders. Through this imagery, in turn, immunology risks contributing to rendering social practices of violence, warfare and domination naturalized within our intimate physiology and, therefore, more socially acceptable.

Finally, as contended by Haraway in her essay “The Biopolitics of Postmodern Bodies” (1991, pp. 203–230), the biological, medical and sociological discourses about the immune system, developed during the twentieth century, are influenced by and thereby reproduce the extant system of dominance, that is capitalism as a patriarchal, classist and racist complex of power relations. Immunology is complicit with western biopolitics and reproduces its ideology on multiple layers of signification, especially concerning its fundamental distinction between self and nonself. Nonetheless, Haraway argues, the contemporary epistemic condition, triggered by the most recent technoscientific development, prompts us to question the reality and efficacy of these definitive and

unbridgeable oppositions between self and nonself, in favour of a vantage based on heterogeneous, continuously recombining fields of forces and differences, where the self may only hold validity as an always contaminated, precarious and variable entity.

I think that we should retain four main insights from the studies reviewed above. First, immunology structurally features biological, medical, juridical and sociological discourses, which mutually influence one another and thereby render their object of study, i.e., immunity in its multifarious meanings, constitutively nuanced and multidisciplinary. Secondly, biological immunity should be conceived of as a fundamentally collective phenomenon, where different organisms from different species, on the one side, symbiotically contribute to producing their immune functions and, on the other, are bound together precisely by their shared immune system. Thirdly, this multispecies organ, on the one hand, works to defend the holobiont from external aggressors and expel harmful hosts. On the other, it operates to include benign entities in the metabolism of the holobiont and manage its different components. Fourthly, the intertwinement of biological, medical, sociological and political discourses about the question of immunity converges around issues of identity and cohesion, thereby interlinking the question concerning how the social synthesis may be acquired with that of how organisms may function as wholes.

Thus, the immune system administers the organism's everchanging identity, mediating its relation to the environment as well as the relationship among its components. I will now turn to philosophical understandings of immunity in order to assess how the latter can be conceived of from an organological perspective, i.e., supplementing biological functions with technical dynamics and social norms.

6.4 Philosophies of Immunity

Before turning to what Sloterdijk terms general immunology, I will briefly outline two other major contributions to the philosophy of immunity, elaborated by Esposito in his books *Communitas* (2010) and *Immunitas* (2011) and by Derrida in his essay "Faith and Knowledge" (2001, pp. 9–100, 2002, pp. 42–101) and his book *Rogues* (2003b, 2005) respectively. As both thinkers set out to develop a general theory of immunity not restricted to the biomedical field alone, this overview should enable us to appreciate the complex interrelations between philosophy, biology and law regarding the question of immunity.

6.4.1 Esposito

Esposito aims to conceptualize immunity starting from an analysis of its opposite notion, namely community. As he points out, the term community (*communitas*) derives from the Latin word *munus*, that is a gift which is offered, differently from a gift which is received (i.e., *donus*). Thus, community,

i.e., the coming together of individuals, is neither their property nor some shared identity. It is a relation, a duty, a debt rather than a thing, i.e., the process of bestowing oneself to others, rendering our survival dependent on theirs, a constitutive gesture of giving which does not presuppose anything in return. The underside of this originary sharing, according to Esposito (2010, pp. 1–19), is the constant risk of individuals dissolving into the community. Subjects are defined by sharing the absence of something in common, i.e., by all not sharing anything with anyone. This originary absence of community, paradoxically (un)grounding our coming together, should be continuously replenished and reconstituted.

However, Esposito argues, in Ancient Roman law, immunity (*immunitas*) means to be exempted from *munera*, i.e., social obligations, thereby representing a privilege and an exception from the norm, the partial and temporary interruption of the social bond, that is an exclusion and an exemption from community. Esposito (2011) develops his enquiry into the notion of immunity starting from the juridical domain but then turns to the more recent biomedical use of the concept, which he interprets as a reactive process aiming to neutralize a potential threat not by destroying it or pushing it back, but rather by assimilating and including it in the (collective) organism:

> the immunitary mechanism presupposes the existence of the ills it is meant to counter, not only in the sense that disease makes it necessary […] but also, in even stricter terms, that the immune mechanism functions precisely through the use of what it opposes. It reproduces in a controlled form exactly what it is meant to protect us from […]: life combats what negates it through immunitary protection, not a strategy of frontal opposition but of outflanking and neutralizing. Evil must be thwarted, but not by keeping it at a distance from one's borders; rather, it is included inside them (Esposito, 2011, pp. 7–8).

Consistently with the current biological understanding of immunity, Esposito claims that immune functions are not so much about warding off the organism from external aggressors and protecting its identity as about including these potentially stressing agents in its metabolism and rendering them innocuous. This dynamic is reiterated in the social domain, where it is exemplified by the juridical system: "if violent means such as the police apparatus or even the death penalty are used to exclude violence external to the legitimate order, the legal system works by adopting the same thing it aims to protect against" (Esposito, 2011, p. 29). Paradoxically, what is dangerous for life—Esposito is referring here to both biological and social life—is dealt with by its integration into life itself. Hence, immunity and community are mutually constitutive, insofar as community needs immunity from inside in order to avoid the total dissolution of its members sharing their (absence of) a social bond.

And insofar as community needs immunity from outside in order to avoid the dissolution of its unity in the external environment.

6.4.2 Derrida

While Esposito tackles the question of immunity starting from its relation to community, Derrida adopts a different strategy and enquires into the relationship between immunity and autoimmunity. He submits two examples of what he conceives of as the mutually constitutive character of immune and autoimmune processes. First, Derrida (2001, pp. 9–100, 2002, pp. 42–101) observes that nowadays we seem to witness a resurgence of Christianity, which is manifesting itself through unprecedented dynamics, such as worldwide broadcasting via modern media technologies backed up by the capitalist, globalized socioeconomic system and related scientific practices. However, Derrida argues, these novel dynamics, despite enhancing and revamping this religious phenomenon on a global scale, also jeopardize its very essence, insofar as Roman Christianity is traditionally bound to a nation-state and people rather than a heterogeneous patchwork of globalized communities.

The analysis of this phenomenon helps Derrida outline his interpretation of the concept of autoimmunity. On the one side, Christianity could not exist nowadays without the global technoscientific apparatus. On the other, the latter structurally calls the essence of the former into question. This is what Derrida understands as an autoimmune process:

> the immunitary reaction protects the "indemnity" of the body proper in producing antibodies against foreign antigens. As for the process of auto-immunization, […] it consists for a living organism […] of protecting itself against its self-protection by destroying its own immune system (Derrida, 2001, p. 67, 2002, p. 80).

In order to survive, Christianity must constantly open itself to its other, which nevertheless endangers and risks dissolving it. Immunity as the pursuit of survival against the external environment needs to turn into autoimmunity to keep the relation to that environment at least partially open because the latter is also essential to survival: "this self-contesting attestation keeps the auto-immune community alive, which is to say, open to something other and more than itself" (Derrida, 2001, p. 79, 2002, p. 87).

Secondly, Derrida (2003b, 2005) submits that to the essence of modern, representative democracy structurally belongs the risk that the democratic process may lead to the suspension of democracy itself. Derrida takes as an example the case of Algeria, where in 1991 elections were cancelled by the military fearing that the Islamic Salvation Front would win and establish a fundamentalist regime. Derrida interprets this event as a temporary, illegal suspension of democracy in order to avoid the

risk of a permanent, legal suspension of democracy, which thereby points to the autoimmune logic of the representative system. The latter, Derrida argues, exhibits a paradoxical tension between its pretension to limitless inclusion, on the one hand, as modern democracy is ideally open to everyone, and its pretension to necessary exclusion, on the other, as there is actually always someone who is excluded from partaking in it—such as minors, foreigners or inmates, for instance. Thus, Derrida claims, one should say

> to *autoimmunize* itself […] in order to designate this strange illogical logic by which a living being can spontaneously destroy, in an autonomous fashion, the very thing within it that is supposed to protect it against the other, to immunize it against the aggressive intrusion of the other (Derrida, 2003b, p. 173, 2005, p. 123).

The process of increasing, unlimited inclusion—a constitutive tenet of democracy—is forcefully conducive to the potential inclusion, in the representative system, of those who may jeopardize the existence of the system itself. Analogously, according to Derrida (2003a), the 11 September 2001 terrorist attacks display an autoimmune logic, insofar as, for instance, the perpetrators were formerly trained by the US army and benefited from US technologies, weaponry and facilities in order to attack the US itself.

6.4.3 Criticisms

While revising some of the most prominent contemporary philosophies of immunity, Mutsaers insightfully summarizes the difference between Esposito's and Derrida's approaches: "where, for Derrida, democracy […] should be thought of in terms of autoimmunity […], for Esposito, autoimmunity is not inherent in democracy or politics as such, but rather is the pathological result of over-immunisation" (Mutsaers, 2016, p. 110). While Esposito regards immunity as constitutive of community, Derrida understands autoimmunity as constitutive of immunity. However, one could also argue that the upshot of these two interpretations is quite analogous.

Indeed, both thinkers submit that the "immunization" of a community, i.e., its defence against external aggressors, should not amount to a total closure because exchanges with external entities are as necessary for that community's survival as is protection from them. An external entity may or may not be dangerous for a community based on many different factors, concerning that particular entity, that particular community and, most importantly, the context and the modalities of their encounter. Hence, it is impossible to certainly and aprioristically determine whether an encounter with an external entity will be beneficial, neutral or detrimental for a community. Biologically, an overreactive immune system may erroneously regard as dangerous for the organism something which

would not normally harm it, thereby releasing an immune reaction which, in turn, may paradoxically endanger the organism that the immune system seeks to protect—as is the case with allergies, for instance. Esposito and Derrida contend that the maintenance of the boundaries necessary to hold a community together must also relate to those instances jeopardizing these boundaries. Thus, social synthesis is acquired by introducing into "society" those dynamics which may endanger the social synthesis itself.

Nonetheless, I think that Mutsaers (2016, pp. 111–116) is right when she contends that, despite their insightful political reflections, ultimately both Esposito's and Derrida's approaches need revision for their conception of immunity to be consistent with the state of the art of biomedical immunology. On the one side, Esposito is right in highlighting a correlation between immunization and autoimmunity. The manifestation of autoimmune adverse reactions following vaccinations indeed obtains—although these reactions are usually rare and mild and this correlation demands further investigation to be confirmed. However, these reactions seem to be due more to converging dynamics, such as genetical predisposition, environmental factors and the side-effects of vaccine adjuvants (Vadalà et al., 2017), than to some rather obscure "excess" in immunization, which Esposito understands as a transversal contemporary tendency. Either way, it may be interesting to note how vaccinations also serve to prevent the emergence of autoimmune reactions, insofar as some autoimmune pathologies are triggered by infectious diseases, which immunizations seek to prevent. Hence, while preventing the development of an autoimmune disease, a vaccination may trigger the emergence of another autoimmune disease.

On the other, Derrida seems to erroneously understand autoimmunity as the immune system reverting against itself and destroying its own immune defences. However, (pathological) autoimmunity rather refers to a malfunction of the immune system, which fails to recognize some components of its organism as part of it and, therefore, releases an immune reaction against them, and not to the immune system attacking itself. The latter condition could possibly resemble more to immunodeficiency, which concerns congenital or acquired decreased immune functions in an organism. Notably, the pathologies relating to these phenomena may be as different as celiac disease and AIDS respectively.

6.5 General Immunology

Sloterdijk develops his general immunology mainly in the three volumes of *Spheres*, *Bubbles* (1998b, 2011b), *Globes* (1999, 2014c) and *Foams* (2004, 2016b), and further elaborates on it in *You Must Change Your Life* (2009a, 2012b). According to Sloterdijk (2004, pp. 192–196, 2016b, pp. 179–183), immunology represents the fundamental epistemic paradigm of our epoch and should not be restricted

to the biomedical field alone, as its emergence corresponds to the increasing explicitness of the constructed and consequently also destructible character of our living conditions:

> I push the concept of immunity so far that it can include the treatment of insurance techniques, as well as juridical, therapeutic, medical, and biological life-insuring systems [*Lebenssicherungssysteme*]. On top of this, I should mention the semantic, imaginary and poetical constructs for immunity. I bring bio-immunity, techno-immunity as well as political, legal, and religious services of immunity under umbrella concepts and submit them to a common function of analysis (Sloterdijk, 2001a, pp. 220–221, 2011a, p. 221, trans. mod.).

Immunity is understood by Sloterdijk as a pervading and constitutive trait of human existence, encompassing its biological as well as social and technical dimensions. Three layers of immunity are singled out relative to the human lifeform:

> the human sphere contains no fewer than three immune systems, which function layered on top of one another in close collaborative interaction and functional augmentation. On top of the largely automated and independent of consciousness biological substrate, in the course of man's mental and socio-cultural evolution, two complementary systems have developed for the pre-emptive processing of injuries: first the socio-immunological methods, especially legal and solidaristic ones, but also the military ones by which people resolve their confrontations with distant and foreign aggressors and insulting or harmful neighbours; and secondly the symbolic or psycho-immunological practices on which humans have always relied to cope—with varying success—with their vulnerability through fate, including mortality, in the form of imaginary anticipations and mental armour (Sloterdijk, 2009a, p. 22, 2012b, p. 9, trans. mod.).

These three layers of immunity, Sloterdijk argues, overlap and interlink, only functioning thanks to their mutual relations. One could debate whether this differentiation should be further complicated by the introduction of other layers or whether the social and the psychical layers could be conflated into one single system, for instance. Either way, what I consider worth retaining from Sloterdijk's conceptualization is the idea that, in order to conceive of the human immune system, biological dynamics should be understood starting from their integration into and constitutive interrelation with nonbiological phenomena. Technics is operating at all three levels of immunity. Biological immunity is already supplemented with medical technologies, such as medicines or other ailments and therapeutic techniques. Social immunity is performed through institutionalized technical devices, from welfare aids to regulations governing, e.g., food preparation and various kinds of weaponry.

And psychic immunity is enacted thanks to multifarious devotional and ritual apparatuses, for instance.

Yet what exactly is an immune system, according to this enlarged understanding? Sloterdijk grounds his definition on the distinction between a personal (internal) and a foreign (external) dimension:

> while biological immunity applies to the level of the individual organism, the two social immune systems concern the supra-organismic, that is to say the co-operative, transactional, convivial dimensions of human existence: the solidaristic system guarantees legal security, provision for existence and feelings of kinship beyond one's own family; the symbolic system provides security of worldview, compensation for the certainty of death, and cross-generational constancy of norms (Sloterdijk, 2009a, pp. 709–710, 2012b, p. 449).

According to Sloterdijk, immune systems regulate and preserve the distinction between what concerns us and should consequently be taken into account, on the one hand, and what does not concern us and should consequently be left unattended, on the other.

Thus, despite some hesitations, highlighted by Mutsaers (2016, pp. 75–93), consistently with the biological interpretation of the immune system outlined above in the wake of Tauber's analyses, Sloterdijk seems aware that immunity is not only or mainly about the elimination of external aggressors or the protection of a predefined identity. The immune system rather operates in order to recognize what is relevant for the organism's survival and should be consequently handled according to different levels of intervention, ranging from neutralization to incorporation and active tolerance, while what is not perceived as relevant for survival will be simply ignored.

Hence, contrary to what is submitted by Antonio Lucci (2021) or Thomas Sutherland (2017), for instance, I think that the relation to exteriority is not understood by Sloterdijk in purely negative, instrumental and solipsistic terms, but is rather constitutive of the process of collective individuation. As pointed out by Sloterdijk, "through immune systems, learning bodies incorporate their regularly recurring stressors into themselves" (Sloterdijk, 2004, p. 449, 2016b, p. 418). Immune systems learn from experience to deal with potentially stressing phenomena by integrating them into our explicitly managed conditions of existence: "immunity implies a preventive power against the harmful power—it interiorizes what it seeks to protect itself from" (Sloterdijk, 2004, p. 538, 2016b, p. 502, trans. mod.). Furthermore, with reference to his analyses of the foetus-placenta dyad, discussed in Chapter 4, Sloterdijk observes that "compared to the individual, the couple constitutes the more real unit—which simultaneously means that we-immunity embodies a deeper phenomenon than I-immunity"

(Sloterdijk, 2004, p. 13, 2016b, p. 14). From the outset, immunity should be conceived of as a multipolar, collective phenomenon, both phylogenetically and ontogenetically.

However, one could argue that Sloterdijk is wrong when he submits that only human social and psychic layers of immunity—contrary to the biological layer and to what is supposed to be the case with nonhuman animals—are structurally collective. As discussed above relative to the pervasiveness of symbiosis in life, immunity is a collective process in all animals even if understood in solely biological terms. Not only organisms should be conceived of as multispecies symbiotic complexes (i.e., holobionts), but immunity itself is performed by this interspecies relation, which it contributes to producing in return. All layers of immunity in all animals are constitutively collective and the only difference lies in the supplementation of biological immunity with technical means in the case of (at least) the human lifeform.

Admittedly, as maintained by Mutsaers (2016, pp. 124–125), this amendment would render, in turn, fairly redundant Sloterdijk's concept of co-immunity, which I will discuss below. Anyway, the emerging operability occurring in the translation of external phenomena into internal ones, Sloterdijk argues, constitutes both the scope and the limits of technics:

> the assumption underlying my undertaking is a metabiological proposition: What we call technology rests on the attempt to replace implicit biological and social immune systems with explicit social immune systems. You need to understand what you want to replace better than a mere user understands it. If you wish to build a prosthetic, you have to be able to define the function of the organ to be replaced more precisely than if you use the original (Sloterdijk, 2009b).

In order to perform bio-socio-technical transindividuation and thereby yield anthropogenesis, biological immune functions should be transferred and reproduced into nonbiological immune functions, supplementing biology with technics. Artificialization works differently from simple utilization, insofar as it requires the knowledge about how to produce, maintain and transmit the organic function which needs to be technically supplemented. According to Sloterdijk, "we only prostheticize what we have understood sufficiently explicitly" (Sloterdijk, 2004, p. 204, 2016b, p. 190). As discussed in Chapter 2, technics is neither "natural" nor "cultural" or "social". It is the transformative process of functional transfer that renders what is inadvertently given for granted something operable, producible and thematically transmissible. From Sloterdijk's perspective, immunity amounts to "distinguishing between protected and unprotected spheres" (Sloterdijk, 1999, p. 205, 2014c, p. 194): potentially stressing agents are taken into account by the community and thereby rendered manageable and integrated into its conditions of existence.

6.6 Second-Order Self-Domestication

Sloterdijk locates a major challenge to the human immune strategy in the current global crisis elicited by the combination of accomplished globalization and overexploitation of limited resources. As outlined above, according to him, human immunity is always co-immunity, i.e., it concerns the whole group rather than the single individual. As contended by Luigi Cavalli-Sforza and Marcus Feldman (1973), indeed, human cultural evolution occurs as group evolution, dampening down within-group phenotypic variation, since also nonrelatives, through the transmission of sociocultural devices and shared norms, contribute to bequeathing to the offspring information essential for their fitness. This condition may lead to an evolutionary trajectory in which groups and not individuals are the units of selection and, therefore, thrive or perish as wholes. Technics thereby enhances the interdependence among groupmates, who must all contribute to establishing their shared living conditions, as well as the competition and differentiation among different groups, whose defining traits are elaborated and transmitted by sociocultural means (Sterelny, 2012, pp. 173–178).

However, Sloterdijk (2009a, pp. 707–714, 2012b, pp. 447–452) argues, every historical configuration of co-immunity has always only been partial because it is formatted based on tribal, national or international, but never global scales. Sloterdijk claims that there is no global immune system, i.e., there are yet no immune procedures taking into account every human (and nonhuman) instance. Immune systems have hitherto always worked "following a logic that repeatedly turns the immune gains of some into the immune losses of others" (Sloterdijk, 2009a, p. 712, 2012b, p. 450).

Pharmacologically, a group of individuals, in order to pursue its immunity, i.e., preserving the differential between given for granted and ignored living conditions, on the one side, and taken into account and taken care of rules of life, on the other, thereby administering and protecting the survival of its members, needs to exclude at least some instances from its functioning, disregarding them and leaving them unattended. However, this historical dynamic is currently short-circuited by the attainment of structural planetary boundaries:

> all history is the history of immune system battles. It is identical to the history of protectionism and externalization. Protection always refers to a local self, and externalization to an anonymous environment for which no one takes responsibility. This history spans the period of human evolution in which the victories of the own could only be bought with the defeat of the foreign […]. Because "global society" has reached its limit, however, and shown once and for all that the earth, with its fragile atmospheric and biospheric systems, is the limited shared site of human operations, the praxis of externalization comes up against an absolute boundary. From there on, […] whoever continues along the line of previous separations between the own and the foreign produces immune losses not only for others, but also for themselves. The history of

> the own that is grasped on too small a scale and the foreign that is treated too badly reaches an end at the moment when a global co-immunity structure is born, with a respectful inclusion of individual cultures, particular interests and local solidarities. This structure would take on planetary dimensions at the moment when the earth […] was conceived as the own, and the previously dominant exploitative excess as the foreign (Sloterdijk, 2009a, pp. 712–713, 2012b, p. 451).

Starting from this perspective, Sloterdijk (1993, pp. 376–381) calls for a translation into operational and pragmatic terms of the ancient religious and philosophical doctrines of cosmopolitanism. Pharmacologically, bio-socio-technical immunity must always leave something aside, i.e., it can never include the whole of our conditions of existence in its domain of operativity, since it must limit itself to what can be technically reproduced, which in turn always presupposes something that is given for granted and lingers in the background.

At first sight, Sloterdijk's general immunology may seem incompatible with his call for a global co-immunity, i.e., a tendentially all-encompassing immune system. Indeed, Sloterdijk (1999, pp. 465–581, 2014c, pp. 441–552) identifies in such a contradictory immunological pretension the failure of traditional western metaphysics. Onto-theo-logy attempted to include the whole of beings in its immunizing performance, without acknowledging the structural finitude of every immune system, i.e., its need to always exclude something in order to preserve the identity of what it seeks to protect. However, we may easily notice how Sloterdijk does not advocate for the effacement of every distinction between the external and the internal dimension, i.e., what should be taken into account and taken care of and what should be ignored and excluded.

In a double pharmacological twist, Sloterdijk identifies what should be excluded from collective immunity precisely with the traditional immunological strategy to only perform inclusion at the expense of exclusion. Overexploitation of finite resources, which I have discussed as the cheapening of nature in the wake of Jason Moore's analyses in Chapter 2, should be regarded as what needs to be abandoned, while ecologically regulated coexistence between different human and nonhuman instances should be regarded as what needs to be included in the global patchwork of communities. According to Sloterdijk, the key to co-immunity is combining different immunological instances in a global immune system, without attempting, in turn, to reduce these different instances to one single, overarching immune process.

Sloterdijk submits that this transition from traditional immunity to global co-immunity may only occur as a transition in the way we conceive of and perform technics. According to Sloterdijk (2001b, pp. 212–230, 2016a, pp. 133–146), technics has traditionally always or almost always been what he terms allotechnics, i.e., the imposition of extrinsic goals to natural processes, thereby conceiving of

materials as generic, servile and inert matter. Technics to come is termed homeotechnics, which is "a non-domineering form of operativity" (Sloterdijk, 2001b, p. 227, 2016a, p. 144) and should utilize materials according to their intrinsic potentials, thereby emulating and cooperating with biological processes. Allotechnics is based on a monovalent ontology and bivalent logic, while homeotechnics rests upon a multivalent and paraconsistent conception of beings and truth, where the supposedly sovereign and active mind is not opposed to the supposedly submissive and inert matter anymore: "in the traditional concept of matter it is assumed that, on the basis of its resistant and minimal qualities, it will only be used heteronomously" (Sloterdijk, 2001b, p. 226, 2016a, p. 143).

As claimed by Sloterdijk (2001a, pp. 328–332, 2011a, pp. 326–330), allotechnics manifests itself as a break with natural processes, that is their simplification and consequent violent domination, while homeotechnics amounts to a novel understanding of the relationship between humans and their (multispecies and artefactual) environment based on intermingling and cooperation. Admittedly, Sloterdijk's conceptualization of homeotechnics risks remaining overly vague and unduly optimistic (van der Hout, 2014). However, it is noteworthy to point out, in this regard, that this transition towards another configuration of technics, in turn, is rendered possible by the constitutive ambiguity of technics itself, whose essence is not given once and for all but rather coevolves with our lifeform (Lucci, 2013).

According to Sloterdijk, concomitantly with this epochal shift in our performance and conception of technics, global co-immunity can only be reached through a scaling-up of the process of self-domestication which he deems pivotal to anthropogenesis, as discussed in Chapter 3. In his essay "From the Domestication of the Human Being to the Civilizing of Cultures" (2016c, pp. 44–59, 2018, pp. 24–34), Sloterdijk submits that, while humans are organisms self-domesticated through sociocultural practices (i.e., anthropotechnics), human communities are not themselves "domesticated". This condition obtains because through self-domestication evolutionary competition shifts from the individual to the collective dimension and cooperation among different groupmates corresponds to warlike behaviours between different groups: "war is the limit situation of domesticated units that simultaneously forms the fundamentally non-domesticated situation between foreign units" (Sloterdijk, 2016c, p. 52, 2018, p. 29, trans. mod.).

In order to exist, groups have to produce domestic, friendly dynamics within them and polemic, hostile dynamics outside and between them: "cultures are to be understood as systems of domestication that are not themselves domesticated" (Sloterdijk, 2016c, p. 55, 2018, p. 31). And in order to face up against the current global crisis, Sloterdijk argues, a second-order self-domestication is required, i.e., a process pursuing the self-domestication of groups rather than individuals, thereby attaining cooperation and coexistence on a global scale.

According to Sloterdijk, human groups should be conceived of as "psycho-political bodies of suggestion that have the character of artificial stress communities"[36] (Sloterdijk, 1998a, p. 44, my translation). Sociocultural identity is acquired as a performative illusion, where the members of a community persuade themselves of their co-belonging through the iteration of self-fulfilling narratives of the origin, where the narration of a fictive, shared past is projected towards the future and retroactively grounds and allows for joint actions. Concurrently, Sloterdijk (2011c, 2015) argues, the readiness to undertake collective endeavours is enabled by the elicitation of waves of shared stress, enacted and spread by the available (technical) media. These stressors performing the social synthesis are identified with a real or fictive external enemy, against which groupmates unite in order to pursue their survival.

Sloterdijk here takes inspiration, first, from jurist Carl Schmitt's (1932, 2007) well-known analyses concerning the friend-enemy opposition as the source of political unity and his related definition of the sovereign power as that instance capable of deciding over the state of exception, i.e., when the suspension of the extant norms should occur and how it should be handled (Schmitt, 1934, 2004). Secondly, Sloterdijk (2004, pp. 412–427, 2016b, pp. 384–398) submits his proposition by building on German philosopher Heiner Mühlmann's Maximal Stress Cooperation theory (MSC), as he develops it in his book *The Nature of Cultures* (2011). According to Mühlmann, communities "produce inner-cultural harmony through outer-cultural conflicts"[37] (Mühlmann, 2002, p. 43, my translation). Friendly intracultural dynamics can only be acquired at the expense of the production of hostile intercultural dynamics, eminently exemplified by wars. From this perspective, the social synthesis can only be attained by stressing the members of a community about potential or actual threats by external aggressors. Once again, we may appreciate how Sloterdijk's general immunology considers how the production of a differential between internal and external living conditions is necessary to attain and upkeep social cohesion.

6.7 Pharmacology of Immunity

In light of the above, I now wish to point to two main consequences of Sloterdijk's general immunology, which I think may render evident how his theory abides by the main tenets of Stiegler's pharmacological approach, outlined in Chapter 2. First, according to Sloterdijk, while human immunity occurs as the supplementation of biological immune processes with nonbiological, that is social and technological immune processes, increasingly insulating hominin populations from their surrounding environment, this condition does not exclusively amount to increased safety and

[36] "Psycho-politische Suggestionskörper, die den Charakter von artifiziellen Stressgemeinschaften haben".
[37] "Erzeugen innerkulturelle Harmonie durch außenkulturelle Konflikte".

resistance to stress: “humans—because they are inner world creatures for whom endoclimatic nest building precedes all other constructions—run a greater risk than any other species of having their wall-less inner worlds destroyed by irruptions from without or endogenous conflicts” (Sloterdijk, 1999, p. 152, 2014c, p. 143). Since the human environment is artificialized, insulated and constructible, it is also extremely sophisticated and fragile.

Hence, the evolutionary trade-off of our pampered living conditions is our enhanced vulnerability to all sorts of stressors in case our immune systems break down or fail to activate. In this sense, the underside of increased protection is increased dependence on our own protective devices, which need to be collectively and actively produced, maintained and administered. This condition, in turn, pharmacologically calls for increased artificialization and, therefore, increased dependence and so on. Without our multi-layered, technically structured immune systems we would be helpless against intrusions from the exterior: “even highly insulated groups stand continually under external pressure; indeed, they create because of their internal refinement a high differential with the outside and, when in crisis, come under increased tension” (Sloterdijk, 2001b, p. 207, 2016a, p. 130, trans. mod.). As discussed in Chapter 3, older, exogenous selection pressures are not eliminated during the process of anthropogenesis but are rather repurposed and transformed into novel kinds of pressures, peculiar to the artificialized environment and to the need to maintain it in order to survive.

Secondly, Sloterdijk’s (2004, pp. 196–207, 2016b, pp. 183–192) conception of immunity features an intrinsic pharmacological dimension. New knowledge, i.e., operational knowhow and practices of environmental modification, usually enhances our immunity, providing us with novel means to orient ourselves in the world and navigate its difficulties. However, it may also lead to shattering our established understanding of existence, disrupting the meaning we confer to the world and consequently jeopardizing our perception of safety. These are the immune and the autoimmune functions of intellect respectively, according to Sloterdijk (1986, pp. 72–104, 1989b, pp. 33–49), who notes that they are initially theorized by Nietzsche who, in writings such as “On Truth and Lie in an Extra-Moral Sense” (1988b, pp. 875–890), gains the “insight into the existential inevitability of the lie” (Sloterdijk, 1986, p. 80, 1989b, p. 37).

Nietzsche submits that the intellect’s sole function is to pursue life and that there is nothing transcending or exceeding this vital drive. Humans craft systems of illusions to confer meaning to their lives and stand the otherwise destructive senselessness of existence. We forget that these constructions are illusory because they become dominant in our sociocultural milieu and, therefore, are collectively considered incontrovertible truths. However, Nietzsche argues, our intellect may also revert against itself and debunk the illusory character of truth. If this is the case, it is not beneficial to life—contrary to when it is crafting reassuring illusions—but is rather detrimental to our own

existence, insofar as it exposes us to the groundlessness of our knowledge about the world and to the meaninglessness of life.

For instance, what Nietzsche defines as the "Death of God" in his book *The Joyful Science* (1988d, pp. 480–482, 2023, pp. 128–130), i.e., the secularization of European societies starting from the Enlightenment and the consequent forsaking of the Christian worldview, on the one hand, was supposed to free people from obscurantist prejudices and thereby enhance scientific rationality as a new way to investigate and act upon the world. On the other, however, it also rendered us more insecure about the meaning we should confer to our existence and more helpless relative to how we should justify and account for suffering and inequalities. Sloterdijk extensively comments on Nietzsche's insights in his paper "Living Hot, Thinking Coldly" (2000, 2007):

> after Nietzsche, the theory of truth […] transforms itself into an element of an expanded metabiological reflection. […] "Truth" is understood as a function of vital systems that serves in their orientation in the "world" and their cultural, motivational, and communicational autoprogramming. […] One would say that the truths (which I shall term "first-order") are symbolic immune systems. Lives are condemned to perform a permanent effort of raising their morpho-immune shields against the microbiological invasions and semantic lesions […] to which they are exposed. […] Nietzsche […] advances into a region where he discovers (second-order) truths, the effect of which is indifferent to the vital interests of human beings or, worse, which is directly opposed to those interests. […] The meta-immune or contra-immune function of the (second-order) truth consequently triggers an internal crisis in the human beings who have ventured too far into these forms of knowledge that transcend life or are definitively harmful to life. […] We think to immunize ourselves […]. We destroy (or transcend) our mental immune system when we think (Sloterdijk, 2000, pp. 76–79, 2007, pp. 316–318).

According to Sloterdijk's interpretation of Nietzsche's theory of truth, human cognition's immune and autoimmune characters pharmacologically combine (Consoli, 2012). After the autoimmune debunking of established truths and precisely thanks to the operational insights brought about by this new knowledge revising the former notions, the restoration of a system of shared beliefs concerning our place in the world must occur, for existence to be borne. New knowledge, therefore, needs to be more sophisticated and elaborate in order to be up to the former autoimmunization. This knowledge, however, may also undergo autoimmune deconstruction in turn, consequently calling for the establishment of further orders of meaning and so on.

In his essay "Wounded by Machines" (2001b, pp. 338–366, 2016a, pp. 217–236), Sloterdijk connects this autoimmune logic with contemporary technoscientific development. Aiming to expand

on the concept of narcissistic offence developed by Freud in his paper "A Difficulty in the Path of Psycho-Analysis" (1947, pp. 3–12, 1955, pp. 137–144), Sloterdijk submits that some advances in science and technology, such as the neuroscientific insights into the foundations of cognition, may jeopardize our anthropocentric narcissism by relativizing our place in the world and downplaying the alleged uniqueness and exceptionality of our faculties. Thus, while technoscientific development is usually deemed to improve our living conditions, it may also render us more insecure about what it means to be humans.

Starting from these remarks, we can appreciate how, first, the production of new knowledge is enabled and constrained by the available technical system, which articulates how we experience and organize the world, as discussed in Chapter 1. Secondly, as I will now turn to discuss, Sloterdijk's immunology underscores the performative (i.e., immune and autoimmune) character of scientific practice. Indeed, by elaborating self-representations, i.e., questioning what it means to be humans in a given episteme, we articulate the domain of operativity we deem suitable for our community. The ethical and political decisions concerning our anthropotechnics, i.e., which kinds of technical interventions on ourselves we wish to welcome and which ones we wish to reject, depend on the particular understanding of the human lifeform prevailing in a given community. This understanding, in turn, is anthropotechnically propagated by pedagogical systems and organologically governed by the laws and norms presiding over the adoptions of our artefacts.

CHAPTER 7

THE GENEALOGICAL METHOD AND THE TECHNICAL MANIFESTATION OF SCIENTIFIC PHENOMENA

In the analyses carried out above, I have enquired into the relationship between humans and technics in the broadest and most general sense, i.e., how all kinds of artefacts contribute to constituting our lifeform as a whole. I now aim to carry out a symmetric operation by reviewing how particular techniques and technologies, namely those concerning scientific practice, especially evolutionary anthropology, contribute to constituting a particular human faculty, that is our capability to reconstruct our own origin and thereby account for our present condition. I thereby set out to account for my own account, i.e., thematizing the conditions of (im)possibility of this research inasmuch as it is an operation carried out by a human subject through artefacts. I will show how, on the one hand, technics enables this operation, i.e., our capability to investigate and account for our origin may only emerge thanks to our relation to artefacts. On the other, technics constrains this operation, i.e., this attempt's proceedings and outcomes may change based on the available technical system.

First, I will criticize Stiegler's concept of mnemotechnics, i.e., technologies produced to thematically store memory, and amend it through recourse to the concept of cultural techniques, i.e., technical practices endowed with the capability to perform their self-representation. I will thereby submit that, thanks to their cultural techniques, hominin populations may evolve the capability to represent themselves as humans and, therefore, recognize themselves in their ancestors. Secondly, I will discuss the method underlying this research, namely genealogy, the methodology of analysis inspired by Michel Foucault's interpretation of Friedrich Nietzsche's work. Enabled by self-representing, cultural techniques, the genealogical method allows for the reconstruction of human origins inasmuch they are our own origins, i.e., by accounting for our evolutionary origin we also account for the origin of our capability to account for our origin.

I will emphasize how both Sloterdijk and Stiegler adopt the genealogical method by critically appropriating Martin Heidegger's concept of being-in-the-world and I will outline genealogy's main features, i.e., the constitutive inclusion of the one who carries out the genealogical reconstruction in this reconstruction itself; the genealogist's explicit situatedness, which makes evident the biases and constraints every reconstructive operation entails; the genealogical account's recursive performativity, which upsets our current beliefs about the phenomenon we set out to investigate and thereby contributes to revising it. Thirdly, I will refer to research in the philosophy of science, Science and Technology Studies (STS) and postphenomenology in order to underscore and illustrate how scientific phenomena are not exempted by the perspectival character rendered explicit by genealogy

and technics plays a pivotal role in their manifestation, both enabling and constraining it. These insights coming from scientific fields such as Science and Technology Studies will enable me to appreciate the embodied, situated and technically mediated character of human cognition and criticize conceptions of scientific knowledge as an impersonal and unbiased "sight from nowhere", including concerning the philosophy of technology itself.

7.1 Mnemotechnics

Stiegler claims that, although technics is co-emergent with anthropogenesis, a particular organization of technics, termed mnemotechnics, would only appear later on in human evolution. Mnemotechnics is defined by its aim, which is thematically storing memory: some tracks

> are produced with entirely different ends from the conservation of memory […]. Nonetheless, they transmit it spontaneously […]. Other traces—other objects—*are* however dedicated to the transmission of memory […]. I have been asserting throughout this discussion that *technics* is before all else a memory support […]. But not all technics is for all that *mnemo*-technics […]. This means that technical systems preceded mnemotechnical systems, and that the latter must not be confused with the former (Stiegler, 2018a, p. 739, 2010d, p. 131, trans. mod.).

According to Stiegler, artefacts are exteriorized mnestic supports. However, some particular technologies would be thematically devoted to preserving and transmitting memory. All tertiary memory would do this, but this is not necessarily the purpose for which it is produced: it does it somehow inadvertently and collaterally.

Stiegler (2004, p. 83, 2017c, p. 71) also calls mnemotechnics hypomnestic tertiary retentions, with reference to Foucault's analyses (Stiegler, 2004, p. 82, 2017c, p. 70). In his essay "Self Writing" (1994b, pp. 415–430, 1997, pp. 207–222), Foucault describes the actual *hypomnemata*, i.e., annotated notebooks drawn up for personal use in Ancient Greece, featuring both traditional quotations and personal reflections, consulted in order to meditate and stimulate rationality through daily exercises of reading and writing. According to Foucault, *hypomnemata*, as "memory aids" (Foucault, 1994b, p. 418, 1997, p. 209), are not meant to occasionally compensate for the fallibility of individual memory, but rather require being "deeply lodged in the soul" (Foucault, 1994b, p. 419, 1997, p. 210), constantly referred to in order to perform subjectivation by combining the authority of inherited, shared knowledge with the singular contextuality of a given occurrence.

Stiegler attributes to Foucault's insights a heuristic value for understanding the general phenomenon of mnemotechnics. According to Stiegler (2004, pp. 60–61, 2017c, pp. 58–59), mnemotechnics would appear in the Upper Palaeolithic, that is around 50 thousand years ago, and is

exemplified by the first cave and body paintings. Its emergence would correspond to that of what Stiegler (2013a, p. 343, 2015b, p. 136), inspired by the French philosopher Sylvain Auroux (1994), terms grammatization, i.e., "the possibility of encoding something other than in the code where it is already encoded, especially mental processes"[38] (Stiegler, 2008a, p. 114, my translation). Stiegler expands on Auroux's contribution, which limits grammatization to language and writing alone, extending its meaning to "the process through which the flows and continuities which wave our existences are *discretized*" (Stiegler, 2009b, p. 47, 2010b, p. 31).

Thus, from Stiegler's (2008c, p. 263, 2010c, pp. 146–147) perspective, grammatization concerns not only discursive knowledge but also bodies, gestures and behaviours, providing standardization and synchronization as well as differentiation and specialization in a community. As an example of grammatization, one may evoke, for instance, disciplinary power, famously analysed by Foucault in his book *Discipline and Punish* (1975, pp. 137–229, 1995, pp. 135–228). This apparatus, i.e., a historical concretion manifesting itself "at the intersection of power relations and relations of knowledge" (Agamben, 2009b, p. 3), is applied during European modernity in order to produce certain types of bodies, by segmenting, discretizing and evening out gestures and behaviours in order to render them docile and controllable through dedicated techniques, institutions and tools. Hence, mnemotechnics ranges from cave and body paintings to the first systems of writing and numbering, alphabetic writing, analogical technologies of reproduction such as photography and cinematography and digital technologies eventually. Stiegler (2013a, pp. 87–96, 2014, pp. 53–59) claims that each of these technological developments represents a new stage of the process of grammatization and implements new structures of coordination and control.

I think that Stiegler's distinction between technics and mnemotechnics presents some problems. First, the concept of grammatization, which is deemed to correspond to the emergence of mnemotechnics as the possibility of reinscribing biological processes into nonbiological media, seems applicable to artefacts in general and also to those appearing before Upper Palaeolithic cave paintings. Secondly, the very distinction of mnemotechnics from technics in general does not seem straightforward. If we understand the former as what is produced with the aim of storing memory, I believe, we risk relying on some inner intention alone in order to conceptualize its special status, thereby underestimating artefacts as what triggers and enables the possibility for humans of anticipating and inventing. Thirdly, it is debatable, for instance, whether cave paintings were actually made in order to store and transmit memory or whether body painting did not occur also earlier than the Upper Palaeolithic.

[38] "La possibilité d'encoder quelque chose autrement que dans le code où cela est déjà encodé, en particulier les processus mentaux".

This ambiguity seems particularly evident relative to Stiegler's (1998a) confrontation with Leroi-Gourhan. According to Stiegler, while technics in general would enable the transmission of "experience related to motor and survival behaviours"[39] (Stiegler, 1998a, p. 193, my translation), mnemotechnics would concern the transmission of "properly symbolic contents and even arguments"[40] (Stiegler, 1998a, p. 193, my translation). And while Stiegler concedes that technics in general always transmits memory, he also submits that "memory that is conserved in this way is gestural, not mental. It was only during the most recent periods of prehistory that mental contents began to be exteriorized" (Stiegler, 2018c, p. 89), i.e., with the emergence of mnemotechnics.

One could imagine that symbolic thinking manifests itself before mnemotechnics and that the latter only allows for its transgenerational transmission. However, coherently with his general approach, Stiegler also contends that "*the technical support of memory is here not a simple means of transmission of knowledge: it constitutes the very possibility of its elaboration*"[41] (Stiegler, 1998a, p. 194, my translation). Thus, if we submit that mnemotechnics enables the emergence of some fundamental human feature and if it is not co-originary with anthropogenesis, we risk presuming that ancient humans are not properly humans (or that ancient technics is not properly technics) and that they become fully so only afterwards, thanks to the invention of mnemotechnics, thereby reiterating the metaphysics of origin criticized in Chapter 2.

In my view, this perspective risks falling prey to a worn-out material-symbolic divide, implying that ancient technics would be bound to animal-like survival alone, while uniquely human capabilities would only emerge later on in anthropogenesis. Perhaps surprisingly, this point seems analogous to the criticism Stiegler raises against Leroi-Gourhan's approach. According to Stiegler (2018a, pp. 184–198), Leroi-Gourhan ultimately does not acknowledge technics as anthropologically constitutive, as some human features would only arise subsequently to and independently of it, following an exclusively neurological evolution. What Leroi-Gourhan calls "intelligence of a not strictly technical nature" (Leroi-Gourhan, 1964, p. 150, 2018, p. 104) is surreptitiously introduced in order to account for the emergence of symbolic language. Stiegler retorts that the manifestation of technics already accounts for the human capability of anticipative abstraction and, therefore, language is symbolic from the outset—just like even the most ancient instruments both presuppose and trigger the abstractive cognitive schemata granting their replication and reuse.

However, it is hard not to see an analogy. On the one hand, we find Stiegler's distinction between what is bound to motoric and survival behaviours and the "symbolic contents". On the other, there is

[39] "Des expériences liées à des comportements moteurs et de survie".
[40] "Proprement des contenus symboliques et même des arguments".
[41] "*Le support technique de mémoire n'est pas ici un simple moyen de transmission du savoir : il constitue la possibilité même de son élaboration*".

Leroi-Gourhan's differentiation between the activities that are "simply an extension of the general development of species" (Leroi-Gourhan, 1964, p. 152, 2018, p. 106) and those in which "thought was being applied to areas beyond that of purely vital technical motor function" (Leroi-Gourhan, 1964, p. 165, 2018, p. 115). Hence, I submit that technics is always also mnemotechnics and vice versa—although the thematic production, storage and transmission of memory often largely relies on writing systems and their techniques and technologies of reproduction. However, I also think that, by posing the question of mnemotechnics, Stiegler tackles a crucial issue regarding a genealogical enquiry into anthropogenesis as a technical process, i.e., the origin of our capability to recognize ourselves, as humans, in our ancestors.

7.2 Recognition and Representation

Starting from his theory of mnemotechnics, indeed, Stiegler (2018b, pp. 134–138) submits that anthropogenesis occurs as a processual and differential, twofold event. First, it manifests itself as the general process of exosomatization (i.e., the production of tertiary memory) taking over our evolutionary trajectory. Secondly, it occurs as the particular process of exosomatization regarding mnemotechnics, which enables knowledge to be conceived of as such, thereby allowing anthropogenesis to be reflectively conceptualized. According to Stiegler (2015a, pp. 161–164, 2017a, pp. 86–88), only thanks to the advent of mnemotechnics we would become capable, as humans, of recognizing ourselves in and identifying as humans our ancestors from the Upper Palaeolithic, which would not be the case with older hominin populations.

This viewpoint can be further articulated, I believe, by referring to the insights submitted by Mathias Gutmann (2002), who argues that we are technical organisms and we may conceive of ourselves as such only through technics. According to Gutmann, when enquiring into human origins, insofar as they are our own origins, we should perform a twofold operation. On the one side, we should reconstruct the origin of us as specimens of Homo sapiens according to our biological definition as members of this species, i.e., organisms characterized by a series of traits based on evolutionary biology's theoretical framework. On the other, we should reconstruct our origin as individuals who consider themselves humans, i.e., beings who are able to develop and account for their self-representation and thereby investigate their own origin. The capability to do science, insofar as evolutionary anthropology represents an attempt among others to enquire into our origin, belongs to the latter definition of what it means to be humans. Conversely, this capability lacks to the former definition, insofar as none of the traits or combinations of traits usually deemed to characterize us as Homo sapiens by evolutionary biology suffices to explain our capability to produce self-representations (Gutmann et al., 2010).

In the first case we set out to detect and account for the emergence of these defining traits, but their combination may not necessarily give us back something which we would consider sufficiently rich and complex for us to identify ourselves in it, while in the second case we should seek to account for the emergence of this capability of recognition itself. For instance, according to Tomasello (2014), cooperative social interaction, which he calls shared intentionality, would lead to human cognitive uniqueness. While this claim may enable us to differentiate humans from the other animals, however, it does not suffice to explain what characterizes us as humans in the here and now of this reconstructive attempt, i.e., why we feel the urge to enquire into what defines us as humans and we try to do so in this particular way, that is by doing evolutionary science. To this end, we should investigate the emergence of our lifeform starting not so much from what differentiates us from the other biological species as from what we regard as distinctive of our humanity nowadays, i.e., what we may recognize ourselves into. Thus, "when we do not distinguish between reference to humans *insofar as they are human* and to humans *as biological objects* (organisms)" (Gutmann & Weingarten, 2015, p. 2558), we fail to account for the human condition as a whole. We should rather carry out these two reconstructive operations complementarily and concomitantly.

I contend that these observations should render evident the twofold dimension of human constitutive technicity, insofar as technics is regarded as constituting both our conditions of existence and our conditions of thinkability and these two sets of conditions coevolve and mutually influence one another. As discussed above, the human lifeform may evolutionarily emerge only thanks to its relation to artefacts. Consequently, technics enables and influences our faculties and especially our cognition. Our capability to think and particularly to think about ourselves is, therefore, technically structured. This condition entails that we may develop self-representations, i.e., accounts of what it means to be humans and reconstructions of how this becoming has been possible, only thanks to technics and based on the available technical system. And yet, how have we evolved the capability to develop self-representations? In order to shed light on this phenomenon, I will now introduce the concept of cultural techniques, which I borrow from cultural science.

7.3 Cultural Techniques

As pointed out by Sybille Krämer and Horst Bredekamp (2003, 2013), the debate about cultural techniques has two main polemic targets. First, it sets out to conceive of sociocultural environments as something fluid and dynamic, an everchanging complex of techniques and technologies, against their reification as sets of inert and accomplished objects, exemplified by artworks or archaeological findings. Secondly, it aims to contrast the identification of the symbolic dimension with abstract, linguistic communication alone. Cultural techniques are deemed to exert a symbolic function while

always being embedded and material. They amount to practices such as speaking, writing, drawing, calculating, measuring, painting etc. and belong to every extant human group.

Krämer (2003), expanding on the concept of cultural techniques, singles out their four main features. First, these practices enable the ones performing them to abstract from given empirical referents, opening up a symbolic, yet technically framed domain. Secondly, as symbolic machines, they perform the exteriorization of cognitive processes onto technical media. Thirdly, they materialize and render perceivable otherwise inconceivable entities, such as infinite quantities, thereby contributing to structuring their concept. Fourthly, since their performance tends to retreat in the background and occur inadvertently, they build up an epistemic field, constituting the implicit, collective frame enabling individual, intentional cognitive operations.

Furthermore, as argued by Macho (2003), cultural techniques originate and may operate without either their explicit thematization (e.g., techniques of numbering are older than the concept of number) or the hypostatization of the abstractions they enable (e.g., time can also be measured without a concept of time). They perform temporalization and spatialization, i.e., they construct the spatial and temporal perception of the individuals who adopt them, synchronizing collective experience.

Among the scholars who elaborate on the concept of cultural techniques, I consider Macho's approach especially relevant. In his paper "Second-Order Animals" (2008, 2013b), Macho highlights how a distinctive feature of cultural techniques is their potential for self-representation, which distinguishes them from the other technical activities. One can speak about linguistic communication or depict paintings and painters and this possibility is structurally embedded in these practices from the outset. Conversely, one cannot thematize, say, hunting through hunting or weaving through weaving. To represent these practices, one needs to rely on cultural techniques:

> the term does not encompass all the techniques a culture has at its disposal, but strictly those techniques that make symbolic work possible. […] Human cultures, however, are not simply composites of these multiple techniques, but evolve out of their symbolic concentration. This symbolic work endows all other activities with their specific meaning; it gives order to the world and enables cultures to develop self-reflexive concepts. […] Cultural techniques differ from all other techniques through their potential self-referentiality, a pragmatics of recursion. […] As second-order techniques, cultural techniques have from their very beginning been operating as techniques of self-reflection, identity formation and identification. Even today, the majority of cultural techniques serve as vehicles of self-description, self-legitimation, and authentication (Macho, 2008, pp. 99–100, 2013b, pp. 30–31).

Cultural techniques enable individuals to reflect on their own making, thereby constituting their identity: “in a certain sense, they generate the subjects that, retrospectively, come to understand themselves as the preconditions and nodal points of their very operations” (Macho, 2008, p. 116, 2013b, p. 44). Consequently, they are techniques of the self in Foucault’s sense and date back at least to Upper Palaeolithic cave paintings. Moreover, as highlighted by Macho (2013a), cultural techniques are understandable as anthropotechnics in Sloterdijk’s sense, insofar as they provide both subjective individuation and disciplining automation.

Thus, I think that Stiegler’s mnemotechnics may be reinterpreted as those technologies characterized by their recursive and self-representational power. They structurally contribute to constituting subjectivity and cultural identity and overdetermine the reflection on other kinds of technologies by rendering them and their conditions of usage symbolically depictable. As inheritable artefacts, they partake in the process of transindividuation, articulating the preindividual milieu of epiphylogenesis. They are a preferred channel to transmit memory not mainly thanks to some mental aim presiding over their production and utilization, but because of their own technical nature, the materiality of their structure enabling symbolic representation, generalization and iteration. Entailed within the technical system constituting our artificial environment, they amount to the means of accessing the shared, non-lived past and conceptualizing it as what frames our identity.

Cultural techniques enable hominin populations to establish universalized meanings by making abstraction from the singular instantiations of their occurrence and reflectively dwelling upon them, i.e., considering the meaning of their meaning-making practices. Through speaking, writing, drawing etc., the explicit thematization and representation of the techniques performing this operation become possible. We become able to conceive of ourselves as those who perform self-representing techniques and conceive of these techniques as what enables, mediates and performs our relation to the world and ourselves. In sum, cultural techniques, embedded into a technical system, partaking, in turn, in an organological collective, structure our capability to question ourselves relative to our condition and elaborate accounts of what it means to be humans in a given episteme.

Hence, the self-reflection on our own condition, first and more generally, is enabled and constrained by the available technical system, which constitutes the cosmotechnics framing our episteme, i.e., how we structure experience and account for our place in the world. Secondly and more specifically, it depends on the available cultural techniques, which make it possible to render our own technical practices the thematic object of symbolic representation and thereby develop discourses about their function and meaning.

7.4 Language as Technics

I wish to further clarify the technical emergence of our capability to develop self-representations by delving into the cultural technique of language. According to Stiegler (2018a, pp. 194–198, 1998b, pp. 164–169), human language, i.e., symbolic vocalization structured by a recursive and generative syntax, is coterminous with the production of detachable, combinable and reusable instruments bearing normative and symbolic functions. From this perspective, linguistic communication and manual dexterity are co-originary. Their coevolution, in turn, elicits the rearrangement and enhancement of hominin populations' neural faculties, whose development accompanies and sustains technological and sociolinguistic evolution.

As contended by Leroi-Gourhan, anatomical, technical and neural evolution mutually imply one another: "technics and language are not two distinct typically human facts but a single mental phenomenon neurologically based on contiguous areas and expressed jointly by the body and by sounds" (Leroi-Gourhan, 1965, p. 260, 2018, p. 403). Moreover, as argued by the evolutionary psychologist Michael Corballis (2003), the hypothesis of a simultaneous emergence and functional coevolution of language and tool use becomes more plausible if we understand the early stages of human language as broadly—but not only—relying on gestural communication, supported by facial visual communication, only afterwards shifting to vocal communication proper, once the relevant changes in morphology enable this transition.

Even the simplest instances of tool use require an "actual state […] of technical consciousness" (Leroi-Gourhan, 1964, p. 134, 2018, p. 92, trans. mod.), which in turn calls for "our unique ability to transfer our memory to a social organism outside ourselves" (Leroi-Gourhan, 1965, p. 34, 2018, p. 235). The exteriorization of somatic memory onto accordingly reorganized exosomatic supports engenders the rearrangement of neural functions, which are now enacted and performed through their relation to artefacts. Reciprocally, the bestowal of organic functions on artefacts triggers the reconfiguration of hominin populations' psychophysical apparatuses, their transformation into organisms only surviving and flourishing thanks to socially transmitted technical behaviour.

Gehlen (1950, pp. 47–52, 1988, pp. 38–42) regards language and symbolic behaviour as eminent instances of unburdening, insofar as they provide humans with the opportunity to act remotely in space and time, redirecting their energies to other purposes. Complementarily, Sloterdijk highlights that "the first resources [*Mittel*] already bring primitive truth-values in their train, namely successes and failures in their deployment" (Sloterdijk, 2001b, p. 180, 2016a, p. 114). The simple acts of cutting, throwing and hitting with stones imply the opening for an originary sense of truth, perceived as the successful production of effects in organized spaces of action. Retrospectively considering the modification of a situation due to one's own technical behaviour (e.g., a target hit or missed) discloses a new way through which beings may become manifest, differently, for instance, from how biological

organisms come to life or natural phenomena occur. According to Sloterdijk (2001b, pp. 180–185, 2016a, pp. 113–117), technical behaviour, mediated by instruments and acting remotely, configures a new way to relate to the environment and appreciate its phenomena.

As submitted by Carmine Di Martino (2019b), the evolutionary emergence of language is strictly correlated with that of symbolic thinking, in a system of feedback loops starting from proto-symbolic, gestural behaviour and culminating in conventional, vocal language. Nonhuman animals such as the other great apes may recognize the ideal type of a phenomenon, i.e., perceive similar events as occurrences of the same phenomenon in different circumstances. However, symbolic behaviour does not depend on mental faculties alone, but necessarily implies language, that is the capability to exteriorize thinking as signs, which thereby makes cognition symbolic retroactively.

Differently from ideal types, signs always refer to a universalized referent, i.e., something that makes abstraction from the present circumstances and can be reapplied to other contexts and combined with other meanings, activated, in turn, by other signs. Crucially, this condition must obtain even when the signified is not concretely present, evoking its meaning in its absence. Furthermore, according to Di Martino, the linguistic sign, by being exteriorized from the individual mind, becomes shared, i.e., relating to common background knowledge. Signs are symbolic insofar as they mean the same thing to a whole community, which coherently reacts to their utterance through a codetermined behaviour.

Thus, on the one hand, language performs the exosomatization of an organic function, i.e., cognitive processes, which are reinscribed into an extrabodily medium, namely air. On the other, this exosomatization rearranges hominin populations' cognition, turning it into symbolic thinking proper. And while cognition is transformed by its exosomatization, the organ exerting this function is also transformed in the process, i.e., our brain circuitry becomes capable of exerting higher-order, symbolic behaviour (Sini, 2021). Starting from this perspective, we may appreciate how our capability to develop self-representations, which enable us, in turn, to recognize ourselves as humans in our ancestors, is technically structured. Notably, the methodology of analysis I have adopted throughout this research, that is genealogy, to which I will now turn, insofar as it operates a reconstruction of our evolutionary origin, represents a particular instance of technically enabled self-representation.

7.5 Genealogy

By genealogy I mean a reconstructive methodology, famously initiated by Nietzsche in the second treatise of *On the Genealogy of Morality* (1988c, pp. 291–337, 2014, pp. 246–285). According to Nietzsche, genealogy is a kind of historical reconstruction which emphasizes how our current conceptions of value have undergone multiple transformations from their origin to their current use.

For instance, the initial meaning of what we regard as good or bad is often very different from or even opposite of its current one. From this viewpoint, every enquiry into the origin of the values prevailing in a community also amounts to the upsetting and reinterpretation of the legitimacy of the system of values undergirding that community and, therefore, of that community itself.

In his essay "Nietzsche, Genealogy, History" (1994a, pp. 136–156, 1998, pp. 369–391), Foucault elaborates on Nietzsche's method, which he contrasts with acritical historicism and traditional metaphysics. Importantly, as pointed out by the Italian philosopher Carlo Sini (2009, pp. 63–78), genealogy can represent a corrective not only to metaphysical conceptions of history but also to the common-sensical scientism prevailing nowadays, providing researchers with critical instrumentation suitable for dealing with scientific findings without falling prey to their undue hypostatization. And as argued by Nicola Russo (2022), Nietzsche's genealogical approach is especially suitable for framing Darwinian evolutionary theory, insofar as it is historical-empirical, nonteleological and concerned with enquiring into the conditions of manifestation of a phenomenon (i.e., its origin) rather than its essence (i.e., its current function).

According to Foucault (1994a, pp. 136–156, 1998, pp. 369–391), Nietzsche's genealogy, contrary to traditional historical reconstructions, does not seek a metaphysical truth, that is atemporal, teleological and pure, as if it were an entity retaining within it right from the start the whole development of the phenomenon it originates. Investigating the genesis of a phenomenon is not about "the slow exposure of the meaning hidden in an origin" (Foucault, 1994a, p. 146, 1998, p. 378), projecting the present state backwards in order to justify and recognize it by evaluating it according to predetermined, metahistorical categories. Conversely, genealogy analyses the historical transformations of both individual truths and the general conception of what truth is. The persuasiveness of an account is determined by how the emergence of the phenomenon studied intersects with our present concerns about that phenomenon. It depends on the compliance of this explanation with our current ideas about what makes an account in general reliable, trustable and ultimately approvable, that is its correspondence with our conception of truth.

As observed by Foucault, "the search for descent is not the erecting of foundations: on the contrary, it disturbs what was previously considered immobile; it fragments what was thought unified; it shows the heterogeneity of what was imagined consistent with itself" (Foucault, 1994a, p. 142, 1998, pp. 374–375). The genealogical operation subverts the present state of knowledge and exposes it to its compromised, controversial and implicated sides. This method reflects on its own proceeding, thereby becoming aware of its limitations as well as of the influence it exerts on its own object of enquiry, in which it is constitutively included: "it is a gaze that knows where it is looking from as well as what it is looking at. Through this historical sense, knowledge is allowed to create its own genealogy in the act of cognition" (Foucault, 1994a, p. 150, 1998, p. 382, trans. mod.). Consequently, the genealogist

must always take up a position in the power struggle every history entails inasmuch as it is a struggle to determine the meaning of our present state and consequently influence the decisions concerning how to manage it.

Performatively, the genealogical operation contributes to constituting its own object of study as well as its own subject, i.e., the one who enacts it. On the one side, it upsets and alters the initial and current conception of what it enquires into by reconstructing the process according to which this phenomenon has become what it is now. On the other, it transforms the perspective of the one who carries out the enquiry, modifying their knowledge, motivations and beliefs based on what the investigation finds out. According to Agamben, who elaborates on Foucault's insights in his book *The Signature of All Things* (2009a), the genealogical origin "is not an origin presupposed in time. Rather, locating itself at the crossing of diachrony and synchrony, it makes the enquirer's present intelligible as much as the past of his or her object" (Agamben, 2009a, p. 32).

Hence, every genealogy is also a self-genealogy. We identify in the past what either confirms or contradicts our current beliefs about the present state of our object of enquiry. The historical reconstruction, therefore, is never neutral, "objective" or disinterested. The current setup of our knowledge and instrumentation defines the entities that may concern us and the operations we deem suitable for reconstructing them—starting from the very intention to develop the genealogy of a given phenomenon—and is transformed, in return, by this operation. Genealogy, Agamben argues, thereby occurs as an intersection and coming together of past events and general objectivity, on the one hand, and present concerns and individual subjectivity, on the other:

> it is not possible to gain access in a new way, beyond tradition, to the sources without putting in question the very historical subject who is supposed to gain access to them. What is in question, then, is the epistemological paradigm of inquiry itself. […] It cannot confront tradition without deconstructing the paradigms, techniques, and practices through which tradition regulates the forms of transmission, conditions access to sources, and in the final analysis determines the very status of the knowing subject. The moment of arising is objective and subjective at the same time and is indeed situated on a threshold of undecidability between object and subject. It is never the emergence of the fact without at the same time being the emergence of the knowing subject itself: the operation on the origin is at the same time an operation on the subject (Agamben, 2009a, p. 89).

The genealogical emergence of a phenomenon conjoins the historical scenario where that phenomenon is detected with our current ideas about what that phenomenon is: therein lies the genealogical origin. While our current perspective frames the epistemic horizon through which the

reconstructive attempt is carried out, the practice of genealogy, upsetting and agitating our current beliefs, contributes to modifying our perspective, pursuing our individuation further.

Organologically, the genealogist always consists in a historical complex of interrelated biological organs, artefacts and social organizations. As submitted by Simondon, conceiving of individuation is actually performing it: "only the individuation of thought can accompany the individuation of beings other than thought; […] we cannot *know individuation* in the ordinary sense of the term; we can only individuate, be individuated, and individuate within ourselves" (Simondon, 2005, p. 36, 2020, p. 17). And as pointed out by Stiegler (2013a, pp. 75–76, 2014, pp. 45–46), while commenting on Simondon's insights, since psychic individuation is always also collective as well as technical individuation, as discussed in Chapter 2, conceiving of/performing individuation is a process involving our whole organological collective, i.e., our being-in-the-world with other biological organs, artefacts and organizations.

7.5.1 Constitutive Inclusion

As argued in the Introduction, Heidegger's concept of being-in-the-world thematizes the constitutive inclusion of a questioning *Dasein* in their own questioning behaviour and, consequently, their capability to appreciate phenomena starting from their conditions of manifestation, i.e., with reference to the event of Being as what renders beings manifest to us as beings. Heidegger's original approach would deny the possibility of enquiring into the genesis of this condition, which he understands as an originary given. However, as argued in Chapter 3 regarding Sloterdijk's spherological critique of Heidegger's existential analytic, the world as the ultimate condition of manifestation of phenomena in general, including *Dasein*'s capability of self-thematization, is itself the outcome of a process of (technical) manifestation and can be thereby reconstructed.

I will now turn to discuss how Sloterdijk articulates the genealogical method from an evolutionary perspective, insofar as he critically appropriates Heidegger's thinking of being-in-the-world and aims to reconstruct the human origin as the origin of an opening for the appreciation of phenomena starting from their conditions of manifestation (i.e., *Lichtung*). This reconstruction, insofar as it is enabled by this originary opening, belongs to our origin as the origin of the *Lichtung* (Mussi, 2007). Hence, both our history and its narration belong to the reconstructive process and what is reconstructed is actually us, contemporary genealogists, rather than some hypostatized, supposedly primitive human lifeform.

Concordantly, as highlighted by Sini (2013), when we investigate our evolutionary origin as humans, we have to account for our fully-fledged, contemporary being-in-the-world, i.e., our present condition of human subjects reconstructing the human origin. We are thereby also accounting for our capability to develop genealogical reconstructions, to which our own attempt thematically belongs. By doing so, we enquire into the origin of our capability to enquire into origins and especially our

own origin, thereby accounting for our own reconstructive operation. Once again, we may appreciate how accounting for the conditions of existence of the human lifeform amounts to accounting for its conditions of thinkability and vice versa.

Since we recognize ourselves as humans in our ancestors, by enquiring into the evolutionary origin of our species, we also enquire into the origin of humans in general and into our individual and present-day origin in particular. Consequently, by accounting for the origin of our worldly condition we also account for the conditions of (im)possibility of our present being-in-the-world, which we have transgenerationally inherited from our ancestors through technics as tertiary memory. Sloterdijk's method, which he calls "fantastic reconstruction" (*phantastische Rekonstruktion*), "is distinguished by the fact that it never leaves behind the starting point in the clearing [*Lichtung*] and at the present state of civilization" (Sloterdijk, 2001b, p. 154, 2016a, p. 97). On the one hand, this methodology of enquiry should always pay attention to the scenario of emergence of the human lifeform starting from its prehuman origin. On the other, it should develop a reconstruction aiming to account for the contemporary status of civilization and for a fully deployed human lifeform able to inhabit and interpret it.

Sloterdijk's approach sets out to complementarily reconstruct the becoming-human of the pre-human organisms and the becoming-world of the pre-worldly environments: "the ontological version of the novel of descent must keep in view, at the same time as the pre-human's becoming human, the pre-world's becoming a world" (Sloterdijk, 2001b, p. 155, 2016a, p. 97). This operation aims to reconstruct both the evolution of our lifeform and the evolution of our capability to reconstruct the evolution of our lifeform. Once hominin populations become capable, thanks to their cultural techniques, inscribed into their technical system, partaking, in turn, in their organological collective, of appreciating phenomena starting from their process of manifestation, they acquire the capability to account for their present condition, i.e., making sense of what it means to be here and now as members of a community and why it is so and not otherwise.

However, as observed by Sloterdijk, every quest for human origins is constrained by the particular circumstances originating that quest:

> research on the human being and what makes him historically possible must run in a circle in such a way that our point of departure, our existential ecstase in our time or our belonging to the appropriative event [*Ereignis*]—it must run in a circle in such a way that this openness concerns us, is attained again and at the same time never left behind, without it being the case that—as is customary among evolutionists—"the human being" is already presupposed and then speciously derived in evolutionary terms (Sloterdijk, 2001b, p. 156, 2016a, p. 98).

This genealogical reconstruction, first, should account for our evolutionary, prehistoric origin as well as for our present situation. Secondly, it should elucidate both our origin as a species and our individual relation to the event of Being, i.e., our present condition of being-in-the-world as members of this species. Thirdly, it should show the interconnectedness and mutual influence of these two operations.

Indeed, although attempts to reconstruct human origins obtain in every extant community, the occurrence of this particular attempt, i.e., reconstructing the evolutionary emergence of our relation to technics, is anything but fortuitous. According to Sloterdijk, "such an undertaking could not have begun at just any time; if it is now attempted it bears the signature of the moment" (Sloterdijk, 2001b, p. 157, 2016a, p. 23). As submitted in the Introduction, we start to appreciate the evolutionary character of our constitutive technicity because we feel increasingly challenged by the current technoscientific development. And we are inclined to explain our origins as the outcome of a process of Darwinian evolution because we operate consistently with the state of the art of the prevailing scientific paradigm, inscribed, in turn, into our episteme.

Prehistoric origins are thereby interlinked with contemporary events and related, in turn, to the somewhat transhistorical quest for the meaning of the human condition. Since technicity is constitutive of our lifeform, modifications in the present state of the technical system amount to modifications not only of our condition but also of our interpretation of this condition, "because everything that happens on the technological front leads to consequences for human self-understanding" (Sloterdijk, 2001b, p. 220, 2016a, p. 139). Consequently, as Sloterdijk argues with a polemic reference to Heidegger's stance, "*Humanitas* depends on the state of technology" (Sloterdijk, 2001b, p. 224, 2016a, p. 142).

I think that Sloterdijk's observations are convergent with Stiegler's approach, which states that "to account correctly for *Dasein's* historiality would be, first of all, to account for the very possibility of accounting for it, to analyze the conditions through which *Dasein* is capable of thematizing its own historiality" (Stiegler, 2018a, p. 327, 2009c, p. 12). Making sense of our becoming also implies making sense of this sense-making faculty. As reviewed in Chapter 2, the conditions of (im)possibility of this operation are technical because *Dasein* inherits their non-lived past through the adoption of tertiary memory. Moreover, it is through technics and especially the abstractive power of self-representing, cultural techniques that we are able to explicitly thematize this process of inheritance.

Thus, while reinterpreting the main tenets of Heidegger's existential analytic, Stiegler observes that what Heidegger regards as *Dasein*'s peculiarity, namely their capability to question Being, "is itself pre-ceded by the *pharmacological situation* of the 'possibility of posing questions', by the pharmacological situation *as placing in question*" (Stiegler, 2010a, p. 217, 2013b, p. 106). One can

question Being because their *Dasein* is already called into question by their constitutive technicity. Pharmacologically, this condition both constitutes us as the questioning beings and may deprive us of this faculty, impeding our capability to think and, therefore, philosophically meditate about the Being of beings.

Consequently, technics both enables and constrains our capability to enquire into our origin. As observed by Stiegler, "historiality is epiphylogenetic in the sense that the forestructure of understanding [*précompréhension*] must vary with respect to possibilities inherent in such and such a support of the already-there [*déjà-là*]" (Stiegler, 1998b, p. 253, 2018a, p. 288). The access to our past, which in turn enables the reconstruction of our origin, depends on the available technical system and varies in accordance with it. Reconstructing the origin of our capability to question our origin is structured and influenced by which techniques and technologies we employ in order to perform this reconstruction. For instance, in this research, I set out to develop this reconstruction starting from the technoscientific apparatus available to and developed by contemporary evolutionary biology and palaeoanthropology.

Moreover, as contended by Michael Lewis (2013), Stiegler's approach highlights how every enquiry into origins must stem from a factual decision—itself inscribed into the possibilities of understanding opened up by our technically structured episteme—regarding how we should preliminarily conceptualize the phenomenon we set out to explain. Stiegler decides to investigate the human lifeform starting from technics in general and the contemporary technical system in particular. On the one side, this decision is arbitrary because other starting points for this enquiry could have well been chosen. On the other, it is necessary because no authentic reconstruction could originate without such a presupposition. According to Lewis, while this decision will retain its mark on the enquiry, relativizing its claims according to the contingence of our present state, it is only starting from a perspectival decision that the human condition can be questioned at all and a narrative initiated—from Heidegger's perspective, the question of Being needs to always concern us, singular *Dasein* existing in a particular configuration of the historical world.

Hence, both Sloterdijk's and Stiegler's appropriations of Heidegger's philosophy prompt us to consider how technics lets us account for both our worldly condition and the possibility of this accounting itself. When enquiring into our origin, I am also enquiring into my origin, insofar as I regard myself as part of the phenomenon that I set out to explain, namely the human lifeform. Furthermore, insofar as I aim to account for this phenomenon as a whole, i.e., something in which I can recognize myself, I should also account for our capability as a species as well as my capability as an individual of this species to carry out genealogical reconstructions. And while at first sight this condition may seem to invalidate the results of the enquiry by relativizing and contextualizing them within a singular, factical instantiation, one should be mindful that this is actually the case with every

reconstructive attempt, including those which do not thematically admit this condition or even overtly deny it. Thus, adopting the genealogical method enables us to explicitly acknowledge the constitutive inclusion of the genealogist in their own genealogy, thereby attempting to render its biases, prejudices and limitations evident, as I will now turn to discuss.

7.5.2 Explicit Situatedness

Every reconstruction, be it historical, scientific, mythical or anything else, is always carried out by someone—an individual, an institution, a community etc. The one who traces the reconstruction embodies a complex of knowledge, interests and expectations, adopts a range of instruments, apparatuses and techniques and abides by a set of norms, rules and procedures. Taken together, these conditions contribute to defining their operations and purposes, thereby constituting their perspective. The latter, in turn, cannot help but be projected onto the object of enquiry, selecting for those criteria, tools and categories which will be employed to carry out the reconstruction, thereby unavoidably influencing its outcome. An impersonal, disembodied and supposedly objective view able to account for the genesis of a phenomenon regardless of the present state of the one who aims to reconstruct that phenomenon simply does not obtain.

I regard this condition as the explicit situatedness of the genealogical method. Every reconstruction of a phenomenon is influenced by the perspective of the one who develops that reconstruction. However, contrary to naïve, positivist approaches, genealogy explicitly takes into account these biases. This critical supervision enables the genealogist to be aware of how their situated perspective constitutively contributes to producing the phenomenon they aim to reconstruct. The genealogist's interests, biases and presuppositions do not forcefully invalidate the outcome of their reconstruction. Indeed, every reconstruction is necessarily conditioned by the situatedness of the one who performs it, regardless of whether this condition is thematically acknowledged or not. This situated perspective actually justifies the genealogy's outcome, insofar as it does not pretend to provide a supposedly universally valid account, but rather explicitly reconstructs the genesis of a phenomenon starting from a particular observer's viewpoint.

As highlighted by Haraway, "the value of an analytical category is not necessarily annulled by critical consciousness of its historical specificity and cultural limits" (Haraway, 1991, p. 130). For instance, the biased and interested character of modern western science, alongside its implicit understanding of power relations and consequent discriminatory stereotypes, does not forcefully render its claims useless and unacceptable. As Haraway submits in her paper "Situated Knowledges" (1991, pp. 183–201), the main flaw of western, modern science does not lie so much in its patriarchal, colonialist and racist biases as in its pretension to perform a pure, unbiassed and incontrovertible canon of objectivity despite them. While biases coming from our current ideologies and power

structures are an unavoidable and constitutive element of scientific "objectivity", problems arise when these prejudices are not recognized and scientific practice pretends to exert a disembodied and omniscient "view from nowhere", supposed to detect and describe things "as they really are". Thus, according to Haraway's constructivist approach, all knowledge claims, including scientific knowledge claims, are produced through particular technologies and embody particular power struggles. Situatedness is "true" objectivity, insofar as localizing the observer's position, while it does not render them innocently freed from interests and prejudices, makes them accountable for the outcomes of their interested observations nevertheless, thereby prompting a critical debate open to constant revision.

Analogously, according to the US philosopher Sandra Harding (1992), knowledge is always socially situated, contrary to the traditional conception of objectivity as the accomplished purification of knowledge from its "social" biases (e.g., class, gender, race etc.). The traditional understanding holds that purified objectivity may be achieved if enough attention is paid to following a rigorous scientific methodology. However, Harding argues, even the scientific method is not free from social influences and, moreover, these influences cannot be detected if they are shared by the vast majority of those involved in performing science—as gender biases, for instance. According to Harding, the dominant scientific paradigm fails to question its own objectivity because it implicitly identifies its particular conception of objectivity with objectivity "in general". This strategy, in turn, is often used to help the ruling class administer and exploit marginalized groups, supporting an ideology that justifies the extant configuration of power. Conversely, these groups are able to question the social biases in their knowledge processes because their own right to produce knowledge is usually called into question, marked as biased and consequently dismissed.

Harding, therefore, observes that the alternatives to traditional universalism (i.e., knowledge can and should be purified by all opinions) are not limited to ethnocentrism (i.e., only our knowledge is objective) and relativism (i.e., all knowledge is nothing but opinion). What she calls standpoint epistemology advocates for a situated, that is socially, historically and biologically embodied subject for scientific research as well as for an equally embodied object of research, which should be considered on the same epistemic and ontological plane of the subject, both being susceptible to all sorts of biases. For instance, Sloterdijk (2009a, pp. 26–33, 2012b, pp. 11–15) claims that his description of the systems of anthropotechnics constituting the historical configurations of our lifeform, outlined in Chapter 3, is a form of anthropotechnics itself and thereby does not aim to elaborate a disembodied, disinterested or absolute perspective on the phenomenon it sets out to study (Leghissa, 2012).

From this viewpoint, we can appreciate how the perspectival constraints biasing historical reconstructions also pertain to scientific accounts in general and evolutionary anthropology in

particular. Myths are not alien to science but rather constitutive of scientific explanations, usually inadvertently helping scientists arrange data into coherent narrations (Perper & Schrire, 1977). Specifically, as the evolutionary biologist Richard Lewontin (1991) points out, the so-called natural sciences, such as biology, exhibit the structure of narratives as much as the so-called historical sciences. On the one hand, scientists arrange facts into theories. On the other, they arrange theories in order to fit in with the facts, with ideologies playing a major, albeit often unacknowledged role in scientific practice. This condition, Lewontin argues, becomes particularly evident relative to evolutionary biology and palaeontology because the study of evolution is the attempt to reconstruct a story, i.e., submitting an account of how things may have happened.

As argued by Misia Landau (1984), scientific reconstructions exhibit the structure of narratives, similarly to novels and myths, insofar as they organize sets of findings into coherent discourses. Palaeoanthropology, according to Landau, eminently exemplifies this phenomenon because anthropogenesis is usually construed as a coming-of-age story where hominin populations, overcoming a series of crises and transitions, eventually reach evolutionary "maturity". Hence, evolutionistic accounts of human origins serve as replacement discourses for mythical accounts of our genesis in the modern western world (Isaac, 1983).

However, scientists seem often unaware of the narrational structure of their theories and mainstream scientific practice usually disavows this condition, deeming itself insusceptible to the perspectival and, therefore, partial, relative and biased character of every reconstruction. For instance, Leroi-Gourhan (1964, pp. 11–14, 2018, pp. 4–6), while introducing his investigation on the prehistoric origins of human technicity, criticizes prescientific ethnocentrism, claiming that who developed these so-called mythical accounts of the human condition—only regarding members of their own cultural grouping as properly human—tended to describe human origins starting from their present idea of humanity, only accepting, therefore, those accounts eventually leading to this idea and retrospectively justifying it.

Perhaps surprisingly, however, Leroi-Gourhan regards the scientific practice of his times, to which his attempt explicitly belongs, as exempted from this perspectival constraint, as if it would not also start from a pregiven, collectively shared and uncritically assumed model of humanity. More than forty years later, Wrangham, in his account of human evolution, displays the same scientistic ethnocentrism: anthropogenesis is considered "a question that every culture answers in a different way, but only science can truly decide" (Wrangham, 2009, p. 2). Only modern western science is deemed able to produce a reliable account of the human origin and this account is considered potentially shareable by everyone by virtue of its alleged objectivity, that is its correspondence to "how things really happened".

This attitude represents what the sociologist Andrew Pickering (1982) calls the discovery fairy-tale of scientific practice. According to this widespread conception, scientists would be passive observers working to discover and reveal facts of nature by simply reporting their existence, which is consequently regarded as incontrovertible and unproblematic. Conversely, as Pickering argues relative to the study of the elementary particles quarks in particle physics, scientific facts and theories are eminently constructed by the scientists' activities.

Alternatives to the discovery fairy-tale of scientific practice have also been proposed. For instance, Canguilhem, in his essay "The Living and Its Milieu" (1965, pp. 129–154, 2008, pp. 98–120), develops a historical reconstruction of the concept of environment (*milieu*), from its physicochemical origins in the eighteenth century to its ascent as a pivotal notion in the biological sciences in the twentieth century. Organisms organize their environment, insofar as the latter represents the complex of what is relevant for them, i.e., perceivable as bearing vital values—the human environment making no exception. However, according to Canguilhem, biology tends to present itself as an absolute environment—the environment where environments can be studied—which would encompass and relativize all the others, thereby unduly prioritizing the human environment over those of the other organisms. Conversely, Canguilhem argues, the scientific worldview should abide by its own results. As (techno)biological activity, it is anything but an expression of the human environment, i.e., the system of affordances proper of the human lifeform, science itself being a relative function of (human) life.

Furthermore, as famously claimed by Trevor Pinch and Wiebe Bijker (1984) regarding social constructivism in Science and Technology Studies, the truth or falsehood of a scientific claim should not be assessed against the touchstone of an alleged "natural" world but is rather socially constituted according to the beliefs and interests of the people involved in the controversy, including scientists. Scientific knowledge is neither superior to nor qualitatively different from the other forms of knowledge, insofar as it reproduces in its outcomes the biases and prejudices of the individuals performing it.

Hence, our perspective's situatedness is an unavoidable dimension of every reconstructive operation attempting to account for the present state of a phenomenon. This is even more evident in case we identify ourselves with the phenomenon we seek to explain. For instance, as pointed out by Stone (2019, pp. 106–112) in her analyses of human natality, outlined in Chapter 4, by being born, we come into the world in a pregiven condition which determines our individuation, insofar as we inherit behaviours, beliefs and devices from the past generations. Although we may take distance from this inherited tradition and criticize it, we can only do so starting from this inheritance and based on the possibilities of subjectivation it offers us. As argued by Stone, "we are situated both as regards what we have to make sense of, and as regards the inherited avenues along which we make sense of

it" (Stone, 2019, p. 113). Our inherited condition is what we have to deal with as well as what gives us the means to deal with it. Thus, our situated perspective is conditioned by the unique individuality of our natal condition, featuring biases coming from our social, political, economic, biological, technological and historical background. These perspectival constraints are projected onto what we do, including when we act as genealogists and set out to enquire into our evolutionary origin.

7.5.3 Retrospective Performativity

The biases every reconstructive endeavour necessarily entails do not only influence and shape the particular account which is produced relative to the genesis of the phenomenon this endeavour seeks to study but also mould and transform what that phenomenon is supposed to be and how we relate to it, i.e., how it manifests itself to us. For instance, as discussed by Sheela Athreya and Rebecca Ackermann (2020), western culture is characterized by a longstanding and deeply rooted practice of otherization towards other cultures, especially Asian and African. These cultures are stereotypically identified as a unified culture through reductions and simplifications and this alleged culture is depicted as inferior to the western one. While African cultures are usually considered primitive, Asian cultures are regarded as degenerate and both are thereby dehumanized, that is excluded by "humanity proper".

Athreya and Ackermann submit that these usually implicit practices also permeate western science in general and evolutionary anthropology in particular because this colonialist ideology is projected onto science, which in return contributes to corroborating it with its supposedly impartial findings. These racial biases have influenced, for instance, the economic and organizational decisions over which continent should host the first searches for human origins, dismissing evidence for alternative interpretations as unreliable or biased. This discriminatory apparatus, in turn, has contributed to affirming and reinforcing western supremacy over Africa and Asia. Nowadays, it is still operating in contemporary science, e.g., by marginalizing and discrediting scholars and theories coming from non-western contexts. Or by regarding African hunter-gatherers as more primitive humans and, therefore, ethnologically studying them to understand human evolutionary origins supposedly better.

Hence, on the one hand, the racial prejudices permeating modern western science contribute to structuring scholarship in anthropology, thereby channelling its resources towards particular research programmes, which will, in turn, yield particular results relative to how we represent our evolutionary trajectory. On the other, these results, once they gauge consensus in the scientific community, will retrospectively reinforce our racial biases, framing our ideas about accounts of anthropogenesis as well as racial issues. However, when explicitly considered by adopting a genealogical method of enquiry, this retrospective performativity may also be beneficial to its object of study.

Indeed, every account of origins, as shown by Bruno Latour and Shirley Strum (1986), regardless of whether it is "mythical" or "scientific", is as much descriptive as prescriptive, thereby being performative. For instance, by submitting a reconstruction of the human origin, we cannot help but make claims about how human life should be carried out nowadays, which kinds of operations on ourselves we should welcome and which we should reject. And the attempts to decide what society is contribute to producing society itself by supporting claims about how it should be. As contended by Strum and Latour, "society is constructed through the many efforts to define it; it is something achieved in practice by all actors, including scientists who themselves strive to define what society is" (Strum & Latour, 2000, p. 268). Modern western science, including evolutionary anthropology, displays the same interested and performative character of any other kind of reconstruction.

Thus, as argued by Haraway (1991, pp. 21–42), interpretations of human origins, including scientific accounts, always imply an interpretation of our present condition, bearing political values. For instance, Haraway (1991, pp. 43–68) analyses how evolutionary anthropology is often permeated by capitalist ideology, which submits an understanding of "nature" based on scarcity, thereby justifying dominance, hierarchy and competition over limited resources, as cogently expressed by Jason Moore's concept of Cheap Nature, discussed in the Introduction. This is also the case, according to Haraway (1991, pp. 7–20), with the ethological study of animal societies, supposed to mirror human societies in simpler forms and whose interpretations often reproduce the categories of the contemporary, hegemonic system of power, alongside its sexist, classist and racist biases.

The "Man the Hunter" hypothesis for human evolution, for instance, clearly illustrates this dynamic. According to this construal, the hunt for large game, performed by groups of men, plays a pivotal role in anthropogenesis (Borshay Lee & DeVore, 1969). This understanding has been criticized, e.g., because it downplays women's contribution to collective survival and emphasizes a masculine-coded activity like hunting as the sole driver of anthropogenesis (Collier & Rosaldo, 1981). It thereby reproduces the current, patriarchal power relations and justifies them by inscribing them into an evolutionary perspective.

Thus, genealogical enquires do not simply bring to the fore and explicate some hidden or forgotten phenomenon based on an incontrovertible and universally valid interpretative framework. They contribute to producing both this phenomenon and the system of knowledge articulating it. Historical truths are not just "found" in some ontological archive of history, they are rather constructed starting from our perspective, while our reconstructive attempt provides us with novel interpretations meant to rearrange this perspective in return. Hence, keeping in mind genealogy's main features reviewed above, let me now conclude these remarks by outlining how technics structurally belongs to these enabling constraints, insofar as it contributes to constituting the manifestation of the phenomena we aim to reconstruct and thereby influences our understanding of them.

7.6 Technical Manifestation

Technics constitutes our lifeform and, specifically, structures our episteme, that is the way we interpret and inhabit the world. This condition concerns our everyday activities as well as highly formalized scientific practice, which is as perspectival and biased as every other reconstructive attempt. Importantly, the biases constraining our perspective are also what enables our perspective to access otherwise inaccessible information—there is no unbiased perspective.

This condition also concerns the constraints presented by the employment of an artefact to investigate a phenomenon. For instance, a thermometer will only react to values exceeding its threshold of tolerance and consequently ignore stimulations falling within this threshold. It will thereby overlook all the variations of temperature lower than a given standard. However, thermometers are also what enables us to measure temperature in the first place, insofar as the latter could not be similarly estimated without this device or an analogous one. And even if a thermometer with higher sensitivity is employed, there will always be variations of temperature falling within its threshold. From this perspective, instruments and their norms of employment are constitutive elements of scientific practice. Scientific fields, as argued by the US philosopher Manuel DeLanda (2015) regarding chemistry, are composed of "a *domain of phenomena*, a *community of practitioners*, and a set of *instruments and techniques* connecting the community to the domain" (DeLanda, 2015, p. ix).

As highlighted by the Canadian philosopher Ian Hacking (1983), the philosophy of science has traditionally one-sidedly drawn its attention to the study of scientific theories, conceived of as abstract and formalized representations of reality. However, Hacking argues, in order to understand the genesis of scientific facts, one should rather focus on experiments, i.e., how the researchers' material practices, especially in modern western science, enable the production of those phenomena which may be subsequently regarded as objects for a theory. This emphasis on experimenting, in turn, entails the appreciation of how instruments contribute to constituting scientific phenomena, which Hacking (1983, pp. 220–232) regards as peculiar kinds of entities which only exist within and thanks to the technical apparatuses presiding over their manifestation.

As Hacking claims relative to the Hall effect in electromagnetism, which denotes the creation of a peculiar potential difference across an electrical conductor, "the Hall effect does not exist outside of certain kinds of apparatus. […] The effect, at least in a pure state, can only be embodied by such devices" (Hacking, 1983, p. 226). From this perspective, scientific phenomena are regarded not as entities which can be discovered in some external and independent "nature" because they have always been there, but rather as products of the technological apparatuses designed and operated by the scientific community.

Thus, as argued by Verbeek (2005, pp. 139–143), science is not only influenced by the sociocultural biases prevailing among those who practice it—on the somewhat general and ideological plane analysed above—but also by the instruments they adopt, i.e., the concrete and individual operations these artefacts allow or inhibit. Techniques and technologies structurally contribute to constituting scientific practice, thereby enabling and constraining its findings. The supposedly natural, prehistoric and precultural phenomena composing the scenario of anthropogenesis, for instance, can only be investigated thanks to sophisticated equipment and refined models. This instrumentation not only provides us with the means to access otherwise undiscernible phenomena but also actively contributes to framing our understanding of them, acting as a "screen" only through which we become able to deal with them.

As Haraway claims, "technologies are […] practices of visualization" (Haraway, 1991, p. 194). All phenomena, especially scientific findings, are inseparable from their conditions of manifestation, i.e., the complexes of techniques and technologies framing the operations according to which something may present itself to us as a particular phenomenon. To put it in feminist theorist Karen Barad's words, "phenomena are inseparable from their apparatuses of bodily production" (Barad, 2007, p. 208): these are actually two sides of the same practice. Hence, as submitted by Verbeek, "the reality studied by scientists is constituted by the technological instruments they use" (Verbeek, 2005, p. 141).

If we can easily consider how relatively esoteric entities such as quanta or blackholes would remain completely alien to our cognition without the technical apparatuses presiding over their manifestation, perhaps more trivial phenomena such as fossil findings could also not be studied and interpreted without dedicated techniques and technologies. The fossil records of the first Hominins, for instance, can only be appreciated and interpreted thanks to those dating, indexing and classification technologies that enable us to detect evidence of our ancestors in what would otherwise probably look like nothing but trivial stones. More generally, we may only gain insights into the dynamics presiding over our evolution thanks to highly elaborate scientific models, developed within laboratories and divulged through essays.

This perspective is contrasted, perhaps unsurprisingly, by Malm, who claims, regarding the ongoing ecological crisis, that "even the famed computer models in themselves play zero role in constituting the reality of global warming. If climate science is basically correct, it means that it had nothing to do with bringing its referent about" (Malm, 2018, p. 128). "Good" science, according to Malm, would not influence its object of study to any extent. Conversely, "bad" science would distort its object of study with its biases and constraints. From Malm's viewpoint, it is possible, at least in principle, to conceive of scientific practice as faithfully describing a reality which is completely independent of it.

However, this does not seem to be the case. As cogently argued by Gerald Moore (2017b), for instance, the phenomenon of climate change is mediated, enabled and structured by specific technologies. On the one side, devices such as computer-modelled simulators and environmental sensors enable us to grasp the vastness and pervasiveness of the looming environmental catastrophe, which would be quite different if we were to rely on the daily, individual experience of weather disruptions alone. On the other, artefacts such as media and scientific publications shape the public conception of global warming, insofar as they may lead us to either believe in the severity of this phenomenon or dismiss it as irrelevant or forged. Thus, techniques and technologies construct the observed, supposedly natural phenomenon of climate change as well as the supposedly unmediated and disinterested scientific and public observers. Perception is thereby framed as the organological intertwinement of our sensorium with the artefacts selecting which aspects of a given phenomenon may become the object of our experience, which is in turn embedded into the norms and habits regulating the exchanges between biological and artificial organs.

Changes in the technical instrumentation, therefore, elicit changes in our representation of a phenomenon. For instance, until a few decades ago, the human evolutionary trajectory was conceived of as a straight, monodirectional lineage leading from Australopithecus to Homo sapiens. However, subsequent studies and fossil findings have fostered scientists to revise this view, appreciating that Hominins split into several lineages, with different species of Homo existing simultaneously. Since ours is the only one surviving nowadays, the others have been initially considered evolutionary dead-ends. More recently, nonetheless, developments in genomics have demonstrated that interbreeding among different species of Homo occurred. The comparative sequencing of DNA samples, indeed, shows that Eurasians usually feature some percentage of Neanderthal DNA, for instance, while Oceanians rather display bits of Denisovan DNA.

How technoscientific development contributes to structuring our experience of reality and, therefore, how technics plays a pivotal role in the reconstruction of a phenomenon may be aptly exemplified by the issue of sex attribution and gender definition, for instance. Traditionally, in western modernity, individuals were supposed to have either male or female sex and attribution of sexual identity was performed postnatally by relating sex to bodily anatomy, with special reference to the configuration of the gonads (testicles or ovaries). More recently, sexual identity is attributed according to chromosome analysis: male sex is usually defined by the presence of a Y and an X chromosome and female sex by the presence of two X chromosomes. However, both this binary and the related attribution procedure are challenged by current technoscientific development.

Indeed, chromosome sex may not match gonads sex and/or sexual anatomy. New technologies in DNA sequencing and cell biology reveal, for instance, how gene expression may render chromosome and anatomical sex more or less convergent. Moreover, some individuals exhibit mixed male and

female chromosomes, with or without this condition manifesting itself in their phenotype. Furthermore, sexual identity is increasingly not regarded anymore as developing and fixating during gestation once and for all, but rather as shifting throughout our whole lifespan, arguably also influenced by environmental factors. Organologically, these insights intersect with our sociocultural conceptions of gender, sex and sexuality as well as with the laws regulating sexual interchanges—such as marriage between persons who have been assigned the same sex—and with the biomedical practices seeking to "normalize" sexual identity and/or cure related pathologies or dysfunctions—such as infertility. Hence, sex is increasingly conceived of more as a spectrum exhibiting a plurality of variations and manifestations than as a mutually exclusive couple of exactly identifiable traits (Ainsworth, 2015).

More specifically, the analyses carried out by Barad in her essay "Getting Real" (2007, pp. 189–222) may help us zoom in on the relationship between technics and human experience relative to sex attribution. The piezoelectric crystal is a transducer employed to carry out obstetric ultrasonography. According to Barad, our experience of the foetus is constructed by the technologies enabling their manifestation, which are embedded, in turn, in symbolic-material discourses and power relations. While in the absence of ultrasound technology the sex of the foetus is usually assigned at birth, thanks to this device it can be determined during pregnancy. This technoscientific apparatus, therefore, modifies our experience of sexual development and bears influence on the socioeconomic relations concerning gender issues. For instance, the increased attention granted to the foetus by this technology may be used to divert attention from the mother, configuring the foetus as an autonomous entity and the pregnant woman as an objectified container. Crucially, Barad argues, the foetus and their sex as an object of observation are constructed rather than discovered by obstetric ultrasonography:

> the transducer does not allow us to peer innocently at the fetus, nor does it simply offer constraints on what we can see; rather, it helps produce and is part of the body it images. That is, the marks on the computer screen (the sonogram images, sonic diffraction patterns translated into an electronic image) refer to a *phenomenon* that is constituted in the intra-action of the "object" (commonly referred to as the "fetus") and the "agencies of observation." Significantly, the objective referent for the properties that are observed is the *phenomenon, not* some presumably preexisting, determinately bounded and propertied object (Barad, 2007, p. 202).

The technoscientific apparatus based on the employment of the piezoelectric crystal renders some particular aspects of human gestation perceivable by particular kinds of observers, while concurrently downplaying the relevance of other aspects of this phenomenon as well as alternative techniques of

observation. Thus, obstetric ultrasonography technology both subjectivizes the observer (as technician, engineer, scientist etc.) and objectivizes the foetus (as object of biomedical practice).

Hence, sex attribution and gender definition are processes taking place throughout our whole development, with artefacts structurally contributing to their articulation. As argued by Ellen van Oost, "gender and material objects are related and mutually constitute each other" (van Oost, 2003, p. 193). For instance, producers design technologies according to their (structurally biased) ideas about the gender of their envisioned users, in order to render them more enticing and thereby increase their saleability. Users, in turn, shape their gender identity through their interrelation with these artefacts. Van Oost (2003) reviews how this phenomenon can be appreciated by analysing the design of electric shavers by Philipps. These devices are produced in two different, gendered versions, for men and women respectively. Contrary to men's electric shavers, women's versions are designed and marketed more as beauty sets than as electric devices, e.g., by limiting the possibility of modifying their settings or concealing screws and junctures, regarded as evidence of advanced technology. And by doing so, these products confirm and reinforce the gender stereotype according to which women are unwilling to or incapable of dealing with technologies.

Relative to the constitutive role played by technics in the manifestation of phenomena, what holds true for everyday activities is equally valid for scientific research. This condition is cogently shown, for instance, by Aurore Hoel (2022) with reference to technologies such as magnetic resonance imaging (MRI), which enable us to produce the scientific facts—in this case, images—around which a theory or a diagnosis may revolve. Magnetic resonance imaging is a medical apparatus employed to highlight relevant features of organic tissues and particularly to discriminate between healthy and pathological tissues, such as tumours. The MRI scanner emits a strong magnetic field designed to appropriately resonate with the bodily area one wishes to examine. Some atomic nuclei, such as those of hydrogen atoms, which are substantially present in organic tissues, especially water and fat, are capable of absorbing radio frequencies and polarizing accordingly. Hence, they are excited by the radio frequency pulse of the machine and their altered position is deduced thanks to dedicated radiofrequency receivers. This magnetic behaviour of them, in turn, varies based on the type of tissue (e.g., "normal" or tumorous) in which they obtain.

Thanks to this technique, the properties of the different tissues are inferred by the rate at which the excited nuclei return to their state of equilibrium once the strong magnetic field has ceased to be emitted, thereby manifesting themselves as a visual contrast between different tissues in the imaging of the area, rendered as grey-level differences. Moreover, contrast agents can be injected in the patient's bloodstream to augment the resolution of the image and the parameters of the machine can be tweaked to attain a more adequate imaging. Thus, as Hoel points out, the resulting images depend on the interrelation between features of both the tissue and the machine and particularly on how the

machine modifies the tissue, thereby individuating a new kind of biotechnical entity. Notably, magnetic resonance imaging is employed not only in medical diagnostics but also in other research fields, such as archaeology, where it is adopted to study ancient mummies.

In his book *Expanding Hermeneutics* (1998), Ihde sets out to approach science as a technically mediated, hermeneutic activity. According to Ihde, imaging technologies in modern scientific practice, such as X-rays, magnetic resonance imaging or positron-emission tomography (PET), are "means by which our perceptions and our wider experience are modified and transformed" (Ihde, 1998, p. 1). Their products, such as charts, graphs and tables, exert a visual hermeneutics, where scientific entities emerge through the technical mediation of experience: "things, the ultimate referential objects of science, are never just naively or simply observed or taken, they must be *prepared* or *constituted*" (Ihde, 1998, p. 163). Scientific facts are not merely found in a supposedly external reality but are rather constructed by the instruments which enable their manifestation to us as scientific facts.

Convergently, in their book *Laboratory Life* (1986), Bruno Latour and Steve Woolgar, by drawing on Latour's anthropological fieldwork at the neuroendocrinology laboratory of the Salk Institute for Biological Studies, cogently show that scientific facts, objects and theories should not be regarded as autonomous, "natural" entities which scientists would innocently discover and bring to the fore of public attention, but are rather constructed within the laboratory setting by the multifarious practices of scientific activity. From this perspective, science is a creative process happening within laboratories, which operate as complexes of inscription devices culminating in the production of scientific papers.

According to Latour and Woolgar (1986, pp. 63–69), the material apparatus of a laboratory, i.e., the particular instruments adopted to carry out the research to which that laboratory is devoted, also works as a set of inscription devices, which the authors, inspired by the French philosopher Gaston Bachelard (1953), call phenomenotechnique. Once an inscription, such as a coloured plate resulting from a bioassay, is produced, the material operations which contributed to its production tend to fall in the background and are regarded as irrelevant "technicalities", while an immediate correlation between the inscription and some substance "out there" is assumed. However, the latter does not exist independently of the technical apparatus devoted to its production and is ultimately undiscernible from it: "the bioassay is not merely a means of obtaining some independently given entity; the bioassay constitutes the construction of the substance" (Latour & Woolgar, 1986, p. 64).

Adopting this viewpoint enables us to appreciate how conceptual as well as material operations contribute to producing scientific knowledge. A scientific statement is constructed in a laboratory according to the interpretation of a set of inscriptions, i.e., scientific papers as well as the direct outcomes of the phenomenotechnique of the laboratory, such as graphs, stats and plates. When this

statement stabilizes, i.e., gauges consensus about its validity, it is considered objective reality and thereby reintroduced, in the form of a new scientific paper or instrument, into another laboratory, where it will operate as an inscription device devoted to constructing, in turn, other statements. Hence, scientific phenomena are constituted by particular sets of artefacts:

> it is not simply that phenomena *depend on* certain material instrumentation; rather, the phenomena *are thoroughly constituted by* the material setting of the laboratory. The artificial reality, which participants describe in terms of an objective entity, has in fact been constructed by the use of inscription devices (Latour & Woolgar, 1986, p. 64).

This conception does not aim to undermine the validity of scientific facts, but rather to draw our attention to their conditions of manifestation, i.e., the whereabouts of their production, thereby emphasizing their concrete specificity and historicity. Moreover, claiming that scientific practice is technically constituted as much as every other human activity should not prevent us from highlighting its specificity, as contended by Bas de Boer (2021b) relative to his postphenomenological analysis of neuroscience.

Genealogically, the reconstruction of a phenomenon amounts to its technical construction, i.e., the complex of operations conducive to its manifestation to us as a phenomenon through a given technoscientific apparatus. I think that this condition becomes evident when enquiring into anthropogenesis as a technical process. By doing so, indeed, we do not only investigate our origin through artefacts but also the origin of our relation to artefacts in general through particular artefacts. In Stiegler's words, "knowledge *of pharmaka* is also knowledge *through pharmaka*" (Stiegler, 2015a, p. 30, 2017a, p. 13): our understanding of technologies (*pharmaka*) is operated through technologies. This is even more so if we focus on those self-representing, cultural techniques, such as writing, on which scientific knowledge relies. As argued by Derrida, "writing is not only an auxiliary means in the service of science—and possibly its object—but first […] the condition of the possibility of ideal objects and therefore of scientific objectivity" (Derrida, 1976, pp. 42–43, 1997, p. 27).

Hence, enquiring into anthropogenesis as a technical process, as I set out to do in this research, presents a double recursion. First, I aim to account for the origin of ourselves as humans, i.e., organisms capable of accounting for their own origin. Secondly, I aim to account for the origin of technics—as what makes us humans, that is potential genealogists—while performing this investigation through technics—as what renders our human condition intelligible to ourselves.

CONCLUSION

THE TWOFOLD DIMENSION OF HUMAN CONSTITUTIVE TECHNICITY

In this research, I believe to have cogently shown how human technicity should be regarded as constitutive, i.e., our lifeform could neither exist nor evolve or be conceived of without its relation to artefacts. Our biology, cognition and behaviour are ontogenetically as well as phylogenetically and individually as well as collectively shaped by the usage, production and transmission of technical objects. Moreover, hominin populations have evolved by creating and employing complexes of techniques and technologies, collectively administered and transgenerationally transmitted, which have increasingly artificialized their environment, thereby altering its selection pressures. These novel affordances, in turn, have selected for those traits which better fit in with their artificial environment and, therefore, prove more suitable for taking advantage of it, thereby gaining better chances to reproduce and be passed on to the next generation. Finally, our self-representations, i.e., our understanding of what it means to be humans and why we are so and not otherwise, are enabled and constrained by particular sets of technical practices, especially concerning the contemporary technoscientific apparatus.

I have carried out this operation by critically interpreting Sloterdijk's and Stiegler's approaches as fully-fledged philosophies of technology and by showing their substantial convergence and compatibility relative to their conceptualization of human constitutive technicity and their focus on human evolution. This conceptual framework, backed up by scholarship in philosophical anthropology and Science and Technology Studies, has highlighted, in turn, Sloterdijk's and Stiegler's divergence from mainstream philosophy of technology. Hence, in this research I think that I have contributed to the state of the art in the study of technology, showing how the debate could be enriched by appreciating Sloterdijk's and Stiegler's insights into the relationship between humans and artefacts and thereby providing contemporary philosophy of technology with major epistemic challenges.

Thus, the main outcome of this research, I believe, consists in a thorough conceptualization of an evolutionarily informed theory of human constitutive technicity. I have developed this conceptual framework, on the one hand, in the wake of Sloterdijk's and Stiegler's insights. On the other, by engaging in a critical dialogue with the state of the art of evolutionary biology and palaeoanthropology. In order to enquire into the relationship between technics and the human lifeform, indeed, one should enquire into the origin of this relationship and, therefore, the findings and models coming from evolutionary sciences offer a privileged vantage on this endeavour.

Concurrently, we can only investigate our evolutionary origin thanks to a highly refined technoscientific apparatus, which enables and constrains this enquiry's proceedings and outcomes.

Specifically, I have submitted that we should consider human constitutive technicity in its twofold dimension. On the one side, technics represents the conditions of (im)possibility of our existence, i.e., we can only survive and thrive thanks to technics, but the latter is also what may jeopardize our mode of existence to the point of radically transfiguring or even destroying it. On the other, technics also represents the conditions of (im)possibility of our thinkability, i.e., we can only develop representations of what it means to be humans and reflectively dwell upon them thanks to our relation to artefacts, but the latter is also what may endanger and disrupt our capability to think and especially think creatively and meditatively about ourselves.

As I have argued above, these two conditions mutually influence one another, coevolving as two aspects of the same phenomenon. Our ideas about what it means to be humans influence what kinds of technical operations we wish to allow on ourselves. These operations, in turn, will alter our biology and, consequently, our cognition, thereby also transforming our self-representations. And these novel conceptions will yield different political decisions concerning how to deal with the human lifeform, thereby pursuing its individuation further.

From this perspective, I believe, we may appreciate how a critical reflection on technics, as it is outlined by my interpretation of Sloterdijk's and Stiegler's original contribution to the study of technology, may help us better understand the human condition. Technics, thusly conceptualized, not only renders us humans but also enables us to think of ourselves as humans, which becomes especially evident nowadays, since we feel increasingly challenged within our most intimate constitution by the contemporary outcomes of technoscientific development. Hence, investigating the modes of usage, production and transmission of artefacts bears major relevance to compelling ethical and political decisions.

BIBLIOGRAPHY

Abbinnett, R. (2019). *The Thought of Bernard Stiegler: Capitalism, Technology and the Politics of Spirit*. Routledge.

Achterhuis, H. (2001). Introduction: American Philosophers of Technology. In H. Achterhuis (Ed.), & R. P. Crease (Trans.), *American Philosophy of Technology: The Empirical Turn* (pp. 1–9). Indiana University Press.

Agamben, G. (2004). *The Open: Man and Animal* (K. Attell, Trans.). Stanford University Press.

Agamben, G. (2009a). *The Signature of All Things: On Method* (L. di Santo & K. Attell, Trans.). Zone Books.

Agamben, G. (2009b). *What Is an Apparatus? And Other Essays* (D. Kishik & S. Pedatella, Trans.). Stanford University Press.

Aiello, L. C., & Wheeler, P. (1995). The Expensive-Tissue Hypothesis: The Brain and the Digestive System in Human and Primate Evolution. *Current Anthropology*, *36*(2), 199–221.

Ainsworth, C. (2015). Sex Redefined. *Nature*, *518*, 288–291.

Alsberg, P. (1975). *Der Ausbruch aus dem Gefängnis: Zu den Entstehungsbedingungen des Menschen* (2nd ed.). Focus.

Ambrose, S. H. (2001). Paleolithic Technology and Human Evolution. *Science*, *291*(5509), 1748–1753.

Antón, S. C., & Kuzawa, C. W. (2017). Early *Homo*, Plasticity and the Extended Evolutionary Synthesis. *Interface Focus*, *7*(5).

Arendt, H. (1958). *The Human Condition*. University of Chicago Press.

Athreya, S., & Ackermann, R. R. (2020). Colonialism and Narratives of Human Origins in Asia and Africa. In M. Porr & J. M. Matthews (Eds.), *Interrogating Human Origins: Decolonisation and the Deep Human Past* (pp. 72–95). Routledge.

Auroux, S. (1994). *La révolution technologique de la grammatisation: Introduction à l'histoire des sciences du langage*. Mardaga.

Bachelard, G. (1953). *Le matérialisme rationnel*. Presses universitaires de France.

Baedke, J., Fábregas-Tejeda, A., & Prieto, G. I. (2021). Unknotting Reciprocal Causation between Organism and Environment. *Biology & Philosophy*, *36*(5).

Baldwin, J. M. (1896). A New Factor in Evolution. *The American Naturalist*, *30*(354), 441–451.

Barad, K. (2007). *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Duke University Press.

Bateson, G. (1987). *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology* (2nd ed.). Aronson.

Beardsworth, R. (1995). From a Genealogy of Matter to a Politics of Memory: Stiegler's Thinking of Technics. *Tekhnema, 2*, 85–115.

Bennington, G. (1996). Emergencies. *Oxford Literary Review*, *18*(1), 175–216.

Bentley-Condit, V. K., & Smith, E. O. (2010). Animal Tool Use: Current Definitions and an Updated Comprehensive Catalog. *Behaviour*, *147*(2), 185–221.

Bergson, H. (1907). *L'évolution créatrice*. Alcan.

Bergson, H. (2005). *Creative Evolution* (A. Mitchell, Trans.). Cosimo.

Berna, F., Goldberg, P., Horwitzc, L. K., Brink, J., Holt, S., Bamford, M., & Chazan, M. (2012). Microstratigraphic Evidence of In Situ Fire in the Acheulean Strata of Wonderwerk Cave, Northern Cape Province, South Africa. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(20), 1215–1220.

Bimbenet, É. (2017). *Le complexe des trois singes: Essai sur l'animalité humaine*. Seuil.

Birmingham, P. (2002). Heidegger and Arendt: The Birth of Political Action and Speech. In F. Raffoul & D. Pettigrew (Eds.), *Heidegger and Practical Philosophy* (pp. 191–202). State University of New York Press.

Bishop, R. (Ed.). (2022). Bernard Stiegler and the Internation Project: Computational Practices and Circumscribed Futures. *Theory, Culture & Society*, *39*(7–8).

Bjorklund, D. F. (1997). The Role of Immaturity in Human Development. *Psychological Bulletin*, *122*(2), 153–169.

Blad, S. (2010). The Impact of "Anthropotechnology" on Human Evolution. *Techné: Research in Philosophy and Technology*, *14*(2), 72–87.

Bolk, L. (1926). *Das Problem der Menschwerdung*. Fischer.

Bonaiuti, G. (2019). *Lo spettro sfinito: Note sul parassitismo metodico di Peter Sloterdijk*. Mimesis.

Borshay Lee, R., & DeVore, I. (Eds.). (1969). *Man the Hunter: The First Intensive Survey of a Single, Crucial Stage of Human Development—Man's Once Universal Hunting Way of Life*. Routledge.

Bowlby, J. (1958). The Nature of the Child's Tie to His Mother. *International Journal of Psychoanalysis*, *39*, 350–373.

Bradley, A. (2011). *Originary Technicity: The Theory of Technology from Marx to Derrida*. Palgrave Macmillan.

Bradley, J. P. N. (Ed.). (2022). Experiments in Negentropic Knowledge: Bernard Stiegler and the Philosophy of Education II. *Educational Philosophy and Theory*, *54*(5).

Bradley, J. P. N., & Kennedy, D. (Eds.). (2021). *Bernard Stiegler and the Philosophy of Education*. Routledge.

Brey, P. (2010). Philosophy of Technology After the Empirical Turn. *Techné: Research in Philosophy and Technology*, *14*(1), 36–48.

Bufill, E., Agustí, J., & Blesa, R. (2011). Human Neoteny Revisited: The Case of Synaptic Plasticity. *American Journal of Human Biology*, *23*(6), 729–739.

Burnet, F. M. (1959). *The Clonal Selection Theory of Acquired Immunity*. Vanderbilt University Press.

Burton, G. J., & Fowden, A. L. (2015). The Placenta: A Multifaceted, Transient Organ. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *370*(1663).

Buskell, A. (2019). Reciprocal Causation and the Extended Evolutionary Synthesis. *Biological Theory*, *14*(4), 267–279.

Butler, J. (1989). The Body Politics of Julia Kristeva. *Hypatia*, *3*(3), 104–118.

Canguilhem, G. (1965). *La connaissance de la vie* (2nd ed.). Vrin.

Canguilhem, G. (1972). *Le normal et le pathologique* (2nd ed.). Presses universitaires de France.

Canguilhem, G. (1991). *The Normal and the Pathological* (C. R. Fawcett, Trans.). Zone Books.

Canguilhem, G. (2008). *Knowledge of Life* (S. Geroulanos & D. Ginsburg, Trans.). Fordham University Press.

Cavalli-Sforza, L., & Feldman, M. W. (1973). Models for Cultural Inheritance I: Group Mean and Within Group Variation. *Theoretical Population Biology*, *4*(1), 42–55.

Cera, A. (2020). Beyond the Empirical Turn: Elements for an Ontology of Engineering. *Információs Társadalom*, *20*(4), 74–89.

Chappell, T. (2012). Varieties of Knowledge in Plato and Aristotle. *Topoi*, *31*, 175–190.

Claessens, D. (1970). *Instinkt, Psyche, Geltung: Bestimmungsfaktoren menschlichen Verhaltens* (2nd ed.). Westdeutscher Verlag.

Claessens, D. (1978). *Familie und Wertsystem: Eine Studie zur "zweiten, soziokulturellen Geburt" des Menschen* (4th ed.). Duncker & Humblot.

Claessens, D. (1993). *Das Konkrete und das Abstrakte: Soziologische Skizzen zur Anthropologie* (2nd ed.). Suhrkamp.

Cohen, E. (1986). Law, Folklore and Animal Lore. *Past & Present*, *110*, 6–37.

Collier, J. F., & Rosaldo, M. F. (1981). Politics and Gender in Simple Societies. In S. B. Ortner & H. Whitehead (Eds.), *Sexual Meanings: The Cultural Construction of Gender* (pp. 275–329). Cambridge University Press.

Colony, T. (2011). Epimetheus Bound: Stiegler on Derrida, Life, and the Technological Condition. *Research in Phenomenology*, *41*(1), 72–89.

Consoli, D. (2012). La filosofia oltre l'esercizio immunitario. *aut aut*, *355*, 171–184.

Consoli, D. (2017). *Introduzione a Peter Sloterdijk: Il mondo come coesistenza*. il melangolo.

Corballis, M. C. (2003). *From Hand to Mouth: The Origins of Language*. Princeton University Press.

Couture, J.-P. (Ed.). (2007). La pensée de Peter Sloterdijk. *Horizons Philosophiques*, *17*(2).

Couture, J.-P. (2015). *Sloterdijk*. Polity.

Cressman, D. (2022). A Short History of the Philosophy of Technology. In T. Swierstra, P. Lemmens, T. Sharon, & P. E. Vermaas (Eds.), *The Technical Condition: The Entanglement of Technology, Culture, and Society* (pp. 43–74). Boom.

Csibra, G., & Gergely, G. (2006). Social Learning and Social Cognition: The Case for Pedagogy. In Y. Munakata & M. H. Johnson (Eds.), *Processes of Change in Brain and Cognitive Development: Attention and Performance XXI* (pp. 249–274). Oxford University Press.

Cykowski, B. (2015). In Pursuit of Something "Essential" About Man: Heidegger and Philosophical Anthropology. In P. Honenberger (Ed.), *Naturalism and Philosophical Anthropology: Nature, Life and the Human between Transcendental and Empirical Perspectives* (pp. 27–48). Palgrave Macmillan.

Darwin, C. (1877). *The Descent of Man, and Selection in Relation to Sex* (2nd ed.). Murray.

de Boer, B. (2021a). Explaining Multistability: Postphenomenology and Affordances of Technologies. *AI & Society*.

de Boer, B. (2021b). *How Scientific Instruments Speak: Postphenomenology and Technological Mediations in Neuroscientific Practice*. Lexington Books.

De Boever, A. (Ed.). (2015). Bernard Stiegler: Amateur Philosophy. *boundary 2*, *44*(1).

de Conciliis, E. (2020). La madre nell'epoca della sua riproducibilità tecnica: Note femminili sulla sferologia. *S&F_*, *23*, 106–126.

de Conciliis, E. (2023). *Sloterdijk Suite: Espansione e riduzione dell'umano*. Meltemi.

DeCasper, A. J., & Fifer, W. P. (1980). Of Human Bonding: Newborns Prefer Their Mothers' Voices. *Science*, *208*(4448), 1174–1176.

DeLanda, M. (2015). *Philosophical Chemistry: Genealogy of a Scientific Field*. Bloomsbury.

Derrida, J. (1962). Introduction. In E. Husserl (Ed.), *L'origine de la géométrie. Traduction et introduction par Jacques Derrida* (pp. 3–171). Presses universitaires de France.

Derrida, J. (1967). *La voix et le phénomène*. Presses universitaires de France.

Derrida, J. (1972a). *La dissémination*. Seuil.

Derrida, J. (1972b). *Marges de la philosophie*. Les Éditions de Minuit.

Derrida, J. (1976). *De la grammatologie*. Les Éditions de Minuit.

Derrida, J. (1978). Introduction to *The Origin of Geometry*. In J. Derrida (Ed.), & J. P. Leavey (Trans.), *Edmund Husserl's Origin of Geometry: An Introduction* (pp. 25–153). University of Nebraska Press.

Derrida, J. (1981). *Dissemination* (B. Johnson, Trans.). University of Chicago Press.

Derrida, J. (1982). *Margins of Philosophy* (A. Bass, Trans.). University of Chicago Press.

Derrida, J. (1997). *Of Grammatology* (G. C. Spivak, Trans.; 2nd ed.). Johns Hopkins University Press.

Derrida, J. (2001). *Foi et savoir, suivi de Le siècle et le pardon*. Seuil.

Derrida, J. (2002). *Acts of Religion* (G. Anidjar, Ed.). Routledge.

Derrida, J. (2003a). Autoimmunity: Real and Symbolic Suicides. A Dialogue with Giovanna Borradori. In G. Borradori (Ed.), *Philosophy in a Time of Terror: Dialogues with Jürgen Habermas and Jacques Derrida* (pp. 85–136). University of Chicago Press.

Derrida, J. (2003b). *Voyous*. Galilée.

Derrida, J. (2005). *Rogues: Two Essays on Reason* (P.-A. Brault & M. Naas, Trans.). Stanford University Press.

Derrida, J. (2006). *L'animal que donc je suis*. Galilée.

Derrida, J. (2008). *The Animal That Therefore I Am* (D. Wills, Trans.). Fordham University Press.

Derrida, J. (2010). *Voice and Phenomenon: Introduction to the Problem of the Sign in Husserl's Phenomenology* (L. Lawlor, Trans.). Northwestern University Press.

Derrida, J., & Stiegler, B. (1996). *Échographies de la télévision: Entretiens filmés*. Galilée.

Derrida, J., & Stiegler, B. (2002). *Echographies of Television: Filmed Interviews* (J. Bajorek, Trans.). Polity.

Descola, P. (2005). *Par-delà nature et culture*. Gallimard.

Descola, P. (2013). *Beyond Nature and Culture* (J. Lloyd, Trans.). University of Chicago Press.

Di Martino, C. (2017). *Viventi umani e non umani: Tecnica, linguaggio, memoria*. Cortina.

Di Martino, C. (2019a). Corpus sive cultura: Nota su tecnica e corpi. *Aisthesis*, *12*(2), 39–50.

Di Martino, C. (2019b). Il simbolismo e i suoi antecedenti. *Sistemi Intelligenti*, *31*(1), 87–118.

Dillet, B., & Jugnon, A. (Eds.). (2013). *Technologiques: La pharmacie de Bernard Stiegler*. Defaut.

Dirakis, A. (2014). Pensée de l'être, pensée de l'homme: L'anthropologie de Peter Sloterdijk. *Le Debat*, *180*(3), 98–111.

Dobeneck, H. von. (2006). *Das Sloterdijk-Alphabet: Eine lexikalische Einführung in Sloterdijks Gedankenkosmos* (2nd ed.). Königshausen & Neumann.

Dubois, M. J. F. (2020a). Technique et néoténie 1: La technique fondatrice du processus de néoténisation vers l'humain. *Cahiers COSTECH*, *3*.

Dubois, M. J. F. (2020b). Technique et néoténie 2: Le rôle de la technique dans les quatre néoténisations qui constituent le processus d'hominisation. *Cahiers COSTECH*, *3*.

Dunsworth, H. M., Warrener, A. G., Deacon, T., Ellison, P. T., & Pontzer, H. (2012). Metabolic Hypothesis for Human Altriciality. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(38), 15212–15216.

Elden, S. (Ed.). (2012). *Sloterdijk Now*. Polity.

Engels, F. (1962). Anteil der Arbeit an der Menschwerdung des Affen. In K. Marx & F. Engels (Eds.), *Werke* (Vol. 20, pp. 444–455). Dietz.

Engels, F. (1987). The Part Played by Labour in the Transition from Ape to Man. In K. Marx & F. Engels (Eds.), & C. Dutt (Trans.), *Collected Works* (Vol. 25, pp. 452–464). International Publishers.

Esposito, R. (2010). *Communitas: The Origin and Destiny of Community* (T. C. Campbell, Trans.). Stanford University Press.

Esposito, R. (2011). *Immunitas: The Protection and Negation of Life* (Z. Hanafi, Trans.). Polity.

Esposito, R. (2012a). *Terms of the Political: Community, Immunity, Biopolitics* (R. N. Welch, Trans.). Fordham University Press.

Esposito, R. (2012b). *Third Person: Politics of Life and Philosophy of the Impersonal* (Z. Hanafi, Trans.). Polity.

Esposito, R. (2015). *Persons and Things: From the Body's Point of View* (Z. Hanafi, Trans.). Polity.

Evertz, K. (2021). Philosophical Aspects of Prenatal Time Using the Example of Peter Sloterdijk. In K. Evertz, L. Janus, & R. Linder (Eds.), *Handbook of Prenatal and Perinatal Psychology: Integrating Research and Practice* (pp. 707–711). Springer.

Feenberg, A. (2000). From Essentialism to Constructivism: Philosophy of Technology at the Crossroads. In E. Higgs, A. Light, & D. Strong (Eds.), *Technology and the Good Life?* (pp. 294–315). University of Chicago Press.

Ferraris, M. (2021). Oedipus' Stick. In S. Chiodo & V. Schiaffonati (Eds.), *Italian Philosophy of Technology: Socio-Cultural, Legal, Scientific and Aesthetic Perspectives on Technology* (pp. 13–29). Springer.

Foucault, M. (1966). *Les mots et les choses: Une archéologie des sciences humaines*. Gallimard.

Foucault, M. (1971). *L'ordre du discours*. Gallimard.

Foucault, M. (1975). *Surveiller et punir: Naissance de la prison*. Gallimard.

Foucault, M. (1981). The Order of Discourse. In R. Young (Ed.), & I. McLeod (Trans.), *Untying the Text: A Post-Structuralist Reader* (pp. 51–78). Routledge.

Foucault, M. (1989). *The Order of Things: An Archaeology of the Human Sciences* (A. Sheridan, Trans.). Routledge.

Foucault, M. (1994a). *Dits et écrits II: 1970–1975*. Gallimard.

Foucault, M. (1994b). *Dits et écrits IV: 1980–1988*. Gallimard.

Foucault, M. (1995). *Discipline and Punish: The Birth of the Prison* (A. Sheridan, Trans.). Penguin.

Foucault, M. (1997). *Ethics: Subjectivity and Truth* (P. Rabinow, Ed.; The Essential Works (1954–1984), Vol. 1). New Press.

Foucault, M. (1998). *Aesthetics: Method and Epistemology* (J. D. Faubion, Ed.; The Essential Works (1954–1984), Vol. 2). New Press.

Foucault, M. (2001). *L'herméneutique du sujet: Cours au Collège de France (1981–1982)*. Gallimard.

Foucault, M. (2005). *The Hermeneutics of the Subject: Lectures at the College de France 1981–1982* (G. Burchell, Trans.). Palgrave Macmillan.

Francis, R. C. (2015). *Domesticated: Evolution in a Man-Made World*. W.W. Norton.

Franssen, M., Vermaas, P. E., Kroes, P., & Meijers, A. W. M. (2016). Editorial Introduction: Putting the Empirical Turn into Perspective. In M. Franssen, P. E. Vermaas, P. Kroes, & A. W. M. Meijers (Eds.), *Philosophy of Technology After the Empirical Turn* (pp. 1–10). Springer.

Freud, S. (1942). *Werke aus den Jahren 1904–1905* (Gesammelte Werke, Vol. 5). Fischer.

Freud, S. (1947). *Werke aus den Jahren 1917–1920* (Gesammelte Werke, Vol. 12). Fischer.

Freud, S. (1948). *Werke aus den Jahren 1925–1931* (Gesammelte Werke, Vol. 14). Fischer.

Freud, S. (1953). *A Case of Hysteria, Three Essays on Sexuality and Other Works (1901–1905)* (J. Strachey, Ed.; Standard Edition of the Complete Psychological Works, Vol. 7). Hogarth.

Freud, S. (1955). *An Infantile Neurosis and Other Works (1917–1919)* (J. Strachey, Ed.; Standard Edition of the Complete Psychological Works, Vol. 17). Hogarth.

Freud, S. (1959). *An Autobiographical Study, Inhibitions, Symptoms and Anxiety, Lay Analysis and Other Works (1925–1926)* (J. Strachey, Ed.; Standard Edition of the Complete Psychological Works, Vol. 20). Hogarth.

Futuyma, D. J. (2017). Evolutionary Biology Today and the Call for an Extended Synthesis. *Interface Focus, 7*(5).

Gabriel, M. (2011). *Transcendental Ontology: Essays in German Idealism*. Continuum.

Garstang, W. (1922). The Theory of Recapitulation: A Critical Re-Statement of the Biogenetic Law. *Journal of the Linnean Society of London, Zoology, 35*(232), 81–101.

Gehlen, A. (1950). *Der Mensch: Seine Natur und seine Stellung in der Welt* (4th ed.). Athenäum Verlag.

Gehlen, A. (1956). *Urmensch und Spätkultur: Philosophische Ergebnisse und Aussagen*. Athenäum Verlag.

Gehlen, A. (1988). *Man: His Nature and Place in the World* (C. McMillan & K. Pillemer, Trans.). Columbia University Press.

Georgescu-Roegen, N. (1977). Inequality, Limits and Growth from a Bioeconomic Viewpoint. *Review of Social Economy, 35*(3), 361–375.

Gibson, J. J. (1977). The Theory of Affordances. In R. E. Shaw & J. D. Bransford (Eds.), *Perceiving, Acting, and Knowing: Towards an Ecological Psychology* (pp. 67–82). Polity.

Gilbert, J., & Roberts, B. (Eds.). (2013). Bernard Stiegler: Technics, Politics, Individuation. *New Formations: A Journal of Culture/Theory/Politics, 77*.

Gilbert, S. F., & Epel, D. (2015). *Ecological Developmental Biology: Integrating Epigenetics, Medicine, and Evolution* (2nd ed.). Sinauer Associates.

Gilbert, S. F., Sapp, J., & Tauber, A. I. (2012). A Symbiotic View of Life: We Have Never Been Individuals. *Quarterly Review of Biology*, *87*(4), 325–341.

Gille, B. (1978). Prolégomènes à une histoire des techniques. In B. Gille (Ed.), *Histoire des techniques* (pp. 3–118). Gallimard.

Gille, B. (1986). Prolegomena to a History of Techniques. In B. Gille (Ed.), & P. Southgate & T. Williamson (Trans.), *The History of Techniques 1: Techniques and Civilizations* (pp. 3–96). Gordon & Breach.

Gould, S. J. (1977). *Ontogeny and Phylogeny*. Harvard University Press.

Gould, S. J. (1982). Darwinism and the Expansion of Evolutionary Theory. *Science*, *216*(4544), 380–387.

Gould, S. J. (1991). Exaptation: A Crucial Tool for an Evolutionary Psychology. *Journal of Social Issues*, *47*(3), 43–65.

Gould, S. J., & Lewontin, R. C. (1979). The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme. *Proceedings of the Royal Society B: Biological Sciences*, *205*(1161), 581–598.

Grillmeyer, S., Müller-Zähringer, E., & Rahner, J. (Eds.). (2015). *Peterchens Mondfahrt: Peter Sloterdijk, die Religion und die Theologie*. Echter.

Günther, G. (2002). *Das Bewusstsein der Maschinen: Eine Metaphysik der Kybernetik* (3rd ed.). Agis.

Gutmann, M. (2002). Der Mensch als technisches Wesen: Systematische Überlegungen zum Verständnis menschlicher Konstitution. In G. Banse & A. Kiepas (Eds.), *Rationalität heute: Vorstellungen, Wandlungen, Herausforderungen* (pp. 171–190). Litt.

Gutmann, M., Hertler, C., & Schrenk, F. (2010). Der Mensch als Gegenstand der Paläoanthropologie und das Problem der Szenarien. In D. Ganten, V. Gerhardt, J.-C. Heilinger, & J. Nida-Rümelin (Eds.), *Humanprojekt: Interdisziplinäre Anthropologie* (pp. 135–161). de Gruyter.

Gutmann, M., & Weingarten, M. (2015). Paleoanthropology and the Foundation of Ethics: Methodological Remarks on the Problem of Criteriology. In W. Henke & I. Tattersall (Eds.), *Handbook of Paleoanthropology* (2nd ed., pp. 2537–2562). Springer.

Hacking, I. (1983). *Representing and Intervening: Introductory Topics in the Philosophy of Natural Science*. Cambridge University Press.

Hadot, P. (1987). *Exercices spirituels et philosophie antique* (2nd ed.). Études augustiniennes.

Hadot, P. (1995). *Philosophy as a Way of Life: Spiritual Exercises from Socrates to Foucault* (M. Chase, Trans.). Polity.

Haeckel, E. (1866). *Generelle Morphologie der Organismen: Allgemeine Grundzüge der organischen Formen-Wissenschaft, mechanisch begründet durch die von Charles Darwin reformirte Descendenz-Theorie*. Reimer.

Hägglund, M. (2011). The Arche-Materiality of Time: Deconstruction, Evolution and Speculative Materialism. In J. Elliott & D. Attridge (Eds.), *Theory After "Theory"* (pp. 265–277). Routledge.

Haidle, M. N., Bolus, M., Collard, M., Conard, N. J., Garofoli, D., Lombard, M., Nowell, A., Tennie, C., & Whiten, A. (2015). The Nature of Culture: An Eight-Grade Model for the Evolution and Expansion of Cultural Capacities in Hominins and Other Animals. *Journal of Anthropological Sciences*, *93*, 43–70.

Haraway, D. J. (1991). *Simians, Cyborgs, and Women: The Reinvention of Nature*. Routledge.

Harding, S. (1992). Rethinking Standpoint Epistemology: What Is "Strong Objectivity?" *Centennial Review*, *36*(3), 437–470.

Harman, G. (2010). Technology, Objects and Things in Heidegger. *Cambridge Journal of Economics*, *34*(1), 17–25.

Harmand, S., Lewis, J. E., Feibel, C. S., Lepre, C. J., Prat, S., Lenoble, A., Boës, X., Quinn, R. L., Brenet, M., Arroyo, A., Taylor, N., Clément, S., Daver, G., Brugal, J.-P., Leakey, L., Mortlock, R. A., Wright, J., Lokorodi, S., Kirwa, C., Kent, D. V., & Roche, H. (2015). 3.3-Million-Year-Old Stone Tools from Lomekwi 3, West Turkana, Kenya. *Nature*, *521*, 310–315.

Hashimoto, T., Ueno, K., Ogawa, A., Asamizuya, T., Suzuki, C., Cheng, K., Tanaka, M., Taoka, M., Iwamura, Y., Suwa, G., & Iriki, A. (2013). Hand Before Foot? Cortical Somatotopy Suggests Manual Dexterity Is Primitive and Evolved Independently of Bipedalism. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *368*(1630).

Havelange, V., Lenay, C., & Stewart, J. R. (2002). Les représentations: Mémoire externe et objets techniques. *Intellectica*, *35*(2), 115–129.

Haworth, M. (2016). Bernard Stiegler on Transgenerational Memory and the Dual Origin of the Human. *Theory, Culture & Society*, *33*(3), 151–173.

Heard, E., & Martienssen, R. A. (2014). Transgenerational Epigenetic Inheritance: Myths and Mechanisms. *Cell*, *157*(1), 95–109.

Heidegger, M. (1969). *Identity and Difference* (J. Stambaugh, Trans.). University of Chicago Press.

Heidegger, M. (1973). *The End of Philosophy* (J. Stambaugh, Trans.). University of Chicago Press.

Heidegger, M. (1975). *Die Grundprobleme der Phänomenologie* (Gesamtausgabe, Vol. 24). Klostermann.

Heidegger, M. (1976). *Wegmarken* (Gesamtausgabe, Vol. 9). Klostermann.

Heidegger, M. (1977a). *Sein und Zeit* (Gesamtausgabe, Vol. 2). Klostermann.

Heidegger, M. (1977b). *The Question Concerning Technology and Other Essays* (W. Lovitt, Trans.). HarperCollins.

Heidegger, M. (1982). *The Basic Problems of Phenomenology* (A. Hofstadter, Trans.). Indiana University Press.

Heidegger, M. (1983). *Die Grundbegriffe der Metaphysik: Welt—Endlichkeit—Einsamkeit* (Gesamtausgabe, Vols. 29–30). Klostermann.

Heidegger, M. (1995). *The Fundamental Concepts of Metaphysics: World, Finitude, Solitude* (W. McNeill & N. Walker, Trans.). Indiana University Press.

Heidegger, M. (1998). *Pathmarks* (W. McNeill, Trans.). Cambridge University Press.

Heidegger, M. (2000). *Vorträge und Aufsätze* (Gesamtausgabe, Vol. 7). Klostermann.

Heidegger, M. (2006). *Identität und Differenz* (Gesamtausgabe, Vol. 11). Klostermann.

Heidegger, M. (2010). *Being and Time* (J. Stambaugh, Trans.; 2nd ed.). State University of New York Press.

Heinrichs, H.-J. (2011). *Peter Sloterdijk: Die Kunst des Philosophierens*. Hanser.

Herder, J. G. (1967). *Sämtliche Werke* (Vol. 5). Olms.

Herder, J. G. (2002). *Philosophical Writings* (M. N. Forster, Trans.). Cambridge University Press.

Hoel, A. A. S. (2022). Styles of Objectivity in Scientific Instrumentation. In S. Vallor (Ed.), *The Oxford Handbook of Philosophy of Technology* (pp. 103–127). Oxford University Press.

Howells, C., & Moore, G. (Eds.). (2013). *Stiegler and Technics*. Edinburgh University Press.

Hrdy, S. B. (2007). Evolutionary Context of Human Development: The Cooperative Breeding Model. In C. A. Salmon & T. K. Shackelford (Eds.), *Family Relationships: An Evolutionary Perspective* (pp. 39–68). Oxford University Press.

Hui, Y. (2016). *The Question Concerning Technology in China: An Essay in Cosmotechnics*. Urbanomic.

Hui, Y. (2017a). Cosmotechnics as Cosmopolitics. *e-flux*, *86*.

Hui, Y. (2017b). On Cosmotechnics: For a Renewed Relation between Technology and Nature in the Anthropocene. *Techné: Research in Philosophy and Technology*, *21*(2–3), 319–341.

Huneman, P., & Walsh, D. M. (2017). Introduction: Challenging the Modern Synthesis. In P. Huneman & D. M. Walsh (Eds.), *Challenging the Modern Synthesis: Adaptation, Development, and Inheritance* (pp. 1–33). Oxford University Press.

Hunt, G. R., & Gray, R. D. (2003). Diversification and Cumulative Evolution in New Caledonian Crow Tool Manufacture. *Proceedings of the Royal Society B: Biological Sciences*, *270*, 867–874.

Hunt, K. D. (2015). Bipedalism. In M. P. Muehlenbein (Ed.), *Basics in Human Evolution* (pp. 103–112). Academic Press.

Husserl, E. (1954). *Die Krisis der europäischen Wissenschaften und die transzendentale Phänomenologie: Eine Einleitung in die phänomenologische Philosophie* (Husserliana, Vol. 6). Springer.

Husserl, E. (1966). *Zur Phänomenologie des Inneren Zeitbewusstseins (1893–1917)* (Husserliana, Vol. 10). Springer.

Husserl, E. (1968). *Phänomenologische Psychologie: Vorlesungen Sommersemester 1925* (Husserliana, Vol. 9). Springer.

Husserl, E. (1970). *The Crisis of European Sciences and Transcendental Phenomenology: An Introduction to Phenomenological Philosophy* (D. Carr, Trans.). Northwestern University Press.

Husserl, E. (1977). *Phenomenological Psychology: Lectures, Summer Semester, 1925* (J. Scanlon, Trans.). Nijhoff.

Husserl, E. (1991). *On the Phenomenology of the Consciousness of Internal Time (1893–1917)* (J. B. Brough, Trans.; Husserliana, Vol. 4). Springer.

Ihde, D. (1990). *Technology and the Lifeworld: From Garden to Earth*. Indiana University Press.

Ihde, D. (1998). *Expanding Hermeneutics: Visualism in Science*. Northwestern University Press.

Ihde, D., & Malafouris, L. (2019). *Homo faber* Revisited: Postphenomenology and Material Engagement Theory. *Philosophy & Technology*, *32*(2), 195–214.

Ingold, T. (2013). *Making: Anthropology, Archaeology, Art and Architecture*. Routledge.

Isaac, G. L. (1983). Aspects of Human Evolution. In D. S. Bendall (Ed.), *Evolution from Molecules to Men* (pp. 509–543). Cambridge University Press.

Jablonka, E., & Lamb, M. J. (2006). The Evolution of Information in the Major Transitions. *Journal of Theoretical Biology*, *239*(2), 236–246.

James, I. (2010). Bernard Stiegler and the Time of Technics. *Cultural Politics*, *6*(2), 207–228.

James, I. (2013). Technics and Cerebrality. In C. Howells & G. Moore (Eds.), *Stiegler and Technics* (pp. 69–84). Edinburgh University Press.

Jerne, N. K. (1974). Towards a Network Theory of the Immune System. *Annales de l'Institut Pasteur/Immunologie*, *125*(3), 373–389.

Johnson, C. (2011). Leroi-Gourhan and the Limits of the Human. *French Studies*, *65*(4), 471–487.

Jongen, M. S. (2008). Sein und Raum: Scholien zum "ungeschriebenen Über-Buch der abendländischen Philosophie". In M. S. Jongen (Ed.), *Philosophie des Raumes: Standortbestimmungen ästhetischer und politischer Theorie* (2nd ed., pp. 59–88). Fink.

Jongen, M. S., van Tuinen, S., & Hemelsoet, K. (Eds.). (2006). *Die Vermessung des Ungeheuren: Philosophie nach Peter Sloterdijk*. Fink.

Jugnon, A. (2022). *Aimer Stiegler: Le panseur sur scène*. Sans Crispation.

Kallscheuer, O. (Ed.). (1987). *Peter Sloterdijks "Kritik der zynischen Vernunft"*. Suhrkamp.

Kant, I. (1923). *Gesammelte Schriften: Akademieausgabe* (Vol. 7). de Gruyter.

Kant, I. (2006). *Anthropology from a Pragmatic Point of View* (R. B. Louden, Trans.). Cambridge University Press.

Kapp, E. (1877). *Grundlinien einer Philosophie der Technik: Zur Entstehungsgeschichte der Kultur aus neuen Gesichtspunkten*. Westermann.

Kapp, E. (2018). *Elements of a Philosophy of Technology: On the Evolutionary History of Culture* (L. K. Wolfe, Trans.). University of Minnesota Press.

Karsenti, B. (1998). Techniques du corps et normes sociales: De Mauss à Leroi-Gourhan. *Intellectica*, *26–27*(1–2), 227–239.

Kiran, A. H. (2015). Four Dimensions of Technological Mediation. In R. Rosenberger & P.-P. Verbeek (Eds.), *Postphenomenological Investigations: Essays on Human-Technology Relations* (pp. 123–140). Lexington Books.

Kissel, M., & Fuentes, A. (2021). The Ripples of Modernity: How We Can Extend Paleoanthropology with the Extended Evolutionary Synthesis. *Evolutionary Anthropology*, *30*(1), 84–98.

Ko, K. H. (2015). Origins of Bipedalism. *Brazilian Archives of Biology and Technology*, *58*(6), 929–934.

Kollmann, J. (1885). Das Überwintern von europäischen Frosch- und Tritonlarven und die Umwandlung des mexikanischen Axolotls. *Verhandlungen der Naturforschenden Gesellschaft in Basel*, *7*, 387–398.

Kollmann, J. (1905). Neue Gedanken über das alte Problem von der Abstammung des Menschen. *Correspondenz-Blatt der Deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte*, *36*(2–3), 9–20.

Krämer, S. (2003). Technik als Kulturtechnik: Kleines Plädoyer für eine kulturanthropologische Erweiterung des Technikkonzeptes. In K. Kornwachs (Ed.), *Technik—System—Verantwortung* (pp. 157–164). Litt.

Krämer, S., & Bredekamp, H. (2003). Kultur, Technik, Kulturtechnik: Wider die Diskursivierung der Kultur. In S. Krämer & H. Bredekamp (Eds.), *Bild, Schrift, Zahl* (pp. 11–22). Fink.

Krämer, S., & Bredekamp, H. (2013). Culture, Technology, Cultural Techniques—Moving Beyond Text (M. Wutz, Trans.). *Theory, Culture & Society*, *30*(6), 20–29.

Kristeva, J. (1977). *Polylogue*. Seuil.

Kristeva, J. (1980). *Desire in Language: A Semiotic Approach to Literature and Art* (T. Gora, A. Jardine, & L. S. Roudiez, Trans.). Columbia University Press.

Kroes, P., & Meijers, A. W. M. (2000). Introduction: A Discipline in Search of Its Identity. In P. Kroes & A. W. M. Meijers (Eds.), *The Empirical Turn in the Philosophy of Technology* (pp. xviii–xxxv). JAI Press.

Lacoue-Labarthe, P., & Nancy, J.-L. (1981). Ouverture. In P. Lacoue-Labarthe & J.-L. Nancy (Eds.), *Rejouer le politique* (pp. 11–28). Galilée.

Laland, K. N., & Brown, G. R. (2006). Niche Construction, Human Behavior, and the Adaptive-Lag Hypothesis. *Evolutionary Anthropology*, *15*(3), 95–104.

Laland, K. N., Kendal, J. R., & Brown, G. R. (2007). The Niche Construction Perspective: Implications for Evolution and Human Behaviour. *Journal of Evolutionary Psychology*, *5*(1–4), 51–66.

Laland, K. N., Odling-Smee, F. J., & Feldman, M. W. (2001). Cultural Niche Construction and Human Evolution. *Journal of Evolutionary Biology*, *14*(1), 22–33.

Laland, K. N., Odling-Smee, F. J., & Myles, S. (2010). How Culture Shaped the Human Genome: Bringing Genetics and the Human Sciences Together. *Nature Reviews: Genetics*, *11*(2), 137–148.

Laland, K. N., Sterelny, K., Odling-Smee, F. J., Hoppitt, W., & Uller, T. (2011). Cause and Effect in Biology Revisited: Is Mayr's Proximate-Ultimate Dichotomy Still Useful? *Science*, *334*(6062), 1512–1516.

Laland, K. N., Uller, T., Feldman, M. W., Sterelny, K., Müller, G. B., Moczek, A., Jablonka, E., & Odling-Smee, F. J. (2015). The Extended Evolutionary Synthesis: Its Structure, Assumptions and Predictions. *Proceedings of the Royal Society B: Biological Sciences*, *282*(1813).

Landau, M. (1984). Human Evolution as Narrative: Have Hero Myths and Folktales Influenced Our Interpretations of the Evolutionary Past? *American Scientist*, *72*(3), 262–268.

Latina, M. (2013). Nicchie ecologiche e nicchia ontologica: Una riflessione tra le teorie della *niche construction* e la *Lichtung* di Peter Sloterdijk. *S&F_*, *10*, 113–124.

Latour, B. (1990). Technology Is Society Made Durable. *Sociological Review*, *38*(1), 103–131.

Latour, B. (1991). *Nous n'avons jamais été modernes: Essai d'anthropologie symétrique*. La Découverte.

Latour, B. (1993). *We Have Never Been Modern* (C. Porter, Trans.). Harvard University Press.

Latour, B. (1994). On Technical Mediation—Philosophy, Sociology, Genealogy. *Common Knowledge*, *3*(2), 29–64.

Latour, B. (1999). *Politiques de la nature: Comment faire entrer les sciences en démocratie*. La Découverte.

Latour, B. (2004). *Politics of Nature: How to Bring the Sciences into Democracy* (C. Porter, Trans.). Harvard University Press.

Latour, B. (2005). *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford University Press.

Latour, B. (2008). Where Are the Missing Masses? Sociology of a Few Mundane Artefacts. In D. J. Johnson & J. M. Wetmore (Eds.), *Technology and Society: Building Our Sociotechnical Future* (pp. 151–180). MIT Press.

Latour, B. (2009a). A Cautious Prometheus? A Few Steps Toward a Philosophy of Design (with Special Attention to Peter Sloterdijk). In J. Glynne, F. Hackney, & V. Minton (Eds.), *Networks of Design: Proceedings of the 2008 Annual International Conference of the Design History Society (UK), University College Falmouth, 3–6 September* (pp. 2–10). Universal Publishers.

Latour, B. (2009b). Spheres and Networks: Two Ways to Reinterpret Globalization. *Harvard Design Magazine*, *30*.

Latour, B. (2012). *Enquête sur les modes d'existence: Une anthropologie des modernes*. La Découverte.

Latour, B. (2013). *An Inquiry into Modes of Existence: An Anthropology of the Moderns* (C. Porter, Trans.). Harvard University Press.

Latour, B. (2015). *Face à Gaïa: Huit conférences sur le nouveau régime climatique*. La Découverte.

Latour, B. (2017). *Facing Gaia: Eight Lectures on the New Climatic Regime* (C. Porter, Trans.). Polity.

Latour, B., & Strum, S. C. (1986). Human Social Origins: Oh Please, Tell Us Another Story. *Journal of Social and Biological Structures*, *9*(2), 169–187.

Latour, B., & Woolgar, S. (1986). *Laboratory Life: The Construction of Scientific Facts* (2nd ed.). Princeton University Press.

Leach, H. M. (2003). Human Domestication Reconsidered. *Current Anthropology*, *44*(3), 349–368.

Leach, H. M. (2007). Selection and the Unforeseen Consequences of Domestication. In R. Cassidy & M. Mullin (Eds.), *Where the Wild Things Are Now: Domestication Reconsidered* (pp. 71–99). Berg.

Leghissa, G. (2012). L'esercizio come condizione di possibilità del soggetto (e della sua sparizione). *aut aut*, *355*, 19–36.

Leigh, S. R. (2004). Brain Growth, Life History, and Cognition in Primate and Human Evolution. *American Journal of Primatology*, *62*(3), 139–164.

Lemmens, P. (2009). The Detached Animal: On the Technical Nature of Being Human. In M. A. M. Drenthen, F. W. J. Keulartz, & J. Proctor (Eds.), *New Visions of Nature: Complexity and Authenticity* (pp. 117–127). Springer.

Lemmens, P. (2017). Thinking through Media: Stieglerian Remarks on a Possible Postphenomenology of Media. In Y. van den Eede, S. O'Neal Irwin, G. Wellner, & D. Ihde (Eds.), *Postphenomenology and Media: Essays on Human-Media-World Relations* (pp. 185–206). Lexington Books.

Lemmens, P. (2021). Thinking Technology Big Again: Reconsidering the Question of the Transcendental and "Technology with a Capital T" in the Light of the Anthropocene. *Foundations of Science*.

Lemmens, P., & Hui, Y. (2017a). Apocalypse, Now! Peter Sloterdijk and Bernard Stiegler on the Anthropocene. *boundary 2*.

Lemmens, P., & Hui, Y. (2017b). Reframing the Technosphere: Peter Sloterdijk and Bernard Stiegler's Anthropotechnological Diagnoses of the Anthropocene. *Krisis: Journal for Contemporary Philosophy*, *2*, 26–41.

Leroi-Gourhan, A. (1964). *Le geste et la parole 1: Technique et langage*. Michel.

Leroi-Gourhan, A. (1965). *Le geste et la parole 2: La mémoire et les rythmes*. Michel.

Leroi-Gourhan, A. (1971). *Évolution et techniques 1: L'homme et la matière* (2nd ed.). Michel.

Leroi-Gourhan, A. (1973). *Évolution et techniques 2: Milieu et techniques* (2nd ed.). Michel.

Leroi-Gourhan, A. (2018). *Gesture and Speech* (A. Bostock Berger, Trans.). MIT Press.

Levivier, M. (2012). Addiction, pharmakon et néoténie. *Psychotropes*, *18*(1), 103–116.

Lewis, M. (2013). Of a Mythical Philosophical Anthropology: The Transcendental and the Empirical in *Technics and Time*. In C. Howells & G. Moore (Eds.), *Stiegler and Technics* (pp. 53–68). Edinburgh University Press.

Lewontin, R. C. (1991). Facts and the Factitious in Natural Sciences. *Critical Inquiry*, *18*(1), 140–153.

Liggieri, K. (2014). "Ich nahm mich selbst in die Hand" (*Ecce homo*): Die Lebenskunst Nietzsches als Selbsttechnik bei Michel Foucault und als Anthropotechnik bei Peter Sloterdijk. *Nietzscheforschung*, *21*(1), 243–254.

Loeve, S., Guchet, X., & Bensaude Vincent, B. (2018). Is There a French Philosophy of Technology? General Introduction. In S. Loeve, X. Guchet, & B. Bensaude Vincent (Eds.), *French Philosophy of Technology: Classical Readings and Contemporary Approaches* (pp. 1–20). Springer.

Lorenz, K. Z. (1965). *Über tierisches und menschliches Verhalten: Aus dem Werdegang der Verhaltenslehre* (Vol. 2). Piper.

Lorenz, K. Z. (1971). *Studies in Animal and Human Behaviour* (R. Martin, Trans.; Vol. 2). Harvard University Press.

Lotka, A. J. (1945). The Law of Evolution as a Maximal Principle. *Human Biology*, *17*(3), 167–194.

Lucci, A. (2010). Il problema dell'uomo tra Peter Sloterdijk e Arnold Gehlen: Una questione antropologica. *Lo Sguardo*, *3*(2).

Lucci, A. (2011). *Il limite delle sfere: Saggio su Peter Sloterdijk*. Bulzoni.

Lucci, A. (2013). Il concetto di tecnica nel pensiero di Peter Sloterdijk. In B. Bonato & C. Tondo (Eds.), *Fabbricare l'uomo: Tecniche e politiche della vita* (pp. 111–130). Mimesis.

Lucci, A. (2014a). *Peter Sloterdijk*. doppiozero.

Lucci, A. (2014b). *Un'acrobatica del pensiero: La filosofia dell'esercizio di Peter Sloterdijk*. Aracne.

Lucci, A. (2016). Antropotecnica e Negantropocene: Un confronto tra Sloterdijk e Stiegler. *aut aut*, *371*, 105–118.

Lucci, A. (2021). The Limits of the Spheres: Otherness and Solipsism in Peter Sloterdijk's Philosophy. *Angelaki: Journal of the Theoretical Humanities*, *26*(1), 92–108.

Lysemose, K. (2012). The Being, the Origin and the Becoming of Man: A Presentation of Philosophical Anthropogenealogy and Some Ensuing Methodological Considerations. *Human Studies*, *35*(1), 115–130.

Macho, T. (1987). *Todesmetaphern: Zur Logik der Grenzerfahrung*. Suhrkamp.

Macho, T. (1993). Zeichen aus der Dunkelheit: Notizen zu einer Theorie der Psychose. In R. Heinz, D. Kamper, & U. Sonnemann (Eds.), *Wahnwelten im Zusammenstoß: Die Psychose als Spiegel der Zeit* (pp. 223–240). Akademie Verlag.

Macho, T. (2000a). Der Aufstand der Haustiere. In Various Authors (Eds.), *Herausforderung Tier: Von Beuys bis Kabakov* (pp. 76–99). Prestel.

Macho, T. (2000b). Mit sich allein: Einsamkeit als Kulturtechnik. In A. Assmann & J. Assmann (Eds.), *Einsamkeit: Archäologie der literarischen Kommunikation VI* (pp. 27–44). Fink.

Macho, T. (2003). Zeit und Zahl: Kalender- und Zeitrechnung als Kulturtechniken. In S. Krämer & H. Bredekamp (Eds.), *Bild, Schrift, Zahl* (pp. 179–192). Fink.

Macho, T. (2008). Tiere zweiter Ordnung: Kulturtechniken der Identität und Identifikation. In D. Baecker, M. Kettner, & D. Rustemeyer (Eds.), *Über Kultur: Theorie und Praxis der Kulturreflexion* (pp. 99–117). de Gruyter.

Macho, T. (2011). *Vorbilder*. Fink.

Macho, T. (2013a). Befehlen: Kulturtechniken der sozialen Synchronisation. In C. Kassung & T. Macho (Eds.), *Kulturtechniken der Synchronisation* (pp. 57–74). Fink.

Macho, T. (2013b). Second-Order Animals: Cultural Techniques of Identity and Identification (M. Wutz, Trans.). *Theory, Culture & Society*, *30*(6), 30–47.

Macho, T. (2013c). Tiere, Menschen, Maschinen: Für einen inklusiven Humanismus. In K. P. Liessmann (Ed.), *Tiere: Der Mensch und seine Natur* (pp. 153–173). Zsolnay.

Macho, T. (2021). Alone with Oneself: Solitude as Cultural Technique (S. Rashof, Trans.). *Angelaki: Journal of the Theoretical Humanities*, *26*(1), 9–21.

Malafouris, L. (2013). *How Things Shape the Mind*. MIT Press.

Malafouris, L. (2019). Mind and Material Engagement. *Phenomenology and the Cognitive Sciences*, *18*(1), 1–17.

Malm, A. (2018). *The Progress of This Storm: Nature and Society in a Warming World*. Verso.

Margulis, L. (1991). Symbiogenesis and Symbionticism. In L. Margulis & R. Fester (Eds.), *Symbiosis as a Source of Evolutionary Innovation* (pp. 1–14). MIT Press.

Marquard, O. (2000). *Philosophie des Stattdessen: Studien*. Reclam.

Martin, E. (1990). Toward an Anthropology of Immunology: The Body as Nation State. *Medical Anthropology Quarterly*, *4*(4), 410–426.

Mauss, M. (1950). *Sociologie et anthropologie*. Presses universitaires de France.

Mauss, M. (1973). Techniques of the Body (B. Brewster, Trans.). *Economy and Society*, *2*(1), 70–88.

Mayr, E. (1961). Cause and Effect in Biology. *Science*, *134*(3489), 1501–1506.

McKinney, M. L. (2000). Evolving Behavioral Complexity by Extending Development. In S. T. Parker, J. Langer, & M. L. McKinney (Eds.), *Biology, Brains, and Behavior: The Evolution of Human Development* (pp. 25–40). School for Advanced Research Press.

McNeill, W. (1992). Metaphysics, Fundamental Ontology, Metontology 1925–1935. *Heidegger Studies*, *8*, 63–79.

Melandri, E. (1967). Michel Foucault: L'epistemologia delle scienze umane. *Lingua e Stile*, *2*(1), 75–96.

Melandri, E. (1970). Note in margine all'"episteme" di Foucault. *Lingua e Stile*, *5*(1), 145–156.

Mesoudi, A., Whiten, A., & Laland, K. N. (2004). Is Human Cultural Evolution Darwinian? Evidence Reviewed from the Perspective of *The Origin of Species*. *Evolution*, *58*(1), 1–11.

Metchnikoff, E. (1901). *L'immunité dans les maladies infectieuses*. Masson.

Metchnikoff, E. (1905). *Immunity in Infective Diseases* (F. G. Binnie, Trans.). Cambridge University Press.

Michaud, Y. (2011). *Humain, inhumain, trop humain: Réflexions philosophiques sur les biotechnologies, la vie et la conservation de soi à partir de l'œuvre de Peter Sloterdijk* (2nd ed.). Climats.

Miller, D. J., Duka, T., Stimpson, C. D., Schapiro, S. J., Baze, W. B., McArthur, M. J., Fobbs, A. J., Sousa, A. M. M., Šestan, N., Wildman, D. E., Lipovich, L., Kuzawa, C. W., Hof, P. R., & Sherwood, C. C. (2012). Prolonged Myelination in Human Neocortical Evolution. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(41), 16480–16485.

Miller, H. (1963). *Progress and Decline: The Group in Evolution*. Ritchie.

Mitcham, C. (1985). What Is the Philosophy of Technology? *International Philosophical Quarterly*, *25*(1), 73–88.

Montagu, M. F. A. (1955). Time, Morphology, and Neoteny in the Evolution of Man. *American Anthropologist*, *57*(1), 13–27.

Moore, G. (2013). Adapt and Smile or Die! Stiegler among the Darwinists. In C. Howells & G. Moore (Eds.), *Stiegler and Technics* (pp. 17–33). Edinburgh University Press.

Moore, G. (2017a). On the Origin of *aisthesis* by Means of Artificial Selection; Or, the Preservation of Favored Traces in the Struggle for Existence. *boundary 2*, *44*(1), 191–212.

Moore, G. (2017b). Phenomenotechnics and Disavowal: Climate Change and the Politics of Deferred Experience. *Azimuth: Philosophical Coordinates in Modern and Contemporary Age*, *5*(9), 113–125.

Moore, J. W. (2015). *Capitalism in the Web of Life: Ecology and the Accumulation of Capital*. Verso.

Moore, J. W. (2016). The Rise of Cheap Nature. In J. W. Moore (Ed.), *Anthropocene or Capitalocene? Nature, History, and the Crisis of Capitalism* (pp. 78–115). PM Press.

Moore, J. W. (2017). The Capitalocene, Part I: On the Nature and Origins of Our Ecological Crisis. *Journal of Peasant Studies*, *44*(3), 594–630.

Moore, J. W. (2018). The Capitalocene, Part II: Accumulation by Appropriation and the Centrality of Unpaid Work/Energy. *Journal of Peasant Studies*, *45*(2), 237–279.

Morin, E. (1979). *Le paradigme perdu: La nature humaine*. Seuil.

Morin, M.-E. (2011). The Coming-to-the-World of the Human Animal. In S. Elden (Ed.), *Sloterdijk Now* (pp. 77–95). Polity.

Mühlmann, H. (2002). Die Ökologie der Kulturen. In B. Brock & G. Koschik (Eds.), *Krieg und Kunst* (pp. 39–53). Fink.

Mühlmann, H. (2011). *Die Natur der Kulturen: Versuch einer kulturgenetischen Theorie* (2nd ed.). Fink.

Mulcahy, N. J., & Call, J. (2006). Apes Save Tools for Future Use. *Science*, *312*(5776), 1038–1040.

Mumford, L. (1966). Technics and the Nature of Man. *Technology and Culture*, *7*(3), 303–317.

Mussi, S. (2007). Préludes à *Sphères*. L'amorce du grand récit fantastique de Peter Sloterdijk: Une lecture de *La domestication de l'être*. *Horizons philosophiques*, *17*(2), 45–59.

Mutsaers, I. (2016). *Immunological Discourse in Political Philosophy: Immunisation and Its Discontents*. Routledge.

Mykhailov, D., & Liberati, N. (2023). Back to the Technologies Themselves: Phenomenological Turn within Postphenomenology. *Phenomenology and the Cognitive Sciences*.

Nagell, K., Olguin, R. S., & Tomasello, M. (1993). Processes of Social Learning in the Tool Use of Chimpanzees (*Pan troglodytes*) and Human Children (*Homo sapiens*). *Journal of Comparative Psychology*, *107*(2), 174–186.

Nancy, J.-L. (1992). *Corpus*. Métailié.

Nancy, J.-L. (2008). *Corpus* (R. A. Rand, Trans.). Fordham University Press.

Napier, A. D. (2012). Nonself Help: How Immunology Might Reframe the Enlightenment. *Cultural Anthropology*, *27*(1), 122–137.

Nennen, H.-U. (2003). *Philosophie in Echtzeit: Die Sloterdijk-Debatte. Chronik einer Inszenierung*. Königshausen & Neumann.

Nietzsche, F. W. (1988a). *Also sprach Zarathustra I–IV* (Sämtliche Werke, 2nd ed., Vol. 4). de Gruyter.

Nietzsche, F. W. (1988b). *Die Geburt der Tragödie, Unzeitgemäße Betrachtungen I–IV, Nachgelassene Schriften 1870–1873* (Sämtliche Werke, 2nd ed., Vol. 1). de Gruyter.

Nietzsche, F. W. (1988c). *Jenseits von Gut und Böse, Zur Genealogie der Moral* (Sämtliche Werke, 2nd ed., Vol. 5). de Gruyter.

Nietzsche, F. W. (1988d). *Morgenröte, Idyllen aus Messina, Die fröhliche Wissenschaft* (Sämtliche Werke, 2nd ed., Vol. 3). de Gruyter.

Nietzsche, F. W. (2006). *Thus Spoke Zarathustra* (A. Del Caro, Trans.). Cambridge University Press.

Nietzsche, F. W. (2011). *Dawn: Thoughts on the Presumptions of Morality* (B. Smith, Trans.; The Complete Works, Vol. 5). Stanford University Press.

Nietzsche, F. W. (2014). *Beyond Good and Evil/On the Genealogy of Morality* (A. Del Caro, Trans.; The Complete Works, Vol. 8). Stanford University Press.

Nietzsche, F. W. (2023). *The Joyful Science/Idylls from Messina/Unpublished Fragments from the Period of* The Joyful Science *(Spring 1881–Summer 1882)* (A. Del Caro, Trans.; The Complete Works, Vol. 6). Stanford University Press.

Noll, W. (1993). *Sloterdijk auf der "Bühne": Zur philosophischen und zur philosophiekritischen Positionsbestimmung des Werkes von Peter Sloterdijk im Zeitraum von 1978–1991*. Die Blaue Eule.

Odling-Smee, F. J. (2007). Niche Inheritance: A Possible Basis for Classifying Multiple Inheritance Systems in Evolution. *Biological Theory*, *2*(3), 276–289.

Odling-Smee, F. J., Laland, K. N., & Feldman, M. W. (2003). *Niche Construction: The Neglected Process in Evolution*. Princeton University Press.

Parrochia, D. (2009). French Philosophy of Technology. In A. Brenner & J. Gayon (Eds.), *French Studies in the Philosophy of Science: Contemporary Research in France* (pp. 51–70). Springer.

Pavanini, M. (Ed.). (2020). *Lo spazio dell'umano: Saggi dopo Sloterdijk*. Kaiak.

Perper, T., & Schrire, C. (1977). The Nimrod Connection: Myth and Science in the Hunting Model. In M. R. Kare & O. Maller (Eds.), *The Chemical Senses and Nutrition* (pp. 447–459). Academic Press.

Petanjek, Z., Judaš, M., Šimić, G., Rašin, M. R., Uylings, H. B. M., Rakic, P., & Kostović, I. (2011). Extraordinary Neoteny of Synaptic Spines in the Human Prefrontal Cortex. *Proceedings of the National Academy of Sciences of the United States of America*, *108*(32), 13281–13286.

Pickering, A. (1982). Elementary Particles: Discovered or Constructed? In P. Trower & G. Bellini (Eds.), *Physics in Collision: High-Energy ee/ep/pp Interactions* (Vol. 1, pp. 439–448). Plenum.

Pigliucci, M., & Müller, G. B. (2010). Elements of an Extended Evolutionary Synthesis. In M. Pigliucci & G. B. Müller (Eds.), *Evolution: The Extended Synthesis* (pp. 3–17). MIT Press.

Pinch, T. J., & Bijker, W. E. (1984). The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other. *Social Studies of Science*, *14*(3), 399–441.

Plato. (1997). *Complete Works* (J. M. Cooper, Ed.). Hackett.

Plessner, H. (1965). *Die Stufen des Organischen und der Mensch: Einleitung in die philosophische Anthropologie* (2nd ed.). de Gruyter.

Plessner, H. (2019). *Levels of Organic Life and the Human: An Introduction to Philosophical Anthropology* (M. Hyatt, Trans.). Fordham University Press.

Portmann, A. (1945). Die Ontogenese des Menschen als Problem der Evolutionsforschung. *Verhandlungen der Schweizerischen Naturforschenden Gesellschaft*, *125*, 44–53.

Portmann, A. (1969). *Biologische Fragmente zu einer Lehre vom Menschen* (3rd ed.). Schwabe.

Portmann, A. (1970). *Entläßt die Natur den Menschen? Gesammelte Aufsätze zur Biologie und Anthropologie*. Piper.

Portmann, A. (1990). *A Zoologist Looks at Humankind* (J. Schaefer, Trans.). Columbia University Press.

Pradeu, T. (2019). *Philosophy of Immunology*. Cambridge University Press.

Rancière, J. (2000). *Le partage du sensible: Esthétique et politique*. La Fabrique.

Rancière, J. (2004a). *Aux bords du politique*. Gallimard.

Rancière, J. (2004b). *The Politics of Aesthetics: The Distribution of the Sensible* (G. Rockhill, Trans.). Continuum.

Rancière, J. (2010). *Dissensus: On Politics and Aesthetics* (S. Corcoran, Trans.). Continuum.

Rank, O. (1924). *Das Trauma der Geburt und seine Bedeutung für die Psychoanalyse*. Internationaler Psychoanalytischer Verlag.

Rank, O. (1993). *The Trauma of Birth* (K. Paul, Trans.). Dover.

Rehmann, J., & Wagner, T. (Eds.). (2010). *Angriff der Leistungsträger? Das Buch zur Sloterdijk-Debatte*. Argument.

Remotti, F. (2010). Antropopoiesi: Presupposti, implicazioni, tipologie. *Rivista Italiana di Gruppoanalisi*, *24*(1), 31–56.

Remotti, F. (2013). *Fare umanità: I drammi dell'antropo-poiesi*. Laterza.

Roberts, B. (2005). Stiegler Reading Derrida: The Prosthesis of Deconstruction in Technics. *Postmodern Culture*, *16*(1).

Rocca, A. V. (2008). *Peter Sloterdijk: Esferas, helada cósmica y políticas de climatización*. Institució Alfons el Magnànim.

Roney, P., & Rossi, A. (Eds.). (2021). Sloterdijk's Anthropotechnics. *Angelaki: Journal of the Theoretical Humanities*, *26*(1).

Rosenberg, K. R., & Trevathan, W. R. (1995). Bipedalism and Human Birth: The Obstetrical Dilemma Revisited. *Evolutionary Anthropology*, *4*(5), 161–168.

Rosenberger, R., & Verbeek, P.-P. (2015). A Field Guide to Postphenomenology. In R. Rosenberger & P.-P. Verbeek (Eds.), *Postphenomenological Investigations: Essays on Human-Technology Relations* (pp. 9–41). Lexington Books.

Rousseau, J.-J. (1780). *Collection complète des œuvres* (Vol. 1). Genève.

Rousseau, J.-J. (1992). *Discourse on the Origins of Inequality (Second Discourse), Polemics, and Political Economy* (J. R. Bush, R. D. Masters, C. Kelly, & T. Marshall, Trans.; The Collected Writings, Vol. 3). University Press of New England.

Russo, M. (2002). Animalitas: Heidegger e l'antropologia filosofica. *Discipline filosofiche*, *12*(1), 167–195.

Russo, N. (2022). L'approccio genealogico. In R. Lanfredini (Ed.), *Filosofia: Metodi e orientamenti contemporanei* (pp. 233–248). Carocci.

Saner, H. (1979). *Geburt und Phantasie: Von der natürlichen Dissidenz des Kindes*. Lenos.

Scheler, M. (1919). *Vom Umsturz der Werte: Abhandlungen und Aufsätze* (2nd ed., Vol. 1). Der Neue Geist.

Scheler, M. (1978). On the Idea of Man (C. Nabe, Trans.). *Journal of the British Society for Phenomenology*, *9*(3), 184–198.

Scheler, M. (1991). *Die Stellung des Menschen im Kosmos* (2nd ed.). Bouvier.

Scheler, M. (2009). *The Human Place in the Cosmos* (M. Frings, Trans.). Northwestern University Press.

Schindewolf, O. H. (1972). Phylogenie und Anthropologie in paläontologischer Sicht. In H.-G. Gadamer & P. Vogler (Eds.), *Neue Anthropologie* (Vol. 1, pp. 230–292). Thieme.

Schinkel, W., & Noordegraaf-Eelens, L. (Eds.). (2011). *In Medias Res: Peter Sloterdijk's Spherological Poetics of Being*. Amsterdam University Press.

Schmitt, C. (1932). *Begriff des Politischen* (3rd ed.). Duncker & Humblot.

Schmitt, C. (1934). *Politische Theologie: Vier Kapitel zur Lehre der Souveränität* (2nd ed.). Duncker & Humblot.

Schmitt, C. (2004). *Political Theology: Four Chapters on the Concept of Sovereignty* (G. D. Schwab, Trans.; 2nd ed.). University of Chicago Press.

Schmitt, C. (2007). *The Concept of the Political* (G. D. Schwab, Trans.; 2nd ed.). University of Chicago Press.

Semendeferi, K., & Hanson, K. L. (2016). Plastic and Heterogeneous: Postnatal Developmental Changes in the Human Brain. In W. R. Trevathan & K. R. Rosenberg (Eds.), *Costly and Cute: Helpless Infants and Human Evolution* (pp. 133–147). School for Advanced Research Press.

Shea, B. T. (1989). Heterochrony in Human Evolution: The Case for Neoteny Reconsidered. *American Journal of Physical Anthropology*, *32*, 69–101.

Sherwood, C. C., & Gómez-Robles, A. (2017). Brain Plasticity and Human Evolution. *Annual Review of Anthropology*, *46*(1), 399–419.

Shilton, D., Breski, M., Dor, D., & Jablonka, E. (2020). Human Social Evolution: Self-Domestication or Self-Control? *Frontiers in Psychology*, *11*(134).

Simondon, G. (1958). *Du mode d'existence des objets techniques*. Aubier.

Simondon, G. (2005). *L'individuation à la lumière des notions de forme et d'information*. Millon.

Simondon, G. (2014). *Sur la technique (1953–1983)*. Presses universitaires de France.

Simondon, G. (2016). *On the Mode of Existence of Technical Objects* (C. Malaspina & J. Rogove, Trans.). University of Minnesota Press.

Simondon, G. (2020). *Individuation in Light of Notions of Form and Information* (T. Adkins, Trans.). University of Minnesota Press.

Simoons, F. J. (1970). Primary Adult Lactose Intolerance and the Milking Habit: A Problem in Biologic and Cultural Interrelations. *American Journal of Digestive Diseases*, *15*(8), 695–710.

Sini, C. (2009). *L'uomo, la macchina, l'automa: Lavoro e conoscenza tra futuro prossimo e passato remoto*. Bollati Boringhieri.

Sini, C. (2013). Il potere invisibile. *Nóema*, *4*(2).

Sini, C. (2021). Machine, Culture, and Robot. In S. Chiodo & V. Schiaffonati (Eds.), *Italian Philosophy of Technology: Socio-Cultural, Legal, Scientific and Aesthetic Perspectives on Technology* (pp. 83–88). Springer.

Sloterdijk, P. (1986). *Der Denker auf der Bühne: Nietzsches Materialismus*. Suhrkamp.

Sloterdijk, P. (1988). *Zur Welt kommen—Zur Sprache kommen: Frankfurter Vorlesungen*. Suhrkamp.

Sloterdijk, P. (1989a). *Eurotaoismus: Zur Kritik der politischen Kinetik*. Suhrkamp.

Sloterdijk, P. (1989b). *Thinker on Stage: Nietzsche's Materialism* (J. Owen Daniel, Trans.). University of Minnesota Press.

Sloterdijk, P. (1993). *Weltfremdheit*. Suhrkamp.

Sloterdijk, P. (1998a). *Der starke Grund, zusammen zu sein: Erinnerungen an die Erfindung des Volkes*. Suhrkamp.

Sloterdijk, P. (1998b). *Sphären I: Blasen*. Suhrkamp.

Sloterdijk, P. (1999). *Sphären II: Globen*. Suhrkamp.

Sloterdijk, P. (2000). Vivre chaud et penser froid: Entretien avec Éric Alliez. *Multitudes*, *1*(1), 64–87.

Sloterdijk, P. (2001a). *Die Sonne und der Tod: Dialogische Untersuchungen mit Hans-Jürgen Heinrichs*. Suhrkamp.

Sloterdijk, P. (2001b). *Nicht gerettet: Versuche nach Heidegger*. Suhrkamp.

Sloterdijk, P. (2004). *Sphären III: Schäume*. Suhrkamp.

Sloterdijk, P. (2007). Living Hot, Thinking Coldly: An Interview with Éric Alliez (C. Turner, Trans.). *Cultural Politics*, *3*(3), 307–326.

Sloterdijk, P. (2009a). *Du mußt dein Leben ändern: Über Anthropotechnik*. Suhrkamp.

Sloterdijk, P. (2009b). Talking to Myself About the Poetics of Space. *Harvard Design Magazine*, *30*.

Sloterdijk, P. (2010). *Scheintod im Denken: Von Philosophie und Wissenschaft als Übung*. Suhrkamp.

Sloterdijk, P. (2011a). *Neither Sun nor Death with Hans-Jürgen Heinrichs* (S. Corcoran, Trans.). MIT Press.

Sloterdijk, P. (2011b). *Spheres I: Bubbles. Microspherology* (W. Hoban, Trans.). MIT Press.

Sloterdijk, P. (2011c). *Streß und Freiheit*. Suhrkamp.

Sloterdijk, P. (2012a). *The Art of Philosophy: Wisdom as a Practice* (K. Margolis, Trans.). Columbia University Press.

Sloterdijk, P. (2012b). *You Must Change Your Life* (W. Hoban, Trans.). Polity.

Sloterdijk, P. (2014a). *Der ästhetische Imperativ: Schriften zur Kunst*. Suhrkamp.

Sloterdijk, P. (2014b). *Die schrecklichen Kinder der Neuzeit: Über das anti-genealogische Experiment der Moderne*. Suhrkamp.

Sloterdijk, P. (2014c). *Spheres II: Globes. Macrospherology* (W. Hoban, Trans.). MIT Press.

Sloterdijk, P. (2015). *Stress and Freedom* (W. Hoban, Trans.). Polity.

Sloterdijk, P. (2016a). *Not Saved: Essays After Heidegger* (I. A. Moore & C. Turner, Trans.). Polity.

Sloterdijk, P. (2016b). *Spheres III: Foams. Plural Spherology* (W. Hoban, Trans.). MIT Press.

Sloterdijk, P. (2016c). *Was geschah im 20. Jahrhundert?* Suhrkamp.

Sloterdijk, P. (2017a). *Nach Gott: Glaubens- und Unglaubensversuche*. Suhrkamp.

Sloterdijk, P. (2017b). *The Aesthetic Imperative: Writings on Art* (K. Margolis, Trans.). Polity.

Sloterdijk, P. (2018). *What Happened in the 20th Century? Towards a Critique of Extremist Reason* (C. Turner, Trans.). Polity.

Sloterdijk, P. (2019). *Réflexes primitifs: Considérations psychopolitiques sur les inquiétudes européennes*. Payot.

Sloterdijk, P. (2020a). *After God* (I. A. Moore, Trans.). Polity.

Sloterdijk, P. (2020b). *Infinite Mobilization* (S. Berjan, Trans.). Polity.

Sloterdijk, P. (2023). *Die Reue des Prometheus: Von der Gabe des Feuers zur globalen Brandstiftung*. Suhrkamp.

Sloterdijk, P., & Macho, T. (2013). Den Kopf heben: Über Räume der Verwöhnung und das Driften in der Zeit. In P. Sloterdijk (Ed.), *Ausgewählte Übertreibungen: Gespräche und Interviews 1993–2012* (pp. 141–175). Suhrkamp.

Sloterdijk, P., & Macho, T. (2016). Raising Our Heads: Pampering Spaces and Time Drifts. In P. Sloterdijk (Ed.), & K. Margolis (Trans.), *Selected Exaggerations: Conversations and Interviews 1993–2012* (pp. 82–105). Polity.

Smith, D. (2015). Rewriting the Constitution: A Critique of "Postphenomenology". *Philosophy & Technology*, *28*(4), 533–551.

Somel, M., Franz, H., Yan, Z., Lorenc, A., Guo, S., Giger, T., Kelso, J., Nickel, B., Dannemann, M., Bahn, S., Webster, M. J., Weickert, C. S., Lachmann, M., Pääbo, S., & Khaitovich, P. (2009). Transcriptional Neoteny in the Human Brain. *Proceedings of the National Academy of Sciences of the United States of America*, *106*(14), 5743–5748.

Spengler, O. (1931). *Der Mensch und die Technik: Beitrag zu einer Philosophie des Lebens*. Beck.

Spengler, O. (1932). *Man and Technics: A Contribution to the Philosophy of Life* (C. F. Atkinson, Trans.). Knopf.

Sterelny, K. (2010). Minds: Extended or Scaffolded? *Phenomenology and the Cognitive Sciences*, *9*(4), 465–481.

Sterelny, K. (2012). *The Evolved Apprentice: How Evolution Made Humans Unique*. MIT Press.

Stiegler, Barbara (2019). *"Il faut s'adapter": Sur un nouvel impératif politique*. Gallimard.

Stiegler, Barbara (2022). *Adapt! On a New Political Imperative* (A. Hocker, Trans.). Fordham University Press.

Stiegler, B. (1995). Ce qui fait défaut. *Césure*, *8*, 233–278.

Stiegler, B. (1998a). Leroi-Gourhan: L'inorganique organisé. *Cahiers de médiologie*, *6*(2), 187–194.

Stiegler, B. (1998b). *Technics and Time 1: The Fault of Epimetheus* (R. Beardsworth & G. Collins, Trans.). Stanford University Press.

Stiegler, B. (1998c). Temps et individuations technique, psychique et collective dans l'œuvre de Simondon. *Intellectica*, *26–27*(1–2), 241–256.

Stiegler, B. (2001). Derrida and Technology: Fidelity at the Limits of Deconstruction and the Prosthesis of Faith. In T. Cohen (Ed.), *Jacques Derrida and the Humanities: A Critical Reader* (pp. 238–270). Cambridge University Press.

Stiegler, B. (2003a). *Aimer, s'aimer, nous aimer: Du 11 septembre au 21 avril*. Galilée.

Stiegler, B. (2003b). *Passer à l'acte*. Galilée.

Stiegler, B. (2004). *Philosopher par accident: Entretiens avec Élie During*. Galilée.

Stiegler, B. (2006). La peau de chagrin ou L'accident franco-européen de la philosophie d'après Jacques Derrida. *Rue Descartes*, *52*(2), 103–112.

Stiegler, B. (2008a). *Économie de l'hypermatériel et psychopouvoir: Entretiens avec Philippe Petit et Vincent Bontems*. Mille et une Nuits.

Stiegler, B. (2008b). L'être soigneux. In B. Stiegler & J.-P. Demoule (Eds.), *L'avenir du passé: Modernité de l'archéologie* (pp. 13–25). La Découverte.

Stiegler, B. (2008c). *Prendre soin 1: De la jeunesse et des générations*. Flammarion.

Stiegler, B. (2009a). *Acting Out* (D. Barison, P. Crogan, & D. Ross, Trans.). Stanford University Press.

Stiegler, B. (2009b). *Pour une nouvelle critique de l'économie politique*. Galilée.

Stiegler, B. (2009c). *Technics and Time 2: Disorientation* (S. Barker, Trans.). Stanford University Press.

Stiegler, B. (2009d). The Magic Skin; or, The Franco-European Accident of Philosophy after Jacques Derrida (P. Skafish, Trans.). *Qui Parle*, *18*(1), 97–110.

Stiegler, B. (2010a). *Ce qui fait que la vie vaut la peine d'être vécue: De la pharmacologie*. Flammarion.

Stiegler, B. (2010b). *For a New Critique of Political Economy* (D. Ross, Trans.). Polity.

Stiegler, B. (2010c). *Taking Care of Youth and the Generations* (S. Barker, Trans.). Stanford University Press.

Stiegler, B. (2010d). *Technics and Time 3: Cinematic Time and the Question of Malaise* (S. Barker, Trans.). Stanford University Press.

Stiegler, B. (2013a). *De la misère symbolique*. Flammarion.

Stiegler, B. (2013b). *What Makes Life Worth Living: On Pharmacology* (D. Ross, Trans.). Polity.

Stiegler, B. (2014). *Symbolic Misery 1: The Hyper-Industrial Epoch* (B. Norman, Trans.). Polity.

Stiegler, B. (2015a). *La société automatique 1: L'avenir du travail*. Fayard.

Stiegler, B. (2015b). *Symbolic Misery 2: The Catastrophe of the Sensible* (B. Norman, Trans.). Polity.

Stiegler, B. (2016). *Dans la disruption: Comment ne pas devenir fou?* Les liens qui libèrent.

Stiegler, B. (2017a). *Automatic Society 1: The Future of Work* (B. Dillet, Trans.). Edinburgh University Press.

Stiegler, B. (2017b). Désir et connaissance: Le mort saisi par le vif. Éléments pour une organologie de la libido. *La Deleuziana*, *6*, 68–81.

Stiegler, B. (2017c). *Philosophising by Accident: Interviews with Élie During* (B. Dillet, Trans.). Edinburgh University Press.

Stiegler, B. (2018a). *La technique et le temps; suivis de Le nouveau conflit des facultés et des fonctions dans l'Anthropocène*. Fayard.

Stiegler, B. (2018b). *Qu'appelle-t-on panser ? 1: L'immense régression*. Les liens qui libèrent.

Stiegler, B. (2018c). *The Neganthropocene*. Open Humanities Press.

Stiegler, B. (2019). *The Age of Disruption: Technology and Madness in Computational Capitalism* (D. Ross, Trans.). Polity.

Stiegler, B. (2020). Elements for a General Organology. *Derrida Today*, *13*(1), 72–94.

Stone, A. (2019). *Being Born: Birth and Philosophy*. Oxford University Press.

Street, S. E., Navarrete, A. F., Reader, S. M., & Laland, K. N. (2017). Coevolution of Cultural Intelligence, Extended Life History, Sociality, and Brain Size in Primates. *Proceedings of the National Academy of Sciences of the United States of America*, *114*(30), 7908–7914.

Strum, S. C., & Latour, B. (2000). Redefining the Social Link: From Baboons to Humans. In J. Thomas (Ed.), *Interpretive Archaeology: A Reader* (pp. 266–277). Leicester University Press.

Suddendorf, T. (2013). *The Gap: The Science of What Separates Us from Other Animals*. Basic Books.

Sutherland, T. (2017). Ontological Co-Belonging in Peter Sloterdijk's Spherological Philosophy of Mediation. *Paragraph*, *40*(2), 133–152.

Svensson, E. I. (2018). On Reciprocal Causation in the Evolutionary Process. *Evolutionary Biology*, *45*(1).

Tănăsescu, I. (2021). Zu Husserls Rezeption von Brentanos Theorie über die Phantasievorstellung. In I. Tănăsescu (Ed.), *Psychologie, Seiendes, Phantasie bei Franz Brentano* (pp. 473–476). de Gruyter.

Tattersall, I. (2012). *Masters of the Planet: The Search for Our Human Origins*. Palgrave Macmillan.

Tauber, A. I. (2017). *Immunity: The Evolution of an Idea*. Oxford University Press.

Taylor, T. (2010). *The Artificial Ape: How Technology Changed the Course of Human Evolution*. Palgrave Macmillan.

ten Bos, R. (2009). Towards an Amphibious Anthropology: Water and Peter Sloterdijk. *Environment and Planning D: Society and Space*, *27*(1), 73–86.

Tennie, C., Call, J., & Tomasello, M. (2009). Ratcheting Up the Ratchet: On the Evolution of Cumulative Culture. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1528), 2405–2415.

Thorpe, S. K. S., Holder, R. L., & Crompton, R. H. (2007). Origin of Human Bipedalism as an Adaptation for Locomotion on Flexible Branches. *Science*, *316*(5829), 1328–1331.

Tomasello, M. (2014). *A Natural History of Human Thinking*. Harvard University Press.

Tomatis, A. (1993). *La nuit utérine*. Stock.

Türcke, C. (2005). *Vom Kainszeichen zum genetischen Code: Kritische Theorie der Schrift*. Beck.

Turner, B. (2016). Life and the Technical Transformation of Différance: Stiegler and the Noopolitics of Becoming Non-Inhuman. *Derrida Today*, *9*(2), 177–198.

Turner, B. (2023). *Returning to Judgment: Bernard Stiegler and Continental Political Theory*. State University of New York Press.

Urválek, A., & Brázda, R. (Eds.). (2017). Special Issue on Peter Sloterdijk. *Pro-Fil*, *18*.

Vadalà, M., Poddighe, D., Laurino, C., & Palmieri, B. (2017). Vaccination and Autoimmune Diseases: Is Prevention of Adverse Health Effects on the Horizon? *EPMA Journal*, *8*(3), 295–311.

van der Hout, S. (2014). The Homeotechnological Turn: Sloterdijk's Response to the Ecological Crisis. *Environmental Values*, *23*(4), 423–442.

van Oost, E. (2003). Materialized Gender: How Shavers Configure the Users' Femininity and Masculinity. In N. Oudshoorn & T. J. Pinch (Eds.), *How Users Matter: The Co-Construction of Users and Technologies* (pp. 193–208). MIT Press.

van Tuinen, S. (2006). *Peter Sloterdijk: Ein Profil*. Fink.

van Tuinen, S. (2011). "Transgenous Philosophy": Post-Humanism, Anthropotechnics and the Poetics of Natal Difference. In W. Schinkel & L. Noordegraaf-Eelens (Eds.), *In Medias Res: Peter Sloterdijk's Spherological Poetics of Being* (pp. 43–66). Amsterdam University Press.

Various Authors (Eds.). (2006). Félix Guattari, Bernard Stiegler: La catastrofe dell'immaginario. *Millepiani*, *30*.

Various Authors (Eds.). (2007). Special Issue on Peter Sloterdijk. *Cultural Politics*, *3*(3).

Various Authors (Eds.). (2009a). Bernard Stiegler and the Question of Technics. *Transformations*, *17*.

Various Authors (Eds.). (2009b). The Worlds of Peter Sloterdijk. *Environment and Planning D: Society and Space*, *27*(1).

Various Authors (Eds.). (2010). Special Issue on Bernard Stiegler. *Cultural Politics*, *6*(2).

Various Authors (Eds.). (2012). Esercizi per cambiare la vita: In dialogo con Peter Sloterdijk. *aut aut*, *355*.

Various Authors (Eds.). (2020). Stiegler, Derrida: Technics and Life. *Derrida Today*, *13*(1).

Verbeek, P.-P. (2005). *What Things Do: Philosophical Reflections on Technology, Agency, and Design* (R. P. Crease, Trans.). Penn State University Press.

Verbeek, P.-P. (2008). Cyborg Intentionality: Rethinking the Phenomenology of Human-Technology Relations. *Phenomenology and the Cognitive Sciences*, *7*(3), 387–395.

Verbeek, P.-P. (2011). *Moralizing Technology: Understanding and Designing the Morality of Things*. University of Chicago Press.

Verbeek, P.-P. (2015). Towards a Theory of Technological Mediation: A Program for Postphenomenological Research. In J. K. B. O. Friis & R. P. Crease (Eds.), *Technoscience and Postphenomenology: The Manhattan Papers* (pp. 189–204). Lexington Books.

Videan, E. N., & McGrew, W. C. (2002). Bipedality in Chimpanzee (*Pan troglodytes*) and Bonobo (*Pan paniscus*): Testing Hypotheses on the Evolution of Bipedalism. *American Journal of Physical Anthropology*, *118*(2), 184–190.

Vignola, P., & Baranzoni, S. (Eds.). (2016). Bernard Stiegler: Per una farmacologia della tecnica. *aut aut*, *371*.

Villmoare, B., Kimbel, W. H., Seyoum, C., Campisano, C. J., DiMaggio, E. N., Rowan, J., Braun, D. R., Arrowsmith, R. J., & Reed, K. E. (2015). Early *Homo* at 2.8 Ma from Ledi-Geraru, Afar, Ethiopia. *Science*, *347*(6228), 1352–1355.

Virno, P. (2009). Natural-Historical Diagrams: The "New Global" Movement and the Biological Invariant (A. Toscano, Trans.). *Cosmos and History: Journal of Natural and Social Philosophy*, *5*(1), 92–104.

Vitale, F. (2020). Making the Différance: Between Derrida and Stiegler. *Derrida Today*, *13*(1), 1–16.

Viveiros de Castro, E. (2014). *Cannibal Metaphysics* (P. Skafish, Trans.). University of Minnesota Press.

von Samsonow, E. (2009). Philosophie der monströsen Mutter. In M. S. Jongen, S. van Tuinen, & K. Hemelsoet (Eds.), *Die Vermessung des Ungeheuren: Philosophie nach Peter Sloterdijk* (pp. 130–142). Fink.

von Uexküll, J. (1934). *Streifzüge durch die Umwelten von Tieren und Menschen: Ein Bilderbuch unsichtbarer Welten mit Georg Kriszat*. Springer.

von Uexküll, J. (2010). *A Foray into the Worlds of Animals and Humans with A Theory of Meaning* (J. D. O'Neil, Trans.). University of Minnesota Press.

Waddington, C. H. (1942). Canalization of Development and the Inheritance of Acquired Characters. *Nature*, *150*(3811), 563–565.

Walrath, D. (2006). Gender, Genes, and the Evolution of Human Birth. In P. L. Geller & M. K. Stockett (Eds.), *Feminist Anthropology: Past, Present, and Future* (pp. 55–70). University of Pennsylvania Press.

Washburn, S. L. (1960). Tools and Human Evolution. *Scientific American*, *203*(3), 63–75.

Weibel, P. (Ed.). (2019). *"Von Morgenröten, die noch nicht geleuchtet haben": Ein Symposium zu Peter Sloterdijk*. Suhrkamp.

Whitehead, H., Laland, K. N., Rendell, L., Thorogood, R., & Whiten, A. (2019). The Reach of Gene-Culture Coevolution in Animals. *Nature Communications*, *10*(2405).

Whiten, A. (2019). Cultural Evolution in Animals. *Annual Review of Ecology, Evolution, and Systematics*, *50*(1), 27–48.

Winner, L. (1980). Do Artifacts Have Politics? *Daedalus*, *109*(1), 121–136.

Winnicott, D. W. (2012). *Playing and Reality*. Routledge.

Wrangham, R. W. (2009). *Catching Fire: How Cooking Made Us Human*. Basic Books.

Zwier, J., Blok, V., & Lemmens, P. (2016). Phenomenology and the Empirical Turn: A Phenomenological Analysis of Postphenomenology. *Philosophy & Technology*, *29*(4), 313–333.