Technophysiology, or How Technology Modifies the Self

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INTRODUCTION

The technological advancements of recent centuries demand a radical reevaluation of how we perceive *techne* in a philosophical framework. This requires moving beyond the humanistic model that views technology as a mere tool, enabling humans to enhance their actions, pursue their goals, be freed from their needs and weaknesses and exert control over the world. Such a conception of technical or technomediated action is built on assumptions that have proven untenable, both theoretically and in terms of practical application. Key pillars of the humanistic interpretation, such as the theory of human incompleteness, the ergonomic and disjointed nature of technological apparatuses, the compensatory, amplifying, and liberating aspects of technomediation, the autarchic understanding of the ideational and design process, and the assumption of complete human control over the functions and structure of machines, have all been discredited.

What emerges today is a new understanding of the organic. It is now viewed as a conjugable entity capable of functioning with external supports to generate performative outcomes, as seen in the theory of the extended mind. At the same time, it is also seen as a metamorphic entity capable of adapting and assuming new functions through the use of instruments that perform similar tasks and therefore replace the dedicated organ. The body's involvement with technology, from a physiological perspective, exceeds traditional conceptions. Hence the need to talk about *techno-physiology*. In an eco-ontological framework that builds upon the classical notion of interpersonality but extends it to a broader ecological conception, intentionality transcends the realm of consciousness and the human sphere; instead, it characterizes a hybrid ontological condition that emerges from our relationship with nature and technology. Indeed, technology itself transcends traditional boundaries, as it directly enters the body through deep interfaces: it has an organic constitution (“wet” or organic technology), possesses self-programming capabilities (deep learning), and assumes performative forms that are indistinguishable from those attributed to human beings.

We are witnessing profound shifts in the conception of *techne* that have implications for the ontological understanding of technomediation, the

relationship between technology and the body with regards to induced physiological transformations, its social and individual impacts, future scenarios, and ethical considerations. Biotechnology has erased the distinction between invention and discovery, genetic algorithms have surpassed traditional notions of programming, biosynthetic grafts have challenged the concept of the body-technology relationship, and digital immersion not only goes beyond analogue reality but also risks disconnecting individuals from the real world. The direct connection of sensory systems with technological interfaces reshapes the principle of interaction between the subject and the world, transforming simulation into lived experience and ultimately shaping one's biography. However, this process does not lead to a loss of the corporeal dimension, as some might suggest. On the contrary, it results in hyper-somatisation, eliminating the need for interfaces and potentially rendering sensory transduction obsolete, ultimately questioning the very notion of individual.

The convergence of various technopoietic directions, including nanotechnology, biosynthesis, and neural networks, leads to a rapid acceleration of circumstances that surpass the capacity of traditional philosophies, rooted in humanism, to provide an adequate interpretation and predictive framework. There appears to be a significant gap, both in terms of timing and understanding, between what technology enables and the philosophical comprehension of the actual consequences and existential possibilities offered by these new devices. Embracing the concept of technophysiology means acknowledging the existence of an extended body that transcends the individual and is no longer solely under the latter’s control. Technological progress is accelerating at a pace that is hard to fully grasp, but what is even more concerning, in my opinion, is that we still perceive it as separate from our bodies and external to our ontology. We continue to view technology as a tool, something to be wielded like a hammer, fully at our disposal, perhaps wearable like clothing, capable of serving our needs or competing with us, but still we persist in considering it external. This is a fundamental mistake.

Technophysiology instead urges us to adopt an integrative and non-dichotomous perspective, recognising that the niche in which an organism exists is an intrinsic part of its body rather than a separate habitat to be occupied. Just as a spider's web is an integral part of its phenotype, the constitution of our own physiology is inherently heteronomous, always relying on external mediums. Failing to recognize this interconnectedness is a significant mistake, one that today may prove more perilous than we currently realize. The cultural imagination still relies on rhetorical devices that hinder our ability to fully grasp the profound implications and

transformative effects of technological innovations. These advancements, in fact, not only open up new existential dimensions but also create novel fields of research and application that were previously unimaginable. Today, the task of understanding technology is mostly carried out by science fiction, albeit inadequately. While this genre can offer some accurate predictions from a technological standpoint, it falls short in addressing the ontopoietic and existential dimensions of the matter. Indeed, science fiction remains a transreal projection that explores the human condition in a limited manner, unable to fully comprehend and depict the profound implications of technological advancements.

Allow me to elaborate. Science fiction, through its transreal narrative approach, explores how human beings would navigate and experience a future world shaped by technological advancements, geopolitical shifts, and the consequences of the ecological crisis. It projects contemporary individuals, with their unique perspectives and worldviews, into these altered environments. However, transrealism primarily serves as a tool for *our own* understanding and contemplation rather than a prefigurative representation. It allows us to confront potential transformations and imagine our responses to various challenges. Science fiction, particularly the works inspired by Philip K. Dick, has a psychotropic and psychoanalytic impact as it delves into the individual psyche, influenced by cultural and generational contexts, and places it within a transformed setting. Nevertheless, science fiction cannot replace philosophical inquiry as it cannot fully address the ontological and epistemological aspects related to change.

Technology has always brought about profound shifts in our ontology, altering the very essence of what it means to be human. Its impact extends beyond providing tools for better understanding, interpretation, and fulfilment of our needs as stable and universal beings. Transrealist science fiction, in this context, can only offer a moment of reflection on our existential condition rather than predict realistic scenarios. To comprehend the true implications of a radical physiological revolution, such as the one that is unfolding in our time, we must recognize that the emerging humans will have a different physiology and a fundamentally distinct mindset from our own. Consequently, their aspirations, goals, values, moral behaviour, dreams, fears, worldview, concept of time, memory, and thinking will all be transformed. This does not imply a complete departure from the human phylogenetic essence, of course, but rather a novel manifestation of our species-specific heritage. Therefore, embracing the concept of technophysiology does not negate the taxonomic specificity of the human being; instead, it is

crucial for understanding the diverse possibilities that arise from our evolving nature.

The present essay aims to explore the distinct characteristics of the morpho-functional and ethological constitution of the human being in relation to technological integration. It emphasizes that the body possesses a certain virtuality or malleability but is not entirely fluid: somatic organisation continually adjusts and adapts to external supports, engaging in reciprocal processes of accommodation. With the advent of a new technomediated condition, performance standards and feedback mechanisms for various organs are altered. Through technological devices, the body develops new interfaces for perception and action in relation to external reality, leading to a transformation of sensory correction mechanisms, sensibility, and agency. This profound change in the organism occurs during the assimilation of the tool, affecting neurobiological connections, endocrine regulation, immune responses, sexuality, the musculoskeletal structure, organ functions, biorhythm, and cell regeneration. Hence, I argue that technology is always infiltrative, becoming embodied even when it initially appears to merely dress the body like a glove that protects it from contamination.

Today's technologies challenge us to move beyond our traditional understanding of devices and to embrace a new *philosophy of technology* that acknowledges the ontological transformation brought about by our relationship with these devices. To comprehend this transformation, it is essential to shed light on the somatic changes that occur when we incorporate new devices into our daily lives. This essay aims to examine the effects of technology on the body, focusing on its morphological configuration and the organisation of its functions. I use the term "technophysiology" to describe the profound impact that technology has on how we exist in the world – our perception of reality, the construction of our identity, our expectations, and the meaning we attribute to our lives. Being a body means living in coherence with the somatic dimension that defines us, but this dimension is not exempt from the modifications brought by technology.

CHAPTER 1

ON HUMAN NATURE

Premise

It is impossible to imagine technology outside of a close relationship with the body. Even tools that may seem distant from the bodily dimension, such as a traffic light or a hydroelectric turbine, ultimately require somatic transactions. They do so through the need for management techniques or attentional mechanisms, either directly or through modifications of the environment, by means of elective stimulation or encryption (Virilio, 1995). There is no doubt, therefore, that technologies consistently influence the biological matrix that constitutes us. *Techne* imposes a formative seminar on the body, which always has to plastically adapt to technology, no matter how much effort is put into finding ergonomic solutions. The body is also called upon to take full advantage of the performative dimensions inaugurated by each device in its specificity of use and in the feedback it produces. In short, the body is subjected to different types of pressure from technological equipment. Each tool, while being specifically addressed to certain parts of the somatic ontogeny, always acts systemically, like an ecological niche (Odling-Smee, 1988). Just as a cobweb is a spider's somatic measure, its extended phenotype, so the technosphere dictates the ordering coordinates of our cell populations.

The spread of personal computers, for example, in just forty years has profoundly changed people's lifestyles and, consequently, the cognitive functions used more or less frequently by the average human (Greenfield, 2015). As a result, people's posture, attentional system, arousal and stress mechanisms have changed as well. Thanks to the progressive miniaturisation and versatility of these media, computer technologies have quickly found their way into electronic games, mobile phones, and music players, becoming the gadget *par excellence*. Caught in such an embrace, the body has made way for the computer: as in a successful transplant, a graft has occurred that has altered the way individuals think as well as their social expectations. The increasingly immersive digital social interactions, so assiduous as to occupy the younger generations for more than eight hours a

day, has had an unsettling effect on their psychological condition. The digital experience has become embodied in people's ways of being, as individuals have gradually realised that they are being watched on the Web and that they are leaving substantial traces of themselves in what were previously innocent forays into the inertial dimension of the analogue (Ferraris, 2020).

The immersion, interaction and reciprocation of the digital produces a very strong attraction as well as a psychotropic effect, so that people are in danger of sidelining direct relations with others, concrete multi-sensory contact with reality, the kinetic dimension of experience, and rootedness in nature. This undoubtedly produces a sentimental diseducation, so to speak, accentuating forms of egocentrism and narcissism (Lasch, 1979), as well as a loss of connection with the world, but at the same time it alters the developmental and organisational guidelines of the entire organism. Especially in the case of minors, who are going through their developmental years – when the use factor has a preponderant influence – the repercussions are considerable. Today we are already beginning to notice the – not always pleasant – consequences of the entrenchment and infiltration of these technologies. But no wonder! The body is a plastic entity that, though predisposed to a certain adaptive niche through phylogenetic selection, provides for *a-posteriori* variation, i.e. ontogenetic adaptation. This already occurs with the translation of genetic contents into the embryo-foetal phenotype: we know, for example, that certain substances ingested by the mother are able to influence the endocrine, immune and neurobiological structure of the foetus (Soto et al, 1991).

The technological apparatus acts as a niche which accommodates the body but at the same time imposes its morpho-poietic guidelines on it. As such, it should be considered in its influence on bodily development and overall organisation (West-Eberhard, 2003). This influence concerns *both* anatomical and functional aspects, i.e. the conformation that the body assumes, *and* the metaplastic and neoplastic predispositions, i.e., what the body can expect from the future with reference to the stressogenic, deficient, mutagenic and traumatic events that are expected to occur. Today, thanks to research in the Eco-Devo field, we know that a genome always implies polyphenies, i.e., phenotypic potentialities, a sort of starting virtuality from which the developmental environment extracts one of several possibilities (Gilbert and Epel, 2015). Therefore, one cannot ignore the weight that the living environment plays in the structuring of the body and, consequently, one cannot underestimate the technological pervasiveness in which the individual is immersed even before being born. This means that it is

impossible to talk about technology without clarifying the nature of the body and the way it behaves in interaction. The traditional ergonomic view does not grasp the mutual convergence of the two terms, because it has an essentialist, predetermined and static view of the body's morpho-functional architecture.

Somatic organisation always has to accommodate and tune in to the media it is exposed to, through reciprocal adjustment processes involving both the development of peculiar techniques of use and the advent of new developmental pressures on the organism (Cregan-Reid, 2018). It is an illusion to think that the body remains untouched by the encounter with technological devices, because it is characteristic of the phenomenology of life to rely on the world's acceptance. The body is an entity that, while maintaining its basic structure, continually modifies itself and does so by following the pressures that come to it from the external milieu. It does not lack a form of its own, it does not have a fluid consistency such as to assume the shape of its vessel, but neither is it imprisoned within a static form. It is a *metastable* entity (Simondon 2020): i) it is endowed with a precise range of phenotypic variability, so that morphogenesis must still respect a certain perimeter; (ii) it has dynamic configurations, i.e., it is constantly changing, while retaining its basic identity; (iii) it is recognisable not because it possesses an essential quality (which never changes), but because it has state singularities that can be categorised by family. The body is a perspective entity and in this sense it is projected into the world.

So, when a technomediated condition is inaugurated, the existential perspective changes: what is altered is the image of the self in the world (Floridi, 2014), and thus not only the landscape of agency, understood as the set of possibilities available to the individual – both in the standards of performance and in terms of desirable goals – but also the sense of one's own body in different situations. Through technological devices, the body builds new interfaces with external reality, so we can see a transformation of sensory correction mechanisms in the areas of both sensibility and agency. Each technological innovation, as it were, opens a new window onto the world and sometimes leads others to obsolescence or neglect, so we can speak of a true existential metamorphosis. On the other hand, not only does the perspective projection onto the world change: we could say that the landscape, the way of looking at it, but also the temporal frame, that is, the alternation of events and thus their configurations in the *continuum*, change as well. Digital technologies, for example, increase the speed of perception, so it is as if time contracted and some details of the landscape were lost, yet the space covered has increased (Rosa, 2010). This is the same

experiential difference as the one that occurs if a given route is taken on foot, by bicycle or by car.

In the niche of the technosphere, the body is not simply housed; it does not rest in it, maintaining its purity and integrity as if enveloped by foetal membranes, but is infected by numerous viral agents that transform its internal metabolism (Leonhard, 2016). The body is infiltrated by technology, which penetrates it through a vast network of capillaries, reprogramming its internal organisation. Therefore, it is the entire organism that undergoes a profound change in the acquisition of a new technology. What occurs is a metamorphosis that involves the neurobiological wiring, the endocrine setting, the immune response, sexuality, the musculo-skeletal chassis, the main organ functions, as well as the biorhythm and cell turnover. This is why I say that technology is always infiltrative: it is embodied, even when at first glance it would appear to only "dress" the body, wrapping it like a glove, preserving it from contamination (Capucci, 1994).

1.1 The plastic and changing condition of the body

The body is always changing in relation to what surrounds it; this is why it is important to consider each interacting element, especially if ongoing, as an *ontogenetic factor*. There is no doubt that technology represents an important counterpart in people's lives, capable of characterising children's development matrix and the subsequent stages of refining and maintaining that morpho-functional configuration that can be defined in terms of individual singularity (Arthur, 2009). On the other hand, in order to understand the influence exerted by technology on somatic physiology, it is essential to shed light on the very concept of the body's plasticity. In fact, we might think that this plasticity arises from a lack of an inherent (proper) form or from incompleteness, whereby the technical or cultural element would merely compensate for the lack of equipment received from nature – like a vessel which, the emptier it is, the greater the amount of liquid it can contain. This explanatory model, which can be defined as the *scarcity principle*, has characterised the humanistic tradition since the classical heritage and still has its appeal, but it has proven to be totally inadequate to explain the body's adaptive capacities (Gehlen, 1988).

If we observe the structure of the various apparatuses that make up the human organism, we note that their capacity to adapt does not arise as a compensation for some deficiency, but rather as pruning of redundancies and in general as differential growth of the resources present. The neurobiological system, for example, presents itself at the beginning of

experience with a *redundancy* of neuronal elements and synaptic connections that are then reduced through processes of apoptosis. This pruning is supported and directed by the different functional activations of the various *neuronal assemblies* of the connectome (Hebb, 1949): therefore, it is the relationship with the external environment that configures the physiological and, consequently, performative structure that the neurobiological network will assume. The subject's experience, especially in the developmental age, when the plasticity-virtuality of the system is at its peak, will define the psychological-behavioural identity of the individual. Moreover, the activation of a particular pathway in the network strengthens this connection, increasing the thickness of the myelin sheath, the capacity of presynaptic neuromodulators and the sensitivity of postsynaptic receptors.

The evolution of very different cognitive identities in humans is thus not attributable to incompleteness or deficiency, but rather to an exorbitant number of possibilities that allow for the structuring of a wiring singularity through i) the pruning of network redundancy and ii) the differential development of possible connections. If we consider other apparatuses, such as the immune system, we will see that the configuration it achieves, for example through vaccination, is realised through the differential replication of certain lymphocyte families that are rewarded, so to speak, by the neutralising efficacy of a certain antigen (Edelman, 1987). The muscular apparatus also has its redundancies that are set in an athletic profile through the law of use and disuse. In the case of the endocrine system we are faced with homeodynamic mechanisms of feedback interaction that manifest a plurality of possible equilibria. And in general, even the phenotypic translation mechanism extracts a configuration from the potentials present in the genome (polyphenism) through epigenetic silencing or emphasising mechanisms.

It is therefore necessary to move from an intuitive view of plasticity, based on the act of filling a gap, to a potentially counterintuitive model based on the *differential wiring of a complex system* (Zhok, 2011). Plasticity is, therefore, the ability to express one’s potential by producing a peculiar configuration that reflects the boundary conditions without betraying its own intrinsic characteristics. Let us take an example: the foliage of an oak tree takes on a peculiar form based on the light conditions present, while remaining true to its species-specific traits. In the phenomenology of life, plasticity does not come from a lack of form but from the generative potential of form (Henry, 2008). We should therefore adopt a different model, which can be defined as the *redundancy principle*: the greater the complexity of a system, the more relevant its virtual condition, i.e. the range

of expressive possibilities and configurations it can assume. The body is not adaptive because it is deficient, but because its redundancy of actualisation potential allows it to introject information from the outside world. Plasticity, therefore, does not derive from an absence of implicit contents, but from their complexity, such that it can reflect its own adaptive history through configurations in the making.

The organism necessarily adapts to the environment, and it does so not by producing a form from scratch, but rather by utilising the endowments received from phylogeny (inherencies), which in turn are the result of an initial form of adaptation, traceable to natural selection (Lorenz, 1973). In essence, the ontogenetic adaptation process, which produces our particular identity, takes place by virtue of a generative dialogue between innate characteristics and the environmental factors that the system will encounter in the course of its development. This is why it is essential to bring plasticity back to the surplus of intrinsic properties and the *singularity of outcome* to experiential occurrences. I speak of singularity because the actualisation process of a system endowed with high virtuality from the start inevitably presents a degree of unpredictability. This can be traced back to chaotic dynamics, as well as to the uniqueness of the configurative conditions. So, the identity of a body is not only unique but also unrepeatable: a replica would not be possible even if the system were subjected to the same adaptive sequences, as utopian as this claim may be.

I mentioned experiential occurrences because the flow of influences that alternate in the configurative pathway of a body has its own irreducible randomness, so that every developmental process is always a somewhat indeterministic event. Having said this, it is evident that the ontogenetic system, alongside an openness to the unpredictable flow of random events, also presents mechanisms to mitigate the variability of this randomness. We can speak of *strange attractors* (Lorenz, 1963) that, while not defining deterministic outcome trajectories, nonetheless establish field probability indices. In the mammalian world, for example, parental care not only serves to nurture and protect the cub, but imposes educational paths that assign a certain direction to its development, through modelling and the masterful intervention of reinforcement and inhibition. The adaptive niche of a species can also be considered an attractor of ontogenetic outcomes, because it lowers the variability of the environment and the randomness of occurrences, creating a specific growth milieu (Lewontin, 1983). In this sense, even the culture and technology of a certain social setting can be defined in terms of an ontogenetic niche and thus a strange attractor. To sum up: plasticity is given by the system's redundancy and its intrinsic virtuality,

while singularity is played out between factors of random occurrence and the influence of strange attractors.

At this point, it is necessary to understand what kind of relationship is established between the inherent contents of a body, which establish the *gradient of virtuality* – the breadth and characteristics of the field of ontogenetic possibilities that it implies – and the external influences called upon to translate this virtuality into a form through *actualisation*. Today, it is clear that the contribution of both factors is indispensable in ontogenesis, but how should we understand their relationship? Once we have assumed the co-factorality of inherent content and external influences, it is essential to define the terms of this relationship. Once again, we must endeavour to abandon the easy suggestions of intuition, which would lead us to consider this convergence as a compensation whereby the external would make up for inherent shortcomings.

Indeed, if this relationship were complementary – with each factor filling the other's gaps – we would fall into the deficiency model, whereby the ontogenetic plasticity of the human being would be attributable to its incomplete nature. This is the explanation that has characterised the *humanist paradigm* (Pico della Mirandola, 1942), to such an extent that to question it is tantamount to ushering a crisis into humanism itself. To consider the human body as incomplete from a biological point of view is, as we shall see, to mistake the *consequences* of technomediation for the *cause* of the process of technological endowment. This is an explanatory inversion based on a logical fallacy, which is nevertheless consistent with an intuitive vision as well as useful for anthropocentric purposes of ontological differentiation of the human from the animal condition (Heidegger, 2001). The redundancy model departs from this in that it modifies the very conditions of the relationship: it does not posit an inverse proportionality between the two terms, but rather a *direct* one, whereby the relationship is dimensional. As a result, the plasticity gradient is directly proportional to the complexity of the body system.

If we move away from the Platonic metaphor of the empty vessel and rather think of a marble slab to be sculpted or a network to be configured, we realise that explaining plasticity through deficiency is nothing more than a gross miscalculation. Variety in configurability belongs to a complex system, not an insufficient one. Only a redundant, non-deficient structure can develop a high gradient of virtuality, with many possible variation paths at the beginning of the development process. In other words, only a marked richness of inherence is capable of presenting a substantial level of

plasticity. At the same time, we must return to the concept of experience, because the configurability of the body is never its passive exposure to the external configurative factor. Redundancy produces a virtuality that on the one hand requires and enables the experiential moment, and on the other is responsible for triggering it: redundancy gives not only virtuality, but also vitality to the system (Bocchi and Ceruti, 2007). Redundancy, in fact, defines planes of complexity that must necessarily rely on external contributions to be realised, just as a ladder is needed to reach a greater height. That is, it creates heteronomy: a level of organisation that can only be maintained by virtue of a high negentropic and dissipative potential, both in terms of energy and in terms of information content.

Heteronomy is an implicit externalisation, a reliance on content from the world, a dependence on external supports to reach a higher level of organisational complexity (Marchesini, 2022). Heteronomy can only be realised through redundancy, the capacity to accommodate and introject the boundary conditions that the organism finds in the environment. Heteronomy is, therefore, an assumption: the wings of an albatross speak of thermals and air resistance, the shape of a dolphin captures the viscosity gradients of water, just as the gills of a fish expect a liquid world to be sifted through and the size of an insect testifies to the oxygen levels in the atmosphere. It is therefore impossible to understand the body through internal inspection alone, because every bodily structure always implies the world: in practice, it presupposes it. The body is like an incomprehensible text without notational references, and these are given by the co-factors present in the reality surrounding it (Scheler, 1970). Heteronomy implies experience, as an event that is not accidental but already predefined, since the somatic dimension is the emergent product of the world itself: the body is coherent with the world because it has been shaped by it.

Therefore, we have to view plasticity not only as a configurative possibility by means of external co-factors, but also as a *yearning for the world*. Plasticity is an implicit reference to presences that, in their chaotic-contingent fluctuation and conversely in their coherence and consubstantiality with the body, allow for individual singularity. Plasticity is thus also a way of looking at the world with interest, whereby the body is an exercise in extroversion, projection and hospitality. In this sense, it is not possible to speak of the body without referring to this openness to the historical dimension of occurrences that we call experience. In it, the body is realised in a proactive manner that is only apparently expositional, because it is precisely through inherencies that the body can *take a position* in the world (Deleuze, 1994). Experience is the capacity for listening, convergence and

correlation, but it is equally the yearning for the world and the ability to create worlds. This dialogical reciprocity of experience makes the becoming of the body an unpredictable event because, just as in a dialogue, the outcome of the discourse is always open. We must therefore move away from all forms of determinism, both internal and external.

The body is an experiential entity, in that it is realised by overcoming itself: it accomplishes transcendence by projecting it into immanence (Tymieniecka, 2007). The plasticity it derives from redundancy makes configurability possible but at the same time exerts it through experiential yearning: the continuous hybridisation with external entities translates virtuality into innovative morphological singularities. In this sense, the body can be defined as a creative workshop. Experience is a dialogue with the world from which we emerge renewed and contaminated; however, this dialogue does not occur between two impermeable and extraneous entities. There are countless reasons for this, but I will only mention two. The first is that the inherent contents of the *body system* speak of the world and are consistent with it, as they have been shaped by the world itself: although *a-priori*, they are nonetheless *a-posteriori* compared to phylogenetic experience (Campbell, 1974). The second is that experience itself, from the earliest moments after conception, produces the assumption of external contents that become inherent to the subject, characterising its subsequent experience. Each interactive moment modifies the individual's internal contents, involving the introjection of many environmental elements, so that it is no longer a dialogue between innate and environment, but between the *past* – what has matured from the previous relationship with the world – and external factors. The environment, consequently, also changes as the interaction proceeds.

As mentioned above, plasticity lies in the willingness to let oneself be "translated" by the external world, by the intrinsic virtuality that is capable of mirroring ontogenetic boundary conditions: through the mechanisms of pruning and evolutionary differential, the body is able to introject information (Changeux, 1986). Plasticity is also given by the propensity to do so, in what I have called *experiential yearning*. The expressive process is not a passive event, where the world is left to select the variants acting on a body that is simply exposed to external influences. Mirroring is a phenomenon of absolute protagonism, where the body plays an active role. Experience is realised not only for the trivial reason that there is a world full of evocations and activities, but because the body is interested in them. The process of morpho-poietic singularity is therefore based on a yearning for the world that creates involvement – that is, openness and interest in the

outside world – and that is also of central importance in the way we approach technology.

Somatic plasticity generates experiential vitality and, from this, the evolutionary creativity emphasised by Henri Bergson. According to the latter, the body is always the emergence of a singular perspective on the world (Bergson, 1907). This implies an interactivity that underlies the phenomenology of life and that cannot be assimilated to other virtual but inert structures, such as the previous example of the marble slab compared to the statue. Life is expansion, infection, colonisation, replication, active pursuit of possibilities, hunger for energy, occupation of space, will to power and power of the will. Plasticity means taking an interest in the world as bearers of inherent drives, whereby feeling and desiring are motivating foundations. Experience is a probing of the possibilities of reality as holders of an intrinsic motivation, which drives the body to interaction through imaginations, hypotheses, transfigurations, epiphanies, and questions. We can say, then, that the body is plastic because it is involved, because it is not disinterested, because it is involved by the world and is therefore sensitive to calls, solicitations, challenges and elicitations. The proactivity of the body is not, in essence, a self-referential motion, but rather openness and self-giving (Marion and Tardivel, 2018).

The body can be envisioned as an exclusively dissipative entity, absorbing energy from its surroundings, but this interpretation, though true in some ways, is incomplete in others. The body, with its plasticity given by its virtuality and its involveability, is a creative entity that constantly produces singularities through processes of dialogic convergence (Haraway, 2016). On the other hand, if experience is not passive exposure but a dialogue, akin to asking questions about the world and formulating epistemic innovations through hypothetical-deductive paths, it is clearly not possible to do so without presuppositions. There would be no plasticity without an *a-priori* platform: thus we should not think of inherence as obstructive to the process of ontogenetic singularity, but as a constructive factor in it. Its role is to catalyse and trigger experience, and likewise to provide it with those basic endowments that enable its implementation. If we think of the body as an incomplete entity that seeks a sort of crutch in the world to find an adaptive centre of gravity, we fail to understand the primary meaning of experience which, conversely, is based on conjugation (Piaget, 1970). We must therefore pre-emptively ask ourselves what *copulative factors* act as a magnet for the world, creating a gravitation that is never thrownness.

We recognise the plasticity of the body by observing its expressive path; that is, we evaluate it on the basis of its capacity to assume multiple configurations, to reflect boundary conditions and to produce singularities. If virtuality were not functional to these outcomes, it could be dismissed as a simple amorphous, not really plastic condition. On the contrary, however, virtuality is plastic because it associates availability with experiential involvement: it proactively gives itself to the relationship with the world, as if intrinsically attracted to it (Patocka, 2016). We must therefore start precisely from this relational fascination that characterises the phenomenology of life: the implicit reference to an attribution of meaning. A child's gaze is full of astonishment and yearning towards the world, his smile in front of his mother's face is evidence of the joy of finding himself again; it is certainly not a confused bewilderment at the strangeness of his surroundings (Rosmini, 2009). The prevalence of a rationalist conception of somatic experience causes a neglect of affective factors that, on the contrary, are a prerequisite for interest in external reality. Technology also produces its ontogenetic influences by acting on the human emotional and motivational factors that create involvement in the immersive experience. Plasticity is commensurate with the gradient of openness, we might say wonder, amazement, exploratory pleasure and desire for self-assertion – all factors that accentuate immersion by acting on interest and involvement, and thus on the depth of experience.

Here, too, we can see how the influence of the external milieu cannot be attributed to a generic vacuity of the body, but rather to its copulative nature, which we can summarise in the body's readiness to be involved in experiential possibilities (Lichtenberg, 1989). The technological factor exerts an appeal that cannot be trivialised as a mere performative need, because it solicits the subject's intrinsic emotional and motivational systems: in other words, technology can speak directly to people's hearts and guts, even before their reason. Ontogenetic plasticity involves experience, a process of integrating environmental elements that translates the initial virtual condition into a specific form. But experience is not a simple exposure to the world: it is an immersive process that requires involvement on the part of the subject.

This involvement that makes the world attractive to the subject's eyes is given by affectivity, in its emotional and motivational characters. Our sentimental and desiring nature plays a fundamental role in our technological experience, as well as in all those processes that reveal plasticity *a posteriori* (Pulcini, 2012). We must not forget that the body is affectively copulative because it evolved through yearning: (i) it has specific

metabolic needs, such as hunger and thirst; (ii) it has a certain hedonic predisposition, marked by an exteroceptive aesthetics and proprioceptive pleasure; (iii) it assigns a dispositional, rather than rational, value to events. This makes the subject interested in the world, not detached from it, and thus inclined to openness: it tends to welcome what is outside and to project itself into the world.

I have defined experience as a dialogue with the world, and this aspect recalls the inadequacy of the expositional conception and the deficiency principle, because a dialogue always refers back to the input of the interlocution. If the ontogenetic result is full-bodied in its vastness and variety of outcomes, as we can see in the human being, it is precisely thanks to the richness of the resources that precede experience itself and make it possible to formulate questions or hypotheses, giving rise to a singular perspective (Dehaene, 2020). It has to be said, however, that by experience I do not only mean the cognitive-behavioural aspect of interaction and explicit learning: muscles, glands, bones, and intestines also experience reality. Therefore, by inherent content I mean more than the classical transcendental *a-prioris*. For example: i) the sensory organs, as media, are contents to all intents and purposes; (ii) time frames construct a precise image of continuity in the configuration of experience; (iii) the enteric structure and intestinal symbiosis establish orientation contents; (iv) endocrine and immune systems define a biorhythm for the entire adaptive metabolism of the apparatuses.

The body is not closed in on itself, it is not autarchic and impermeable in its essential, monadic fixity, but has evolved by implicitly taking on the ordering action brought about by external entities. Heteronomy is, therefore, an intrinsic characteristic of the body that presupposes a contribution beyond its own individual presence. I said that an organism could not maintain its internal organisation without energy and information from the external environment: in this sense we can say that it is an open system (Prigogine and Stengers, 1979). At the same time, the body could not subsist without a hereditary content, that is, without the contribution of a package of information that comes to it from phylogeny. For this reason, we can speak of a *dissipative structure of experiences* that preceded it. In other words, the body is a diachronic entity: without the hereditary legacy, a living being could not open itself up to experience, without a niche it could not achieve adaptation, without an ecological-relational location it could not position itself in the world (Odum and Barrett, 2005). Plasticity, therefore, is based on heteronomy, i.e. on the presence of a somatic dimension whose realisation already implicitly envisages the contribution of the world. It is

plastic insofar as it is not based on autonomy, autopoiesis and self-sufficiency. The presupposition of the world allows the body to reach an organisational level that would otherwise be impossible, so plasticity is the very ground of the *phenomenology of life*.

Plasticity is openness but not passivity, and this awareness also produces an explanatory reversal of no small importance in understanding technophysiology, which we would be wrong to view as a superstructure or as something that dominates the body. If it is incorrect to read technology with the classical focal point of the passive tool in the hands of the human being, it is equally misleading to imagine a body ruled by technology. Experience is a yearning for the world that involves the body and expresses it through the environmental matrix, whether it is the result of technology or not. Without involvement there is no experience and no expression: plasticity, therefore, is not fluidity or an amorphous condition, but the creative manifestation of inherencies in their morphogenetic capacity. It is therefore necessary to presuppose implicit contents that not only allow for plasticity, but also implement it. Without affective components, for example, there would be no interest in the world and, more generally, there would be no involvement that transforms experience into a moment of immersion (LeDoux, 1996). Likewise, without *a-prioris* there could be no experience, because we would have no questions to ask and no hypotheses to formulate. The plasticity of the body does not lie in the absence of inherencies or intrinsic endowments, but in the experiential vocation – that is, in the heteronomy of the system itself.

1.2 The somatic dimension of technological experience

Looking at the relationship between body and technology is a necessary step in understanding the technical dimension of human experience and how the somatic dimension as a whole is strongly influenced by the technosphere. How is it that our species has developed such an articulated and profound technical dimension that has no equal in nature? This technological propension substantiates the Promethean definition that characterised classicism. As mentioned, the answer given by the humanistic tradition is based on the deficiency principle, assuming that cultural intervention in its most generic sense – and therefore including the technical sphere – should be understood as a compensatory factor (Herder, 1869). Instead, I will try to set out a different line of reasoning, no longer based on the supposed incompleteness of human nature – that is, of some original deficit to be compensated for – but by investigating the characteristics of our species'

phylogenetic heritage that have enabled and facilitated the emergence of such a robust, articulate and multifaceted cultural dimension in human history. I will therefore not attribute the technical emphasis of the human being to a lack to be made up for through the use of tools, understood as an adaptive crutch, but to propensities and endowments that have evolved characterising the hominid lineage (Leakey, 1994).

We know that mammals also have cultural traditions and that primates, in particular, use a plurality of tools. Chimpanzees, for example, use sticks as weapons against potential enemies, fashion longer sticks to catch termites, use stones to open nuts, and use medicinal plants to cure diseases (Goodall, 1990). Lithic art was already present in the Australopithecines and developed progressively with the advent of the genus *Homo*, over the course of 2.5 million years, until it reached extremely complex forms in the Aurignacian period, some 40,000 years ago. Therefore, we must assume an already established tendency in the *Hominidae* family, which has become specialised in the genus *Homo* through processes of adaptive selection. This means that, contrary to the customary interpretation of human nature and, consequently, of the technical tendency, this propensity must be sought precisely in *coherence* with the phylogenetic heritage of our species. Obviously, when I speak of propensity, I am referring to certain qualities that have fostered technical expression and others that are the very outcome of technological behaviour, in a process that can be described as recursive.

The technical dimension can be represented using the theory of niche construction, which involves: i) on the one hand, a species already predisposed to modifying its environment through particular operations – think, for example, of the beavers' dam building; ii) on the other, selective pressures directed or modulated by the niche itself, defining a particular phylogenetic trajectory and increasingly tying the species to its niche. In other words, we can identify in the genus *Homo* a technopoietic emergence of a character already present in primates in general and in the *Hominidae* in particular. This strengthening may have been stimulated by environmental adaptive factors, but also by changes in population. The increased use of tools would then have contributed to modifying selective pressures or Evo-Devo effects on hominids with recursive repercussions acting as a driving force for further technopoietic developments. It is therefore necessary to see human nature not as something incomplete that requires tools to compensate for its maladaptation, but as full of productive, dispositional and creative traits underlying its technopoietic tendencies.

The expressive plasticity attributable, for example, to neuronal redundancy may be a good starting point for understanding both the gradient of niche predisposition in the technical sense and the recursive effects of technomediation. There is no doubt that human beings have a pronounced tendency to modify their environment, most likely because their phylogenetic cradle presents strong state fluctuations and habitat characteristics of considerable problematicity (Morris, 1967). Here, too, plasticity proves to be a source of adaptability and likewise of acute experiential singularity: it is a still recognisable quality that causes human beings to assume identity profiles reflecting their circumstances of growth. In other words, the influence of technology fits into a natural human condition, a trait already predisposed to variation by external factors. The biological characteristics of our species – involving neonatal immaturity, a strong motivational drive, a highly developed neocortex, and the social dimension – are an inescapable prerequisite when it comes to understanding the technical predisposition and the ontogenetic influence exerted by technologies. Contrary to the claims of the humanistic tradition, there is a close and directly proportional relationship between bodily plasticity and phylogenetic heritage.

So, human nature is by no means deficient. It is precisely by virtue of its redundancy that it achieves its degree of virtuality, which gives it a high level of openness to circumstances and to the attainment of singularity. This is how we must view technology, rather than thinking of it as a crutch that compensates for supposed biological inadequacies. The technological dimension must be analysed in terms of an ecological niche: built on the basis of latent propensities in the phylogenetic lineage, in turn, it acts as a flywheel for stimulating such tendencies. As we shall see, the relationship with technology produces considerable influences on ontogenesis through various avenues, the most important of which is the differential exercise of organs and apparatuses. On the other hand, we would be equally mistaken if we considered the technosphere to be a kind of foetal membrane that shields us from external contamination (Sloterdijk, 2011). In reality, technology does not disconnect us from the world but intervenes by modulating its relationship with it, and in this sense we speak of technomediation. In some areas, there is a greater dependence on external contributions because the system assumes a more dissipative configuration and a higher level of integration.

We are wrong, therefore, whenever we depict the technological dimension as a containing envelope, a surrogate for a uterus, or as a sphere that preserves, protects and decontaminates us. Conversely, technomediation is comparable to an anastomosis that metaphorically expands our circulatory

system beyond our body, placing it in even more direct contact with external reality and, above all, making it more in need of energy and information. It is therefore indispensable to talk about *technophysiology*, today more than ever. In fact, we are still caught up in an explanatory framework that considers technology as a garment that, while characterising us, does not alter the presumed purity and autonomy of the human being. On the contrary, in technological hybridisation, we do not divest ourselves of our human condition. We do not become inhuman: we realise dispositions that are inherent in our nature (Eibl-Eibesfeldt, 1989). When we imagine the technosphere as an exoskeleton that envelops us, standing alongside our biological condition, we make a big mistake that may even be the harbinger of great sorrow. In reality, technology dissolves any barrier between us and the world; if anything, it operates a somatic boundary reduction, making the body more permeable and unstable. Every technology bursts the body open, scattering it to the four winds, precisely because it reinforces physiological openings.

A technology can shield an organ from the strain of performing a certain function, while simultaneously subjecting it to a different performative pressure. Moreover, this process does not increase the autonomy of the body with respect to the outside world, but rather reinforces the dependency gradient. In fact, the more a system increases the devices needed to achieve a certain result, the more it requires negentropic mechanisms (Schrödinger, 1940). Our dependence on the world is not to be assessed in terms of mere contact, but in terms of the number of input levels it produces: a greater complexity of the niche inevitably results in increased energy demand. Moreover, a device is able to raise the performance bar and sometimes make otherwise unattainable goals possible. This is not to say that it absolves us from the contract with the outside world or that it diminishes the effort required, for the simple fact that raising the quality of the result pushes the body ever further to the limits of its powers. This is a fact for all to see: technology makes the body *more* needy and *more* projected towards high-profile goals, which necessarily require *more* external inputs (Gawdat, 2021).

The plasticity of the body and the readiness of human nature to open itself up to external contamination produce the metamorphosis, especially in physiological dynamics, that we derive from the different variations of cultural dimensioning, of which *techne* is an integral part. A sort of ontogenetic dance is thus created between body and technology that penetrates deeply into the metabolic meshwork and reshapes the somatic dimension of the human being. Today, we are witnessing a heated debate

on the interactions between the body and technology, which can be traced back to the development of certain practices – I am referring in particular to the digital world and biosynthesis – that have literally revolutionised our perception of the human being's operational potential (Bostrom, 2014). On the one hand, these advances set off a fairground of futuristic fantasies; on the other, they raise perplexities and fears, which can be summed up in the question of whether everything that is technically possible is also licit or desirable. By a strange convergence of factors, as if in a space-time wormhole, the end of the 20th century brought to the fore the reflections of 15th century humanism, questioning the modern age.

This calls for a new philosophy of technology and, at the same time, a new anthropology, so as to break away from the traditional positions that have characterised humanism over the last five centuries. The challenge is not to give rise to new forms of anti-humanism – a sterile deconstruction that does not offer interpretative and propositional keys for the future – but to trigger a new paradigmatic revolution capable of offering a better picture of the human condition immersed in an increasingly complex and articulated technosphere (Benasayag, 2015). The somatic dimension is no longer interpreted as adherence to a stable form, but rather as a *generative principle of possible forms*. This, although confined within a range, presents a gradient of ontopoietic freedom that requires a much more articulated reflection than the Vitruvian canon. We can see this shift as the advent of a new awareness of the necessarily hybrid condition of human ontology, taking leave of the essentialist, autarchic and emanative approach so well represented by Leonardo's image. Becoming aware of the ontogenetic mutations occurring in the increasingly frenetic succession of new technologies requires a critical vision capable of avoiding both easy techno-enthusiasm and neo-Luddite pessimism.

At the centre of my discourse, therefore, is the somatic dimension of technical experience and, in particular, of the peculiar form called technomediation. From a merely external and instrumental conception of technological devices, as auxiliary entities called upon to passively serve the dictates of the human being, we must move on to a hybrid vision capable of profoundly transforming the somatic dimension of the human being in all its expressions. Instead of accepting the compensatory reading, which claims that *techne* acts as an external – therefore non-contaminating – crutch, I will question the somatic dimension in order to understand what biological factors have allowed our species to excel in the technical domain. If in the supplementary conception we turn to alleged somatic deficiencies to explain the exemption and compensation offered by technology, in this

book I will attempt to investigate the phylogenetic specialisations that have enabled the technological emphasisation of the human niche. Our bodies have a certain plasticity, but it is equally clear that our cognitive endowments, our practognostic and eye-hand coordination skills, our social and collaborative propensity, and our abstract and representational intelligence have made the technical-cultural trajectory of humanity possible (Morin, 1974). It was not deficiencies that drove us to the use of tools, but rather a strongly copulative and creative psychic dimension, an extraordinary memory, and a body that is ductile in its kinesthetic abilities and manipulation of objects.

The effects of technology on the grammar of the body also require us to reflect on how technology manifests itself to the subject's experience by redefining the individual's life (Carr, 2010). The close interaction between body and technology does not only concern the performative aspect, but also the many facets of a person's life – things like social participation, wellbeing expectation, physical condition, or the expression of propensities. Therefore, we need to be aware of the strong influence of technology on the individual's existential dimensions (Vaidhyanathan, 2018). In order to understand the functional remodelling effect, however, it is necessary to overcome a number of misconceptions about the body and technology that still hinder the development of a truly interactive interpretation of the two terms. Accustomed to considering devices as tools to be used, in a unidirectional logic – as if we were immune to any induced consequences – we do not realise that every innovation produces a true somatic revolution in the body (McLuhan, 1964). The thesis I will illustrate in this essay is that each device should be considered as a body-building machine, capable of modelling the structural and functional organisation of the body.

This comparison may seem paradoxical and should certainly be taken as a simplification, aimed at illustrating the general mechanisms of *technophysiology*. The muscular conformation and the influences that exercise determines in its structure are obvious: a cyclist strengthens certain parts of the body, while a swimmer and a weightlifter develop others. Conversely, those who lead a sedentary life run the risk of muscle tone loss and, in cases of total inactivity, serious forms of atrophy. Even the body's posture, if repeated over time (e.g. someone who spends many hours on a mobile phone or computer) causes muscular tension that acts on the joint systems, intervertebral discs and cartilaginous portions (Cregan-Reid, 2018). The exercise of specific parts of the musculoskeletal system determines a growth differential and is easily observable in outer appearance. Other somatic dimensions are not as obvious – I am thinking,

for example, of the neurobiological wiring or the endocrine setting – however, the differential development mechanism caused by exercise is the same, so that our brain and hormonal metabolism also receive growth or decrease impulses depending on how much the different apparatuses are stimulated (Siegel, 1999).

The somatic dimension is a plastic entity, a kind of ecosystem between competing and cooperating populations. The body is affected by a large number of constituent factors and systemic dynamics, achieving a condition of dynamic equilibrium between the forces in play. In this stage of climax, it is difficult to establish the boundary between internal and external, between stability and becoming, between intrinsic and extrinsic (West-Eberhard, 2003). The architectural and functional conformation is sensitive to environmental influences, especially during the developmental years: what happens is a genuine introjection of otherness. On the other hand, at every single moment there is an ongoing remodelling, however small, involving tissues and system assemblies. The external element may disarticulate or conjugate cellular groups, forming new functional convergences that reflect the contextual conditions (Waddington, 1959). Technology is thus never external, but always embodied, modifying the texture of the organism. This is nothing new in biology, where an entity is never viewed as an essence but always as a consortium. Suffice it to say that 90% of the cells that make up our organism do not have a human genome: they are symbionts that do not merely inhabit the body, but constitute it and define its functions (Margulis, 1991).

Plasticity makes the somatic structure susceptible to external influences. Technology is no exception, and it should come as no surprise if our physiology adapts to it, matching the various devices it engages with daily. In some ways, these devices have the same effect as nutrition, which, with its excesses and deficiencies, alters metabolism. The body needs nourishment and cannot maintain its thermodynamic complexity without receiving energy from the world: the external contribution is, therefore, the foundation of metabolism itself, the consequence of the co-evolutionary pact established in phylogeny. We are relational entities that nourish not only our energetic appetite, but our very ontology, by leaning on the world and introjecting its imprints (Vygotskij, 1962). Technology is a form of nourishment, something that enters into the meshes of our bodies and transforms them: sometimes so subtly that it is not easy to be aware of it, at other times blatantly, with a true metamorphosis affecting both morphology and behaviour. The organism, in fact, is an adaptive entity that presents a

condition of phenotypic virtuality and, consequently, can give rise to different anatomical and physiological morphotypes (Mayr, 1963).

This plasticity or phenotypic virtuality must, however, be contextualised, assuming that having the capacity to adapt to external conditions does not mean lacking content or being passively exposed to the world. Even over different ages, the body maintains a degree of continuity, which is recognisable if one follows the evolution of a physiognomy. While it is true that identity is the permanence over time of a succession of events inscribed in the flesh, of somatised encounters and metabolised otherness, it is also undeniable that these acquisitions are positioned within a predefined framework. Stating that external factors influence the development of the body does not mean denying the existence of a species-specific canon, characterised by basic architectural lines (Carlson, 2013). The matrix of the organism has its own very precise structure, albeit plastic and influenced by external factors, and it is thanks to this constitution that the body is able to introject environmental influences, inscribing them within its identity (Abouheif et al., 2014). The somatic dimension is, therefore, the site of reception, a substratum endowed with its own conformation, capable of incorporating the incessant becoming of influences bound together by the very identity of the individual (Bateson and Gluckman, 2011).

The body is therefore diachronic and inclusive. Its plasticity is neither total liquidity (a condition that would lead it to always take the shape of its container), nor a lack of its own organisational matrix, which would condemn it to the determinism of the occasional and the contingent (Tinbergen, 1965). Rather, its plasticity grants the body a certain conformative freedom to move within a virtual space, becoming a malleable substratum, subject to the influence of the chaotic flow of possibilities that is readily introjected into its constitution. The body is thus a relational entity that faces the dialectic of encounter through the synthesis of somatisation. For this reason, concomitant factors have a considerable impact in shaping the body: we are also the otherness with which we engage (Levinas, 2000). It is not a matter of counterparts or space: a niche is the expression of an inclusive principle, where the becoming of the body is always the outcome of a dialogue. Any modification of this principle inevitably has repercussions on ontogenesis, because it involves the very course of the body-river, both in its configuration and in its evolvability. The capacity to introject organisational information is, in the final analysis, a quality of the body, which necessarily demands interpretation but already gives us the measure of incorporation.