SUPERPOWER AND IMITATION
BODY AND MACHINE

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ABSTRACT

This work is an attempt to clarify the sense in which two ideas - indicated with the terms *superpower* and *imitation* - are used by a number of authors of contemporary philosophy to describe the relationship that developed between the human body and machinery in the passage from the Second Industrial Revolution to the early decades of the 20th century. Pages from works by Ernst Kapp, Karl Marx and Arnold Gehlen are analyzed to sketch the outlines of a discourse that shows undeniable signs of a conceptual continuity among thinkers usually seen as belonging to very different "ideological" spheres. The conclusions contain a few brief considerations on possible ways in which the evolution of body and machine seems to be converging today, particularly in certain technological sectors.

1. INTRODUCTION

Over the brief course of a century, all aspects of human life have been shaken up by the arrival of machines in every space where we live our lives. The most profound changes initially took place in the working world. Within a few dozen years, all technological sectors founded on manual-visual technicism, and on controlling natural energy were revolutionized by the introduction of automated machinery at every node in the production chain. For the first time in the history of civilization, an artifact could substitute a human worker in those elementary gestures traditionally implemented with our own hands with the aid of simple tools. After thousands of years of being put to limited use in workshops and domestic laboratories, a scarcely noticeable presence, machines became the undeniable protagonists of the economic practice most typical of our time: industrial mass production. It was during what has been called "the century of the machine" that steam-driven mechanical devices received a new, more adequate definition:

> The name of machine is used for all systems of bodies destined to transmit the work of forces and consequently capable of modifying the intensity of said forc-

> es and varying a movement in terms of its intensity, velocity and direction. The variations in the path covered by the moving parts are what make machines particularly suitable for an infinite number of industrial uses (Laboulaye, 1853, LXV).[1]

Machine body, work, transmission of forces, intensity, and speed variations became the load-bearing lemmata of a new "philosophy of the machine" that spread at a remarkable rate. Though still not accurately encoded, this new language was needed to describe real experiences of a time that, in many ways, is still our own. We can draw on a few descriptions of this new thinking about the machine as noteworthy examples of how the interpretation of the phenomenon of automation was dominated by concern about the loss of an order based on the central role of the human agent.

2. Organ projection

Ernst Kapp takes the merit for one of the concepts most strongly influencing contemporary thinking on the meaning of technology. He expresses it for the first time in his brief *Einführung* to the *Grundlinien einer Philosophie der Technik*[2]:

> First of all, it is demonstrated by means of incontestable facts that man transfers (*uberträgt*) the shape, function and normal proportionality of parts of his body to his handiwork, and it is only afterwards that he becomes aware of these analogies. This fashioning (*Zustandekommen*) of mechanisms based on organic models, like the interpretation of the human body in terms of mechanical devices and,

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1 For general and specific aspects relating to the "century of the machine", see especially: L. Munford, *The Myth of the Machine, Technics and Human Development* (New York: Conroy Booksellers, 1967); A. De Palma, *Le macchine e l'industria da Smith a Marx* (Torino: Einaudi, 1971); G. B. Dyson, Darwin among the Machines: The Evolution of Global Intelligence (Boston: Addison-Wesley, 1997).

2 *Le Grundlinien einer Philosophie der Technik* by Ernst Kapp was published in Braunschweig in 1877. Few people noted this book and even fewer paid attention to the figure of its author. It is only recently, and not only in Germany, that Kapp's thought has attracted more interest. Among the most important works, see the study by B. Timmermans, *L'influence hégélienne sur la philosophie de la technique d'Ernst Kapp* (Chabot-Hottois ed., *Les philosophes et la technique*, Paris: Vrin, 2003, 95-108), which mentions that Kapp's fundamental idea derives from Hegel, while acknowledging Kapp's innovative contribution in anticipating concepts expressed later by Leroi Gourhan and Canguilhem. In an essay of 1930, *Form und Technik* (*Gesammelte Werke*. Hamburger Ausgabe. Hg. von Birgit Recki. Band 17: *Aufsätze und kleine Schriften (1927-1931)*, Hamburg: Felix Meiner Verlag, 2004, 139-183), E. Cassirer had already charted a clear line of continuity on the topic of technology between Hegel, Marx and Kapp.

> above all, the adoption of the principle of organ projection (*Organprojektion*) as the only way to achieve the goals of human activity, form the specific content of this volume (Kapp 1877, VI, our translation).

As a geographer and scholar of primitive cultures, Kapp had often encountered the problem (well known to paleo-anthropologists) of how to explain the resemblance of man-made tools to parts of the human body. The analogy was not limited to the shape, but also extended to how the artefact was used, often reproducing the specific action performed by the corresponding bodily organ in the economy of living processes.

According to Kapp, this had not happened by chance, but was the outcome of a natural process by virtue of which the form (*Gestalt*) and function (*Funktion*) of body organs were transferred to the tools (*Handwerke*).

This transfer was originally entirely unintentional. Tools were simply found (sticks and stones, for instance), or they were manufactured (like an axe) without any clear awareness of this emulation process. According to Kapp, the first person to construct a hammer did not deliberately copy the shape of a human fist. He unwittingly replicated a shape that had proved effective, without a care for making it resemble the anatomical original. Nonetheless, as Kapp went on to explain, as soon as the tool evolved and reached a degree of perfection, its performance enabled us to gain a better understanding of how the prototypic human organ functions. The example used is the mechanical pump, which had been invented long before Harvey, while looking at such a machine, became the first to realize the role of the heart in the general physiology of the human body.

In Kapp's view, the organ projection of forms and functions is not one-way (from living to artificial objects), but two-way, returning from the latter to the agent as well. At each stage of technological development, this exchange increases what the philosopher called understanding or awareness of the "Self" (*Selbst*) (Kapp, 1877). Kapp used this term not to mean only the human mind or spirit, but the whole organism (*Organismus*) equipped with "life and body" (*Leben und Leib*), its capabilities the product of a combination of thought and the particular mechanics expressed in the arrangement and movement of its organs. Among these organs, the hand has a very special role. It is the primary means of transfer from the organic to the artificial body of objects. This is not only because it serves as the model for the form and function of many tools, but also because it regulates and controls the use of all such tools. As for the shapes they have acquired, the axe and the hammer differ in that the former is a projection of the structure of teeth, while the latter reproduces the shape of a fist. Both are held, lifted and set in motion by the brandishing of an arm and its prehensile extremity. Much the same can be said of flints, knives, burins, and every other tool that is useful inasmuch as it has been constructed to suit the capacity for movement afforded by manual mechanics.

Kapp makes the point that our handling of tools is not just about reproducing a function performed by a body part. We also obtain an increase in the power differential of the capacity the tools incorporate. Primitive humans used spears not just to replicate the ability of their extended arm to hit something from a distance, but also to do so far better than the model organ could have done. This extension of their range of action gradually improved as technology developed increasingly complex types of apparatus, and played an essential part in the conception of systems of measurement and vision. Dimensions like feet and inches, handfuls and pinches, the size of a head, or a glance, are rather small quantities in themselves, but - if repeated an indefinite number of times - they can measure the whole quantity of the world. The same applies to optical devices: magnifying lenses, binoculars and telescopes reproduce the human sense of sight, but using them enables us to go well beyond the boundaries visible to the human eye on its own.

Generally speaking, the domain of the artificial carries evident traces of an anthropological measure (*anthropologische Maßstab*) that betrays the eminently human – not natural or divine – origin of all the aids in which our species has unwittingly reproduced and amplified particular capabilities already available in the human body.

As mentioned earlier, the adoption of the organ projection principle belongs to the realms of the subconscious. When inventors come up with new devices, they are unaware that they have designed objects that reproduce a certain aptitude of their own bodies. Their mind is on other goals, such as to reduce the human workload, or to make an existing machine's performance more effective and economical. Even further developments, after a new apparatus has been inserted in the production line, do not seem to be guided by a conscious project. Neither Watt nor Stephenson had in mind the link between the steam engine and the transmission organs that led to the construction of the locomotive and the expansion of the railway. The end result, totally unexpected by the single inventors involved, was nonetheless the development of a vast network of railroads that now covers the whole surface of the Earth, like an immense circulatory system (Kapp, 1877). With his organ projection principle, Kapp described two different phases: in the first, humans unwittingly transferred forms and functions of the self (*Selbst*) into artificial devices; in the second, they regained control of this self in the form of a greater awareness of what they had inadvertently passed on before.

Apart from the vague echo of Hegel's approach (Timmermans 2003), Kapp primarily reveals a very convincing stance on the role that technology may have had in our evolutionary history. Tools and machines would be not entities totally foreign to human beings, but expressions (albeit instinctive and initially subconscious) of their very nature. Humans have continuously transferred forms and functions to other materials, with which they manufacture the technological equipment that our species has always used. Kapp sees this turning outwards of the self not as unnatural or contrary to the development of the human essence, but the very opposite, as the condition for its most authentic promotion. It would be precisely by creating an artificial world that humans fully achieve their own being, because this is the only way to trigger that cognitive advancement that leads them to a more complete self-awareness. Culture in general, in all its spiritual forms (religion, art, philosophy, …) was made possible by extending organic abilities that are constantly being unwittingly exploited in the construction and transformation of instrumental means. For the purposes of our present discussion, it is worth emphasizing some corollaries implicit in Kapp's view. For a start, only human groups capable of equipping themselves with technical devices can achieve higher levels of cognitive development. Second, the real driver of growth in the sense of an ever greater awareness of the psychosomatic self is the capacity for technological innovation or, in other words, the relative frequency with which a given culture succeeds in inventing new instrumental means starting from specific capabilities of the self. Third, subsequent steps in the development of these artificial devices must coincide with a greater capacity for retroaction and intervention on the human body that triggered the whole process. It is not a generic direct knowledge of what we are that enables us to take action on the "natural" disposition of our bodies, but the knowledge that we can gain by manufacturing increasingly complex tools, machines and devices.

3. The steam engine

Kapp acknowledges that the organ projection principle is easily confirmed when we look at the tools used by a craftsman, while it is not so obvious how it could have led to the construction of more complicated machines, the forms and functions of which do not seem to be modeled on the human body in any recognizable way. In actual fact, Kapp said, even though machines bear no physical resemblance to human beings, they are perfectly capable of replicating abilities (*Leistungfähigkeiten*) typical of the living body. This is the case of the steam engine:

> What inspires our utmost admiration for the steam engine lies not in the single technical details – like the reproduction of an organic connection of members by means of planes revolving on lubricated surfaces, for instance, or the bolts, connecting rods, firing pins, levers, and pistons – but in how the machine is pow-

> ered, the transformation of the fuel into heat and motion or, in other words, the devilishly particular appearance of its own autonomous capacity for work. (Kapp, 1877, 138, our translation).

Unlike what happens with tools, machines reproduce not functions related to the shape of a single body part, but processes of a more articulated nature. A steam engine does not, in itself, transpose any human capability by imitating particular anatomical structures. Instead it recreates the living being's ability to convert the energy contained in food into mechanical work. This faculty – unknown to all manual tools – is what enabled us, for the first time, to construct artificial beings capable of independent movement, without resorting to any of the natural forms of motive power (wind, water or animals). Kapp makes the point that, when the machine made by Watt[3] was connected to pumps, rolling mills, weaving frames and, ultimately, carriages on wheels, it was immediately clear that the animation, i.e. the principle that makes organic beings capable of voluntary movement, had been definitively transferred to the field of artificial devices.

Another example of the projection of "higher" organ functions is the electric telegraph, which is based on the organic model of the human nervous system. In the electric cable (the fundamental element of the new technology), Kapp sees the "externalization" of a function – the capacity to transmit an impulse – but also the particular structure of our nerve fibers. Contrary to what we might think from its mere outer appearance, the organ projection principle proves extremely effective in the case of the technology behind the telegraph too. The vast and intricate network of wires along which the current travels (and, already in Kapp's time, this network covered a fair proportion of the Earth's surface) could quite easily be described as the nervous system of humanity (Kapp, 1852), a planetary replica of the small system of nerves connecting the parts of our body. With universal telegraphy, and the consequent opportunity to transmit and receive information everywhere, we have effectively constructed what Kapp was the first to call the "machine of the spirit":

> The technology for manufacturing machinery reached a peak in its development when the steam engine, in terms of the concept of the storage of power on the one hand, and the development of the locomotive on the other, came to reproduce the body's vitality. The same happened with the telegraph in terms of the

[3] The close connection Kapp saw (though he did not further develop the idea) between the unwitting organ projection phenomenon and the frequently casual or unplanned future applications of inventors' ideas seems particularly interesting. On this issue it might be worth reconsidering the comments in N. Wiener, *Invention. The Care and Feeding of Ideas* (Cambridge Ma: MIT Press 1997).

> functions for the communication and transmission of thought, and again in that ultimate purification of raw matter called the "universal telegraphic", which expresses the greatest proximity to the forms of the Spirit (Kapp, 1887, 153, our translation).

In the world of machines, human beings began reproducing not just the forms and functions of single body parts, but whole processes like nutrition and thought that govern not just the completion of single actions, but the overall efficacy of living systems. This explains the "dominant" role of multi-purpose machines over the more straightforward types. The power hammer that, in the dawn of industrial metalworking, came down on a giant steel sheet, was still an organ projection of a hand shaped like a fist, just like the blacksmith's hammer, but its beating action (i.e. its particular function) was now controlled by a fully-mechanized driveshaft moved by steam power, no longer by the relatively weak arm of a human being.[4] On the machine level, the organ projection principle took effect according to a complex logic. It was no longer a matter of any similarity in appearance, or the transfer of simple actions of limited intensity, but based on a gradual expansion of the actions involved, and a concomitant increase in the power of their execution. By departing from any direct resemblance to the human body, the steam engine could be connected to all sorts of other devices, quickly becoming – after the human hand – the new "all-purpose" machine. Along the way, it became the first instance of the principle of serial composition: by assembling different machines it was possible to construct automated systems increasingly capable of doing typically human jobs. The transposition only concerned the type of function the machine could perform, however, not the measure of energy required. Machines could reproduce the capabilities and specific actions of the organic body, but with far more power at their disposal. As we shall see in a moment in Marx (but Kapp had already guessed as much), the amount of work that could be done by a single machine exceeded by far, in every quantitative parameter[5] – be it production per

[4] According to Kapp, the only difference between tools held by a human hand and those "driven" by an engine lay in that the latter, while retaining the form and function of the organ of which they were a projection, completed the task automatically, making it unnecessary for a human body to be involved in the action. The real innovative moment in the progression from simple tool to machine thus seems to lie in the greater power available for performing the functions transposed in the tools once they have been connected to an engine.

[5] On this matter, we must also credit Kapp with realizing how the introduction of the new engines contributed to changing our relationship with energy sources: the steam engine put the natural elements – earth, water, wind and fire - to a new type of use, based on the need to obtain an uninterrupted supply of enormous quantities of power. In subsequent German philosophy, this aspect was further analyzed by F. G. Jünger (1947), *Die Perfektion der Technik* (Frankfurt: Klostermann, 1994).

unit of time, strength, or precision – what could be achieved by dozens of humans.

4. The organic model

A theoretical approach like the one developed by Kapp seems to suggest that technology is capable of replicating all aspects of the organic body, but this is absolutely not the case. In terms that are impossible to misinterpret, the German philosopher claims precisely the opposite. Certainly, structures and functions typical of the body could be transferred to artificial devices, but the living body continued to have features impossible to reduce to any mere automated actions. Kapp's attention focuses on two such features: hegemonic or self-regulating intelligence; and the capacity for self-replication:

> The machine is an artefact built by an external will, while the human body grows *ex ovo* according to an inherent, hidden law. The *egemonicon* of the machine is not intrinsic, nor does it belong to the machine; the stoker of the steam engine and the driver of the locomotive govern their machines just like a jockey on his horse. Instead, the *egemonicon* of living beings (their will and intelligence) are intrinsic, a constitutive and integral part of them. Drawing an abstraction from their physical functions, we could say that the parts of a machine always remain identical to themselves until such time as the machine has to be repaired, *whereas the parts of a living being only remain the same in terms of their shape, while their substance changes continually, it is self-regenerating and self-repairing* (Kapp, 1887, 132, our translation).

Machine and living body have different origins: the machine owes its creation to human will, which designs and constructs it; the living body is developed on the basis of inner laws governing a matter that is capable of self-organization right from the very beginning. No mechanism can be self-generated or run itself; its existence and uses are governed entirely by humans. Vice versa, the organic body comes into being and grows already equipped with the criterion governing its own existence and every subsequent action it takes. Volition and reason, according to Kapp, are simply the highest spiritual expressions of the living being's autonomy. It is clear not only at the moment in which it originates, but also in particular types of behavior that are completely unknown to machines, the most important of which is purpose-oriented behavior.

In animated beings equipped with cognitive, or what Kapp calls hegemonic[6] faculties, apparent movements of the body are made by means of

[6] This term certainly refers to Aristotle and, in all likelihood, to the Stoicism to which it

continuous adjustments prompted by changes in environmental conditions and depending on the goals being pursued. When a cat runs after a mouse, it adjusts its movements to those of its prey. If the mouse suddenly changes direction, the cat will instantly follow suit. If the mouse finds a hole to hide in, the cat will try to make it come out, continuing to adjust its own kinematics until it catches its prey or abandons the chase. The set of parts of a mechanism can serve a purpose established by its manufacturer, but they cannot rearrange themselves unassisted to adapt to different purposes. The intended use of any device remains the same throughout its "life", whereas living beings can pursue goals that change with time, and that are impossible to predict a priori. This fixity of machinery is expressed in the structural stiffness of the physical parts of any device: once assembled, their arrangement never changes, it remains identical from every point of view unless something needs replacing. Living matter, on the other hand, only retains some stability of form, while the rest grows and regenerates itself without any external intervention.

In the era of cybernetics and robotics,[7] Kapp's approach undeniably sounds obsolete. But there is an aspect of his stance that may be well worth bearing in mind inasmuch as it sheds light on a tendency, over the longer term, that is certainly at work in the overall dynamics of technological evolution. In one passage not often mentioned by the critics, he writes:

> The theory of organic development coincides with a practice of continuous mechanical improvement that has led from the first stone axes, through a variety of tools, apparatuses and devices, right up to that complicated mechanism that is the idea of the "model machine" […] *intended as a type of physical apparatus that should serve for the purpose of understanding and reproducing the reciprocal action existing between physical forces and vital bodily processes* (Kapp, 1887, 133, our translation).

In the continuous transfer of form and function between the organism and artificial devices, the ideal machine - or rather the ideal of machine, the model apparatus that all technological evolution takes for reference - is none

belongs. It is used to indicate the primacy of the *logos*, the higher part of the soul, responsible not only for elaborating representations of the world, but also for controlling movement. Going beyond the specific lemma (*egemonikòn*), Kapp actually seems to refer to the pages of *De Anima* where Aristotle discusses the *psyché* as the essence and guiding principle (*kybernetes*) of the body. See: Aristotle. *De Anima*, B, 412 et seq.

[7] We know that cybernetics has always disputed the feasibility of establishing a difference between organic beings and machines on the grounds of their teleological behavior. See, in particular, the classic text by Rosenblueth A,. Wiener N., Bigelow J. 1943. "Behavior, Purpose, Teleology." *Philosophy of Science*, Vol. 10, N. 1:18-24.

other than the organic machine, the living body, the best-perfected product of a non-technical nature.

The organ projection principle thus points technical developments in a very clear direction: the ultimate goal of the artificial is not to replace the organic, but to become organic too. According to Kapp, the living being is the ideal machine, the one in which the balance between the forces acquires its most appropriate configuration.

The epistemological consequences of this approach are equally clear: on the one hand, our machines give us a greater awareness of our own organic apparatus; on the other, we can already foresee that it will never be possible to perfect a machine beyond the maximum capabilities (that we have yet to know) of the living body. In short, machines do not evolve from machines. Their improvement stems from the greater awareness that they gradually help us to gain about the physiology of the living. Asked the crucial question of whether there can ever be devices as perfect as organic bodies, Kapp would most definitely answer no.[8] In this strange co-evolution in which improvements in our self-awareness go hand in hand with technological advances, our artificial devices can only be copies – increasingly efficient, of course, but still only copies – of the unattainable model represented by the living being. The same considerations apply to the issue of how the body might be changed by technology. No engineering intervention can improve on the performance and capabilities of an individual, other than in the strictly quantitative sense – an aspect that Kapp judges to be entirely secondary. From machines, man can only expect a little relief from the fatigue of certain jobs, a greater speed of execution in merely mechanical operations, and help in recovering an "organic measure" that remains paradigmatic, in both the human world and the sphere of devices.

On the horizon delineated by Kapp, the action of machines was confined within the boundaries of the unbeatable dominion of human powers. Incapable of real autonomy, machines could invade the spaces of human existence as nothing more than powerful tools produced by a being that they could never fully surpass or substitute.

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[8] In fact, Kapp saw as degrading the view taken by Helmholtz (see: *Ueber die Wechselwirkung der Naturkräfte und die darauf bezüglichen neuesten Ermittelungen der Physik: ein populär-wissenschaftlicher,* Vortrag, gehalten am 7. Februar 1854. Königsberg: Gräfe & Unzer, 1854) that the physical concept of 'work' corresponds exactly to the type of activity that goes by the same name in human life. He argues that, if it were really true that mechanical work is indistinguishable from human work, then humans could be replaced with machines in every type of activity, including the design and construction of the machines themselves! Kapp considered such a possibility absurd and impossible. On this issue, see the chapter *Maschinentechnik*: Kapp 1887, 168-225.

5. MACHINE-TOOL AND SUPERPOWER

According to Marx, the eruption of machines in the domain of human work was the effect of two closely-linked causes. The first was the capitalists' decision to employ machines as soon as it became clear that they were a formidable way to generate added value. The second lay in the machine itself, with its internal structure forming part of that "productive organism that is purely objective" (Marx, 1867, 405; 2004, 407) and represented by a set of machinery (*Maschinerie*) such that workers no longer had tools (*Handwerke*) at their disposal, but were faced with a whole apparatus of which they were bound to become subordinate elements.
Unlike Kapp, who saw the machine as the principal technological agent of the Industrial Revolution, Marx judges the contribution of the machine tool even more decisive, because it is by means of the latter that "the subject of labor is seized upon and modified as desired" (Marx, 1867, 405; 2004, 407) to complete the production process. In its tooling parts, the machine uses working instruments that are no different from those handled by humans:

> The machine proper is therefore a mechanism that, after being set in motion, performs with its tools the same operations that were formerly done by the workman with similar tools (Marx, 1867, 394; 2004, 494).[9]

It was thanks to this capacity to "imitate" basic human technicism (the connection between hand and tool) that the machine could gradually replace human workers in mass production. This process was completed in two fundamental stages, both promoted and guided by the power of replication typical of mechanical equipment. The first consisted in the opportunity for serial multiplication, and the second - made necessary by the first - in the adoption of a method for supplying enough energy to power the whole process.

Marx distinguishes between two separate stages in the transfer of work from humans to machines: mechanization and its subsequent (but not unavoidable) industrialization. The former entailed a transfer of abilities and competences from the organic body of the human worker to the artificial one of the machine. With the latter came the massive multiplication of the operation transferred thanks to the number of tools capable of working simultane-

[9] There has been renewed interest in the figure of Marx, partly because of the topics discussed here. Among others, it is worth mentioning E. Michael 2000. *Kapital und Technik*. Dettelbach: J.H. Röll. J. Vioulac 2009. *L'époque de la technique, Marx, Heidegger et l'accomplissement de la métaphysique*. Paris: Presses Univ. De France. A. Bradley 2011. *Originary Technicity. The Theory of Technology from Marx to Derrida.* Basingstoke: Palgrave Macmillan.

ously, governed by a single machine[10]. It is only at this point that the extra power needed to drive the process comes into play. The energy generally supplied by an average human body, or even by harnessing natural sources such as wind and water, would obviously no longer suffice. According to Marx, the steam engine - in a manner entirely unpredictable and far beyond Watt's intentions - was adopted by the machine tool and obliged to provide the manpower required, just as slaves or animals had been obliged to do in earlier times.

Marx's analysis reveals a distinctive facet of technological evolution. For the work of human hands to be completely replaceable in a given "capacity", a process of "mechanization" (the transfer of a tool and its function to the body of a machine) is not enough. There has to be a subsequent multiplication of these "hands" (i.e. of tools working simultaneously) that relies on the availability of an infinitely greater drive power than that of a living body. We could call this combination of imitative ability, serial repetition, and energy mobilization the *superpower* of the machine.

While Kapp tended to focus mainly on the "mimetic" aspect of organ projection (i.e. the transfer of form and function), Marx identifies this other, no less important, energy intensification feature. Without the latter, it would have been impossible to go once and for all beyond the merely "instrumental" conception of the technical apparatus, that Marx describes so precisely and memorably:

> As soon as tools had been converted from being manual implements of man into implements of a mechanical apparatus, of a machine, the motive mechanism also acquired an independent form, entirely emancipated from the restraints of human strength. Thereupon, the individual machine, that we have hitherto been considering, sinks into a mere factor in production by machinery. One motive mechanism was now able to drive many machines at once. (Marx, 1867, 396; 2004, 497).

Machines were not just a bigger version of the old craftsman's tools. In Marx's very acute analysis (despite some ambiguities), the switch to mechanized work and industrial production was due to the sudden arrival on the scene of a new kind of machine that operated as if it were human, but could complete the same old movements at a rate impossible for any non-mechanical being to deliver. This step, from mechanization to industrialization proper, imposed a new system of relationships, with features of *excess*,

[10] Again, reading Marx, we can grasp the enormous impression made by the realization that even the least-evolved spinning machines could work with 12 or 18 spindles, while human workers, however capable they might be, could only work with one.

irreversibility, and *imitation*.

Faced with the performance delivered by machines - with their power curve not fixed by any “natural” limit, but capable of increasing in geometrical proportion with every new generation of propellers - the mean productivity of a human being is miniscule, intermittent, and very quickly exhausted. The anthropological measure (*anthropologische Maßstab*) that Kapp saw as the criterion for all human action (their technology included) was replaced by a tendency to raise the power threshold, continuously exceeding previously-achieved levels of performance. This feature of machines, that here we have called *excess*[11], is what gave rise to the second feature of the new approach imposed by automated dynamism – *irreversibility*. Once installed on the superpowered body of a machine, tools and the expertise needed to use them will never be placed back in human hands. Once the various stages of a superpowered process involving a particular working capacity are complete, the type of work being performed will always be done mechanically. The third feature, *imitation*, is the most interesting in relation to the matter of the somatic changes induced in humans by their relationship with machines. According to Kapp (and Marx would agree), although machines do not appear to resemble humans, they do reproduce essential human behavior in their clever use of tools, in their precision in completing certain actions, and (already in the 19th century!) in their ability to memorize data and keep count. As we have seen, these functions are also managed by machines with a remarkable efficiency that operators equipped with an organic body unwittingly admire. Such a tendency to admire them can generate a sort of envy and even hatred of machines too. On the other hand, it may also prompt efforts at emulation that are expressed mainly in the desire to become machine-like by making appropriate changes to our natural biological apparatus. Although this takes on a negative connotation in Marx, between the lines of his masterly descriptions of the factory environment disseminated in his writings we can find the first germinal elements of a new protocol for the use of the human body that, with the dawn of the Second Industrial Revolution, begins to take effect (together with its worst elements) as a new science of humanization on techno-mechanical grounds.

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[11] I owe this idea to the thorough analysis conducted by G. Anders in his essay *On Promethean Shame* (G. Anders 1956. *Die Antiquiertheit des Menschen. I. Űber die Seele im Zeitalter der Zweiten industriellen Revolution*. München: Beck, 31-94). The idea of *imitation* expressed immediately afterwards is also inspired by Anders, but departs somewhat from the “positive” meaning that he attributed to the mimetic relationship.

6. MACHINE-LIKE PRACTICES

Like humans, machines can cooperate effectively in the workplace. According to Marx, they can join forces in two main ways: either as combinations of different tools acting simultaneously or as chains of different machines operating partially on the basis of a workload-sharing principle. In the former case (what Marx called *simple cooperation*), the activity of a single machine fitted with differentiated tools replaces a number of human workers passing on the workpiece from one to the next.[12] *Complex cooperation*, on the other hand, describes the semiprocessing work done by a number of connected machines in series fitted with specific tools complete different parts of a process, each of which was previously done by a single worker.[13] While the former case involved substituting – in mechanical terms – a production line comprising several operations completed in a limited and finite number of successive manual steps, in the latter the whole workload-sharing system contained in the manufacturing process is mechanized. In this new, complex form of techno-organization based on a network of different devices, there is no longer a single machine that has value in its direct relationship with the worker. Instead, there is a factory system as a whole, surrounding the worker's body like a broad artificial ecosystem of countless mechanical parts driven by a single source of energy, and necessarily connected to non-mechanical elements such as the limbs and eyes of human operators. Marx describes this new situation in various ways, e.g.

> To work at a machine, the workman should be taught from childhood, in order that he may learn to adapt his own movements to the uniform and unceasing motion of an automaton. When the machinery, as a whole, forms a system of manifold machines, working simultaneously and in concert, the cooperation based upon it requires the distribution of various groups of workmen among the different kinds of machines. But the employment of machinery does away with the necessity of crystallizing this distribution after the manner of Manufacture by the constant annexation of a particular man to a particular function. Since the motion

[12] In Marx's time, the model of simple cooperation was represented by the machine for making paper envelopes. Before modern manufacturing, the production of a single envelope was the result of a precise succession of operations performed by several workers: one folded the paper with a ruler, the next applied the glue, a third opened the flap ready for stamping, a fourth attached the stamp, and so on. Already the first fully-automated envelope-making machines that Marx himself might have known could handle all these steps simultaneously, producing more than 3000 completed envelopes per hour.

[13] In this case, the classic example comes from the wool industry: all the operations –beating, combing, carding and spinning – are handled by combining separate machines together, each of which can be seen as a partial, independent component in a non-homogeneous system of elements.

> of the whole system does no proceed from the workman, but from the machinery, a change of persons can take place at any time without an interruption of the work (Marx, 1867, 443; 2004, 546).

In what I might be tempted to call Marx's "neutralized" description of the fully-automated factory, we can focus (leaving aside as far possible his criticism of the capitalist economy) on his presentation of a new training space that, by its very architecture, offers the body of participants unexpected opportunities to practice and to change. Now, however, there is no longer a human individual establishing the engine layout, workloads, and serial frequencies, but a totally depersonalized super-trainer - the machinery. The machine develops a training protocol based on principles that act as genuine transcendental constituents of fitness circuits to be completed at the factory. Flexibility of use, condensing/expanding space and time, and intensity of repetitions – Marx was already looking at how the new working environment imposed by large-scale automation was taking shape.

As concerns the usage of these machines, Marx notes that – despite their huge dimensions and the enormous drive power they possessed – the start-up of such automated systems generally demanded a limited energy expenditure on the part of the humans involved. Factor in the standardization of the movements required thanks to the operating instructions being reduced to a few essential gestures at each phase of the working process, and it is easy to see that such machines could be managed by virtually *any* human operator. Not only adult males, but also women and children could be connected to these devices without this making any significant difference to the performance of the overall process.[14] The lack of particular usage limitations and the ease with which the factory environment provided the man-machine interfaces suddenly cancelled any differences on the side of the non-artificial agents, converting every human being into a potential worker. The flexibility of usage offered by artificial environments makes humans easier to exploit (and this is what worried Marx), but it also means that – with an appropriate training that is within everyone's grasp – anybody can learn and use otherwise impossible combinations of organic movements, develop new forms of eye-to-hand cooperation, and replace expertise that has been lost with new somatic-creative capabilities.

The spatial-temporal conditions in which biomechanical actions are completed also change in much the same way. In the fully-automated factory,

[14] This use of labor is recalled in several famous passages with an accusatory tone: "Insofar as machinery dispenses with muscular power, it becomes a means of employing laborers of slight muscular strength, and those whose bodily development is incomplete, but whose limbs are all the more supple. The labor of women and children was therefore the first thing sought for by capitalists who used machinery" (Marx, 1867, 414; 2004, 547).

people move within narrow spaces left free by the increasingly imposing mass of machinery. Corridors, raised walkways, gaps between assembly lines and side openings are the only spaces accessible to the workers. These are the spaces where they perform various operations, some of them simple, automatic and routine, others unforeseeable and highly precise, sometimes demanding body positions that verge on the balancing act. The shrinking spaces left for taking action on and around the machines (during production, surveillance, and servicing) combined with the huge distances separating the single automated units (in factories and stores) has prompted the birth of a hitherto unknown "ergonomic" view of work according to which cost-effectiveness and worker health and safety become integral concepts of a science that sees the assembly comprising the human body and the machine as a constantly changing, integrated system.

Much the same can be said of the time element too. Unlike humans, machines can function without any time limits. After being employed for a certain amount of time in any physical or intellectual activity, even the fittest organic body needs to rest, and requires lengthy periods of sleep. Machines can work round the clock and this has the effect of turning all the time available into labor time.[15] The timing of the workers' day (as Marx had already noted) and of their whole lives is governed by the incessant activity of machines. Even the more or less lengthy pauses imposed by the need to eat and rest are simply interruptions that workers are permitted with the sole purpose of keeping the continuum of the mechanical movement alive. Although some restrictions have been introduced, the dominant and natural tendency in the world of automation is to favor a totalization of the labor time. In whatever form humans may be required to cooperate with machines, they feel an almost irresistible call to continue indefinitely in whatever activity they are involved, engaging the body in a test of strength to the limit. As there is no longer any clear distinction between production time, spare time, play time, and time for ordinary activities in the unprecedented regime imposed in all fields of human existence since the Second Industrial Revolution everyone works and everyone works all the time.

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[15] For understandable reasons, Marx saw the topic of labor time as crucially important. He said there is a very close link between the extension of the working day and the use of machines: "*If machinery be the most powerful means for increasing the productiveness of labor – i.e., for shortening the working time required in the production of a commodity, it becomes in the hands of capital the most powerful means, in those industries first invaded by it, for lengthening the working day beyond all bounds set by human nature. [...] Hence, too, the economic paradox, that the most powerful instrument for shortening labor-time, becomes the most unfailing means for placing every moment of the laborer's time and that of his family, at the disposal of the capitalist for the purpose of expanding the value of his capital*" (Marx 1867, 414; 2004 547).

This last aspect is the one that has certainly had the greatest impact - on the non-philosopher's imagination too.[16]

The rate of execution required of workers supervising superpowered devices is in no way comparable with that of the old manual tool user. In the field of action made possible by machines, human gestures become ever more accelerated, essential and repetitive.

The rhythm and the giddy increase in the number of single movements completed in a given unit of time no longer bear any resemblance to the slow, deliberate motions of a craftsman. The new operating format that quickly supplanted many human skills demands a model of performativity: instead of a mute acceptance of naturally impassable limits, it programmatically demands that thresholds just reached in a previous stage are constantly and ever more promptly exceeded.[17] The paradigm of superpowered intensifications has slowly, but inexorably become the goal not only for the development of devices, but also for all the efforts to improve the performance of which human beings are capable. It is common knowledge that Marx (and he was not alone) interpreted all this in the light of his concept of alienation (*Entfremdung*), and imagined that - under economic conditions no longer dominated by capitalist interests - machines could be a means of liberation and objective improvement of the human condition.[18] He believed this could be achieved by "humanizing" machines, or in other words by using them like the craftsman's tools of old, within the rigid boundaries of a typical human being's strength and resistance. Prisoner of an anthropology that saw limitations as values to be preserved and defended, Marx failed to develop a vision

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[16] Consider the extraordinary factory scene in Chaplin's *Modern Times* (1936). The frenetic, uncontrollable rhythm of the worker's body movements on the assembly line had a "visual" effect that was far more remarkable than any conceptual description. Nonetheless we have to wonder just how much intelligence, self-control and training must have gone into completing such a task. Recent studies based on brain scans have shown that the areas of our brain activated when we hit an object at a high rate of repetition (as if to fashion a flint axe) are much the same as those engaged when we speak. So there is a strong link between our manual skills and those required by the use of language.

[17] On this issue, see the charming pages dedicated by P. Sloterdijk to the "athletic renaissance" that, hardly surprisingly, began to expand from the latter half of the 19th century, when the techno-industrialist ideals were at their peak (P. Sloterdijk 2009. *Du mußt dein Leben ändern. Über Anthropotechnik*. Frankfurt a. M.: Suhrkamp, 409 e sgg.).

[18] *"The contradictions and antagonisms inseparable from the capitalist employment of machinery, do not exist, they say, since they do not arise out of machinery, as such, but out of its capitalist employment! Since therefore machinery, considered alone, shortens the hours of labor, but, when in the service of capital, lengthens them; since in itself it lightens labor, but when employed by capital, heightens the intensity of labor; since in itself it is a victory of man over the forces of Nature, but in the hands of capital, makes man the slave of those forces; since in itself it increases the wealth of the producers, but in the hands of capital, makes them paupers"* (Marx 1867, 414; 2004, 517).

(although we have seen it was implicit in many of his writings) in which the machine could serve as an influential model on the path of self-improvement.

7. EXONERATIONS

With Arnold Gehlen, a new anthropological approach appears on the horizon of the debate on technology. Gehlen raises the issue of what he calls the real conditions of human existence.[19] On pages dense with meaning, he draws a picture that expresses a radical change from Marx's approach:

> Put your mind to this unique and incomparable being which lacks all conditions of animal life and ask: in spite of this, whattasks does this being faceif it simply wants to save its life, save its own existence, last in its mere being here. Man is an animal that has not been defined yet and is somehow still not completely understoodin a final way. He is, thus, as I've said, a being who finds himself through his tasks […] that his life becomes its own task and its own business; in elementary words: it is already quite a challenge for him to be alive the following year (Gehlen, 1940, 17, our translation).

In other words, from the morphological standpoint - unlike all other higher mammals - humans are fundamentally defined by a series of weaknesses, which can be explained in the specifically biological sense of failure to adapt, lack of specialization, primitivism – in other words, developmental shortcomings, and therefore in a strictly negative sense. Humans lack a coat of hair to protect themselves from the elements. They have no natural defenses, nor are they designed for flight. Their senses are not as acute as those of most other animals and – to a degree that is even hazardous to their very lives - they are short of authentic instincts. They need protection from birth and throughout their childhood, for an incomparably longer time than other animals. Simply put, in their natural, original conditions as land-bound animals amongst others that are either better able to flee or better predators, humans would have already disappeared from the face of the Earth a long

[19] There have been numerous contributions dedicated to Gehlen's anthropology. Among the most recent relating to our present topic, it is worth mentioning: H. Delitz 2011. *Arnold Gehlen*. (Klassiker der Wissenssoziologie 14), Konstanz: UVK Verlag. H.P. Krüger 2011. *Gehirn, Verhalten und Zeit. Philosophische Anthropologie als Forschungsrahmen*, Berlin: Akademie Verlag. W. Eßbach 2009. *L'homme risqué. Arnold Gehlen et l'anthropologie philosophique en Allemagne*. In: Arnold Gehlen, Essais d'anthropologie philosophique (Préface de Jean-Claude Monod. Introduction des textes et Postface de Wolfgang Essbach) Paris: Ed. de la Maison des sciences de l'homme, 147-151. P. Wöhrle 2010. *Metamorphosen des Mängelwesens. Zu Werk und Wirkung Arnold Gehlens*. Frankfurt a. M.: Campus.

time ago (Gehlen, 1940).

From Gehlen's point of view, humans are the outcome of a project that has no equal in nature. Considering our biological structure as a whole, we seem totally deficient in highly-specialized organs, and consequently wholly incapable of surviving in an environment (*Umwelt*) with characteristics that demand particular capabilities. The concept of *Mangel* (shortage, poverty) that Gehlen uses to qualify the typical nature of humans expresses not only the idea of a deficiency of one or other apparatus, but also the essential nature of a being maladapted from every point of view, or what could be described as disabled. Right from very ancient times, and for reasons unknown, it is clear that our species never embarked on the path that leads to organic specialization[20]. A number of anatomical primitivisms – the shape of our skull, the lack of differentiation of our teeth, the architecture of our hands and feet – demonstrate the immature and very poorly-differentiated constitution of creatures that, at birth, seem objectively incapable of survival in any given environment on the strength of their natural capabilities alone. According to Gehlen, humans have a way of "being in the world" that has no analogies (not even in the species that most resemble us), and that is characterized by objective traits of fatigue and unpredictability. Faced with an overabundance of stimuli that we are initially unable to control, and with constantly new obstacles that we are not biologically equipped to cope with, we are obliged to observe the environment with circumspection, time and again, take steps to exploit it and devise countermeasures that go beyond the set of options afforded us by Nature. To define this course of action (*Handlungen*), seen as a unitary process, Gehlen uses the term *Entlastung*, which is generally translated as "exoneration", but can also mean: release, exculpation, unloading, and relief. Clearly, the core meaning of the word alludes to situations involving the need to overcome oppression, to be relieved of a burden, restriction, or impediment. Gehlen uses this idea of exoneration to

[20] On this particular point, Gehlen took an interesting look back at Lodewijk Bolk's theory of *retardation*. The great Dutch anatomist identified a lengthy series of primitivisms that he interpreted as *fetal states or conditions that had become permanent.* According to Bolk, such anatomical features as orthognathism, hairlessness, depigmentation of the skin, hair and eyes, the shape of the ear lobes, the epicanthus, the central position of the occipital foramen, the considerable weight of the brain, and many others, are all transient qualities or morphological conditions in other primates, but for some reason in humans they have become *so stable as to become permanent*. Successive stages of fetal development that apes grow out of thanks to a series of subsequent particular specialization steps are fixed and stable in humans as part of a permanent picture of genuine developmental inhibition. The essential trait of the human being would thus be represented by the *definitively fetal configuration of his bodily forms* (L. Bolk 1926. "Vergleichende Untersuchungen an einem Fetus eines Gorilla und eines Schimpansen", *Zeitschrift für Anatomie und Entwicklungs-Geschichte*, 81; ID. 1926. *Das Problem der Menschwerdung*, Jena: Fischer).

indicate a pattern of action serving as a "*key to understanding the structural law governing all human performance*" (Gehlen, 1940, 34, our translation) inasmuch as it is specifically human. Faced with a stimulus that acts as an obstacle on their path to survival, instead of reacting directly to the difficulty, humans will modify the environment so as to enable them to retroact on their organic weaknesses and thus exonerate themselves from the burden of the negative stimulus.

An example may help us to clarify this idea. The absence of a coat of hair or fur is a handicap, exposing the human body's surface to a variety of stimuli – cold and heat, warmth, humidity, light and dark, impact, excoriations and all sorts of other lesions. No animals are as receptive to input from the outside because their constitution (their coat of hair or fur) has already been adapted to a certain habitat, protecting them against "unwanted" stimuli. Humans must take action to protect themselves and, having no readily-available biological solution, they have to find one in the outside world, where they can exploit some exonerating resource. Humans will then either kill other animals for their fur, or they will find materials suitable for manufacturing clothing. In either case, they do not take action directly on the negative stimulus (such as the cold), they change another sector of reality (*cognitive and disclosing behavior*) to equip themselves with the means (*appropriation of resource*) to modify their biological conformation and find relief forever more from an environmental condition that posed a problem (*comprehensive exoneration*).

As we can see, this action of finding "relief" has three characteristic aspects: A) an orientation that has its decisive direction in the movement of turning towards the self, to modify one's own body; B) the creation of an artificial world of objects that did not exist in nature; and C) the incorporation of a series of physical, cognitive and emotional behavior patterns that develop into a highly-refined system for governing vital actions. Right from childhood, which - on the individual (ontogenic) plane - reproduces the same conditions of indeterminacy characteristic of our species on a phylogenetic level. Things are seen, tasted, moved and consequently handled and processed in a controlled, learned series of movements (*Handlungen*) the end result of which will be a simultaneous re-elaboration (*Bearbeitung*) of the human body and of the world. It is in technology that this enormous power of exoneration is developed first and most intensively.

8. Hybridization and Reinforcement

While animals can simply live, thanks to their perfect anatomical and functional determinacy, humans have to work on their organic apparatus, which they need to modify appropriately in order to survive. In Gehlen's view, they do so by means of a very particular form of self-manipulation - technology. To cope with our organic shortcomings, technology serves primarily as a form of compensation, a substitute for a missing organ:

> The oldest evidence of manual labour actually relates to weapons, which don't exist as an organ, to which should also be added the use of fire, which likewise became popular as a safety measures or thermic insulator. Present since the beginning alongside this principle of absent organ replacement has been the enhancement principle: a stone taken in one's hands to strike has a far greater effect than a bare fist. So alongside integration techniques, which find a replacement for abilities ruled out by our organs, intensification techniques yield effects beyond our natural abilities: the hammer, the microscope, the phone do no more than enhance human aptitudes. Finally, there are facilitation techniques, aimed at lightening the labour of our organs, by freeing it and generally enabling them to save labour, as a wheeled vehicle makes it unnecessary [21] to drag heavy objects by hand. Airplane travellers have the three principles in one: the plane replaces the wings which never grew, it certainly beats all organic flight techniques and it economize on once inevitable exertions for those who want to travel far away (Gehlen, 1957, 12-13, our translation).

It is through *integration*, *intensification* and *facilitation* that tools and machines exonerate humans from their natural organic shortcomings. In lieu of structures that we lack, we can integrate our bodies with artificial prostheses capable of performing a function that already exists elsewhere in nature. Particular shortcomings can thus be overcome and human performance can be intensified beyond the normally achievable parameters, while still retaining the same type of behavior. Then there are technologies for easing our burden, that enable us to become disengaged from the toil of daily activities, reducing the wear and tear on the limited resources of our biological body.

According to Gehlen, the most advanced devices achieve a combination of these three benefits in a single machine, and that is why they may appear so unnatural and monstrous. The element common to the use of various technological aids lies in the fact that their exonerating effect is never the product of action taken by the organic body alone, but of a hybridization of the body with some artificial device. Even more radically, we could say that, on the premises of Gehlen's anthropology, man becomes what he is only by means of a continuous technological retrofitting of his own basic equipment. Machines, be they separate from our body or attached in various ways as reinforcing prostheses, are simply the "natural" flipside of a deficient condition that obliges us to place between ourselves and the environment an artificial world that is increasingly elaborate and pervasive, but in no way extraneous or hostile:

> Despite its simply incredible brilliance, and indirect connection with nature, technology truly mirrors human beings: to be convinced it is enough to think that the oldest inventions, the essential discoveries, are not imitations of models existing in nature […] So the world of technology is, so to speak, 'the super man'; genius and wealth of intelligence, both promoter and destroyer of life like man himself and likethe latter in multiple connections with pure nature. Technology is also, like man, *nature artificielle* (Gehlen, 1957, 13, our translation).

The idea that it is only in the unique case of our species that Nature itself has evolved into an artifice has two very important consequences. For a start, it brings to light a necessary, but not immediately obvious fact: in implementing our technological exoneration, we pass from a sub-powered condition, burdened with shortcomings and limitations, to a super-powered condition impossible to compare with any hypothetical measure of "normal" or "average" in the absolute sense. Individuals who have lost their lower limbs below the knee can exonerate themselves from the effects of their disability by attaching titanium prostheses to their legs. From then on, they will not have been restored to a state of "normality", as it might seem at first glance. They will have become a sort of new "species" of biomechanical being whose performance may be superior, and in any case will not be comparable with that of wholly natural individuals. Now, bearing in mind that Gehlen considers disability the natural, unsustainable condition of every human being, we understand that hybridization with artificial elements, and reinforcement are not conjunctures, but essential and generalized prerogatives of a being who has no firmly established form or structure.

In the light of the above considerations, we can understand the second consequence implicit in the idea of "artificial nature". Gehlen speaks of this in vaguely "dramatic" terms, introducing the idea of the destruction of life, an expression he uses to indicate an emerging trend for an increasingly massive use of the inorganic in lieu of the organic. There is a growing tendency for living matter to be replaced with synthetic products, and for the power of natural organs to be substituted by artificially produced energy. Gehlen says this is not a recent development, but a fundamental orientation of civilization as a whole. Every step towards a subsequent stage of technological evolution has succeeded in engendering increasingly-advanced forms of emancipation from the constraints that our organic substrate imposed on human existence. Already in prehistoric times, metal working not only led to transformations of engineering type, but also paved the way to the manufacture of tools and devices by means of which the body could be exonerated from the fatigue and restrictions associated with hard work and physical wear and tear. Chemistry went on to achieve the most extensive medicalization of life on artificial grounds that humanity has ever been able to imagine. Today, we might add, with the aid of nanotechnologies and synthetic biology, we can expect to have the opportunity to definitively go beyond the living organism, in the sense of the merely biological object.[22]

Leaving aside the expressions used by Gehlen, which may betray a certain nostalgia for the romantic myth of the living in his idea of man's "natural imperfection", which can only be overcome by means of a technological solution, we receive a strong image of an artificial world no longer seen as an inferior "reproduction" of organic perfection, but quite the opposite. It is a model on which to focus in our efforts to transform the organic body. In symmetrical opposition to Kapp (and Marxist humanism), from Gehlen's perspective it is no longer the machine that unwittingly seeks to become human, but the human who chases after the efficiency of the machine in a never-ending effort to reinforce his own biological equipment.

9. Conclusions

Our analysis leads us to draw a few conclusions. The concepts of imitation and superpower have emerged repeatedly in the different authors we considered (and we could have drawn on other examples too) for the precise epistemic purpose of clarifying the new order of relationships established between man – intended especially as an organic entity – and machine. Clearly, terms like imitation or simulation are used in the sense not of any sort of deception or falsity, but of a replication in other, artificial instead of biological matter of the real capabilities of human beings. In other words, under particular conditions and for specific purposes, devices can substitute an operator equipped with the average capabilities of our species. Interpreted in this way, the idea of imitation takes on a dual meaning: the transfer of humanity to machines; and the machines' acquisition of partly human fea-

[22] The reference to sectors called techno-science should not seem excessive nowadays. Gehlen was the first to note that the acceleration towards a complete artificialization of life is due not to the *tool* being replaced by the *machine* (Marx), but to the strengthening connection between our understanding of nature and our capacity for manipulation. Technology, wrote Gehlen, "has absorbed the dynamic rhythm of progress from the new natural sciences; the natural sciences, in turn, have absorbed a more functional, constructive and non-speculative character" (Gehlen, 1957, 13, our translation). On more specific topics relating to reinforcement and technological care for the body, see the numerous works by R. Campa, and particularly (2010) *Mutare o perire*. Bergamo: Sestante e ID. 2013. *La specie artificiale. Saggio di Bioetica evolutiva*. Monza: Deleyva Editore.

tures. This results clearly in an ambiguous play on words in the writings of the authors considered, and the cultural perceptions they generated (especially in the case of Marx) concerning the relationship between body and machine.

The concept of superpower, on the other hand, suggests an attempt to understand what distinguishes machinery from man. Assuming that human psychosomatic traits are reflected and at work in the world of devices, all the texts we have considered here emphasize the enormous discrepancy in volume, speed and repetition rate between actions performed by machines and those achievable by a living organism. It is in this aspect that what we have called the superpower of machinery is most influential. Machines not only raise the productivity threshold in quantitative terms, they also bring about structural changes of a qualitative nature. The work that once came within, and was defined by, the limits of the "power" that a biologically healthy individual could deliver has changed into a type of activity that, by definition, would be impossible for any human to perform. The working parameters that applied to the craftsman or early factory worker have not just been extended, they have been left behind forever in another region of existence. The power of which machines are capable is not – as it is for humans – a finite quantity, but an energy reserve that can be mobilized to meet the needs of a tendency to constantly exceed performance levels already achieved.

We have also noted a sort of "mirror effect" such that imitation and superpower – in addition to being prerogatives of the machine – have become ways in which humans interact with their own bodies. Due to the effect of a process of identification through similarity, the machine has become a model of structural and functional perfection that should inspire us to strive to reinforce our biological equipment. It becomes imperative for us to exonerate ourselves from a condition that is seen as impaired and inadequate. In this light, reaching beyond our limits means accessing a new condition in which resorting to hybridization and technological reinforcement is not seen as alienating or going against nature, but as a very human effort to achieve self-fulfillment. Starting from the ambiguous imitative relationship established between body and machine, we can foresee two very clear paths for the evolution of the artificial world. On the one hand, devices will seek to acquire more and more human capabilities until they become almost entirely similar, even in exterior appearance, to humans. On the other, human beings will strive increasingly to resemble machines (though not so much in appearance) that, already today, demonstrate that it is feasible for us to develop the chance to exist on Earth no longer restricted by our own, "naturally" too fragile and defective ontic apparatus.

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