

Research Article

# Dialectical Evolutionism and Historical Materialism: Placing Human Societies, and Cultures, in the Broader Context of Natural History

**Paolo Crocchiolo\***

Philosophy of Science, Università Popolare Antonio Gramsci, Rome, Italy

## Abstract

Present day humans are the result of a continuous evolutionary process, which is still underway (although imperceptibly since the last wave of Out of Africa migrations). Our physical traits, and both our “emotional” and “rational” mental features co-evolved, dialectically interacting with each other, and with the outer physical and social-cultural environment. In fact, *H. sapiens* is genetically preadapted to dialectically interact with the material and cultural contexts it is exposed to, contexts that on the other hand were, and are, increasingly created by mankind itself. Also, our species is the result of a “species sorting” mechanism, among a number of different, though closely related, hominid and hominin genera, species, and subspecies. At the time being, *H. sapiens* is the only surviving, and genetically very homogeneous, species of the genus *Homo*. There were blurred boundaries, however, between our species and our closely related species, especially *H. neanderthal* and *H. denisova*. Furthermore, we all evolved, physically and mentally, from our common ancestor species of the genera *Australopithecus*, *Paranthropus*, etc. Due to our profound biological roots, evolved physical traits, evolved individual and collective mind plasticity, and evolved social complexity still keep dialectically interacting with each other in an inextricable tangle. The point where Marxian historical dialectics grafts on, and merges with, Darwinian biological dialectics roughly coincides with the beginning of Holocene. In fact, there is no apparent solution of continuity between the historical timeframe of the last 10-12,000 years, and the previous period as, once reached the stage of extended consciousness, all material/social/cultural niches and mind plasticity-driven adaptations dialectically interacted with each other according to the principles of historical materialism.

## Keywords

Dialectical Evolutionism, Niche Construction, Evolution of the Mind, Brain Plasticity, Nature-Society/Culture Relationship, Historical Materialism, Capitalocene

## 1. Introduction

The history of mankind, dating back roughly to the beginning of the Holocene, i.e., 10 -12,000 years ago, and its pre-history, dating back to approximately 200,000 years ago, grafts, without solution of continuity, on the evolutionary

history of life on earth. In fact, humans, in a naturalistic vision, are themselves a product of evolution, hence part and parcel of natural history. What Marx and Engels most appreciated of Darwin’s theory was precisely his placing nature in an evo-

\*Corresponding author: [paolo.crocchiolo@libero.it](mailto:paolo.crocchiolo@libero.it) (Paolo Crocchiolo)

**Received:** 8 June 2024; **Accepted:** 12 July 2024; **Published:** 17 February 2025



Copyright: © The Author(s), 2025. Published by Science Publishing Group. This is an **Open Access** article, distributed under the terms of the Creative Commons Attribution 4.0 License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

lutionary, hence historical context, while excluding any teleological and creationistic view [1]. In his “Dialectics of Nature” [2], published posthumously in 1925, Engels, instead of counterposing the historicity of human societies, and cultures, to the then generally assumed lack of historicity of nature, insists on the dialectical connection between the two historicities, whereby human labour, transforming, and being in turn transformed by, the natural environment, plays the role of mediator between nature, culture, and society. These dialectical materialistic intuitions were subsequently confirmed in the light of the scientific discoveries in population genetics and, more recently, molecular genetics, palaeoanthropology and the neurosciences. The latter have contributed to elucidate the fundamental role played during evolution by the mental development of our hominid ancestors in shaping the social and cultural complexity of human societies. *H. sapiens*’ peculiar brain plasticity paved the way for the emergence of verbal language which in turn resulted in a further leap towards the evolved mental capacity, unique to our species, to transform, and dialectically interact with, both their natural and social-cultural environments. Furthermore, with the development in hominids, and especially in *Homo sapiens*, of extended self-consciousness, nature, *sub specie hominis*, for the first time in the history of life on earth, was able, as a subject, to observe itself as an object. In the present historical phase called Anthropocene, or Capitalocene, the Marxian “metabolic rift” [3] between nature and human societies, characterized by a dramatic acceleration of the destructive trends of the capitalist mode of production, is emerging in all its evidence, involving individuals, communities, species, inextricably interconnected with each other, and the natural environment they are all part of. The evolved self-consciousness of humans, however, permitting to both memorize past history, and envisage different future scenarios, creates the premises for a rational socialist niche construction replacing the so far prevailing irrational capitalistic niche construction, thus enabling mankind’s extended consciousness to contrast its instinctive unconsciousness.

## 2. The Dialectics of Evolution

### 2.1. Sex and Sexual Selection as Eminently Dialectical Processes

Arguably, Marilyn Monroe has been one of the greatest American actresses ever. One of her most charming talents was to play the role of the enchantingly naïf girl making males desperately lose their head over her. She and Arthur Miller fell in love with each other, each of the two attracted by the other’s outstanding artistic talents. In fact, the mechanism of sexual selection, universally present in all sexually reproducing living beings, can be broken down into three stages, that co-evolved interacting with each other during evolution. The first stage consists of the emergence and consolidation of

a naturally selected trait, such as the magnificence of the peacock’s tail, reflecting optimal immune and muscular fitness, and hence resulting in a higher survival and reproductive rate of its carriers. The second stage is where sexual selection steps in, involving the peahens, instinctively attracted, by those gorgeous tails, in the reproductive success of their male counterparts. The third stage of this kind of ping-pong game, still based on sexual selection, occurs when peacocks instinctively advertise that very trait that had granted their reproductive success in the first place. It should be noted that the three stages evolved in parallel, dialectically interplaying with each other [4]<sup>1</sup>.

The sexual way of reproduction prevailed over the earlier forms of asexual reproduction, i.e., binary fission, mainly because meiosis, although much more complicated than mitosis, created a higher number of variants, thus ensuring a greater biodiversity by reshuffling at each generation the offspring’s genetic makeup. In multicellular organisms, for whom mutations alone would have represented an insufficient generator of biodiversity, this proved essential, while in prokaryotes and monocellulars a sufficient diversification was granted by the cosmic rays-induced mutations’ rate alone (which is the same across all organisms), thanks to their exponentially higher number of replications per time unit.

The evolutionary history of sexually reproducing animals shows that sexual dimorphism, i.e., the set of different *qualitative* traits that distinguishes the two sexes, only depends, ultimately, on the different *quantitative* amount, size, and mobility, of the two kinds of gametes (ovum and spermatozoa) underlying their respective female and male organisms.

In the evolutionary transition from asexual to sexual reproduction, isogametes were originally same sized germ cells carrying each 50% of the genes of a given species’ genome. Subsequently, however, due to a sort of *clinamen* that made one of the two isogametes (conventionally designated as the female) retain a greater amount of cytoplasm and cytoplasmic organelles, the other one (the male) counterbalanced that disadvantage with a reduction of its size which, however, entailed a greater mobility. This dialectical play reminds us of the yin-yang dialectics of Taoism, whereby we observe a reciprocal conditioning of the two interdependent principles, each of which acquires its own meaning, not in itself, but in relation to the other. The cleft widened until it yielded, at one end of the spectrum a motionless and enormous egg cell and, at the other end, a myriad of extremely mobile spermatozoa reduced to the minimum indispensable volume, i.e., to little more than their simple DNA. The genes, once harnessed by this forced path set up by themselves, had no other way to propagate than to board the gamete-shuttles; so, they were forced to build around themselves carrier-organisms, not only

<sup>1</sup>According to Geoffrey Miller [4], sexual selection may have also contributed to the development of “intelligence”, appreciated as a sort of survival-enhancing “ornament” by the potential sexual partner. As a typical example, we could mention the case of the bowerbirds, where the females choose their sexual partner based on the “artistic” skills observed in, and eagerly exhibited by, the males in building an aesthetically beautiful, and richly decorated bower.

able to grant their survival as prerequisite for their reproduction, but also able to induce the required encounters of their respective gametes.

Here comes into play the eminently dialectical phenomenon of sexual selection, which is based on sexual *attraction*. As attraction, in all sexually reproducing animals including man, is the *condicio sine qua non* for reproduction, the genes that ended up being selected were those that simply instilled the mating instinct into their propagation instruments, i.e., into their potentially reproductive carriers; so much so that the birth of any sexually reproducing animal may be defined as a *possible side effect of pleasure*. Mating instinct is not the same thing as reproductive instinct (the latter being unnecessary if the former is present): in fact, no other animal but man is aware of the link existing between mating and reproduction [5]<sup>2</sup>.

However, as reproduction is the *primum movens* of the whole living universe, the emergence of sexuality needed to be associated with both attraction *and* movement, both indispensable for effecting the two gametes' encounters, at least in animals. (In plants, insect pollinators do the job, with sexual selection/attraction however still playing a decisive role, although indirectly, through the flowers). Attraction itself, like its counterpart, repulsion, as well as instincts-regulating pleasure and pain sensations are all emergent properties of the very same neural-hormonal substrate that developed the ability to displace bodies within space in the first place. In fact, the complex neural-hormonal network, and especially the brain, and the mind, grew out, interdependently, of the cell membrane of our monocellular ancestor organisms, still basically fulfilling, however, the same functions, i.e., movement, maintenance of the internal homeostatic balance, pre-requisite of survival, growth, and, consequently, potential reproduction.

## 2.2. Parallel, and Interconnecting Evolution of Sexual Reproduction, and Neural-Hormonal System

Multicellularity, sexual reproduction, and neural-hormonal system all evolved dialectically interrelated to each other, as instances responding to the needs emerging from their interaction with the environment. The cell membrane gradually evolved into the ectodermal embryonic layer giving rise to, and differentiating into, nervous cells, skin, and the prostheses of our brain called senses. The first instance of the multicellular structure was to grant the body's integrity, an objective that was gradually reached through the evolution of the most ancient part of the brain, devoted to the perception of outer environmental threats, and inner homeostatic imbalances. In this connection, a pivotal role was played by the evolution of a complex neural-hormonal network centred on the reward

system, capable of transforming into qualitative sensations of pleasure, pain, and all emotional shades in between, the quantitative release of certain molecules, such as neuropeptides, neuro-hormones, and various kinds of chemical mediators impacting on the receptors of nervous cells located in certain areas of the most ancient part of the brain. The reward system, one of the main *emergent properties* of our neural-hormonal structure, plays an essential role both in motivating decisions and in reacting to inner and outer signals, thus implementing the Epicurean programme ("Avoiding pain, seeking pleasure").

Through its proprioceptive sensors distributed over the whole organism, the brain carries out an incessant monitoring of all vital parameters of organs, apparatuses, and systems operating within the living machine (pH, temperature, osmotic pressure, imbibition of tissues, glycemia, concentrations of calcium, kalium, etc.), converting the various levels of the detected values into sensations ranging from extreme well-being to profound malaise (and everything in between), depending on the extent to which those levels, respectively, place themselves within, or distance themselves from, the mean values of the normal distribution curve that ensures the integrity of their bodies.

The instincts are genetically selected, and consolidated, associations of positive or negative *hedonic tones* [6] (i.e., pleasant, or painful sensations, and all intermediate emotional tinges in between) with perceptions and actions ultimately leading in the past, respectively, to a significant increase or decrease of survival and reproduction rates in their carriers. Hedonic tones are the expression of their underlying biological substrate, the previously mentioned neural-hormonal network that connects certain ancient cerebral areas (mainly the "limbic system") with specialized neural cell groups secreting neurotransmitters such as dopamine, serotonin etc., and neuro-hormones such as endorphins, oxytocin, etc. All these molecules, whose release is triggered by specific perceptions and situations, impact on the receptors of their target cells, thus inducing the instinctual behaviours perceived as fittest in the circumstances the individual is exposed to during his/her life. Hedonic tones, that we share with all other neural-hormonal system-provided animals, are, therefore, the actual prerequisites of instincts. The well-being sensation, perceived through the filter of the body's homeostatic equilibrium [7]<sup>3</sup>, was reached through the positive response of the living organism to sensations of hunger, thirst, sexual drive, etc., and turned out to be fundamental to preserve its integrity in view of a possible reproduction.

In parallel to the pleasure-pain binomium, the distinction between the reciprocally demarcating self and non-self sensations also originated from the sensing capacity of the system placed at the interface between the inside and the outside of

<sup>2</sup> In fact, even among certain human populations, according to Bronislaw Malinowski (3), procreation is not linked to sexual intercourse

<sup>3</sup> According to Antonio Damasio (5), there is a one-to-one correspondence between physical pain or pleasure, and psychological pain or pleasure, as they are generated by the same chemical mediators, which convert homeostatic imbalance into psychological uneasiness, and vice versa and psychological well-being into homeostatic balance, and vice versa

living organisms, ultimately evolving into the development of rising degrees of consciousness, as will be further detailed below.

It should be noted, however, that in this evolutionary context, the “rational” component of the brain appears merely as one last marginal touch, almost ancillary to its most ancient basal structures, that were shaped, like any other organ, as a body’s survival instrument during hundreds of millions of years of evolution. In a sort of Copernican revolution, this new approach reverses the traditional vision of the human mind [8]. In fact, it considers the “rational” brain just as an evolutionary by-product, functional to survival, growth, and potential reproduction of its body, subordinately to its ancestral “emotional” brain. In fact, the “rational” thought, although undoubtedly very useful in the natural and social context of our ancestors, could not possibly prescind from its underlying, and motivating, instinctual drives.

In this regard, the attempt, largely pursued by contemporary “mainstream” scientists, to extrapolate from the complex evolved human mind its mathematical-logical component (“artificial intelligence”, robotics) represents a typical example of mechanistic reductionism. In fact, a diametrically opposite logics underlies the construction of a living machine as we are, on the one hand, and a non-biologic machine like a robot, on the other. While the latter is the result of a very accurate project which, by definition, utilizes non-“DNA/cellular” materials, the former instead is the non-preprogrammed result of the replicative and proteino-genic emergent properties of nucleic acids, generating an infinity of random phenotypic variants exposed to the sieve of natural selection. Now, since natural selection essentially consists of the differential reproduction rate of organisms built around themselves by their underlying genes, a machine that is not subjected to the very constraints as a function of which it has evolved, i.e., being conceived, keeping the homeostatic balance indispensable for survival, growing up and, potentially, reproducing, is a radically different object than a biologic organism. Furthermore, all the parts of a living organism (including its neural-hormonal system) are interdependent: neither the brain, nor the rest of the organism can survive without each other, as they are both the result of a dialectical “co-evolutionary” process. The brain itself, like any other organ, is a coordinated set of specialized cells and chemical mediators that depends, to survive, to grow and to function, on an uninterrupted bidirectional flow of metabolic, endocrine, immunologic molecular signals synergically interacting with the respiratory, digestive, and excretory apparatuses of its belonging organism, all of which are grounded on a DNA/cellular substrate. Emotions, feelings, emotional colouring, hedonic tones and, most importantly, “extended consciousness”, which subsumes all its presupposing rational and emotional components, can only be elicited as emergent properties of a biologic, “DNA/cellular” substrate as previously described.

In the light of the above, it appears that each individual

member of our, as well as of all other neural-hormonal system-endowed species, is driven by satisfaction of needs-promoting instincts that cannot be prescinded from, since the reward system is inbuilt in our very mind-body structure.

What said apparently disproves the narrative, largely publicized by the dominant ideology, attributing to the post-industrial technological development, and especially to robotics, thaumaturgic properties capable of solving the problems of mankind without introducing the slightest modification to the classist social structure intrinsic to the profit-based economy. In fact, at a more accurate analysis, this turns out to be an illusory hope, a sort of wishful thinking devoid of any connection with reality.

Robotics and artificial intelligence, like any other achievement of science, in fact are not positive or negative in themselves, but only in relation to the way they are used, hence to the social and political context they are part of. “Intelligent machines”, if widely adopted in a context of equitable distribution of resources, may prove very useful to reduce working times for all, allowing much more free time to be dedicated to creative, recreational, and enjoyable activities in general. If, however, applied to the present context of the profit-driven economy, they would not relieve humans from the slavery of labour, but on the contrary would effect a swelling of the ranks of the unemployed, without the slightest reduction of the weariness and the working times of the employed.

In this connection, other typical examples of mechanistic reductionism are the phrenological theories that subdivide the brain into clear-cut separated components, such as MacLean’s model [9], disconnecting the most ancient “reptilian” brain from the “paleomammalian”, and from the more recent cortical “neomammalian” brain, or Fodor’s model [10], subdividing the brain into autonomous, separate modules each of which exclusively devoted to a different function. These are models that neglect the fundamental dialectical interpenetration of the different parts of the brain, and interdependence of the brain with the other parts of the organism. “Phrenological thinking”, according to Damasio “should be resisted at all costs” [11].

### 2.3. Parallel, and Interpenetrating, Human Physical and Mental/Neural Evolution

The history of human evolution is characterized by an uninterrupted sequence of genetic- and environment-driven developments, dialectically feeding back on each other.

A decisive factor determining the original separation of the hominin branch from the other primates was the geographical separation between the quadruped forest-dwellers westward of the Rift Valley, and the tendentially biped species evolving in the savannahs eastward of the Rift Valley. Bipedalism, in fact, grew out of quadrupedalism as it granted a much easier sighting of preys and predators by turning the head in all di-

rections and, most importantly, the opportunity to release from locomotion the anterior limbs by transforming them into hands, fine instruments of mobility, especially through the opposition of the thumb to the other fingers. Conversely, the posterior limbs, and particularly the feet, turned into solid factors of stability. Bipedalism played a fundamental role in favouring the gradual enlargement of the brain, associated with the emergence of a series of free hands-linked skills. Also, quantitative brain enlargement resulted in qualitatively enhanced brain plasticity, dialectically boosting, and being boosted by, a growing complexity of human societies. On the other hand, however, bipedalism caused a narrowing of the pelvic ring bones and hence of the birth canal, necessary to avoid the prolapse of the uterus and other viscera through the pelvic floor. Thus, an evolutionary compromise between these two equally powerful, although conflicting, selective pressures was reached by calibrating a fetus whose skull size at birth was the amplest possible still able to pass through a necessarily narrowed birth canal. As a result, in all other mammals, delivery is less painful than in human females, and allows the birth of an already mature cub, fully capable of performing all the tasks of an adult individual while, in human newborns, a forcibly reduced cerebral space only enables the initially survival-ensuring functions, while delaying all other skills (walking, talking, reasoning, etc.) by months and years. Paradoxically, this very drawback (resulting, however, from two with each other contrasting advantages), turned out to be very beneficial for the genus *Homo*, and particularly for *H. sapiens*. Our species, in fact, is the only one to protract for many years the stage of childhood, a phenomenon called *neoteny*, which permits to acquire during such prolonged period a whole lot of knowledge and experiences to be stored in the parallelly developing cerebral neocortex. Neoteny, another factor potently contributing to the development of “intelligence” (in addition to sexual selection as mentioned before), has represented, at least so far, a decisive asset for the success, and the widespread expansion of mankind across the whole planet.

The history of hominins, of the more recent species of the genus *Homo*, and ultimately of *H. sapiens*, largely intertwines with the evolutionary history of their complex mind, dialectically co-evolving with its physical and neural-hormonal underpinnings. In fact, as body and mind are tied together in an inextricable unit, our mind has evolved as an instrument serving the integrity of our body, thus preserving its survival, growth, and reproductive potential.

As explained by Antonio Damasio [12], our mind is placed at the end of a several billion years’ evolutionary process [13], hallmarked by an infinity of intermediate passages, adjustments, and developmental stages, starting from the “proto-self” of simpler organisms, then gradually reaching the stage of core consciousness and conventional memory of more complex species, and finally acquiring the extremely sophisticated extended consciousness and, in parallel, the autobiographic memory, that allows us to memorize past situations, as well as

to imagine future scenarios. The evolution of extended consciousness, of its corresponding “feelings” (resulting from the reflexion on one’s own emotions), and of their underlying neural-hormonal correlates, basically required the capacity of the subject to observe him/herself as an object. All this complex system did not evolve overnight: autobiographic, extended consciousness evolved along a continuum, with variants emerging in dialectical response to inner and outer environmental constraints, which different hominin species were exposed to. No clear-cut line can be drawn, in the evolution of consciousness, between us and our intricate “bush” of ancestor species, as testified, for instance, by the archaeological remnants of Neanderthals’ ritual and artistic manifestations [14]. In fact, despite a separation of over 500000 years since the branching from their common ancestor, *H. sapiens* and *H. neanderthal* were still able to interbreed generating fertile offspring, which was made possible by an extremely high affinity of their genomes [15]. The gradual transition from one to another closely related species can be currently recognized in nature observing the blurred boundaries existing between the so-called ring species [16]. The gradual transition of species-defining traits that we observe in the progressively evolving ring species *spacewise*, can be hypothesized to have occurred in the hominin species *timewise*.

In sum, autobiographic, extended consciousness as any other physical/mental feature, was gradually developed by the different hominin species in close interaction with their evolving natural, social, economic, and cultural environments.

## 2.4. Brain Plasticity and the “Adaptable” Mind

Genes are not rigid entities, but environment-adapting instruments exhibiting a remarkable flexibility; in fact, according to the definition of Matt Ridley they are “subtle devices designed by ancestral selection to extract experience from the world” [17]. Several genetic mechanisms increase, and improve, the plasticity of organic tissues, and particularly of the neural-hormonal system.

These mechanisms include: “pruning”, which determines, for instance during the formation process of the nervous system, the removal for disuse of a number of potentialities originally present at birth, which means that the brain is “organized” by experience [18]; “alternative splicing”, i.e., “switching”, based on which the same gene, or coordinated set of genes, produces different proteins according to the different signals it receives, which results in different instincts or behaviours (e.g., fight or flight) [19]; “mirror neurons”, that are activated in tune with the activation of homologous neurons, and with the corresponding actions and emotions observed, or perceived, in a partner belonging to the same species [20]. In fact, according to Giacomo Rizzolatti<sup>4</sup>, mirror neurons show the close dialectical interconnection between

<sup>4</sup> Giacomo Rizzolatti (University of Parma, Italy) is the leader of the team of neuroscientists who discovered the mirror neurons’ system.

perception and action characterizing the human mind [21], i.e., between theory and praxis, intimately and immediately interconnected with, and transforming into each other, which represents one of the pillars of Karl Marx's *Weltanschauung* [22]. Mirror neurons, deeply imbued with the emotional colouring that characterizes our perceptions, and actions, may also be considered part of that extreme development, and refinement, of the cell membrane's in- and outside-connecting functions we were talking about earlier.

In addition to these general mechanisms, it should also be noted that all living beings evolve individually according to a sequence of genetically preprogrammed phases of development, allowing, however, for an infinity of slight individual, contingent, environment-conditioned variations ("evo-devo") [23]. In animals, and particularly in humans, mental and physical development stages are strictly interconnected, and interdependent (e.g., puberty) [24]. Genes, and "gene-teams" continuously trigger, and are triggered by, each other, entering a new phase whenever their organism matures the physical, and psychological pre-conditions of the subsequent stage of development.

Another very important component of brain plasticity was elucidated by John Tooby and Leda Cosmides, the founders of evolutionary psychobiology, who described the remarkable capacity of the human brain to be moulded by, and to introject, experiences, knowledges, practices, and beliefs from their cultural environment. According to their theories, we are prepared to come across, and react to, certain outer signals in certain specific stages of our phenotypic development [25].

Moreover, recent research in epigenetics shows that certain modifications in gene expression can occasionally be transmitted to the offspring, thus occasionally breaking the so-called Weismann barrier preventing the transmission of acquired traits [26].

According to an evolutionary definition, "intelligence" is a problem-solving instrument, evolving, individually and collectively, in dialectical relationship with the inner physical and with the outer natural, social, and cultural constraints. Conventionally, intelligence may be defined as the perception of the world, which can be converted into purposeful action to transform it, of the adult human in a state of wakefulness. This concept of intelligence includes, in Pascalian words, both the logico-mathematical "esprit géométrique" as well as, compounded with it, the intuitive "esprit de finesse" [27]. It has co-evolved with the emerging problems to be solved, both internal and external to the organism (the latter represented by other members of the community, of the species, of other living organisms, and by the non-living physical environment, all of which inextricably linked to, and interacting with, each other).

The evolutionary development of intelligence in neural-hormonal system-provided animals, from vertebrates to mammals, primates, hominids and humans, does not present solutions of continuity, as it is made up of a set of intertwining traits allowing their carriers to best cope with the multiple

environmental challenges they are exposed to. There are different factors contributing to the construction of "intelligence": sexual selection (as previously mentioned), that we share with all other sexually reproducing animals; neoteny, that we share with all other (by now extinguished) terrestrial bipeds, i.e., bipedal hominins, for the above illustrated reasons; and a set of traits such as the right-angling of the larynx, the consequent vocal chords elongation, and the high position of the hyoid bone, that we share only with the members of our species (however, not with the other very closely related *Homo* species such as *H. neanderthal* and *H. denisova*). In fact, language, and all its implications, represented a very evolutionary hub generating a whole cascade of consequences in the most recent phases of human evolution, as it was closely linked to the finetuning of symbolic thinking, itself enhancing our reasoning capacities, and thus the effectiveness of our individual and collective activities [28]. Also, language represents a typical example of "exaptation", or "pre-adaptation" [29], i.e., a trait that serendipitously acquires functions for which it was not originally selected. According to William Tecumseh Fitch,

"Comparative data indicate that many cognitive aspects of human language predate humans, suggesting that pre-adaptation and exaptation have played important roles in language evolution. Thus, substantial components of what many linguists call 'Universal Grammar' predate language itself. However, at least some of these older mechanisms have been combined in ways that generate true novelty. I suggest that we can insightfully exploit major steps forward in our understanding of evolution and development, to gain a richer understanding of the principles that underlie human language evolution" [30].

Much more recently, i.e., in historic times, roughly coinciding with the beginning of the Holocene period, the potential tool-making abilities, evolved in connection with bipedalism, and combined with the emerging verbal-mental skills, resulted in the spread of agricultural-cattle growing societies gradually supplanting, in certain world areas, the hunter-gatherer populations. These latter recent developments, however, involved a by far too small number of generations (~ 500) to imply the selection of any objectively perceivable significant difference within our otherwise perfectly homogeneous species. In historic times, in fact since the last great wave of migration out of Africa (about 70000 years ago), subtle evolution-driven physical and mental modifications fell, and still fall, below the threshold of perceptibility<sup>5</sup>. We are all Africans, without exception, and human "races" do not exist, as definitively confirmed by the 2022 Nobel Prize awarded to

<sup>5</sup> Hominid species, and especially *H. sapiens*, have always been characterized by a remarkable genetic stability, mainly due to their migrant nature and to the consequent frequent cross-mating between populations even quite distant from each other, as well as their ability to adapt to even extreme habitats (due to the use of man-made instruments such as hunting tools, clothes, dwellings, etc.), which resulted in a selection less hard than in other species. Assistance and care of the sick and the wounded, a mankind's exclusive characteristic, also played a fundamental role in minimizing the impact of natural selection.

the geneticist and paleoanthropologist Svante Pääbo [31]. Establishing a hierarchical scale of values according to skin pigmentation is just as ridiculous as establishing a scale of values according to blood group, or to major histocompatibility complex. Which proves that racism is an invention functional to increase the discrimination rate, itself directly proportional to the exploitability rate, of salaried or slavish manpower. In fact, the historical transition from hunter-gatherer to agricultural-cattle growing societies transformed the previous troop/tribal hierarchies evolved within the value of use-driven, *re-productive* economy into the master/slave, and later owner/subordinate worker hierarchies (underpinning the social class-structure) taking over in the new value of exchange-driven, *productive* economy. The very transition from non-productive to productive societies “exapted” as soon as other concurring environmental factors reached a level capable of triggering the potentialities accumulated in the meantime in the human mind (analogously to the concurrent factors that in the individual development trigger, for instance, the process of puberty).

What, in historical times, played, and continues to play, a decisive role is the well-established genetically evolved brain plasticity of our species, resulting in its great cultural diversity within its remarkable biological unity that underlies the economic, political, and cultural transformations of human societies. According to Telmo Pievani,

“If the origin of *Homo sapiens* is so recent, unique and African, and then, if our young species has been so mobile and promiscuous, it means that it is highly unlikely that there was any time or way to divide human populations into genetically distinct ‘races’. The dual message of this story is the strong biological unity while there is also the extraordinary cultural diversity within the human species. The ‘civilizations’ in this scenario are similar to evolving organisms, full of internal differences and interdependent upon each other as to both time and space. The roots of these model systems of culture are all intertwined” [32].

### 3. From Dialectical Evolutionism to Historical Materialism: No Solution of Continuity

#### 3.1. Dialectic Emergentism vs. Mechanistic Reductionism

Organic life can be considered an emergent property of nucleic acids, a particular combination of inorganic molecules, and grows out of what has no life; the mind, in its broadest sense of survival and reproductive strategy of both individual and collective lives, can be considered an emergent property of living organisms [33], and grows out of what has no mind; and any degree of consciousness can be considered an emergent property of neural-hormonal systems, and grows out of what has no consciousness [34]. However, evolution at every

step is profoundly dialectical, in the sense that the *new* subsumes, while transforming it, the *old*, and creates a whole that each time is different from the sum of its parts taken separately.

The centuries-old philosophical split between dialecticists and reductionists underlies today’s still lively debate concerning all aspects of sciences, including human sciences. In their seminal book “The dialectical biologist” [35], published in 1985, Richard Levins and Richard Lewontin, two of the most prominent evolutionists of the second half of the XX century, argue very convincingly the strength of the dialectical method to interpret an extremely broad range of biological, historical, and anthropological issues. Since then, new scientific acquisitions in paleoanthropology, genetics, and neurosciences have further confirmed the validity of their scientific approach, based to a considerable extent on Friedrich Engels’ original intuitions exposed in his “Dialectics of Nature” [36] which, however, were conceived in 1873-82, and published posthumously in 1925, i.e., in a historical epoch that by far preceded a whole host of scientific discoveries (in fact, in their dedication Levins and Lewontin say: “To Frederick Engels, who got it wrong a lot of the time but who got it right where it counted”) [35].

In fact, all the above-mentioned, interdependent entities (living beings, minds, consciousness, etc.), did not, and do not, play the passive role of being selected by the outer environment, but actively contribute instead to create the environmental conditions that in turn influence their own evolution. This concept, which is becoming of growing importance in science, takes the name of “niche construction” [37] and perfectly fits the dialectical co-evolutionary interplay characterizing the history of life. A typical example of niche construction is the production of oxygen by cyanobacteria and, subsequently, by plants about a billion years ago, which in turn resulted in the selection of, at first oxygen-tolerant, then even oxygen-dependent organisms, including ourselves. However, although oxygen’s benefits are largely prevalent, especially the energy it provides to all vital functions starting from movement, its costs are also considerable, in the first place the release of free radicals due to the oxidative wearing out of tissues. We may even say that oxygen is the element that, dialectically, allows us to live but, “killing us softly”, also makes us die. Another typical example of niche construction, rebounding not only on the organisms that produce it, but also on the rest of the living world, is the coral reef formation. On a smaller scale, beavers construct their dam-niche which feeds back on their own physical and instinctual-behavioural evolution.

The concept of niche construction can be extended to the much shorter timeframe of Pleistocene, Holocene, and Anthropocene, not in the sense of a radical modification of *H. sapiens*’ physical and mental structures, but in the sense of a continuous interaction of environment-acquired mindsets, due to the genetically predisposed brain plasticity, with their products, i.e., with the different natural, social, and cultural

“niches”, that in turn dialectically feedback, while modifying them, the individual and collective minds’ previously introduced religious, ideological, and ethical-political principles.

According to Jeremy Kendal et al.,

“Human genetic inheritance in combination with human cultural inheritance provides a basis for gene-culture co-evolution, and multivariate dynamics in cultural evolution. Niche construction theory potentially integrates the biological and social aspects of the human sciences” [38].

### 3.2. Altruism, and the Emergence of Ethics

Another aspect of the dialectical relationship between individual, community, and species is the widely debated issue of genetically predisposed altruism.

For centuries, the naturalistic vision of man was based on a mechanistic-reductionist philosophical approach. Descartes’ separation between *res cogitans* and *res extensa* presupposed the conception of man as a living machine, clearly distinct from the soul-less animal machines [39], all framed, however, within a rigorously creationist context. The same mechanistic conception of man as a competing rather than a cooperating actor in the social arena, probably reflecting the XVII century burgeoning early capitalism, inspired the Hobbesian view of “*homo homini lupus*”. The positivistic reductionism of the late XIX century, ideological expression of the flourishing industrial bourgeoisie, epitomized by Tennyson’s famous sentence “nature red in teeth and claw”, also profoundly influenced Herbert Spencer’s [40]<sup>6</sup>, Carl Vogt’s [41, 42]<sup>7</sup>, and others’ simplistic misrepresentations of Darwin’s theories, a glorification of aggressive selfishness, whose poisoned fruits were eugenics, racism, genocides, and the most brutal forms of colonialism. These ideologies were enthusiastically embraced by Friedrich Nietzsche, the most reactionary philosopher of that period, who grossly misrepresented Darwin’s theory to adapt it to his own thought, which was grounded, however, on the logical fallacy of attributing a prescriptive ethical value to a descriptive “scientific” theory [43].

Only in the mid XX century evolutionary scholars and, more specifically, population geneticists such as Robert Axelrod, William Hamilton and others started to question, and contributed to scientifically disprove, the hitherto prevailing dogma of the egoistic essence of “human nature”, thus dispelling centuries-old prejudices [44]<sup>8</sup>. However, genetic altruism itself was interpreted at first in a typical mechanis-

tic-reductionist way, i.e., as exclusively determined by the individual’s underlying genetic setup. Altruism, in fact, was generally attributed to the so-called kin selection, i.e., a way of the genes to protect themselves in closely related individuals [45], a result of a higher genetic affinity due, for instance in the case of social insects, to the mechanism of haplodiploidy [46]. Reciprocity was also invoked as a determining factor in the evolution of altruism [47]. More recently, however, the concept of “genetic altruism” has undergone profound modifications, and Edward O. Wilson himself reconsidered his own previous rigorously gene-based approach [48] in the light of the new notion of “super-organism” (theory of the “group selection”) [49], resting upon a vision of dialectic interdependence of the species and their individual members, a concept that is gradually prevailing in the scientific community. In fact, the superorganism theory reflects, to a great extent, Steven J Gould’s vision of the species as an evolving unitary organism (“species sorting”) [50]. While any species is made up of individuals, the single individual is meaningless if not related to the species, of whose genome it represents but a variant. In a dialectical vision, individual and species in the broader biologic perspective, and individual and community in the more restricted social perspective, represent the two poles of an indivisible, dialectically evolving system.

The recent discovery of mirror neurons [20] has further confirmed the paramount role played by empathy, and the resulting cooperative rather than competitive attitudes, in the evolution of altruism. The co-existence of selfish and unselfish attitudes, manifesting themselves according to the different circumstances individuals, and social groups, come across, largely reflects, on the one hand, our dual prey-predator nature and, on the other, the dialectical relationship between individuals, communities, and species.

In this context, the homosexual use of the sexual drive may also be considered, at least to some extent, to fall into the broader category of genetic altruism [51]. The development of strong friendship and deep solidarity within the hunters/warriors’ group during the long Pleistocene period, able to cement the unity of the males often facing life-threatening risks and dangers to defend their community and to acquire food and space for the whole tribe, turned out to be a highly desirable requirement. These very instinctive relationships have been developed *also* on a sexual basis, taking advantage of the erotic drive that, at a neural-hormonal level, was already present within the members of the group.

The co-presence of hetero- and homosexuality in variable, environment-conditioned proportions falls into the set of dialectically interacting dualities characterizing mankind and other sexually reproducing species. Nature is totally unprejudiced in using *whatever* may be ‘at hand’ regardless of whether it stays in the external environment, or in the mind itself, ‘pre-imprinted’ as a consolidated archetype or a primordial instinct. It’s, again, a typical case of exaptation: if there is a way to use sexuality that proves advantageous to survival and, ultimately, reproduction, nature does not refrain

6 In his *Principles of Biology* (39), Herbert Spencer uses for the first time the expression “survival of the fittest” (“This survival of the fittest, which I have here sought to express in mechanical terms, is that which Mr. Darwin has called ‘natural selection’, or the preservation of favored races in the struggle for life”).

7 Carl Vogt, a German scientist emigrated to Switzerland, had a long litigation with Karl Marx (40), and was also the object of a polemical writing by Friedrich Engels (41). In September 2022, after a long debate, the Rectorate of the University of Geneva decided to change the name of a university building named after Carl Vogt, due to his racist and sexist writings.

8 The studies on genetic altruism, dating back to the mid-XX century (see, for instance, [43]), contributed to dispel the Hobbesian myth of “*Homo homini lupus*”, i.e., of an intrinsically selfish human being.

from doing so only because that very primigenial instinct in its heterosexual version was originally functional to another aim, i.e., to pure and simple reproduction. Leonida's 300 men at Thermopylae who immolate themselves to save their own 'enlarged tribe' (the whole of Greece) from physical destruction, and the rigorously selected homosexual corps of Theban soldiers under the command of Epaminondas (the "holy battalion") who are willing to die for each other and, ultimately, all together for their community, represent examples of the biological advantage deriving from the homosexual use of erotism.

Ethics, a matter of choice that goes beyond instincts, consists of the set of principles, and rules, that inspire and govern our actions. The emergence of ethics (whose neural correlates, according to Damasio, are mainly located in our ventro-frontal cortex) [52] closely parallels the emergence of extended consciousness, which grafts, so to say, on the *unconscious* instincts that we share with all other animals. So, ethics depends ultimately on how our brain, and reward system, have evolved as a function of the sensation of well-being of the individual which, however, was also dialectically related to the survival and reproduction-driven altruistic impulse towards the other members of the community. Instincts were transformed into ethical rules, and principles, with the growing influence exerted on them by our parallelly evolving cognitive, extended consciousness-furnished mind. As noted by Edward O. Wilson, "biologically rooted" ethics, in the sense of valuing habits that have proved useful in previous generations, is potentially present even in other socially organized animals [53] but only in the evolved mind of the hominin species, and especially in *H. sapiens*, it "exapts" as a full-blown character, triggered by the conscious awareness of a multiplicity of concurring factors. Also, it dialectically co-evolves with the expansion of a complex network of social relations. Ethics, however, presupposes qualitative judgments, which in turn can only rest upon the fundamental emergent property of positive and negative hedonic tones which, as previously mentioned [6], our neural-hormonal system is endowed with. As social harmony proved to be a decisive asset for the human species, ethics apparently was developed as a tool to inhibit instincts believed to cause harm, while encouraging those believed to be beneficial to human communities. Thus, while other animals act exclusively according to the instincts they identify themselves with, only the human species, as a side effect of the further development of its mind, operates both on instinctual *and* ethical grounds. Historically, ethics tends to convert, and "solidify", into the laws.

### 3.3. Capitalist Niche Construction, or Socialist Niche Construction

During the '50s and '60s of the past century, the Marxian dialectic idea of matter transforming into spirit, and spirit re-transforming into matter was concretely interpreted, among

others, by Frantz Fanon [54] and Immanuel Wallerstein [55], by applying it to the mechanisms underlying imperialism and neocolonialism. Replacing the term "matter" with "money", and the term "spirit" with "knowledge", it appears that money converts into knowledge and knowledge reconverts into money, and who gets hold of the one gets hold of the other as well, whereas who is deprived of the one, is deprived of the other as well, thus deepening the ditch between the exploiters and the exploited. Which is precisely the condition suffered by all lower social classes, and by all non-industrialized countries and oppressed peoples of the "Third World".

According to Wallerstein, the "world-system" consists of a unidirectional flow of resources from the non-industrialized peripheries to the industrialized "core" of the planet, and therefore represents the perfect achievement of the neoliberalist model. The pillars upon which rests the whole edifice are the intensive exploitation of the human workforce, and the depredation of natural resources available in the peripheric countries, from which both primary commodities and processed products are systematically withdrawn at very low prices, and subsequently sold at very high prices in the core countries and, in part, in the semi-industrialized, semi-peripheric countries. Minimizing labour costs in the Third World periphery is therefore essential for the very survival of the world-system. To this purpose it is indispensable to deeply root, in the collective unconscious of the inhabitants of the "core", the narrative that takes for granted the distinction between "us" and "them", functional to the maximization of the profits of those who are at the apex of the socioeconomic pyramid. Conversely, as stressed by Frantz Fanon, the inhabitants of the third world introject the sense of inferiority hammered into their minds by the imperialist and colonialist rulers. The stereotyped representation of the migrant who, after escaping poverty (into which we ourselves had thrown him/her), is obviously willing to do even the humblest job, responds to the need of maintaining, in fact stabilizing, the existent socioeconomic hierarchies on which to rely to optimize exploitation. Essential for the survival of the world-system is the "principle of inequality", ensuring the technical, economic, and industrial backwardness, and the low standard of living of the peripheric countries, necessary to grant very cheap labour, and commodities.

Therefore, while for the peripheric countries it's about preventing the looting of their resources, for the core, and semi-peripheric countries it's about dividing the "loot" collected, proportionally to its consistency, among those low-middle classes that might otherwise question and, possibly, threaten the current system; in other words, finding the margins to make the necessary concessions without, obviously, curtailing the profits of the rich and powerful. Possible grievances, or revolts, can still be conveniently channeled against other target groups, such as the migrants, or the "diverse".

All this is made possible by our evolved adaptable, extended consciousness-furnished brain, which permits the

ruling classes to instill their religious and secular ideologies, and their ethical standards, expressing their material interests, into the minds of the underprivileged, exploited classes. In fact, the great mouldability of the human brain makes it absorb and introject the contents of the cultural messages it is exposed to. Material production, and cultural production keep dialectically converting into each other.

Religion itself may be interpreted as a biological phenomenon [56, 57], i.e., as a side effect of the human mind's evolution. In fact, the development of self-consciousness, and the awareness of individual death, are the main factors that facilitate its spread in humans. Furthermore, selection rewarded the ancestral, fundamentally defensive, aggregating instinct promoted by religions while penalizing the opposite self-exclusion instinct, which explains the propensity of the neural-hormonal system to absorb religious creeds and ethical principles from the surrounding cultural environment. On the other hand, religions, especially monotheistic and patriarchal religions, tend to adapt to the productivity demands, and to bend to the material interests of ruling classes, tribes, and nations.

As far as the neocapitalistic mantra “free market/free enterprise/free profit/free exploitation” is concerned, it is smuggled through, and hammered into the ideology-absorbing human minds as if it were a *natural*, hence ineluctable, condition.

The construction of an increasingly pervasive capitalistic niche, and the consequent deleterious effects of capitalistic globalization, have undergone a dramatic acceleration since the end of World War II, the historical period called Anthropocene or, perhaps more appropriately, Capitalocene [58] or Capitalinian [59].

As we have seen, in an evolutionary perspective, *ethical reference standards* can be considered both the single individual's inbuilt well-being's sensation on the one hand, and the ultimate survival of the species (evolved as a “super-organism”) on the other hand, dialectically intertwined with each other. Individual and community in the social perspective, and individual and species in a broader biological perspective, evolved as the two poles of a dialectically interdependent system. Both are interconnected, and reciprocally interacting with their natural environment. Hence, the ruthless depredation of human workforce on the one hand, and of natural resources on the other hand, results in a severe harm for both the individual, who is denied the fulfillment of her/his basic needs, and the species, threatened of extinction because of its close, symbiotic interdependence with the imperilled natural environment.

The instinct to accumulate resources, emerged and gradually strengthened during the momentous transition from hunter-gatherer to agricultural-cattle grower societies, tends to convert into a rewarding sensation of self-realization, to the extent that money, as a quintessential value of exchange, and its deriving economic success, convert into symbolic surrogates of power. A society that credits money with a supreme

value, combined with the persistent stimulation of the reward centre, transforms the obsessive yearning for ever growing productivity levels, and for accumulating properties in a sort of hybris, taking on the features of a pathologic addiction. On the other hand, the profit-driven production of superfluous goods requires an advertising-generated consumers' demand. In this context, the instrumental use of science for commercial purposes has provided the producers' companies with the so-called neuromarketing, a system based on the Nuclear Magnetic Resonance (NMR) technique which allows them to choose the most effective among a variety of promotional messages, i.e., the one capable to induce the greatest possible activation of the reward system-specific brain areas [60].

## 4. Conclusion

Economy, i.e., the social organization dealing with the production and distribution of goods, can either promote the well-being for all or, like in the present historical phase hallmarked by the worldwide privatization of resources, reserve to a minority the full availability of whatever is produced at the expense of a majority that suffers the severe physical and psychological consequences of being partly or totally deprived of it.

In the present phase of neo capitalistic globalization, the logic of profits founded on inequality overrules the logic of rights founded on equality, which results in the progressive widening of the gap between privileged and underprivileged social classes. In addition, the ecologic disruption, due to industrial pollution, use of non-renewable energy resources, forest fires propaedeutic to intensive farming, wild urbanizations, and the deriving pandemics, intertwines with the social harm.

However, historically the emergence of an extended consciousness, fundamentally based on the capacity of the subject to observe itself as an object, has also introduced contradictions arising from its intrinsic capacity to transform itself ipso facto into *critical* consciousness, which concerns both individual consciousness, and, in a class-divided society, class consciousness. The Achille's heel of capitalism is precisely the fact that critical consciousness is potentially able to make the difference in turning upside down the social, economic, and political situation if a critical mass of people develops a collective subjectivity converting critical awareness into a coordinated revolutionary praxis, contrasting both the ecologic disruption, and the social iniquity produced by capitalism.

## Abbreviations

NMR Nuclear Magnetic Resonance

## Author Contributions

Paolo Crocchiolo is the sole author. The author read and approved the final manuscript.

## Conflicts of Interest

The author declares no conflicts of interest.

## References

- [1] Engels F.: in *Marx-Engels Collected Works*, Vol. 40, p. 441. Lawrence & Wishart Electric Books, London (2010).
- [2] Engels F.: *Dialectics of Nature*. International Publishers, New York (1940)
- [3] Foster, J. B.: Marx's Theory of Metabolic Rift: Classical Foundations for Environmental Sociology. *American Journal of Sociology*, 105, 2: 366-405 (1999).
- [4] Miller, G.: *The Mating Mind: How Sexual Choice Shaped the Evolution of Human Nature*. Doubleday, New York (2000).
- [5] Pulman, B.: Malinowski and Ignorance of Physiological Paternity. *Revue française de sociologie*, 45, 5: 121-142 (2004).
- [6] Johnston, V.: *Why We Feel. The Science of Human Emotions*, pp. 61-62. Perseus Books, Reading (1999).
- [7] Damasio, A.: *The Strange Order of Things*, pp. 117-142. Random House Vintage Books, New York (2019).
- [8] Popova, M.: I Feel, Therefore I Am: Neuroscientist Antonio Damasio on Consciousness as a Full-Body Phenomenon. Available in: <https://www.themarginalian.org/2021/12/24/feeling-knowing-damasio/>
- [9] MacLean, P. D.: *The Triune Brain in Evolution: Role in Paleocerebral Functions*. Plenum Press, New York (1990).
- [10] Fodor, J. A.: *The Modularity of Mind: An Essay on Faculty Psychology*. MIT Press, Cambridge, MA (1983).
- [11] Damasio, A.: *The Feeling of What Happens. Body and Emotion in the Making of Consciousness*, p. 154. Harcourt Harvst Books, San Diego, CA (2000).
- [12] Damasio, A.: *The Feeling of What Happens. Body and Emotion in the Making of Consciousness*, p. 310. Harcourt Harvst Books, San Diego, CA (2000).
- [13] Crocchiolo, P.: *The Touch of Life*, pp. 87-99. Davies Group Publishers, Aurora, CO (2010).
- [14] Marquet, J. C. et al.: The earliest unambiguous Neanderthal engravings on cave walls: La Roche-Cotard, Loire Valley, France. *PLoS ONE*, 18, 6: e0286568 (2023).
- [15] Green, R. E. et al.: A Draft Sequence of the Neandertal Genome. *Science*, 328: 710-722 (2010).
- [16] Pereira, R. J., Wake, D. B.: Ring species as demonstrations of the continuum of species formation. *Molecular Ecology*, 24, 21: 5312-5314 (2015).
- [17] Ridley, M.: *Nature via Nurture*, p. 247. Harper Perennial, London (2004).
- [18] Low, L., Cheng, H. J.: Axon pruning: an essential step underlying the developmental plasticity of neuronal connections. *Philos. Trans. R. Soc. London B Biol. Sci.*, 361: 1531-1544 (2006).
- [19] Irimia, M., Blencowe, B.: Alternative splicing, decoding an expansive regulatory layer. *Current Opinion in Cell Biology*, 24: 323-332 (2012).
- [20] Rizzolatti, G., Sinigaglia, C.: The mirror mechanism: a basic principle of brain function. *Nature Reviews Neuroscience*, 17, 12: 757-765 (2016).
- [21] Treccani Channel: Interview with Prof. Giacomo Rizzolatti (26 May 2009). Available from: <https://www.youtube.com/watch?v=IG0GY0oQspE>
- [22] Marx, K.: *Theses on Feuerbach*, in *Marx/Engels Selected Works, Vol. I*, pp. 13-15. Progress Publishers, Moscow (1969).
- [23] Wallace, A.: *Understanding Evo-Devo*. Cambridge University Press, Cambridge, UK (2021).
- [24] Oliverio, A., Oliverio Ferraris, A.: *Le et à della mente*. Rizzoli, Milano (2021).
- [25] Barkow, J. H., Tooby, J., Cosmides, L.: *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*. Oxford University Press, Oxford, UK (1995).
- [26] Riggs, A. D., Russo, V. E. A., Martienssen, R. A.: *Epigenetic mechanisms of gene regulation*. Cold Spring Harbor Laboratory Press, Plainview, NY (1996).
- [27] Pascal, B.: *The Pensées*. Penguin Books, London (1961).
- [28] Dehaene, S. et al.: Illiterate to literate: behavioural and cerebral changes induced by reading acquisition. *Nature Reviews Neuroscience*, 16, 4: 234-244 (2015).
- [29] Barve, A., Wagner, A.: A latent capacity for evolutionary innovation through exaptation in metabolic systems. *Nature*, 500: 203-206 (2013).
- [30] Fitch, W. T.: Evolutionary Developmental Biology and Human Language Evolution: Constraints on Adaptation. *Evolutionary Biology*, 39, 4: 613-637 (2012).
- [31] Pääbo, S.: The human condition – a molecular approach. *Cell*, 157, 1: 216-226 (2014).
- [32] Cavalli Sforza, L. L., Pievani, T.: *Homo sapiens. The great history of human diversity*. Excerpt from the Archives of the Exhibition held between April 11, 2011, and April 9, 2012, at Rome's Palazzo delle Esposizioni.
- [33] Damasio, A.: *The Strange Order of Things. Life, Feeling, and the Making of Cultures*, pp. 53-56. Random House Vintage Books, New York (2019).

- [34] Damasio, A.: *Self Comes to Mind. Constructing the Conscious Brain*, pp. 157-179. Pantheon Books, New York (2010).
- [35] Levins, R., Lewontin, R.: *The Dialectical Biologist*. Harvard University Press, Cambridge, MA (1985).
- [36] Engels, F.: *Dialectics of Nature*. International Publishers, New York (1940).
- [37] Odling-Smee, F. J., Lala, K. N., Feldman, M. W.: *Niche Construction: The Neglected Process in Evolution*. Princeton University Press, Princeton, NJ (2003).
- [38] Kendal, J., Tehrani, J. J., Odling-Smee, J.: Human niche construction in interdisciplinary focus. *Philosophical Transactions of the Royal Society of Biological Sciences*, 366, 1566: 785-792 (2011).
- [39] Descartes, R.: *Discours de la méthode*, pp. 35-57. Union Générale d'Éditions, Paris (1962).
- [40] Spencer, H.: *Principles of Biology, Vol. I*, pp. 444-445. Williams and Norgate, London (1864).
- [41] Marx, K.: "Herr Vogt". *Der Volksstaat*, 31: 4 (1871).
- [42] Engels, F.: "Abermals Herr Vogt". *Der Volksstaat*, 38: 1-4 (1871).
- [43] Richardson, J.: *Nietzsche's New Darwinism*. Oxford University Press, Oxford, UK (2004).
- [44] Axelrod, R. M., Hamilton, W. D.: The evolution of cooperation. *Science*, 27, 211: 1390-1396 (1981).
- [45] Hamilton, W. D.: The Genetical Evolution of Social Behaviour. II. *Journal of Theoretical Biology*, 7: 17-52 (1964).
- [46] Hamilton, W. D.: Altruism and related phenomena, mainly in social insects. *Annual Review of Ecology and Systematics*, 3: 193-232 (1972).
- [47] Rothstein, S. I., Pierotti, R.: Distinctions among reciprocal altruism, kin selection, and cooperation and a model for the initial evolution of beneficent behaviour. *Ethology and Sociobiology*, 9, 2-4: 189-209 (1988).
- [48] Wilson, E. O.: Kin Selection as the Key to Altruism: Its Rise and Fall. *Social Research*, 72, 1: 159-166 (2005).
- [49] Wilson, E. O., Hölldobler, B.: *The Superorganism. The Beauty, Elegance, and Strangeness of Insect Societies*. W. W. Norton & Company Inc., New York (2009).
- [50] Lieberman, B. S., Vrba, E. S.: Steven Jay Gould on species selection, 30 years of insight. *Paleobiology*, 31, 2: 113-121 (2005).
- [51] Salais, D., Fischer, R. B.: Sexual preference and altruism. *Journal of Homosexuality*, 28, 1-2: 185-196 (1995).
- [52] Damasio, A.: Neuroscience and Ethics. Intersections. *The American Journal of Bioethics*, 7: 3-7 (2007).
- [53] Wilson, E. O.: *Consilience. The Unity of Knowledge*, p. 283. Random House Vintage Books, New York (1999).
- [54] Fanon, F.: *The Wretched of the Earth*. Grove Press, New York (2005).
- [55] Wallerstein, I.: *Welt-System-Analyse. Eine Einführung*. Springer Verlag, Wiesbaden (2018).
- [56] Dennett, D.: *Breaking the Spell. Religion as a Natural Phenomenon*. Penguin Books, London (2007).
- [57] Pievani, T., Girotto, V.: *Nati per credere*. Codice, Torino (2016).
- [58] Moore, J. W.: *Anthropocene or Capitalocene?: Nature, History, and the Crisis of Capitalism*. PM Press, New York (2016).
- [59] Foster, J. B.: The Return of the Dialectics of Nature: The Struggle for Freedom as Necessity. *Monthly Review*, 74, 7: 17 (2022).
- [60] Cherubino, P., Martinez-Levy, A. C. et al.: Consumer Behaviour through the Eyes of Neurophysiological Measures: State-of-the-Art and Future Trends. *Computational Intelligence and Neuroscience*, 2019: Art. Ident. 1976847 (2019).