What Is Specific about Humans?

with Paolo D'Ambrosio, "A Heuristic Science-Based Naturalism as a Partner for Theological Reflections on the Natural World"; Lluis Oviedo, "Religion as a Language: Exploring Alternative Paths in Conversation with Postreductionist Anthropologies"; and Ivan Colagè, "The Human Being Shaping and Transcending Itself: Written Language, Brain, and Culture."

A HEURISTIC SCIENCE-BASED NATURALISM AS A PARTNER FOR THEOLOGICAL REFLECTIONS ON THE NATURAL WORLD

by Paolo D'Ambrosio

Abstract. After a few general observations on scientific activity, the author briefly comments on different versions of naturalism. Subsequently, he suggests that the birth of evolutionary biology and its successive developments may show how the natural world comes to be differently conceived as scientific advancements are accomplished. Then the main thesis is outlined by introducing the principles of a heuristic science-based naturalism not conclusively defining the real and the knowable. From the epistemological perspective, heuristic naturalism is meant to be framed in critical realism, whereas from the ontological standpoint it may be framed in emergent monism, given that the latter can also underpin recent trends in investigation addressing human specificity. Finally, attention is turned to some implications of heuristically guided scientific activity with regard to the issues of divine action and of *imago Dei*.

Keywords: critical realism; divine action; emergent monism; evolutionary biology; human specificity; *imago Dei*; nature; naturalism; science

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Science may be generally seen as a human enterprise aimed at achieving reliable and testable knowledge about the natural world. During the past century, scientists and philosophers reverted to discussions of fundamental issues such as the object of science, the scientific method, how science

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works and develops in time, and the relevance of experimental surveys. The so-called "epistemological debate" of the second half of the last century, which saw the contributions of Karl Popper, Thomas Kuhn, Imre Lakatos, and Larry Laudan among others, also concerned the ontology underlying scientific activity, or the theoretical assumptions regarding basic entities and their correlations. Changes in the underlying ontology accompany significant turns in scientific activity, for instance as certain theories are combined or even replaced with other theoretical constructs. Eventually, the conception of what is defined as "natural," and therefore potentially within the range of scientific investigations, changes as well. Here, I argue that a *heuristic science-based naturalism* (HSN) may represent an open horizon of thought defining formally the scope of the scientific enterprise, rather than a dogmatic standpoint for distinguishing conclusively what is real and knowable from what is not. In this way, HSN could foster the dialogue between scientific knowledge and those branches of theology more specifically addressing the natural world and the human condition, namely, theology of creation and theological anthropology.

To begin with, let me sketch some brief considerations about scientific activity. In particular, I would like to stress the connections among the following:

(1) *descriptions*: analyzing the composition, properties, and behavior of natural phenomena;

(2) *explanations*: identifying the causal factors responsible for the occurrence of natural phenomena;

(3) *predictions*: inferring the behavior that phenomena will follow over time, or the conditions required for a future occurrence of those phenomena; and

(4) *generalizations*: formulating regularities or laws pertaining to the class of phenomena of interest.

Descriptions, explanations, predictions, and general regularities are comprised in the theoretical constructs of a scientific discipline, which are meant to be checked through *experimental trials*. Experimental investigations can be employed for testing hypothesized explanations and predictions, and the obtained data may provide evidence for supporting or disclaiming the incidence of quantifiable parameters. It may be said that a virtuous circle gets established between experience and theory, allowing for a progressive acquisition of controllable knowledge (cf. Colagè 2013).

The resistance that phenomena oppose to our expectations—insofar as experimental outcomes keep on clashing with what one is willing to demonstrate—may turn out to be more constructive for scientific progress than several confirmations. Recognizing the mismatch between theories

and empirical evidence pushes one to modify aspects of the former in order to let it fit better with the real world. Recurrent counter-evidence coming from experimental trials may be so striking as to urge significant theoretical emendations and revisions, sometimes even a redefinition of the class of phenomena of interest. However, an accepted theory is not rejected any time that, say, a single prediction is proved to be false; nor does empirical disproof always reveal fatal anomalies eventually leading to a "paradigm shift," in the terminology introduced by Kuhn (1962). One of the main Kuhnian arguments is that crucial passages in the history of science are marked by the substitution of a dominant theoretical framework (a "paradigm") with another, which is incompatible with the former one and introduces innovative guidelines to future research. But scientific "revolutions," in which scientists start to look at the same things with different eyes, are quite rare episodes. And even in these cases, part of the amount of knowledge obtained in the past is often preserved, although interpreted according to different criteria. It seems indeed unlikely that effective scientific advances are gained by periodically setting apart all of the results achieved in the course of decennia or of centuries, and starting again from scratch. Moreover, and more importantly for our present concerns, science goes on in investigating more and more complex systems, and this progressive approach to complexity seems to imply a twofold challenge. On the one hand, it becomes necessary to excogitate appropriate conceptual frameworks, models, and empirical research programs for dealing with *the specificity* of the phenomena at stake. On the other hand, novel theoretical constructs should not contradict sound acquisitions obtained in the past, but often lead to relativize their validity to a certain spectrum of phenomena and/or to particular conditions. The combination of these two aspects corresponds to what I call *coherent discontinuity* characterizing the heuristic naturalism proposed in what follows. The general suggestion is that *a parallel can be traced between the epistemological and the ontological orders of considerations* as scientific and philosophical efforts are aimed at accounting for both homogeneity and heterogeneity displayed in the natural world. Such an ongoing endeavor may be understood in terms of the "essential tension" between tradition and innovation, to make a further reference to Kuhnian epistemology (Kuhn 1977, Ch. 9).

A Variety of Naturalisms

Naturalism may be generally seen as a philosophical perspective concerning the constitution of the physical world and the knowledge attainable about it. Naturalistic conceptions have often been opposed to a theistic worldview. As Niels Henrik Gregersen recalls, such an opposition can be traced back to late scholasticism, since "pure nature" was seen in contrast with "supernatural intervention," a separation maintained through the end

of seventeenth century (Gregersen 2014, 100). Notably, this represented a rupture of the traditional view of medieval thinkers who were interested in understanding natural phenomena in their specificity and contingency in conformity with theological argumentations (cf. Numbers 2003; Harrison 2007, 151). With reference to current debates about naturalism and the scope of the scientific enterprise, it has been pointed out that

> the exigency that animated the medieval thinkers is still worth emphasizing: nature should be studied in its own right, and science should follow its enquiry in full autonomy; even when we do not desire to put the creative and sustaining action of God into question, no supernatural explanation should be used when explaining natural phenomena in scientific terms, even when we feel that our explanations are incomplete. (Auletta 2011, 63).

Since the Greek fathers and the work of St. Augustine, one major concern of Christian thinkers has been to interpret the Sacred Scripture consistently with the knowledge that human beings, by means of their experiences and intellectual capabilities, can acquire about the created world, that is, what is recognized as "natural" in the variety of its manifestations. The infinite Primary Cause was thought of as *granting the autonomy* of finite secondary causes, so that the study of physical phenomena and metaphysical reflections on Creation were distinguished but neither opposed nor confused. After the spread of modern science, scholars tended to see "the domain of the natural" in close relation to scientific knowledge. Here, I follow the distinction between *ontological naturalism* or naturalistic ontology, *methodological naturalism*, *epistemological naturalism*, and *metaphysical naturalism* (Stanzione 2011, 380–83).

According to ontological naturalism (ON), the totality of nature is constituted by spatio-temporal events and processes, which exist antecedent to and/or independently of our perception, conceptualization, or knowledge (see also Drees 1995, 12–20). Massimo Stanzione argues that this definition implies two metaphysical options: either (a) nothing exists beyond nature, mind is a completely natural process, and any kind of supernatural reality does not exist, or (b) the natural world depends on a supernatural being, its Creator, no matter if one considers mind as a completely natural process or not. I would say that these options represent two alternative basic assumptions that may be coupled with the definition of ON. If one assumes (b), then ON may result compatible with a theistic view, as long as the dependence of the natural on the supernatural is conceptually articulated. I also underscore the "independence" of the natural world from our perceptions, conceptualization, or knowledge, included in the definition; it may support a realistic conception of the scientific enterprise to which I will return later.

Methodological naturalism (MN) may be defined as the position stating that natural phenomena have natural causes, and therefore attempts at

explaining these phenomena should recur to factors (recognized as) pertaining to the natural world. MN is, so to speak, theistically neutral (cf. Sober 2011). It is a minimal assumption that may ground ordinary scientific activity especially as to the formulation of explanations and predictions (points 2 and 3 above). I will somehow incorporate this idea in the heuristic naturalism here proposed.

Epistemological naturalism (EN) holds that the human capabilities of understanding and interpreting nature in a meaningful way are completely natural as well, and therefore objects of scientific inquiry (epistemology included). This corresponds, more or less, to the thesis maintained by W. V. Quine (1969) and those philosophers of mind who not only consider mind and the world of meanings homogeneous with nature but also argue that the only appropriate way for dealing with these issues is the scientific approach. Maybe even more than in the case of ON, the mind-body relationship and the dualism/monism debate represent crucial topics. The radical position championed by Daniel Dennett is well known: "there is only one stuff, namely *matter*—the physical stuff of physics, chemistry, and physiology—and the mind is somehow nothing but a physical phenomenon. In short, the mind is the brain" (Dennett 1992, 33).

This brings us to the most rigid version of naturalism, which may be designated as metaphysical naturalism (MetN). As again Stanzione (2011) points out, quoting in turn Michael Ruse, metaphysical naturalism is an epistemological *and* ontological commitment: a metaphysical naturalist would simply assume that nothing really exists beyond scientific knowledge. In the words of Ruse, "such a person I take to be an atheist (not just an agnostic) and a materialist (inasmuch as materialism makes sense today)" (Ruse 2005, 84–85).

Is there a significant difference between MetN and pure scientism? Maybe not. However, scientism seems more related to the epistemological side of the problem because *true knowledge* is claimed to be achievable only through the method of empirical sciences, which should be applied also to philosophy and the humanities in general. An advocate of scientism could admit the reality of other spheres of experience, like emotions or inspiration, but either it is possible to scientifically analyze them or they are considered as subjective states of mind, irrelevant for what knowledge is concerned. As to the supernatural dimension, a skeptic or an agnostic position might be professed. Instead, since one affirms that what is real *is* what science can demonstrate, and nothing else exists, the emphasis is put on ontology. It seems that a metaphysical statement is placed at the foundation of arguments denying the validity of metaphysics. In any case, it is quite difficult to reconcile the presuppositions of both scientism and MetN with a theological understanding of Creation and of the human being.

In present times, a philosophical consideration of the natural world cannot but take into account scientific and technological progresses, or the so-called "scientific culture" at large. However, *scientific naturalism* (SN), in the way in which it has been conceived in the milieu of American philosophy of science (second half of the last century), has much in common with MetN. As again Gregersen remarks (2014, 101), the key assumption is that "modern science, in particular physics, could in principle define ontology in a conclusive manner and set up strict constraints for what can be deemed as 'real' in all areas of existence and life." Consequently, philosophical disciplines other than philosophy of science, including first philosophy or metaphysics, are seen as almost meaningless: "philosophy of science is philosophy enough," famously declared Quine; "science is the measure of all things," stated Wilfrid Sellars (1963, 173).

Now, I would like to call attention to the problem concerning *the contents* that could be assigned to the afore mentioned versions of naturalism. What are supposed to be "the spatio-temporal events and processes" constituting the world according to ON? What can be the causal factors pertaining to the natural world in the case of MN? In what specific sense are our capabilities of understanding and interpreting the world natural, as EN wants? How can we conceive "matter" or the "physical stuff of physics, chemistry, and physiology" as proposed by Dennett? And what about the basic characters of reality to be admitted according to MetN?

Since the birth of modern science, with the work of Galileo, Descartes, Leibniz, and Newton, the answers to these questions have changed considerably. Particularly during the last century, scientists introduced new entities, measurable quantities, notions, and conceptualizations for dealing with the constitution of the universe: think about relativity, information, biological constraints, quantum correlations, and so forth. In a not distant past, many of these features would have been probably considered beyond the boundaries of what could have been plausibly acknowledged as "natural." Nevertheless, it became more and more clear that there exist phenomena, at both the microscopic and the macroscopic scales, the dynamics of which cannot be reduced to the ones characterizing physical entities previously thought of as basically composing the universe. Moreover, macroscopic properties and behaviors displayed by complex systems have been showed not to be entirely derivable or deducible from processes relative to microscopic systems. In other words, ontological reductionism has been challenged *on scientific grounds* and, with that, generalized "physicalism" has been brought into question as well (cf. Giberson and Artigas 2007, 189). Hence, the need for envisioning an extensive, multilayered, and as much as possible coherent worldview, in which complex systems can emerge from interactions between more elementary ones (bottom-up causality), and can in turn affect lower-level processes (top-down causality; see Ellis 2005; Auletta, Ellis, and Jaeger 2008; Auletta, Colagè, and D'Ambrosio 2013). Without deepening these issues here, I would only like to stress once more that as science goes on in exploring

the unexplored, the consideration of what is "natural" or "physical" evolves accordingly, as Noam Chomsky had to admit (Chomsky 1980, 5). From this point of view, regarding the whole of reality as confined to what science can demonstrate at one or another stage of its history seems problematical.

In criticizing forms of naturalism that dispute the significance of the supernatural dimension, Charles Taliaferro remarks that developments in the field of physics seem "to have deconstructed our ordinary concept of what is physical," so that we do not currently have a clear-cut philosophical notion of physicality or of materiality; thus, how is it possible to put in question the existence or the coherence of what is not physical or immaterial? Talliaferro argues for the primacy of philosophy for weighing the merits of naturalism: without philosophical reasoning and conceptual powers "we would be unable to consider whether or not mind-independent objects have mass, volume, size, color, odor, sound, taste . . . , or whether the physical consists in individual things (particles) or events or fields" (2014, 96). I would stress in turn that philosophical efforts are inherent in the development of the scientific enterprise and are generally aimed at finding a key of intelligibility for dealing with what is still unclear or puzzling. New entities, mechanisms, properties, or causal connections are provisionally hypothesized as they allow us to formulate promising explanations, plausible predictions, and general regularities, all to be tested through experimental trials. This might eventually lead us to rethink significant pieces of the ontology taken for granted in the background of one or more areas of scientific investigation. An example of this inferential process can be found by considering evolutionary theorizing in biology.

Extending the Domain of the Natural: Biological Evolution

Charles Darwin has been usually praised for having brought biology into the context of modern science. I have suggested elsewhere that such an achievement was accomplished because Darwin took into consideration *the specificity* of living beings, the distinctive features characterizing the realm of life (D'Ambrosio 2013a). Within the Darwinian theory first delineated in *The Origin of Species* (1859), organisms are neither reduced to inanimate physical entities nor treated as if they were artificial objects purposefully designed by humans. Such a commitment enlarged the boundaries of what used to be considered natural and therefore objects of scientific investigations.

On the one hand, the Darwinian theoretical framework shows a line of continuity with previous scientific acquisitions. Darwin was unavoidably influenced by the then paradigmatic Newtonian physics (see Depew and Weber 1995). Consistent with the general strategy of modern science, he abandoned an essentialist view which was not compatible with the

evolutionary perspective (see Mayr 1988; Waters 2003). Moreover, Darwin did not break with the two main traditions of research concerning the classification of organisms, the one focusing on adaptive dissimilarities (championed by Georges Cuvier), the other on commonalities or homologies (advocated by Étienne Geoffroy Saint-Hilaire and Richard Owen). Darwin rather synthesized these positions (Gilbert and Epel 2009, 291) in the light of evolution intended as "descent with modification": commonalities between life forms reflect descent from common ancestors, whereas dissimilarities stem from continuous and gradual production of variation in the progeny as well as to persistent selection of variants in relation to environmental conditions.

As previously mentioned, Darwin focused on the specificity of living beings and on peculiar factors responsible for the occurrence of evolutionary transitions; for instance: (1) relationality common to all life forms (organisms–environment mutual relations are deemed the most important causal factor to be taken into account; Darwin 1859, Introduction, Chs 11–12); (2) differential fulfillment of vital functions through unintentional goal-directed behaviors (see Auletta, Colagè, and Jeannerod 2013), requiring teleological explanations of adaptations (Ayala 1970; Lennox 1993; cf. Hösle 2011); and (3) context-dependency of adaptive forms and of their fixation via natural selection (Darwin 1859, Ch 4). The Darwinian "winning move" may be seen in having introduced these intertwined features into the domain of the natural and of the naturalistically explainable.

Here, I cannot dwell upon the reasons why the Darwinian theoretical framework turned out to be so successful that it still represents, after more than 150 years since the publication of *The Origin*, a point of reference for all life sciences (see D'Ambrosio 2014). To make a long story short, the integration of the Mendelian theory of particulate inheritance, the establishment of the so-called Modern Synthesis or Synthetic Theory of Evolution, and the burst of molecular biology definitively confirmed the *fact* of biological evolution. As the title of a famous paper by Theodosius Dobzhansky (1973) says: "Nothing in biology makes sense except in the light of evolution." However, the *explanation* of this fact requires us to assess the actual incidence of a plurality of factors still to be elucidated.

Evolutionary theorizing is currently undergoing further stages in its own development. Some prominent scientists and philosophers of biology advocate the need for an "extended synthesis" aimed at a more comprehensive and realistic understanding of biological processes than the one maintained by neo-Darwinists (Laland et al. 2014). The Modern Synthesis seems to have provided a satisfactory account for the differential distribution of genes in populations but not for the transmutation of forms occurring over evolutionary timescales (Pigliucci 2009). The complexity of phenotypic dynamics challenges the reliability of both strict genetic

determinism and gene selectionism (see Schlichting and Pigliucci 1998; Lewontin 2002; Rosenberg 2007). Contextually, phenotypic variation, innovation, and evolution are increasingly recognized as having to do with the *epigenetic* dimension (see Waddington 1942; cf. Jablonka and Lamb 2006). According to the epigenetic view of development, the interconnection of parts characterizing a mature organism is formed by gradually building structures upon less differentiated ones. Significant phenotypic modifications crucially depend on changes in the regulation of gene expression during developmental stages, throughout a process considerably influenced by external (environmental) factors (see Gilbert 2001; Moczek et al. 2011). The interdisciplinary field of studies committed to rejoin evolutionary and developmental biology (evolutionary developmental biology: Burian et al. 2000; Arthur 2002) is based on a network of old and new concepts referring to further distinctive features of living beings, such as phenotypic plasticity (West-Eberhard 2003), modularity (Schlosser and Wagner 2004), evolvability (Kirschner and Gerhart 1998; cf. D'Ambrosio 2013b), among several others. The proponents of an extended synthesis also recovered relevant aspects of the original Darwinian conception, which have been almost neglected by neo-Darwinists. One example is the active role played by organisms in modifying the environment during their life span ("niche construction": see Odling-Smee et al. 2003), thus contributing to modify the biotic and abiotic conditions with which successive generations will have to cope.

All this is to say that, as far as living beings and evolution are concerned, what is ontologically conceivable as natural is far from having been settled once and for all. The elaboration of an ontology of biological systems can be seen as a work in progress accompanying the "evolution of evolutionary theorizing," starting from a Darwinian theoretical core to more and more integrative conceptualizations. And yet, we are somehow still scratching the surface of the phenomena at stake, especially with regards to the relationships linking the genetic, the epigenetic, and the phenotypic dimensions (cf. Robert 2004).

It is also worth recalling that the evolutionary perspective has been acknowledged as favoring renewed theological interpretations of the dynamism inherent in the created world (see for instance Haught 2010; Maldamé 2011; Russell 2011). Reflections concerning divine action and divine providence may be particularly stimulated by considering the directionality or "progress" that can be *a posteriori* ascribed to biological evolution (see Darwin 1905[1868], vol. I, 9–10). No finalism directs the evolutionary process, in the sense that phylogeny is not necessitated to follow a predetermined pathway toward a culminating *specific* result. Moreover, novel life solutions are usually formed by means of rearrangements of preexisting structural and functional motifs (continuity), rather than being generated from scratch (see Jacob 1977; cf. Fitch 2012; Colagè and D'Ambrosio 2014). Yet, despite context-dependency

and contingency (including a component of genuine chance), evolutionary transitions are accomplished according to constraints and regularities that we are beginning to properly understand. In the long time run, evolution brought about complexification of life forms with the emergence of species characterized by diversified functionalities and behaviors (discontinuity). Evolutionary directionality can be understood in terms of a spontaneous convergence toward *a range* of functional solutions (cf. Conway Morris 2003). The uniqueness of human higher cognitive faculties—through which human beings are indeed able to directly shape the world much more than any other biological species—does not contradict ordinary evolutionary dynamics, although deserving a very specific treatment as we will see later in some more detail.

A Heuristically Conceived Naturalism

The heuristic science-based naturalism (HSN) here proposed can be defined by the following principles:

(a) There are no *a priori* limitations to what can be intended as natural.
(b) Any natural phenomenon can find a sufficient explanation by means of natural causal factors.
(c) Coherent discontinuity: Natural phenomena should be addressed in their distinctive features with no violation of dynamics pertaining to other orders of physical reality.

HSN does not indicate the entities or the kind of causal relations embedded in the texture of the universe; clarifying these matters rather represents the enduring mission of the scientific enterprise supported by philosophical inquiries addressing ontological and epistemological issues. HSN neither excludes a supernatural influence upon the natural world nor denies that the comprehension of the world may be enlightened by theological reflections on the ultimate meaning of Creation. Similarly to MN, HSN only affirms that any phenomenon can be explainable in terms of finite causal factors sufficiently accounting for its manifestation. So, on the one hand, no phenomenon is in principle out of the reach of scientific investigations; at the same time, however, not all of the phenomena are in principle completely intelligible in the light of scientific investigations alone.

In this sense, HSN is not meant to lead, as the aforementioned conception of SN would likely do, to a stronger version of MN taking scientific methodology to be the only safe pathway to knowledge (Gregersen 2014, 108). HSN is rather closer to the view that Roy Wood Sellars proposed in his *Evolutionary Naturalism* (1922): a general direction of intellectual commitments to which different opinions can partake, a broad horizon of thought. Through this perspective, it is also possible to recognize both the relevance and the limits of scientific generalizations, so that one should

probably not worry so much about the issue of universal laws taken as "ideological constructs" (Gregersen 2014, 107). As it has been remarked, a physical law "captures essential features of a system but does not account for all aspects of dynamics in real examples"; the laws of invariance and conservation in physics "cannot predict how a real, complex, heterogeneous and open system will evolve over time" (Frank 2011, 2, 5). However, expressing in formal language the rate of change of certain parameters assumed to be relevant is not a secondary task in the scientific practice (cf. Auletta 2011, 27–28). General laws relative to certain orders of phenomena represent desirable outcomes of scientific investigations, which may turn out to be corroborated by the identification of specific causal mechanisms. Challenging problems may arise, for instance, as one considers systems in which parameters do not result correlated in a traditionally intended deterministic way, causal factors are poorly understood in their actual incidence, and/or random occurrences (having nothing to do with our ignorance) take place. In any case, the elaboration of theories delineating wide-ranging regularities followed by entire classes of phenomena, as well as attempts at envisioning an integrated worldview in the light of scientific knowledge, do not necessarily represent ideological operations, provided that they are not crystallized into dogmatic closures.

Critical Realism and Emergent Monism

The aspiration of human beings to understand the constitutive order of the world seems not renounceable. Western science used to be animated by a tendency toward universality and by the purpose of achieving a form of objective knowledge, without distortions due to individual prejudices. Philosophical efforts, like the epistemological debate recalled at the beginning of this paper, helped to assess the potentialities of the scientific enterprise. Advocates of scientific realism came to recognize that scientific theories cannot reflect, in all details, reality or portions of reality. A mirror-like picture of the natural world seems more a fancy than an ideal result to be accomplished one day or another. On the other hand, "science works": it is not an arbitrary creation of the mind, as it can be showed by the fact that we can effectively interact with the world and test the validity of theoretical constructs. Indeed, we can interact with portions of reality and obtain responses by employing technological means, which have been in turn designed and realized on the basis of successful scientific investigations—not to speak of the impact that current technological devices can have on other cultural activities, human societies, as well as ecological equilibria.

The connection between the knowledge that science can acquire about reality and reality as such may be seen as a matter of progressive achievements—rather than of reaching exhaustive accounts—accomplished through the aforementioned virtuous circle between theory

and experience, working hypotheses and experimental trials, tentative explanations and empirical evidence. These ideas are at the core of *critical realism*, which may be considered as the epistemological frame of HSN. Introduced by Roy Wood Sellars (1916), critical realism has been reevaluated in its significance by prominent scholars who, during the last fifty years, have contributed to make the science–theology debate an established field of studies (see Barbour 1966; Polkinghorne 1998; cf. McGrath 2001–2003, vol. II, 195–226; Auletta 2011, 44–46).

Let me deepen these issues a little bit. In the previous pages, it has been suggested that what is considered "natural" is related to the entities (and their correlations) assumed to exist in the background of scientific disciplines, and to which these disciplines, implicitly or explicitly, make reference. Does this suggestion open the door to a certain relativistic drift? One might think that the three principles of HSN merely refer to what scientists *believe* to be natural or true from time to time. The problem is to my mind related to the very possibility of obtaining dependable responses from the external world. If a mirror-like picture of reality is not what science can reasonably pursue, one may want to consider that also a completely pure observation of the world is a result not attainable. From the biological standpoint, human perception, like the perception of any other organism, is—I would say—*naturally selective and interpretative* with regard to the stimuli received from the environment. Moreover, observations are, to a certain extent, influenced by the cultural context in which each person is situated and in which he/she partakes. In the case of science, experimental surveys do not represent an exception, nor are they neutral: empirical investigations are biased by theoretical assumptions generating certain expectations, and an experiment is designed by individual scientists as an attempt to reproduce the conditions in which phenomena naturally occur, fixing parameters taken as relevant, excluding factors held to be responsible for the production of particular effects, and so forth. In addition, as said, scientists are sometimes brought to postulate theoretical entities whose existence cannot be directly shown because of the limited possibility of interacting with a certain level of reality and/or the insufficiency of technological means. Indeed, attesting the existence of hypothesized entities or causal connections might require several decades of research. "Atom" and "gene" are clear examples of initially postulated (and differently modeled) basic entities, successively observed and confirmed in their "natural status," and then increasingly studied in their composition and properties. Does this ongoing inferential/interactional process enrich our comprehension of the natural domain? The answer seems positive. In the perspective of critical realism, objective knowledge about nature is conceived by taking into consideration also the subjects actually involved in the research. It may be said that the progressive understanding of natural processes ultimately stems from the *specific relationality* of human beings,

allowing them to grow in the widest sense of the word: an intentional openness toward the other, including phenomena occurring in the external world. Here, "otherness" does not imply extraneousness, because it represents the pole of a mutual relationship dynamically engaged on a common ground. Let me suggest that such a ground is significantly provided by the natural origin and constitution of human beings.

In this sense, I think that philosophical and theological arguments in favor of a *substantial* separation between the mental and the physical may raise some perplexities. Besides the long-lasting controversy about the effective connection between mind and body, a strict dualist conception should be able to justify our grasping of reality—in the case of science, the correspondence between theoretical constructs, however incomplete and fallible, and the physical world existing *in its own right* (as also ON and MN assume). In line with what has been previously mentioned about complex causal relations (bottom-up/top-down) and in analogy with the third principle of HSN (coherent discontinuity), I am inclined to maintain that highly complex systems emerge from less complex ones with no ontological inconsistencies. I would thereby provisionally propose *emergent monism* (see Bracken 2004; Clayton 2004; Auletta 2011, 147–149) as the ontological frame of HSN. The realm of life cannot be entirely reduced to pure chemical-physical interactions: biological systems display peculiar features requiring a proper scientific treatment, as an assessment of the Darwinian theory can show. However, the biological is embedded in the physical, and without conformity to physical constraints the very preservation of any organized biological system, with all its specificities, would be impossible. *Mutatis mutandis*, the mental results are instantiated in the biological constitution of human beings; human-specific higher cognitive faculties are involved in the fulfillment of biological functionalities, and mental constructs as well as intentional purposes can have an actual impact on the external world only by means of a physical medium. The evolutionary emergence of human cognitive faculties seems plausibly related to epigenetically formed synaptic networks and to rearrangements of brain areas connectivity (Changeux 2012). Cognitive neurosciences are opening innovative pathways of research addressing the brain mechanisms *subserving* distinctive human features like consciousness, language, free will, emotions, and religious aspirations. In this respect, the contributions coming from comparative studies in evolutionary anthropology are worth mentioning as well (see, e.g., Di Vincenzo and Manzi 2013). A systematic understanding of human cognitive abilities is still far from being accomplished (cognitive neurosciences are even younger than modern biology), and we are rather in the presence of promising trends of investigation that could lead to extend, in the future, our comprehension of what is natural (cf. Colagè 2014).

Now, these scientific approaches neither necessarily imply a reduction of the mental to the biological, nor presuppose the existence of two separated principles completely different in kind. I would somehow transpose the terms of the problem in the perspective of *an integrated (not undifferentiated)* view of the dynamical human *nature*. This would require consideration of the indissoluble interdependency tying the "world" of meanings, reasoning, desires, and imagination, with the bodily dimension including the neural substrate of human-specific cognitive faculties. From this perspective, cultural processes which are not simply a direct consequence of the biological constitution of the species *Homo sapiens*, yet are capable of back-affecting the biological dimension, may be of particular interest. For instance, evidence has been found for arguing that symbolic cognition is a (relatively) recent acquisition notably postdating the first appearance of our species. The rearrangement of patterns of regulation of gene expression responsible for the evolutionary fixation of modern human brain anatomy seemingly provided the appropriate neural substrate for the emergence of symbolic cognition. Quite significantly, however, it seems that this potential has been exploited only successively, in relation to cultural innovations (Tattersall 2004, 2009). I also mention that, in parallel to the aforementioned recovery of developmental dynamics in the context of evolutionary biology, the old issue of human delayed development and "neoteny" (see Gould 1977, 397–404) has received renewed attention as well: trends in cognitive studies focus on the formation of human cognitive functionalities during post-natal stages of life, where interactions with the social and cultural environment play a crucial role and can bring about modifications in the functional organization of the adult brain. This represents a relevant point in the agenda of developmental cognitive neurosciences, another recent interdisciplinary field of studies aimed at providing a unified explanatory framework bridging the gap between different levels of empirical descriptions (neuronal or behavioral) and cognitive accounts relative to higher functions (Johnson 2011). Finally, I would like to stress the importance of studies addressing the specific modalities of human evolution, the results of which are also driven by cultural processes. According to "gene-culture coevolution," cultural practices can modify biotic and abiotic environmental conditions and significantly affect the rate of change of gene frequencies in human populations, thus biasing further evolutionary steps. Contextually, the proponents of gene-culture coevolution "view culture as a dynamic process that can shape the material world" (Laland, Odling-Smee, and Myles 2010, 138; see also Richerson, Boyd, and Henrich 2010).

A theological treatment of the embodied human person could benefit from a scientific anthropology focusing on the deep connections between the biological and the cultural dimensions. In order to promote such anthropological studies, a further "Darwinian maneuver," in the line of

coherent discontinuity, could be helpful. If Darwin elaborated a theoretical construct consistently with the then attained knowledge about the physical world (continuity), at the same time addressing the distinctive characters of living beings (discontinuity), it is now becoming possible to outline a conceptual framework addressing the human kind in its distinctiveness, consistent with what we are coming to understand about biological systems in general.

Scientific Knowledge, Divine Action, and *Imago Dei*

Finally, let me briefly stress two orders of considerations concerning how a critical appraisal of the scientific enterprise can be insightful for theological reflections on creation and human uniqueness.

First, restricting or anthropomorphizing conceptions of divine action can be forestalled by a certain confidence in the human capability of progressively understanding nature by means of scientific commitments, theologically justifiable according to the intelligibility of the created world. Even when scientific inquiries fail to achieve encouraging results—as has been recently emphasized with regard to the evolution of human language (Hauser et al. 2014)—the heuristic perspective sketched in these pages may lead us to acknowledge that, in principle, there are not insurmountable barriers, and particularly complex phenomena can be treated without recurring to punctual supernatural interventions. In criticizing naive "God of the gaps" conceptions, Dobzhansky emblematically wrote:

> Only *some* phenomena are *in part* understood, and the realm awaiting explanation is far greater. It is *precisely the unknown* that inspires scientists to press on their quest. There are people, however, to whom the gaps in our understanding of nature are pleasing for a different reason. These people hope that the gaps will be permanent, and that what is unexplained will also remain inexplicable. *By a curious twist of reasoning*, what is unexplained is then assumed to be the realm of divine activity. (Dobzhansky 1967, 13; italics added)

Indeed, if one only considers all aspects of reality which used to appear unfathomable but successively were showed to be explainable, together with the plethora of phenomena still calling for a scientific understanding, it would be pointless to relegate divine interventions to what science cannot account for in any epoch. Among other things, it would be in this way problematic, if not impossible, to rationally grasp the mentioned autonomy of secondary (finite) causation: an issue that, not by chance, is often disregarded in the context of the so-called Intelligent Design (ID). Neocreationist positions, including those claiming to take scientific methodology seriously ("scientific creationism"), tend to put in question human natural evolution and might even favor fundamentalist tenets (cf. Numbers 2010). Notably, the theologian John Haught emphasized how unfortunate

it is that some Christian denominations still consider it compulsory for educated people to accept literal interpretations of the biblical narrative concerning Adam and Eve and original sin. Contextually, Haught objected to the advocates of ID and creationism who claim that it is necessary to reject biological evolution for the sake of defending the notion of human dignity (Haught 2010). Apart from particular scientific matters, ID and similar conceptions regarding the relationship between the supernatural, the natural, and scientific knowledge seem to turn the entire problem upside down. Instead of seeing in what is still scientifically unexplained the room for supernatural interventions, one may realize that what humans come to know through scientific commitments can also allow for a progressive comprehension of the Word of God sustaining and empowering the natural world. For instance, Giuseppe Tanzella-Nitti (2010) suggests that, while respecting the core doctrinal lessons traditionally drawn from revelation, it is possible to take advantage of scientific achievements in order to obtain a riper understanding of revelation itself and of what being a creature in a created world means. Thus, I would conclude by saying that, on the one hand, HSN could grant the possibility of achieving a reliable and testable knowledge on the natural world without envisioning an all-inclusive *Weltanschauung* closed to the level of intelligibility that theology may enlighten. On the other hand, HSN could be a valid partner for a theology which recognizes itself as a work in progress as well, engaged in the tension between tradition and innovation (continuity and discontinuity) for the sake of clarifying the ultimate sense of what human beings learn through their experiences and endeavors, science included.

Second, I would like to hint at the extent to which an appraisal of the scientific enterprise has to do with the intrinsic worth implied in the notion of "human dignity." The point is to my mind strictly linked to the unique condition of human beings as "created co-creators" (Hefner 1993), particularly in relation to the cooperation that each person is called to provide in following God's will by means of a freely chosen, rational usage of the knowledge attainable about Creation (see Życiński 2006, 157). An assessment of the human capability of grasping the dynamics inherent in the created world may shed some light on the intertwinement between the structural, functional, and relational interpretations of the doctrine of *imago Dei*. Some authors have recently argued for a multifaceted approach to *imago Dei*, in which no aspect pertaining to personhood is set against the other (cf. Vainio 2014; De Smedt and De Cruz 2014). In the line of what has been suggested with regard to HSN, critical realism, and emergent monism, the distinctive human intellectual capacity (with reference to structural *imago Dei*) can enable an effective apprehension of the physical world since humans are intentionally open toward the other (relational *imago Dei*); this is quite clearly connected with the

role of stewardship over creation to which humans are called according to scripture (functional *imago Dei*).

Nevertheless, let me also add that, whatever interpretation of the *imago Dei* one chooses to emphasize, the critical consideration of scientific activity cannot exhaust the subject. As to the structural interpretation, being able to pursue a reliable and testable knowledge of the physical world does not represent the *whole* of rationality, and science is not, in general terms, the only source of intelligibility available to humans. With regard to the relational interpretation, the scientific enterprise can be seen, as said, as allowed by the human capacity of establishing a meaningful and participable relationship with the created world, so to eventually give rise to a "community of minds." Yet, much more remains to be said about the gist of the relational interpretation, that is, the capability of engaging an authentic relation with God, receiving His revelation within the historical dimension, and actively responding to it. The latter point brings us to the functional intepretation for which the relevance of the scientific enterprise seems more patent: how can we exercise a responsible care over something without understanding and knowing it as thoroughly as possible? Nonetheless, it may be worth considering not only that a human person can contribute to care of the created world even without scientific competences, but also that being a steward of creation demands moral commitments which are neither entailed in epistemological reasonings, nor apparently deducible from arguments regarding the ontological constitution of the world as such. Especially in relation to the pressing problems deriving from the effects of highly advanced technological devices on nature and on the human being itself, I would stress again that a scientifically informed integrated anthropology, focusing on the embodied human person, could offer invaluable contributions.

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References

Arthur, Wallace. 2002. "The Emerging Conceptual Framework of Evolutionary Developmental Biology." *Nature* 415: 757–64.

Auletta, Gennaro, in collaboration with Ivan Colagè, Paolo D'Ambrosio, and Lluc Torcal. 2011. *Integrated Cognitive Strategies in a Changing World*. Rome: Gregorian and Biblical Press.

Auletta, Gennaro, Ivan Colagè, and Paolo D'Ambrosio. 2013. "The Game of Life Implies Both Teleonomy and Teleology." In *Si può parlare oggi di una finalità dell'evoluzione?*, ed. Gennaro Auletta and J. Santiago Pons, 267–84. Rome: Gregorian and Biblical Press.

Auletta, Gennaro, Ivan Colagè, and Marc Jeannerod, eds. 2013. *Brains Top Down: Is Top-Down Causation Challenging Neurosciences*? Singapore: World Scientific.

Auletta, Gennaro, George Ellis, and Luc Jaeger. 2008. "Top-Down Causation by Information Control: From a Philosophical Problem to a Scientific Research Program." *The Journal of the Royal Society Interface* 5: 1159–72.
Ayala, Francisco J. 1970. "Teleological Explanations in Evolutionary Biology." *Philosophy of Science* 37: 1–15.
Barbour, Ian G. 1966. *Issues in Science and Religion*. Englewood Cliffs, NJ: Prentice-Hall.
Bracken, Joseph A. 2004. "Emergent Monism and the Classical Doctrine of the Soul." *Zygon: Journal of Religion and Science* 39:161–74.
Burian, Richard M., Scott Gilbert, Paula M. Mabee, and Billie J. Swalla, eds. 2000. "Evolutionary Developmental Biology: Paradigms, Problems and Prospects." *American Zoologist* 40:711–831.
Changeux, Jean-Pierre. 2012. "Synaptic Epigenesis and the Evolution of Higher Brain Functions." In *Epigenetics, Brain and Behaviour*, ed. Paolo Sassone-Corsi and Yves Christen, 11–22. Heidelberg: Springer-Verlag.
Chomsky, Noam. 1980. *Rules and Representations*. New York: Columbia University Press.
Clayton, Philip. 2004. *Mind and Emergence: From Quantum to Consciousness*. Oxford: Oxford University Press.
Colagè, Ivan. 2013. "Le scienze naturali e la filosofia della natura: Alcune riflessioni epistemologiche." In *Si può parlare oggi di una finalità dell'evoluzione*?, ed. Gennaro Auletta and J. Santiago Pons, 59–79. Rome: Gregorian and Biblical Press.
———. 2014. "Prospective Fruitfulness as a Criterion for Theory-Change and Research-Strategy Option." *Comprendre* 16(1):61–86.
Colagè, Ivan, and Paolo D'Ambrosio. 2014. "Exaptation and Neural Reuse: A Research Perspective into the Human Specificity." *Antonianum periodicum trimester* 89(2–3):333–58.
Conway Morris, Simon. 2003. *Life Solutions: Inevitable Humans in a Lonely Universe*. Cambridge: Cambridge University Press.
D'Ambrosio, Paolo. 2013a. "Oltre il meccanicismo? Darwin e la spiegazione funzionale/teleologica in biologia." In *Si può parlare oggi di una finalità dell'evoluzione*?, ed. Gennaro Auletta and J. Santiago Pons, 107–22. Rome: Gregorian and Biblical Press.
———. 2013b. "The Key Notion of Evolvability in the Framework of Evolutionary Developmental Biology." *ESSSAT News and Reviews* 23(4):5–19.
———. 2014. "Il dinamismo dell'evoluzione e l'evolvibilità del vivente." *Comprendre* 16(1):87–103.
Darwin, Charles. 1859. *On the Origin of Species by Means of Natural Selection or, The Preservation of Favoured Races in the Struggle for Life*. London: John Murray.
———. 1905 [1868]. *The Variation of Animals and Plants under Domestication*. London: John Murray.
De Smedt, Johan, and Helen De Cruz. 2014. "The *Imago Dei* as a Work in Progress: A Perspective from Paleoanthropology." *Zygon: Journal of Religion and Science* 49:135–56.
Dennett, Daniel. 1992. *Consciousness Explained*. Boston: Back Bay Books.
Depew, David, and Bruce H. Weber. 1995. *Darwinism Evolving*. Cambridge, MA: MIT Press.
Di Vincenzo, Fabio, and Giorgio Manzi. 2013. "Social Learning and the Origin of the Language Faculty by Means of Natural Selection." *Journal of Anthropological Sciences* 91:23–52.
Dobzhansky, Theodosius. 1967. *The Biology of Ultimate Concern*. New York: New American Library.
———. 1973. "Nothing in Biology Makes Sense Except in the Light of Evolution." *The American Biology Teacher* 35:125–29.
Drees, Willem B. 1995. *Religion, Science and Naturalism*. Cambridge: Cambridge University Press.
Ellis, George. 2005. "Physics, Complexity, and Causality." *Nature* 435:743.
Fitch, W. Tecumseh. 2012. "Evolutionary Developmental Biology and Human Language Evolution: Constraints on Adaptation." *Evolutionary Biology* 39:613–17.
Frank, Steve A. 2011. "Wright's Adaptive Landscape versus Fisher's Fundamental Theorem." In *The Adaptive Landscape in Evolutionary Biology*, ed. Erik Svensson and Ryan Calsbeek, 41–57. Oxford: Oxford University Press.
Giberson, Karl, and Mariano Artigas. 2007. *Oracles of Science: Celebrity Scientists versus God and Religion*. Oxford: Oxford University Press.

Gilbert, Scott. 2001. "Ecological Development Biology: Developmental Biology Meets the Real World." *Developmental Biology* 233:1–12.
Gilbert, Scott, and David Epel. 2009. *Ecological Developmental Biology*. Sunderland, MA: Sinauer.
Gould, Stephen Jay. 1977. *Ontogeny and Phylogeny*. Cambridge, MA: Harvard University Press.
Gregersen, Niels Henrik. 2014. "Naturalism in the Mirror of Religion." *Philosophy, Theology, and the Sciences* 1:99–129.
Harrison, Peter. 2007. *The Fall of Man and the Foundations of Science*. Cambridge: Cambridge University Press.
Haught, John F. 2010. *Making Sense of Evolution: Darwin, God and the Drama of Life*. Louisville, KY: Westminster John Knox Press.
Hauser, Marc, Charles Yang, Robert C. Berwick, Ian Tattersall, Michael J. Ryan, Jeffrey Watumull, Noam Chomsky, and Richard Lewontin. 2014. "The Mystery of Language Evolution." *Frontiers in Psychology* 5:1–12.
Hefner, Philip. 1993. *The Human Factor: Evolution, Culture and Religion*. Minneapolis, MN: Augsburg Fortress Press.
Hösle, Vittorio. 2011. "Why Teleological Principles are Inevitable for Reason: Natural Theology after Darwin." In *Biological Evolution: Facts and Theories*, ed. Gennaro Auletta, Marc Leclerc, and Rafael A. Martínez, 433–60. Rome: Gregorian and Biblical Press.
Jablonka, Eva, and Marion J. Lamb. 2006. "Evolutionary Epigenetics." In *Evolutionary Genetics: Concepts and Case Studies*, ed. Charles W. Fox and Jason B. Wolf, 252–64. Oxford: Oxford University Press.
Jacob, François. 1977. "Evolution and Tinkering." *Science* 196:1161–66.
Johnson, Mark H. 2011. "Interactive Specialization: A Domain-General Framework for Human Functional Brain Development?" *Developmental Cognitive Neuroscience* 1:7–21.
Kirschner, Marc, and John Gerhart. 1998. "Evolvability." *Proceedings of the National Academy of Sciences of the United States of America* 95: 8420–27.
Kuhn, Thomas. 1962. *The Structure of Scientific Revolutions*. Chicago, IL: University of Chicago Press.
———. 1977. *The Essential Tension*, Chicago, IL: University of Chicago Press.
Laland, Kevin N., John Odling-Smee, and Sean Myles. 2010. "How Culture Shaped the Human Genome: Bringing Genetics and the Human Sciences Together." *Nature Review Genetics* 11:137–48.
Laland, Kevin N., Tobias Uller, Marc Feldman, Kim Sterelny, Gerd B. Müller, Armin Moczek, Eva Jablonka, and John Odling-Smee. 2014. "Does Evolutionary Theory Need a Rethink?" *Nature* 514:161–162, 164.
Lennox, James G. 1993. "Darwin *Was* a Teleologist." *Biology and Philosophy* 8:409–21.
Lewontin, Richard. 2002. *The Triple Helix: Gene, Organism, and Environment*. Cambridge, MA: Harvard University Press.
Maldamé, Jean-Michel. 2011. "The Various Meanings of the Word 'Evolution' in Science, Philosophy, and Theology." In *Biological Evolution: Facts and Theories*, ed. Gennaro Auletta, Marc Leclerc, and Rafael A. Martínez, 557–71. Rome: Gregorian and Biblical Press.
Mayr, Ernst. 1988. *Toward a New Philosophy of Biology*. Cambridge, MA: Harvard University Press.
McGrath, Alister. 2001–2003. *A Scientific Theology*. London: T&T Clark.
Moczek, Armin P., Sonia Sultan, Susan Foster, Cris Ledón-Rettig, Ian Dworkin, H. Fred Nijhout, Ehab Abouheif, and David W. Pfennig. 2011. "The Role of Developmental Plasticity in Evolutionary Innovation." *Proceedings of the Royal Society B*. doi:10.1098/rspb.2011.0971
Numbers, Ronald. 2003. "Science without God: Natural Laws and Christian Belief." In *When Science and Christianity Meet*, ed. David C. Lindberg and Ronald Numbers, 265–85. Chicago, IL: University of Chicago Press.
———. 2010. "Scientific Creationism and Intelligent Design." In *The Cambridge Companion to Science and Religion*, ed. Peter Harrison, 127–47. Cambridge: Cambridge University Press.
Odling-Smee, John F., Kevin N. Laland, and Marcus W. Feldman. 2003. *Niche Construction: The Neglected Process in Evolution*. Princeton, NJ: Princeton University Press.
Pigliucci, Massimo. 2009. "An Extended Synthesis for Evolutionary Biology." *Annals of the New York Academy of Science* 1168:218–28.

Polkinghorne, John. 1998. *Belief in God in an Age of Science*. New Haven, CT: Yale University Press.
Quine, W. V. 1969. "Ontological Relativity." In W. V. Quine, *Ontological Relativity and Other Essays*. New York: Columbia University Press.
Richerson, Peter J., Robert Boyd, and Joseph Henrich. 2010. "Gene-Culture Coevolution in the Age of Genomics." *Proceedings of the National Academy of Sciences* 107:8985–92.
Robert, Jason Scott. 2004. *Embryology, Epigenesis, and Evolution*. Cambridge: Cambridge University Press.
Rosenberg, Alexander. 2007. "Reductionism (and Antireductionism) in Biology." In *The Cambridge Companion to Philosophy of Biology*, ed. David L. Hull and Michael Ruse, 120–38. Cambridge: Cambridge University Press.
Ruse, Michael. 2005. "Darwin and Naturalism: Identical Twins or Just Good Friends?" In *Darwinism and Philosophy*, ed. Vittorio Hösle and Christian Illies, 83–91. Notre Dame, IN: University of Notre Dame Press.
Russell, Robert J. 2011. "Theological Debates around Evolution." In *Biological Evolution: Facts and Theories*, ed. Gennaro Auletta, Marc Leclerc, and Rafael A. Martínez, 645–63. Rome: Gregorian and Biblical Press.
Schlichting, Carl D., and Massimo Pigliucci. 1998. *Phenotypic Evolution: A Reaction Norm Perspective*. Sunderland, MA: Sinauer.
Schlosser, Gerhard, and Günter Wagner, eds. 2004. *Modularity in Development and Evolution*. Chicago, IL: The University of Chicago Press.
Sellars, Roy Wood. 1916. *Critical Realism: A Study on Nature and Conditions of Knowledge*. New York: Rand McNally.
———. 1922. *Evolutionary Naturalism*. Chicago, IL: Open Court.
Sellars, Wilfrid. 1963. *Science, Perception and Reality*. London: Routledge.
Sober, Elliott. 2011. "Why Methodological Naturalism?" In *Biological Evolution: Facts and Theories*, ed. Gennaro Auletta, Marc Leclerc, and Rafael A. Martínez, 359–78. Rome: Gregorian and Biblical Press.
Stanzione, Massimo. 2011. "The Recurrent Debate: Darwinism and Philosophy." In *Biological Evolution: Facts and Theories*, eds. Gennaro Auletta, Marc Leclerc, and Rafael A. Martínez, 379–400. Rome: Gregorian and Biblical Press.
Taliaferro, Charles. 2014. "Is Naturalism Too Big to Fail? An Audit of Strict and Broad Naturalism." *Philosophy, Theology: and the Sciences* 1:87–98.
Tanzella-Nitti, Giuseppe. 2010. "The Influence of Scientific World View on Theology: A Brief Assessment and Future Perspectives." In *The Relationships between Science and Philosophy: New Opportunities for a Fruitful Dialogue*, ed. Gennaro Auletta, 131–54. Vatican City: Libreria Editrice Vaticana.
Tattersall, Ian. 2004. "What Happened in the Origin of Human Consciousness?" *The Anatomical Record* 276B:19–26.
———. 2009. "Human Origins: Out of Africa." *Proceedings of the National Academy of Sciences* 38:16018–21.
Vainio, Olli-Pekka. 2014. "Imago Dei and Human Rationality." *Zygon: Journal of Religion and Science* 49:121–34.
Waddington, Conrad H. 1942. "The Epigenotype." *Endeavour* 1:18–20.
Waters, C. Kenneth. 2003. "The Arguments in the *Origin of Species*." In *The Cambridge Companion to Darwin*, ed. Jonathan Hodge and Gregory Radick, 116–39. Cambridge: Cambridge University Press.
West-Eberhard, Mary Jane. 2003. *Developmental Plasticity and Evolution*. Oxford: Oxford University Press.
Życiński, Józef. 2006. *God and Evolution: Fundamental Questions of Christian Evolutionism*. Washington, DC: The Catholic University of America Press.