

The Unity of Biological Systems in Polo's Philosophy

Juan José Sanguinetti
Pontifical University of
the Holy Cross (Rome, Italy)
sanguinetti@pusc.it

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ABSTRACT: Life as self-organization is philosophically understood by L. Polo in terms of co-causality between matter, formal configuration and intrinsic efficiency. This characterization provides a dynamic account of life and soul, capable to explain both its identity and its continuous renovation. In this article I especially highlight in this author the metaphysical notions of finality, unity and cosmos, which may be helpful to understand the sense of biological systems in the universe.

KEYWORDS: Life, Living systems, Soul, Co-causality, Unity of life, Final cause, Unity of order, Universe.

1. THE SOUL IN LIVING BEINGS IN POLO'S METAPHYSICAL PERSPECTIVE

This paper aims to present Leonardo Polo's philosophical account of life and to relate this insight to the problem of the unity of life in the universe. The first point is, in general terms, well-known by Polo's scholars. I devoted to it an article focused on self-movement and growth as the essential features of life in Polo's view (Sanguineti 2009). The initial approach followed by Polo in this topic is fairly methodological. The main concern is to avoid a too easy objectivist view of the soul, an approach which Polo considers to be confined in which he calls the "limit" of our thought. The second point, perhaps not fully developed in Polo's writings, is the problem of the unity of life within the context of the universe. I try to get an insight on this issue with the help of the notion of the order of the universe, which according to this author completes the definitive essence of natural beings.

The problem addressed by Polo represents a genuine philosophical attempt to attain the essence of life. The phenomenon of life can be studied by biological sciences or by a philosophical biology. Both perspectives are mutually linked and are not always easily distinguishable at a certain level. Scientific biology follows the traditional experimental method, which was fully successful in natural sciences. This approach enables to get an understanding of many basic aspects of living beings, such as their molecular structure and functions, their thermodynamic features, functions as growth and reproduction, and so on. Specific concepts, such as biological functions, self-organization, homeostasis, metabolism, complexity, information control, became indispensable to understand the emergent characteristics of life. They surpassed the epistemological framework of classical physics and chemistry. As a result, biology in the twentieth century was no longer the merely descriptive second-order science which seemed imperfect in the nineteenth century when compared with the analytical approach typical of classical physics. Life sciences, together with ecology and Earth sciences, created a new scientific paradigm that could not be assimilated by the alleged rational perfection of physics.

Philosophy of biology, being a part of the philosophy of nature, can be introduced in this area inasmuch as some essential questions are addressed to the problems involved in biological scientific ap-

proaches. Some traditional questions refer to the basic criteria necessary to define life and to conceptually distinguish it from inanimate bodies and machines, and of course to many other related topics (the problem of the soul, the nature of species, etc.). New problems are posed facing the modern evolutionary comprehension of life and the challenge represented by the technological possibilities of manipulating life not only in individuals but also in the whole biosphere¹.

The classical metaphysical view on life goes back to Aristotle (*De Anima*). This tradition, renewed by many Neo-Aristotelian and Thomistic authors, does not renounce to the notion of soul as the intrinsic principle of natural life². A fundamental meta-empirical dimension in living beings – the soul as a substantial act – is not necessarily incompatible with the scientific approach to life. The act of the soul is understandable as an ultimate substantial principle of organization of organic matter (Aristotle, *De Anima* 414 a 12-15). It can be rendered intelligible in the context of the hylomorphic framework of the Aristotelian philosophy of nature. The soul is necessary to explain the coherence, unity and specificity of biological operations such as self-organization, growth, self-conservation, and the specific identity of living organisms³.

Contemporary objections against the consistency of the soul/body duality characteristic of living beings usually arise from the modern prejudice against the recourse to forms or to the essence as an explanatory principle of things, which was normal in the Platonic and Aristotelian traditions. The prejudice has a long history which I will not tackle in this paper. In current biological and neurobiological literature, the appeal to the soul seems equivalent to dualism and vitalism, which are positions with a very bad reputation in many scientific and philosophical circles. Dualism, ascribed to Platonism and

¹ For some central views in the contemporary philosophy of biology, cf. Ayala and Arp (2009); Bertolaso (2013); Garvey (2007); Godfrey-Smith (2014); Griffiths (2014); Hull (1974); Hull and Ruse (1998); Hull and Ruse (2007); Rosenberg and McShea (2008); Ruse (2007); Sarkar and Plutynski, (2008); Schrödinger (1994); Sober (1993); Weber (2009).

² See Boylan (2005); Caston (2006); Jonas (1982); Lennox (2001 and 2014); Mercado (2013).

³ Cf. Frede (1995); Nierderbacher and Runggaldier (2006, especially the articles by U. Voigt, E. Stump, M. Schark, M. Liske and E. Runggaldier).

Cartesianism, is often caricaturally depicted as the position that conceives the soul as a kind of gratuitous immaterial thing embodied in a piece of matter, useful for a comfortable *a priori* explanation of living functions.

The philosophy of Leonardo Polo acknowledges, in my view, the rationalistic trend that aims to reduce things to human concepts or models or, more philosophically asserted, to reduce beings to the way in which we understand them. The form or essence of things, as represented by our intelligence, is not exactly as it is realized in the real or extramental thing. To build representations or models of things is characteristic of the methodology of sciences, but it is problematic as a genuine philosophical method. Now, the soul or the substantial form as a target of criticism in current philosophy of mind is imagined as an object framed by the human mind to remain free from further research in more detailed explanations, especially in the empirical and operational field. Sometimes the soul is seen as a meta-empirical – therefore, invalid – notion in science, though many concepts used in natural sciences, such as consciousness, Self or mind in neurobiology, are meta-empirical as well.

Polo's philosophical method of abandoning the limit of the human thought faces this problem⁴. His interpretation of the soul, which is mainly Aristotelian, rejects the representation of the soul as a kind of pure act present in the organism. Rather, the soul is to be seen in the context of the Aristotelian four causes, understood as co-causally interacting. To imagine the soul as a special act present in the body corresponds to the philosophical position called vitalism⁵. Vitalism, as dualism, is a too quick philosophical conclusion that tries to

⁴ The problem arose in the late Scholasticism that gradually transformed Metaphysics into Logic, in the sense that the metaphysical issues were faced using simple logical procedures (definitions, distinctions, classifications). The rationalistic reaction against the Scholastic method increased the recourse to the human thought, instead of going to the core of things. This method was successful in natural sciences, but was deleterious in philosophy. I cannot follow these points in these pages, though I think they represent the main motivation of Polo's philosophy.

⁵ Cf. Polo (2004, 205 and, more extensively, 199-208): life cannot be captured in terms of objective thought. The translations from Polo are mine.

give a reason for life just by attributing to living beings the presence of a special form⁶.

I am not going to reproduce in this paper the whole Polian approach to life and soul, which can be consulted in his books, particularly in the fourth volume of his *Curso de teoría del conocimiento* (2004). My main interest here is to present some considerations regarding the unity of biological systems on the earth, but let me previously remind the central Polian insight on the soul, precisely to avoid a characterization of this principle “within the limit of thought” (=objectivism, representationalism), which is typical, as I said above, of the caricatures of the soul framed in the usual criticisms against vitalism and dualism.

A very well-known thesis in Polo’s writings on this topic is the combination of the formal principle with efficiency according to his characterization of life in plants and animals (*cf.* Polo 2004, 206-208). This thesis is in agreement with the usual view of life as self-organization, and is the correct interpretation of the classical Aristotelian account of living beings as self-moving substances.

Obviously, organisms receive external inputs –actions from agents– which come forth from the environment. These inputs produce various kinds of alterations in the dynamism of the living being. However, a purely external causation is not responsible for typical vital operations such as nourishment or development. It can only be fully responsible for negative consequences, such as illness or death. The environmental inputs are received as material elements – physical and chemical energy – that are assimilated by the internal functional structures of the organism. Thus, vital movements are *formalized* and *organized* movements. They are the result of the co-causal action between the formal and the efficient cause, as well as between those two principles and the material cause (*Cf.* Polo 2004, 199-333).

Polo calls living beings *three-causal* substances and not merely *bi-causal*, since the latter do not incorporate movements as an intrinsic feature controlled by the substance and addressed to the fulfilment of some special tasks existing for the sake of the very substance. There-

⁶ This form is rather the result of the operation of abstraction, just as we can simply say that living beings can live because they have a special form called “life”. To think in terms of this operation means, in Polo, to remain inside the “limit” of our thought.

fore, living beings cannot be understood as purely hylomorphic substances. “If the efficient cause is intrinsic, the substance is three-causal and not hylomorphic. This is typical of the living body” (2004, 194).

Now, this three-causal consideration of the living being corresponds exactly, according to Polo, to the soul as the vital principle⁷, something different from conceiving it as pure formal cause. “The formal cause as co-causal with the efficient cause is called soul. The soul is not a formal cause, but co-causality of formal cause and intrinsic efficient cause, differently from what happens in the transitive movement” (Polo 2005, 153) (the movement typical of non-living beings).

It could seem that finality should be considered as well as co-causal in relation to the complex and dynamic structure of the organism. Indeed, we speak of living beings in terms of self-preservation and self-regulation. The very word “organism” etymologically alludes to the fact of being an instrument, i.e. something which is defined in terms of service to some end. The anatomic parts of the organism are organs, that is, members of a whole and not simply parts of the whole.

According to Polo, however, finality is not properly or completely intrinsic to the organism, since it is generated from the general system of life. Even in this level finality cannot be seen as completely *possessed* by organisms and species, because otherwise we should be inclined to conceive the living being as conscious. “The object which is known is a possessed end, but not a final cause” (Polo 2005, 158).

In Polo’s view, cognition alone involves a *full* possession of the end and, therefore, a perfect praxis. The possessed end is what is actually known as the object of immanent operations, in the Aristotelian sense of immanence. This aspect, though rather subtle, preserves the potential condition of living beings. To imagine the living being

⁷ This characterization refers to the soul of plants and animals. The human soul, being spiritual, corresponds to what Polo calls “added life” (the human person created by God) inasmuch as is joint to the “received life” (the human body generated through biological reproduction). This does not mean that the human soul is the person. I cannot develop these points in this article. For more details, see J. I. Murillo (2014, 84-86).

as a fully actual substance would imply conceiving it as an intentional object, i.e. as possessing the actuality of things when they are formally present in the intellect, and therefore would imply identifying reality or being with our human way of representing it. This means to lose, due to the abstract condition of the object of thought, the dynamic characterization of life, which cannot be objectified by concepts and representations.

Polo generally claims that the final cause is *extrinsic* to living beings and ultimately coincides with the entire order of the universe, which is conceived not as something pursued, i.e. as the object of a tendency –which would be vitalism–, but as the simple yet marvelous realization of the cosmological order as such.

Even so, I think that the co-causality between finality and the three-causal account of living beings could be considered in some way –not cognitive nor fully possessed– as intrinsic to living beings. Polo writes: “The internal distinction of the vegetative formal cause, in agreement with the functional diversity, is co-causal with the final cause as an ordered difference” (Polo 2004, 218). The final cause in Polo is the realization of the cosmological order, which entails a conjugation between the cosmic unity and the differences (the formal differences). “It can be proposed that the living being, as a substance, is potentially three-causal, but this potentiality would be impossible without the concurrency of the ordering cause (final cause)” (Polo 2004, 261).

Nevertheless, I am convinced that in a certain sense living beings, inasmuch as they are not completely “transitive”, since they manifest some degree of immanence, can be considered as having an intrinsic teleology, which is neither cognitive nor absolute or actual, but rather potential (*cf.* Polo 1985, 173-177). Moreover, animals, to the extent that they are cognitive living beings, manifest an intentional inclination to ends, i.e. goal-directed actions, for example when they pursue preys, and they also exhibit a weak possession of ends, since they have pleasures and sensitive satisfactions⁸. The *full* possession of the end,

⁸ Polo does not clearly develop this point. In my opinion, it is open to discussion. See 2004 (227-239), especially for the interesting distinctions between cognitive praxis in animals and ends of the sensitive nature (“the end of sensitive nature is not the end of its cognitive praxis”: p. 227), and also regarding the function of tendencies and desires as a consequence of that distinction (“the difference between the end of the

rather, is proper to the act of thinking of an object, which is the *perfect* immanent operation.

Additionally, an explanation of the intrinsic relationship between final and efficient cause can be found in Polo's article *La cibernética como lógica de la vida* (2002). Sensitive knowledge is explained by Polo in terms of what he calls "formal leftover" (*sobrante formal*), a concept that could be related to the Scholastic notion of *immateriality*. Accordingly, the cognitive dimension of animals is situated over the purely organic dimension and does not correspond entirely to the Polian philosophical physics (causal physics). Cognitive operations – even sensations– are not movements towards a not yet possessed end, but are, instead, the possession of the end, which Polo carefully distinguishes from causal processes and ultimately from the final cause (*cf.* 2004, 239-255). Knowing is not causal because it surpasses the kinetic order. To see presupposes some physical movement, but is not a movement towards something beyond it. It is the actual possession of a form (immanent act): the representation viewed.

Let us consider another aspect of the internal formal-efficiency-in-matter (three-causal substances=living beings). The intrinsic efficiency does not come out from one single element of the living body. It is rather a *conjoint efficiency* integrated by several coordinated efficient elements which contribute to the correct functioning of the organism. Their reciprocal action constitutes a systemic framework. So efficiency in life can be understood in the light of systems and hierarchical levels (*cf.* Polo 2004, 260-283). Moreover, the conjoint and formalized/organized efficiency is always *in fieri*. It is never finished, and therefore it cannot be conceived as something fully and definitely constituted. It is all the time in action, creating many feedbacks in relation to endogenous and exogenous variable inputs, and it is distributed and organized throughout the organism's various levels. Complexity and self-organization are explained according to this integrated and never closed causal account of vital dynamism.

The conjoint and formalized efficiency does not generate a full outcome. It is rather continuously renewing the organism, according to Polo's characterization of the living being as an *incessant renova-*

faculty and the final cause of the animal nature confers to the tendency the character of desire": p. 228).

tion or as *an incessant starting again and again* (2004, 331 footnote 30). Every part of the organism –cells, tissues, organs–, in very specific ways, contributes to the organism’s particular internal modifications that are required for the fulfilment of the vital functions, taking into account the required energetic payoff.

I close this summary of Polo’s central point of his philosophy of biology with a remark regarding the relationship between the physical inanimate cosmos and the biosphere. The cosmic cycles, though maintaining the stability of the universe to the extent that they can, are not typical of vital cycles⁹. Rather, the latter are added to the inanimate bodies and to their large cosmological cycles. But life cycles on earth require another sense of unity and preservation which we consider in the next section of the article. Organisms use the energy provided by the physical universe, but they are not energy machines. They are essentially self-maintaining substances and self-maintaining species that contribute to the higher level of the order of the universe. They are not eternal, as Aristotle erroneously thought. Living substances and species become destabilized due to the occurrence of many factors which are an aspect of the cosmological contingent order. They succeed within a certain time –internal time– to “formalize” the energy received from the environment. They perform this task in terms of the vital co-causality typical of the three-causal substances. On creating an internal time, they absorb the delay originated from the material cause¹⁰.

⁹ These cosmic cycles and their underlying physical dynamisms are what Polo calls the *circular movement*. This is a cosmological dynamic formal feature that provides an order to the physical universe in attention to its final cause. Polo is inspired, in this respect, in the Aristotelian circular cosmic movement. He attempts to preserve this intuition in the modern cosmological view (*cf.* 2005, 158-162).

¹⁰ *Cf.* J. J. Sanguinetti (2010, 39-40); Polo (2004, 614). Accordingly, “the temporal precedence indicates its co-causal character as a delay. The interval between praxis and delay of the praxis is the desire” (Polo 2004, 310), naturally in relation to animals, not in plants. As a general principal, “the material cause causes delaying” (Polo 2004, 319).

2. THE OVERALL SENSE OF LIVING SYSTEMS

Let us now turn to the main point of this paper, i.e., the unity of the different biological systems (substances, species, groups of species, degrees of life). Obviously life is not present in the universe as a mere dynamic harmony between formal structures. Harmony rather belongs to the inanimate cosmos (galaxies, stars, planetary systems). Life on earth –there would be no problem if life were also present in other parts of the universe– is a large proliferation of organisms and species in an ever growing evolutionary drive, within a dynamic but contingent physical scenario¹¹. The fundamental feature for the comprehension of the unity of life on earth is clearly evolution. Organisms and species are genetically linked. They constitute an arborescent genealogical chain which again and again goes back to common ancestors.

Evolution explains many things, but at the same time must be explained. To say that something is originated from something through certain mechanisms, laws and principles, is a part of the story. The philosophical question attempts to make sense of structures and evolution. The essence of the universe, as the essence of life, cannot be sufficiently explained through the narration of a story, even if the story is true. Human history, likewise, does not explain the essence of the human being.

The genuine philosophical interest is addressed to finality, and in this case to the finality of life. This can be conveyed through a very simple expression: to make sense. What is the sense of life in the universe? The answer cannot be given *a priori*, but must emerge from observation and reflection. Life is a very special topic when the problem of sense is raised, because it seems to be an end in itself, a value in itself, i.e., not a pure function of something else. Finality appears when something deserves to be preserved. Every living being attempts to survive and struggles to maintain its life. So we can conclude that, at least at a certain level, life is like a treasure. It is something valuable, something that we humans would desire to find in many regions of the universe and to preserve wherever it flourishes.

The unity of life in the biosphere is understood by Polo in terms of *propagation*. Propagation, more generically, is also present in the

¹¹ For proliferation, evolution, and life, cf. Polo 2004 (2004, 234-236).

inanimate universe regarding the communication of unity to the plurality of beings, which is contemplated at the level of the circular movement. This circularity, as we have seen¹², confers to the universe its unity of order, not to be confounded with a substantial unity. Now, life is everywhere communicated by way of generation or evolution to countless single units and systems in the earthly environment (and perhaps elsewhere).

The communication of life considered at the level of the universe –i.e. the biosphere situated in the cosmological environment– is an efficient factor to be taken, according to Polo, in co-causality with the final cause, which ultimately is the overall order of the physical universe¹³. Life propagation keeps also a co-causal relationship with the formal cause of life, which at this level of consideration is called *light* by Polo.

However, light here is not the physical or cosmological light (photons). Life –using an analogy– is like light in the sense that it is propagated, received, and emitted by the receptors –the three-causal substances– just to be continued throughout the propagation. Polo uses the term “light” to mean an intrinsic reception of life in the new entities which are the terms of life propagation, just as the sense of sight intrinsically incorporates the cosmological light –physical information– in a higher way, i.e. as light as seen by the viewer (*cf.* Vanney 2008, 242-247; García 2009). Thus, Polo calls *propagation* the communication of the unity of order to the biosphere, while *light* means here the formal cause, i.e., life in itself (*cf.* 1984, 245-247; 2004, 319 –footnote 24– and 513-522; 2008, 447-451).

Propagation is the link between the order of the universe and living beings. It manifests the measure of the intervention of the final cause in the universe. In evolutionary processes this measure is constantly increased¹⁴. So the universe, as far as it evolves in its earthly propagation, even if this happens only in a little spatial part of the cosmos, becomes formally amplified¹⁵. Nevertheless, it never reaches

¹² *Cf. supra*, footnote 9.

¹³ “The final cause is the unity or order of the universe” (Polo 2004, 184).

¹⁴ Accordingly, “to live is not only to survive, but to improve” (*perfeccionarse*): Polo 2004 (211, 299-230).

¹⁵ Evolution can be seen, in this respect, as a *hyper-formalization* (*cf.* Polo 2004, 234-

a final term, which is unthinkable in a physical frame¹⁶. In this sense, “evolution is a growing degree of the accomplishment of the final cause, not complete” (Polo 2003a, 131). Physical substances cannot support a full possession of finality. As we said above, only immanent cognitive operations attain or, better, *are* the full possession of the end. In this sense, cognitive beings are situated above the hylomorphic cycles.

Physical substances, including plants and animals, tied to the material order, are a constant reserve of potentialities that will never be accomplished in a total way. In Polo’s view, there is not a final end for evolutionary processes. This does not mean a privation of teleology. It only means that the sense of evolution is fully shown only when we consider the co-causal four causes which constitute the essence of the entire physical cosmos.

The universe is an open essence. It is a perennial reserve of potentialities in relation to the act of being. This is the sense assigned by Polo to the Thomistic distinction between essence and *esse*. The order of the universe, i.e., its final cause, co-causal with the other three senses of causality, is potential regarding the act of persistence, i.e. the non-contradictory existence, apprehended as a first principle through a metaphysical insight (*cf.* Polo 2004, 320-333 and Polo 1993). I presuppose these aspects of Polo’s thought, very well known to the readers of his writings.

3. THE UNITY OF LIFE IN EVERY SPECIES AND THROUGHOUT ALL THE SPECIES

Let us turn to the unity of life in more detail, not completely explicit in Polo in all the points I will mention in this section, but consistent with his philosophical view.

Unity is an essential feature of life. “Unity and life may be converted: the more something is alive, the more it is one. Inversely, going against unity leads to death or to an inferior vital level” (Polo 2004, 200). Growing, in a biological sense, means to “incorporate the

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¹⁶ For the concept of increasing measure of order as a key to understand evolution, see Polo (2004, 631-632), and C. Vanney (2008, 284-289).

improvement typical of the unity” (Polo 2004, 200). According to Polo, growing is the main feature of life¹⁷ (even more than self-movement), but only in terms of unity and improvement, not as a mere quantitative accumulation (*Cf.* Polo 2004, 211-225). It has a stop in the single organism, but it is prolonged in the species and in evolution. Its utmost realization is found in the human person, who can always go beyond his or her deeds and give himself or herself more and more: “the living being that never stops growing, though organically entering the process of wearing and aging, he who can grow until death, is the human being” (Polo 2004, 201; *cf.* 1999 and 2006). Living growing in the universe is regulated by the final cause, i.e. the unity of order of the entire cosmos.

We can now consider two aspects of the unity of life in the universe: the unity of the individuals within the species (intraspecific unity), and the unity of the species within the entire biosphere (interspecific unity)¹⁸.

First, it is not too difficult to acknowledge *the essential and quasi-organic unity of any species*. Organisms are clearly unified systems, subdivided in many subsystems –their functional parts–, but also species constitute a strong kind of unity, though not substantial. Sometimes the division of tasks, typical in living systems, is distributed in different kinds of individuals within a single species. Consider, for instance, the division of males and females, which in this respect are like organic members of the same species. This characteristic notoriously happens in species that are very socialized, like bees and ants, not only for sexual ends, but also for many other biological tasks.

Even if species are not substances, because they are instantiated in many individuals which express the potentialities of the species, the survival of the species over time, in the biological teleology, is a much more important intrinsic finality than the mere survival of single individuals. Therefore, species are more important than individuals¹⁹.

¹⁷ “The main function of the living being is to grow. More than a special operation, growing is the primary feature of the different degrees of life” (2004, 200).

¹⁸ For the relationship between living beings and the universe, *cf.* Polo 2004 (306-320).

¹⁹ “The intraspecific plurality does not exhaust the living species. Accordingly, the species is neither a general idea, nor the numerical set of living beings. But the

The latter exist for the sake of the former. Nonetheless, species are not eternal. Rather they constitute a stable and partial end which is subject to many environmental constraints, as it is shown in reproduction and ecological adaptation. Species are eventually subject to extinction. Therefore, they are contingent, as are all the physical entities of the universe.

Secondly, we can consider *the unity of life throughout the interspecific domain*. Different species coexist in ecosystems within an evolving framework, without displaying a special plan regulated by a central system. There is nothing “central” governing the biosphere. The only unity between individuals belonging to different species, even if expressed in many forms of competition and collaboration, is the weak unity of a network that can be described as a very special self-regulated system or as a complex adaptive system.

Though the unity exhibited between the different species is not organic, it is not subject to pure chance. It is not a purely accidental unity. It is contingent and dependent on many environmental variables. Neither species nor ecosystems are ever stable (Polo 2004, 309). This point implies that the increase of order in the evolutionary process is not unidirectional, or that it does not follow an univocal progressive direction. New advantages usually involve unexpected disadvantages. Yet, the emergence of new properties contributes to the improvement of the biosphere. Lastly, we are able to describe many different levels of life in hierarchical terms, with higher and lower properties and capacities (*cf.* Piá 2001).

The essential point here is that life ultimately is shown not as a mere multiplication of species, but as a very big, dynamic and contingent super-system, incorporated to the physical universe. Despite its apparent spatial smallness, this super-system constitutes the best part of the order of the universe.

4. THE POTENTIAL (IM)PERFECTION OF THE UNIVERSE AS A UNITY OF ORDER

Reserving many potentialities, the universe is ever open to new forms of organization. Its formal unity is not complete or closed. This

species is *reconstituted* in them through their capacity of growing” (Polo 2004, 309).

point does not mean that Polo's philosophy of nature shares the Epicurean cosmology of the infinite universes, renewed in some modern cosmologies, for example in Andrei Linde²⁰.

The consideration of the material cause isolated from the other causes, especially from finality, leads to the idea of matter as pure indetermination never exhausted. To see the universe as grounded in a sheer indetermination open to all the possibilities –like an infinite abyss– produces in humans what Polo calls *fascination* (cf. 2004, 312-313). It is a sort of sentiment attributed to certain forms of naturalism or pantheism. Polo assigns it to some visionaries of the Renaissance, for example Giordano Bruno, who imagined the universe as an immense laboratory, mixing mechanism with a vitalistic fervour (cf. 2004, 312-313).

On the contrary, matter, i.e. the material cause, though never exhausted in itself, cannot be considered as such, i.e. it cannot be thought as separated. It is rather “exhausted” (*agotada*) or completed by the final cause²¹. The unity of order of the universe is precisely what completes the entire network of the different natural substances and systems of the physical world. “The final cause is the unity of the universe, and the unity of the universe is precisely its order” (Polo 2008, 422). As seen before, this order cannot be conceived as an object, a perfect *enérgeia*. In this sense it is not a possessed end of the universe (cf. Polo 2008, 422).

At this level of consideration we can suspect that the unity of order imperfectly achieved by the universe corresponds to God's design. Indeed, Polo writes: “We call the unity of order the *design*, with an allusion to the Divine Intelligence” (2004, 532)²². God “creates a design: this design is *fulfilled* (but not by God). Being the unity of order, its fulfilment is up to the co-causes which are ordered, so it is

²⁰ Cf. Linde (1986, 395-400 and 1990). Linde, creator of the so-called “chaotic inflationary cosmology”, reproduces in a quantum framework the Epicurean view of infinite self-reproducing universes.

²¹ This idea is mentioned as Polo's 12nd thesis about life. The point can be extended to the comprehension of the universe (cf. 2004, 314-320).

²² This issue, Polo explains, is related to the third and fifth Thomistic ways for the demonstration of God's existence: cf. Polo (2004, 315). For a very detailed exposition of these topics, cf. Polo 2004 (531-535).

not complete” (2004, 532). This account of God’s Providence, with the distinction between the *design* and its *fulfilment*, is completely Thomistic²³.

The universal unity of order is imperfectly realized by the different natural dynamic orders. “Though the unity of order is fulfilled, it is never fulfilled, so to say, in a complete way, because the plurality or the distinction between the causes prevents it” (Polo 2004, 422). A full realization of all the possibilities of the physical universe would be equivalent to the so-called principle of plenitude, explicitly rejected by Polo (2003a, 124-126)²⁴. This principle, close to the Hegelian notion of system, is asserted in many versions by different philosophers and even cosmologists, and according to Polo is ultimately a manifestation of idealism (2003a, 125). The imperfection inherent to nature rather corresponds to the notion of contingency, which signifies that this world is not necessary, because it could be different in many ways and because it is corruptible.

The “imperfect perfection” of the universe, emphatically shown in the contingency of living systems, metaphysically corresponds to its fourfold essence. The unstable material cause receives different configurations –formal cause– and enables, when penetrated by formal efficiency –efficient cause–, the rising of many biological systems. As such these configurations are infinite, since they never attain a perfect form, but nevertheless they are “complete” in the sense that they realize a cosmological order which ultimately goes back to a divine design. The four causes, and especially the final cause, complete the essence of the potential universe. “The final cause as the unity of order is not fulfilled as such, but it must be fulfilled by the other causes. Therefore, the order of the universe is never definitively fulfilled. It can be said, likewise, that the physical universe is the extramental essence, truly distinct from the act of being” (Polo 2008, 423).

²³ In *S. Th.*, I, q. 22, a. 3, Thomas Aquinas distinguishes between the *ratio ordinis rerum*, which pertains to the Divine Intelligence, and the *gubernatio*, executed by the secondary causes of the universe. Polo’s theological appeal to the Divine Design has nothing to do with the “theory of the Intelligent Design” developed in the United States in recent decades. This theory confounds (or mixes) the scientific level with the philosophical perspective. It jumps too quickly to the level of the intelligence, with an insufficient philosophical view of nature. Cf. Collado 2008.

²⁴ The principle of plenitude was discussed by A. Lovejoy in his famous book of 1936.

The last remark, “truly distinct from the act of being”, is an allusion to the metaphysical perspective. I anticipated this point at the end of section 2. The imperfection of the potential essence of the universe is a sign of its real distinction from its act of being (existence as persistence). If the universe would be conceived as a perfect essence, the way to idealism would be open, because the “perfect” essence corresponds to the actuality of thought or, in other words, to the object of human thinking (this aspect is called by Polo the *mental presence*). The real essence is beyond the scope of human intentional thought. Only beyond this limit it is possible to attain the potential essence of natural things and its corresponding act of being, which is the metaphysical way to understand the universe as created by God²⁵.

5. CONCLUSIONS

Polo’s characterization of life and soul in plants and animals provides a philosophical explanation far from vitalistic or dualistic positions. These approaches share the conception of the vital principle – the soul – as an object, in the Polian sense of “object”. The Aristotelian view of life and soul is developed by Polo through the analysis of the integrated four causes, material, formal, efficient and final. The soul as the principle of teleological self-organization is particularly understood as formalized efficiency intrinsic to the material basis²⁶.

Any single living unit is a part of the whole earthly biosphere, constituted by a network of several species situated in different ecosystems. We added to Polo’s considerations the difference between the intraspecific unity, organic but not substantial, and the interspecific unity, a non-organic self-regulated complex network. Both domains are correlated. Individuals exist for the sake of the species. The

²⁵ Another positive aspect of the imperfect and open condition of the universe is related to human work and technology. The fact that the universe’s unity of order is never perfectly fulfilled “enables the existence of the human being, because if the fulfilment of the final cause should depend totally and exclusively on physical co-causalities, the human person would have absolutely nothing to do in the universe”: Polo (2003a, 129).

²⁶ This is called by Polo “received life”, in the case of humans, to which is added the rational and personal dimension or “added life”: *cf.* 2003b (13-16).

different species constitute an immense network which is able to manifest the potentialities of life.

The dynamic unity displayed in this cosmological scenario is propagation, which can be understood in an evolutionary sense. Life in earth is always growing in some sense (which could not be the right sense, if humans are not ecologically careful)²⁷. Evolution is the amplification of formal perfections in the universe. In spite of some Polo's assertions, living beings exhibit an intrinsic and non-intentional teleology, which in animals attains the level of an imperfect possession of the end, in sensitive cognition.

The cosmological unity manifests its higher order in the orderly unity between the various biological systems. The entire relationship between these systems is open and contingent. Its contingency is correlated with a reserve of potentialities. It is ultimately a design present in God's intelligence and imperfectly fulfilled by the immanent cosmological order. Its "perfection" is precisely to remain imperfect and potential, ever evolving within a certain order. The universe, in its dynamism, cannot culminate in itself. It culminates in God's plan. Metaphysically, the potential essence of the universe is to be understood in relation to the act of being. This last point, impossible to develop in this article, inaugurates the transition from philosophy of nature to the metaphysics of creation.

Theologically, we believe that the universe will undergo an eschatological transformation which includes the resurrection of the dead. I don't think that this transformation would be considered by Polo as a culmination of the biological drives in the universe, let alone the culmination of the human dominion of nature. It should be rather conceived not as an outcome of the orderly dynamics of the living systems, but as a new gift coming from the Creator of the universe.

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²⁷ See, in this respect, Pope Francis 2015.

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