Difference and robustness: An Aristotelian approach

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1. Introduction: Robustness and difference

"Robustness" is usually defined as the condition of being robust. The word "robust" itself derives from the Latin "robur", meaning "oak". The oak tree can be said to be paradigmatically robust. In English, we have the common expression "strong as an oak", and in other languages, such as Spanish, similar expressions exist. The contrary of "robust", in ordinary language, is expressed by words like "weak", "fragile", "vulnerable" or even "sickly". In more abstract terms, we say that something is robust if it is able to maintain its identity, unity and correct functioning in the face of internal and external stressors. Something is fragile or sickly if it breaks down or comes apart as a result of minor perturbations.

The term "robustness" has recently entered into the language of science, as a result of the influence of systems theory. In this context, "robustness" refers to a condition proper to systems. Not that there are no fragile systems, is that every system has one degree or another of robustness. Indeed, it is a condition that is by definition present in all systems, to a greater or lesser degree. A system with zero robustness is, in reality, not even a system, since it would completely lack identity, permanence over time and functional stability. It would be a mere random and ephemeral aggregate of elements. [1] In contemporary science, the notion of robustness is completely linked to that of system. In fact, both notions apply to the same domains. Wherever we speak of systems (economic, social, conceptual, mathematical, engineering, informational, chemical, biological, etc.) we also speak of robustness. Clearly, the nuances that this term acquires in each of these domains are in function of the characteristics possessed by the systems in question.

[1] On the other hand, the degree of robustness of a system is always finite, since otherwise the system would be eternal, which cannot be said even of the entirety of the universe as a whole.

An economic system is not the same as a computational or biological system. Even within each class of system we find distinct subtypes. Within the range of biological systems, for instance, an ecosystem is not the same as an organism. As a result, robustness is not the same across all of the systems in question. To be more specific, they all possess analogous formal characteristics, simply by the fact that all are systems and are viewed from the perspective of general systems theory. But there are important ontological distinctions among them. A computational system, as well as, for instance, a building and a city, ontologically depends on the actions and intentions of human beings, while a biological system can maintain its identity even if no human being is observing it. A conceptual system is, obviously, more abstract than an ecosystem, and we can similarly enumerate other ontological differences between system types. In Aristotelian terms, we can say that a computational system, for instance, is only *ousia* in an accidental sense, as well as a building, while a conceptual system is so in a secondary sense, while a biological system (and above all an organism) is *ousia* in a full and paradigmatic sense.

What I propose here, in view of the great diversity in possible types of system, is to begin—from the ontological point of view—with the study of the paradigmatic case of a robust system, i.e. that of a living organism (Nicholson 2014, 347–359), such as an oak. On that basis, and proceeding via analogy, we may perhaps come to be able to study in an organized fashion the characteristic of robustness in other systems of highly diverse types. In other words, the general principles that determine the robustness of a system, which are paradigmatically present in organisms, will require an analogical interpretation and application in other types of systems. In the Aristotelian tradition, the most relevant ontological concepts have an analogical application. To begin with, this happens with the concept of "being", which according to Aristotle is said in many ways. It can be said regarding an animal, a color or a number (an animal *is*, a color *is*, a number *is*), but it is said differently in each case. That is, the term is not univocal. But neither is it equivocal, for all these entities, each in its own way, in effect, *are*. What mediates between univocity and equivocality is analogy. An analogy establishes a certain proportionality. Thus, between the lens of the human eye and the lens of a photographic camera there is a relation of

analogy, since they fulfill the same function in different systems, despite all the differences that may exist between these two entities, by their origin, their material composition, durability, size... Similarly, when we apply the term "robustness" to both an oak and a computer we do so analogically.

Organisms, then, constitute themselves through a process of differentiation, also called development or ontogenesis. In this context, the term “canalization” is sometimes used as a synonym of robustness. Waddington popularized the use of this term in order to speak of developmental stability in the presence of certain perturbations. During ontogenesis, the organism maintains its identity and functionality despite internal and external perturbations. It also maintains its unity despite the fact that numerous differences or distinct characteristics arise out of what was originally an undifferentiated cell. Organisms, then, exhibit a notable robustness during their development. If we define robustness -as we have done- in terms of the ability of a system to maintain its identity, then it seems clear that any attempt to study the robustness of organisms ontologically will require us to think about the notion of difference, since the constitution of an organism is achieved precisely through a process of differentiation, and since its identity is maintained—or is even attained—in and through its internal differences. It is also reasonable to conjecture that the concept of difference will also play a crucial role in the confluence zone between evolutionary biology and developmental biology, currently called evo-devo (Amundson 2005).

2. Aristotle and the Ontology of Difference

Some contemporary authors, such as James Lennox (Lennox 2017), think that the rescue of certain Aristotelian concepts (difference, identity, form, function…) may be advantageous for contemporary science, and especially for biology. So, the concept of difference might play an important role in current debates. Actually, the emphasis on the notion of difference places us into the atmosphere that is typical of postmodern philosophy. The Heideggerian critique of the forgetting of difference, as well as his own emphasis on the importance of that notion (Heidegger 2002), was immediately picked up by other contemporary philosophers, such as Deleuze (1968),

Lyotard (1983) and Derrida (1967). And with this revitalization of the topic, we also encounter an important difficulty, which is that of the intelligibility of difference. There is an older tradition according to which only identity is truly intelligible. If we seek to grasp the constitution of an organism by way of the notion of difference, we may run the risk of not understanding what an organism is.

Allow me, then, to discuss the notion of difference at this point. Perhaps, once we have reconsidered it, we can employ it to understand the ontology and characteristics of organisms, including their robustness, and will be able to employ this case as a paradigm for comprehending it in other systems. We may even be able to do so without putting at risk the identity of the organism, which is seemingly threatened by the process of differentiation. And it may further be possible that our investigation of the notion of difference may show that, at base, and in its own way, not only identity is intelligible, but difference as well.

2.1. Constitutive difference and comparative difference

The notion of difference does not appear with postmodern philosophy, but rather has a long history. It was a key notion as far back as the biology of Aristotle. Thus, when we read Aristotle from the perspective of his biology, as has become more common in recent decades, his thought connects in a very natural way with that of contemporary philosophers of difference, and especially with the thought of Deleuze. Aristotle's biological texts call each characteristic or trait of a living being *difference* (*diaphorá*). Being viviparous or herbivorous, or having wings or a biliary vesicle, are differences. In fact, the biology of the Greek thinker is structured according to differences, and not according to species. For example, it is possible to encounter closely together references to the dolphin and to the horse, due to the fact that they are both viviparous. Also: Aristotle is interested in the mole because it embodies two differences, namely blindness and viviparity, which rarely appear together. The biology of Aristotle deals, in sum, with differences, such as viviparity, blindness or herbivority, and not with this or that species (Pellegrin 1982; Balme 1987).

But in Aristotle the notion of difference has, at least, two meanings that it is important to distinguish. Difference can be understood in a *logical sense (logikos)*, as a trait that differentiates, distinguishes or separates one class from another, or else in its *physical sense (physikos).*[2] In this second sense it is a matter of a trait qua something constitutive of a concrete living being. We can find analogues for both senses in today's terminology. According to the first sense, we say that two entities are different from each other in virtue of this or that characteristic. Here, the difference compares and classifies. According to the second sense, we speak of the process of differentiation of an organism, which is its ontogenesis, the genesis of the heterogeneous starting with the homogenous, and, as a result, the constitution of the entity itself. Here the difference constitutes the being as such. Of the two kinds of difference, the latter is intuitively more relevant to the question of robustness than the former.

Aristotle inherits the first sense of difference from Plato, and maintains it. He adds, however, the second, which is properly biological. The concept of differentiation is used in this second sense today in embryology, in order to indicate the process by which more differentiated tissues arise out of others that are less differentiated. The first sense is more classificatory, comparative and static, while the second sense is more dynamic and constitutive. The first is principally logical and the second physical and, in the case of living beings, biological. One could also say, therefore, that comparative differences are in reality a subproduct of the constitutive. That is, as a living being gradually differentiates itself, and a second living being does the same, both become increasingly different from each other. This is why living beings, even of different species, resemble more each other in the earliest embryonic stages.

In the contemporary philosophy of difference we can also encounter an idea of constitutive difference that is very close to that of Aristotle, which is what Deleuze (1968) has termed *internal difference.* If we wish to come to know the characteristics of organisms, including their capacity

[2] Here "physical" is read as being opposed to "logical". The physical is that which has reality apart from thought. In this sense, the physical is not opposed to the biological. In fact, all living beings have their own reality whether or not they are thought of. Nor is there any assertion of reductionism here: it is not held that biology can be reduced to physics, but only that living beings have their own reality.

for canalization, we must go first to what is primary and constitutive, to difference in the physical sense. Difference in its physical sense directs us towards the organization of the organism itself, towards its constitution, i.e. towards its individual form, towards its essence.

The allusion to an individual form—which is a *form of life* in the case of living beings—might appear strange, and it might seem even stranger that we would identify the concrete and individual organism with its essence. But, in my opinion, there are good arguments in favor of this identification. Aristotle himself, if we take into account recent research into his biology, can be perfectly well interpreted as being a defender of a form that is quantitatively and qualitatively individual, which is identifiable, in each being, with its essence.[3] As David Balme (1987a, 306) wrote: "In *GA* [*De Generatione Animalium*] as in *Metaph. Z*, neither essence nor form correspond to 'species' ". In this regard, Theodore Scaltsas (1994, 3) has written: "The essence cannot belong to the subject, it must be the subject itself". Quoting Balme (1987, 19) again: "In *HA* [*Historia Animalium*] the aim is evidently to collect and analyze differentiae so that animal form can be defined, and such definition will be able to be individual". And Aristotle himself wonders: "What is there that impedes certain realities from being identified with their essence, given that essence is substance?"[4]

In sum, we have access to knowledge of an organism by way of knowledge of its constitutive differences; and ontogenesis—with its capacity for canalization—would consist, precisely, in a process of differentiation. Nevertheless, the question of the unity of the organism is still a concern, since we are still speaking of differences, in plural. Is it possible that all of them could be integrated into a single difference?

2.2. The unity of differences in the final difference

The constitutive difference can only be one and unique, since it constitutes a being that is one and unique. Even more, the constitutive difference, in reality, is identified with the very substance it

[3] In the interpretation I present here, I follow contemporary authors such as Pierre Pellegrin (1982) and David Balme (1987; 1987a). I have argued in favor of this interpretation in various works (Marcos, 1996 and 2012).
[4] *Metaphysics*, 1031b 31 and ff.

constitutes. In the case at hand, the constitutive difference would be the organism itself. Various texts from the treatise *On the Soul* and from the rest of the biological works of Aristotle point in this direction. Allow me to consider one of them, perhaps the most significant. There is a passage from the treatise *On the Parts of Animals* in which Aristotle affirms that "the difference is the form in the matter".[5] For some, this affirmation might appear strange.[6] And it is if we read it from the logical point of view, but not if we do so from the physical point of view.

From the logical point of view, the species is the result of adding the difference to the genus. That is to say, one gets the impression that the species is closer to matter, and that matter is the principle of individuation of the species. But from the physical point of view things change, and it is the difference that is closer to the matter. The difference is the form in matter, the form in the concrete individual entity, and, in reality, it is that entity itself, since there are many texts in which Aristotle affirms the unity of matter and form.[7] It is the form, understood as difference, which here plays the role of principle of individuation of an undifferentiated or generic matter. As a result, the constitutive difference is not a form in the abstract, but rather the form in the matter, the concrete organism, if we are speaking of living beings. This is not an unusual reading, but rather it links in a very natural way to other texts found in Book II of the treatise *On the Soul* and in the *Metaphysics*, Books VII and VIII.

It is clear, then, that from the physical point of view the constitutive difference is unique and is identified with the thing itself; in the case of living beings, this is the concrete organism. However, we are now faced with the problem of the relationship between the physical and the logical. That is to say, can we somehow capture this difference by means of our concepts? Can we define each organism, come to know its individuality? Can we integrate the distinct traits or differences proper to the organism in one single and final logical difference that corresponds with the constitutive physical difference? In this case, the final difference would be at once the

[5] *On the Parts of Animals*, 643a 24.
[6] There have even been cases of editors and translators of Aristotle's texts that have sought to amend this reading. Nevertheless, it figures precisely in this way in all manuscripts save one (Inciarte 1974, 276).
[7] *Metaphysics* VIII 6; On the Soul II 1; *On the Parts of Animals* I.

substance and the definition of the thing.[8] We are in the presence of the problem of the intelligibility of the difference, or, if one wishes, of the concrete individual, which in the case at hand is the same as speaking of the intelligibility of the organism. I will now proceed to a consideration of this question.

2.3. The intelligibility of the final difference

If the separation between *logos* and *physis* were unbridgeable, we would have to renounce any knowledge of concrete organisms. Aristotle seeks in two ways to close the gap between logical differences and physical difference. He does so, first of all, via a reworking of the theory of definition. And he fails. He then makes a new attempt, seeking a new form of knowledge (*alle gnosis*[9]), this time by way of practical philosophy and a new constellation of ideas, including the ideas of analogy, metaphor, similarity, prudence and practical truth. The contemporary philosophy of difference has taken note, and rightly so, of the failure of the first attempt, that of the definition and the univocal logos, but has not been able to give sufficient value to the potential of the second.

The reform of the logical apparatus of the definition is carried out by the Greek thinker via the following steps: First, he reduces to one all the genera that can figure in a definition: "In the definition nothing else enters except the genus called first and the differences".[10] Next, he reduces the genus to the species: "The genus does not exist at all apart from the species of that genus, or if it exists it is as matter".[11] In a third step he reduces the species to the differences: "It is clear that the definition is the statement constituted on the basis of the differences".[12] And the fourth step reduces all the differences to the last: "It is clear that the final difference will be the substance and the definition of the thing"[13]. Later, if the whole process was well performed, that is, always

[8] *Metaphysics*, 1038a 19-20.
[9] *On the Generation of Animals*, 742b 32.
[10] *Metaphysics*, 1037b 30 - 1038a 4.
[11] *Metaphysics*, 1038a 5-8.
[12] *Metaphysics*, 1038a 8-9.
[13] *Metaphysics*, 1038a 19-20.

dividing by the difference of the difference[14], then, the entire definition—and even more, the substance itself—would be contained in the final difference, which would be both logical and physical at the same time.

But in the treatise *On the Parts of Animals*[15] there already appear numerous problems that arise from attempting to establish connections between the *physis* and the *logos* via the path of the definition. The definition that leads to the final difference, dividing by the difference of the difference (animal→ legged animals→ quadruped→ soliped…), does not appear workable. As a result, when investigating animals one must proceed via various series of differences that are, so to speak, parallel, and which do not resolve into one single such series. Thus, the most recommendable thing is to proceed as common knowledge does, putting those individuals together that share a certain constellation of differences, which we cannot yet reduce to one single difference. For instance, we understand birds as being blood-bearing, oviparous, winged, feathered animals with hollow bones, beaks and no teeth. Each of these differences can be the extreme limit of a distinct series and none of them need necessarily include all of the others.

It appears that the idyllic communion between *physis* and *logos* ends here. The closest we find them to one another is in the context of formulas such as "Socrates is rational" (his specific difference), which expresses more about Socrates than does "Socrates is human" (his species).[16] Even so, it does not correctly express the integration of the various differences in the concrete individual. We discover here—pace Parmenides and Hegel—that the relationship between thought and reality cannot be one of identity. It should come as no surprise that Aristotle himself would demonstrate in certain passages a clear lack of confidence towards a univocal logos and the virtualities of the definition.[17]

What would this other form of knowledge (*alle gnosis*) consist in, this knowledge that would bring us closer to the concrete organism? In the first place, in order that this knowledge be

[14] *Metaphysics*, 1038a 9; *On the Parts of Animals*, 642b 5 - 644a 12.
[15] *On the Parts of Animals*, 643b 10 and ff.
[16] *On the Parts of Animals,* 645b 13-22; *On the Soul,* 402b 10-16, 415a 16-20.
[17] *Sophistical Refutations*, 165a 5-14.

possible at all, it is important to note the formal nature of the difference qua principle of individuation. Only if we recognize this formal aspect in individuals will they turn out to be intelligible. Aristotelian philosophy can be interpreted in many ways, and historically commentators have done precisely that. However, in our times, and on the basis of a close attention to the biological texts, a reading is emerging according to which the form is individual. It is individual in a quantitative sense in each and every being, and it is individual in a qualitative sense in a graded manner. That is, the individual qualitative differentiation admits of degrees; thus, an ant, whose behavioral flexibility is very limited, since its behavior is genetically regulated in a very rigid way, shows fewer differences with respect to other ants than does a dolphin, whose ability to learn is considerably greater, with respect to other dolphins. Therefore, in certain cases, what we learn about the species can nearly exhaust what we can learn about each individual. But in other cases, once the traits of the species have been learned, there still remains much to be learned about each organism.

For this task, the integration of multiple scientific methods will be necessary, as will a certain analogical interpretation of scientific concepts, but attention will also have to be paid to other forms and sources of legitimate knowledge that will get us closer to the plane of the concrete individual. These will include, for instance, the arts, with their capacity for metaphor creation, as well as philosophy, praxis and the daily experience of life interpreted through the modulation of prudence. As Sandra Mitchell (2004, 81) suggests, "both the ontology and the representation of complex systems recommend adopting a stance of integrative pluralism, not only in biology, but in general".

In my opinion, if we wish to achieve a kind of knowledge that is reasonable and close to the concrete individual, this pluralism of methods will have to include those offered by the natural sciences, and will probably have to go beyond even those. Even more, the natural sciences themselves will have to be reoriented towards methodological forms that are not exclusively reductionist, towards analogical interpretations of their conceptual systems and, as Thomas Nagel (2012) has recently suggested, towards a reconsideration and broadening of our models of

causality. It is possible to conjecture, in this regard, that the deep explanation of the robustness of certain systems resides in the capacity of the system itself to act on its own parts, in a kind of top-down causality. This functional or teleological perspective seems to demand an ontology that recognizes the substantial existence of the system as such and not only of its parts. This top-down causality, in my view, is found in a paradigmatic manner in the development and functioning of living organisms. It is no accident that in Aristotle it is organisms that are substances in a paradigmatic sense. Nor is it an accident that developmental canalization is the paradigmatic instance of robustness.

It appears that through this pluralist reorientation of the sciences, and a sensible integration of diverse sources of knowledge, we can attain—or nearly so—to knowledge of the individual, which is important, because we construct the scaffolding of science on the basis of a certain knowledge of concrete individuals, through similarity among differences. This is how we elaborate and apply concepts, laws, classifications and models.

3. Difference, identity and similarity

The intelligibility of difference can be cast into doubt, however, since according to a certain philosophical tradition, intelligibility depends on the identity of the object. But I have characterized the organism here as the process and result of differentiation. The organism is seen, in this way, as a difference. However, has the organism, seen as difference, thereby lost its identity? Is it, then, knowable at all? We must, as a result, investigate the relationship between difference and identity.

One of the most profound and influential studies of identity and difference is that undertaken by Martin Heidegger. A lecture he gave in 1957 has been published, together with another text from the same period, under the title *Identity and Difference*. This text became especially fashionable in the circles of postmodern philosophy, and has been seen as marking the beginning of the so-called *philosophy of difference*. We can say that, together with difference, we also receive identity: Heidegger (2002, 21) spoke about "the close relation [*zusammengehörigkeit*] of identity and difference". He argues that "what the principle of identity […] states is exactly what the whole

of Western European thinking has in mind: […] If science could not be sure in advance of the identity of its object in each case, it could not be what it is. By this assurance, research makes certain that its work is possible. Still, the leading idea of the identity of the object is never of any palpable use to the sciences" (Heidegger, 2002, 26).

I suggest interpreting Heidegger's text in the following terms. The *physical identity* of the beings that the sciences deal with is a condition of possibility of those very sciences. If each thing were not one and the same with itself, it would be difficult to think scientifically. The world –and this term is already exaggerated– would be a chaos that is totally refractory to reason. On the other hand, however, the physical identity of each being with itself is not a very useful notion in doing science. Science needs also another form of identity that connects beings, that takes them out of their individuality, puts them in contact and joins them together. This kind of identity would be identity in concept: any two horses or any two drops of water are just that, and can be respectively bundled together under the same concept, thanks to their conceptual identity; they are subsumed under one and the same concept. We can speak here of *logical identity*, as opposed to the *physical identity* of any concrete being with itself.

But this type of logical identity, or identity according to concept, has come in for fierce criticism from some postmodern thinkers (from Heidegger onwards, including thinkers such as Deleuze, Derrida and Lyotard). The basis of their criticism lies in the fact that identity, understood in this way, leaves differences out; instead, the peculiarities of each being and each process, never exactly the same as any other, pass to a second level of reality. Difference is thus forgotten.

According to postmodern thinkers, this forgetfulness goes hand-in-hand with an attempt to impose identity over difference. Postmodernity can be seen, in fact, as being the fruit of the cultural and vital malaise of a reason that has forgotten difference. Postmodern thought has been based on this critique ever since its ultimate origins in Nietzsche and Heidegger.

I think that the postmodern attempt to rescue difference may be valued positively, along with its emphasis on the dynamic and vital aspects of reality and its denouncing of the excesses of a reason that focuses exclusively on identity. We hear, for instance, Deleuze's voice against a

background of Bergsonian resonances leading us to the mobile, the fluid, the concrete, the diverse, the living. Nevertheless, we should ask ourselves whether difference alone will ever allow us to regain identity. The question is important. Without a certain minimum stability, without identifiable objects, the work of science would become impossible.

However, forgetting differences distances us from the real world, from things themselves. If reason aligns itself exclusively with identity, then it becomes separate from life and experience, from development, from time, from the diverse, from the plural, from the concrete and real. But the unilateral favoring of difference does not auger well for the results of science, bringing instead fragmentation, deconstruction, relativism and, finally, nihilism. Heidegger was right when he invited us to think of identity and difference *together.* How can this be done? Would the mediation of similarity be useful here?

First, let us return to the Aristotelian distinction between the logical (*logikos*) and physical (*physikos*) points of view.[18] The Spanish philosopher Xavier Zubiri (1980, 22) clarifies the meaning that the *physical* has here: "'Physical' is the original and ancient expression for designating something which is not merely conceptual, but real". This distinction would be bereft of meaning if being and thinking were indeed one and the same. Affirming the identity of being and thinking means forgetting or denying difference. However, the everyday experience of the search for knowledge is the experience of effort, of the making of mistakes, of inaccuracy. The fallible, contrived and unpredictable nature of human knowledge makes us see that there is a distance, a *difference*, between being and thinking.

In a complementary way, achievements and acquisitions, moments of insight and even our very survival clearly indicates that the gap between being and thinking is not unbridgeable. Reality is not concept. Nevertheless, the two are not totally refractory to each other; they may be linked through the work of a subject. Reality is *not identical* with the concept, but it is intelligible, in a contrived, unpredictable, not algorithmic, fallible but revisable and critical way. It is therefore

[18] *Physics* 204b 1-12; *Metaphysics* Z and H.

probable that the very relationship between being and thinking may be better described through the concept of *similarity*.

Secondly, the distinction between the *logikos* and *physikos* points of view will have to be applied to the very notions of identity and difference. Recall that identity, from the physical point of view, is the relationship that each entity has with itself. It is true that the beings around us are subject to change. Change, however, need not always mean the loss of identity. Beings can change some of their properties over time without losing their physical identity. In part this is the very basis of their capacity for robustness and resilience. In turn, when we consider different entities under a single concept, we are thinking of identity in logical or conceptual terms, apart from time, change and physical processes. Both types of identity are indispensable in human knowledge, the former as a condition of possibility for knowledge and the latter as a result of conceptual construction and as a tool for explanation and application.

On the other hand, we can also discern a logical and a physical way of looking at difference, as we have seen above. Both prove necessary, as was the case with the two meanings of identity. Without difference in the physical sense, there would be no identifiable objects, only an undifferentiated magma–or nothing, pure and simple. For its part, difference in the second sense, the logical sense, is the key to establishing comparisons and drawing up classifications.

This observation allows us to clarify the relationship between identity and difference in the physical sense. Neither has priority: the self-identical is constituted by differentiation, and difference is always the constitutive difference of an entity which is identical with itself. In Heideggerian terms, they belong to each other. We have to think them together.

However, and thirdly, we know that neither the physical identity of each substance with itself, nor their differences alone, serve to construct concepts, laws, metaphors, or models. Identity and difference are ontological presuppositions for all of this. But is *similarity* the force that unites things in concepts and representations.

In speaking of similarity here, I am not speaking of a dyadic relationship between objects, available in the world to be used and consumed by science. It is rather a triadic relationship

between two objects and an active subject. It is one of those triadic relationships that Peirce talks about. Without a subject there would not be actual similarity.

Both in Aristotle and in Peirce, similarity is understood as a relationship between three poles. From the Platonic point of view as well, the relationship of similarity is triadic: it demands reference to an Idea. Aristotle keeps the triadic scheme but the third pole is no longer an Idea, but a human subject who actualizes a similarity that exists in the objects as a real possibility. Consequently, similarity is not one of those relationships that Peirce calls relationships of "brute force" among pairs, but a triadic relationship. This triadic relationship is removed from its original setting within Platonism and comes to rely, not on immobile Ideas, but precisely on the activity of a subject.

Nevertheless, this triadic character does not strip similarity of its objective basis. If it lacked an objective basis, we could establish any relationships of similarity we wished at whim, between any objects and in any way. We know from experience that this is not so, that sometimes reality simply says *no* to our desires to connect things, that our classifications are sometimes erroneous, that laws do not always predict correctly, that the theories, models and metaphors with which we try to understand reality are not always satisfactory. This is due to the fact that reality also has its say. In fact, similarity has an objective basis. It is rooted as a possibility in physical difference and identity.

In the case of organisms, the objective possibility of similarity derives from genesis, i.e. from differentiation. Differentiation is the physical basis for similarity. But the objective possibility of two things being seen as similar is only actualized because of the activity of a subject. So, thanks to similarity, we can pass from the game of physical identities and differences to the game of concepts and representations, with its logical relationships of conceptual identity and comparative differences. We do this by actualizing the similarities that exist as possibilities in reality. And the connection itself between the logical and the physical level, that is, between thinking and being, should be described not as identity, nor as absolute difference, but as a kind of similarity.

4. Conclusion

Robustness is defined as the capacity that a system has to maintain its identity despite the internal and external perturbations that it may suffer. For example, an organism can suffer various perturbations over the course of its differentiation and even so still be able to preserve its identity. This phenomenon is called canalization. The canalization of development constitutes a paradigmatic case of robustness. Therefore, prior to beginning a philosophical reflection on the robustness of systems in general, I believe it is useful to focus on one paradigmatic case, that of the systems we call organisms, and their particular form of robustness that we call canalization. In this case, there are certain base ontological conditions that can illuminate the phenomenon in question.

The development of organisms is a process of differentiation. It will be, therefore, vitally important to study the ontology of difference, the relationship between difference and identity, and the relationship between difference and intelligibility. I have done so by using the Aristotelian distinction between the *logikos* point of view and the *physikos* point of view. From the physical point of view, identity and difference—in Heidegger's terminology—belong to each other mutually, since the identity of the organism is constituted by differentiation, and the result of a process of differentiation can only be a difference. From the logical point of view, we speak of conceptual identity—based on the similarity amongst differences—and of comparative difference. The play of both allows for the construction of an entire scaffolding of scientific models. On the other hand, the relationship between the two planes, physical and logical, has been characterized as being a relationship of similarity.

The canalization of development of organisms occurs thanks to the mutual belonging of identity and difference in the organism itself, and it is intelligible to us via a certain interweaving of similarities. Although robustness admits of an analogous formal description in diverse types of systems, my conjecture—and it is only that, a conjecture—is that we will encounter diverse ontological foundations. It is most likely the case that we will only encounter mutual belonging between identity and difference, or, stated in other terms, the capacity to canalize differentiation

itself, in living organisms. It is likely, instead, that the ontological bases of a system of another kind (a computational one, a building, a city…) are displaced out of the system itself, and will ultimately refer to the identity/difference of a living organism.

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