

Article

The Natural Philosophy of Experiencing

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Abstract: A new philosophy of nature is urgently needed. The received ontological view, physicalism, is unable to account for experiential phenomena and in particular for consciousness in all its varieties. We shall outline the concept of experiencing which should figure as a new conceptual primitive in natural philosophy. Experiencing refers to a process which comprises the interaction of an agent with its world through action based on phenomenal experience. This process can be viewed under two different aspects. One regards the subjective aspect of experiencing, the other one regards it in terms of physical objects. The first case illustrates the “what-it-is-likeness” of experiencing, the second illustrates how experiencing gets “objectified” in nature. We furthermore wish to delineate our concept of experiencing from the concept of (meta-cognitive) awareness. Scientific theories that explain how awareness comes about in sufficiently organized brains should respect the distinction between experiencing and awareness. We also sketch how experiencing could be related to theoretical biology in terms of information processing by organisms. Experiencing is non-exclusive; it refers to a primitive and a-personal natural process and not to a property possessed only by humans or other persons.

Keywords: natural philosophy; subjective experience; process; dual aspects; consciousness; information-theory; theoretical biology; 1st-person and 3rd-person perspectives

1. Introduction

Natural philosophy (*philosophia naturalis*) fell into oblivion in the course of the 20th century, because it appeared that the natural sciences—an outgrowth of natural philosophy which originated in the 17th and 18th century—could in principle account for any natural phenomenon. In academic philosophy, the scientific success story led to the broad endorsement of a position known as “physicalism”, which could roughly be stated as the ontological claim that all being is or “supervenes on” the physical [1]. To put this definition into the perspective of natural philosophy, we hasten to add that physicalism, as we understand it in this article, implies the thesis that being is describable comprehensively¹ in terms of our best physical theories, and only in their terms.

Physicalism is still the dominating metaphysical view in contemporary analytic philosophy (a little less so on the continent). Yet, a big shortcoming of physicalism is its seeming inability to account for subjective experience as part of the natural world, most notably for consciousness in all its forms. Even though the cognitive and neural sciences made substantial progress in understanding the relation of brain and world, it is still unclear (to some it is even “inconceivable” [3]) how a science of the brain could ever explain the inherently subjective and qualitative nature of consciousness. This is

¹ Up to some phenomena which seem not relevant for subjective experience: This is expressed most clearly in Sean Carroll’s idea of a “core theory” [2] that accounts for the vast majority of natural phenomena, including meaning and consciousness, but not quantum gravity or grand unification.

clearly an area where a rejuvenated philosophy of nature that provides conceptual space for subjective experience is urgently needed. One possibility is to embrace “emergentism”, understood roughly as the idea that complex arrangements of matter give rise to novel properties in nature [4]. But emergentism, while *prima facie* plausible and conceptually close to physicalism in its “non-reductive” variety [5], has its inherent problems: So far, no universal theory of emergence has been accepted within the scientific or philosophical community. Even less intelligible are accounts of emergence in the field of consciousness studies: Suppose that “emergence” in fact turns out to be a useful concept for science, it will probably not be useful enough to account for a supposed emergence of thought [6,7].

An alternative view regards subjective experience as fundamental, which would mark—in contrast to emergentism—a true rival to physicalism in its conception of nature. But how best to conceive of such a new philosophical world view? In contrast to mainstream physicalists, we propose that nature is only intelligible in terms of processes which comprise subjective experience (qualia) but also decisions and actions. We refer to such processes as *experiencing*, objectified by *any* natural phenomenon. Our concept of experiencing is based on the interaction of an agent with its world. A comprehensive understanding of experiencing necessitates a description of it in terms of dual aspects [8]: one in terms of phenomenality, another one in terms of object-structures. Importantly, we do not equate “agents” and “persons”. The notion of “person” is taken to refer to an evolved biological structure. Agents are primitives; persons are historical and biological entities.

To start the analysis, we shall first look at the most difficult problem for physicalists: explaining consciousness. One could make the case that there is *not even conceptual space* to allow for consciousness within physicalism. In Section 2 “Working definitions of consciousness”, we briefly outline and discuss two often-heard proposals which try to give a (short but concise) “working definition” of consciousness. Closer inspection reveals that both definitions are each limited to a particular perspective. On the one hand, it is the perspective of a naturalist who looks at biological systems “from the outside”; on the other hand, it is the perspective of an introspectionist who only looks at the system “from the inside”. Both are faced with difficulties when urged to account for consciousness as natural property. Any notion of consciousness which is (i) adequate to its phenomenology and (ii) conceives of it as referring to a natural phenomenon should be able to consistently relate a subjective 1st-person and an objective 3rd-person perspective without reducing one to the other. We call this the “consistency requirement” for studying consciousness, and we propose that the resolution of the distinction “subjective-objective” shall be found on a higher, ontological level.

In Section 3 “Experiencing”, we thus introduce a conceptual stance which regards the process of experiencing as primitive². It derives from the simple idea that an agent (a primitive, a-personal entity) perceives its environment, autonomously makes decisions and acts. An agent’s environment could be regarded as entity that carries the disposition to cause (qualitative) experiences in the agent, whereas the agent could be regarded as entity that is responding appropriately. The subjective perspective of the agent is assumed to be the dual of a theorist’s description of the whole process. “Awareness”, referring to a (meta-cognitive) biological phenomenon, could then be understood as complexification of the process of experiencing. A description of this complexification should explain the transition from a-personal embodied agents to evolved persons, and it should satisfy the consistency requirement. Once we have accepted the conceptual innovations proposed in this section, there exists a chance to make substantial progress on the problem of consciousness. If we stick with physicalism, this will likely not be the case.

As a concrete example, we introduce and discuss the prospects of the notion “meaningful information” (in the *phenomenal* sense of meaning) in biological systems and its relation to experience and awareness in Section 4 “The biology of meaning”. We shall first review some empirical work

² We are not the first to propose this. Similar ideas could be found, for example, in the works of Charles S. Peirce [9], William James [10] or Alfred North Whitehead [11].

that might justify the belief in the ubiquity of experiencing in biology, which is closely related to an understanding of “information”, not as purely syntactic but as inherently meaningful (semantic) concept. This will eventually lead to a tentative discussion of awareness, understood as biological phenomenon based on experiencing. Our model bears some formal similarities to established approaches in theoretical biology; however, the concepts that underlie it are quite different.

2. Working Definitions of Consciousness

2.1. *Consciousness = Whatever-Is-Lost in Dreamless Sleep*

“Everybody knows what consciousness is: it is what vanishes every night when we fall into a dreamless sleep and reappears when we wake up or when we dream” [12] (p. 216). Does this mean that consciousness is an object that could be lost just as one could lose his car keys? Could we perhaps locate it somewhere in the brain? Does it “consist of [other things, such as] inner, qualitative, subjective states and processes of sentience or awareness” as John Searle [13] (p. 559; our italics) believes? Is it of a certain size or at least a concrete “going-on” that is located in space and time [14] (p. 3)?

These and similar descriptions ground most research that is done in consciousness studies today. Phenomenologically, this seems to miss an important point. This can be illustrated using a metaphor that likens consciousness to the process of waking up in the morning. After a deep and peaceful slumber, our metaphor’s protagonist awakes in the morning when the first rays of sunlight are tickling his eyes. While he senses the smell of coffee from the kitchen, the thought of his overdue tax filing is forming in his mind and enters his consciousness together with a stream of perceptual experiences: the visual scenery of his bedroom, the sounds that are coming from the streets through the window, and a strong itching in his left foot. Is it reasonable to assume that something emerged here? Clearly, the answer is “yes”: Certain objects formed in the protagonist’s conscious mind when he woke up, but it is not consciousness that (re-)emerges, nor is it “phenomenal experience” or its “what-it-is-likeness”.

This could further be illustrated by taking a phenomenologist’s perspective: We never experience a world without being consciousness, all there is for us is the world as it is “given to consciousness”. It would be even more adequate to say that as soon as we fall asleep the (experienced) world is what “vanishes overnight and reappears when we wake up or when we dream”—not consciousness. The guiding intuition behind this is that we should not think of consciousness as a property of some (natural) object, but (perceived or intentional) objects as emerging within consciousness. Phenomenologists have argued for this on philosophical grounds at least since Edmund Husserl has criticized the “natural attitude” [15]. (Cf. [16,17] for a similar point in a contemporary setting). We need to let go of the intuition that consciousness corresponds to a property of physical objects: Being conscious is unlike having mass and position. Consciousness is what lets us see objects in space and what lets us feel their masses.

But why is it so natural to suppose that consciousness is just like any other (physical or biological) property of an organism, something which might be lost or regained? “Consciousness = whatever-is-lost in dreamless asleep” is a useful circumscription, when we read it the following way: Given an outside perspective on a particular organism, part of its (overt and neuronal) behavior is such that it vanishes when the organism falls into a dreamless sleep and reappears again when it wakes up or when it dreams. But this does not directly inform us about phenomenality—how it feels like for the organism to have an experience. It is a description of how the organism would appear to an external observer. However, we must not confuse this external perspective with the subjective experience of the organism itself.

2.2. *Consciousness = Having Qualia*

Another competitor for a working definition of consciousness stems from the fact that being conscious implies that “it-is-something-like” [18] to have a particular experience. It is sometimes heard

that consciousness is tantamount to having certain things, namely qualia³, where, more precisely, qualia are understood as intrinsic, non-representational and unstructured properties of experience; or for short: “consciousness = having qualia”.

It therefore comes as no surprise that with respect to a 1st-person perspective this definition is more adequate. Yet, it seems that this definition does not help much when trying to relate consciousness to the (neuronal or manifest) behavior of an organism just because the definition is only about the intrinsic perspective of a subject. Whereas the first definition, “consciousness = whatever-is-lost in dreamless sleep”, misrepresents the subjective perspective of an organism, the definition “consciousness = having qualia” seems to imply that consciousness is an inaccessible, ineffable and purely internal thing. It precludes any chance of relating it consistently with a scientific account of the world (even if consciousness figures as primitive concept in our account of it).

This finds expression in the skeptical claim that, as involved as it might get, no explanation could ever make it plausible why physical dynamics should be accompanied by phenomenology at all, instead of “going-on in the dark”. It seems to imply a form of dualism, which is mirrored in conceiving of a purely internal 1st-person perspective and a purely external 3rd-person perspective. Some thinkers have hoped this would give rise to two corresponding sets of “data” [22]. Accordingly, one would be able to arrive at a science of consciousness by demanding consistency between these two kinds of data and derive “bridge laws” between them. So far, this dualist proposal has not been fruitful, though, and it is doubtful whether the notion of “1st-person data” is at all coherent. Data, by definition, belong to the domain of recordings. They result from reports or measurements, they are inherently “post-subjective”, or, as one might wish to say: “they only exist in the world of objects”. 1st-person data are thus more like the chimera than like pointer readings of measuring devices for subjectivity.

2.3. Consistency between Perspectives

Neither “consciousness = whatever-is-lost in dreamless sleep” nor “consciousness = having qualia” is able to express an adequate concept for the phenomenon of consciousness as natural property. The former because it misses a crucial property of experience: To any conscious being, consciousness means its world; to any outside observer, consciousness is invisible and all she could see are correlated brain states or the conscious being’s behavior; the latter if it is taken to imply an ineffable, purely internal notion of experience.

This indicates a fundamental conceptual asymmetry. Given one perspective, consciousness is all there is, and the experienced world with all its objects emerges within consciousness. Given the other perspective, all there is are atoms in the void; no consciousness to be seen anywhere, neither in our heads nor behind curtains, but only neurons firing and ions moving. An important constraint for a theory of consciousness then is that the first story—call it “the phenomenal story”—is consistent with the second—“the physical story”. We call this the consistency requirement which states that two descriptions of the very same process need to be consistent with each other.

To respect the consistency requirement, it is logically not necessary that consciousness is identical to a certain physical structure (e.g., the brain) or is caused by it. In other words, it is not the case that only forms of physicalism could guarantee such a consistency. The challenge for many contemporary approaches in consciousness studies is therefore not (only) to overcome skepticist arguments regarding

³ For example, Hameroff & Penrose [19] (p. 40) in a review of their Orch-OR theory of consciousness state that “phenomenal conscious awareness, experience, or subjective feelings [are] composed of what philosophers call ‘qualia’”. To be fair, the authors arguably do not explicitly state that consciousness is a thing-like substance, composed of elementary qualia. However, they could easily be seen to imply exactly this. In another example, Leopold Stubenberg wrote a book centering around the notion of “consciousness as the having of qualia”. [20] Importantly, he notes that both the notions “having” and “qualia” need to be qualified due the problematic relation between qualia and their bearers. Stubenberg finally arrives at a “bundle theory” of experience that is very dissimilar from the (ordinary-language) concept of “thing-ness”. Similarly, Galen Strawson argues for “selves”, the subjects of experiences, to be “things” but later qualifies this to be understood in a “thin” way [21], actually more in line with Buddhist teachings of the no-self and primarily referring to an a-personal phenomenon.

the bridging of an “explanatory gap” [23] but also to state the mind-matter relation in a way which satisfies the consistency requirement. But there are possibilities other than stating subject-object identity to ensure consistency. Recall, for example, the assumption of “functional coherence” proposed by David Chalmers [3]. This assumption restricts the possible structure of theories of consciousness to those theories where “awareness” (taken as an access-related psychological property, cf. [24] is systemically linked to phenomenology without being identical to it. In contrast to the notion of functional coherence, however, we propose that consistency should be understood as perspectival and dynamical. If our concepts only referred exclusively to the “intrinsic” or “extrinsic” properties that things have, then it would be hard to see how statements about experiences could be related to statements about physical structures without making a Cartesianist assumption (that is, without assuming that consciousness resembles a “thing-like” substance that “is contained” in a body). A different strategy would think of consciousness as pertaining to the interaction between an organism and its environment (hence consistency is dynamical), and that a comprehensive description would correlate different aspects of these interaction (hence consistency is perspectival), without reducing one to the other. In many cases it is futile to approach a resolution of a conceptual distinction (such as “subject-object” or “mind-body”) at the same descriptive level. Rather, one could only resolve it on a more fundamental descriptive level. Such is what we wish to propose in Section 3 “Experiencing”, where we introduce the concept of experiencing, which eventually plays the role of establishing consistency on a fundamental level.

3. Experiencing

3.1. Experiencing as Fundamental and A-Personal Process

It is sometimes heard (e.g., by Eric Kandel [25]) that the mind will be to the sciences of the 21st century what the gene was to the sciences of the 20th. We believe this to be an accurate prediction, however, one that will only turn out to be true, once the philosophical image of nature is revised such that it includes the concept of *experiencing as primitive*.

We would also like to distinguish two senses in which the notion of “consciousness” is used in the literature: On the one hand it refers to the notion of “subjective experience”, which we take to be an irreducible part of experiencing; on the other hand, it refers to a particular biological phenomenon which we henceforth denote as “awareness” to distinguish it from pure experiencing (we simply use the term “awareness”, which is sometimes also referred to as meta-cognitive form of consciousness). In addition, we postulate that *experiencing is a-personal*, whereas awareness is intimately related to the concept of a “person”. Awareness should be explained on the basis of the more fundamental notion of experiencing.

Experiencing has a subjective aspect and is assumed to manifest itself in any natural phenomenon, which we could study in the physical, chemical and biological sciences. Experiencing gets “objectified in nature”, in the terminology of Arthur Schopenhauer [26], or it is “embodied” in a slightly more contemporary *façon de parler*. While awareness denotes a species-specific (and hence evolutionary constrained), 1st-personal phenomenon, experiencing denotes a fundamental process in nature and thus a primitive concept for a renewed philosophy of nature, similar as “mass” or “extension” were primitive concepts in the mechanistic philosophy of René Descartes [27]. We could circumscribe the concept of experiencing as follows:

Experiencing refers to a structured process of interaction of an agent with its world. Experiencing can be studied under different aspects. One of these pertains to the subjective perspective of the agent, which is irreducibly phenomenal for that (and only for that) particular agent; the phenomenality of experiencing couldn't thus be accessed by an external observer. However, experiencing is also structured. This makes it possible to precisely describe this structure and trace experiencing empirically. This leads to a second perspective which corresponds to the physical aspect of experiencing.

The onto-epistemic thesis says that experiencing manifests itself in any natural phenomenon. Given this, experiencing could be scientifically studied. The thesis does not say that subjectivity or consciousness reside “within” matter or that physical objects “ground”, “produce” or “give rise” to experience. For the onto-epistemic thesis to be substantial, though, it should be the case that whenever we look closely enough at nature, we find bits and pieces that hint at experiencing.

3.2. A Post-Kantian Model

It seems helpful to illustrate the concept of experiencing using a model inspired by Immanuel Kant’s transcendental philosophy put forward in his *Critique of Pure Reason* [28]. (But we shall also point out some necessary adjustments that need to be made to this framework in our opinion). There, mind is “affected” by a “thing-in-itself”, and the raw sensory material is structured according to space-time and categories such as causation⁴. Using a schematic representation this could be depicted as:

$$W \xrightarrow{p} X, \quad (1)$$

where a “world” W stands for Kant’s (hypothetical) thing-in-itself that affects a receptive mind in the act of “perception” p which, in turn, sculpts experience X . It is crucial to note that the only things one could attend to are the contents of X . Neither the “world” as such nor the mind’s conceptual faculty that “sees through” the sensory apparatus is consciously given to it. That is why the world must first and foremost be regarded as a hypothetical entity that triggers perception. This should not be confused with the “world” in a physicalist’s sense, i.e., with the totality of material systems, but could simply be taken as everything that has the disposition to cause changes in X .

While the Kantian analogy serves an illustrative purpose, there are many differences between Kant’s transcendental philosophy and our proposed natural philosophy. First, we explicitly reject any notion of a world-mind dualism on our account. Our model comprises a “world” of dispositions to cause (changes in) the experiential content of a receptive “mind”. “World” and “mind” do not, however, refer to two distinct entities of our ontology but merely to different conceptual abstractions (cf. the notion of a “conceivable world” by Ivan Havel [30]). Second, there are cognitive connotations when discussing “conceptual schemes” or “categories”, eventually turning into a kind of neuro-Kantianism, which we reject. Experiencing is taken to refer to any natural process, rather than to processes ascribable to only humans or other persons. Third and perhaps most importantly, the mind-world relationship is sometimes conceived of as merely passive “stimulus-matching” relationship. We approach it instead in terms of active participation or interaction. In other words, instead of a (passive) mind-world model, we need to consider the *agent-environment interaction*,

$$W \begin{array}{c} \xleftarrow{a} \\ \xrightarrow{p} \end{array} X, \quad (2)$$

which is reminiscent of the sensory-motor (perception-action) cycle known to biologists [31,32] and philosophers (e.g., John Dewey [33]). In particular, from an empirical point of view, the feedback component of such a model is crucial because it permits us to experimentally engage with the agent: Without having the possibility of getting responses from the agent there would in principle be no way to test any claims pertaining to the structure of experiencing, and researchers would need to exclusively rely on philosophically motivated *a priori* arguments. Even though the phenomenality of an agent’s

⁴ To be a little more precise, Kant explicitly distinguishes between “forms of intuition” (=space and time) and genuine “mental” categories such as causation, substance or unity. For the sake of this article, however, we shall not ponder deeply on this distinction. In the course of 19th and 20th century philosophy, the Kantian a-priori has been subject to various interpretations and modifications, see for example the symbolic constructivism of Ernst Cassirer [29]. We do not wish to engage in the debate how to best conceive of the a-priori in this article.

perceptions is in principle inaccessible from an external perspective, a stimulus-response architecture of the kind expressed in Equation (2) in principle allows us to derive and test predictions relative to the dynamics of the agent-environment system, unlike a “negative theology of experience”. This also marks a methodological advance compared to physicalist approaches toward the mind, where the mental is often defined solely in terms of the “negative” (the so-called “*via negativa*” approach to physicalism; cf. [34,35]). While our model seems primarily related to perceptual processes, any general account also needs to say something about “internal” mental phenomena, such as abstract thoughts, emotions or moods. The following is preliminary (self-consistency and empirical adequacy need still to be worked out further), but it shows how the model seems in principle able to accommodate such phenomena as well. In general, there exist two possible approaches toward internal mental phenomena. The first reduces them to (implicit or explicit) representations of the workings of the physical body. Such a strategy is the default approach in physicalism, and largely faces the same problems as physicalist accounts of perception. Another strategy would acknowledge the possibility of endogenous “self-interactions” of agents. A description of this process is projected onto an “external world” relative to the agent. (Recall that “world” should not be understood in terms of a *physical* environment, but rather in the sense of a totality of dispositions to cause experience.) The consistency requirement furthermore demands this projection to be consistent with a description in terms of the agent’s subjective experience.

To make the model more powerful, we consider in addition some “internal processing” or “decision-mechanism” that connects the agent’s experiences to the agent’s actions. This can be motivated on empirical grounds too. Decision mechanisms are now found to be ubiquitous in biological systems (see also Section 4 “The biology of meaning”). Such a model has been proposed recently in terms of a very general mathematical structure by [36],

$$W \begin{matrix} \xleftarrow{a} \\ \xrightarrow{p} \end{matrix} \begin{pmatrix} G \\ \uparrow d \\ X \end{pmatrix}, \tag{3}$$

which consists of perception-, decision-, and action-Kernels p , d and a that loop through the world W , the experiential content of an agent X , and the group of possible actions G available to that agent⁵. Such an account aims at understanding what experiencing *does*, not what it is; it is a model of experiencing and not a theory about its essence.

In the next section we discuss how the new philosophy of nature could be related to recent empirical studies. We argue that (i) the biological dynamics should be re-conceived in terms of *information* theory. This is largely an epistemic point, based on well-established scientific work⁶. It could be interpreted along the lines that it merely “appears as if” a system were processing information meaningfully, but one might alternatively conclude that (ii) it refers to an embodied process of experiencing. One could justify this second interpretation by appealing to the necessity to account for jointly irreducible perspectives in order to exhaustively describe biological phenomena. In other words, the physical dynamics of biological systems could be thought to *objectify* experiencing in the physical world. One could relate this (iii) to the study of *awareness* as biological phenomenon which arises from a complexification of experiencing. While this would explain, why it is “something-like”

⁵ Expressed mathematically, W , X , and G each represent measurable spaces, i.e., a set Y equipped with a sigma algebra \mathcal{Y} ; and the “pda-loop” represents the succession of Markovian Kernels p , d , and a which mediate between these spaces such that $z: Y_j \times Y_k \rightarrow [0, 1]$. Intuitively, this means that the Markovian Kernel z assigns to any combination of an “element” $j \in Y_j$ and an “event” $k \in Y_k$ some probability between 0 and 1. Finally, there exists an integer n that counts the number of pda-loops executed by the agent.

⁶ There is a well-known difficulty in exhaustively defining the concept of “information” when used other than in the syntactical (Shannon) sense. Any appeal to “information” is therefore provisional. However, we note that “information” does not refer to an ontological primitive in our philosophy. It thus resembles notions such as “cause”, “probability” or “purpose” which all need further conceptual clarification in a renewed philosophy of nature (cf. also the discussion in Section 4.2).

to be conscious (because experiencing has an irreducibly phenomenal aspect), two important and non-trivial constraints are that any description of this complexification should make it intelligible why it results in a 1st-person perspective and that it satisfies the *consistency requirement* for the study of consciousness introduced in Section 2.3. In contrast to the “hard problem”, this line of inquiry seems promising and is rooted in a philosophy of nature that takes experiencing as primitive.

4. The Biology of Meaning

4.1. “Meaning” and Information

The principles governing biological systems are increasingly studied from the angle of information theory [37–39], and it is often claimed that the study of energy transfer through these systems should be re-conceived in the language of information theory in order to arrive at a more comprehensive understanding of biological processes. Consistent with this, one could regard biological systems as units that process information acquired via sensory organs to adjust their behavior.

We also know from genetic, cellular and systems-level analyses that the behavior of biological systems is not only dependent on the incoming (sensory) information but, as least as much, on the organization and the internal processing (sometimes also referred to as “internal decision mechanisms”) embodied in the organism, for example, in gene regulatory networks or predictive neuronal mechanisms [40–43].

This is not premised on any ontological account of “information,” but it only requires acceptance of the claim that certain systems are best described in terms of information-processing units and could be regarded as quasi-intentional or quasi-perceptual. In biology, this has been recently argued for a large class of systems (e.g., [44,45]); in philosophy, similar claims were put forward as “mind-life continuity thesis” based on sensory-motor coupling (for example [46]). This perspective necessitates understanding of how biological systems manage information flows and integrate exteroceptive signals with bodily sensations (interoception), anticipations about the future (predictions) and past experiences (memories). The information processed by a biological system could then be regarded as “meaningful” in the sense that it underlies behavior which limits entropic tendencies or leads to various adaptive changes. Accordingly, organisms embedded in an environment could be conceived of in terms of systems that use information that “stands for” and thus “refers to” external entities or internal processes in order to guide adaptive behavior.

One particular approach that has been postulated to analyze information processing in (neuro-) biological systems is “integrated information theory” (IIT: [12,47]), originally conceived as “measure of consciousness” but recently applied to information processing in biological systems more generally [48]. The main idea behind using IIT to analyze information flows in biological systems is to quantify how much an element or a set of elements within the system constrain the system’s past and future states. The exact mathematical form of how this should best be measured has changed over the course of publications, but it crucially involves calculating differences between state repertoires, e.g., KL-divergences or the “earth mover’s distance” (for details we refer the reader to [47]). This distance measure is evaluated for the total system and a “minimum information partition”, and thus quantifies the amount of information in the system “as whole” as compared to the sum of its parts. Importantly, while one might be skeptical regarding the claim that IIT resembles a modern-day version of panpsychism [49,50] or whether its “central identity” claim does not in fact propose a reductionist account of consciousness “through the backdoor”, its concepts might still be useful to study the properties of information-processing networks, in particular, how “meaningfulness” could be encoded by the way how an organism’s current state constrains its (past and future) evolution, mirroring Bateson’s dictum that “information is a difference that makes a difference” (cf. [51]). In other words, IIT could be thought of as pertaining to the physical aspect of a meaningful process objectified in biological networks.

4.2. Meaning and Perspective

The previous subsection argued that sufficiently complex biological systems could be understood in terms of entities that process information “meaningfully”. But are we justified to conclude that such processing really is meaningful (from the system’s perspective), rather than merely “appearing as if” it were meaningful (from a theorist’s perspective)? “Meaning”, as it was used in the last paragraph, refers primarily to our 3rd-person perspective as theorists or observers, and it is unclear how this is related to any notion of subjectivity at all.

Let us repeat the discussion so far. By interacting appropriately with the world, we recorded some physical dynamics which looks as if they were meaningful. We could interpret this along the lines that we have interacted with a complex mechanism that “causes our perceptions” and “informed our minds” accordingly. Another, perhaps more natural, interpretation would be that we have interacted with something that in fact is (phenomenally) meaningful and the physical dynamics we have recorded reflected this. The benefit of this position—in addition to being metaphysically more parsimonious, that is, without postulating a “jump” from the physical to the subjective at some place—is that it explains why it can only look “as if” (because the physical dynamics merely provides an extrinsic perspective on the process) and that it explains the seeming increase of “mental-looking properties” emerging within the hierarchy of natural phenomena (because of the complexification that characterizes the transition from the physical to the biological). This is different from saying that there is meaning “inside” the organism, a claim which strikes us as dualist.

One way of justifying (ii) is rooted in the rejection of the claim that a mechanistic model could comprehensively account for biological phenomena, a claim which unfortunately seems to be the mainstream opinion of current physicalism. An argument against a mechanistic philosophy of nature was famously laid out in Kant’s *Critique of the Power of Judgement* [52]; for a modern appreciation of the Kantian Critique in developmental and molecular biology see, e.g., [53]. The argument is usually based on the inability of theoretical frameworks to explain prototypical examples of biological mechanisms such as the seemingly intentional behavior during pattern formation or embryogenesis. We do not wish to enter the specific debates here. Instead, we wish to present some more principled reasons to doubt the claim that mechanistic descriptions are sufficient to exhaustively describe biological phenomena. This is, on purpose, *not* an empirical claim but relates to some concepts any philosophy of nature needs to be clear about:

1. Scientific concepts usually have a long history, and to a philosopher it seems puzzling that their genesis is sometimes overlooked in their conceptual analysis. Take the concept of entropy that is now very well known in the physical sciences (though often confusedly employed). Whereas many believe that entropy refers to an objective property of thermodynamic systems (but see for example E.T. Jaynes [54] who argued that entropy is an “anthropomorphic concept”), the inventor of the term “entropy”, Rudolf Clausius, purposely conceived it to refer to a natural process that derives from our everyday experiences in and outside the laboratory. (“Entropy” derives from the Greek word *εν-τροπη* meaning “content of transformation”. [55]) It could even be argued that all scientific concepts such as “energy”, “force” or “field” have their genesis in a multitude of subjective experiences that led to an inter-subjectively true description of the world (cf. [56]). This suggests that, in fact, apparently objective descriptions are not necessarily about the “true states of the world out there” but result from a generalization of concrete experiences.
2. One of these concepts, the concept of *probability*, is still in need of clarification. Objectivists conceive of probability as (ignorance about) a property of the system under study and compete with subjectivists that tie probability to the degree of belief of an observer (see, e.g., the overviews in [57,58]). Objectivists would need to show that their concept of probabilities is really free from any reference to (subjective) belief; subjectivists would need to demonstrate the explanatory benefit of their position. Settling this dispute is beyond the present state of play in logic. Until it

is settled, however, we need to be careful when interpreting theoretical frameworks that explain a system's behavior primarily in terms of probability.

3. Biological systems (such as, but not limited to, the brain) are often described as probabilistic systems under thermodynamic constraints. Generalizations about the workings of such systems are subject to the caveats that pertain to thermodynamics and probabilities. In particular, this pertains to any explanation in biology cast in terms of information-theory. If it is the case that the concept of probability *logically necessitates* a subjectivist approach, both observational *and* theoretical statements must not be regarded as being about some "objective truth out there". It then follows that generalized biological theories too must not lightheartedly be regarded as being "objective" (in the same sense), and a description purely in terms of physical concepts would not exhaustively describe a system's behavior.

The above indicates that some of the concepts we employ in scientific theorizing might indicate an irreducibly subjective (and as a corollary: phenomenal) ontological counterpart, in particular the concept of probability as applied to systems dealing with uncertainty. This also pertains to other "more biological" concepts such as "function" or "purpose", which hinge on the status of more primitive concepts such as causation, probability or chance. This therefore defines another area where conceptual work in philosophy is relevant for the scientific enterprise. A new philosophy of nature would probably lead to very different conceptions than those of physicalism.

We can summarize this subsection by saying that a minimal account of "phenomenal meaning" seems to be necessary for understanding biological phenomena expressed in the language of information-theory. We henceforth shall say that "information is meaningful" to a particular organism, noting that we thereby do not claim that organisms resemble "little persons". The notion "information is meaningful" arises naturally from regarding experiencing as primitive concept in our ontology, together with the onto-epistemic thesis that experiencing gets objectified in nature. We could also justify this by pointing to a deficiency of the "received view" of physicalism, according to which purely mechanical (literally meaningless) descriptions supposedly afford exhaustive explanations of biological phenomena—a claim which should be rejected eventually.

4.3. Meaning and Awareness

How could this lead to a model of awareness? When discussing a potential "referential nucleus" for consciousness studies, [59] noted that, while the presence of perception-action cycles might indicate the presence of experience, the ascription of awareness to such systems might nevertheless be precluded by an apparent lack of reportable 1st-personal content. Thus, any empirically accessible conception of awareness should involve such contents. This seems consistent with ideas coming under the heading of "global workspace" theory [24] where awareness supposedly derives from accessibility of neuronally encoded information, which ultimately leads to subjective reports. This framework has recently been developed into a neuro-computational direction [60]. Some might doubt, however, that the notion of computation is more than a convenient fiction by which one represents the system's dynamics (from a scientist's 3rd-person perspective), rather than referring to the idea that certain complex biological systems actually do take a 1st-person perspective on their environment. In other words, it does not become intelligible how the consistency requirement as sketched in Section 2.3 would hold for such an explanation.

The things that organisms perceive are not detached Cartesian ideas but the inferred objects and structures that constitute the organism's *experienced world*. A good example that lets one see the difference between descriptions of mere behavior and awareness is provided by a discussion of "time consciousness". Many organisms are able to vary their action according to temporal cues they get from their environment. Yet, this does not imply that they represent time from a 1st personal perspective; rather their action is simply coded to an external periodic pattern (expressed, e.g., in circadian rhythms [61]). While the latter is sometimes understood in terms of an intricate mechanism pertaining to biological homeostasis, this is different from the "time consciousness"

of a personal subject, which (phenomenally) experiences an enduring “now”. The canonical phenomenological discussion of this is due to Edmund Husserl [62]: Awareness is structured according to temporal patterns (according to Husserl these are the “temporal moments” of “retention”, “primal impression” and “protention”), which lets the organism see distinguishable objects that appear in consciousness. Similarly, this might hold for the representation of space in terms of spatial patterns.

How could a merely computational mechanism account for this difference? Our concept of experiencing comes to help. While we do acknowledge the role of computational mechanisms in generating reportable (or otherwise accessible) content, we add that the information thereby processed is already meaningful. Making it available to the system could make intelligible how biological systems become aware by computing over “meaningful information” and thus create the rich phenomenal structure such as the one coming under the header of “time consciousness”.

The important meta-theoretical constraints are (i) that such reportable content could be identified, in some non-trivial sense, with 1st-personal descriptions and (ii) these descriptions are consistent with the overall biological dynamics. (We have suggested earlier that the consistency requirement should be taken as referring to the interaction of an organism with its environment and not merely to the functional organization of its nervous system.) At this point, it is good to remind ourselves that we have defined experiencing itself to be subject to two different and dual descriptions – a phenomenal one and a physical one. We have thus good reason to assume that the problem of awareness might be resolvable when accepting the conceptual innovations proposed in this article.

5. Discussion

A novel philosophy of nature should overcome the impasse of our current naturalist world view. In physicalism, this is the inability to account for subjective experience, in particular consciousness in all its forms, as natural property of the world. We therefore put our focus on this question and pointed at novel concepts that should be incorporated into natural philosophy. Unsatisfied with “emergentist” solutions to the problem of consciousness, we proposed that experience should figure as primitive concept in the theory.

The conceptual inadequacy to account for consciousness in physicalist terms can readily be seen when looking at two widespread “working definitions” of consciousness that are frequently found throughout the literature. After briefly stating them in Section 2 “Working definitions of consciousness”, we noted that both seem to reduce the phenomenon of consciousness to either its physical or its subjective aspect. In contrast to this, we have put forward a “consistency requirement” which demands that any account of consciousness as natural property should treat it as perspectival entity that defies mutual reduction. Such consistency will likely be given by appealing to a more fundamental ontological primitive.

We then elaborated on a philosophical alternative to physicalism in Section 3 “Experiencing”, according to which “experiencing” refers to the structured process of interaction of an agent with its world. Experiencing refers to an a-personal process in nature and can be studied under different aspects. One of these aspects pertains to the subjective perspective of the agent, which is irreducibly phenomenal for that (and only for that) particular agent. A second perspective on this process corresponds to the physical (or “objective”) aspect of experiencing. Furthermore, experiencing is assumed to be an a-personal phenomenon, marking a clear distinction between experiencing and any notion of awareness. The latter should then be understood to “arise” from a hierarchy of objectivations of experiencing in sufficiently complex organisms, making intelligible how a 1st-personal perspective arises from experiencing. The consistency requirement serves as constraint on such theories.

This is the broad outline. Yet, there are many issues which still need to be addressed in more detail, for example, how the mechanism of complexification of experiencing works or how experiencing is related to biology more generally. We have discussed a model in Section 4 “The biology of meaning”, which illustrates how the process of experiencing could be regarded as being objectified in a biological setting. Information processing in biological systems was argued to be meaningful.

However, the biological system does not correspond to a “person” in any substantial sense of the word. The model is formally consistent with recent trends in theoretical biology, for example, Friston’s cognitive-biological approach [63], which could aptly be named “the physics of belief”, since the mathematical description of the dynamical system appears to be a functional on “beliefs” (a “Lagrangian” according to [64], that is, a functional on probabilities derivable from the internal states of a network). This type of “belief” is a-personal. Furthermore, our approach is not about specific “causal powers” [13] of the brain but about natural tendencies of self-organizing biological systems *tout court* and lends itself to a very different interpretation, more in line with naturalized phenomenology and models of dynamical agent-environment couplings. Of course, the brain has an important role to play in the process of generating awareness, but it is not the role of “magically” creating phenomenology. Rather, the brain seems to afford a particularly efficient way of systematically correlating and processing a vast amount of (sensory and endogenous) inputs that result in suitable (behavioral) output. The brain, on our view, should be thought of as processing information that is literally meaningful to the organism by regulating an organism’s self-sustaining and adaptive behavior.

The transition from simple information-processing to complex representation furthermore indicates how personalist human psychology might be related to an a-personal precursor phenomenon embodied in biological systems. Personalist psychology could be regarded as a scaled-up and evolutionarily constrained result of natural biological processes. Our approach has much in common with the cell-theory of life: The minds of complex (psychological) agents arise from the minds of simpler (biological) agents. However, the mind is not emergent, it is fundamental and objectifies itself in nature.

The model promises to be productive for the scientific project. We have illustrated this along the (seemingly hopeless) problem of consciousness. If true, is this enough reason to abandon physicalism? One could be skeptical. Nothing could directly verify (or falsify) physicalism, as long as physicalism has the last say on what does or does not count as substantial anomaly to the framework. The best one could do is show how certain assumptions eventually lead to self-contradicting consequences. The reason to reject physicalism (or any other philosophical view) is usually not to be found in an *experimentum crucis* but derives from its inability or inadequacy to account for the experiences we make inside and outside of our laboratories. It is thus the task of natural philosophy to make experience intelligible again.

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