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TEMPORAL EXPERIENCE*

I step out of my house into the morning air and feel the cool breeze on my face. I feel the freshness of the cool breeze *now*, and, as the breeze dies down, I notice that time is passing—I need to start walking or I will be late for class.

We all know what it is like to have these sorts of experiences. Reflection on the qualitative character of such experiences suggests that events occurring now have a characteristic property of *nowness*, responsible for a certain special "feel," and that events pass from the future to the present and then into the past. The question that I want to explore is whether we should take this suggestion to support an *antireductionist* ontology of time, that is, whether we should take it to support an ontology that includes a primitive, monadic property of nowness, responsible for the special feel of events in the present, and a relation of *passage* that events instantiate in virtue of literally passing from the future to the present and then into the past. It will be important in what follows to avoid prejudging whether the world actually does include nowness and passage, so I will use the locution "as of" instead of just "of" to signal that descriptions like "experience as of passage" merely describe experiences with a certain qualitative character.

It should be obvious that we need to take temporal experience seriously: experiences as of nowness and as of the passage of events are central to our subjective perspective. In some deep but hard to define way, our temporal experience is caught up with our sense of being,

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that is, our sense of what we are and how we are. (Martin Heidegger engages this idea in his *Being and Time*, and Edmund Husserl develops an account of the way our consciousness of temporality connects with perceptual experience.)[1] Making sense of the features of temporal experience is fundamental to our ability to make sense of the world and of ourselves as agents in the world and bears important connections to one's having a point of view and to one's sense of being a self.

One central way in which temporal experience is taken seriously is when it is cited by antireductionists as evidence for the existence of nowness and passage. But do events really have properties of nowness, or do they just seem to? Do events literally pass from the future into the past, or do they just seem to? These questions come down to whether, to account for temporal experiences as of nowness and passage, we need to endorse an antireductionist ontology of time, or of events in time, that includes nowness and passage. Must we grant the existence of a primitive property of nowness and of a relation of passage, or do we merely need to grant that we have experiences *as of* nowness and *as of* passage?[2]

There is more to be said. In addition to accounting for our temporal experiences as of nowness and as of passage, we need to account for the way we, at least pretheoretically, seem to experience qualitative change. One standard ontological characterization of change in object O defines qualitative change in O as O having suitably intrinsic property P at time t_1 and O having suitably intrinsic property Q (instead of P) at time t_2. A feature of this definition, however, is that O having P at time t_1 never changes, and O having Q at time t_2 never changes. To paraphrase D. H. Mellor, one might be inclined to reject this ontological characterization of change because it seems to reduce change to a series of changeless events.[3] Intuitively, the rejection is motivated by an antireductionist understanding of change as something involving more than just changeless events: for change, there must be passage, so that there is a flow of successively existing events (and their corresponding property instances), from the future to the present and into the past. The inference is that this flow of successively existing events is responsible for the animated character or flow of change, which is necessary for real change.

[1] Heidegger, *Being and Time*, trans. John Macquarrie and Edward Robinson (New York: Harper & Row, 1962); and Husserl, *On the Phenomenology of the Consciousness of Internal Time (1893–1917)*, trans. J. B. Brough (Dordrecht: Kluwer, 1990 [1928]). The work of Heidegger and Husserl does not engage with the reductionist-antireductionist debate as I am framing it.

[2] "Now" and "present" can be used interchangeably.

[3] Mellor, *Real Time II* (New York: Routledge, 1998).

We can cash out the overall antireductionist claim about change more precisely as the claim that, first, for O to change from being P (at t_1) to being Q (at t_2), the event of O having P must become present at t_1 and then the event of O having Q must become present at time t_2 (while the event of O having P is not present at time t_2). Second, we detect this change in virtue of detecting its flow or dynamic character. Antireductionists infer from this that, for there to be real change, there has to be passage, cashed out as the successive nowness of different events moving from the future to the present and into the past. In what follows, to avoid prejudging whether real change requires passage, I will use "experience as of change" to describe an experience in which we seem to detect a flowing or animated change, and occasionally I will refer to "flowing" or "animated" change to describe change defined as actually involving passage.

Ontologists think that our ordinary judgments drawn from our experience of the world can give us knowledge about the world and that we can use this knowledge, perhaps via a route involving some conceptual analysis, to develop metaphysical theories about what there is.[4] My comments above are designed to elucidate the way in which some ontologists, whom I have labeled "antireductionists," are inclined to hold that our ordinary judgments drawn from our temporal experiences tell us there are monadic properties of nowness in the world responsible for our experience as of nowness and relations of passage (sometimes also called the "flow of time" or "becoming") responsible for our sense as of passage. Such a view holds that our experience as of the nowness of events is best explained by ascribing the irreducible, monadic temporal property of nowness to events and that our experience as of the passage of events is best explained by holding that time actually passes—that is, that events do not merely stand in unchanging relations of being earlier than, later than, or simultaneous with other events. According to this sort of view, experience provides an almost non-negotiable starting point for a metaphysics of time.

Donald Williams characterizes the situation thus: "The final motive for the attempt to consummate the fourth dimension of the manifold with the special perfection of passage is the vaguest but the most substantial and incorrigible. It is simply that we *find* passage, that we are

[4] For an account of the role of ordinary judgments in ontology, see Paul, "A New Role for Experimental Work in Metaphysics," *Review of Philosophy and Psychology*, Special Issue: Psychology and Experimental Philosophy (Part II), ed. Joshua Knobe, Tania Lombrozo, and Eduard Machery, 1, 3 (April 15, 2010): 461–76. For a description of a standard methodological approach in metaphysics, see Paul, "The Handmaiden's Tale: Metaphysics as Modeling," forthcoming in *Philosophical Studies*.

immediately and poignantly involved in the jerk and whoosh of process, the felt flow of one moment into the next. Here is the focus of being. Here is the shore whence the youngster watches the golden mornings swing toward him like serried bright breakers from the ocean of the future. Here is the flood on which the oldster wakes in the night to shudder at its swollen black torrent cascading him into the abyss."[5]

Antireductionist views rely, either explicitly or implicitly, on these intuitive views about our experiences as of nowness, passage, and change when it is argued that mind-independent temporal properties such as nowness and passage actually exist. Some defend the intuitive plausibility of presentism based on the fact that we have experiences as of the temporal properties of nowness and passage. For this sort of presentist, nowness is what makes the present ontologically special, and passage is the ontological ground for events coming into or out of being.[6] Some instead defend a moving spotlight view: as time passes, events come into being or have a special ontological status when the spotlight shines on them.[7] Some positions are a little harder to box up but seem to rely on antireductionist intuitions. For example, in defense of a thesis about the direction of time, Tim Maudlin says that "[a]bove and beyond and before all these considerations, of course, is the manifest fact that the world is given to us as changing, and time as passing...all the philosophizing in the world will not convince us that these facts are mere illusions" and "[i]n sum then, it is a central aspect of our basic picture of the world that time passes, and that in virtue of that passage things change."[8] Or, consider Bradford Skow: "I cannot survey all the motivations philosophers have had for the moving spotlight theory. But the motivation that I like best appeals to the nature of our conscious experience. Of all the experiences I will ever have, some of them are special. Those are the ones that I am having NOW. All those others are ghostly and insubstantial. But which experiences have this special feature keeps changing. The

[5] Williams, "The Myth of Passage," this JOURNAL, XLVIII, 15 (1951): 457–72, see pp. 465–66.

[6] See for example William Lane Craig, *The Tensed Theory of Time* (Dordrecht: Kluwer, 2000); and George N. Schlesinger, "E pur si muove," *The Philosophical Quarterly*, LXI, 165 (1991): 427–41.

[7] See for example C. D. Broad, "Ostensible Temporality," in Michael Loux, ed., *Metaphysics: Contemporary Readings* (New York: Routledge, 2001 [1938]), pp. 272–78; and Quentin Smith, *Language and Time* (New York: Oxford, 1993).

[8] Maudlin, *The Metaphysics within Physics* (New York: Oxford, 2007), pp. 135, 142. Maudlin is not actually defending passage as it is usually defined, namely, as involving events literally passing from the future to the present and into the past. He is defending the view that time has a direction. But the quote evokes standard antireductionist intuitions, even if, strictly speaking, Maudlin does not endorse them.

moving spotlight theory explains this feature of experience: the vivid experiences are the ones the spotlight shines upon. As the spotlight moves, there are changes in which experiences are vivid."[9] Or, consider Caspar Hare's description of the motivation for endorsing ontological properties of nowness and passage: "realism about tense is uniquely capable of making sense of the phenomenology of temporal experience."[10] Such antireductionist intuitions involve an element of naturalness and common sense that many philosophers find appealing.

Not everyone is impressed. *Reductionists* argue that, for reasons of ontological parsimony, we should not postulate the existence of fundamental properties of nowness or passage unless we have better metaphysical and empirical reasons to do so. They hold that there is no reason to take these features of our experience as ontologically robust, since there is no sufficiently attractive metaphysical or empirical reason for endorsing the existence of nowness or passage. According to reductionists, what exists is an ontologically tenseless, four-dimensional universe of events, with each event or temporal stage of the universe located at a particular time and with events standing in unchanging relations of being earlier than, later than, or simultaneous with other events.[11] There are no primitive monadic properties of nowness; events do not literally pass from the future into the past; and every stage of the four-dimensional universe is on an equal ontological footing, temporally speaking. On this view, real change of O from P to Q is simply the ontological fact of O having a suitably intrinsic property P at time t_1 and O having a suitably intrinsic property Q (instead of P) at time t_2; so, real change does not require passage.

The objection to such reductionist parsimony is to charge that such views cannot account for the character of our experiences as of nowness and our experiences as of passage. We need properties of nowness and passage to explain the fact that we have experiences as of nowness and as of passage (and change). In general, the objection to the parsimonious view of the reductionist is that, without the properties of nowness and passage, we would not have any way to account for the features of our temporal experience. Since we do have experiences as of nowness and experiences as of passage and as of change as flowing or animated, the reductionist's parsimony is a false economy.

[9] Skow, "Relativity and the Moving Spotlight," this JOURNAL, CVI, 12 (December 2009): 666–78, see section IV.

[10] Hare, "Realism about Tense and Perspective," *Philosophy Compass*, forthcoming, see section I.

[11] See Mellor (*op. cit.*) for a good defense of this view.

What I have just described gives us an intuitive way to characterize the nexus of a philosophical debate over the ontology of time. The antireductionist holds that temporal properties of nowness and passage exist (as opposed to it being merely *as if* such properties exist) and that real change requires passage. The antireductionist's parsimonious opponent is the reductionist, who holds that there are no properties of nowness or passage and that change is just the replacement of properties at successive times.

As I noted, antireductionists want to argue that reductionist views do not explain how our experiences as of nowness, change, and passage arise. As the passages from Williams, Skow, and Hare bring out, the intuitive importance of accounting for our temporal experiences functions as the linchpin in the antireductionist case. The trouble for the reductionist is that she needs to provide an account of *why* (or how) we have such temporal experiences, instead of merely arguing that reductionist views should be adopted because they are ontologically, scientifically, and semantically superior. By not explaining how we could have such experiences, the reductionist can be dismissed by the antireductionist, who, with some intuitive justification, can claim that antireductionists are the only ones who can adequately explain why we have experiences as of nowness, passage, and change.

I see the justice of this antireductionist reply. Moreover, there is something even stronger that the antireductionist can say. Noting that successfully perceiving or detecting motion is one of our most cognitively basic functions and is essential to our success as functioning agents in the world, he can extend this to the way we seem to perceive the motion of passage and the centrality of such perceptions to successful functioning, to justify his claim that we must really be detecting passage. Furthermore, our conception of ourselves as beings caught in the ebb and flow of time is historically, aesthetically, linguistically, and psychologically important to us and so must be accommodated by any adequate philosophical account of time. So, in the absence of a reductionist account of temporal experience, the antireductionist can hold that we are perfectly justified in taking our experiences as of nowness and passage seriously enough to infer the real existence of nowness and passage. Spelled out in this way, the antireductionist seems to be in a pretty good dialectical position.

The antireductionist argument can be summarized as follows:

(1) We have experiences as of the nowness of events.
(2) We have experiences as of passage (and as of change).
(3) The thesis that there are temporal properties of nowness and passage provides the only reasonable explanation of why we have these experiences.

(4) The thesis that there are temporal properties of nowness and passage provides the best explanation of why we have these experiences.
(5) Hence, there are temporal properties of nowness and passage.

I will assume the truth of (1) and (2). In the absence of any reductionist explanation of (1) and (2), the antireductionist can defend (3) with ease. (4) follows from (3), and (5) follows from (4) using inference to the best explanation. The antireductionist also may argue that (4) is independently true because it follows from supplemental assumptions about the character of the antireductionist explanation, but I shall not explore that position here. My focus will be on undermining (3).

So, I engage in the dispute on behalf of the reductionist. It is absolutely essential for reductionists to be able to provide an alternative, reasonable explanation of why we have temporal experiences as of nowness and passage. Without such an explanation, we cannot claim to have provided a theory of time that satisfies some of our most central intuitions about our ordinary experience. Moreover, we have no explanation to offer in place of the antireductionist explanation of the source of temporal experience and, hence, no rebuttal to the inference to (4). My concern in this paper is not to argue for reductionism in the usual ways but to show how the reductionist can plausibly explain temporal experience—hence, to show why (3) is false. If the reductionist can show why (3) is false, then she can muster other arguments from science, language, and metaphysics to undermine the plausibility of (4) and thus block the move to (5). If my argument below is sound, the most influential and plausible route to antireductionism is blocked. It also blocks the argument that only the antireductionist has an adequate account of change (assuming that an adequate account of change requires an adequate account of passage).

I will argue against (3) by providing an account of how temporal experience could arise from the way the brains of conscious beings experience and interpret cognitive inputs from series of static events. Once we have such an account, a reductionist ontology in conjunction with empirical results from cognitive science can be used to provide a reasonable explanation of how we have experiences as of nowness, passage, and change. The result, I hope, will be to change the dialectic by shifting the burden of proof. Since the linchpin of the antireductionist stance is that the reductionist has no reasonable explanation of the central features of temporal experience, my dialectical revision undermines the antireductionist. If the reductionist can provide a reasonable explanation of why we have temporal experiences with the qualitative character that we do, then the antireductionist will be forced to defend (4) and (5) on other grounds.

Start with our temporal experience as of nowness. To make progress here, we must recognize the tight connection between the ontology suggested by temporal phenomenology and the ontology suggested by consciousness. There is an intimate connection between the subjective force of our experiences as of, say, redness and the subjective force of our experiences as of the nowness and passage of events. By extension, there is an intimate connection between the ontology necessary for our experience as of redness and the ontology necessary for our experience as of nowness. (This extends to our experience as of passage, since it involves experience as of a succession of nows, but experience as of passage, because it also involves impressions as of motion and flow, will need additional special treatment. More on this later.)

The connection is a matter of how ontology supports the subjective *oomph* of experience. In other words, it is a matter of the ontology needed to make sense of the subjectivity of experience. The reductionist should argue that our experience as of nowness is simply part of the experience involved in being conscious and that, as long as we endorse enough ontology to make sense of the oomph of consciousness, we have enough ontology to make sense of the oomph of nowness.

So, we need to think carefully about how the ontology needed for consciousness relates to the ontology needed for temporal experience. But first, we need to explicitly set aside an irrelevant asymmetry between the debate about consciousness and the debate about time. The asymmetry can be described as follows: the debate over the ontology of consciousness has focused on the question of how to account for our phenomenal knowledge of experiences as of qualitative properties of objects, such as the redness of a tomato. The existence of the qualitative properties had by objects usually is not disputed (or, more carefully, the existence of some fundamental or manifest property of the object responsible for the relevant qualitative property ascribed to the object is not disputed), since the dispute centers on whether we need additional *distinctively mental* properties in order to account for the character of our experiences as of these qualitative properties of objects. This is not the dispute in debates over the status of properties of nowness or passage: we are concerned about whether events need to have certain temporal properties in order to explain temporal experience, not whether we need new distinctively mental properties to explain temporal experience. (We can see this by imagining the dispute between the reductionist and the antireductionist occurring between a pair of dualists. In other words, a pair of dualists could have opposing views about the ontology needed to support temporal experience.)

With the irrelevant asymmetry set aside, let's discuss the way the ontology needed to support the qualitative character of phenomenology is related to the ontology needed to support temporal experience. Recall that the antireductionist argues that we should infer the existence of nowness and passage from our temporal experience and that real change requires passage. The claim trades on the idea that a reductionist theory of time cannot account for what the antireductionist argues we seem to perceive, namely, that present events have a special property, nowness, and that real change in events requires passage.

The antireductionist point is that there is a certain specialness to our experience that suggests the inference to the existence of special properties of nowness and passage. The claim is that the reductionist's parsimonious characterization of events in time gives us only a static world without nowness, change, or the "whoosh" of passage and that we need more ontology to adequately capture reality. The antireductionist then claims that we need to include properties of nowness and *n*-adic properties (relations) of passage in our ontology. The similarity here to a dualist's approach in the philosophy of mind is striking. In each case, the claim is that reductionist characterizations of the world are somehow incomplete and that, to capture what it is like to have certain experiences, we must add special additional properties to our catalogue of what is in the world. In each case, the move is faulty.[12]

The move by the antireductionist about temporal experience is faulty because it makes a fallacious inference from temporal phenomenological oomph to temporal ontological oomph. It fails to account for the possibility that a temporal experience is simply a part of a purely phenomenological experience and nothing more. But a temporal experience *is* just a part of an overall phenomenological experience and nothing more.

Let me amplify this. Consider our experience as of nowness. The reductionist can argue that the subjective character of our experience as of nowness is entirely encompassed by the subjective power of what-it's-like experiences.[13] When we have a phenomenological experience, such as an experience as of redness, there is a certain way it is like to have such an experience. (As my "as of" locution here suggests, I am not taking "experience as of redness" to mean that we

[12] Craig Callender, "The Common Now," *Philosophical Issues*, XVIII, 1 (2008): 339–61, and John Perry, "Time, Consciousness, and the Knowledge Argument," in L. Nathan Oaklander, ed., *The Importance of Time* (Dordrecht: Kluwer, 2001), pp. 81–93, compare the method made to support temporal ontological inferences to the method used to support dualist inferences motivated by the knowledge argument.

[13] The discussion in Robin LePoidevin, *The Images of Time: An Essay on Temporal Representation* (New York: Oxford, 2007), chapter 5, supports this view.

are successfully seeing an instance of redness. Rather, I take it to mean that we are having a redness quale.) But, when we have an experience as of seeing red, there is more to this experience than just experience as of redness, that is, than just having a red quale. Along with having an experience as of redness, we also have an experience as of the *nowness* of the redness. We also have a nowness quale. In other words, when we have experiences as of redness, these experiences are not just as of redness *simpliciter*. They are experiences as of redness-now.[14]

This point generalizes across different sorts of qualia. The what-it's-like character of phenomenology has as much to do with temporal experience as with qualitative experience. All experiences combine the character of the qualitative experience caused by the relevant properties (for experiences as of different colors, let us assume we would have different light reflectances as the different properties causing the qualitative experiences) with an experience as of nowness. The idea is that the what-it's-like of an experience contains within it the experience as of nowness along with further experience (for example, as of redness). What it is to have an experience as of nowness is part of what it is to have an experience *simpliciter*.

Let us try to be a little more precise about what our sense as of nowness at each specious present reduces to (for simplicity, I will assume that the duration of the specious present is some nonzero t). For ease of exposition, assume that cognizers perdure as fusions of temporal stages. When we perceive the occurrence of an event, certain phenomenal properties are caused in us by the event. Individual I's experience as of the nowness of an event at time t is just I having instances of such properties at t—in other words, it is just I having a phenomenal experience at t. The claim I am making is that the subjective character of experience in general suffices for our experience as of the nowness of events. Different phenomenal properties will result in experiences with different qualitative characters, but each experience will include the same sense as of nowness. At each time that a stage of an individual exists with the relevant phenomenal properties, the individual will have the experience as of nowness at that time, within that temporal stage.[15]

[14] And here or there, that is, redness-here-now or redness-there-now.

[15] See Callender (*op. cit.*) for an interesting and plausible account of our "nowness" gestalt as a "present patches theory." Adolf Grünbaum, "The Meaning of Time," in Eugene Freeman and Wilfrid Sellars, eds., *Basic Issues in the Philosophy of Time* (Chicago: Open Court, 1971), pp. 195–228; Steven Savitt, "On Absolute Becoming and the Myth of Passage," in Callender, ed., *Time, Reality, and Experience* (New York: Cambridge, 2002), pp. 153–67; and Sider, *Four-Dimensionalism* (New York: Oxford, 2001), all include suggestions that our experience as of nowness is somehow related to consciousness.

A slightly more complex version of this claim can be put as follows: (i) (nontemporal) qualitative properties of events cause phenomenal properties in us. (ii) At some time t_0, there is a (nontemporal) qualitative property R of event E that causes phenomenal property instance C at t_1 in me. (iii) My having C at t_1 realizes my experience as of R-ness now, at t_1. The experience that is the having of a neural state is more than just an experience as of a quality like redness; it is an experience as of nowness (and of thereness or hereness) as well.[16] With this analysis in hand, reductionists can explain the temporal experience as of nowness as (merely) a feature of consciousness.[17]

We can apply the explanation to a familiar case. Consider Arthur N. Prior's famous case of "thank goodness that's over."[18] I have a migraine beginning at noon that lasts for two hours. At 3pm, I say, "thank goodness that's over." Am I thankful that the event of having the migraine is past? Is the difference between what I experience at noon and what I experience at 3pm based on a difference between the headache being present and the headache being past? Prior says that it is. He claims that the reductionist cannot explain the difference we detect, since, for the reductionist, events at noon are on the same ontological footing as events at 3pm.

But if the special sense as of nowness that we attach to events is just part of our conscious experience of such events, the flaw in Prior's thought experiment is exposed. At noon, I have the mental state of being in pain, and so I am conscious of the pain. At 3pm, I lack that mental state. The reason that I say "thank goodness that's over" at 3pm is because my experience of being in pain is not located at 3pm, and so I do not have the pain quale at 3pm. I am thanking goodness at 3pm for the fact that I lack a certain phenomenal property at that time. At 3pm, I have no conscious phenomenological state (apart from memories and the like) caused by the event at noon, but I do have conscious experience caused by events at 3pm.[19]

It is worth noting that my argument applies even if one is a dualist. I am a physicalist, so I assume that dualism is false and that the argument from the oomph of consciousness to the existence of special

[16] Of course, I am not ruling out the possibility that merely locational properties of events are also causal contributors to the relevant phenomenal properties.

[17] As Tyler Doggett noted to me (and as other detensers have sometimes noticed), we do not infer from our experience of "hereness" that there is some mind-independent property of hereness in addition to a property of having a particular location. So why do it with nowness?

[18] Prior, "Thank Goodness That's Over," *Philosophy*, XXXIV, 128 (1959): 12–17.

[19] I am glossing over the fact that it takes a brief amount of time for an event to cause an experience in a subject.

mental properties fails. But, for the reductionist, dualism furnishes just as much ontology as does physicalism; once we have accounted for the oomph of consciousness, whether it be by endorsing physical brain states or by endorsing irreducibly mental brain states, we have endorsed enough to account for the oomph of the now. We do not need a property of nowness in addition to everything else.

Let us turn to the antireductionist argument for the ontological relation of passage. The heart of the antireductionist view of time is that passage is an ontological feature of the spatiotemporal manifold and that our experience of the world reflects our ability to detect this fact. Recall Williams's evocative description of how the antireductionist takes our experience as of passage to be an undeniable feature of our experience and Maudlin's emphasis on "the manifest fact that the world is given to us as changing, and time as passing."

One problem is that it can be hard to figure out exactly what passage is supposed to be. As Richard Taylor notes, "passage, which seems to be such a basic and even necessary characteristic of reality, has always profoundly bewildered philosophers."[20] The reductionist needs to consider the idea of passage carefully and with as much clarity as possible in order to understand how to address antireductionist intuitions about its existence.

First, we will need to try to be clear about what, exactly, passage is supposed to be. It might help first to be clear about how it is supposed to be necessary for change. What is common to all antireductionist accounts of passage is a heavy emphasis on the idea that some sort of passage, which we detect by detecting some sort of animated character or flow, is necessary for (real) change. Now, the question is, is passage simply change? If so, is it simply change of the sort that we detect when we see a spinach leaf change from crisp to wilted?

Antireductionists usually take passage to be something more than the sort of change we see in the spinach leaf. The something more is what necessarily underlies the change of the leaf: events such as the event of the leaf being crisp passing out of the now (perhaps understood as this event passing out of existence or, at least, as passing out of some sort of robust form of existence), and the event of the leaf being wilted coming into the now by coming into existence (or by the event gaining some sort of more robust existence than it already had).

The antireductionist C. D. Broad liked to understand passage in terms of becoming. Becoming is probably best understood as the successive coming into nowness of events in the manifold, at each

[20] Taylor, "Time and Eternity," in Loux, ed., *op. cit.*, pp. 279–288, see p. 279.

successively present time. Those who endorse "pure" or "absolute" becoming as what passage fundamentally is will hold that even without qualitative change there still is passage.

Taylor has the clearest account of passage and its relation to change that I have found: "Let us use the expression 'pure becoming' to designate the passage through time to which all things seem to be subjected, merely by virtue of their being in time. It is aptly called *pure* becoming because any other kind of change or becoming that anything might undergo *presupposes* this kind of change, whereas this pure becoming presupposes no other change at all. Thus, in order for anything to become red, or square, or larger, or weaker, or whatnot, it must pass through a certain amount of time, which is equivalent to saying that it must *become older*. The fact that something becomes older, however, or that it acquires a greater age than it had, does not entail that it undergoes any other change whatever."[21]

The question that we must consider here is just how we are supposedly detecting or experiencing the fundamental physical fact of passage. What experience is it that underlies the antireductionist's reverence for the ontological posit of passage? The antireductionist seems to think that, if we deny the existence of passage, by extension we deny a fundamental element of human experience. Hence, for him, the denial of passage borders on the absurd.

Let us look at this more closely. As I have noted, the antireductionist seems to take it for granted that we perceive passage. But what exactly do we perceive when we are supposed to be perceiving passage? How, exactly, does our temporal experience support the inference that there is passage? The "received view" for the antireductionist seems to be that (i) we all have experience as of change (which can include experiences as of things beginning or ending their existence), that (ii) this experience as of change involves the detection of a certain sort of animated character or flow that really exists in the world, and that (iii) this detection allows us to infer that there is passage (or becoming). The inference to the existence of passage is the inference that there exists some sort of physical flow or ontological relation (namely, passage) that we are detecting via our experience as of change, such that this physical relation (namely, passage) is the source of the character of the experience that we are having. In sum, the antireductionist thought seems to be that we need to have passage in order to have the animation associated with "real" change and that we need to have this sort of "real" change in order to account for our experience as of change.

[21] Taylor, *op. cit.*, p. 281.

We can certainly call to mind many examples in which we have an experience as of motion or animation as part of our experience as of change. As the leaf turns from crisp to wilted or one's coffee cools from hot to lukewarm, we do seem to observe a change of properties in an animated way. But do we have experiences as of pure becoming independently of our experience as of change? Antireductionists are silent on this point. There is no claim (at least no claim that I have been able to discover) that we somehow have experiences as of passage apart from experiences as of change, although, as we saw with Taylor, the antireductionist certainly infers that pure becoming is possible on the basis of our experience as of change. The argument for the existence of passage relies solely on our experience as of change, rather than on any claim that we somehow directly or independently detect passage as a fundamental feature of the universe.

What should the reductionist say in response? She definitely should not deny that we have experiences as of change. We do have such experiences. (Recall that, by "experience as of change," I merely describe an experience in which we seem to detect a flowing or animated replacement of suitably intrinsic properties.) She also should not deny that there is real change, although she will define it differently from the antireductionist, since she will hold that real change is just the replacement of suitably intrinsic properties at successive times. In response to the antireductionist, the reductionist should deny the inference from our experience as of change to the existence of passage. To do this, she should explain how our experiences as of change could derive from our cognitive reaction to the successive replacement of properties—but in a universe without passage.

Let's explore how the reductionist can do this. What needs to be given is a plausible account of how our experience as of change could be a cognitive reaction to the successive replacement of suitably intrinsic properties (as understood by the reductionist—that is, when O changes from P to Q, this is merely the successive replacement of suitably intrinsic properties). What needs to be shown is how experience as of change does not require some sort of empirical detection of passage.

Perhaps the reductionist can explain our experience as of change as resulting from a kind of comparison that we make from within. In this approach, we (mentally) step back and notice a contrast between the subjective experiences that we had of events in the past and the subjective experiences of more recent events, and this is responsible for our experience as of change and hence our experience as of passage. Put that way, it just cannot be right.

Here is the philosophical problem with such an account (there may be empirical problems, too). The four-dimensionalist understands

events in time to exist as a series of temporal stages, with a stage located at each time. Individuals having experiences are parts of such stages: the (continuously persisting) individuals having experiences exist as a series of stages that are proper parts of the world-stage at every time. We cannot explain our experiences as of change in terms of mentally stepping back and making a subjective comparison or marking a contrast between experiences had at earlier times and experiences had in the present, because an experiencing stage cannot escape the stage that it is in. We cannot, as subjects, compare experiences in different stages, because we cannot stand above or apart from our stages to make such a comparison, and we always have an experience at a time and, hence, within a stage. Experiencers are stage bound.[22]

This relates back to the point made above that one's sense as of redness-now is a stage-bound sense. How, then, can the reductionist explain our experience as of change? Perhaps we make "from within" a cognitive contrast between the subjective nature of memories we are having at that time and more "direct" subjective experiences that we are having at that time. Bertrand Russell suggests something like this in his account of time and temporal experience.[23] As long as such a contrast is within-stage, it is philosophically possible for this to be the explanation, but it is not particularly plausible. A surmountable worry is that it seems like we need to multiply subjective stances at time *t*: we have the subjective experience of the memory at *t*, the subjective experience caused by the event at *t*, and the subjective experience of the contrast at *t* between the other two subjective experiences. A more problematic worry (at least for me) is that we notice contrasts in our experience on a regular basis—for example, between differently shaded portions of a drawing or between different locations of the red and green M&Ms scattered across the desk; yet, such contrasts do not seem to suggest the sense of movement or flow that we have when we have experiences as of change.[24] Merely detecting a phenomenal contrast is not enough to cause our experience as of change.

There is a much better way for the reductionist to use our detection of contrasts to make sense of our experiences as of change and passage. To prepare the ground for my account, I will first describe an interesting

[22] The endurantist might have a slightly easier time with this problem, but I think it will get her in the end. The trouble is that, even if an individual endures through each period of time, just as with perdurantism, she never steps outside of the temporal period that she is in, and so she cannot make the cross-time comparison that would be needed.

[23] Russell, "On the Experience of Time," *Monist*, xxv, 2 (1915): 212–33.

[24] I am indebted to Robin LePoidevin for this observation.

and empirically well-documented fact about our experience—namely, the illusion we have when, first, one small dot is shown on the left-hand side of a computer screen and then, very quickly, that dot disappears and a small dot is shown on the right-hand side of a computer screen. Then, the right-hand dot disappears, and the left-hand dot appears, again and again, in rapid succession. Even when we are told that what the computer is actually doing is merely blinking different dots on alternating sides of the screen, as long as the succession is rapid enough and spatiotemporally close enough, *the effect is that we have the illusion of the dot moving back and forth across the screen.* This is what cognitive scientists usually describe as "apparent motion."[25] To get an intuitive sense of this experience, think of the way in which we experience the illusion of motion when we view a series of slightly different slides quickly, as in films, time-lapse photography, or old-fashioned flip books. It is the very same phenomenon.

To the extent that other sensory modalities (such as our sense of touch) might give rise to similar phenomena, there are similar results available. The cutaneous rabbit experiment documents how one seems to feel an object continuously hopping along one's arm with only a series of appropriately spaced taps (usually, three places are tapped—the wrist, close to the elbow, and the upper arm area—but the subject experiences the illusion of the "hopping" moving up the arm, with the feeling of hopping occurring even between the taps).[26] One might argue that related auditory phenomena have been observed with spectral motion aftereffects, with appropriate experiences of a Shepard scale, or with everyday experiences of listening to stereo.[27] However, I will focus on our visual experience, as visual stimuli seem to be the primary vehicle that sighted individuals use to detect change and motion.

The results about apparent motion are part of a wealth of data from cognitive science showing that the brain performs some sort of interpretative function when it processes sensory information that it receives from relevant, appropriately located stimuli. Experimental

[25] Max Wertheimer, "Experimentelle Studien über das Sehen von Bewegung," *Zeitschrift für Psychologie*, LXI, 61 (1912): 161–265. Another, related phenomenon is "flicker fusion," where the rate of the flickering light of a computer or television screen or of a fluorescent light is calibrated so that we have an experience as of a light that is on continuously.

[26] Frank Geldard and Carl Sherrick, "The Cutaneous 'Rabbit': A Perceptual Illusion," *Science*, CLXXVIII, 57 (1972): 178–79.

[27] I am indebted to Daniel Dennett and the members of his Tufts reading group for the suggestion about stereo. A member of that group, Anselm Blumer, also suggested that auditory backward masking might be another good example.

results strongly suggest that some sort of sensory processing prior to the brain's representation of motion is responsible for our experience as of motion or as of change, in these experiments. Another well-known case in which we see the interpretative role of the brain in the representation of motion is with the "flash-lag" phenomenon, which involves visual effects derived from comparisons between the trajectory of a moving object juxtaposed with a brief presentation, or "flash," of a second object.[28]

So, the psychological response that generates the illusion of apparent motion is well documented and has been extensively analyzed. But with our case of apparent motion, how exactly does the brain process the inputs of the series <dot flash, left side>, <dot flash, right side>, <dot flash, left side>, <dot flash, right side>, and so on? One model of how to understand the processing involves the brain somehow modifying the series of conscious experiences of static left- and right-side flashes, to give the impression of motion, and we somehow ignore (or erase) the experiences of the static flashes qua being static. But a second model allows the input to the brain to be modified prior to any conscious experience, such that the only conscious experience is of the illusory motion.[29] In the second model, there is no experience of a static dot that is somehow erased; rather, there is an input to the brain at one time and then a second input at a slightly later time, and then the brain interacts with these inputs *prior* to producing a conscious experience.

Personally, I prefer the second model (such a model can be made consistent either with Dennett and Kinsbourne's "multiple drafts" model or, for example, with Velmans's integrationist model of consciousness[30]), but this is not essential for the use that I want to make of the fact that we have this illusion. I simply think that the second model makes the overall story cleaner and more plausible, because the second model itself is cleaner and more plausible. What really

[28] David M. Eagleman and Terrence J. Sejnowski, "Motion Integration and Postdiction in Visual Awareness," *Science*, CCLXXXVII, 5460 (2000): 54–60. See LePoidevin (*op. cit.*, section v.5) for more discussion of our interpretation of phenomena and the brain's role in our experience of motion and the flash-lag phenomenon.

[29] Max Velmans, "Is Human Information Processing Conscious?" *Behavioral and Brain Sciences*, XIV, 4 (1991): 651–726; and Velmans, "Is Consciousness Integrated?" *Behavioral and Brain Sciences*, XV, 2 (1992): 229–30.

[30] Daniel Dennett and Marcel Kinsbourne, "Time and the Observer," *Behavioral and Brain Sciences*, XV, 2 (1992): 183–247. Velmans (*op. cit.*) would say that the inputs are processed by the brain and then there is a single, integrated stream of consciousness or experience that results. Dennett and Kinsbourne would say only that the resulting representation is the product of the brain's interpretation or processing: there is only a "parallel stream of conflicting and continuously revised contents."

matters for what I want to say is that it is an experimentally documented fact that we have the illusion of motion when presented with a series of appropriately related static images and that our best data indicate that the brain plays an important interpretative role in representing the animated effects we experience (but not in any way that Russell envisioned). I will use this fact in giving an account of our experience as of change and passage, although I also will assume the preconscious model of how this happens.

Fix in your mind what happens with our sample case of apparent motion created by the computer: our experience as of motion arises when the brain receives a series of inputs from an ordered set of events at closely located spatiotemporal positions, where the source of each input has a different spatiotemporal location from the one prior to it in the ordering. In the experiment, two things happen. First, the brain responds by somehow managing these inputs to create the impression that a persisting dot is moving back and forth between different spatiotemporal locations. Second, the brain's response also creates the impression that the change is continuous—that is, it creates the impression that the dot moves across the screen by moving smoothly and continuously from one side of the screen to the other. What seems to be creating this experience is that the brain needs to (precognitively) manage some contrasting appearances: the brain receives an image of a dot with a spatiotemporal location, and then, in the next moment, it receives another image representing a qualitatively identical dot at a different spatiotemporal location quite close by; in order for the brain to make sense of these contrasting facts, it represents the images as a persisting dot moving from one location to the other. The illusion also is perceptually stable, in the sense that even when a subject knows that she is merely seeing a series of discrete, unmoving images, she will still experience an illusion as of a persisting, moving dot.

The original experiment only compares changes in location. But when the *color* of the dot differs (the color depends on which side of the screen an image flashes, say, red on the left and green on the right), the brain's response to these incompatible colors creates the impression that there is still a single, persisting, moving dot, but this single, persisting dot's color seems to *change* from red to green and back again as it moves back and forth across the screen (each color change seems to occur about halfway along the trajectory). This is often called the "color phi" experiment.[31] Color phi is important

[31] Paul Kolers and Michael von Grünau, "Shape and Color in Apparent Motion," *Vision Research*, XVI, 4 (1976): 329–35. The experiment was conducted at the suggestion of Nelson Goodman.

for my view: when there are qualitative differences between the static images of the dots shown on the different sides of the screen, the brain represents the situation as though there is an animated qualitative change in a dot from red to green, and this representation is as of an animated, qualitative change that is no different in character from other sorts of visual experiences as of change that we normally have as part of everyday experience. The take-home message here is that *the color phi experiment gives us the illusion of the animated character of qualitative color change.*

The results of this experiment should not surprise us if we have any knowledge of how films, television, and video representations work. We constantly use these media to generate experiences as of change that are indistinguishable from our ordinary experiences as of change in our immediate surroundings (setting aside picture quality and other irrelevant issues). But the media work by presenting a succession of static images with only short temporal intervals between them. In other words, all they present to us is a series over time of static impressions with a certain amount of constancy of resemblance. Our brain then receives and interprets these inputs, representing certain types of constancy as persistence and successive contrasting properties as changes that have the animated, flowing character of our ordinary experiences as of change.[32]

This gives us the basis on which to explain our experience as of change and passage in the static universe of the four-dimensionalist. Recall that we are assuming that conscious experience is reducible to the having of neural states. In these terms, the way to interpret the color phi case is that the illusion of animated color change occurs when the inputs <red dot flash, left side>, <green dot flash, right side> are manipulated by the brain to produce a neural state that (falsely) represents that there is a moving dot that is changing color as it moves. The phenomenal experience that we have is as of a persisting, moving dot changing its color from red to green. Here, the qualitative character of the change that we seem to experience is just as it would be if we were to see an actual color change of a persisting, moving dot.

How can the reductionist use this to provide an account of our experience as of change and passage? Recall the reductionist's theory of change: object O's change from P at time t_1 to Q at time t_2 reduces to

[32] For an excellent review of work in psychology on the ways in which we make representative sense of contrasts and constancies in order to construct impressions of objects persisting and changing over time, see Brian J. Scholl, "Object Persistence in Philosophy and Psychology," *Mind and Language*, XXII, 5 (2007): 563–91, especially section IV. For new work on the topic, see Brandon Liverence and Scholl, "Do We Perceive Events in Time, or Time in Terms of Events?" (unpublished manuscript).

O having suitably intrinsic property *P* at t_1 and *O* having suitably intrinsic property *Q* (instead of *P*) at t_2. Now recall the antireductionist objection: how can the reductionist, with only her static universe on which to draw, accommodate experiences that seem to suggest that change requires more than (so-called) changeless facts? If all she admits into her temporal ontology are the stages of *O* being *P* at t_1 and *O* being *Q* at t_2, how can the reductionist account for our experiences as of passage and change?

The color phi experiment gives us the key. Remember what the cognitive science shows: when we have as inputs (i) the frame or slide <red dot flash, left side> and then in close succession (ii) the frame or slide <green dot flash, right side>, and so on, we experience the illusion of motion and the illusion of an animated change of color in order to accommodate the contrasts between the frames.

Now think about our experience as of change in *O* from *P* at t_1 to *Q* at t_2 in the same way: when we have this experience, the brain receives information from the temporal stage t_1, in which *O* is *P*, and then information from the subsequent temporal stage t_2, in which *O* is *Q*. The reductionist can hold that, just as with cases of apparent motion (and with color phi in particular), we experience an illusory sense as of flow and change as the result of the brain's need to accommodate the contrasts between the stages t_1 and t_2.

How does this work? The idea is that, just as the cognitive science suggests, the brain processes the series of inputs and produces a mental representation or experience as of *O* changing in some suitably animated or flowing way from being *P* into being *Q*. More generally, when we have an experience as of passage, we can interpret this as an experience that is the result of the brain producing a neural state that represents inputs from earlier and later temporal stages and simply "fills in"[33] the representation of motion or of changes. Thus, according to the reductionist, there is no real flow or animation in changes that occur across time. Rather, a stage of one's brain creates the *illusion* of such flow, as the causal effect of prior stages on (this stage of) one's brain.

Do not claim that a direct perception of the flow of passage must be what is responsible for our illusion of the flow of the apparent motion—this cannot be right. For increasing the spatiotemporal distance between the images does not change the fact that there is

[33] Not literally. It just gives the impression of being filled in. There is no "figment," as Dennett would say. See for example Dennett, "Filling In versus Finding Out: A Ubiquitous Confusion in Cognitive Science," in H. L. Pick, P. van den Broek, and D. C. Knill, eds., *Cognition: Conception and Methodological Issues* (Washington, DC: American Psychological Association, 1992), pp. 33–49.

passage (or would not change this fact, if passage actually existed): the images still occur in the same spatiotemporal order and so would still pass, in the relevant sense, from the future to the present and into the past. However, merely increasing the spatiotemporal distance between the images causes the illusion of flow (and of flowing color change in the color phi test) to disappear: subjects just have experiences of a series of qualitatively different static images at different locations, instead of a persisting object that appears to move and change (in a flowing sense) from red to green. The reductionist draws from this the conclusion that our experience as of flow in this case is simply a cognitive response to the spacing of the different causal inputs.

The reductionist can then argue that, if the brain can create the illusion of flow in cases of apparent motion, then it can create the illusion of flow in cases of experiences as of passage. In other words, the reductionist can use the experimental facts involving apparent motion, apparent change, and apparent persistence to argue that, even though all she endorses is the existence of a static universe of a series of stages, this is sufficient for the brain to produce the illusion of motion and flow involved in the experience as of change. She can argue that, just as the series of frames of <red dot flash, left side> and <green dot flash, right side> are static inputs that create an experience as of change in color and an experience as of a persisting dot moving from the left side to the right side, the series of temporal stages in which *O* is *P* and in which *O* is *Q* are static inputs that create an experience as of change from *O* being *P* at t_1 to *O* being *Q* at t_2. To rephrase slightly, frame one (temporal stage t_1) is *O* having *P* at t_1. Frame two (temporal stage t_2) is *O* having *Q* at t_2. Frame three (temporal stage t_3) is the brain having the neural state caused by input from frames one and two. The reductionist can argue that the neural state at t_3 realizes the experience as of *O* having *P* at t_1 and then changing in some "flowing" way to *O* having *Q* at t_2. In this way, the reductionist shows how the brain could interpret the information it receives in order to realize experiences as of flow or animation, that is, as of change and, by extension, as of passage. As a result, the reductionist's parsimonious ontology is sufficient to explain how we can have experiences as of change.

To take us back to a concrete case, think of how time-lapse photography works, and imagine watching a film of a seedling in the ground sprouting and then the bud slowly growing and, finally, bursting into bloom. The film is a series of stills, but our experience is as of watching a flower come into existence, with all the glory and animation suggested by Broad's and Taylor's ideas about becoming.

The representations that give us experiences as of change also are responsible for our sense of forward motion through time. Part of the

intuitive basis for the antireductionist view about passage, as Williams described, is the subjective sense we have as of being selves moving through time or moving into the future: "Here is the flood on which the oldster wakes in the night to shudder at its swollen black torrent cascading him into the abyss." An individual has an experience as of time's passing, one that the antireductionist might describe as an experience that one has in virtue of experiencing the becoming of successive nownesses of events along the timeline.

This strong sense of temporal motion is part of what is explained by the reductionist as an illusion derived from successive qualitative inputs. Our sense of temporal motion is an illusion that is a cognitive response to a series of qualitative inputs from a temporally ordered series of events, akin to the visceral sense of forward motion that one gets by sitting in a stationary train and looking out the window at another train moving backward. (Just understand the cognitive input described as the "train moving backward" as a series of inputs from appropriately spaced images with the right qualitative contrasts.)

This makes good reductionist sense. Just think about what it is like to watch an action movie or to have a virtual reality experience in which the perspective of the viewer is located as though it were within a moving vehicle. When one has such an experience, all one literally has as cognitive inputs is a succession of static images, yet one can have the experience as of having cars speed past you in the opposite direction on the highway or as of swerving right and left (in order to avoid the bullets of the bad guys flying past you). The reductionist argues that our cognitive management of and representation of a series of inputs is what gives us, in the same sort of way, the experience as of moving temporally forward or, conversely, the experience as of being stationary while events move past us.

So, the reductionist explanation of our temporal experiences as of passage and change is that the brain manages contrasts between causal impressions of property instances that it receives in quick succession in a way that creates these experiences. The brain responds to closely spaced inputs that have sufficient similarity (yet have qualitative contrasts of some sort) by accommodating and organizing the inputs. In doing so, our brains create the experiences we have as of change and as of temporal motion. As I described above, the claim that the brain does this is supported by work in experimental psychology.[34]

[34] For a thoughtful and interesting discussion of the data on children's temporal experience, see chapter 6 of Alison Gopnik, *The Philosophical Baby* (New York: Farrar, Strauss & Giroux, 2009).

This understanding of the cognitive science suggests the following thought experiment: if we were in an entirely static environment where there were no contrasts between property instances (this would have to include no contrasts with respect to properties of my thoughts), then it would seem to us as though time were standing still. And, indeed, I think this is a very plausible supposition. We can even have such a sensation when there are contrasts in our environment that we could perceive in principle but, for some reason, are unable to attend to, such as when we are extremely shocked or surprised. If the brain does not have a suitable series of successive inputs involving contrasts it needs to manage (such contrasts even can include apparent differences in location or existence at a location where nothing existed at the previous stage), then it need not resolve anything by representing a change. In such a case, the subject will have no experience as of change or as of passage. This conclusion is supported by the work of Brandon Liverence and Brian Scholl, who show that subjects' perception of discrete events affects their perception of the rate of passage.[35] It also is important to remember that my account of just how the brain constructs the experience as of passage is put forward merely as an empirical possibility that is suggested by the science: further work in psychology may confirm or disconfirm the account. As long as there is some plausible reductionist account available of the way the brain constructs experiences as of passage, the reductionist is vindicated.

The antireductionist may wish to object by arguing that the reductionist's account cannot really capture our experiences as of passage

[35] There is a lot of work on the subjective perception (as) of the rate of passage. Although there is still debate over the exact mechanisms behind the various ways in which subjects experience changes in how time seems to pass, it is abundantly clear that many extraneous factors affect subjective temporal experience as of passage, including the subjects' emotions, the amount of repetition and flickering of stimuli, and external environmental factors, and there seems to be abundant evidence that brain processing is heavily involved in our experience as of passage. Eagleman, "Human Time Perception and Its Illusions," *Current Opinion in Neurobiology*, XVIII, 2 (2008): 131–36, describes the current physiological model as proposing that "the passage of time can be encoded in the evolving patterns of activity in neural networks" (p. 134). Another paper speculates that richer memories are somehow involved in our experience (as) of the slowing of passage (the speculation is based on data collected from bungee-jumping subjects, along with the assumption that perceptual resolution would increase during such an experience). See Chess Stetson, Matthew P. Fiesta, and David M. Eagleman, "Does Time Really Slow Down during a Frightening Event?" *PLoS ONE*, II, 12 (2007). There is also fascinating work on what has been labeled "akinetopsia" that is based largely on a famous case study of a woman with neurological damage who experienced the world as a series of sequential frozen images. For a classic article describing the phenomenon see Josef Zihl, D. Yves von Cramon, and Norbert Mai, "Selective Disturbance of Movement Vision after Bilateral Brain Damage," *Brain*, CVI, 2 (1983): 313–40.

and change because the experiencer is stage bound. The claim here is that we cannot transcend our stages, and so we cannot represent cross-time change and passage in the way that the reductionist wants us to. It is a version of the objection to understanding our experience as of passage as resulting from standing back and making a subjective comparison between experiences. We might explain the concern as follows: if, for some subject *I*, each permanent, unchanging stage of *I* experiences its properties only within its stage, how can our experience as of passage and change be accounted for?

In the context of an explanation that attributes our sense of passage to representations created by the ways that the brain preconsciously manages certain sorts of contrasts over time, this objection makes an important error. The error involves the implicit assumption that, for one to have experiences as of change or passage, there is a need for some sort of cross-stage homunculus that can step outside the stages and watch changes occur. If there is no such homunculus (and of course there is not) and if the individual at a time cannot step outside her stage, the error generates the problem of how an individual can compare cross-stage facts in order to have experiences as of change and passage.

To see the mistake here, look back at how we need to understand apparent motion. Recall that the brain preconsciously manages successive inputs of <red dot flash, left side>, <green dot flash, right side> to produce the conscious experience that is an illusion of flowing change in location and color. We know that the inputs in this case are two static "stages," not a single changing entity. Each input is an input of information from a static stage: input 1 at t_1 is <red dot flash, left side>, input 2 at t_2 is <green dot flash, right side>, and so on.

Here's the important bit of the reply to the objection: the best interpretation of what happens with apparent motion is that a stage of the brain collects static inputs of earlier stages and then a successor stage of the brain modifies them, producing a neural state in yet another stage that gives the subject (*I*) an experience as of passage and as of change. What is *not* happening is that a part of *I*'s brain is somehow acting like a homunculus, stepping apart from stages and interpreting a series of experiences to produce an experience as of passage and change. Rather, there is a stage of *I*'s brain that results from the causal inputs of the stages of <red dot flash, left side> at t_1 and <green dot flash, right side> at t_2. A subsequent stage is the result of *I*'s brain having processed these inputs, a stage that realizes *I*'s experience as of a persisting, moving dot animatedly changing from being red into being green. So, the first point is that the process is a series of causally connected frames or stages. But the

second point is crucial: we must remember, as William James famously noted, that the representing entity need not be similar to what it represents. In other words, the neural state that represents the change, the state which is the experience as of change and passage, can itself be *static*. (Or, if one denies token-token identity, take the realized mental state to be a static event.) That is, the neural state realizes in us the experience as of change and passage by representing things in a certain way; to do so, the state does not itself have to change, nor does it require the experiencer to step outside her stage.

I am sure that I have not accounted for every conceivable intuition about our experiences as of nowness, change, and passage that the antireductionist can evince. But I believe I have shown how the reductionist can reasonably account for the main intuitions that antireductionists have deployed in support of their ontology. If the reductionist can provide a reasonable explanation of how we have experiences as of nowness, passage, and change, she breaks the connection between temporal experience and temporal becoming, thereby working a deep change in the dialectic.

Recall the antireductionist argument:

(1) We have experiences as of the nowness of events.
(2) We have experiences as of passage (and as of change).
(3) The thesis that there are temporal properties of nowness and passage provides the only reasonable explanation of why we have these experiences.
(4) The thesis that there are temporal properties of nowness and passage provides the best explanation of why we have these experiences.
(5) Hence, there are temporal properties of nowness and passage.

If the reductionist account of how we have experiences as of nowness, passage, and change provides a reasonable explanation of why we have these experiences, (3) is false. This immediately changes the dialectic: reductionists and antireductionists now need to argue over which explanation of temporal experience is the best explanation.

My own view is that, given the amount of support from cognitive science that the reductionist explanation enjoys, the explanation refutes (4) as well. Moreover, although I have not discussed them here, other reductionist arguments from metaphysics, the philosophy of science, and the philosophy of language bolster the refutation of (4). But putting forward a fully developed argument against all ways of defending (4) requires a paper of its own, so I will not argue the case here.

I will close with a discussion of how these experimental results suggest a number of further points that I find philosophically interesting (a series of papers is in the works). First, as I have discussed above, our

experience as of change associated with motion can be an illusion in the sense that a series of static, ontologically distinct images of similar instantaneous objects can create a response in us that is phenomenally identical to what it is like to see a persisting, changing, moving object. This gives us the interesting result that, for normal humans, there may never be a phenomenal difference between our experience of a series of instantaneous, qualitatively similar objects that are appropriately spatiotemporally spaced and our experience of a moving, changing, persisting object with the same qualitative and locational variation as the series.

A second point follows: an important ontological difference between a moving, persisting object and a series of instantaneous objects that are appropriately spaced is that the moving object persists while the objects in the series do not. But is there another ontological difference? In particular, does the motion of the persisting object actually involve any sort of animated character across time? Does real motion, as opposed to merely apparent motion, really involve the sort of flow or animation that we commonsensically ascribe to it? I think that if the animated character of our experience is illusory in the instantaneous case, there is no reason to suppose that it is any less illusory in the case in which a persisting object is actually moving. Indeed, Occam's razor suggests that the flow or animated character that we often refer to as "motion" is just a mistake. Motion is simply the change of location of a persisting object, and the flow or animated character that we notice and identify with motion is merely an effect of the brain. Recall the Kripkean distinction between heat and the sensation of heat: the distinction here is similar.

Hence, the apparent motion in our sample case in which a computer blinks dots on alternating sides of its screen presents us with two illusions. The first illusion is as of motion, that is, as of a persisting object changing its location (motion requires persistence, but the dots are not causally related in a way that is suitable for the persistence of a single dot, so our sense that we are seeing the motion of a dot is illusory). The second illusion is as of flow or animated character, that is, of the animation arising from "the motion of the dot," which derives from the brain's need to preconsciously accommodate certain kinds of contrasts of property instances. These illusions are different because motion is not flow.

Finally, these results have implications for work on the metaphysics of persistence. The two main ontological approaches to persistence are those of the perdurantist, who takes objects to persist as a series of appropriately related temporal stages of objects, and the endurantist, who holds that at least some of the objects in the world endure

through time without perduring.[36] Endurantists often assume that their view is the more plausible one, since it reflects our experience of persisting objects as enduring through time and change. Since the perdurantist takes persisting objects to persist only by having a bunch of appropriately related but numerically (and perhaps mereologically) distinct stages spread across time, she seems to be adopting a view that is harder to make consistent with our commonsense experiences. But perdurantists should take note: my discussion above suggests that, just as there is no argument from ordinary experience for nowness and passage, there is no argument from ordinary experience for endurantism.

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[36] I am falsely assuming, for the sake of simplicity, that stage theory is classed as a variety of perdurantism.

NATURE WITHOUT ESSENCE*

Sense-making animals that we are, we would like to understand Nature. I grew up being taught and thinking on my own steam that if only we could understand the essences of things, we would understand the things proper. Essence was the key to Nature. I thus saw the great modern essence-dissolver, Quine, as wrong at the seams when he stigmatized the study of essence as merely "engendering an illusion of understanding."

And so my present findings are surprising; at least, they surprised me. The familiar *essentialist* line—one I trace back to Aristotle, Descartes, and, in our times, the inventive metaphysics of Kripke—is driving us away from, not closer to, the real nature of things. This line promised us a sort of Hubble telescope—*essences*—able to reveal the deep structure of reality. As often in such philosophical undertakings, we fall in love with the means and forget the original end—we linger on the telescope's mirrors and shun the galaxies beyond. I call this methodology *Essences (natures!) without Nature*. To re-embed us in Nature, we must excise the telescopic high technology—essences—and let raw global (capital-"N") Nature make—*produce* by intra-cosmic processes—our (little-"n") local natures, be they the natures of the primes and right triangles, of whales and diamonds, all the way down to singularities, such as the natures of Queen Elizabeth II and this particular volcanic peak, Krakatoa. I characterize the alternative methodology as pursuing *Nature without essence*.

Descartes hailed essences as the "light of Nature." But his "light" was not real light—intra-cosmic radiation—and by "nature," he meant true and immutable natures (essences!) given prior to and independently of...Nature. It was this kind of armchair x-ray vision that led Quine to berate essences as engendering an *illusion* of understanding.

The findings below reveal a double illusion. On the metaphysical front, the natures of things are neither exhausted nor even partially given by their "defining essences." On the epistemological front, knowledge of (enlightenment about) the nature of things—which, I argue, we do achieve in this life—is not reached by reasoning from

*Dedicated to the memory of Paul Hoffman, whose unexpected death took from us a dedicated student of essence and a philosophical gentleman. The paper urges a turnabout against my earlier work on nature, essence, and necessity. For detailed references to earlier work, the onset of the turn, and my intellectual debts, see the final footnote of the paper.

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associated essences but by interacting intra-cosmically with real Nature by means of its true light (energy transfer).

I. THE CRADLE OF ESSENTIALISM

By the time Descartes wrote, there were two paradigmatic "models" of essence ("real definitions")—mathematical kinds and God. Both are cosmic outcasts, items existing apart from the material cosmos, with its natural-historical developments such as diamonds and whales. When Descartes describes the essence of the (piece of) wax ("flexible," "extended," and so on) in his Second Meditation, he operates at a very abstract level, assimilating this essence to the purely intellectual grasp we have—according to his famed Fifth Meditation—of the essences ("true and immutable nature") of a triangle and God.

In providing an essence for such an item, we provide an encapsulating formula defining the phenomenon—to be God is to be the supreme perfect being; to be a triangle is to be a three-sided polygon. The essentialist's capsule is meant to satisfy two desiderata—it is both *existence-* and *truth-exhaustive*. It is existence-exhaustive because it specifies an attribute the satisfaction of which is logically necessary and sufficient for being, for example, God or a triangle. Second, the capsule is truth-exhaustive because it promises that all the structural truths about triangles, God, and so on, follow from the attributive essence. Subsequent attempts to extend essentialism to natural-historical phenomena such as (the kinds of) physics, chemistry, and biology; a variety of artifactual kinds; and even, supposedly, particular historical individuals, follow this initial paradigm, with local tweaking. Perhaps in the natural-historical cases we must do a little "peeking" at the world ("Whales are mammalian!" "Diamonds are made of carbon!"). After this quick glance, however, we again assign existence- and truth-exhaustive essential attributes, giving us (i) logically necessary and sufficient conditions for being a whale or a diamond, from which follow (ii) all the structural (necessary) features ("propria") of whales and diamonds.

For Descartes, the case of God is modeled after the mathematical case of the triangle. In other discussions, in ancient Greece or in our time, while the case of God is bracketed away, the case of mathematical natures (and our understanding thereof) remains the cornerstone. I am happy to conjecture, in the mantle of an amateur historian of ideas, that if essentialism did not seem to us to work for mathematics, nobody would have tried to apply the idea to the intra-cosmic natural-historical kinds of physics and biology.

The primality of mathematics as a paradigm cuts our work for us. We must understand essentialism in its ground-zero case—as applied

to primes and triangles—if we are to assess its extendibility to natural kinds and historical individuals.

II. GROUND ZERO OF THE ESSENTIALIST MAN'S DREAM: MATHEMATICS[1]

Let us take the "simplest" mathematical case—the natural numbers—and attend to Richard Dedekind's analysis of the "essential nature" (his words, in his letter to Wilhelm Keferstein) of that structure he calls *N*:

> Which are the mutually independent fundamental properties of this sequence N, i.e. those properties which are not deducible from one another and from which all others follow? How should we divest these properties of their specifically arithmetical character so that they are subsumed under more general concepts and such activities of the understanding, which are necessary for all thinking, but at the same time sufficient, to secure reliability and completeness of the proofs, and to permit the construction of consistent concepts and definitions?[2]

[1] My title is a variation on "*jugendtraum*" (the "young man's dream"), which is the name Leopold Kronecker gives to a generalization-seeking program in number theory (taking off from a ground-zero case regarding all finite Abelian extensions of the rational numbers). Like the young man's dream, our essentialist man's dream begins with a ground-zero case of understanding-structure—mathematics—in which (he thinks) he has established a very powerful result about the role of essences. He then looks to (dreams to) generalize the technique to natural-historical extensions, such as physical and biological kinds.

[2] Dedekind's 1890 letter to Keferstein is reproduced and translated with helpful annotations in Hao Wang, "The Axiomatization of Arithmetic," *Journal of Symbolic Logic*, XXII, 2 (June 1957): 145–58. I first discuss arithmetic, which first was cast as the most elementary case in the late nineteenth century. Earlier, Euclidean geometry was regarded as another (or *the*) primal case. I turn to Euclidean geometry after arithmetic. For Aristotle's conception of Euclidean space and a foundational organization of his body of work, see Jonathan Lear, "Aristotle's Philosophy of Mathematics," *Philosophical Review*, XCI, 2 (April 1982): 161–92. For modern discussions of axiomatizations of Euclidean space (including the case of the "Archimedean axiom"), see immediately below in the text. For a basic introduction to the modern axiomatic project and David Hilbert's rationalist-essentialist program in particular, see Hilbert's "Mathematical Problems," *Bulletin of the American Mathematical Society*, VIII, 10 (July 1902): 437–79. Also important are Hilbert's "Axiomatic Thought" (1918) and "Logic and the Knowledge of Nature" (1930), both reproduced in William Bragg Ewald, ed., *From Kant to Hilbert: A Source Book in the Foundations of Mathematics*, vol. 2 (New York: Oxford, 2000), pp. 1105–15 and 1157–66, respectively.

Kurt Gödel offers related reflections on axiomatic thinking. The introduction to his 1929 thesis begins beautifully, with what is in effect a paragraph-by-paragraph response to Hilbert's discussion of Problem Two (see Gödel's *Collected Works*, vol. 1 (New York: Oxford, 1986)). Gödel further reflects on the complete-understandability project in his 1946 "Remarks on Definability" (*Collected Works*, vol. 2 (New York: Oxford, 1989)), and in his 1951 Gibbs lecture, "Philosophical Theorems in the Foundations of Mathematics" (*Collected Works*, vol. 3 (New York: Oxford, 1995)). Ernst Zermelo's key paper for building the operation 'set of' is the 1930 paper wherein lies his "second-order" categoricity result for his axioms (up to a rank of the hierarchy) (see "On Boundary Numbers and Domains of Sets: New Investigations in the Foundations of Set Theory," *From Kant To Hilbert*, vol. 2, pp. 1219–33). The strong infinity axioms (as in the axiom *F* of

Dedekind proposes two desiderata for such essentialist-axiomatic analysis. The first is *descriptive completeness*: the axioms must specify up to isomorphism the target structure, here the natural numbers. The second is *deductive-computational completeness*: Dedekind would like the understanding to track through the structure and "deduce all the truths that follow."

Dedekind considers an arbitrary domain *D* admitting a map *M* that is one-one from *D* to *D*. He also assumes a certain ground object *g* in *D* that is not given as an output of the map *M*. This much gives Dedekind infinite structures. Let us call such domains *Dedekind successor structures*. Dedekind worries that the map *M* might admit into such structures many "alien intruders," entities that (arithmetically speaking, for a moment) have infinitely many predecessors and thus are unlike the standard natural numbers, each of which has only finitely many predecessors. Of course, if we were allowed to use the determiner "finitely many," we could rule out the alien intruders. But this would be a vicious circle in a conceptual analysis meant to specify a numeric essence in the most fundamental terms.

Dedekind's solution is set theoretic. For instance, take the intersection of all such *M*-chains, the smallest among the Dedekind successor structures. This he calls the *simple infinite system*. Therein lies his analysis of the essence of *N*. In fact, we must be a tad more cautious than Dedekind. Here he specifies a certain isomorphism class of sequences, what we call omega sequences (his "simple infinite system"). Let us call this set-theoretic kind—whose instances are such set-made omega sequences—the kind of *Dedekind's omega sequences* (DOS). Dedekind makes a further substantial conjecture that *N* just is DOS. We will examine this more closely below, but for the moment, let us assume the conjecture and focus on the kind DOS.

There are reasons to worry about the feasibility of Dedekind's essentialist project. In Dedekind's time, before much sophistication was reached about the limits of formal systems, problems already were brewing. There were algebraic (or, if you will, purely *model-theoretic*) reasons to worry whether the informal compactness of logical reasoning can be combined with descriptive completeness. To give us a sense

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replacement) are independent and do not concern us here. Zermelo's work on finite sets in connection with a categorical understanding of the natural numbers (a case we will consider via Dedekind) is in "Sur les ensembles finis et le principe de l'induction complète," *Acta Mathematica*, XXXII, 1 (1909): 185–93. Our essentialist man's dilemma ("categoricity or compactness but not both") applies in all these cases.

of the impossibility result percolating here, I mention a quick (but not dirty) way to see the problem.

Suppose God came to Dedekind and said, "I have a straightforward solution to your descriptive completeness condition. Just write the condition 'everything x is such that $x=0$ or $x=1$ or $x=2$ or...'. I have now specified uniquely the target domain—the natural numbers."

"Indeed, God," would retort Dedekind, "but you have specified it in ways which are not computable by us humans. We are finite minds and can form only finitely long sentences (and arguments). Your divine characterization is descriptively complete, but it does not allow us understanding by means of computations we can carry out. Furthermore, the notion of *logically following* in your language will not be compact and thus will not be locally representable to finite minds. Either way, God, I cannot get an essence for N that is both descriptively and computationally complete."[3]

There is more in this vein in the domain of primal mathematics. Ironically, the essentialist's dilemma just raised—descriptive or computational completeness but not both—attaches to the original paradigm for the essentialist/axiomatic project, our understanding of the nature of Euclidean space. For this dilemma strikes Dedekind's notion of (the completeness of) the real line, eventually put in full axiomatic form by Hilbert in his 1899 axiomatization of Euclidean

[3] Such a reply would not have been available to Dedekind in 1888–1890. The insight was available by the time of Skolem's work on compactness and nonstandard models (see footnote 18 below). Still, as I will show, quite apart from the understanding that emerged between 1922 and 1930 of the limits of formal systems, there was purely *model-theoretic* ("algebraic") information available to Dedekind that could have clued him in to the tradeoff between descriptive completeness and consequence compactness. That is, any retreat to a consequence-compact (and mind-friendly) characterization of N would admit those "alien intruders"—meaning, nonstandard models of N—and hence descriptive incompleteness.

When teaching Dedekind and Hilbert's 1888–1900 work on axiomatization, I amplify on this alternate, purely model-theoretic route—via algebraic work on field extensions—to draw out the tension between the compactness of semantic consequence and the categoricity of axiomatization. I should also note that God's trouble here (namely, that his descriptively complete characterization is incompact and thus mind-boggling) is not contingent upon this particular choice of the infinitary axiom. Other such familiar descriptive-completeness inducers are also incompact, including: (i) use of the infinitary omega rule; (ii) use of the generalized quantifier 'finitely many' (to characterize the numbers in terms of each item in the domain having at most finitely many predecessors); (iii) use of the notion "finite set" (as in so-called "weak second-order logic" and as developed by Zermelo, see below), and (iv) the demand that the critical functions Dedekind introduces (addition, multiplication) be recursive functions (recall that nonstandard models of first-order Peano Arithmetic involve nonrecursive interpretations for addition or multiplication). Once the standard model, and thus the numbers' structural truths, are given uniquely incompactness strikes.

geometry.[4] Again, we find the split between (i) descriptive completeness afforded by a fuller ("second-order") language and (ii) the tractability of logical consequence ("compactness"). Here is a simple illustration of the problem.[5]

Very early in Euclid's work on overlapping circles sharing a point, he wishes to be able to presuppose that, given a segment (a straight line going a certain distance) *AB*, we can cover it by laying over it finitely many times another, shorter segment *CD*. We often call this the "Archimedean character" of lines. To so prove, Euclid needs to assume the continuity of lines (in Euclidean space). Now, when our language is strong enough to express the continuity intuitions, we do indeed get a categorical characterization of Euclidean space (with the notion of line coming as one would like it to be—Archimedean). But the notion of consequence is not compact (our language uses the idea of "finitely many" essentially). When we fall back on a restricted language with a mere schema for continuity (allowing us to characterize-analyze the features of the line only by means of the resources of the formulae definable in our formal first-order language), we get nonstandard models, with what is called the "hyperreal line," filled with infinitesimally small segments all close to a given point.

III. SUMMARY: PROBLEMS WITH THE GROUND-ZERO CASE OF THE ESSENTIALIST MAN'S DREAM

So much for the dilemma threatening the essentialist man's dream—a theory that is at once *exhaustive* of the structure of the domain and allows us to *reason* to all the domain's structural truths. However, there is one more problem here, and it lurks in Dedekind's reaction to the intrusion of the unintended twin alien structures. I will call this new problem of Dedekind's (with an eye to extensions to natural-kind cases, immediately below) the *H_2O problem of mathematics*. I so call it because, as with our understanding of water, it is natural to initially encapsulate our understanding in a functional essence/concept relating to how water looks and tastes; in the analogous case of the numbers, we would give a first-order (or: purely algebraic) characterization of the structure coming up in arithmetical computations. But we soon discover that this kind of surface-functional characterization is not *exhaustive*.

[4] Hilbert also alludes to this axiomatization in Problem Two of his "Mathematical Problems" (*op. cit.*) in which he set the essentialist man's "we must know, we will know" program.

[5] For background, consult Robin Hartshorne, *Geometry: Euclid and Beyond* (New York: Springer, 2000).

It allows unintended twins, alien intruders with different structures—water lookalikes that are not H_20 and lookalike infinite structures that are not the natural numbers. What is more, this nonexhaustiveness is in the very *nature* of such functional-algebraic characterizations—they admit of *extensions*. How are we then to segregate the intended core structure?[6]

The common response is to shy away from surface-functional concepts and move to a deeper level of structure. In the case of water, we specify the structure at the atomic level by characterizing our intended liquid as hydrogen hydroxide. Dedekind's move is analogous, stepping one level down from mundane combinatorial arithmetic and into a primitive set-theoretic language, an atomic-level language of mathematics rich enough to give us a description cutting off the intruding twins. Now, with the exhaustive "hydrogen hydroxide" and "the smallest infinite set (of course not just cardinality-wise but vis-à-vis the right well ordering)" we may wonder whether we are out of the woods.

The question now arises of our grasp of the deeper atomic language. How are we to understand "hydrogen" and "oxygen"? How are we to understand "all one-one maps on the domain" (or "all arbitrary subsets of the domain")? If we apply a surface-functional, definitionalist understanding at *this* level, we are back at square one, open afresh to alien intruders, pseudo-hydrogen and oxygen lookalikes, and, in tow, pseudo-theories of subsets or finitude.[7] The only way to stem the resurgence of alien intruders at the atomic level might be to *understand directly* the atomic notions—oxygen and hydrogen, or the notions of "arbitrary subset" and "finitely many"—not understand them through further conceptual essentialist definitions. We thus will be saying, "The buck stops here, and we can no longer employ understanding by way of definitional essences (axioms); we must now rest our case on direct cognition of some primitive notions of mathematics (Nature)."

This problem of Dedekind's, which I called the *H_20 problem of mathematics*, is one we shall return to later. It sends us looking for what it means to understand the H_20 nature of water and, more generally, for how to understand our account of the natures of natural (nonmathematical) kinds.

[6] We can view Hilary Putnam's twin-earth cases (and those discussed below) as such extensions displaying the limits of qualitative characterizations. See Putnam, "Reference and Meaning," this JOURNAL, LXX, 19 (Nov. 8, 1973): 699–711.

[7] Consider, for instance, Leon Henkin's second-order logic, formal understanding of "subset." See Henkin, "Completeness in the Theory of Types," *Journal of Symbolic Logic*, XV, 2 (June 1950): 81–91.

IV. NATURAL-HISTORICAL KINDS AND THE ESSENTIALIST'S DILEMMA

We are not the first to wonder about the feasibility of the essentialist program when it comes to natural kinds. Locke worried about just this question: simultaneously getting an essence that is both *real* (completely descriptive) and mind-friendly. He thought (without traversing the just-mentioned mathematical landscape) that we are trapped in such a dilemma. There is a *real essence* of gold all right, but it is mind-boggling, for it consists of an alignment of tiny physical particles making up the metal, and this alignment is inaccessible to the mind. On the other hand, the concept (essence) that is mind-friendly, for example, "yellow shiny metal" admits of alien intruders, that is, fool's gold. We might think that Locke was as worried as we are—no complete understanding-description of gold or tigers can combine metaphysical adequacy (genuine characterization) with human understanding.[8]

Modern work by Kripke and Putnam on the essences of natural individuals and kinds responds optimistically to Locke's dilemma. Compared to Aristotle's real definitions, Kripke and Putnam offer us *enhanced* essences, but essences—formulable in one short sentence and locally graspable—all the same. Kripke and Putnam appear to present an intermediary to Locke, in between his Nature-definitive but mind-boggling *real* essence and his mind-friendly but not definitive *nominal* essence—"*x* is water iff *x* is hydrogen hydroxide"—a "deep-structure essence" that is both mind-friendly and metaphysically definitive.[9]

V. KRIPKE-PUTNAM: ENHANCED ESSENTIALISM OF KINDS MADE OF NATURE?

It is often acknowledged that deep-structural essentialism is not as successful (for the Kripke and Putnam enhanced-essentialism project)

[8] Says Locke:

> Essence may be taken for the very being of anything, whereby it is what it is. And thus the real internal, but generally (in substances) unknown constitution of things, whereon their discoverable qualities depend, may be called their essence....
>
> ...the supposition of essences that cannot be known; and the making of them, nevertheless, to be that which distinguishes the species of things, is so wholly useless and unserviceable to any part of our knowledge, that that alone were sufficient to make us lay it by, and content ourselves with such essences of the sorts or species of things as come within the reach of our knowledge: which, when seriously considered, will be found, as I have said, to be nothing else but, those *abstract* complex ideas to which we have annexed distinct general names.

See John Locke, *An Essay Concerning Human Understanding*, vol. 2, trans. Alexander Campbell Fraser (New York: Dover, 1959), pp. 26, 28.

[9] For Kripke, see his *Naming and Necessity* (Cambridge: Harvard, 1980), Lecture III and pp. 156–58 (in the appendix). For Putnam, see "Reference and Meaning," *op. cit.*

when it comes to biological species (or other such historically sensitive kinds, like nations, continents, and so on; I will focus here on biological species). It is admitted that structural identity—at the genetic level—does not suffice for species identity. Animals roaming jungles on some planet at the other end of the galaxy with the tiger-look *and* the tiger genetic make-up but with a disjoint evolutionary history are not of the same species as the earthly tigers.

While this form of *cosmic historicity* is granted for species, it is taken as a peculiarity of species; ordinarily, kinds are considered ahistorical and exhausted by deep-structure definitions. I want us to look closely at the alleged contrast between species and substances, for I would like to argue that the cosmic historicity of species is not an exception that makes the rule. All kinds are Nature-made, and by intra-cosmic historical processes. It is just a question of isolating the right form of cosmic historicity for a given (type of) kind.

Why are species and substances thought to differ so deeply? Perhaps the guiding thought here—at least, so it is often put to me—is that to be a tiger, the newly born cub Nick has to be engendered *by* tigers. Thus, to be a tiger one has to come *from* tigers, and thus one has to be connected back through the pertinent branch of the tree of life. However, it is said, to be water or gold one need not have come from water or gold. And so any old material at the other end of the galaxy that displays the right structure—is made of oxygen and hydrogen atoms in the right way, or of protons and electrons in the right way (adding up to atomic number 79)—is an instance of water or gold, respectively. For physical-chemical kinds, deep-structure identity is sufficient for kind identity and existence.

VI. LOCALIST ESSENTIALISM

I have stated two claims regarding the sufficiency conditions of kind identity according to deep-structure essentialism. First, the essentialist claims that for the identity of chemical kinds, satisfaction of the sheer structure-concept (hydrogen hydroxide, for water) is sufficient. Second, it is claimed that the satisfaction of another structure-concept, *made of DNA* D, is *insufficient* for the identity of the species tiger. The two claims are illustrated by alleged (im)possibility claims about "twin earth" cases. It is not possible to think of a twin planet with hydrogen hydroxide that is not water. On the other hand, it supposedly is possible to contemplate a twin earth with items of DNA *D* make-up that are not members of *Felis tigris*.

Both claims seem to me to rest on a blind spot. The blind spots are related: the essentialist uses a conceptual essence that is an abstraction away from cosmic history; he replaces a cosmic *process* with

a defining *concept*. The essentialist strips away cosmic history (to wit: nonlocal information which is, in Locke's sense, "mind-boggling") and hopes he can reconstruct all there is to water and tigers from local, static-instantaneous snapshots, as if the generative cosmic history is redundant. Let us now develop this account of localist essentialism in some detail.

VII. THE INCOMPLETENESS OF LOCALIST ESSENTIALISM

The first issue before us is the alleged sufficiency of various essentialist definitions of kinds and how twin-earth cases bear on them. It is often said, using the idea of "accidental" swamp tigers, that items (the description says "animals," but this is unwarranted) with DNA *D* could materialize by "quantum accident" in a swamp, but they would make no tigers. In like manner, a lump of cells structurally isomorphic to a tiger's heart could arise in the swamp, but since it is not pumping blood in an animal (tiger), it is not really a heart. Living stuff—animal kinds or organ kinds—transcends the purely structural, as it transcends the purely qualitative. I will call he who so claims the *vitalist essentialist*.[10]

I think the vitalist observes something correct—the indispensability of nonlocal historical interactive processes—but draws the wrong theoretical conclusion—that conceptual definitions need to be preserved and so must be amplified to contain functional and historical conditions.

At the root of the vitalist's argument about the essence of living kinds lies a persisting abstractionism. Writers like Thompson invoke a depleted notion of instantaneous chemistry-physics, devoid of allusion to dynamical processes. The structural feature "entity of DNA *D*" is given in static, abstract terms, as a configuration of molecules plotted purely geometrically and disconnected from the cosmic processes giving rise to it. This abstractionism generates two interrelated mistaken claims. The first is that such swamp replicas satisfying the structural conditions are indeed possible. But they are not. What made in real life the real exemplar—the real tiger or heart—was not that it satisfied a structural predicate. What made it was a particular energy-involving generative cosmic process. And absent such an active cosmic cause—a complex process assembling particular ingredients in a particular niche under particular pressures—no tiger species and no

[10] A forceful example is provided by "The Representation of Life," Part One of Michael Thompson's *Life and Action* (Cambridge: Harvard, 2008), pp. 25–82. I read such claims as tracing back in inspiration to work by Philippa Foot and Elizabeth Anscombe on what is termed a "Neo-Aristotelian" approach to biological kinds. I owe thanks here to discussions with Mandel Cabrera.

hearts would emerge. So, first, the only way for such animals to emerge and for hearts to evolve is by cosmic processes. The threat to which the vitalist responds—the abracadabra mushrooming of structural twins—is illusory, for it is only the *process* by which the original living kinds emerged that made them the *kinds* they are. No such process, no emerging kinds. Conceptual definitions do not produce kinds.[11]

Next to the vitalist's second mistake. Having frightened himself that a structural defining predicate can have an unintended, "accidental" as it were, satisfier (swamp tigers and hearts), the vitalist's remedy is another dose of conceptual definitionalism. Just as the structuralist threw out the unintended qualitative twin intruders (twin-earth "water") by injecting structural conditions into his predicative essence, the vitalist blocks structural twin alien intruders by injecting functional and historical conditions into his defining predicates ("animal descending from ur-group *T*," "organ pumping blood"). The vitalist's proposed lesson is that essentialism is quite right, and it only needs an epicycle definition infusing functional-historical information. His lesson should have been orthogonal—the very method of conceptual definition is wrong at the seams. A definition, whether qualitative, structural, or functional, cannot replace a real causal cosmic process.

Since we are about to hit an analog issue in the philosophy of language regarding the definition of names (rather than things and kinds of things), let me explain the vitalist's mistaken theoretical conclusion by reflection on the semantic analog. The analog semantic question is what describes correctly the linguistic function of a name like "Aristotle," what explains its reference to that ancient Greek philosopher. Ever since Frege, semantic definitionalists have posited a *meaning* (Frege: *sinn*) for the name; the meaning/*sinn* is their semantic analog to the conceptual essence, as ontologically defining of the kind.

Frege was a first-wave meaning definitionalist. His meaning for "Aristotle" involved "surface" predicates such as is given by the description "the teacher of Alexander the Great." It is pointed out against Frege's surface-meaning definitionalism that (i) it is possible that the referent, the man Aristotle, might not have taught Alexander, and (ii) as in the twin cases, someone else might have been Alexander's

[11] The Thompson technique of imagining a molecule-to-molecule identical physical twin of mine that is not thinking or acting is as bankrupt as he who imagines, as in Kripke's *Naming and Necessity* (*op. cit.*), that this wooden table is iced or (and here Kripke himself errs, in my view) that my Zombie twin with his C fibers afire feels no pain. See more on such imaginative illusions below. I dissected them in my "Pains and Brains," *Philosophical Topics*, xxx, 1 (Spring 2002): 1–29.

teacher. "Very well," the second-wave meaning definitionalist replies, "look out for a descriptive meaning that is *modally rigid*, one that is satisfied only by the man Aristotle in all 'possible worlds'."

Yet problems still abound for the meaning definitionalist. In their semantic work, Kripke and Donnellan point out that the way a word comes to function in my mouth as a name for Aristotle is not at all by my head having a description—rigid or otherwise—whose satisfier is Aristotle. My head may have no such definite description. Rather, a process in history starts in the man Aristotle, and information from him is transmitted through that cosmic process all the way up to me. I am bound to that Greek man by the external process that brought his name to me, any (rigid) description in my head notwithstanding.

"Very well," says the epicyclic third-wave meaning definitionalist, "take this very process and make a descriptive condition out of it, namely, 'individual at the origin of the chain leading to our use of "Aristotle."' This is the definitive meaning explaining why the name 'Aristotle' refers to that Greek man, for it is he who satisfies the condition."[12]

The third-wave meaning definitionalist misunderstood Kripke and Donnellan's insight. Kripke and Donnellan did not point to the role of historical transmission in order to put a complex description into my head, the satisfaction of which is criterial for using the name. On the contrary, they pointed to the overall falsehood—at the seams—of the Fregean idea that the linguistic function of names is explained by a defining conceptual meaning. Rather, we look to worldly processes in cosmic history to explain how one object—the man Aristotle—gave rise to a name. By spatio-temporal energetic transmissions, the name ended up in another cosmic agent, Joseph Almog, who is thus linked to that ancient Greek man. To think this energy-based linkage is a conceptual meaning is a category mistake. An energetic cosmic process is not a conceptual definition.

In the case of biological kind identity, similar remarks apply to the epicyclic—function- and history-involving—ontological definitionalism of the vitalist. What the emergence of tigers and hearts teaches us is not that we should make the defining-concept conditions relate, in the former example, to sexual reproduction in that ur-group *T*, subsequent DNA transmission, and so on; and in the latter, the need, under earthly gravitational conditions, to pump blood to feed brain and

[12] See Kripke, *op. cit.*, note 38 where Robert Nozick so responds. Many others have so responded. I ignore the (important anti-definitionalist fact) that the description is not unique for any persons also called "Aristotle"; separating them in a conceptually pure way is very hard. But no matter—let there be only one person so called.

body. Rather, from these cosmic-history observations we have learned that the method of essentialist definitions of kinds is fundamentally wrong. Yet again, the essentialist tries to abstract a local, mind-friendly essence—a definition—to substitute for an actual cosmic process.

VIII. ON BEING WATER (AND ICE AND VAPOR)

I have argued that the definitionalist errs by abstracting away from differences in cosmic processes, freezing real, dynamic processes in snapshot-concepts. The same mistake occurs in defining what water is by the structural predicate "*x* is hydrogen hydroxide."

Some years ago Mark Johnston pointed out that ice, liquid water, and vapor make intuitively different and feature-discernible ("manifest") kinds. I concur and would add that they are not merely different to the eye or touching hand but are also different in (little-"n") nature and so made by different processes of (capital-"N") Nature. The definitionialist latches onto a certain level of abstraction, suppresses the interactive, thermodynamical processes undergone by the hydrogen hydroxide molecules, and selects a single formulaic kind—hydrogen hydroxide. In doing so, he substantially resembles the prior generation's surface-qualitative definitionalists, who abstracted over static (thermodynamics-free) chemical differences between Earth water and twin-earth twin-water, the difference between H_20 and *XYZ* structures.

One level down, the modern essentialist—in the Kripke-Putnam vein—opts again for abstraction in lumping ice, water, and vapor into one kind. In fact, if Nature itself were to speak, it would describe different processes of molecular cohesion (covalent bondage), different manners of statistical behavior of the atomic ingredients as the stuff gels, melts, and vaporizes. There is more in Nature—and the natures it produces by its processes—than the abstract, common H_2O formula. The nature—as induced by Nature's thermodynamical processes—of each kind is different.[13]

[13] Based on such considerations, it now may be appreciated why I find the original twin-earth Kripke-Putnam claim that a sensation can be identical to my sensation of water but produced by a totally different chemical unfounded. The postulation rests on abstracting an "internal image" as the full sensation, shedding the water-involving process by which I came to have the bodily sensation. Like remarks apply to Kripke's popular claim that there could be what are often called "zombies," items that feel no pain while nonetheless having the same brain configuration I do when I feel the pain of a needle in my arm. Yet again, the facile postulation of such zombies rests on an MRI-esque image of a brain state (the firing of C fibers) combined with an abstraction away from the process by which they come to fire. Were we to embed ourselves in the process, we would find that already ingrained in the C fibers firing is my feeling the pain. See my "Pains and Brains," *op. cit.* Finally, the explanation here given applies to grounding Johnston's correct intuition that diamonds and carbon are, by nature, distinct kinds.

IX. THE UNITY OF COSMIC KINDS

I mentioned earlier that it is said that whereas chemical kinds go by structural conditions, biological kinds require allusion to cosmic processes. I would like to explain why this oft-professed distinction rests on a blind spot.

The blind spot has its source in the observation that to be a tiger one must come from tigers, but to be water one does not have to come from water. It is then concluded, erroneously, that only the former kind involves irreversible generation processes. The error lies in not appreciating that to be water one still must come from somewhere in the cosmos, indeed, from hydrogen and oxygen. Following our remarks about the differentiation of ice, liquid water, and vapor, we may say more strongly that, in each case, one must combine the relevant atoms by a particular process under specific environmental (thermodynamical) conditions. Thus, for there to be liquid water in the world, already there must have been in the cosmos oxygen, hydrogen, and a process of molecular bondage of the pertinent kind.

And there is more. Just as, for any two tigers, we can climb back through the tree of life and find a common ancestor (and common DNA structure), for any drops of water we can climb back through the cosmic tree of being and find a common stock of materials—oxygen and hydrogen. Indeed, that is the key message of the present essay: no-thing is alien to no-thing in the cosmos. One level up, for example, the (living) kind of *tigers* and (nonliving) kind *water* share a common stock of ancestor materials. And on it goes: all kinds trace back through the tree of being to common elements.

I do not say this in the merely aesthetic spirit of a cosmic fraternity of all kinds. The common cosmic basis of all kinds is critical to understanding how carbon makes up the many kinds of the living, how water makes up much of the tiger's body, why potassium levels matter in my muscles, why a certain absence of lithium in the brain is dangerous, and so on. This cosmic unity of kinds is also salutary in discouraging man(-kind) from indulging in illusions of being a demigod visitor (or resident alien) in Nature, as if categorically disjoint from all other natural kinds. The famed ancient philosopher was right, of course, in saying that nothing human is alien to me, but he also could have said that nothing cosmic is alien to us humans.

X. KRIPKE: HISTORICITY OF LANGUAGE VERSUS AHISTORICAL METAPHYSICS

So much for embedding in cosmic history the natural kinds of biology and chemistry. At this point, readers familiar with Kripke's seminal *Naming and Necessity* might wonder about an incongruity between

his definitionalist account of the essence of kinds (and the induced necessities) and his definition-free account of naming.

Kripke's account of the metaphysics of names does not start from us late users of words who might ask, "Isn't there a conceptual definition, a meaning, in my head governing the use of the name 'Aristotle' and by means of which I reach out of my head through cosmic history to Aristotle, the cosmic object?" Rather, his account starts at the other end, with the cosmic object Aristotle. The name comes to us from ancient times by an intra-Nature transmission process, by the light (energy) of Nature. An object-of-Nature generates a process that transfers to me the name. By riding back that cosmic wire I can use the name competently, to refer to that source object. On the other hand, Kripke's metaphysics of necessity/essence does seem to start with us thinkers and our heads, with the conceptual (even if upgraded deep-structure) essences, with which we reach into Nature and its objects (kinds). We must use (structural) concepts to track and differentiate Nature's structure.

The present account of the natures of things removes the incongruity. We simply generalize Kripke's insights about the natures of a subclass of the things (the linguistic things) to all things. We understand this thing—the name "Aristotle"—not by grasping an essence, its semantic meaning, and defining which name it is. In the very same way, we understand this thing—the man Aristotle—not by grasping a local conceptual essence, whether superficial or deep-structure. We understand the man's nature by being in contact with Nature's product: the man himself. Just as I can have the name in mind because Nature's processes infused me with it, I can have the man in mind because Nature's processes—real light bouncing from that man—embedded this man in my mind and so made me, one Nature development, able to think of that other Nature development, the man Aristotle.

XI. THE FLIGHT FROM ESSENCE AND NATURE'S RETURN: QUINE VINDICATED

We are not the first to spot the connection between forms of essentialism about language and forms of essentialism about nonlinguistic things. Quine famously said, "Meaning is what essence becomes when divorced from the object of reference and wedded to the word." This conceptual character of essence is a two-way street. Quine may well have said, "Essence is what meaning becomes when divorced from the word and wedded to the object of reference." My blind spot in 25 years of enthusiastic essentialism has been to ignore this conceptual lineage of essence and, in tow, not listen to ordinary language (this

last is the original sin). I have been taking this key word "nature," as used for example in "the tiger's nature," to just be the cognate of the word "essence." At the same time, I took it to be a mere homonym of the word "Nature." My project here is to undo this tone deafness. Little-"n" "nature" is no cognate of "essence," and further, nature there is only one: Nature. Little-"n" natures, such as the tigers' nature, are simply developments of Nature. We may well call it our *Nn principle*:

(Nn) The nature of x = Nature at x

On the present reading, natures are not second-order objects, attributes (predicates) of purported objects, but very much the cosmic individuals themselves, Nature's objects. With conceptual essences gone by the board and only cosmic (capital-"N") Nature and its development to live by, what picture emerges regarding the little-"n" natures of things?

First, as pointed out early on by Quine in "Two Dogmas of Empiricism," we need not expect an elite class of truths "by nature" to be somehow squeezable out of the defining class of essential attributes. There are no such predicative essences. To say that Joseph is by nature human is not to say that my defining predicative essence contains (entails) humanity. It is to say that the process of Nature that generated me was part and parcel of Nature's development and sustenance of the species mankind. What makes me human is not a case of *formal causation*, the logical relation of satisfaction between me, the flesh-and-blood man, and an essential attribute (for example, "is a rational animal"). What makes me human is the process by which I was made in the first place, a case of *efficient causation*. What made me human was an intra-cosmic process, wherein the species *Homo sapiens* had me made, by energy transfer, from two other species members. This holds the key to why I am by nature (and thus by Nature) human. Though I play soccer and teach philosophy, I do not do so by my very nature.

It was not part of Nature's production process of Joseph Almog to make me at the outset a soccer player or philosopher. There is no prior Cosmic Nature phenomenon—as the *Homo sapiens* species is—which is a kind of philosophers or soccer players and which by cosmic energy exchanges made Joseph Almog emerge as a tiny bud on the tree of soccer players or philosophy teachers. I am such a tiny bud on the human species tree.

Second, the switch from formal to efficient causation that grounds being human as fundamental to what Joseph is (but not his playing soccer) points to a more generalized switch brewing here. This general switch concerns the metaphysical primality of the familiar

notions of (i) necessary conditions (for being Joseph) and (ii) the process sufficient for making Joseph.

When we proceed by essence and formal causation, we focus on necessary conditions for the given target phenomenon. We have a given subject (and never mind how it came to be)—Queen Elizabeth II, the species of whales, the substance gold—and the essentialist's premium is on bringing the Nature-singularity, the object, under a key classificatory concept ("form") provided by human reason. The predication "is human" must be justified as more revelatory than "is a soccer player."

This is the key for the essentialist: classificatory predication. It is only a subsequent extension of this prime idea that leads us to cobble together enough such essential predications to make an individuative essential property. Coming up with a concept that can effect individuation within the sortal category—segregation of Joseph from all other humans—involves quite a struggle. We encountered this problem above in the recurring appearance of "alien intruders," unintended twin satisfiers of the essential (necessary) conditions for being a tiger or gold, let alone for being Joseph or the Nanga Parbat.

The alien-intruders syndrome is anything but accidental. Our reason-made form (essence-concept) is trying to catch up with the singularities of Nature. In Nature proper, the singular thing (species, substance) is, of course, as determinate and as distinct as can be. On the other hand, in our metaphysical radars, our thin tracking concept is inevitably behind, potentially satisfied by a variety of twins. We need to upgrade the concept, enrich it with segregative information (Joseph is the human being who was originated by sperm and egg *A*; whales are the mammalian species with DNA *W*; gold is the yellow metal with atomic number 79). Our forms run behind Nature because they abstract from the distinct cosmic process that in history efficiently differentiated—as part of bringing the singularity into existence—the specific item in question. It is as if we understanders turn up after the show is over; the specific production processes have all taken place, and now, with rather generic categorizations, we are trying to reconstruct, using our conceptual toolbox, what it took Nature to achieve by a vast array of specific cosmic processes. Of course, we can, in the above manner of the structuralist and the vitalist, infuse conceptual essences with process-related information reflecting Nature's actual productive work. But at the outset, conceptual essence is focused on categorizing, boxing un-individuated items in similarity classes. Individuation becomes a challenge.

In contrast, when we proceed by efficient causation, we never run into individuation problems. At the outset, each thing is introduced

and thus individuated by its maker, the pertinent cosmic production process. Indeed, the diversity of various singularities—you, me, the tigers, the elephants, and so on—emanates from an underlying cosmic unity. As in a tree structure, the specificity of this bud as opposed to that one is underlined by their emerging from a shared common branch. Their differentiation, their distinct processes of coming into existence, take place by a variation on a common basis: me, you, Obama, all develop as variations on the human tree, the humans as a variation on the primate tree, and so on. As inherent in our above Nn principle, each Nature singularity is a variation on a commonly shared cosmic kernel. The singular nature developed here is Nature's development at this locale.

On this efficient causation methodology, Joseph's being human is no longer the key predication to be supplemented by a variety of add-on relational essentialities: JA was born in the twentieth century; he is a mammal; his body is made of carbon and water; he is Leah's son. The process by which Nature has generated me, the process that has generated the little-"n" nature of JA, has it all: the humanity making up Joseph as a branch, the mammalian-hood making up the humans (that make up Joseph) as a branch, the period in cosmic history when all this is produced, the carbon and water exploited in the production, Leah's egg being critical, and so on.

In so shifting to the efficient process, we have reversed logical priorities between necessary conditions and sufficient conditions. The conceptual essentialist starts with essential predications, necessary conditions *P* for being Joseph—(necessarily) if Joseph exists, then Joseph is *P*. To assemble a sufficient condition is logically posterior—it is to assemble a cluster of necessary conditions that no one but Joseph has. Sufficient conditions are thus necessary conditions that add up to cosmic uniqueness; no wonder such sufficient conditions are a precious rarity. However, when we proceed by following Nature's own course, the necessary conditions are a byproduct of the differentiation process that generated me. My being human is a byproduct of the generation process that produced this specific human bud, me; so is your being human a byproduct of your distinct, singular cosmic generation process. Necessary conditions for *x* are byproducts of the process that sufficed for Nature to produce *x*.

Third, again with Quine, we note the dissolving of any category of super truth—truth solely by conceptual analysis, truth solely by meaning relations, truth by essence alone. All truths are historical, and truth is made by goings-on in cosmic history. If difference there is between Joseph's being human and his playing soccer, it is one of placement in that man's history, the soccer playing being subsequent to and conditional upon the production of that man.

XII. MORE UPGRADED ESSENTIALISM: DEDEKIND AND MATHEMATICAL KINDS

So much for the unified natural cosmic kinds, all little-"n" natures, products of Nature's development. But what of the kinds that started off the essentialist's program, the mathematical kinds? How do they fit into Nature? And, of course, still pending is what we called, following Dedekind's work, the *H_20 problem of mathematics*—in what "vocabulary" do we attain a delineation of specific mathematical kinds such as *N*?

XII.1. N *as a Nature-kind.* The question before us is what is the nature of the natural numbers, the structure *N*. I am going to give two answers to this question, one I believe in and one due to Dedekind. On the key issue of how to understand the nature(s) in question, there will not, in the end, be any difference.

My own view is that the natural numbers are the numbers (0), 1, 2, 3.... There are many set-theoretic sequences (sequences made of sets) that are isomorphic to them (they make up the instances of the kind DOS). As mentioned, there are various contexts where one may let set-theoretic sequences (omega sequences whose individual members are sets) represent the natural numbers. But practiced number theory or Diophantine geometry really talks about what it seems to talk about: (natural, rational, real, complex, quaternion, and so on) numbers, points, lines, curves, and so on. Dedekind, a most distinguished algebraic geometer, surely engaged in such talk. It involved no set theory.[14]

In earlier work,[15] I explained how when Nature exists, some-thing exists, that is, Nature does, and thus at least one thing exists, and this is enough to generate the number kind One. For any kind to exist *in* Nature, I argued, there must be a generating instance of the kind. This is true of the tigers (perhaps we need here an interbreeding plurality) and of water (we need a water molecule, and for that we need hydrogen and oxygen, and so on). And for the arithmetic kind One to come into being, at least one Nature-thing, including Nature

[14] Of course, if Dedekind were asked the model-theoretic—but not number-theoretic—question, "Are any set-theoretic structures isomorphic to *N* preserving the truths of *N*?" the answer would be yes (as proved by Dedekind in "Was sind und was sollen die Zahlen?" sections 132–34). This is a theorem in the set-theoretic model theory (of an axiomatic theory), not in practiced number theory, where the number theorist speaks not of set-theoretic structures but of...numbers (and functions and curves and so on, just what Dedekind talked about, for example, in speaking of prime ideals, Riemann surfaces, and so on).

[15] Almog, "Nothing, Something, Infinity," this JOURNAL, XCVI, 9 (September 1999): 462–78.

itself, suffices. If this ur-thing, Nature, exists, the arithmetic kind One exists.

So, if Nature exists, One does. Next, if Nature and One both exist, two Nature-bound things exist, and thus we have an original generating instance of the arithmetic (ordinal) kind Two. And it continues: Nature, One, and Two originate Three. In general, once some-thing exists—namely, Nature, the *sine qua non* of all existence—we are given in tow that infinitely many natural numbers exist. Thus, *N* is a kind made of individual number kinds 1, 2, 3....

On this view, the numbers, like the elementary particles of matter we discussed above in the context of natural kinds, are that common stock of Nature materials—I will let myself call this common stock *the DNA of Nature*. The common stock comes into existence with Nature; it is what it is for Nature to exist. No mathematics comes later than Nature into existence. But this is just as well, since mathematics neither did nor could exist prior to or independently of Nature.[16]

[16] See *ibid*. The present discussion is an abstraction. It focuses on how Nature generates One, which together as a pair generate Two, and so on. This is cast as an improvement on Dedekind (or Zermelo or Von Neumann) so as to defend the view that the basic character of the existence of the natural numbers is not set-theoretic. There, I stop. The discussion is not meant to get to the bottom of what it takes for mathematics to exist in Nature, for mathematics does not come into Nature in stages—it comes *en bloc*.

As I explain in "The Cosmic Ensemble: Reflections on the Nature–Mathematics Symbiosis" (*Midwest Studies in Philosophy*, XXXI, 1 (September 2007): 344–71), in the ontological order of existence (namely, generation by Nature)—as opposed to the pedagogical order by which we are introduced to simple structures (like *N* and Euclidean space) before more complex structures—Nature has written into its very existence (what is called above the DNA of Nature and what Galileo aptly referred to as Nature's grammar) the existence of the space-time structure. The existence of Nature just is that space-time existence. This makes mathematically more complex structures ontologically primary. An example discussed in "The Cosmic Ensemble" is the complex plane and algebraic-geometric structures within it, such as the *moduli* spaces of elliptic curves or Abelian varieties.

The common philosophical impulse (flowing from both Leibniz and Frege) to separate the allegedly prior "logical" realm of numbers—let me call it more generally the algebraic realm—from the merely posterior, space-dependent "synthetic" realm of the geometric, strikes me as (i) ill-founded as an account of what is built into the structure of space-time (thus into "physical" Nature) but also (ii) wrong about the order of dependencies in mathematics proper, where algebraic-geometry structures contain various number systems. One pertinent example is the just-mentioned *moduli* space of elliptic curves inside the complex plane; for another, the key action of the Galois group over the algebraic numbers cannot be detached from deep results about the structure of the complex plane. At bottom, the point can be made by attending to the mathematically simple notion of "variety," as it were, a system of polynomial equations that Leibniz would have liked to make algebraic but which is in effect essentially geometric (or more properly, algebraic-geometric). So the separation, much pursued in philosophy, of the algebraic and the geometric seems to me to

Using the cases of the tigers and water, we may mark the difference between *N* and DOS as follows. *N* is like the species of tigers in that an entity *n* is in *N* if it originates from the particular lineage Nature, One, Two.... On the other hand, the kind DOS is rather like the kind water. A sequence *S* is a member of the kind DOS if it is isomorphic to some ur-DOS generating sequence DOS_{Nature} = Nature, {Nature}, {{Nature}}... or Nature, {Nature}, {Nature, {Nature}}... or .... Of course, the sequence *N* is also in DOS. But what matters from our Nature-engenders-all perspective is that the materials of any omega sequence in DOS come from Nature.[17]

XII.2. Dedekind's DOS = N, *and How to Understand Sets.* So much for my own view. But what if we assumed with Dedekind that *N* = DOS? Dedekind's set-theoretic analysis faces the same essentialist dilemma we have been addressing. If the understanding of "subset" is genuinely purely axiomatic, the theory is prey to the problem of unintended satisfiers and the alien intruders return. This was Skolem's point in his classic paper, which in effect stated a form of our dilemma: no computationally tractable axiomatic basis can give us a grounding in the target, uncountable structure of sets (nor, it follows, in the target ideas of finitude—the natural numbers). Indeed, Skolem applied his

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project epistemological foundationalistic programs and does not reflect mathematical practice, in which algebraic geometry (and algebraic topology) come as unified wholes and are rooted, in the end (at least so I believe), in the structure of space-time. I do not want to go into this complex set of issues here but will do so in some detail in the future. In a nutshell, I would only say that Nature generates the algebraic-geometric inside the complex plane, including familiar number systems like *N*, *Q*, and so on.

[17] Some formulations of set theory speak of starting from the *empty set* (I do not know what it is, but I assume its existence is meant not to be Nature-dependent). Zermelo calls the empty set a "fictitious object" and uses ur-elements in his mature, 1930 theory. There is, of course, nothing wrong mathematically in using some posited, purified ground object. But philosophers—overly happy to read quotes of mathematicians—read deep metaphysics into this trick. In contrast, I point out that, mathematically speaking, the hierarchy generated gives us the same truths (theorems) whether we start with Nature, with the man Zermelo, or with the empty set. If a mathematician (philosopher) wants to use a "pure object" (whatever that is) as his basis to attain epistemological purity—that is, to know a priori of set existence—he should declare his true, philosophical reason rather than hang on to the alleged mathematical indispensability of the empty set. I note that even conceptual-essentialists like Zermelo and Gödel stress that the concept here analyzed is *set-of-things*, and both Cantor and Gödel assert that the notion of multitude (plurality) is prior to that of the set as unity. If so, the empty set is not a set-of-things at all, and it is no instance of the concept it is supposed to ground. Sets of things should get going—do get going—from things. In any event, Dedekind was quite clear about all this and demanded a grounding of his kind of DOS in a real ground object (for example, his self). See immediately below, in section XII.2, my comment on Dedekind's Theorem 66 of *Was Sind.*

point not just to the characterizability of (un)countability, but also to Dedekind's analysis of "finite." On Skolem's account, to "get" the natural numbers—that primal structure—do not "look for it" as the satisfier of some abstract (set-theoretic) axiomatic essence; *start* with that primitive structure.

Dedekind himself did not opt for a purely axiomatic foundation. In section 66 of his *Was Sind und was sollen die Zahlen?* and again in the letter to Keferstein, he points to a non-axiomatic/essentialist method and instead to an existence-based *generative* starting point. His ur-omega sequence is Nature-grounded. He gives us: Dedekind, {Dedekind}, {{Dedekind}}.... The kind of DOS is grounded/generated by an intra-cosmic (*wirklich*—actual and spatiotemporally embedded) omega sequence. When we say it is the kind of all the omega-sequence structures, we say: it is the kind of all sequences standing in the same structure-relation to the generating cosmic sequence DOS_{Nature}.[18]

XIII. CONCLUSION: UNDERSTANDING NATURE BY HAVING NATURE ITSELF IN THE UNDERSTANDING

We started with the gap between Nature and essence. I close with it by going back to a telling example due to Saul Kripke. His example has obsessed me throughout 25 years of essentialist involvement. Every four years or so, I have written a paper struggling with it. I believe I finally understand the example.

In the opening passages of his *Naming and Necessity* (pp. 23–24), Kripke mentions his (by his own admission) "surprising view" about unicorns. He asserts that he has no problem acknowledging predicates with an empty extension, of which it is said that they might have had exemplars (such as, "female United States president"). Kripke notes that "is a unicorn" frequently appears as an example of such a predicate: it is said that although "is a unicorn" has no exemplars, it might have had some. This, Kripke denies.

When he gives his argument (pp. 156–57), Kripke tells us that the conceptual information associated with "unicorn" is superficial and

[18] This had also been Poincaré's position in his discussion of Hilbert's 1904 paper: no categorical account of the natural numbers could be compact; we must use "finitely many" as primitive. I read Poincaré as anticipating Skolem's technical definability work on "finitely many." For Skolem, see "Some Remarks on Axiomatized Set Theory," pp. 290–301, and "The Foundations of Elementary Arithmetic," pp. 302–33, both in Skolem, *Selected Works in Logic*, ed. Jens Erik Fenstad (Oslo: Scandinavian University Books, 1970). I should like it noted that it is possible to read Dedekind as specifying an essence first, and only subsequently showing that the isomorphism-type DOS has an actual (*wirklich*) instantiation, the aforementioned grounded omega sequence. I read Dedekind orthogonally, namely, as generating the isomorphism type from a *wirklich*, given Nature-based omega sequence.

incomplete. We cannot just peer into a possible world, see animals that look like the unicorns, and say, "There go the unicorns." In different such imagined situations, different species—some amphibian, some reptilian, some mammalian—might display the unicorn look. They cannot all be the unicorns. The unicorns are meant to be a specific species.

So put, the problem of the unicorns is their depending on too superficial an essence. Indeed, Kripke says, with tigers we have a genuine essence because we have structural information involving genetic make-up. We do not have such information for the unicorns (p. 156).

This is true but inconclusive as an argument. Even if for the unicorns it is too late, surely some modern day Asimov (or a true zoologist) might introduce a new species term, "schmunicorns," to designate whatever has specified but unrealized genetic make-up *G*. In spite of the enhanced character of the defining essence, it still gives us no real species. There are no schmunicorns in cosmic history, and thus there is no species of schmunicorns among Nature's fauna.

There lies the key to Kripke's unicorns insight, even if he did not intend the argument to go this way (in his last theorem, Fermat asserted a true proposition, even if the reason for it in his head was probably not quite right). There is no unicorns-nature because Nature has never produced unicorns and thus never introduced that distinct little-"n" nature, the unicorns-nature. Not so with dinosaurs and dodos. In those cases, Nature acted and produced. Local natures evolved, and two distinct species enjoyed a cosmic moment of real existence.

This Nature-produced account of the local natures grounds corresponding claims about our understanding. We do understand what it is to be a dodo and a dinosaur because information from those once-existing Nature developments impinges on us (by means of Nature's light): we know by the real light of real Nature of the dinosaurs and the dodos. In contrast, we have no understanding of unicorns because there is nothing to begin with in Nature to make for subsequent human understanding. There is the word "unicorn" and its history, and this we understand fairly well, correctly translating it, as deftly noticed by Keith Donnellan, as "licorne" and not as "griffon" (the cognate of "griffin"). We understand the word because it is historically real and transmitted to us by the light of Nature. We do not understand the purported *species* because there is no-thing to understand.

Let me summarize our findings. Our focus has been the essentialist's man dream: complete understanding of Nature by the

by-nature finite human understanding. The project grinds to a halt with what I presented as the idealist conjecture that the pursuit is better undertaken—indeed, *must* be undertaken—by way of local conceptual essences/axiomatizations. There, in dissecting the surrogate conceptual essences and the attendant essential truths by analysis, lies the illusion of understanding. The understanding of Nature need not be undertaken from a mental bunker outside it (as many read Descartes' thinker in Meditation I's battle with Nature). We often look upon Nature as a sort of complex (evil) genius, an alien enemy we must defeat to undo its hidden encrypted structures. Instead we should think of ourselves, the understanders, as Nature products, each a force-of-Nature, endowed by Nature with his/her cognitive structure, cognitive mechanisms receptive to Nature's light and reflective of the information transmitted. Our understanding Nature is nothing but Nature taking its course.[19]

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[19] A word about the *volte face* urged in this paper. My own "The What and the How" (this JOURNAL, LXXXVIII, 5 (May 1991): 225–44) was conceived in the mid-1980s as a critique of Kripke's reduction of whatness (nature) to necessity. I developed a whatness(nature)-preceeds-modal-necessity view but continued to think of the whatness (as of the derivative necessity) in local terms, that is, with parameters regarding the item's immediate origins. See, for example, my "The What and the How II: Reals and Mights," *Noûs*, XXX, 4 (1996): 413–33, and "Nothing, Something, Infinity," *op. cit.*

It was work in the last decade on two different topics that led to the turnabout. One tributary was a series of classes I taught (some with Tony Martin) on the turn-of-the-century mathematical axiomatic thinkers: one was dedicated to Gödel, one to Hilbert's motif "we must know, we will know," and, most critically, one focused on Dedekind and Skolem. In the last, I read off the rationalist man's dilemma vis-à-vis the limits of axiomatic set-theoretic foundations for arithmetic from Skolem (see the last few pages of the present paper). The other tributary was continued work on Descartes' concept of Nature (and "true and immutable natures") in a monograph called *Cogito?* (New York: Oxford, 2008). This drove me to wonder about a theme spanning the seventeenth and eighteenth centuries making Nature-as-a-whole into the prime object of both scientific and metaphysical investigation. Goaded by teaching Nature-theorists like Spinoza with John Carriero, I came to revisit my own "modern" work on essentialism and natures. This led to the present work.

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BOOK REVIEWS

The Idea of Justice. AMARTYA SEN. Cambridge: Belknap Press of Harvard University Press, 2009. xxviii + 496 p. Cloth $29.95, paper $22.95.

Amartya Sen's *The Idea of Justice*[1] is the most illuminating book on a gamut of questions about justice since the publication of John Rawls's *A Theory of Justice*[2] some 40 years ago. Sen counts Rawls as teacher and friend, and his book is filled both with admiration of Rawls's transformative work, and with deep and insightful criticisms of its basic arguments. A short review can cover only some of its themes, and those too briefly, but can hope to show something of the range and depth of his thinking.

Sen's central charge is that Rawls, followed by many other liberal theorists of justice, concentrated on the institutions and structures that justice requires, but said too little about lives led within those structures: "characterization of perfectly just institutions has become the central exercise in modern theories of justice" (8). All too often an unvindicated assumption that people will comply with the requirements of just institutions substitutes for showing that they will (or even can) do so, and little attention is paid to lives actually led within supposedly just institutions (67–68). Even if we know what perfect justice demands, this is never enough, because just institutions do not guarantee that people act or are treated justly. Sen proposes that for practical purposes we need "an agreement, based on public reasoning, on rankings of alternatives that can be realized" (17).

Sen calls the positions he rejects *transcendental institutionalism*, because they focus on the 'transcendental' justification of ideal institutions, and contrasts them with more promising approaches to justice that concentrate on *comparative realizations* of justice. At first blush an accusation of *transcendental institutionalism* seems a curious criticism of John Rawls, who consistently used coherentist strategies of justification to build a theory of justice, and claims that he simply carries the social contract tradition "to a higher level of abstraction" (*TJ* 10). In *A Theory of Justice*, Rawls argued that we should aim for a *reflective equilibrium* between our considered judgments and proposed principles of justice, and that justice is a form of fairness achieved when institutions

[1] Unless otherwise indicated, page numbers refer to this work.
[2] John Rawls, *A Theory of Justice* (Cambridge: Harvard, 1971); cited as *TJ*.

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reflect the principles rational agents would choose in ignorance of their own social position and interests. As Rawls developed this coherentist line of thought, he modified this justificatory strategy in favor of one that he saw as fundamentally *political* rather than *metaphysical*, in that its justifications are based on reasoning among fellow citizens in polities that enjoy boundaries, democracy, and liberalism, but lack shared conceptions of the good. Rawls certainly did not intend to justify his proposed principles of justice by appealing to any *transcendent* moral reality. Nor did he offer a *transcendental* justification in the Kantian sense of the term: although a deep and perceptive reader of Kant, Rawls offered no transcendental arguments to identify necessary conditions for the possibility of justice.

In spite of these reasons for querying Sen's labelling of Rawls as a *transcendental institutionalist*, I think his line of thought is convincing. Rawls is certainly an institutionalist who "concentrates primarily on getting the institutions right and…is not directly focused on the actual societies that…emerge" (6), and he goes beyond abstraction by relying on idealizing accounts of human agency and rationality. So the underlying problem with Rawls's approach is not really, or not only, that he fails to consider actual societies and their improvement. Any approach to justice will be normative, so must consider standards that actual societies may not satisfy. The problem is rather that Rawls's models of agency and rationality assume features neither found in nor realizable in human agents or societies. Sen lays particular emphasis on Rawls's idealizing, and false, view of human motivation as incurably self interested, so in need of veiling in order to generate disinterested principles of justice; on his idealizing view that just institutions will secure unproblematic compliance (79–81); and on his idealizing view of bounded societies. He argues that each idealization is unacceptable. I think Sen is right to reject these idealizations, and might also have queried other idealizations on which Rawls builds, such as non-envy, or complete knowledge of the general features of human societies. Idealizations have their place in rigorous inquiries, but their role in normative reasoning is delicate: relying on them may lead to conclusions that are irrelevant to flesh and blood human beings or blind us to the reality of vile or harmful action, even when institutions are just (85).

Sen then criticizes Rawls for assuming that if agents in the original position were (by hypothesis) rendered ignorant of their own interests they would agree on principles of justice. There are other possible sources of disagreement, and convergence on any principles of justice, let alone on the two Rawls favored, is not guaranteed (58, 109). It seems to me that Rawls implicitly came to accept this point, and

that his turn in the 1980's to a 'political' justification of principles of justice, that draws on a conception of public reasoning among fellow citizens of liberal democracies, accepts that the 'device' of an original position in which interests are veiled is not enough to secure convergence. However, the 'political' turn in Rawls's work once again relies on idealizing conceptions, particularly of societies, boundaries, and citizenship, and fails to show that agreement will emerge. As Sen sees it, the later strategy too is inadequate for an account of justice for a globalizing world, because it relies on exclusionary views of who counts and which views count. Rawls's defective account of impartiality is confirmed rather than remedied in his late work on justice beyond borders, *The Law of Peoples*, which ignores the fact that "International justice is not adequate for global justice" (143).

In place of exclusionary reasoning among fellow citizens, Sen proposes a more Smithian view of impartiality that considers reasons from 'far and near' and subjects claims and proposals to scrutiny from a plurality of viewpoints, not restricted to those of fellow citizens of liberal democratic polities (44–46). He rejects the view that the remedy for an exclusionary approach to justice is an appeal to a global original position that supports a cosmopolitan contract (140), in favor of a pluralist view of the diversity of sources of relevant reasons. Rather than arguing for including all in a world state, Sen argues that we should attend to reasons wherever they may come from, and suggests again and again how likely they are to come from unexpected quarters. One of the many pleasures of *The Idea of Justice* is Sen's vast cultural range and sympathy, which finds inspiration in the participatory discussion and reasoning of many societies. He illustrates his themes by drawing on ideas and arguments from many sources: from the Buddha to Alexander the Great's Indian interlocutors, from Nelson Mandela to contemporary Islamic thinkers, from Shakespeare to the Bhagavadgita.

But if public reasoning is to ground normative claims, it is not enough to insist that all voices be considered: we must also distinguish better from worse reasons. Sen's accounts of reason and justification are complex, but at times elusive. It is easier to work out what he rejects than what he endorses. He rejects in the first place the thought that some uniform feature of human motivation underpins all normative reasoning: reasons for action are heterogeneous, ranging from self interest to commitments made, from concern for others to the fact that an agent has powers to act that others lack. (This motivational diversity has profoundly unsettling implications for economics. They do not trouble Sen, who remarks in an engaging aside that "economics is supposed to be my profession" (269).) Sen also

rejects the thought that reasoning must yield a complete ordering of alternatives, and accepts that we may be able to do no more than rank some options over others. Partial orderings of realizable possibilities can provide reasons for changing actual situations to make them less unjust.

Indeed, it is not clear that any publicly agreed (partial) ordering will rank actual social arrangements as more and less *just*. Why should public reasoning, as Sen depicts it, focus tidily on justice, any more than it focuses solely on institutions, on configurations of rights, or on configurations of duties that should be coercively enforced? The sharp division of justice from (other) ethical considerations that is central to most recent liberal writing on justice and human rights, is unlikely to be sustained by appealing to a broad and hospitable account of public reasoning. Sen takes note of this, welcoming claims about imperfect as well as perfect obligations, and his position probably leads further than he explores; I suspect that it precludes drawing any very clear boundary to justice.

However, if Sen's approach to justice (or a wider range of normative concerns) is to work, he needs to say something about the differences between sound and unsound public reasoning. Conceptions of public reasoning form a spectrum. Some demand that discourse be *public* in specified ways, but are vague about what it takes for it to be *reasoned*; others are more explicit about what sort of *public* discourse can count as *reasoned*. As I read them, both Habermas and the later Rawls lie to the former end of the spectrum: they are strong in their demand that discourse take place among 'the public', but rather general in their accounts of reason. Sen is even clearer and stronger on what it takes for reasoning to be *public*. He argues that public reasoning must take an *open* rather than a *closed* view of impartiality (123–24, 198–99, 326), manifest in willingness to engage with all and any considerations, arising within or beyond boundaries. Public reasoning is the conversation of mankind, not reasoning among fellow citizens. Evidently, public communication at this great scale cannot be face-to-face, and Sen accepts that it needs the support of "free, energetic and efficient media" (337). Yet what is to be done if the media are less than free, energetic, and efficient, as they nearly always are? Where media power is concentrated, or media preoccupations are driven by partisan agendas, a free press may provide distorting and even corrupting conduits for public discourse, even if no voices or considerations are excluded. Sen emphasizes the importance of "unobstructed discussion and scrutiny" (386–87), yet says little about the standards of reasoning needed in discussion and scrutiny, or about which publicly offered considerations have normative force.

He is surely right to argue that reasons do not have to come from 'insiders', and that we should attend to the full range of reasoners and reasons. But we still need to say why some reasons are better than others: without a distinction between better and worse reasoning there will be no ways to justify some rather than other normative claims, and in particular no standards by which to arbitrate among publicly endorsed normative claims. The mere fact that a position receives public discussion or endorsement—however wide the public, however rapturous the endorsement—does not make it reasoned, so does not justify. There are all too many cases of wide public enthusiasm for cruel or disastrous action, or manifestly damaging policies. Public discourse may endorse questionable proposals, or invite, even encourage, deference and compliance.

Yet a requirement that reasoning be nonexclusionary may be able to identify significant normative standards. Anybody who offers reasons to others needs to communicate with them, so needs to ensure that what they offer as reasons are both *accessible to* and *assessable by* those whom they invite to consider, accept, or reject their claims and proposals. If they aspire to offer reasons to an unrestricted public, they therefore need to put forward considerations that are *accessible to* and *assessable by* that unrestricted public. A nonexclusionary view of the scope of reasoning can therefore point to cognitive norms that must be among the minimal standards for reasoning. This route to an account of public reason, which seeks to anchor standards for reasoned communication in the requirement for it to be fully public, was tantalizingly explored by Kant in his late political writings. On a plausible reading, he suggested that reasoning that rejects exclusionary views of who counts must also reject claims and proposals unless they are intelligible and assessable by all others. Sen does not take this Kantian approach, indeed may suspect Kant of indelible 'transcendental institutionalism'. However, this or another way of deriving normative standards from the conditions of public communication is needed if communication about justice is to be reasoned as well as public.

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