

What it is like to be a Quark

by Pat Lewtas

Abstract: The most plausible type of panpsychism explains high-level consciousness the way science explains high-level electric charge – as the result of compounding operations performed on basic properties instantiated by basic physical objects at the bottom-most level. Arguments for panpsychism stand little chance in the absence of a detailed elaboration of the view. Such an account must make sense of experience at the bottom-most level. It must also explain how bottom-level experiences combine to yield high-level experiences. This paper tackles the first task. It starts by developing a method for investigating the experiences of basic physical objects. This method identifies constraints, motivated by scientific and philosophical considerations, that collectively force a unique account. The paper then applies this method, using quarks as stand-ins for basic but conscious physical objects. It determines that quark-consciousness is (1) maximally simple (in ways explained); (2) multiple (the quark has multiple phenomenal fields, each filled with a maximally simple experience, each with its own subject); and (3) internal (experience is a stable aspect of the quark's nature, not a response to entities external to the quark). The paper ends with some implications for high-level consciousness.

What conscious experiences might a basic physical object have? And why would anyone even ask?

Consider the following three claims. (1) Consciousness exists as a property of physical objects. This rules out substance dualism. (2) Consciousness doesn't reduce *ontologically*. This denies that consciousness reduces to anything other than itself. It rules out physicalism (which token-reduces conscious property instances to physical property instances), neutral monism (which token-reduces both conscious property instances and physical property instances to instances of basic but non-conscious and non-physical properties), and proto-phenomenalism (which token-reduces conscious property instances to instances of basic but non-conscious and non-physical properties instantiated by basic physical objects). (3) Consciousness does reduce *metaphysically*. This asserts that consciousness, as a complex high-level property, token-reduces to simple basic properties instantiated by basic entities at the bottom-most level.¹ This puts consciousness on a par with properties like electric charge and

¹ Throughout I speak of properties at the bottom or bottom-most level. But you can apply what I say to a world of gunk. Each time I write “property that obtains at the bottom level”, substitute “property for which there is no level below

saltiness. It rules out emergentism (according to which basic but complex non-physical conscious property instances emerge at high levels, out of nothing and from nowhere, to characterize complex non-basic physical objects).²

Put these three claims together and you get a kind of panpsychism. Two tenets follow immediately. (1) Simple, basic experiences characterize basic physical objects at the bottom-most level. (Here and throughout, this paper treats experiences as conscious properties or conscious property instances.) (2) Complex, high-level experiences are built from these bottom-level experiences (and characterize non-basic physical objects). A third tenet doesn't follow directly, but nevertheless fits naturally with and fleshes out the two just mentioned. (3) A non-basic physical object's structure determines whether and how the experiences of its constituents combine to form higher-level experiences. These tenets entail that some, but not necessarily all, basic physical objects have experience. They don't entail that all non-basic physical objects have experience. Maybe brains, but not tables or rocks, possess structures that build complex experiences out of basic bottom-level experiences.³

No argument for panpsychism⁴ – no matter how powerful – will win minds unless accompanied by a plausible and detailed account showing that the view works. Such an account must do at least two things. It must make sense of basic bottom-level experiences. Most people find it incredible that a quark experiences. It must also explain how bottom-level atomic experiences combine to yield high-level complex experiences – what Nagel (1979) called “mental chemistry”. This paper tackles the first task. Another will address the second.

which instances of it do not obtain”.

2 Emergentism includes standard property dualism, the sort advocated by Chalmers (1996), for instance.

3 Thus we have the kind of panpsychism debated by James (1890/1950), Nagel (1979) and Van Cleve (1990). James calls it a “mind dust” theory.

4 Such as one defending the three claims in the second paragraph.

I

But first some terms, concepts and a framework.⁵ This paper understands a basic entity as a basic building block not composed of anything else (much less anything more basic than itself). It construes a basic *property* as a specific type of basic building block. Basic properties don't consist of anything else (much less other properties more basic than themselves). Think of properties like a quark's mass or an electron's charge.⁶ Call these *strictly basic* properties.

Composite entities, including composite properties, do consist of other and more basic entities. It will help to distinguish three types of composite properties: *compositely basic* properties, *mixed* properties, and *non-basic* properties. A property qualifies as *compositely basic* iff (1) its instances result from, and only from, instances of some strictly basic property A; and (2) its instances confer all but only the same kinds of characteristics, powers and susceptibilities as are conferred by instances of A; except insofar as (3) its characteristics, powers and susceptibilities are affected by the spatio-temporal distributions of the instances of A which result in it. (This paper will soon define “results-from” and “results-in”. For now, understand them, respectively, as *arises from because consisting of* and *gives rise to because constituting*.) Think of properties like your mass and a towel's electric charge. Note that compositely basic mass differs from strictly basic mass in that (1) its value exceeds the values of strictly basic masses; (2) its value can vary over time; and (3) it confers traits that depend on how the relevant object sits in space and time (your center of gravity changes as you box). The same types of differences hold between compositely basic and strictly basic charge.

If a compositely basic property is a basic property once removed, then a mixed property is a basic property twice removed. A property qualifies as *mixed* iff (1) its instances result from instances of

⁵ Much of this I develop elsewhere, in other papers currently under review.

⁶ I assume here that mass and charge really are strictly basic properties. Mass won't qualify as basic if it results from the interaction of a particle with the Higgs Field (if such exists). And charge won't qualify as basic if it results from the vibration of an underlying string.

more than one type of strictly basic property; but (2) these strictly basic properties come from the same genus or family of strictly basic properties. Because this definition turns on judgement and choice (in the specification of sameness of genus or family), it can't reliably single out a metaphysical type. This paper will use "mixed properties" to refer to composite conscious properties that result from, but only from, two or more types of strictly basic *conscious* properties. (By contrast, a compositely basic conscious property results from only one type of strictly basic conscious property.)

Non-basic properties include all properties neither strictly nor compositely basic.⁷ A non-basic property results from strictly basic properties but either (1) results from more than one kind of strictly basic property; or else (2) confers a characteristic, power or susceptibility of a kind different from those conferred by instances of any of the strictly basic properties that result in it.⁸ Wetness provides an example. Wetness results from strictly basic charge properties, but also from other properties of the objects making up the liquid and the objects making up the wet thing. Furthermore, wetness confers kinds of traits different from those conferred by strictly basic charge.

A simple property confers a single (kind of) characteristic, power or susceptibility. Again, think of strictly basic mass.⁹ A complex property confers more than one (kind of) characteristic, power or susceptibility. Think of the saltiness of blood.

This paper presupposes universal constitutive supervenience. We say that high-level entities B constitutively supervene on lower-level entities A when the B entities are built of the A entities. We say that constitutive supervenience holds universally when all high-level entities constitutively supervene on basic entities at the bottom-most level. Universal constitutive supervenience makes two claims: (1) all high-level entities obtain in virtue of basic bottom-level entities; and (2) all high-level entities are

7 We can choose whether to treat mixed properties as non-basic. The definition in this paragraph does. It doesn't much matter so long as the context makes the metaphysics clear.

8 It turns out that satisfaction of condition one guarantees satisfaction of condition two. This doesn't matter here.

9 General relativity entitles us to regard inertial and gravitational dispositions as two sides of the same coin.

nothing over and above basic bottom-level entities. The first condition captures the asymmetric dependence of all high-level entities on basic bottom-level entities. The second ensures that all high-level entities are somehow contained within or constituted by, and not merely correlated with, basic bottom-level entities. These conditions guarantee that all tokens/instances of high-level entities consist of spatio-temporal arrangements of tokens/instances of basic bottom-level entities.

The paper uses *results-from* and *results-in* to encompass the ways a high-level entity B can relate to lower-level entities A where B is nothing over and above A.¹⁰ The results-from/results-in relation covers relations like identity, composition, realization, ontological determination, necessary supervenience,¹¹ and any others which guarantee ontological nothing-over-and-aboveness. Of course, the results-from/results-in relation holds where, and only where, constitutive supervenience obtains.

Finally, this paper uses quarks and electrons as stand-ins for basic bottom-level physical objects, and quarks for basic bottom-level physical objects with experience.¹²

II

How can we think usefully about quark-consciousness? We face two sorts of challenges. (1) Nagel (1974) drove home the gulf between a bat's consciousness and ours, a gulf so wide we can't conceive how a bat experiences. If bats – complex mammals – have conscious lives impossible for us to fathom, then surely we have no hope of putting ourselves into a quark's shoes. (2) How, in any case, can an account of quark-consciousness do more than tell a pretty tale? What could lift it above arbitrary speculation – fantasy?

Let us begin with the second problem. This paper will lay down constraints on an account of

10 The paper borrows this terminology from the British emergentists, who contrasted resultants with emergents. Emergents stand over and above their subvenient bases. Resultants don't. See the discussion in McLaughlin (1992).

11 Necessary supervenience holds where some other relation underlies the supervenience correlation to guarantee that the higher-level properties are nothing over and above their subvenient bases. See Horgan (1993).

12 It doesn't matter if strings, super-strings, branes, or something not yet dreamt of underlie quarks and electrons, or if all physical objects result from protean mass-energy. We still need labels for objects at the bottom, and "quark" and "electron" will do.

quark-consciousness. These will limit the theorist's free choice, forcing, ideally a unique account, but at least a much narrowed range of accounts. Some of these constraints will come from science. Thus we will want strictly basic conscious properties to look and behave (more or less) like strictly basic physical properties. And (although this won't come into play here) we will want lower-level conscious properties to combine to make higher-level conscious properties in (more or less) the same ways lower-level physical properties combine to make higher-level physical properties. Other constraints will come from panpsychism. Thus we will need strictly basic conscious properties that, at higher levels, can result in the kinds of experiences you and I have. Still other constraints will come from the *arguments* for panpsychism. We have no reason to believe panpsychism if consciousness doesn't reduce metaphysically, and no reason to think consciousness reduces metaphysically if property emergence occurs. So we will insist that any account forswear emergence. Similarly, we have no reason to believe panpsychism if consciousness does reduce ontologically – if it constitutively supervenes on non-conscious entities. But any ontologically reductive theory must remain explanatorily opaque. So we will insist that our account not tolerate explanatory gaps. This paper will produce and justify constraints as needed. The justifications will draw upon both philosophy and science. They won't always add up to proofs. But they will at least motivate and support.

Now for the first problem. It turns out – surprisingly? – that we can more easily imagine and reconstruct quark-consciousness than bat-consciousness. Consider Nagel's pessimism about bats.

We cannot form more than a schematic conception of what it is like [to be a bat]. For example, we may ascribe general *types* of experience on the basis of the animal's structure and behavior. Thus we describe bat sonar as a form of three-dimensional forward perception; we believe that bats feel some versions of pain, fear, hunger and lust, and that they have other, more familiar types of perception besides sonar. But we believe that these experiences also have in each case a specific subjective character, which it is beyond our ability to conceive. (p. 521)

Nagel allows that our experiences of pain, fear, hunger and lust might give us partial insight into bat-pain, bat-fear, bat-hunger and bat-lust. But he denies us any grip on bats' sonar-experience.

[B]at sonar, though clearly a form of perception, is not similar in its operation to any sense that we possess, and there is no reason to suppose that it is subjectively like anything we can experience or imagine. (p. 520)

In short, and for all we know, bat sonar-experience might differ as much from (any of) our experiences as visual experience differs from olfactory experience.

Fair enough. But this difficulty doesn't arise with quark-consciousness. We begin with the following two constraints.

Constraint 1: An account of strictly basic experience should attribute to basic physical objects all but only those types of experience needed to explain higher-level (including human) consciousness.

Justification: Panpsychism posits strictly basic experience at the bottom-most level solely to explain higher-level consciousness consistent with the ontological irreducibility but metaphysical reducibility of consciousness.

Constraint 2: An account of panpsychism must eschew explanatory gaps.

Justification: If panpsychism posits strictly basic experience at the bottom-most level solely to explain higher-level consciousness, but nonetheless contains explanatory gaps, then it offers an explanation no better than that provided by physicalism. On the assumption that physicalism has greater *prima facie* plausibility than panpsychism – on grounds of simplicity, etc. – we should prefer panpsychism only if it supplies a *better* explanation of consciousness.

Assume now that your experience of red qualifies as a basic type of experience. This means the experience doesn't result from experiences of more than one strictly basic type. In other words, your experience of red qualifies as a compositely basic experience. Panpsychism requires that we explain this experience by attributing a strictly basic experience of some kind to basic physical objects at the bottom-most level. This follows from from Constraint 1. But of what kind? We can't say your compositely basic experience of red results from strictly basic quark-experiences as of the taste of brine.¹³ For then we explain the experience of red in terms of the experience of brine, in violation of Constraint 2's prohibition against explanatory gaps. Our explanation works only if the quark's

¹³ I described the quark's experience as an experience *as of* brine rather than an experience *of* brine. This suits because the experience lies internal to the quark as one of its intrinsic properties. The experience doesn't represent anything outside itself because the quark doesn't have the complexity of structure needed for perception. I say more about this shortly. From here on, in the interests of style, I drop the cumbersome "as" in "as of".

experience of red counts as an experience of red in exactly the same way your experience of red counts as an experience of red. But then we don't run into Nagel's bat-sonar problem when trying to understand a quark's experience of red. It's exactly like ours, at least insofar as its redness goes.¹⁴ Of course, if bat sonar-experience qualifies as a compositely basic experience unavailable to us, then, following Constraint 1, we must attribute strictly basic bat sonar-experiences that do raise Nagel's problem. But the problem then concerns a *type* of quark-experience rather than quark experience *per se*.

Nagel hints at a constructive method when he says (in the first-quoted passage) that "we may ascribe general *types* of experience on the basis of the animal's structure and behavior" (p. 521). He bases this on the supposition that "structural features of perception might be more accessible to objective description [than purely subjective features], even though something would be left out" (p. 525). This suggests two methods. (1) If we can discover how human brains underwrite human experience, then we might extrapolate to the bat's case by noting similarities (and differences) between their brains and ours. (2) We might infer (some) structural features of bat experiences from the structures and processes within the tissues responsible for them.

We have enough to get going. We've seen that our grasp of a quark's experience of red doesn't "leave anything out" insofar as its redness goes. And we know everything about the structure and internal processes of a quark – namely that it has none.

II

Now we formalize a constraint mentioned earlier.

Constraint 3: An account of panpsychism must eschew property emergence.

Justification: We have already seen why this constraint makes sense. We have no reason to believe panpsychism if consciousness doesn't reduce metaphysically, and no reason to think consciousness

¹⁴ You will see soon that this amounts to a big qualification.

reduces metaphysically if property emergence occurs. We must treat emergence as incompatible with panpsychism.

This allows us to state and justify an extremely useful constraint.

Constraint 4: The maximum possible complexity of an object's experience varies with the complexity of the object's structure. "Structure" includes processes and activities – structures spread through time. (The complexity of a higher-level structure matters only insofar as the structure combines experiences in the first place.)

Justification: (1) This constraint fits naturally with panpsychism's second and third tenets. At the very least, a higher-level conscious object must have enough complexity both to underwrite the relevant compounding operations and to provide them with the necessary strictly basic raw material. Insofar as the constraint says more than this, it draws support from three additional sources. (2) Science makes clear that complexity of high-level experience depends on and varies with complexity of brain. (3) Complex experiences contain large amounts of information. This information could only result from the information provided by the object's structure. No other source exists, at least none suitably related to the experience.¹⁵ (4) Any contrary principle would involve property emergence. Think of information as a characteristic or property of the information bearer. If the complex experience acquires information, but can't get it from its subvenient base, and no other base stands in a suitable relation to the experience, then the information must emerge out of nothing and from nowhere, in violation of Constraint 3. We can put this differently. If the high-level experience arises independently of the entities and inter-relations within its subvenient base, and no other base stands in a suitable relation to the experience, then not all aspects of the high-level experience result from something. Some aspects must instead emerge out of nothing and from nowhere, again in violation of Constraint 3.

A physical structure gains complexity (1) as it acquires more parts and a greater variety of parts; (2) as the spatial relations amongst its parts become more various and/or more complex; and (3) as the temporal relations amongst its parts become more various and/or more complex.¹⁶ We can understand the complexity of an experience likewise. (1) An experience gains complexity as a greater number and variety of presentations fill out the relevant phenomenal field. Thus an experience of a meadow of wildflowers has more complexity than an experience of homogeneous red. (2) An experience gains complexity as the synchronic relations amongst its constituent presentations become more various

15 This point draws strength from two conclusions reached later. (1) A quark's experience is narrow, in that it exists as an intrinsic property given by the quark's essential nature. It doesn't arise in response to causal influences on the quark. (2) Even complex high-level experiences have a narrow aspect, in that they model an external reality rather than including it.

16 There are, of course, trade-offs between number of parts and variety of parts and between variety of parts and complexity of parts. But we needn't go into this here.

and/or more complex.¹⁷ Thus an experience of an Escher print has more complexity than an experience of four blue polka dots against a red background. (3) A temporally extended experience (consisting of sequential experiences) gains complexity as the diachronic relations amongst the temporally distributed presentations become more various and/or more complex. Thus the experience of reading a novel has more complexity than an experience of homogeneous red alternating regularly with homogeneous green.

The following constraint provides needed information about basic physical objects.

Constraint 5: Basic physical objects are perfectly simple. They lack parts, structure and internal processes.

Justification: (1) Physics suggests that basic physical particles lack parts, structure, and internal processes. They seem to occupy mathematical points. And they seem not to exhibit the sorts of nonlinear behaviors characteristic of composite objects. (See Ford 2004, pp. 99 – 100.) (2) Basic objects can't have parts. Otherwise they would consist of and thus result from entities more basic than themselves, and therefore wouldn't qualify as basic objects in the first place. Without parts, a basic object can't have structure; and without structure, it can't have internal processes.¹⁸

If complexity of experience varies with complexity of structure (Constraint 4), but quarks lack structure (Constraint 5), then quark-consciousness has *maximal* simplicity. This has many consequences. On the negative side, it prevents quarks from having conscious states of *any* complexity. They therefore can't entertain propositional attitudes or muster second-order self-awareness. Although sentient, they lack all intelligence. On the positive side, it tells us that quark-consciousness takes the form of wholly simple and unstructured experience. If a quark has an experience of red, it experiences homogeneous red: a red without texture, variety, borders, magnitude, location, change or relations. The quark won't have any perspective on that red or any self-awareness of itself as experiencing red. It just

17 These synchronic relations present as spatial relations in the case of visual experiences.

18 Can an object have parts even though it doesn't result from entities more basic than itself? That is, could a quark have internal structure and processes without its being nomologically possible to break it into "smaller" bits? If so, then the second part of the justification fails. However, I don't think these possibilities obtain. My reasons unfortunately draw upon the debate about atoms vs gunk and therefore can't be developed here.

experiences red. It has a phenomenal field completely and exclusively occupied by red.¹⁹

Constraints 4 and 5 have another consequence. Perception depends upon perceptual apparatuses (e.g. eyes and visual cortex, nose and olfactory cortex) that transduce external causal signals. But quarks lack the structures needed for both apparatus and transduction. The quark's experience of red therefore can't represent a redness outside the quark. The experience must exist as an internal and intrinsic property of the quark. This conclusion immediately yields an elegant solution to the problems of qualia and secondary qualities. We no longer need to explain how a physical entity consisting solely of primary quality raw material can generate experiences as of secondary qualities as a result of representing another (and often external) physical entity also consisting solely of primary quality raw material. We instead treat the basic building blocks of our experiences as of qualia and secondary qualities as strictly basic experience types. Everything happens within experience. We never reduce entities of one type (experiences) to entities of another type (non-experiences) despite an explanatory gap between their tokens/instances.

The following constraints help us round out this picture.

Constraint 6: Insofar as both possible and appropriate, our account should posit strictly basic experiential properties that resemble strictly basic physical properties – that have similar second-order structural and behavioral properties.

Justification: (1) We should prefer a unified over a fragmented account of the world. (2) Our account will be less arbitrary, and to that extent more plausible, insofar as strictly basic experiential properties resemble the other strictly basic properties we know about.

Constraint 7: Basic objects with strictly basic experiences have them constantly and continuously.²⁰

19 You can experience something at least vaguely similar. Through imagination, and as best you can, strip away your higher conscious thoughts. Peel away experiences based on your other senses. Fill your phenomenal field with a single red hue. Now close your eyes to dispel any sense of looking at an external red thing. This brings you as close to a quark's experience as your complex mind allows. You don't experience exactly as a quark experiences, of course. But how much more determinate your grasp of a quark's red-experience is than your blind gropings for a bat's sonar-experience!

20 This constraint in fact holds only of free-standing basic objects – basic objects not part of a structure that combines atomic experiences into composite experiences. But I can't motivate this qualification here. I develop and explain it in the paper on mental chemistry.

Justification: (1) Science tells us that strictly basic physical properties don't change. Thus the electron instantiates its mass and electric charge continuously.²¹ (2) Strictly basic properties can't change. At least their non-relational traits can't. Strictly basic properties can't change because they don't have parts. If a strictly basic property seems to gain a feature, then the new entity counts as a non-basic composite consisting of the original strictly basic property plus something else. And if an alleged strictly basic property loses a feature, then the original entity couldn't have been a basic building block in the first place. If we allow strictly basic properties to change, then we lose sight of what it means for something to be basic.²² (3) If we allow strictly basic properties either to change or to come and go, then we commit ourselves to property emergence – in the forms of creation *ex nihilo* and/or destruction *ad nihilo*.²³ (If a strictly basic property gains something, remains strictly basic, and at all times lacks parts, then the accretion must have popped into existence out of nothing and from nowhere. And if a strictly basic property loses something, remains strictly basic, and again at all times lacks parts, then the entity lost must have disappeared into nothing.)

If constant, continuous and intrinsic, the quark's experience of red can't depend on relations to entities external to the quark. It can't arise in particular conditions in response to particular causes. The quark doesn't perceive, represent or react. It simply experiences red, the same way it instantiates mass and charge. The experience is a stable aspect of the quark's basic nature.

III

Constraint 2 proscribes explanatory gaps. This entitles us – in the present context, at least – to use the *epistemological* notion of an explanatory gap as a *metaphysical* criterion for property basicness. Thus we can say that one type of experience A is *basic with respect to* another type of experience B when an explanatory gap lies between A and B such that 1) we don't, and don't see that we ever could, see how A could result from B; and 2) we don't, and don't see that we ever could, see how A and B could both result from experience(s) of the same other type(s) C. It seems plausible that any sensory experience of one sensory modality is basic with respect to any sensory experience of another sensory

21 Relativity only affects these properties as they interact with entities in different frames.

22 This justification doesn't suffer from the uncertainly besetting the second justification for Constraint 5. That earlier constraint claimed that basic physical *objects* lack parts. This constraint claims that strictly basic *properties* lack parts.

23 Both creation *ex nihilo* and destruction *ad nihilo* violate constitutive supervenience. Creation *ex nihilo* involves creation out of nothing. Destruction *ad nihilo* involves the creation of nothing (taken as a substantive) out of something. But nothing (taken as a substantive) can't constitutively supervene upon something. Put differently, nothing (taken as a substantive) stands over and above something.

modality. Thus any visual experience is basic with respect to any olfactory experience. This gives us at least five basic types of experience – and more if we count pain, proprioception, kinesthesia, etc., as additional sensory modalities.

We also have a plurality of mutually basic types of experience within each sensory modality. It seems, in fact, that the types of experience associated with the different axes along which a given sensory modality collects and represents information about the world are basic one to another. Thus red and yellow qualify as mutually basic types of experience within the visual modality, as do sweet and bitter within the gustatory modality. (This allows that the experience of orange counts as a mixed type of experience resulting from a combinatorial or “blending” operation performed on the basic experiences of red and yellow. Otherwise we would have to countenance the experience of orange as a basic type, along with the experiences of every other hue including Hume's missing shade of blue. And similarly for every type of sensory experience.) We can hypothesize that, for the most part, each distinct type of sensory receptor correlates with a distinct basic type of experience. This won't always hold, of course. Some types of receptors may do nothing.²⁴ In other cases two or more distinct types of receptors might need triggering to generate a single basic type of experience. Still, we see the number of basic types of experience growing fast.

It seems plausible that the “raw feels” associated with our basic emotional states are basic both with respect to one another and also with respect to all our sensory experiences. Many psychologists believe that every human emotion results from a limited palette of primitive emotions (such as lust, desire, fear, aversion, contentment) and a smaller number of “higher” emotions (such as shame and guilt).²⁵ It makes sense that each of these basic emotional building blocks would call upon at least (and

24 For instance, only about 600 of our original 1,000 or so olfactory receptors work. The other 400 “broke” as the stabilizing selective pressures for them relaxed. This happened as we came to depend on sight rather than smell. See Gilad (2003).

25 See Wade and Tavris (2000), pp. 406 – 408, which surveys research suggesting that fear, anger, sadness, joy, surprise,

perhaps just) one basic type of experience.

We shouldn't forget the types of qualia humans can't experience. Bats echo-locate. Fish feel pressure changes with their lateral lines. Dolphins and electric eels do with electric pulses what bats do with sonar. Birds have four rather than three types of retinal cones. Bees see ultraviolet and infrared. Vipers give an entire sensory modality to infrared. Migrating birds and sea turtles sense the Earth's magnetic field. And so on. And what of basic types of sensory experience no currently existing organism can manage? What of basic types of emotional experience as beyond us as guilt eludes lizards?

Furthermore, perhaps phenomenal consciousness extends beyond qualia to (occurrent) attitudes, thoughts, understandings, reasonings, etc. And perhaps these states/activities involve types of experiences over and above experiences of the qualia associated with them. This would give us still more basic types of experience.²⁶

We must obviously countenance a large number of basic types of experience even if we regard most types of experience as mixed products of blending operations (as we surmised for the case of orange). Each of these basic types of experience has its strictly basic form, a property as basic as strictly basic mass or charge. C. D. Broad (1925) arrived at the same general conclusion, albeit in a different (and emergentist) context.

[The] appearance of a plurality of irreducible sensible qualities forces us, no matter what theory we adopt about their status, to distinguish two different kinds of law. One may be called "intra-physical" and the other "trans-physical". ... [So] far as I can see, there must be at least as many irreducible trans-physical laws as there are irreducible determinate sense-qualities. (p. 490)

Constraint 1 tells us that basic physical objects must instantiate the strictly basic forms of each of these

disgust, contempt and love are basic or *primary* emotions, with other, *secondary*, emotions being constructed out of them.

26 I don't say more here about what sorts of strictly basic conscious properties might result in occurrently conscious propositional thoughts, understandings, reasonings, etc. I leave this issue aside because it doesn't so much concern the nature of quark-experience as the structure of non-qualitative conscious thought generally. I will present this aspect of the account on a later occasion.

basic experience types. It makes sense to express this result as a further constraint.

Constraint 8: Each basic type of experience, in its strictly basic form, must characterize (at least some) basic physical objects as one of their strictly basic properties.

The Standard Model of physics provides for 12 fermions, as many corresponding anti-particles, and five bosons (including the graviton but excluding the Higgs boson), for a total of some 29 basic physical objects (Greene 2000, pp. 9, 389 – 390). An expanded Standard Model might one day accommodate whatever exotics underlie dark matter and dark energy. It seems safe to say, however, that few of these particles have much to do with us. Conscious organisms consist, for the most part, of up quarks, down quarks, electrons, gluons and photons – five types of basic physical objects. By contrast, we can easily envision hundreds, maybe thousands, of strictly basic conscious properties. Certainly a panpsychism honoring Constraint 2 (proscribing explanatory gaps) must acknowledge a minimum of many dozens. Hence:

Constraint 9: There are fewer types of basic physical objects than types of strictly basic conscious properties.²⁷

Furthermore:

Constraint 10: All instances of a given type of basic physical object have the same strictly basic properties.

Justification: (1) The quantum principle of particle interchangeability provides that all instances of a given type of basic particle (in a given state) are identical and hence interchangeable (Lockwood 1989, pp. 252 – 253). (2) If alleged instances of a single type of basic physical object did possess distinguishing intrinsic properties, then we would regard them as having different basic properties and thus as instances of different types of basic objects. (3) The justification for Constraint 6 argued that strictly basic properties can't change. The same considerations apply to basic objects. Thus basic objects can't gain and lose intrinsic characteristics. If basic objects start out the same they must continue the same.

Constraints 9 and 10 – together with Constraints 7 (constancy of strictly basic conscious properties) and 8 (strictly basic experiences instantiated by basic physical objects) – entail that at least

²⁷ This holds even more starkly if all (so-called) basic physical particles result from a single physical substrate – mass-energy, say. Then instances of a single type of basic physical object will instantiate all strictly basic conscious properties.

some basic physical objects simultaneously instantiate a plurality of strictly basic conscious properties. This conclusion might appear to clash with the simplicity of quark-consciousness. After all, if a quark experiences a simple and homogeneous red – which fills its phenomenal field completely and exclusively – how can it at the same time experience a simple and homogeneous yellow – which also fills its phenomenal field completely and exclusively? We can't say that part of the quark experiences red while another part experiences yellow, since, by Constraint 5 (simplicity of basic objects), quarks don't have parts. We must say that, somehow, the whole quark experiences a simple red and nothing but and at the same time a simple yellow and nothing but.

This doesn't pose a problem, however, appearances to the contrary. But we must precisely locate the source of the apparent clash in order to appreciate why not. The difficulty can't lie with the quark's having more than one strictly basic property. We don't feel any tension between the quark's simplicity and its instantiating a plurality of strictly basic *physical* properties (such as mass, charge, spin, color, etc.). You might find quark-consciousness incredible, but you likely haven't objected on the grounds that a maximally simple object couldn't have another property in addition to the several physical ones it already has. So why should a plurality of conscious properties create problems where a plurality of physical properties doesn't?

We likely scent trouble because we mistakenly see no alternative to giving the quark an overall experience of red *and* yellow. But, again, the quark lacks the structure needed to sustain such a complex experience. The quark must instead have a simple experience of red and a wholly separate simple experience of yellow. We might say that the quark instantiates [Exp(red) & Exp(yellow)] but not Exp(red & yellow). This can work only if we attribute multiple and wholly separate phenomenal fields, one occupied exclusively by red, another by yellow, and so on for all the quark's other strictly basic conscious properties. Further, since each phenomenal field needs a subject of experience, and all the phenomenal fields are completely disconnected one from another, we must recognize as many

completely disconnected subjects as strictly basic conscious properties. The quark won't (because it can't) have a subject experiencing red *and* yellow. The quark instead has one subject experiencing red in one phenomenal field and another wholly separate subject experiencing yellow in another phenomenal field. Again, don't think of these subjects as self-aware minds capable of personality and/or attitudinal thought. Their subject-hood amounts to nothing more than the experiencing of a maximally simple conscious property. And remember to treat these different phenomenal fields-with-subjects as distinct basic features of a single object in the same way you treat mass, charge, color and spin as distinct basic features of a single object.²⁸

IV

We've seen that quark consciousness has three main features. (1) It is simple. A quark has an unstructured experience of a single (and strictly) basic type of experience. (2) It is constant, continuous and independent. A quark has experience(s) as a stable consequence of its intrinsic basic nature. The quark doesn't perceive or respond to conditions external to its phenomenal field(s). The quark's experiences present but don't represent. (3) It is multiple. At least some basic physical objects (and let's assume quarks) simultaneously experience a plurality of distinct basic types of experiences. Each such experience occupies its own, wholly separate phenomenal field with its own, wholly separate subject.

We should find this picture encouraging. On the one hand, it tells us that quark-consciousness resembles human consciousness enough for us to form an intelligible and determinate conception of it (in contrast to bat sonar-experience, say). It thus makes it relatively easy to understand how our own experiences could result from combinatorial or “mental-chemical” operations performed on basic

28 It might help to compare the multiple nature of quark-consciousness with quantum superposition. Suppose a quark only experiences red and yellow. And suppose an electron passes through a barrier with two slits. Experiments show the electron doesn't pass through slit one, doesn't pass through slit two, doesn't pass through both slits, and doesn't pass through neither slit (see Albert 1994, p. 11). Instead it makes the journey in a superposition of all four possibilities. In contrast, the quark *does* experience red and at the same time *does* experience yellow.

atomic experiences.²⁹ On the other hand, quark-consciousness differs enough from ours to accord with our hunch that consciousness on so small and impoverished a scale must be very strange indeed. Humans don't experience phenomenal fields filled with single, homogeneous presentations. Humans can't readily (or ever) purge experience of high-level thought or self-awareness (except perhaps and partially in intensely visceral experiences like sudden terror, or in pathological states like high fever). Nor can humans experience anything like the multiplicity of quark-consciousness. (In fact, no entity, not even a quark, can *experience* multiplicity, since no single *subject* has multiple phenomenal fields. An *object* can have multiple experiences, but only by instantiating a plurality of subjects each of which has non-multiple experiences in non-multiple phenomenal fields. Even humans suffering from multiple personality disorder have separate and distinct subjects each experiencing a single and unified personal narrative.)

The account offered here promises to bear fruit. We've already seen that it straightforwardly offers the germs of a satisfactory theory of qualia and other secondary qualities. We can flesh this out a bit by building further on the fact that atomic experiences are presentational, non-representational, internal, intrinsic – and therefore at least partly narrow. On this view, when a complex mind – like yours – does consciously represent the world, it doesn't somehow make direct contact with represented objects external to it. It instead uses a stock of internal resources – those strictly basic conscious properties that feed up the structural hierarchy as a result of mental chemistry – to *model* features of the world. Our minds thus use information supplied by our internal and external senses to constrain models built out of purely internal raw material. These models thereby achieve isomorphism with the represented objects in functionally relevant respects. Our minds manage to construct richly detailed

²⁹ The structure of our account guarantees this, of course. Constraints 1 (telling us to posit all, but only those, strictly basic experiences needed to explain higher-level (including human) experiences) and 2 (the prohibition against explanatory gaps) ensure that our own experiences result *intelligibly* from bottom-level experiences. We find bat sonar-experience opaque because it results from bottom-level experiences none of our experiences results from.

models because they have so many internal resources to draw upon, and such sophisticated means of combining them into representational wholes.

We can hypothesize that our brains exploit a subset of the available strictly basic experiences when translating sensory information into conscious representation. The information from each distinct type of sensory receptor contributes to the representation through presentations of (or mental-chemical operations on) a distinct strictly basic type of experience. As more sophisticated and informative sensory systems evolve, the evolving brain calls upon additional strictly basic types of experience. When birds acquired a fourth light-sensitive cone, their brains tapped into a fourth strictly basic type of experience in order to construct richer and more informative visual representations. Similarly, when emotions and then conceptual thought evolved, the brain made use of still further strictly basic types of experience. But here our discussion grades from quark-consciousness into mental chemistry. So here, for now, it should stop.³⁰

30 This paper takes very seriously certain views about philosophy and philosophizing. Many physicalists (as well as others) have opined that no big divide marks off philosophy from science. Swoyer & Orilia (1999/2011) has argued that philosophers, or at least metaphysicians, put forward explanations. This paper pursues these ideas under the conviction that logical and conceptual analysis no more exhaust the method of philosophy than the domains susceptible to them exhaust its subject. The philosopher must not only craft fine arguments for a metaphysical view. He must also describe the world entailed by it. Here he advances explanations, hypotheses and models which he must develop in enough detail for them to be put to the test. These tests may use any defensible means available – but at the very least must determine whether the metaphysical view *works*. In a word, metaphysics must traffic in nuts and bolts and not just grand abstractions. This paper has endeavored to do all these things, as well as conceptual and logical analysis where appropriate, of course.

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