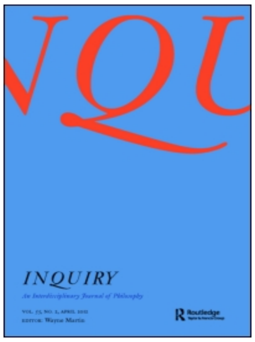

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Building minds: solving the combination problem

Pat Lewtas

Department of Philosophy, American University of Beirut, Beirut, Lebanon

ABSTRACT
Any panpsychism building complex consciousness out of basic atoms of consciousness needs a theory of 'mental chemistry' explaining how this building works. This paper argues that split-brain patients show actual mental chemistry or at least give reasons for thinking it possible. The paper next develops constraints on theories of mental chemistry. It then puts forward models satisfying these constraints. The paper understands mental chemistry as a transformation consistent with conservation of consciousness rather than an aggregation perhaps followed by the creation of something in addition. The paper suggests that this kind of mental chemistry alone yields a workable panpsychism.

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Panpsychism[1] bestows basic conscious properties on basic physical objects.[2] And it builds complex conscious properties, minds like yours and mine, out of these basic conscious properties. Panpsychism thus understands consciousness as a property, reduces high-level consciousness to bottom-level consciousness, and declines to reduce bottom-level consciousness to anything else, much less anything non-conscious.[3] The view needn't claim that all basic physical objects have conscious properties. It only has to put enough basic consciousness 'down there' to build high-level consciousness 'up here'. So it might say that quarks, but not electrons, are conscious. Nor

CONTACT Pat Lewtas pl03@aub.edu.lb

[1]At least the kind debated by James ([1890] 1950), Nagel (1979) and Van Cleve (1990). The paper soon contrasts this with related views.
[2]'Basic' means not built of anything.
[3]This paper assumes a bottom level. Believers in gunk can replace 'property whose instances obtain at the bottom level' with something like 'property for which there is no level below which instances of it don't obtain'. The paper's models and arguments work on a gunk-friendly metaphysics. But switching them over takes some work.

need panpsychism insist that all high-level objects have consciousness. The view ties 'mental chemistry'[4] – the ways lower level consciousnesses come together to build higher level consciousness – to physical structure, for reasons we'll see shortly. So the view can allow that brains, but not trees, have mental-chemically effective structures. This frees panpsychism from things like world souls and conscious tables. Many arguments might lead to panpsychism. Perhaps the best combines anti-reductionism about consciousness with anti-emergence about everything, consciousness included.[5] This argument makes consciousness a basic property and then pushes it down to the bottom level.

Panpsychism won't easily win minds, no matter how good the case for it, without a detailed account showing that the view works. This account must overcome two challenges. It must make sense of basic bottom-level experience. And it must explain mental chemistry. This paper tackles mental chemistry. It argues that minds can indeed sum. Then, it presents a theory, consistent with restrictive and independently justifiable constraints, showing how basic experiences, subjects, and phenomenal fields might yield complex experiences, subjects, and phenomenal fields. A companion paper puts forward a theory of basic bottom-level experience.[6]

Needless to say, much that follows involves speculation. Systematic work on panpsychism has only begun. As Section I explains, two distinct motivations animate panpsychism and related views: simplicity/beauty and a kind of rationalism. These sometimes pull in different directions. This paper takes one of these, rationalism, and pushes it without compromise, exploring where it leads. The reader should therefore treat what follows as a tentative first attempt along these lines.

I

But first some background. This section locates the panpsychism treated here, and the paper's overall approach, against the backdrop of relevant literature. The next section lays out terms, concepts, and tools.

Much recent interest in panpsychism traces to optimism about the prospects of a related view, *Russellian monism*, with *Russellian panpsychism* a subtype. This paper, by contrast, elaborates a kind of *mind-dust panpsychism*.

[4]Nagel (1979) supplies the label.

[5]Emergentism, in this context, asserts the existence of high-level but nevertheless basic properties: high-level properties not built of anything, much less lower level or pre-existing entities. See Lewtas (2013a, forthcoming).

[6]Lewtas (2013b).

Mind-dust panpsychism rests solely on the claims listed in the paper's opening paragraph. It thus accepts the existence of the irreducibly non-conscious physical. It puts consciousness at the bottom level, but only as a non-physical property of otherwise physical objects like quarks. It grants that a quark's physical properties (mass, charge, spin, etc.) need have nothing to do with its consciousness. And it might allow that some basic physical objects (electrons, say) lack consciousness altogether.

Russellian monism issues from three sources. First, it notes that science (including physics) only reveals structural/relational/dispositional properties. Put otherwise, science only describes causal structures and the causal dynamics that govern them. Science can't do more. It can only gather as data causal effects on scientists' senses (either direct, or indirect through prior effects on instruments) and then explain these data by postulating entities disposed to cause them. Non-causal hypotheses would lack explanatory power and stand aloof from empirical test. So science doesn't and can't say anything about the entities, if any, that ground physical dispositions, fill out physical structures or characterize a physical entity apart from its structure and relations to other things.[7] Second, Russellian monism insists upon underlying entities that do ground physical dispositions, etc. And third, it ventures that these underlying entities also ground conscious properties.[8]

Russellian monists recognize two kinds of grounding entities: conscious properties and protophenomenal properties.[9] Russellian *panpsychists* posit underlying conscious properties. They thus rid their concrete metaphysic of irreducibly non-experiential entities. Most Russellian monists posit underlying protophenomenal properties. These properties are non-conscious and non-physical (meaning distinct from the dispositional properties of science) and ground both higher level conscious properties and physical dispositions. They appeal to Russellians who judge it incredible that full-blown consciousness exists at the bottom level.[10]

This paper believes that all these views stem, in varying degrees, from a rationalist outlook rooted in a strongish principle of sufficient reason. They therefore spurn metaphysical and epistemological gaps: they take it that all high-level entities reduce, and reduce *intelligibly,* to bottom-level entities.

[7]See Lewtas (2015) for more about this.

[8]Different Russellian monists envision different relations between the grounding entities and higher level conscious properties: identity, constitution, necessitation, supervenience, causation. See Alter and Nagasawa (2012).

[9]Alter and Nagasawa (2012) recognize four: conscious properties, protophenomenal properties, neutral properties and physical properties of a new kind. The present paper sees only verbal differences between the last three.

[10]For more about these views, see the essays in Alter and Nagasawa (2015) and Part I of Kriegel (2014).

They part with radical emergentism because emergentism allows high-level entities that don't reduce to bottom-level entities. They part with physicalism because physicalism allows high-level entities that reduce, but not intelligibly, to bottom-level entities.[11] Because our three views hold metaphysics and epistemology to the same reductive standard, they keep metaphysical and epistemological explanations from drifting apart. In each case a good explanation shows how high-level entities are nothing over above basic bottom-level entities. These views thus put themselves forth as explanatory theories offering what they see as best explanations of high-level consciousness (and, in the case of Russellian views, of physical reality).[12]

Russellian views have another motivation: simplicity/beauty. (1) They claim to more tightly integrate consciousness and physical reality than other mind–body theories. (2) They claim to solve two big problems elegantly and together: what underlies physical dispositions and how consciousness relates to physical reality. (3) They claim to alone allow for non-physical yet causally relevant conscious properties. Here, they have their eyes on the causal argument for physicalism. This token identifies conscious properties with physical properties on the grounds that (a) conscious properties cause physical events (understood, for these purposes, as physical properties instanced at times);[13] (b) all physical events have sufficient physical causes (the doctrine of physical causal closure); and (c) systematic over-determination doesn't occur.[14] Non-physicalists don't draw the physicalist conclusion, of course. But most accept the second and third premises.[15] This sets the price of non-physicalism at epiphenomenalism. Here, Russellian views hold out hope of non-physicalism without epiphenomenalism. Maybe conscious properties can't flex muscle in their own right. But if basic conscious (or protophenomenal) properties give being to physical properties that can, then basic conscious (or protophenomenal) properties put a causal stamp on the world nonetheless. Causation springs from them and would be nothing without them. And if higher level conscious properties inherit causal relevance from the basic conscious (or protophenomenal) properties that build them, perhaps they too make a difference.[16]

[11]Physicalism claims that all concrete entities are either physical or nothing over and above the physical. See Lewtas (2014a) for more. *A priori* physicalists claim that consciousness reduces intelligibly to non-conscious entities. Panpsychists deny that a priori physicalism achieves this.

[12]See Section VI and Lewtas (forthcoming) for more about rationalism and panpsychism's commitment to it.

[13]Different understandings of events call for different formulations of the argument. These nuances don't matter here.

[14]Systematic over-determination occurs when every instance of every conscious cause is over-determined by some (and not necessarily the same kind of) physical cause.

[15]See, for example, Jackson (1982), Chalmers (1996) and Kim (2005).

[16]See Chalmers (1996, 136–140; 2013; forthcoming). Rosenberg (2004) explores a Whitehead-inspired Russellian panpsychism grounding causation in experience.

This paper finds these further reasons wanting (and here it can offer only argument sketches). (1) We no more see how to 'get' physical dispositions out of consciousness than we see how to 'get' consciousness out of the physical. Put otherwise, the explanatory gap between consciousness and the physical seems to cut both ways.[17] We face similar troubles 'getting' consciousness out of the protophenomenal. For an explanatory gap apparently lies between conscious and non-conscious entities. All this commits the Russellian to *unintelligible* reductions. This undercuts his rationalism. It also undermines his warrant for rejecting physicalism. For if his theory includes an explanatory gap, the Russellian should become a physicalist: given its simplicity, unity, and empirical backing, physicalism should, but for its explanatory gap, serve as our default metaphysic. (2) A well-elaborated Russellian theory might not have the lean elegance its defenders suppose (even if, which we may doubt, simplicity/beauty carries much weight in the first place). Briefly, we might have to recognize more basic conscious (or protophenomenal) properties than basic physical dispositions.[18] This imbalance makes it hard, maybe impossible, to craft a serviceable grounding relation between them. (3) Russellian views might fail to outflank the causal argument for physicalism. We have no good reason to reject physicalism if we grant consciousness a causal essence. For if we identify consciousness with causal properties, consciousness amounts to a role needing something to implement it. But nothing, it seems, stops the physical from doing this. Further, what holds of the overall conscious property holds of its parts. Any part that doesn't stand over and above the causal yields to physical realization and therewith (at least token) physical reduction. This forces the non-physicalist to treat consciousness as wholly non-causal. And if protophenomenal properties ground physical dispositions, they too must have a wholly non-causal nature (for otherwise they would need grounds themselves). But then, having denied our grounding properties causal efficacy, we can't readily extrude physical dispositions from them. This leaves conscious (and protophenomenal)

[17]An explanatory gap exists wherever a reduction of some higher level entity to one or more lower level entities fails to explain the higher level entity. The reduction of water to H_2O *does* explain the higher level properties of water: given the properties of H_2O, we see why water has the properties it does. We even see that water must have them. So no explanatory gap lies between water and H_2O. On the other hand, the reduction of consciousness to physical (neural) entities doesn't explain consciousness: nothing about the physical (neural) properties suggests that consciousness supervenes upon them, much less consciousness of the kind that does. So here we do face an explanatory gap. The explanatory gap has two components. Not only don't we see how physical (neural) properties equal, realize or otherwise amount to consciousness. More, we don't see how they ever could.

[18]Lewtas (2015) explains why.

properties causally ineffective.[19] (4) The paper suggests that other non-physicalist views *can* make room for causally effective conscious properties. Both mind-dust panpsychism and emergentism can withhold active causal powers from consciousness, yet accord physical nature the capacity to change itself in response to otherwise passive conscious properties. This gives consciousness causal oomph while keeping all *active* efficacy on the physical side.[20] The above argument sketches show that Russellian views sometimes sacrifice rationalism for esthetic considerations. Put otherwise, simplicity/beauty and rationalism can work at cross purposes. As noted earlier, this paper asks what follows from rationalism alone.

The paper also suggests that Russellian theories and mind-dust panpsychism lead to different mental chemistries. Russellian theories countenance very few basic conscious (or protophenomenal) properties, one per bottom-level physical property, whose intrinsic natures are set, not by the demands of mental chemistry, but by the structures of the physical dispositions they ground. This paper believes that both mismatches – between the number of basic conscious (or protophenomenal) properties available for mental chemistry as against the number needed for it, and between the natures of the conscious (or protophenomenal) properties available for mental chemistry as against the natures needed for it – make it difficult, if not impossible, to build high-level experiences while shunning explanatory gaps. Worse, the Russellians' basic conscious (or protophenomenal) properties can't undergo mental–chemical transformations, because they must continue to ground the same unchanging lowest level physical properties. This means the Russellian must identify a high-level experience with a collection of basic conscious (or protophenomenal) 'pixels'. But this either fails to generate an overall experience, because the necessarily unchanging pixels can't merge into a single whole, or else does so only through the creation of something in addition to those 'pixels': in a word, through metaphysically discontinuous emergence. Mind-dust panpsychism doesn't face these problems. As the paper hopes to show, nothing stops it from understanding mental chemistry as a process whereby simple conscious inputs are transformed into a more complex conscious output. (For a crude example, think of a finished

[19]This paper doesn't believe the Russellian can evade this result with a radically contingent grounding relation of the kind envisaged by Armstrong (1997) or Lewis (2009). These thinkers see no necessary link between grounding property and grounded disposition. Any suitably intrinsic/categorical/non-dispositional property could ground any disposition given the right natural laws. But if the grounded property stands over and above the grounding property, then the grounding relation becomes a kind of radical emergence. We've seen already (and will see more clearly later) that emergence/emergentism runs counter to panpsychist rationalism. Nor can the Russellian accept, unqualified, Heil's (2003) identification of dispositions with their grounds. Rationalism prevents the Russellian from identifying properties lacking intelligible connections between them: such as necessarily non-causal grounds and essentially causal dispositions.

[20]Lewtas (Manuscript) offers a theory of mental causation along these lines.

meal and the ingredients that went into it. The cook transforms the ingredients into something else, which nonetheless remains nothing over and above them. Nothing emerges.) This provides another argument for mind-dust over Russellian views.[21]

How does this paper relate to the literature on mental chemistry? Chalmers (forthcoming) divides panpsychism into two kinds.

> Constitutive panpsychism is the thesis that macrophenomenal truths are (wholly or partially) grounded in microphenomenal truths. Nonconstitutive panpsychism is the thesis that macrophenomenal truths are not grounded in microphenomenal truths. (3)

Chalmers then shows that non-constitutive panpsychism fails to build higher level consciousness out of basic conscious properties and therefore doesn't feature mental chemistry. He also argues that constitutive panpsychism must identify higher level conscious properties with 'mosaics' of contemporaneously existing bottom-level conscious properties. As we'll see, this paper finds cause to reject this. Chalmers considers and dismisses a third kind of panpsychism, wherein 'low-level subjects "merge" or "blend" or "fuse" to yield higher-level subjects' (20). This paper follows this third way, effectively treading a middle path between constitutive and non-constitutive panpsychism. Most of the paper details this approach. Section XVI returns to Chalmers' arguments and explains why the paper deems them unconvincing.

Other philosophers have investigated this third way too, most recently Seager (Forthcoming) and Morch (2014). This paper differs from them in its unwavering commitment to rationalism and hence intelligibility. In its judgment, neither Seager nor Morch achieve full intelligibility, in Seager's case, at least, because he allows elements of emergence into his mental chemistry. This keeps their theories from meeting the paper's rationalist demands. This paper strives for a mental chemistry that does meet these demands.

II

Now for some terms, concepts and tools. This paper understands a basic entity as a basic building block not built of anything else. That makes a basic property a kind of basic building block. Think of a quark's mass or an electron's charge.[22] Call these *strictly basic* properties. Composite entities are built of basic entities. In particular, composite properties are built of basic properties. Call *compositely basic* a composite property built of instances of

[21] See Sections XIV and XVI for more.
[22] These examples assume, perhaps contrary to fact, that mass and charge qualify as basic.

a single kind of strictly basic property. Think of your mass or a computer's electric charge.[23] Call *mixed* a composite *conscious* property built only of instances of more than one kind of strictly basic *conscious* property. Think of the conscious property you instantiate now. And call *non-basic* any composite property neither mixed nor compositely basic. Think of the saltiness of blood. A simple property (whether basic or not) confers very few (kinds of) characteristics, powers, or susceptibilities. Again, think of strictly basic mass.[24] A complex property (whether basic or not[25]) confers more (kinds of) characteristics, powers, or susceptibilities. Think of the acidity of an orange.[26]

The paper presupposes universal constitutive dependence. We say that high-level entities B constitutively depend on lower level entities A when the B-entities are built (only) of A-entities. We say that constitutive dependence holds universally when all high-level entities constitutively depend on basic bottom-level entities. Universal constitutive dependence ensures that all tokens/instances of high-level entities equal, and don't merely correlate with, spatiotemporal arrangements of tokens/instances of basic bottom-level entities. It thus guarantees the asymmetric dependence of high-level entities on basic bottom-level entities.

Throughout we use *results-from*/*results-in* to encompass the ways a high-level entity B can relate to lower level entities A such that B is nothing over and above A. The results-from/results-in relation covers relations such as identity, composition, and realization. It relates all high-level entities to bottom-level entities where, and only where, universal constitutive dependence obtains. Note that B-entities can result from A-entities where A-entities don't compose B-entities, but the constituents of A-entities do.[27]

We'll treat one type of experience A as *basic with respect to* another type of experience B where (1) we don't, and don't see that we could, see how instances of A could result from instances of B; and (2) we don't, and don't see that we could, see how instances of A and B could both result from experience(s) of the same type(s) C. For example, it seems plausible that any experience from one sensory modality (e.g. an experience as of red or, more briefly, a red experience) is basic with respect to any experience from another sensory modality (e.g. salty-taste experience). Panpsychist rationalism, which, recall, forbids metaphysics from outrunning epistemology,

[23]The second example ignores positive and negative charges.
[24]General relativity entitles us to regard inertial and gravitational dispositions as two sides of the same coin.
[25]Emergentism recognizes complex basic properties.
[26]Lewtas (2014b) develops these distinctions as part of a theory of property composition.
[27]It follows that humans can result from dogs, since the sub-atomic constituents of dogs can fully constitute a human. Of course, although a human can result from dogs, almost certainly no actual human ever has (although many have gone to the dogs).

justifies the use of the explanatory gap as a criterion for the absence of a results-from/results-in relation. The paper says more about this later.

The paper uses quarks and electrons as stand-ins for basic bottom-level physical objects (concrete metaphysical simples) and quarks for basic bottom-level physical objects with experience. Although the paper takes into account some general features of science and physics, it engages little with the substantive details of current physics. In particular, it doesn't tie its conclusions to quantum mechanics or quantum field theory.[28]

The paper regards any experience as having three aspects conceptually distinct but metaphysically one. An experience requires a presentation (what is experienced), a subject (what experiences), and conscious awareness (what sets experience apart from the 'perceptions' of an electric eye). These are one because a subject, as such, *consists* of its conscious presentations. The subject might issue from non-conscious neural processing or ride atop a stew of unconscious drives. But, as a consciousness, it exists as and through its experiences. If this holds true, experiences relate to their subject, not as contents to container, or percepts to perceiver, but as parts to whole. The directness/immediacy of experience then derives from the metaphysics of identity.[29]

III

Mind-dust mental chemistry builds a single subject having complex conscious properties arrayed in a single phenomenal field.[30] It works upon many basic subjects having strictly basic conscious properties in many phenomenal fields. It thus crafts single subjects from many, single phenomenal fields from many, and single experiences from many. In all cases, physical structure determines whether and how a given object performs mental chemistry. Physical structure plays this role because nothing else could, at least nothing else in the lean ontology of the mind-dust panpsychist.

[28]Perhaps the paper's particle ontology misses the mark, because deepest reality consists of fields instead. It doesn't matter. If fields occupy the bottom level, the arguments for panpsychism push basic consciousness into them. If those fields result from a single mass-energy or space-time field, then our arguments put basic consciousness there. Now, field ontologies envision at most as many basic fields as the number of basic particles recognized by particle ontologies. So the conclusions reached in the companion paper, summarized in Sections VI and VII and built on here, hold true on them as well. It therefore wouldn't take much to adapt the paper's mental–chemical models to fit a field ontology.

[29]Subject, presentation, conscious awareness, and phenomenal field (introduced shortly) all count as properties given their identity with each other, their identity with consciousness, and consciousness' status as a property.

[30]This paper takes unified subjects for granted. Single overall experiences are experienced all at once from one point of view. Could this unity be illusory? An illusion had by what? For further arguments, see Tye (2003), xii and chapter 1.

A *theory* of mental chemistry must explain how single subjects and single phenomenal fields result from many subjects and many phenomenal fields. It must thus overcome the combination problem, the argument, or intuition, that distinct subjects, with their distinct phenomenal fields, can't merge because of their *essential* isolation. Most panpsychists believe the combination problem their biggest challenge; most critics judge it their most telling argument.[31] This paper finds the combination problem less troublesome and less significant. Sections IV and V address it.

Our theory of mental chemistry must also explain how complex experiences result from simple experiences. No doubt the brain uses many (and many very complicated) mental–chemical processes for many (and many very complicated) features of experience. Here, we focus on three processes needed for most any experience. (1) How mental chemistry *chooses* experiences of a given type, from the many instantiated at the bottom level, to feed into a higher level experience. For example, your high-level red experience might result from bottom-level strictly basic red experiences rather than bottom-level strictly basic salty-taste experiences. (2) How mental chemistry *places* experiences of two or more distinct types within a complex experience. For example, to build an experience of red stripes interleaved with yellow stripes, mental chemistry must first choose strictly basic red experiences and strictly basic yellow experiences, then place them into a striped composite. (3) How distinct strictly basic experiences *blend* to yield mixed experiences. For example, to get an orange experience, mental chemistry might need to choose strictly basic red experiences and strictly basic yellow experiences, then blend them into a mixed orange experience. Here, our theory confronts the *blending problem*: the possibility that orange qualifies as a basic type of experience even though we can make orange paint by mixing red paint with yellow. In Section XII, we see that panpsychism must either overcome the blending problem or shoulder prohibitive theoretical costs.

IV

Seager (1999) identifies the combination problem as 'the problem of explaining how the myriad elements of "atomic consciousness" can be combined into a single, new, complex and rich consciousness such as we enjoy' (241). William James ([1890] 1950) puts the problem forcefully.

[31]See Section XVII for references.

> Take a sentence of a dozen words, and take twelve men and tell to each one word. Then stand the men in a row or jam them in a bunch and let each think of his word as intently as he will; nowhere will there be a consciousness of the whole sentence …. (160)

The problem derives from a subject's inability to directly experience the presentations in another subject's phenomenal field(s) (the same inability that underlies the problem of other minds). Yet the walls around a subject would have to melt for mental chemistry to happen. Some philosophers see a contradiction here.[32] Note that James' point depends partly on his assumption that the separate individual thoughts coexist with the overall combined thought.

James offers a second and different statement of the problem.

> Where the elemental units are supposed to be feelings, the case is in no wise altered. Take a hundred of them, shuffle them and pack them as close together as you can (whatever that might mean); still each remains the same feeling it always was, shut in its own skin, windowless, ignorant of what the other feelings are and mean. There would be a hundred-and-first feeling there, if, when a *group* or series of such feelings were set up, a consciousness *belonging to the group as such* should emerge. And this 101st feeling would be a totally new fact; the 100 original feelings might, by a curious physical law, be a signal for its *creation*, when they come together; but they would have no substantial identity with it, nor it with them, and one could never deduce the one from the others, or (in any intelligible sense) say that they *evolved* it. (160)

Here James speaks of a combination problem *within* a mind. He suggests that each feeling has features of subject-hood ('shut in its own skin, windowless') preventing the traffic between feelings that mental chemistry requires. He allows that a new feeling might radically emerge from the original 100. But he rightfully denies that it would thereby result from them. Note that James' point depends on his assumption that, when feelings A and B at t_1 trigger the creation of feeling C at t_2, then at t_2 all three feelings exist together.

James' first statement of the combination problem points to the difficulty of combining subjects A and B to yield subject C. His second statement points to the difficulty of combining feelings A and B within subject S to yield feeling C also within S. This paper addresses both problems and also a hybrid third: how experience A in subject S and experience B in subject T combine to produce experience C in a subject produced by combining subjects S and T.

[32] See Goff (2006) and Coleman (2014).

V

Many have wondered about the experiential lives of split-brain patients (veterans of commissurotomies, operations severing the corpus callosum, which connects left and right hemispheres and allows high-level communication between them.[33]) Tye (2003) summarizes academic and clinical opinion.

> It has been variously suggested (a) that split-brain subjects are really two persons with two separate minds; (b) that the responses produced by the right hemisphere are those of an unconscious automaton; (c) that it is indeterminate how may persons split-brain subjects are and that the concept of a person is thrown into jeopardy by the experimental results; (d) that split-brain subjects have a unified phenomenal consciousness but a disunified access consciousness; (e) that split-brain subjects are single persons who undergo two separate streams of consciousness that remain two from the time of the commissurotomy; (f) that split-brain subjects are single persons whose phenomenal consciousness is briefly split into two under certain special conditions, but whose consciousness at other times is united. (111–113)

Tye favors the last.

> The conclusion I draw is that...split-brain subjects are single persons whose consciousness is unified except in certain very special experimental situations. On those occasions, their stream of consciousness splits into two, which rejoin again once the experimental controls are removed – just as a river sometimes splits into two separate channels around islands, channels that merge again afterward. (128)

Dennett (1991) acknowledges that most philosophers and many primary researchers believe split-brain patients have separate minds (424). Yet he settles on an interpretation like Tye's.

> For brief periods during carefully devised experimental procedures, a few of these patients bifurcate in their response to a predicament, temporarily creating a second center of narrative gravity. A few effects of the bifurcation may linger on indefinitely in mutually inaccessible memory traces, but aside from these actually quite primitive traces of the bifurcation, the life of a second rudimentary self lasts a few minutes at most, not much time to accrue the sort of autobiography of which fully fledged selves are made. (425)

Consider two scenarios: (1) the standard, which accords split-brain patients separate streams of consciousness; and (2) Dennett's and Tye's, which accords them single streams that split briefly during artful experiments. Focus first on (1). Suppose a surgeon performs a commissuroplasty

[33]This leaves the hemispheres connected through mid-brain structures letting them communicate indirectly and share certain emotional states (Dennett 1991, 423). Dennett (198) describes a patient whose right hemisphere wanted to say 'pencil'. It had to bring the speech-responsible left hemisphere onside. So the hand it controlled jabbed a pencil into the hand whose sensations the left hemisphere felt.

rejoining the hemispheres. What results? Perhaps the reconnection shorts out consciousness. Perhaps the patient suffers a chaos of presentations. Perhaps the two streams carry on in defiance of the restored linkages (as brains ignore optical information after prolonged blindness). Perhaps the two streams persist, but with James' 'windows' into one another. Perhaps the hemispheres war over brain and body. But maybe (and maybe most plausibly?) the brain relearns its old ways. The patient recovers a single integrated consciousness, albeit perhaps gradually. Even if you don't judge this outcome the *most* plausible, you likely don't find it implausible, much less impossible.

What experiences would our patient have? We'd expect them to differ from the experiences of his former 'halves'. We'd expect them to differ, maybe markedly, from the additive sum of those earlier experiences. The commissuroplasty hasn't thrown two sets of experiences into a single container. It has created a single experience-generating machine by integrating two separate experience-generating machines. It therefore shouldn't surprise us to discover the restored mind capable of experiences beyond the divided minds (just as it shouldn't surprise us to discover the divided minds capable of experiences beyond the restored mind). If the patient enjoyed a balanced mood before the original commissurotomy, but had a depressed left hemisphere and a carefree right hemisphere after, we shouldn't marvel if the commissuroplasty restored a balanced mood. Other outcomes wouldn't astonish either. But we wouldn't expect a single mind with two inconsistent moods running in parallel, or a mind that flip-flopped between sadness and joy.

We can think about the outcome diachronically and synchronically. From the diachronic outlook, we have two relatively simple objects, each supporting (what is probably) a relatively simple consciousness, combining to form a more complex object supporting (what is probably) a more complex consciousness. Either two subjects merge to become one, or else cease to exist when a third results from them. From the synchronic outlook, we have a composite object which supports a single consciousness and single subject because it contains as parts two objects which, if unconnected, would support separate consciousnesses and separate subjects.

If you find this plausible, even possible, then you admit the possibility of mental chemistry, of overcoming the combination problem. In this case, James' intuitions and scenarios don't attack mental chemistry per se so much as bad ways of going about it. It won't do to stand twelve men in a row or jam them in a bunch. Nor will it help to slop two hemispheres into a jar. But reconnecting those hemispheres by way of a restored corpus callosum might do the trick.[34] Now, if we countenance mental chemistry at the level of human brains, where complexity likely renders the outcome exquisitely sensitive to detail, we have little principled reason for dismissing it at lower levels.

Now focus on the second scenario, where the split-brain patient has a single consciousness that briefly splits in contrived situations. Here, we witness actual mental chemistry in action.[35] The patient's abnormality doesn't interfere with everyday mental integration. But the weird situation shuts down the usual integrating mechanisms and causes the patient's consciousness to divide. When the experiment ends, the integrating mechanisms kick back in. The separate streams merge to create a unified mind out of two pre-existing separate minds.

Although dissolved, the combination problem still holds important lessons. It suggests that mental chemistry happens only when lower level conscious objects are appropriately *integrated*. This reinforces panpsychism's claim that the *structure* of a non-basic physical object determines whether and how mental chemistry occurs. By the same token, the combination problem suggests that mental chemistry doesn't involve an aggregation of subjects/experiences, but rather their transformation, integration, and unification. This means that a high-level subject/experience can't exist alongside the lower level subjects/experiences from which it results. The lower level subjects/experiences lose their identities, their separate existences, when mental chemistry acts upon them. Mental chemistry thus works like the metamorphosis of caterpillar into butterfly. The caterpillar, as such, loses its existence as the butterfly results from it. It serves merely as raw material from which the butterfly is built.[36]

VI

This paper lays down constraints on a theory of mental chemistry. These force ideally a unique account, but certainly a narrowed range of accounts. The paper justifies these constraints, sometimes proving them, always motivating and supporting them. Some constraints come from science. We want strictly basic conscious properties that resemble strictly basic physical

[34]What would happen if we connected Sally's left hemisphere to Irma's right? Probably something sad. Similarly, we likely couldn't integrate your mind and mine by connecting our brains with something like a corpus callosum. To get a coherent whole, we'd likely have to break our minds down into more basic parts, then integrate the structures responsible for them. We likely wouldn't end up with anything much like the old you or the old me.

[35]On the assumption that panpsychism holds true.

[36]This shows that panpsychism needn't attribute human-like minds/experiences to basic objects. It need only attribute the basic ingredients from which human-like minds/experiences result.

properties, in their higher-order features at least. Otherwise we end up with a fragmented account of the world. Worse, our account could accommodate almost any kind of bottom-level consciousness. Similarly, we want lower level conscious properties that result in higher level conscious properties more or less the same way(s) lower level physical properties result in higher level physical properties. Other constraints come from panpsychism. We need strictly basic conscious properties that result in the kinds of experiences you and I (and other higher level conscious objects) enjoy. Still other constraints come from panpsychism's epistemic warrant. Panpsychism requires that higher level consciousnesses reduce to bottom-level entities. But we have no reason to think consciousness reduces if property emergence occurs (after all, if some properties emerge, why not consciousness?). So our theory must forswear emergence. Furthermore, if panpsychism posits bottom-level consciousness only to explain high-level consciousness, but contains explanatory gaps, then it fares no better than physicalism. On the assumption that physicalism has greater *prima facie* plausibility (on grounds of simplicity, etc.) we should prefer panpsychism only if it supplies a *better* explanation. So our theory won't tolerate explanatory gaps. (This further justifies Section II's use of the explanatory gap as a criterion for the absence of a results-from/results-in relation.)

The companion paper, about bottom-level consciousness, follows the same method. Here, we build upon the constraints developed there (listed below without their justifications).

Constraint 1	Panpsychism should attribute to basic physical objects all but only those types of experiences needed to explain higher level consciousness.
Constraint 2	Panpsychism must shun explanatory gaps.
Constraint 3	Panpsychism must shun property emergence.
Constraint 4	Maximum possible complexity of experience varies with complexity of physical structure. 'Structure' includes processes and activities, structures spread through time. 'Maximum *possible* complexity' leaves it open that complex structures result in (at least relatively) simple experiences: e.g. that your brain is capable of simple trance as well as complex math.
Constraint 5	Basic physical objects have maximally simple structures. They lack parts, internal structure, and internal processes.

Constraint 6	Where possible and appropriate, panpsychism should posit strictly basic conscious properties similar, in their higher-order (i.e. structural and behavioral) features, to strictly basic physical properties.
Constraint 7	Basic objects with strictly basic experiences have them constantly and continuously. (This holds only of basic objects not part of mental–chemical structures. The paper later explains this qualification.)
Constraint 8	Each basic experience type, through its strictly basic instances, characterizes (at least some) basic physical objects.
Constraint 9	There are fewer types of basic physical object (and likely far fewer consciousness-relevant types of basic physical object) than types of strictly basic experience.
Constraint 10	All tokens of a given basic physical object-type have the same strictly basic properties. Furthermore, basic physical objects with the same strictly basic physical properties also have the same strictly basic conscious properties.

VII

The companion paper argues that the above constraints entail a unique account of quark-consciousness. (1) Quark-consciousness is maximally simple. A quark has an unstructured experience of a single basic experience type. This experience characterizes the whole quark in the same way the quark's mass characterizes the whole quark. (2) Quark-consciousness is constant, continuous, and independent. A quark has experience as a stable consequence of its intrinsic nature. The quark doesn't perceive or respond to conditions external to its phenomenal field.[37] The quark's experience presents but doesn't represent. (3) Quark-consciousness is multiple. At least some basic physical objects (including quarks, let's assume) simultaneously experience instances of more than one distinct basic experience type. Each such experience occupies its own wholly separate phenomenal field with its own wholly separate subject. The quark has a plurality of distinct and wholly separate conscious properties (e.g. red experience, taste-of-brine experience) just as it has a plurality of distinct and wholly separate physical properties (e.g. mass, spin).

[37]Subject to a qualification made later.

This paper asks how mental chemistry builds complex conscious properties from this kind of raw material.

VIII

The paper builds upon the following additional constraints.

Constraint 11 Consciousness is a conserved quantity. It can neither be created nor destroyed.

This constraint combines quantitativeness and conservation. Quantitativeness says that consciousness comes in amounts. You have a determinate amount, a lizard less, a quark a minimum.[38]

Justification: (1) Mental chemistry presupposes quantitativeness. A process can't build a composite out of ingredients unless each ingredient is less than or smaller than the whole. Otherwise we lose the metaphysical contrast between a building-relation (where the whole results from the ingredients) and an emergence-relation (where the whole has features over and above the ingredients), contrary to Constraint 3 (anti-emergence). (2) Quantitativeness follows from Constraint 6 (the higher-order resemblance of basic conscious and basic physical properties) together with the quantitativeness of physical properties. (3) Our intuitions support the constraint. We think of a mouse's consciousness as smaller than a human's. We speak of brain-damaged patients as having lost some consciousness. (4) Conservation presupposes quantitativeness, mental chemistry requires conservation, and panpsychism requires mental chemistry.

Constraint 11 also states that consciousness is conserved, that it can neither be created nor destroyed.

Justification: (1) If consciousness isn't conserved, then new amounts are created out of nothing or existing amounts are destroyed into nothing. But both processes/events involve property emergence, contrary to Constraint 3. (Emergence involves destruction into nothing because emergent properties disappear into nothing when their subvenient bases cease to obtain. Destruction into nothing involves emergence because such destruction involves the creation of nothing (taken as a 'thing') out of something. But nothing (taken as a 'thing') can't constitutively depend upon something. Nothing (taken as a 'thing') stands over and above something.[39]) (2) Panpsychism presupposes mental chemistry, mental chemistry involves building, and without conservation we lose the metaphysical contrast between building and emerging, in violation of Constraint 3. (3) Most basic physical properties obey conservation laws, so, by Constraint 6 (property resemblance), consciousness should

[38]It follows that consciousness isn't a vague property.

[39]Another argument against destruction into nothing: If creation out of nothing can't happen (because of Constraint 3: no emergence), but destruction into nothing can, then the stock of consciousness should fall through time. But we have no reason to think it has. In fact, most believe the stock grew from nothing to something when complex brains evolved.

too. (Here we distinguish basic physical properties like mass-energy and charge that obey conservation laws from basic physical properties like baryon number and parity that don't. Properties like mass-energy and charge exist as basic building blocks whereas baryon number and parity exist as abstract features of micro-physical interactions: natural bookkeeping devices. Conservation laws hold only of building blocks. According to panpsychism, consciousness qualifies as a building block and not as a bookkeeping device.)

The paper noted earlier that subject-hood, conscious awareness, and presentation come to the same thing. It follows that mental chemistry conserves the *amount* of all three. But it doesn't follow that it conserves their *number*. In fact, mental chemistry *must* conserve the amount of point-of-view-edness (since it obeys Constraint 11) but *can't* conserve the number of points of view (since it merges many subjects into one). Think of small water droplets coming together to make a bigger drop. The total mass-energy remains the same even though the number of droplets and their collective surface area fall. We can compare the walls between subjects, which define the number of subjects, to the surface-films bounding the individual droplets.

Constraint 11 says much. It tells us that lower level parts lose consciousness when they contribute to the consciousness of a higher level whole (while leaving open whether they surrender all or only some[40]). It also throws light on changes like falling asleep, waking up, and dying. Falling asleep and dying can't destroy consciousness any more than waking up can create it. Probably death and dreamless sleep turn off the mental–chemical mechanisms responsible for higher level consciousness. The mental whole decomposes: the lower level objects recover their former conscious properties. Conversely, mental–chemical mechanisms turn back on when sentient creatures wake up. (This fits with our conclusions about split-brain patients on Tye's and Dennett's understanding of the facts.)

Now a constraint that prevents consciousness from moving about.

Constraint 12 Consciousness can't move from a conscious basic object to a non-conscious basic object in such a way that the latter becomes a free-standing conscious object.[41]

Justification: (1) Strictly basic physical objects don't seem to change their basic natures.[42] Constraint 6 tells us that strictly basic physical and strictly basic conscious properties share higher-order features. (2) Strictly basic properties can't

[40]We'll see later that some likely lose all while others keep some.
[41]The qualification allows non-conscious basic objects to 'share in' the consciousness of a mental-chemical whole they form part of. See Section IX.
[42]See Ford (2004), 100.

change because they don't have parts. If a strictly basic property seems to gain a feature, then the new entity is a non-basic composite consisting of the original strictly basic property plus something else. If a so-called strictly basic property loses a feature, then the original entity couldn't have been a basic building block. We lose sight of what it means to be basic if we let strictly basic properties change. (3) If strictly basic properties either change or come and go, then property emergence occurs (as creation out of nothing and/or destruction into nothing) contrary to Constraint 3 (anti-emergence). (4) Constraint 7 provides that free-standing conscious basic objects have strictly basic experiences constantly and continuously. It follows that a (free-standing) non-conscious basic object can't acquire consciousness at a given time any more than a (free-standing) conscious basic object can lose it at a given time.

The next constraint touches upon mechanisms.

Constraint 13 Mental chemistry occurs at many levels, from very simple physical composites to brains. Complex consciousness needn't result only from mental chemistry performed at the highest level on strictly basic experiences from the lowest. Complex consciousness can result from mental chemistry at different levels hierarchically integrated.

This constraint combines two ideas: mental chemistry occurs at many levels, and higher level mental chemistry can work upon the results of lower level mental chemistry.

Justification: (1) Assume that consciousness has or bestows causal powers. Then higher level consciousness likely evolved because it enhanced fitness. Evolution typically proceeds by small steps starting from structures/characteristics simple enough to arise by chance.[43] Mental chemistry (in organisms) therefore probably occurred first in very simple structures, the results of which later fed into more complex mental-chemical structures, and so on.[44] (2) The brain apparently evolved by adding new structures to, and expanding existing structures within, an inherited core.[45] At each stage, tissues serving new functions built upon and connected to tissues serving older functions. Add in the supposition that many of our ancestors had consciousness of one kind or another.[46] All this suggests that new structures performed mental chemistry on the mental-chemical outputs of older structures. (3) Some psychologists hypothesize that many human

[43]See Futuyma (2005), 43–66, and Dawkins (1991), 223–228.
[44]This assumes mental chemistry didn't evolve by exaptation from already-complex structures. This assumption makes sense given the unlikelihood that a complex brain structure serving some other function would chance upon a mental-chemically effective configuration.
[45]See Macphail (1982), 330–343.
[46]This supposition on two counts fits well with panpsychism. It tends towards inconsistency to attribute consciousness to quarks, which don't have brains, while denying it to fish, which do. And panpsychism's intolerance of explanatory gaps leaves it hostile to changes in kind which supervene on changes of degree.

emotions result from blending operations performed on a limited palette of primitive and ancestral emotions.[47] Those earlier emotions in turn result from other mental chemistry.

The paper's mental–chemical models need something like Constraint 13 because they postulate multi-step mental–chemical processes, in which the output of a mental–chemical operation at one level serves as input to another mental–chemical operation at a higher level, and so on. For example, building an experience of orange stripes interleaved with purple stripes takes at least two steps: one (or two) to build the mixed orange experiences and purple experiences out of strictly basic experiences, and another to place them in the overall experience. More generally, the richness of our complex experiences could result from a relatively small number of building blocks and a relatively small number of building operations only if those operations worked iteratively and cumulatively.

Now a constraint that deals with mental–chemical laws.

Constraint 14 Basic mental-chemical laws (with structure-types somehow relevant to their antecedents and mental-chemical operations or operation-types given in their consequents) are simple and modular.

A law's simplicity increases as the entities the law's antecedent refers to decrease in number, level, number of types, and complexity, and bear fewer and simpler relations one to another. Modular laws govern processes at multiple, and ideally all, levels. Separate justifications follow.

Justification (simplicity): (1) All basic physical laws seem simple.[48] Extending Constraint 6 (property resemblance) to basic laws argues for simple basic mental-chemical laws.[49] (2) Positing complex basic mental-chemical laws leads to a fragmented account of the world. (3) Some mental-chemical laws must be (at least relatively) simple, since, by Constraint 13, mental chemistry takes place at (at least relatively) low levels where only (at least relatively) simple laws can govern. (4) Unless basic mental-chemical laws are simple, with simple entities in their antecedents, they involve basic powers which obtain only at higher levels. This would commit panpsychism to property emergence in the form of emergent powers, in violation of Constraint 3.

Justification (modularity): (1) Parsimony favors a few simple basic laws governing all levels over many basic laws of varying complexity governing the same

[47]See Wade and Tavris (2000), 406–408, which surveys research suggesting that fear, anger, sadness, joy, surprise, disgust, contempt and love are basic or *primary* emotions, with other, *secondary*, emotions built out of them.
[48]See Ford (2004), 57–59.
[49]If we understand laws merely as artifacts recording the dispositional capacities of concrete entities, and bear in mind Constraint 6 (property resemblance), then this extension follows straightforwardly.

types of mental-chemical operations at different levels. (2) Basic laws limited to higher levels would have complex antecedents in violation of the simplicity requirement (see above). (3) Modular laws facilitate the evolution of complex consciousness by allowing organisms to apply the same biological inventions to all levels. Otherwise evolution would have to discover new mental-chemical structures as consciousness becomes more complicated. Worse, the organism would have to include and integrate all these structures in an already biologically expensive organ. Worse still, some of these structures might lack simpler adaptive forerunners, making them unattainable through a process dependent on adaptive intermediate stages.

The paper's mental–chemical models need something like Constraint 14 in order to (1) frame basic mental–chemical laws; (2) tie them to physical structure; and (3) apply them at multiple levels. The constraint seethes with issues, however. (1) It links the antecedents of basic mental–chemical laws to structures or structure-types whose tokens/instances obtain only at higher levels. As the justification points out, this threatens to commit panpsychism to property emergence in the form of emergent powers. This would doom the view. (2) Laws with structures/structure-types (or any high-level entities) in their antecedents (tend to) hold only other things being equal. But this makes little sense for supposedly basic laws.[50] Fortunately, Section XIII resolves both difficulties. It gives strictly basic conscious properties basic dispositions to respond to other basic entities, which entities the higher level structures merely direct or channel. In this way, the paper avoids giving basic powers to high-level entities. This explains Constraint 14's odd wording: 'with structure-types somehow relevant to their antecedents'. The paper nevertheless advances two sets of models. Those in Sections X through XII attribute basic powers to higher level structures, whereas the complex amended models in Section XIII don't. The paper first presents flawed models because they more clearly reveal the structure of mind-dust mental chemistry.

And a final constraint about place.

Constraint 15 Strictly basic conscious properties obtain where their instantiating basic objects obtain.

Justification: (1) Anything else would be arbitrary and unmotivated. The experience characterizes the basic object and not something else. (2) Anything else would saddle panpsychism with the problems substance dualism faces linking minds and bodies. (3) Constraint 12 (no transfer) makes less sense otherwise. (4) Strictly basic experiences are intrinsic and inner (presentational but non-representational) properties of their instantiating objects (Section VII). They don't 'reach' beyond themselves. It therefore makes little sense to locate them

[50] Jonathan Simon (personal communication, July, 2012) pointed this out.

elsewhere than the location of the object whose intrinsic nature they form part of. (Basic physical properties, by contrast, have causal/dispositional and hence relational natures and thus, in a sense, do 'reach' beyond the location of their instantiating objects. In this way they 'spread' the physical entity out whereas the conscious properties 'pull it together'.)

IX

Where does mental chemistry put complex consciousness? Constraint 15 (location) sites strictly basic consciousness with the basic objects that have it. Constraint 12 (no transfer) stops conscious properties from moving to free-standing non-conscious basic objects. Constraint 4 (dependence on complex structure) keeps free-standing basic objects from having complex consciousness. These constraints allow, but don't oblige, complex consciousness to sit with the (smallest?) non-basic object whose conscious parts give rise to it. But any other location runs afoul of Constraint 15's justifications, not to mention panpsychism's overall thrust.[51]

The non-basic conscious object might have parts without conscious properties. It might also have conscious parts whose experiences don't feed into the overall experience. It therefore makes sense to propose that complex consciousness characterizes the (smallest?) object that *contains* the basic objects whose conscious properties result in the overall experience. This allows a brain, or brain region, to instantiate complex consciousness even if, say, its quarks have strictly basic conscious properties but its electrons don't. Furthermore, if a strictly basic conscious property characterizes the whole of the basic physical object that instantiates it (Section VII), then it seems right that a high-level conscious property should characterize the whole of the high-level object it characterizes. Again, anything else would be arbitrary (if, say, the conscious property characterized the south but not the north half of the object) or implausibly and perhaps discontinuously gerrymandered (if the conscious property characterized only those parts of the object whose lower level experiences contributed to it).

Because experience, subject, and phenomenal field come to the same thing, complex consciousness locates experience, subject, and phenomenal field together.

[51]It follows that composition, in some cases at least, yields metaphysically real entities: entities marked off independently of our classifications.

X

Recall that bottom-level consciousness is multiple (Section VII): at least some basic physical objects have a plurality of experiences of distinct basic types, where each such experience occupies its own wholly separate phenomenal field with its own wholly separate subject. Quite apart from this, basic bottom-level objects collectively instantiate all the strictly basic conscious properties that serve as raw material for higher level experience. A non-basic conscious object must therefore (be able to) *choose* which strictly basic conscious properties feed into its overall experience. Thus, structures in the visual cortex must choose visual experience types and not olfactory experience types. Choosing is fairly straightforward: the relevant structure picks one of the strictly basic properties 'waiting in the warehouse'. How might this work?

We begin with some consequences of Constraint 11 (conservation). Since mental chemistry doesn't create new (amounts of) consciousness in addition to the (amounts in the) strictly basic conscious properties it takes as inputs, it must work a transformation upon those inputs (a conclusion arrived at, for other reasons, in Section V). Recall from Section II that consciousness comes in basic types marked off by the results-from/results-in relation.[52] Thus, visual experiences are basic with respect to olfactory experiences because they can't result either from olfactory experiences or from the strictly basic experiences from which olfactory experiences result. More generally, no strictly basic property (conscious or otherwise) can result from strictly basic properties of other kinds. It follows that conservation applies individually to each kind of basic experience type and not just to consciousness overall. Hence, each kind of strictly basic conscious property fed into a mental–chemical operation survives it both as to kind and amount. It follows that mental chemistry involves a transformation of strictly basic conscious properties which nevertheless persist intact. How should we address this apparent contradiction?

Consider an example. Suppose someone has a complex experience of a single basic experience type, red, let's assume. The relevant basic conscious constituents must have their own red experiences (Constraint 11: conservation). But they also instantiate, multiply, many other basic experience types (Section VII): perhaps yellow, taste-of-sweet, smell-of-rotten-eggs, feel-of-disgust, whatever. Constraint 13 (nested levels) suggests an integrated

[52]And recall that we deem a results-from/results-in relation not to obtain where we find an explanatory gap between the would-be relata.

hierarchy of successively more complicated red experiencers, from basic objects to the relevant brain structure (or even full brain).[53] Suppose some simple molecule chooses red experiences from the conscious properties of its basic parts. Then, a more complex molecule, containing one or more of the simple molecules, works mental chemistry on their experiences so as to experience red itself. And so on. Constraint 14 (simplicity/modularity) says the same kind of mechanism operates at each level.

Attend to lowest level choosing. And suppose, to keep it simple, that all basic physical objects are identically conscious: each possesses equal amounts of every kind of strictly basic conscious property. Let simple molecule M possess a structure S_1 that chooses red experience(s). How might this go? An elegant model understands choosing on analogy to quantum collapse. Each basic object, when incorporated into M, undergoes a collapse of its original multiple experiences into a single red experience. But this model violates Constraint 11 (conservation), since all of the basic object's strictly basic experiences, other than its red experience, vanish into nothing.[54] The following model, though less elegant, does better. M's structure S_1 chooses the red experiences of M's basic parts, combining them into a single red experience characterizing M. M's basic parts now no longer experience red (Constraint 11).[55] M, for its part, has only its red experience: not being basic, it has only the conscious properties fed to it. Conservation tells us that M's basic parts retain the strictly basic conscious properties not chosen by S_1. So choosing yields one 'big' red experience had by M alone and many 'little' experiences, of other basic kinds, had by M's basic parts.[56]

Now run through the example again, this time focusing on subjects and phenomenal fields rather than experiences. M's structure S_1 chooses red to yield an overall red experience characterizing M. The red-filled phenomenal fields of M's basic parts merge into a single red-filled phenomenal field of

[53]A suggestion qualified shortly.

[54]Also much red experience emerges out of nothing. Otherwise the total amount of consciousness falls, contrary to Constraint 11 (conservation).

[55]The basic objects can't feed only part of their red experiences into M's overall red experience. Their red experiences are strictly basic properties and accordingly lack parts.

[56]Victor Caston (personal communication, 2007) argues that this conclusion, that basic conscious objects lose experiences when mental-chemically worked upon, conflicts with Constraint 7, that basic conscious objects have experiences constantly and continuously as a consequence of their intrinsic natures. But both theses follow from considerations solid enough to warrant living with the tension. (Constraint 7 issues from considerations about what features a basic building block necessarily has, and the conclusion in the text follows from Constraint 11, the all-important conservation principle.) In Section XIII, the paper, responding to a different difficulty, attributes to basic entities dispositions to react mental-chemically in various settings. The same move could avail here. Then, strictly basic experiences would stand immune to all but mental–chemical outside influences. (This issue relates to Constraint 7's restriction to *free-standing* basic objects.).

M's. The subjects associated with the red-filled phenomenal fields of M's basic parts merge into the single subject associated with M's overall phenomenal field. M's basic parts thus cease to exist as red-experiencing subjects. But, with M's gains, no entity disappears into nothing. Note that the other phenomenal fields and subjects of M's basic parts, those tied to basic experiences other than red, persist unchanged. Now, since all input strictly basic conscious properties survive, either unchanged or as transformed in a manner preserving type and amount, the contradiction three paragraphs back reveals itself as apparent only. Note also that a single mental–chemical operation occurs, even though we can think about it in terms of conceptually distinct operations on experiences, phenomenal fields, and subjects. Since experience, phenomenal field, and subject come to the same thing, we only have *apparently* distinct operations.

Earlier we took Constraint 13 (nested levels) to entail a chain of red experiencers from M's basic parts up. This now needs qualification. M's basic parts lose the subjects associated with their former red-filled phenomenal fields while retaining the subjects associated with their other phenomenal fields. But M loses more when mental chemistry works on it. As a non-basic object, it lacks multiple experiences, multiple phenomenal fields, and multiple subjects. It therefore endures as a conscious subject only so long as its conscious property remains unincorporated into a higher level consciousness.[57] When that happens, its phenomenal field becomes incorporated into a higher level phenomenal field and its subject into a higher level subject. It no longer experiences in its own right. (The same thing happened to the split-brain patient. Once his two hemispheres were re-connected, he regained a brain supporting a unified consciousness. The hemispheres lost their individual capacities to experience.)

The real work of choosing falls to structure S_1, left here as a black box. We can't usefully ask about S_1's physical characteristics, because that question addresses contingencies beyond the reach of philosophically defensible constraints. Nor can we usefully ask how S_1 does its job. That question asks what lies behind a basic law of nature when, of course, nothing lies behind basic entities. We can only characterize S_1 functionally. However, as noted in Section VIII, black boxes like S_1 hide problems that will force us, in Section XIII, to amend and complicate our models. The amended models won't put so much work off-stage.

[57]Unless M feeds only part of its red experience up the chain. The paper sets this possibility aside as unmotivated and as needlessly multiplying subjects, experiences, and phenomenal fields.

XI

Placing takes already-chosen lower level experiences and places them within a single higher level phenomenal field. A 'mosaic' results, containing instances of different experience types, side-by-side if visual and therefore straightforwardly spatial, otherwise compresent if not. Placing matters because complex consciousness often consists of variegated experiences. A theory of placing thus helps us explain the phenomenal structures of complex experiences. Placing raises no new problems of principle.

Consider a mental–chemical operation resulting in an experience of red on the right and yellow on the left. Imagine a molecule O which consists of or contains red-choosing M-molecules (each with structure S_1) and yellow-choosing N-molecules (each with structure S_2). Suppose that O has structure S_3 which takes the Ms' red experiences and the Ns' yellow experiences and places them so as to yield an overall experience with red on the right and yellow on the left.[58] The subjects of the Ms and Ns result in O's single subject; the phenomenal fields of the Ms and Ns result in O's single phenomenal field. We can speculate about mechanisms affecting the proportions of red and yellow in O's phenomenal field. Maybe S_3 allows O to 'connect' or 'disconnect' the experiences of its constituent Ms and Ns, ideally in response to outside influences.[59] In this case, S_3 represents a family of structures with generically similar but specifically different effects.[60] Note that placing, by working upon already-chosen experiences, occurs at least one level higher than choosing.

XII

Blending builds mixed experiences out of instances of distinct basic experience types: for example, an orange experience out of red experiences and yellow experiences. Blending causes trouble because, maybe, orange experiences stand over and above red experiences and yellow experiences even though orange paint results from red paint and yellow paint. More generally, perhaps all experience types deemed here as mixed in fact qualify as basic experience types instantiated, as strictly basic properties, by basic objects.[61] Call this the *blending problem*. Blending also raises open-ended issues. Not

[58]Assume for simplicity that borders aren't basic experience types. Or ignore them if they are.
[59]If in response to outside influences, then the experience more easily represents entities external to it.
[60]This would add to the number of basic mental–chemical laws but for the amendments of Section XIII.
[61]This problem doesn't arise with placing. The experience with red on the right and yellow on the left contains instances of two basic experience types. It therefore can't be an instance of a basic experience type.

only can panpsychism make do without it, at terrible cost, but also blending might occur in different ways.

This paper considers blending one of *the* issues facing panpsychism. Unfortunately, the paper doesn't see clear to a satisfactory solution to the blending problem. Overall it descries three cases. (1) We could deem blending impossible and carry on without it. But then panpsychism shoulders a bloated ontology and excessively many choosing mechanisms (see ahead). (2) We could deem blending possible, even though we can't see a solution to the blending problem, on the grounds that we can see, not only that the blending problem likely has a solution, but also the rough outlines of it. (3) We can judge the blending problem insoluble, the costs of forgoing blending prohibitive, and treat the impasse as a *reductio* of panpsychism.

If panpsychism forgoes blending, it must stomach hugely many strictly basic conscious properties, with very many of these nearly the same as very many others (think of the all the hues of orange). Worse, it must posit a distinct choosing mechanism for each such strictly basic conscious property capable of feeding into higher level consciousness. This puts heavy demands on objects supporting higher level consciousness. Human brains, for instance, would need a vast amount of nearly-but-not-quite redundant machinery. This would interfere with their evolution, since nature would have to discover all those mechanisms and then realize, combine, and coordinate them in an already biologically expensive organ. This paper judges these costs unacceptable.

Panpsychism could avoid blending in another way, but only with big and dubious changes to bottom-level consciousness. Suppose all color experiences result from a single strictly basic conscious property existing as (something like) a superposition of all such experiences. And suppose it works this way with other families of experiences. Quarks then have multiple phenomenal fields each containing one of these 'superposed' conscious properties.[62] Choosing therefore becomes a two-step process. The relevant structure first chooses a family of experiences by choosing a phenomenal field. Then, it chooses a specific experience by 'collapsing' the 'superposed' property within that field. This paper considers this alternative unacceptable. It's ad hoc. It doesn't cohere with quantum mechanics, which envisions superpositions of property *values* rather than superpositions of properties.

[62]We saw that quark-experiences lack all complexity (constraints 4, 5 and Section VII). The 'superposed' property must therefore involve a 'superposition' of distinct phenomenal fields each with its own subject having a maximally simple presentation. Otherwise the quark would have a single subject experiencing many things – unacceptable phenomenal complexity. So the 'phenomenal field' containing the entire superposed property is really a collection of phenomenal fields and not itself a phenomenal field. The text ignores this wrinkle in the interests of clarity.

And it postulates complex strictly basic properties that require complex basic objects, since only complex objects could instantiate such properties and respond to the necessary choosing mechanisms. But Constraint 5 (simple basic objects) rules this out.

It seems that panpsychism must solve the blending problem or fail as a mind–body theory. How, then, might blending work? Suppose simple molecule M has structure S_1 that chooses red and simple molecule N has structure S_2 that chooses yellow. Suppose more complicated molecule P contains M- and N-molecules. And suppose P has structure S_4 that blends the Ms' red experiences and the Ns' yellow experiences yielding a higher level orange experience had by P. Maybe the hue depends on the proportion of the Ms to Ns. Or maybe, as we speculated with placing, variations of S_4 feed different numbers of M-experiences and N-experiences into P's overall experience. This way P might experience different and changing hues.

As before, P retains consciousness (experience, phenomenal field, subject) only until incorporated into a higher level conscious structure. Similarly, its constituent Ms and Ns lose consciousness (experiences, phenomenal fields, subjects) when their experiences feed into P's. (This coheres with Constraint 11 (conservation) only if orange experiences result from red experiences and yellow experiences in such a way that the underlying strictly basic conscious properties somehow persist within the orange experience. But this merely restates the blending problem.) Blending, like placing, occurs at least one level higher than choosing since it works upon already-chosen experiences.

But how might S_4 overcome the blending problem? This paper canvasses two unsuccessful proposals and then offers a palliative.[63] The palliative suggests that a solution lies to hand even though we don't yet have it.

(1) Perhaps orange experiences result from a pointillist illusion. The phenomenal field mingles 'tiny' red experiences and yelow experiences, and the subject confuses their locations and runs them together. Here, the orange experience results from a first-order experience coupled with a type of ignorance or mistake about it. Unfortunately, this proposal calls for a higher-order subject who confusedly experiences the red experiences

[63]Eric Lormand (personal communication, 2007) suggested the would-be solutions and the palliative.

and yellow experiences the way we confusedly experience pixels on a TV screen. But mental chemistry can't work this way. First, mental chemistry requires the higher-order subject to result from the first-order subjects, not exist alongside them; otherwise, it emerges from them. Second, everything must happen internal to the relevant subjects; otherwise, we base our theory on telepathy (perceptions of other subjects' experiences). Third, the proposal doesn't in fact *build* orange experiences out of anything and therefore doesn't supply a model of blending. It instead has the orange experience emerge when the right triggering conditions obtain. Fourth, by generating orange experience out of ignorance and confusion, the proposal relocates the explanatory gap without dispelling it. (2) Perhaps orange experience results when the subject has a red experience and a yellow experience at the same phenomenal location.[64] This proposal also fails to build big subjects out of small. Worse, it *assumes* that orange experiences result from red experiences and yellow experiences. But this begs the question.

This paper doesn't see how to tackle the blending problem head on. It nevertheless finds reason to judge it tractable. Begin by noting that orange experiences resemble red experiences and yellow experiences more than they resemble blue experiences. Now, the panpsychist won't readily allow that these relations hold primitively. His commitment to the principle of sufficient reason, and therewith metaphysical and epistemological reduction, fosters a hostility to high-level patterns which don't result from, which aren't constitutively caused by, basic bottom-level entities. The panpsychist therefore insists that constitutive causes underlie, and ground explanations of, the similarity-and-difference relations touching upon orange experiences. This paper therefore proposes, as a best explanation, that orange experiences share constituents with red experiences and yellow experiences but not with blue experiences; more precisely, that red experiences and yellow experiences exhaust the constituents of orange experiences. Sharing constituents in this way counts, of course, as a composition relation falling under the results-from/results-in umbrella. We must take care, however. Orange experiences and blue experiences do resemble as experiences of colors, just as red experiences and yellow experiences resemble as experiences of warm colors. But these subtleties don't matter so long as we focus on the possible explanatory gap between orange experiences and red experiences/yellow experiences. Although orange experiences and blue experiences resemble as color experiences, we can't see that orange experiences could result either

[64]Chalmers (forthcoming) also suggests this.

from blue experiences or from any constituents of blue experiences. And although red experiences and yellow experiences resemble as warm-color experiences, we can't see that either could result from the other or any constituents thereof.[65] These facts anchor a distinction between the possible explanatory gap between orange experiences and red experiences/yellow experiences on the one hand and the very real explanatory gap between experience and things physical on the other hand. The experience/physical gap has two parts. We neither see constitutive links between experience and the physical nor even the possibility of such links. But the possible gap between orange experiences and red experiences/yellow experiences has at most one part. Even if we don't see constitutive links, we have no trouble envisioning their possibility. More, our intuitions urge that such links must exist. This suggests (but doesn't, of course, prove) that orange experiences result from red experiences and yellow experiences even though we perhaps don't yet see how.

XIII

The above models risk violating Constraint 3 (anti-emergence). They envision *basic* mental–chemical laws whose antecedents directly refer to high-level structures S_1, S_2, S_3, etc.[66] These structures therefore have *basic* but high-level capacities (high-level capacities that don't result from bottom-level entities). Emergence. Panpsychism therefore faces a dilemma. If emergence can occur, panpsychism loses its warrant. But if emergence can't occur, mental chemistry can't happen and panpsychism fails. Our earlier models face other problems too. Constraint 14 (modularity) says that basic mental–chemical laws apply at many levels. This means that any structures mentioned in their antecedents can't refer to determinate level-specific structures. They must refer instead to more-or-less general *features* or *types* of structures whose more specific tokens/instances can obtain at many levels. This threatens to accord causal efficacy to a determinable structure that, as determinable, only exists abstractly. But presumably only fully determinate concrete entities can cause things. Worse, laws whose antecedents refer to high-level entities like

[65] Red experiences resemble blue experiences only as experiences of colors, as the same determinable type of entity. They can do this without sharing constituents. Otherwise we wouldn't have to recognize more than one basic color experience type. Hence, the different types of explanatory gaps between orange experiences and blue experiences on the one hand and between orange experiences and red experiences/yellow experiences on the other hand. Similarly, red experiences resemble yellow experiences only as experiences of warm colors, which resemblance we can understand in terms of similar extrinsic effects on our emotional systems.

[66] This section treats laws as artifacts whose antecedents *refer to* other entities rather than as independently existing entities whose antecedents *include* those entities.

structures likely hold only other things being equal. But this won't do for *basic* laws of nature, laws which don't result from other more basic entities.

The following amendments suggest ways, albeit speculative, of overcoming these problems. Allow that structures S_1, S_2, S_3, etc. encompass not merely spatial (or spatiotemporal) properties of molecules M, N, O, etc., but also some of the external influences upon them. And understand these influences in terms of the electromagnetic (EM) interaction. So suppose that each strictly basic conscious property has a strictly basic disposition to respond to several frequencies of EM radiation. Suppose further that different EM frequencies allow otherwise identical mental–chemical structures to 'tune into' one or another strictly basic conscious property.

Consider choosing. Previously, simple molecule M had structure S_1 that chose the red experiences of M's basic conscious constituents. Suppose instead that M has shape Sh_1, old S_1 relabeled, and that new S_1 consists of Sh_1 'lit up' by EM radiation of frequency F_1 (EM-of-F_1).[67] Perhaps Sh_1 generates a pulse of EM-of-F_1; perhaps it takes on EM-of-F_1 from elsewhere. Either way it bathes M's basic conscious constituents in EM-of-F_1. Suppose also that each strictly basic red experience has a strictly basic disposition to respond to EM-of-F_1. When thus irradiated, it combines with other similarly irradiated strictly basic red experiences, within the object overspread with EM-of-F_1, to form a higher level red experience characterizing the overspread object. S_1 thereby merges the red experiences, red-filled phenomenal fields, and red-experiencing subjects of M's basic conscious constituents into, respectively, M's one red experience, one phenomenal field and single subject. The red experience can then work its way to higher levels, provided the strictly basic sensitivities to EM-of-F_1 result in similar higher level dispositions characterizing higher level red experiences. At each step, an object with shape Sh_n spreads EM-of-F_1 over its lower level red-experiencing constituents and comes to experience red itself. Sh_n can be any high-level structure that, like a spark plug or parabolic disk, suitably channels electromagnetic radiation. At no point does the revised model resort to emergent entities or basic laws dependent on high-level structure. It accounts for choosing solely in terms of the strictly basic properties of bottom-level objects.

Now turn to blending. Previously, molecule P had structure S_4 that blended the red experiences of its constituent M-molecules and the yellow experiences of its constituent N-molecules to yield P's orange experience. Suppose instead that M-molecules choose red through S_1, shape Sh_1 channeling EM-of-F_1, and N-molecules choose yellow through S_2, shape Sh_2

[67] The paper puts it thus to make clear the structural carryovers from the earlier models.

channeling EM-of-F_2. The next steps could unfold in (at least) two ways. (1) Perhaps P has shape Sh_4 which spreads EM-of-F_4 over P's constituents. Assume that EM-of-F_4 doesn't prevent the Ms and Ns from continuing to choose red and yellow (maybe EM-of-F_4 has lower frequency and lower frequencies don't block the effects of higher frequencies). Suppose that all strictly basic conscious properties have a strictly basic receptivity to EM-of-F_4. When thus irradiated, they combine with other conscious properties similarly irradiated, within the object overspread with EM-of-F_4, to yield a blended experience characterizing the overspread object. And assume that this disposition results in a similar higher level disposition characterizing the experiences of the Ms and Ns. Thus, S_4, Sh_4 channeling EM-of-F_4, merges the experiences, phenomenal fields, and subjects of the Ms and Ns into P's single experience, phenomenal field, and subject.

This accounts for blending without recourse to emergence. But it packs many dispositions into strictly basic conscious properties. This paper doesn't believe this matters. But blending could happen otherwise if it does. (2) Suppose, as before, that red experiences have a strictly basic receptivity to EM-of-F_1 and yellow experiences to EM-of-F_2. Suppose also that P has shape Sh_4 that spreads over P's constituents a 40-hertz EM field oscillating between EM-of-F_1 and EM-of-F_2. Assume that each strictly basic conscious property has a basic receptivity to EM oscillations. When thus irradiated, and when receptive to one of the oscillating frequencies (here F_1 and F_2), it merges with all conscious properties similarly irradiated, within the object overspread with the oscillating EM field, to yield a blended experience characterizing the overspread object. And assume that this disposition results in a similar higher level disposition characterizing any higher level experiences. Thus, as with (1), S_4 (here Sh_4 channeling the oscillating field) merges the experiences, phenomenal fields, and subjects of P's constituents into P's single experience, phenomenal field, and subject. Note that this model might allow blending without previous choosing. It also hints at an elegant account of placing (based, say, on 60 rather than 40-hertz oscillations).[68] But it fails if strictly basic receptivities to complex entities, in this case oscillating fields, involve an unacceptable dependence of basic properties on non-basic entities.

This paper does find the second sort of amendment unacceptably emergentist and thus unsuccessful even on its own terms. It therefore puts forward the first amendment as its tentative best account. Note that that amendment

[68]Subject to details, such as what determines which parts of the phenomenal field have which experience type(s).

anchors mental–chemical laws in strictly basic dispositions of strictly basic conscious properties to respond to other strictly basic entities. Nowhere do these laws involve higher level entities with basic characteristics or powers. The mental-chemically effective structures merely channel electromagnetic radiation so as to activate the relevant dispositions in mental-chemically useful ways. No doubt isolated mental–chemical operations occur without those structures in place. But only those structures allow for iterated and cumulative mental chemistry resulting in complex consciousness rather than mere momentary flashes of constitutively basic or mixed conscious properties. Our amendment also solves the problem about laws holding only other things being equal. Basic mental–chemical laws in fact include only the relevant basic entities and dispositions, and not any mental-chemically effective structures. These basic laws, like all basic laws, do hold universally. However, higher level structures make use of these basic laws in a manner dependent on all kinds of contingencies. The higher level laws which refer to those structures thus result from the relevant basic laws as well as other entities, and therefore do hold only other things being equal.[69] But none of this sullies the paper's models or sets apart the processes and laws described therein from straightforwardly physical processes and laws.

But can our models legitimately pack dispositions into strictly basic conscious properties? Anyone can replace emergent properties/powers with strictly basic bottom-level dispositions to do thus-and-so at some higher level. But when does this gambit capture rather than hide the underlying metaphysics? In the physical realm, we judge it ad hoc when we don't need the proposed dispositions to explain bottom-level phenomena.[70] And here? Well, note first that the panpsychist has only two options open to him. He can either tie basic mental–chemical laws to high-level entities like structures or structure-types. Or he can pile dispositions into his strictly basic conscious properties. The first option fails because it involves emergence and thereby undermines the warrant for panpsychism. That makes the second a forced move. If it too fails, panpsychism itself fails.

But there are relevant differences between the physical and conscious cases. With the former we have an active disposition to cause a specific higher level effect at a specified higher level. The disposition's nature therefore directly provides for both the unique higher level at which it manifests as well as the unique higher level physical entities that trigger its activity. For this reason, a statement or description of the disposition will explicitly

[69]Unless the higher level non-basic law defines the relevant structure so inclusively as to spell out all relevant contingencies, in which case it becomes radically disjunctive.
[70]David Chalmers (personal communication, July, 2012) suggested this test.

refer to these higher level entities. In sum, the high-level capacity in no sense results from capacities that manifest at the bottom level. With consciousness, however, we don't have a disposition to actively produce some effect. You'll recall, from the discussion of Russellian views in Section I, that a conscious property can't have an actively causal/functional nature. The disposition therefore exists merely as a passive capacity to be acted on thus-and-so in a manner consistent with the conscious property's qualitative nature. More, the disposition 'contains' no level-specific provisions: none about levels at which it manifests, none about higher level entities that cause it to manifest. The disposition exists as a level-independent susceptibility that could potentially manifest at the bottom level if something could trigger it there.[71] That only higher level physical entities, entities with the right higher level structure(s), can 'call upon it' stands as a contingent fact independent of any facts essential to the disposition's nature. This explains why our first amended models allow the same mental–chemical operation(s) to occur at different levels and in response to different physical structures all of which channel the right EM frequency. In sum, the disposition in question, when triggered at a high level, results from a disposition of the same kind that could, at least potentially, manifest at the bottom level. Again, the difference between the physical and conscious cases lies in the difference between wholly active and wholly passive dispositions. Active dispositions call for metaphysical detail that passive dispositions not only don't need but can't abide.

We should note, in passing, that both sets of amended models are less arbitrary than they might look. Mental chemistry demands that strictly basic conscious properties have basic receptivities to at least some external influences. Given what we know about neurons and brains, electromagnetic fields are promising candidates. The electromagnetic interaction also has discrete effects, at short and medium ranges, and at high and low ontological levels, of the kind mental chemistry requires and that none of the other basic physical interactions has. In this context, we should bear in mind Crick's and Koch's (1990) correlation of 40-to-60-Hz electromagnetic oscillations with binding processes underlying conscious visual experience.

[71]How might mental chemistry occur at the bottom level? Speculate (contrary to Section IX) that strictly basic conscious properties exist as phenomenal fields extending out some distance from their instantiating physical objects. Assume that a mental–chemical operation, blending say, occurs when (among other occasions) two such phenomenal fields overlap spatially *and* at the same time suffer exposure to electromagnetic radiation of the right frequency. Then, we could have momentary flashes of mental chemistry at the bottom level, much as we have two electrons repelling each other at the bottom level.

XIV

Chalmers (1996) raises a panpsychist version of Sellars' grain problem.

> On the face of it, our conscious experience does not seem to be any sort of sum of microphenomenal properties corresponding to the fundamental physical features in our brain, for example. Our experience seems much more holistic than that, and much more homogeneous than any simple sum would be … If the roots of phenomenology are exhausted by microphenomenology, then it is hard to see how smooth, structured macroscopic phenomenology could be derived: we might expect some sort of 'jagged,' unstructured phenomenal collection instead. (306)

In the same vein, Victor Caston (personal communication, 2007) remarks: 'Instead of consciousness as a magic lantern or the silver screen, on [panpsychism] we have *pixels* of consciousness! (A thousand points of light.)'

Both the pixel image and the panpsychist grain problem misunderstand mental chemistry. Or rather they frame the issues as the Russellian must but as the mind-dust panpsychist can't. The pixel image presupposes a homunculus who gazes upon the pixels and whose experience of them mirrors their particulate structure. Somewhat differently, the grain problem presupposes that macro-experiences are mere aggregations of micro-experiences. Both assume that micro-experiences survive intact when wrought upon by mental chemistry. They therefore take mental chemistry to increase or at least preserve the number of subjects. But we've seen that mental chemistry, at least mind-dust mental chemistry, can't work this way. Constraint 11 (conservation) rules it out on pain of emergence. Instead, mental chemistry takes micro-experiences as raw material and refashions them into a single unified macro-experience. It therefore necessarily decreases the number of subjects. Recall what happens when the split-brain patient's two streams of consciousness merge at experiment's end. Two points of view cease to exist when a distinct and unified third results from them. It goes thus with all mind-dust mental chemistry. The red experience of molecule M need no more display grain than the patient's re-unified mind need exist as two adjacent 'panels' of experience.

XV

How much slack do our models leave? As befits largely a priori reconstructions of processes many of whose details must be knowable only a posteriori, they do contain a lot of slack. In addition, the paper says too little about some issues and leaves others untouched. (1) The paper speaks about simple molecules performing mental chemistry. But maybe mental chemistry first occurs in non-basic subatomic particles like protons. Or maybe it doesn't happen short of living tissue. (2) The paper assumes, on grounds of simplicity, that a conscious object surrenders the entire conscious property fed 'up the chain'. But maybe it doesn't.[72] (3) The paper speculates, in Section XIII, about possible roles for electromagnetism. But maybe electromagnetism affects mental chemistry differently, or not at all. Perhaps other mechanisms allow for mental chemistry without emergence. Or maybe none does and panpsychism fails. (4) The paper extends the reasoning behind Constraint 15 (location) to conclude that higher level conscious properties obtain where their 'generating' objects obtain. But location is a fraught issue, one treated too briefly here. Where actually does the merged property lie? And what might this mean for its nature? In particular, does it force a view according to which conscious properties exist as *phenomenal fields* spatially centered on their instantiating objects? This could have big effects on our understanding of consciousness. (5) The paper doesn't do justice to the blending problem. (6) The paper says nothing about the mental chemistry underpinning complex conscious states like understanding, reasoning, and occurrent propositional attitudes.

XVI

This section expands Section I's remarks about the paper's relation to the literature on mental chemistry. Perhaps Chalmers (2013, Forthcoming) and Goff (2009) develop the relevant issues most fully (Chalmers relies heavily on Goff). As we saw, Chalmers (forthcoming) divides panpsychism into two kinds, constitutive and non-constitutive. He canvasses two sorts of non-constitutive panpsychism: emergent panpsychism, where higher level conscious properties emerge from strictly basic conscious properties, and identity panpsychism, where each higher level conscious property is identical to some strictly basic conscious property (14–15). Chalmers rightly notes that these theories don't build higher level conscious properties out of strictly basic conscious properties and therefore don't involve mental chemistry (18). He favors constitutive versions of panpsychism, whose mental chemistries, in his view, necessarily identify higher level conscious properties with 'mosaics' of contemporaneously existing strictly basic conscious properties (18). We saw that Chalmers briefly considers the kind of mental chemistry advanced here.

[72]That is, maybe red-experiencing molecule M retains some red experience when it feeds the rest 'up the chain'.

> An idea that is sometimes mooted is that low-level subjects 'merge' or 'blend' or 'fuse' to yield higher-level subjects. After the merging, the low-level subjects no longer exist in their own right. Only the higher-level subject exists. Seager (forthcoming) calls this 'combinatorial infusion', on which a combined mental state 'supersedes' the original mental states. (20)

But Chalmers dismisses this approach.

> [I]s the relation between the original subjects and the merged subject a synchronic or a diachronic relation? If it is a synchronic relation, then presumably the low-level and high-level subjects exist at the same time, and we have lost the distinctive aspect of this view whereby the high-level subject supersedes the low-level subject. ... Presumably the merging relation is diachronic, then. If so, it is hard to see how it can be a constitutive relation. Diachronic relations are naturally understood to be contingent causal relations, not constitutive relations. Perhaps two subjects at an earlier time can nomologically necessitate the existence of a subject at a later time, but it is hard to see how they can metaphysically necessitate or constitute it. But constitution is what we need for a combinatorial solution to the combination problem. (20)

Chalmers (and Goff) make several mistakes here. First, they construct a false dichotomy between constitutive panpsychisms (in their terms) that involve mental chemistry and non-constitutive panpsychisms that don't. Second, they wrongly assume that constitutive mental chemistry must work on the 'pixel' or 'mosaic' model discussed and rejected in Section XIV. They thereby lose sight of a middle path between constitutive panpsychism with pixel mental chemistry and non-constitutive panpsychism without mental chemistry.

As noted before, this paper treads that middle path. (1) Where Chalmers and Goff treat combination as a logically necessary relation between higher level conscious properties and their strictly basic conscious constituents, this paper treats it as a lawfully necessary relation. Chalmers and Goff complain that lawful relations don't support a priori connections between higher level and strictly basic conscious properties. Lawful relations, in their view, thus leave pansychism vulnerable to conceivability arguments (we can conceive of the strictly basic conscious properties without the higher level conscious properties) and knowledge arguments (we can't deduce the higher level conscious properties from full information about the strictly basic conscious properties) (see Chalmers Forthcoming, 8–9, 11). But here Chalmers and Goff neglect to include, in the conceptual or deduction base, the causal properties (postulated above in Sections X through XIII) through which the strictly basic conscious properties result in higher level conscious properties. Perhaps Chalmers and Goff worry that including them would introduce higher level entities into the relevant base, turning constitutive panpsychism into non-constitutive emergent panpsychism. But Section XIII showed how to limit these causal properties to basic bottom-level causal dispositions together with higher level dispositions that result from them. This keeps the relevant base free of emergent 'contaminants'. And that base, thus supplemented, will entail higher level conscious properties.[73] (2) Where Chalmers and Goff treat mental chemistry as involving relations of synchronic composition, this paper treats it as involving relations of diachronic causation. This underwrites big differences. Chalmers and Goff must understand each higher level conscious property as identical to some mosaic of contemporaneously existing strictly basic conscious properties. This makes it hard to explain how higher level conscious properties and higher level subjects arise. The paper canvassed these difficulties in Section XIV and judged them intractable. This paper, by contrast, understands higher level conscious properties and higher level subjects as diachronic causal results generated by transformative operations performed on strictly basic conscious properties in ways consistent with the conservation principles required by Constraint 11. This makes it relatively easy to explain how higher level conscious properties and higher level subjects arise.[74] The paper points to the mental–chemical models of Sections X through XIII in support of this claim. These must overcome problems of detail, of course. But they don't falter before problems of principle the way Chalmers' mental chemistry seems to.

XVII

Most thinkers deem the combination problem panpsychism's Achilles' heel. Critics think it fatal (see Coleman 2006 and Goff 2006). Even panpsychists blanch before it: James ([1909] 1996), Strawson (2006), and Skrbina (2006) all wonder whether we solve it only by renouncing discursive thought for intuitive apprehension of metaphysical truth through non-discursive contemplation. This paper argues that the combination problem has been oversold. The paper offers, in Section V, reasons for thinking it soluble. Then, in Sections IX through XIII, it puts forward models exploring ways mental chemistry might go. Any progress made here flows from the insight that mental chemistry necessarily involves transformation consistent with conservation rather than aggregation perhaps followed by the creation of something in addition.

[73]This receives further support from Lewtas (Forthcoming), which argues that panpsychism must commit to a powers-based causal account. These accounts include metaphysically robust causal powers within the intrinsic natures of causally interacting entities. They therefore understand causal relations as necessary results of these powers. This not only strips causation of the contingency Chalmers worries about. It also puts the relevant causal powers in any entailment base.

[74]Assuming the blending problem has a solution.

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