Postscript to “Principles of Plenitude” (2016)

The most detailed attempts in the literature to provide precise formulations of a Lewisian principle of recombination are Efird and Stoneham’s “What is the Principle of Recombination?” and Darby and Watson’s “Lewis’s Principle of Recombination: Reply to Efird and Stoneham.”[1] It is interesting and instructive to compare their formulations with my own. The comparison will highlight what I take to be an important contribution of my account, namely, the tripartite division of a theory of plenitude into independent components: plenitude of recombinations, plenitude of world-structures, and plenitude of world-contents. Failure to keep these components distinct has led each of these author pairs to attempt to provide formulations that do too much. In particular, both author pairs hold that an adequate principle of recombination should entail what I call the Principle of Solitude, roughly, that anything can exist all by itself. But that principle does not follow from any appropriately qualified principle of recombination; it requires for its support the plenitude of world-structures. Moreover, both author pairs hold that an adequate principle of recombination should entail what I call the Principle of Contingent Existence, roughly, that anything can fail to exist. But that principle does not follow from any principle of recombination, qualified or unqualified; it requires for its support the plenitude of world-contents, the possibility of alien individuals. Thus, the formulations of the principle of recombination that these author pairs provide are bound to miss their mark.

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[1] David Efird and Tom Stoneham, “What is the Principle of Recombination?” *Dialectica* 62 (2008), 483-494. George Darby and Duncan Watson, “Lewis’s Principle of Recombination: Reply to Efird and Stoneham,” *Dialectica* 64 (2010), 435-445. See also Daniel Nolan, “Recombination Unbound,” *Philosophical Studies* 84, 239-262.

I begin by reviewing how the Principle of Solitude (PS) and the Principle of Contingent Existence (PCE) fit into the Lewisian framework presented above in "Principles of Plenitude." The Principle of Solitude, recall, when formulated in terms of duplicates, is this:

> **(PS)** For any possible individual *a*, there is a world containing a duplicate of *a*, and containing no individual that is not a part of that duplicate of *a*.

How does (PS) relate to a combinatorial (Humean) conception of possibility according to which distinct existences are modally independent of one another? An informal argument for (PS) might go something like this: On a combinatorial conception of possibility, anything can exist without anything else; by letting the 'anything else' be 'everything else', we get that anything can exist all by itself. Can this argument be formalized within the Lewisian framework introduced above? Indeed, it is essentially the argument I used above to show that (C2) entails (C2)′ (pp. 32-3). And (PS) is just a special case of (C2)′ taking the class *C* to have only one member. Thus, if we take as the basic combinatorial principle an *unqualified* principle such as (C2) or, equivalently, (C2)′, then (PS) will be part of the combinatorial conception.

As noted above (fn. 51), Lewis later endorsed (PS), and called it "part of an attractive combinatorialist conception of possibility …" (Langton and Lewis, "Defining Intrinsic," p. 341.) But here I think Lewis was mistaken. For neither Lewis nor I accept any unqualified principle of recombination such as (C2) or (C2)′ as part of our combinatorial conception; we do not allow that a principle of recombination, by itself, should have implications for what spacetimes are possible.[2] But (PS) does have such implications. As (PS) is to be understood, for an individual to

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exist all by itself is not for it to exist surrounded by empty spacetime; it is for spacetime to have whatever shape the individual has. Thus, consider my spacetime worm. By (PS), there is a world where my worm exists all by itself. Since my worm (unfortunately) is finite and bounded, the spacetime of that world is also finite and bounded. So, starting from spacetimes that are infinite and unbounded, (PS) entails the possibility of spacetimes that are finite and bounded. And that possibility, of course, is controversial, to some even paradoxical. Now, this is not the sort of case that motivated Lewis to qualify his principle of recombination: he was concerned that his principle would entail the possibility of really big spacetimes, not really small ones. But once one accepts, as I have argued, that the plenitude of recombinations should be independent of the plenitude of world-structures (for Lewis, spatiotemporal structures), I think the two cases must be treated alike. I conclude, then, that (PS) does not follow from a combinatorial conception of possibility, properly construed.[3]

I turn now to the Principle of Contingent Existence:

> **(PCE)** For any possible individual *a*, there is a world that contains no individual that is a duplicate of *a*.

In "Principles of Plenitude" (pp. 26-7), I showed that (PCE) can be derived from a principle of recombination, such as (LPR), when supplemented by a principle of plenitude for world-contents, such as the principle (PIP) that I endorsed. (PCE) does not follow from the plenitude of recombinations alone. Even if we were to classify strong, unqualified principles such as (C2) or (C2)* as principles of recombination, we still would not be able to derive (PCE) without a

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[3] For a defense of (PS) based on a principle of plenitude for world-structures, see the postscript to "Plenitude of Possible Structures."

principle of plenitude for world-contents. A principle of recombination, as I understand it, does not tell us what worlds there are absolutely, but only that, given some initial worlds – the base worlds – certain additional worlds can be generated by patching together (duplicates of) parts of the base worlds.[4] But no amount of "patching together," or "cutting and pasting," will guarantee that, given some part of a base world, there is a world where that part fails to have a duplicate. To see this, it suffices to consider the case where the base worlds are all Democritean worlds composed entirely of duplicates of a single atom, variously arranged.[5] Clearly, any world that is generated by cutting and pasting parts of the base worlds will also be composed of duplicates of that one atom. Of course, if we could cut without pasting, thereby generating an "empty world," then (PCE) would trivially follow. But on a Lewisian conception of worlds, an "empty world," a world with no parts, is a contradiction in terms.

Now, I don't want to put too much weight on what to call a "principle of recombination." I suppose someone could claim with some plausibility that, since it is part of a principle of recombination that anything can fail to coexist with anything, it should also be part of the principle of recombination, as a limiting case, that anything can fail to exist, full stop. What I insist upon is the importance of separating out the distinct sources of modal plenitude, and discovering which claims about the plenitude of worlds depend on which source. What matters is that (PCE) depends inevitably on a principle of world-contents that guarantees the possibility of alien individuals. For the only way to guarantee in full generality that an individual can fail to

[4] This seems to be Lewis's understanding. He writes: "I require a principle of recombination according to which patching together parts of different possible worlds yields another possible world." (p. 87)

[5] I have in mind a construal of Democritean worlds that does not reify the void.

exist is to have available in logical space something *alien* to take its place, that is, something that is not a duplicate of the individual, nor a duplicate of any of its parts.

I turn now to Efird and Stoneham's account. Two things are clear. First, they take themselves to be providing an unrestricted, or unqualified, principle of recombination: the final section of their paper is devoted to countering arguments that some restriction is needed. Second, they take their principle of recombination to entail some version of (PS), or, as they put it, that for any "distinct part of a possible world … there is a possible world that consists of that part and nothing else." (p. 485) But a closer look at the principle that they provide calls both of these claims into question.

The seventh and final formulation of their principle of recombination is this:

> **(ES)** For any sequence of intrinsically distinct individuals[6] $x_1, x_2, x_3, \ldots x_m$ and any sequence of cardinals ($n_i \geq 0$) $n_1, n_2, n_3, \ldots n_m$ and any spatiotemporal relation between those individuals, there exists a possible world that contains: exactly n_1 duplicates of x_1, exactly n_2 duplicates of x_2, exactly n_3 duplicates of x_3, … , exactly n_m duplicates of x_m in that spatiotemporal relation.

That will take some unpacking. First, what do they mean by 'spatiotemporal relation'? It does not seem to be what ordinarily would be meant. For example, I would take *being ten meters from* to be a spatiotemporal relation. But when this is plugged into (ES) we get things like: there exists

[6] I replace their term 'objects' with 'individuals', and assume throughout that individuals are *spatiotemporally connected* parts of worlds. They do not say how 'object' is to be understood; but the restriction to connected individuals is needed if (ES) is not to entail, *contra* Lewis, that there are worlds with disconnected spacetimes.

a possible world that contains exactly seventeen duplicates of x_1 and exactly eleven duplicates of x_2 ten meters from one another. And that appears to be nonsense. The problem is that the spatiotemporal relation that holds between the initial individuals (if there is any such relation) is not the spatiotemporal relation that holds between the duplicates of those individuals in the posited possible world. They claim that they can avoid this problem by quantifying (only) over "multigrade relations"; *being ten meters from* is dyadic, not multigrade. They give no examples of a multigrade spatiotemporal relation, so it is unclear what they have in mind. There are multigrade spatiotemporal relations, to be sure; consider: *being equidistant from some point*. But we need not pursue this further because their reason for wanting to quantify over multigrade relations is spurious. We do not need the same spatiotemporal relation to hold between the initial individuals and the duplicates of those individuals because we do not need, and in general will not have, any spatiotemporal relation holding between the initial individuals at all; the initial individuals may all come form different worlds.[7]

But Efird and Stoneham do say this: "By spatiotemporal relation, we mean to be no more specific than a distribution of individuals in space and time, which can be modeled by a coordinate system." (p. 487) Now, a "distribution of individuals in space and time", it seems to me, is just a what I called a spatiotemporal arrangement of those individuals within some spatiotemporal structure. So I propose to interpret their quantification over spatiotemporal relations as my quantification over spatiotemporal arrangements.

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[7] Darby and Watson make essentially the same complaint, and revise the principle accordingly (pp. 440-1).

There is still the difference that they are quantifying over sequences of individuals, not classes of individuals as I do.[8] I take this to be an artifact of their thinking in terms of spatiotemporal relations rather than spatiotemporal arrangements. It introduces an irrelevant feature: how the initial individuals are ordered is irrelevant to how the duplicates of those individuals are arranged. Moreover, the arrangement need not determine any well ordering of the duplicates, or indeed any ordering at all. What matters is just what individuals get mapped to what places in the spatiotemporal structure. Once we switch from quantifying over sequences to quantifying over classes, we can capture the cardinality demands by quantifying over *numbered classes*, where, recall, a numbered class is an assignment of cardinal numbers to members of the class.[9]

Next I ask: given that their principle quantifies universally over spatiotemporal arrangements (or distributions or relations), how can they maintain that the principle is unqualified? For what possible worlds are guaranteed to exist according to the principle depends

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[8] Their notation suggests they are quantifying only over *finite* sequences, but that is too limited to give a full account of the plenitude of recombinations. I suppose, then, that they intend to quantify also over *transfinite* sequences. But note that even that might be too limited if all transfinite sequences have a definite cardinality and there are proper-class many possible individuals.

[9] Note that (ES) allows that every member of the initial sequence (or numbered class) be assigned cardinality zero. That leads them to say that (ES) "has the obvious consequence that there is a possible world that contains zero objects" (p. 492). But although that was an obvious consequence of an earlier principle they considered and rejected (p. 488), a principle that allowed the initial sequence to contain *every possible individual*, it isn't at all obvious that (ES) will generate an "empty world." Indeed, as follows from the discussion below, (ES)'s restriction to "intrinsically distinct" individuals will block the generation of an "empty world" if there are worlds composed of gunk. In any case, an "empty world" is not compatible with Lewis's mereological analysis of worlds. For a way to ground the possibility of nothing that *is* compatible with a mereological analysis of worlds, see my "Island Universes and the Analysis of Modality."

on what spatiotemporal arrangements there are. Since they clearly do intend their account of the plenitude of recombinations to be unqualified, they must be implicitly assuming what I called:

> **(E)** There exists a spatiotemporal arrangement for every numbered class of possible individuals.

(E) is a substantial claim about the plenitude of world-structures. It makes two substantial demands: first, that for every numbered class there is some possible structure[10] within which the class can be arranged; and second, that the possible structure in question is a *spatiotemporal* structure, a possible *spacetime*.

But (E) is not strong enough to allow Efird and Stoneham to derive (PS): (E) does not require that there be an arrangement of the given numbered class that *fills* the spacetime within which it is arranged. Thus, even granting that Efird and Stoneham can somehow mimic the argument given above from (C2) by a judicious choice of "intrinsically distinct" individuals and an assignment of cardinality one to the selected individual and an assignment of zero to all the others, the argument will fall short if there is no possible spacetime that has *exactly* the shape of that individual. It appears, then, that they are presupposing the stronger claim:

> **(E)*** There exists a *full* spatiotemporal arrangement for every numbered class of possible individuals.

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[10] In "Principles of Plenitude," I understood 'possible structure' as *metaphysically* possible structure, the structure of some world. If instead 'possible structure' is understood as *mathematically* possible structure, then the demand made by (E) is weaker and the demand made by (ES) stronger. But the same total demand on the plenitude of world-structures is made by the theory.

Recall that, if a world recombines a class according to a *full* arrangement, then the world is determined up to indiscernibility; for there are no places in the world's structure left to fill. Given (E)* and their principle (ES), (PS) will follow. But now it is plain to see that (ES) alone, *contra* what they claim, is not up to the task. It must be supplemented by a substantial principle of plenitude for world-structures.[11]

It is interesting to note that an account of plenitude that accepts (E)* can make do with a simple formulation of a fundamental principle of recombination:

> **(LPR)*** For any class *C* of possible individuals, and any full, consistent spatiotemporal arrangement $\mathscr{A}$ of *C*, there exists a world that recombines *C* according to $\mathscr{A}$.

(LPR)* and (E)* together entail both (C2) and (C4). (LPR)* conjoined with (E)*, then, appears to provide, within my framework, a succinct formulation of the sort of unrestricted account of the plenitude of recombinations that Efird and Stoneham are seeking.

But the principle that they give, (ES), is both stronger and weaker than (LPR)* in ways that make it problematic. It is stronger because it specifies, for each of the initial individuals, *exactly* how many duplicates of that individual exist at the posited world. It is weaker because it includes a restriction to "intrinsically distinct" individuals, which is needed to counterbalance the added strength of the 'exactly'-clause. For suppose the initial individuals, *a* and *b*, are distinct duplicates of one another. Then (ES) without the restriction would demand that there be a world containing exactly *n* duplicates of *a* and exactly *m* duplicates of *b* with $n \neq m$, which is

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[11] I reject (E)* for reasons discussed in the postscript to "Plenitude of Possible Structures."

impossible. Or suppose *a* is a duplicate of a part of *b*. Then (ES), without the restriction would demand that there be a world containing exactly *n* duplicates of *a* and exactly *m* duplicates of *b* with $n < m$, which is impossible. The restriction to "intrinsically distinct" individuals is intended to rule out the threat of such counterexamples.

The most natural way to define "intrinsically distinct" within a framework that recombines individuals but not properties is this: *a* is *intrinsically distinct from b* iff no part of *a* is a duplicate of any part of *b*.[12] (Note: restricting to intrinsically distinct individuals is overkill; the counterexamples above can be ruled out by requiring just that no part of one is a duplicate of the other.) But a restriction to intrinsically distinct individuals will not save (ES) from generating impossible worlds. Call an individual *reflexive* if it is a duplicate of one of its proper parts. Reflexive individuals certainly seem to be possible: consider, for example, the worlds of one-way eternal recurrence discussed by Lewis (*On the Plurality of Worlds*, 63). But whenever a reflexive individual exists at a world, infinitely many duplicates of that individual also exist at the world. And that makes trouble for (ES): applying (ES) to a one-term sequence containing a reflexive individual and a finite cardinal number *n* leads to a world that has exactly *n* duplicates of that reflexive individual, which is impossible.

There is an easy fix, of course: restrict (ES) not only to individuals that are (pairwise) intrinsically distinct, but also to individuals that are not reflexive. But note that, so restricted,

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[12] This is weaker than the definition Efird and Stoneham give, but not in any way that matters for the current framework, or the discussion below. Their definition is this: *a* is *intrinsically distinct from b* iff (1) *a* possesses an intrinsic property not possessed by *b*, or *b* possesses an intrinsic property not possessed by *a* (where to possess a property is to have a part that instantiates that intrinsic property), and (2) every duplicate of one is mereologically disjoint from every duplicate of the other. But I don't understand why the second clause is needed. It seems to follow from the first: if some duplicate of *a* overlaps some duplicate of *b*, then mustn't *a* and *b* have parts that share intrinsic properties?

(ES) will no longer entail (PS) since it no longer applies to every one-membered sequence. In any case, this strategy for restricting a principle of recombination to intrinsically distinct individuals is a bad idea introduced to solve a problem of the authors' own making. It is a bad idea because, as noted in "Principles of Plenitude" (pp. 30-2) in connection with principle (B0.1), any such restriction will fail to express the full force of Hume's Dictum, that there are no necessary connections between distinct (i.e., non-overlapping) individuals. When individuals are distinct, but not intrinsically distinct, Hume's dictum applies; and so therefore should a principle of recombination designed to capture Hume's dictum. Moreover, no such restriction is needed to avoid generating impossible worlds. For example, the principle (LPR)* provides all of the power one can consistently extract from (ES)'s 'exactly'-clause by quantifying over full arrangements.

I turn now to Darby and Watson's critique of Efird and Stoneham's principle of recombination. Darby and Watson focus their criticism of (ES) on its restriction to intrinsically distinct individuals, arguing that (ES) will fail to be extensionally adequate when applied to gunky worlds. (A world or individual is *gunky* iff every one of its parts has proper parts.) Worlds that they claim should be generated by recombination from gunky worlds will not be generated by (ES). This leads them to drop the requirement that there be *exactly* a given number of duplicates and replace it with a "and nothing else" clause in the form: "nothing else that isn't a part of the fusion of the duplicates." Here is their final formulation (again replacing 'objects' by 'individuals'):

> **(DW)** For any sequence of individuals $x_1, x_2, x_3, \ldots, x_m$ and any appropriate m-place spatiotemporal relation there exist numerically distinct individuals $y_1, y_2,$

> $y_3, \ldots, y_m$ such that y_i duplicates x_i and the y's form a maximal spatiotemporally related mereological sum in that spatiotemporal relation.

Now, I agree that (DW) is an improvement on (ES); indeed, it is arguably equivalent to (LPR)* if transfinite sequences are allowed and the quantification over "appropriate" spatiotemporal relations is glossed as quantification over my full arrangements. But I think that their claim that (ES) is not extensionally adequate when applied to gunky worlds is misguided. They are demanding that a principle of recombination do too much, that it generate worlds that can only be generated with the help of a principle of plenitude for world-contents. Moreover, I do not see how their principle would do any better with generating the worlds in question: if (ES) is extensionally inadequate, then so is (DW).

Let me make four brief comments about their formulation before turning to their objection to (ES) based on gunky worlds. First, they get the same effect as my quantification over one-many arrangements by allowing the sequence of initial individuals to contain duplicates: including, for example, κ duplicates of an individual *a* in the initial sequence is equivalent to mapping *a* into κ places of the spatiotemporal structure that corresponds to their *m*-place spatiotemporal relation. Second, their formulation makes use of Lewis's definition of a world as a maximal spatiotemporally connected sum; so its claim that there exist *y*'s that duplicate the *x*'s and form such a sum is equivalent to my claim that the there exists a world that recombines the *x*'s according to a full arrangement. Third, (DW), like (LPR)* and all my principles of recombination, will not generate an "empty world": there is no such thing as a null sum. Fourth, (DW), no less than (ES), is a qualified principle of recombination in virtue of its initial universal quantifier over "appropriate spatiotemporal relations." Since Darby and Watson seem to be supposing that (PS) should follow from (DW), they must be implicitly assuming (E)*. But, as argued above, this is a substantial principle of plenitude for world-structures, and not something that should follow from the plenitude of recombinations alone.

Now, why might one think that (ES) has a problem with gunky worlds? Consider how Efird and Stoneham argue that (ES) is extensionally adequate in spite of its restriction to intrinsically distinct individuals. They illustrate with the case of Lewis and Lewis's right arm. A principle of recombination, if it is to be extensionally adequate, should generate a world that contains one duplicate of Lewis and a further duplicate just of Lewis's right arm, without the rest of his body. But (ES) is powerless to do this directly because Lewis and Lewis's right arm are not intrinsically distinct.[13] They claim, however, that (ES) will generate the required world if instead we apply it to Lewis's body parts – say, his arms, legs, head, and trunk – requiring that there be one duplicate of each suitably arranged, and a second duplicate of his right arm located elsewhere. So far, so good.[14] What if we instead wanted a duplicate of Lewis and a further duplicate of one of his cells? No problem: we just apply (ES) at the level of Lewis's cells. Recombining at this level, too, will leave some recombinations out. But there is a general strategy for ensuring that we include *all* possible recombinations of Lewis and his parts: apply (ES) to Lewis's mereological atoms, requiring appropriate numbers of duplicates suitably arranged. Note that it is no obstacle if some (or even all) of Lewis's atoms are duplicates of one another and so not intrinsically distinct. For we can get the same effect by applying (ES) to an intrinsically distinct sequence of atoms, getting the desired recombination by upping the number

[13] My own principles also don't directly apply because Lewis and his right arm are not distinct. But I can first apply (LPR) to get a world with two duplicates of Lewis and then apply (B2) to get a world that contains a duplicate of Lewis and a further duplicate of Lewis's right arm without the rest of his body.

[14] Well, as long as the body parts are intrinsically distinct, which is doubtful. If not, we can generate the required world by recombining parts at a lower level.

of duplicates. In an extreme case, say, starting from a Democritean world composed of duplicates of a single atom, we generate all the Democritean worlds by applying (ES) to the sequence consisting of that atom as its sole member.

This general strategy of applying (ES) to the mereological atoms won't work, as Darby and Watson note, if the base worlds are gunky: there are no mereological atoms at gunky worlds. And, surely, Efird and Stoneham do not want their principle (ES) to presuppose that gunk is impossible. So consider a gunky possible Lewis in some gunky possible world. Will (ES) succeed in generating all the possible recombinations involving duplicates of gunky Lewis and his parts? Although we can no longer generate all these recombinations by applying (ES) to mereological atoms, we can apply (ES) to successively smaller parts, *ad infinitum*, and then take the union of all the recombinations generated by this infinite process.[15] Why think that any recombinations will be left out? Of course, at every level we can only apply (ES) to sequences of parts of gunky Lewis that are intrinsically distinct, and that may limit the recombinations that can be formed from parts at that level. In the extreme case of a homogeneous gunky Lewis, we can only ever apply (ES) to one part of gunky Lewis at a time by recombining multiple duplicates of that one part. But I know of no reason to think that (ES) will fail to generate any of the recombinations involving duplicates of gunky Lewis and his parts. Considering cases of this sort do not, so far as I can tell, give reason to think that (ES) is extensionally inadequate.[16]

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[15] See Armstrong, *A Combinatorialist Theory of Possibility*, for a similar approach to generating recombinations from gunky worlds.

[16] Could there be a world at which every individual is reflexive? If so, then a version of (ES) restricted to non-reflexive individuals will fail to generate any recombinations based on that world, which is wrong. If we suppose that all possible individuals have a property of *size* and that size is an intrinsic property, then no individual of finite size could be reflexive, that is, a duplicate of one of its proper parts. But if we allow worlds that have topological

Darby and Watson's argument that (ES) is not extensionally adequate, however, does not rest upon cases like Lewis and Lewis's right arm. Rather, they claim that (ES) should entail, but fails to entail, a principle of contingent existence for parts:

> **(PCEP)** For any individual *a,* there is a world that contains no individual that is a duplicate of any part of *a*.

(PCEP) is stronger that (PCE). Although (ES) trivially entails (PCE) by setting the number of duplicates of the individual *a* to zero, it will not be able to set the number of duplicates of the parts of a gunky individual to zero, because the parts of a gunky individual, or distinct duplicates of those parts, or not intrinsically distinct.[17] Now, why do Darby and Watson think that (ES) should entail (PCEP)? Because otherwise (ES) applied to gunky worlds will not generate worlds without gunk. But, they say, assuming that gunk does not exist necessarily, "our principle of recombination should be such that it entails that there are worlds at which there is no gunk." (p. 439) But then, since every part of a gunky individual is gunky, if (ES) doesn't entail (PCEP) when applied to gunky worlds, then it won't entail, when applied to gunky worlds, that there are worlds with no gunk.

It seems to me, however, wrongheaded to expect a principle of recombination when applied to gunky worlds to generate worlds with no gunk. Whether there are gunky worlds or non-gunky worlds in logical space is a matter of the possible shapes of spacetime.[18] If, as I have

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and mereological structure, but lack metrical structure, then it seems there will be topologically gunky worlds at which every individual is a duplicate of some or all of its proper parts. (ES) would fail to be extensionally adequate when applied to such worlds.

[17] For a fuller rendition of the argument, see Darby and Watson, pp. 439-40.

[18] Recall: I suppose a principle of mereological harmony according to which the mereological structure of an object matches the mereological structure of the spacetime

argued, a principle of recombination should not have implications for what shapes of spacetime are possible, then the fact that (ES) by itself does not entail, when applied to gunky worlds, that non-gunky worlds are possible (or, for that matter, when applied to non-gunky worlds, that gunky worlds are possible) is a virtue, not a vice. In any case, I do not see how (DW) is supposed to do any better than (ES) on this score. Starting from gunky individuals, (DW) merely allows one to recombine duplicates of those individuals into maximal spatiotemporally interrelated sums. But duplicates of gunky individuals are gunky, and so the worlds generated by (DW) from gunky worlds will also be gunky.[19]

Could the case for the extensional inadequacy of (ES) better be made by focusing on its failure to entail (PCEP)? Certainly I concur that (PCEP) should be part of a complete account of plenitude. On my own account, it follows from (DND), just as did (PCE), as a simple corollary: just apply (DND) to the class comprised of all parts of *a*. But it does not follow from (LPR) and (B2): it requires a principle for world-contents such as (PIP) that guarantees the existence of aliens. And, as I argued above with respect to (PCE), that is how it should be.[20] How then does (DW) manage to entail (PCEP) or (PCE)? It doesn't, *contra* to what Darby and Watson seem to

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region it occupies. This principle has sometimes been denied. See, for example, McDaniel, "Extended Simples."

[19] Could they perhaps be rejecting what has been called the "trickle down" account for recombining individuals, thereby supposing that when gunky individuals are recombined we ignore their internal mereological structure and treat them as atoms? But surely this isn't compatible with a Lewisian account that understands recombination in terms of duplicates. For more on the trickle down account, see Sider, "Another Look at Armstrong's Combinatorialism."

[20] Indeed, Darby and Watson themselves hold that a principle of recombination has no implications for the existence of aliens. They write: "the recombination principle is extensionally adequate only in nearby logical space, the worlds in which [there are] no alien individuals or properties. Something more than recombination is needed to get out of that region …" (p. 436)

believe. For, as argued above, when applied to Democritean worlds composed entirely of duplicates of a single atom, it will never generate a world where a duplicate of that atom fails to exist. And this, as I see it, is a virtue of (DW), not a vice. On the other hand, the fact that (ES) entails (PCE) gives reason to object that (ES) is not really a principle of recombination, but something more: applied to Democritean worlds, with an assignment of cardinality zero to the atom that composes the worlds, it generates worlds containing individuals alien to those Democritean worlds (or, worse, it generates an empty world). And that is to overstep its rightful bounds.

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