Another Look at Armstrong's Combinatorialism*

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The core idea of David Armstrong's combinatorial theory of possibility is attractive. *Rearrangement* is the key to modality; possible worlds result from scrambling bits and pieces of other possible worlds. Yet I encounter great difficulty when trying to formulate the theory rigorously, and my best attempts are vulnerable to counterexamples.

The Leibnizian biconditionals relate *possibility* and *necessity* to *possible world* and *true in*:

> p is possible iff p is true in some possible world
>
> p is necessary iff p is true in all possible worlds

Given an account of the latter notions, one can reduce the former via the biconditionals. In *A Combinatorial Theory of Possibility*, and then again in *A World of States of Affairs*, Armstrong characterizes *possible worlds* as rearrangements of elements of the actual world. But he says comparatively little about *true in*. This omission figures prominently in what follows.

Section 1 of this paper reconstructs Armstrong's theory, section 2 defends it from criticisms due to Fraser MacBride and Holly Gail Thomas, and section 3 gives a number of objections to that theory. Section 4 develops yet another objection, building on work by David Lewis.

1. A reconstruction of Armstrong's theory

Armstrong's theory of worlds is based on an ontology of particulars, universals, and states of affairs. Universals and particulars are familiar, states of affairs only slightly less so. If particulars $a_1 \ldots a_n$ instantiate an n-place universal, U, then in addition to $a_1 \ldots a_n$ and U there exists another entity, the state of affairs: $\boldsymbol{a_1 \ldots a_n}$**'s standing in** $\boldsymbol{U}$. But if $a_1 \ldots a_n$ do not instantiate U then this state of affairs does not exist – there are no such things as false or non-obtaining states of affairs.[1]

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[1] His states of affairs are thus like the facts of Russell (1985) and Wittgenstein (1961).

Armstrong identifies possible worlds with "rearrangements". These rearrangements are to be states of affairs. Possible worlds typically concern states of affairs that do not actually obtain. Armstrong therefore needs to speak of merely possible states of affairs, despite their absence from his ontology. His strategy is fictionalist: though merely possible states of affairs do not, strictly speaking, exist, talk of them is as acceptable as talk of ideal gasses and frictionless planes (1989, pp. 49–51). Think of this as talk about what is true according to a fiction of merely possible states of affairs, a fiction laid out (not explicitly) in his books.[2]

For the moment assume atomism: all universals are made up of simple universals (ones containing no other universals as "constituents" – more on this below) and all particulars are made up of simple particulars (ones with no proper parts). What Armstrong calls a *Wittgenstein world* is a conjunction w of possible states of affairs involving only simple individuals and universals, in which i) every (actual) simple individual and universal is a constituent of w ("no contraction"), ii) for every simple individual a, for some property F the state of affairs $\boldsymbol{a}$**'s having** $\boldsymbol{F}$ is a constituent of w ("no propertyless particulars"), and iii) for every n-place universal, U, for some particulars $a_1 \ldots a_n$, the state of affairs $\boldsymbol{a_1 \ldots a_n}$**'s standing in** $\boldsymbol{U}$ is a constituent of w ("no uninstantiated universals").[3]

The Wittgenstein worlds are Armstrong's first approximation of possible worlds. He then introduces modifications. He allows (1989, chapter 4) *contractions* (worlds involving a proper subset of the actual universals and individuals) and *expansions* (worlds involving more individuals than actually exist), and drops the assumption of atomism (1989, chapter 5).

Even after a close reading of *A Combinatorial Theory*, it is difficult to see exactly how the modified theory is supposed to work. My reconstruction must therefore go beyond the letter of what Armstrong said; it is, I hope, nevertheless in the spirit of what he intended. The goal is to provide a definition of what I will call an *Armstrong world*, a possible world according to Armstrong's final view.

Contractions are easy: define Armstrong worlds as conjunctions of possible states of affairs (fictional entities, recall), but drop the requirement that every (actual) simple individual and universal show up somewhere.

Expansions are less easy. Armstrong wants worlds with non-actual individuals, but I do not follow Armstrong's proposal to introduce them, nor do

[2] Compare Rosen (1990).

[3] 1989, chapter 3. I ignore the "totality" condition (p. 48).

I follow Skyrms (1981) (cited approvingly by Armstrong and included as an appendix to *A Combinatorial Theory*). In *A Combinatorial Theory*, Armstrong disallowed worlds with an expanded set of universals, thus treating particulars and universals differently. In *A World of States of Affairs* (pp. 165–169) he allowed alien universals, restoring symmetry; but again, the details of their introduction are obscure.

The problem of possibilities involving non-actual entities confronts any actualist theory of possible worlds. But as I have argued elsewhere (2002), actualists can solve this problem. In brief, Armstrong can appeal to more fictionalism here, and stipulate that his fiction of possible states of affairs says that there are an infinity of non-actual individuals and universals capable of entering into non-actual states of affairs. It will be true in this fiction that for any individuals $a_1 \ldots a_n$, whether actual or merely possible, and any n-place universal U, whether actual or merely possible, there is a (perhaps merely possible) state of affairs consisting of $a_1 \ldots a_n$ instantiating U.

The real trouble begins when the assumption of atomism is dropped. Some universals contain *constituents*. A conjunctive universal contains its conjuncts as constituents; a structural universal, whose instantiation by a particular involves that particular's parts instantiating certain other universals, contains those other universals as constituents. The Wittgenstein worlds were built from simple universals, those without proper constituents. But perhaps each universal is a structural combination of further universals — "structures all the way down". In that case the actual world would contain no simple universals, and so the Wittgenstein worlds as defined by Armstrong would not exist (not even as fictional entities). Armstrong's solution is to construct possible worlds from non-atomic universals and particulars, which he calls *relative atoms*. We may choose any *non-overlapping* universals and particulars we like to serve as relative atoms (the importance of non-overlap will emerge below). Using those relative atoms, we may construct possible worlds as above, as any distribution of the chosen relative atomic universals over the chosen relative atomic particulars (some of which may be fictional, recall). We may later choose other relative atoms, perhaps "smaller" or "larger" than those initially chosen, to obtain other worlds. An Armstrong world is thus any conjunction of possible states of affairs obtained from some choice or other of relative atoms.

At this point certain details are missing from *A Combinatorial Theory*. The chief unanswered question is whether the actual mereology of the relative atoms that make up a possible world, w, is part of what is *true in* w — whether, one might say, mereological facts "trickle down". Suppose we choose the

universal **being a water molecule** as one of our relative atoms, and construct an Armstrong world, w, containing the state of affairs of a certain actual particular, a, being a water molecule. In w, does a instantiate a property with proper constituents? Of course, **being a water molecule** does indeed have constituents — in actuality — namely **being a hydrogen atom** and **being an oxygen atom**. The question is whether it is *true in w* that **being a water molecule** has these constituents. Likewise, if a has, in fact, certain parts, is it true in w that a has parts?

It is not trivial that mereological features trickle down, for features do not in general trickle down. I am a philosopher; but this fact about me does not trickle down to an Armstrong world containing the merely possible state of affairs of my being a mathematician. I am a constituent of this Armstrong world, and I am in fact a philosopher; nevertheless it is not *true in* this Armstrong world that I am a philosopher.

So, does Armstrong intend mereological features to trickle down? Here are two possibilities for formulating Armstrong's theory that answer our question:[4]

> **The trickle-down theory:** x is part of y at w iff x is (in fact) part of y; U_1 is a constituent of U_2 at w iff U_1 is (in fact) a constituent of U_2
>
> **Relative atoms are atoms:** the chosen relative atoms used to construct w are atomic *at w*

The choice here concerns how to conceive of truth-in-a-world. Armstrong never explicitly defines truth-in, and so does not address our question directly. However, the following passage, which discusses the need for requiring that relative atoms don't overlap, *seems* to suggest the trickle-down theory:

> If the putative relative atoms a and b overlap, partially or totally, then …[there will] be a cause of particular embarrassment if we then go on to consider worlds which contain a but in which b is totally absent…These will be impossible worlds (p. 69)

Armstrong seems to presuppose that since a and b *actually* overlap, they would overlap at the world in question, and hence if it is true in that world that a exists, it must automatically be true in that world that b exists as well.

[4]Let these be restricted to actually existing relative atoms. Throughout I ignore complications involving non-actual, and so fictional, relative atoms.

Unfortunately, the trickle-down theory is inconsistent with the necessary truth that a particular instantiating a structural universal must contain parts instantiating the constituents of the universal. Suppose that while some universals and particulars are endlessly complex, some are simple. Suppose that one of these endlessly complex universals, U_c is, in fact, instantiated by an endlessly complex particular, c, and that a wholly distinct atomic universal, U_a, is in fact instantiated by a wholly distinct atomic particular a. Choose U_c, U_a, c, and a as relative atoms; Armstrong's theory then generates a possible world, w, in which a instantiates U_c. (Remember that *any* particulars are allowed to be paired with *any* universals – of the appropriate -adicy – in constructing merely possible states of affairs.) By the trickle-down theory, U_c is in w a structural universal, with constituents. So anything that instantiates it in w must have parts in w. But by the trickle-down theory, a does not have any parts in w.

It isn't much better to claim that relative atoms are atoms, for then properties do not seem to retain their "quiddities" when used to represent possibilities. In the example of the previous paragraph, property U_c no longer has constituents in w. Then its use in representation of a possibility has little to do with its actual nature. What, then, *does* world w represent? Not much of anything, beyond that there exist two things, each of which instantiates a single universal. Combinatorialism would become highly structuralist, as in Heller (1998). Armstrong intends no such thing.

How, then, should we understand the relationship between mereology and mereology *at* a world? I would recommend a mixed strategy: drop "relative atoms are atoms" in favor of the trickle-down theory, but hold the trickle-down theory only for universals.[5] On this theory, possible worlds may be regarded (within the fiction) as the result of following these steps:

step 1: choose any non-overlapping universals[6] as relative universal atoms

step 2: choose any particulars (actual or fictional) as relative particular atoms

step 3: any conjunction, w, of (perhaps fictional) states of affairs made up from these is a possible world, (provided w includes some

[5]This meshes with Armstrong's acceptance of quidditism and anti-haecceitism (1989, pp. 57–61). An alternate response, pointed out to me by Brian Weatherson, would be to retain the pure trickle-down theory, but allow only those combinations of universals and particulars where the mereology of the particular matches that of the universal.

[6]For simplicity I refrain from incorporating fictional universals here.

state of affairs Fa, where F is monadic, for each particular a that shows up in w)

step 4: the universals that exist at w are: i) the chosen relative universal atoms, and ii) their constituents (that is, their actual constituents). The constituents of a universal at w are its actual constituents.

step 5: the particulars that exist at w include the chosen original set of particulars, plus some other fictional particulars — particulars whose existence is forced given which structural universals are instantiated in w. (For example, if one of the relative atoms is **water**, and w contains the state of affairs ***a*'s instantiating water**, then w must also contain three fictional things that are part of a (at w): two instantiating **hydrogen** and the other instantiating **oxygen**.) But something that is actually part of one of the chosen particular relative atoms need not exist at w

step 6: the states of affairs that are actual at w include those in the conjunction chosen in step 3, plus any other states of affairs forced to exist by the constituent nature of the universals in that conjunction (as explained in step 5).

The idea is to use particulars as mere "placeholders".[7] A world is given by a pattern of distribution of universals; the particulars that exist at the world are only those required to instantiate the chosen pattern.

It probably would be best to include the "trickle up" theory (for particulars) as well:

step 7: the particulars that exist at w are closed under aggregation — for any objects that exist at w, it is true at w that there exists an aggregate of those objects

This, then, is my best attempt at reconstructing Armstrong's theory.

2. MacBride and Thomas

Before evaluating the theory I want to consider an objection that the theory is not genuinely reductive. Fraser MacBride (1999) and Holly Gail Thomas

[7] Compare Armstrong's (1989, pp. 64–65) metaphor of hooks on a peg-board.

(1996) have argued that Armstrong's theory requires primitive modality to rule out possibilities that do not follow the "canonical form" of states of affairs. For Armstrong a possible state of affairs must take the form of n particulars instantiating an n place universal. Why not states of affairs in which a universal instantiates a particular, or a particular instantiates a particular, or n particulars instantiate an m place universal (where $n \neq m$)? These states of affairs are surely impossible, but how can Armstrong rule out their possibility? Each is a kind of combination of particulars and universals. Are these combinations "*repugnant* to the natures of particulars and universals *per se*"? (Thomas, 1996, p. 243) If so, MacBride and Thomas argue, Armstrong must appeal to primitive modality to disqualify them as impossible.

Objection: primitive modality is not needed because it is analytic that these combinations do not occur. Reply (MacBride, 1999, p. 496): even if it is part of the meaning of 'particular' that nothing instantiates any particular, it does not follow that something that is *actually* a particular could not possibly be instantiated by something. The meaning of 'bachelor' ensures the truth of the *de dicto* sentence 'Necessarily, each bachelor is unmarried', but not the truth of the *de re* sentence 'Every bachelor is necessarily unmarried'. Likewise, the meaning of 'particular' can at best secure the *de dicto* sentence 'Necessarily, every particular is uninstantiated', whereas we also want the *de re* sentence 'Every particular is necessarily uninstantiated'. Likewise, it is impossible for anything that is actually a two-place universal to be instantiated by three particulars. Analytic constraints on 'universal' and 'particular' will not rule out these repugnant combinations.

This reply is correct as far as it goes, but MacBride and Thomas ignore the rejoinder that it is analytic to 'possible' rather than to 'universal' and 'particular' that these combinations are impossible. Armstrong could claim that it is part of the meaning of 'possible' that the possible states of affairs are all and only the combinations of universals and particulars that respect the canonical form of a state of affairs. In fact, he could claim that 'possible' just means 'combination of universals and particulars fitting the canonical form'. Or, to bypass subtleties about what "just means" means, we could semantically descend and take the claim thus: possibility *just is* being a combination of universals and particulars fitting the canonical form.[8] "Being a combination of universals and particulars

[8]Assuming Armstrong is attempting an analysis of possibility, this is what he *must* say. An analysis of possibility says what possibility *is*, and so a combinatorial analysis of possibility *identifies* possibility facts with facts about combinations.

fitting the canonical form" is non-modal, and so the analysis is not circular. Primitive modality would not be required to disqualify the problematic states of affairs as impossible. They have a non-canonical form simply in view of their non-modal nature; given the analysis of possibility, they count as impossible simply because they have this form.[9]

3. Problems involving relative atoms

So: Armstrong's theory of possible worlds, as formulated in section 1, is genuinely reductive. But it faces numerous challenges.

An initial challenge: since *all* distributions of universals over particulars count as Armstrong-worlds, there will be Armstrong-worlds in which things are taller than themselves or are red and also not-red. But these are impossibilities.

Many such challenges are answered by Armstrong's *sparse* theory of universals, according to which there exist only enough universals to explain the genuine similarities in the world.[10] According to this view, *internal* relations, like **taller-than**, which would supervene on the intrinsic properties of their *relata*, do not exist, since there is no need to postulate them in addition to the intrinsic properties of their *relata*. Moreover, there are no negative or disjunctive properties, for when these would be shared there need be no genuine similarity. There is no such universal as **being not-red** (1989, pp. 48–49).

Some impossible combinations apparently remain, for example states of affairs in which a single thing instantiates both **having (exactly) 5g mass** and **having (exactly) 1g mass** (1989, chapter 6). Armstrong responds that to have 5g mass is to have five parts, each of which has 1g mass. Thus, the universal **5g mass** is a structural universal containing the universal **1g mass** as a constituent. Combinatorialism only allows unrestricted combinations for *non-overlapping* universals. A special case of this was the original set of Wittgenstein worlds, where the universals in the combinations were all atomic and therefore non-overlapping. Atomic universals were thought to be genuinely modally independent. In the final theory, the requirement that relative atoms not overlap was intended to preserve this independence. Necessary connections

[9] Armstrong says things somewhat like this in Armstrong (1989, chapter 10). He could perhaps give a similar defense of the exception he admits to combinatorialism for higher order states of affairs (1989, chapter 7).

[10] The theory is defended in full in Armstrong (1978*a*,*b*). The term 'sparse' is from Lewis (1986, pp. 59 ff.).

between universals are due to overlap. Thus, since **5g mass** and **1g mass** overlap, one cannot simultaneously choose each as a relative atom, and so we cannot construct a world in which a particular instantiates each.

A natural objection is that there might be distinct atomic masses. Perhaps quarks and electrons are point particles with different masses m_1 and m_2. If they are, then m_1 and m_2 must be simple universals, for if they were structural universals then their instances would have parts. But if m_1 and m_2 are simple universals then there are Armstrong worlds in which a thing has both. Armstrong's reply is that even if quarks and electrons are *spatial* point particles, they are not *mereologically* simple. Quarks and electrons have infinitely many parts, all spatially point-sized, instantiating smaller and smaller mass universals. The masses m_1 and m_2 are thus complex and overlapping, ruling out the unwanted combinations. Sounds like a tall tale, but I will not push at this point. There are other places to push.

Grant Armstrong that each mass universal contains all the infinitely many smaller mass universals as constituents. How will he generate all the possible worlds in which one thing has 1 gram mass and another thing has π grams mass? Only one mass universal can be a relative atom at a time since any two mass universals overlap. Let the chosen mass universal have mass m grams. Given this choice of a relative atom one can construct worlds with objects larger than mass m: as aggregates of objects with mass m. But any such object will be either infinitely massive (if it is made up of infinitely many parts each with mass m), or will have a mass in grams that is some multiple of m. So if m is a rational number, none of these objects will have an irrational mass in grams; if m is irrational then none will have a rational mass in grams.

It is actually not strictly correct that no object in any of these worlds will have a rational mass in grams, if m is irrational.[11] Suppose m is π. We are supposing that each mass has all the smaller masses as constituents. So π **grams mass** has **1 gram mass** as a constituent. Thus, anything in any of these worlds that instantiates the former must have (at the world in question) a part that instantiates the latter (given the mixed trickle-down theory of section 1.) In this way, certain objects "tag along" when others are added to a world. But some possible worlds with 1g and πg objects cannot be generated in this way, for example a world in which something that is πg bears a certain relation R to something that is 1g. Combinatorialism allows all combinations *of the chosen relative atoms*; a choice of π **grams mass** and R as relative atoms will not

[11] Thanks to John Hawthorne here, and for discussion of this and the next paragraph.

generate the desired world.

Might we choose a single relative atom, the structural universal **having two parts, one with 1g mass and another with πg mass, standing in relation R**? But this universal may not be actually instantiated. Given that Armstrong rejects uninstantiated universals (1989, p. 43), there will be no such structural universal to utilize as a relative atom in generating the desired possible world. Moreover, relaxing the prohibition of uninstantiated universals would not help. We would then need a criterion of which uninstantiated structural universals are possibly instantiated (some are not, e.g., **having two parts, one which is blue and has 1g mass, the other of which has 1g mass and also 2g mass**.) Presumably one would follow the same combinatorial strategy as before: any structure constructed from any chosen non-overlapping relative atoms is a possibly instantiated structural universal. But now the problem is back — we cannot generate the desired structure, since the mass properties we would need to construct the structure, **having 1g mass** and **having πg mass**, overlap.

For that matter, it is unclear how combinatorialism will generate a world where a 1g thing bears R to a 2g thing. The existence of a world with three 1g things is assured. The trickle-up theory — step 6 — insures that every pair of these objects has an aggregate. These things will be 2g (assuming that to have 2g just is to have two non-overlapping parts, each with 1g). But we cannot require that one of these 2g sums bears R to the remaining 1g thing, because the 2g sum is not a relative atom. Combinatorialism only applies to the relative atoms, and so only guarantees worlds where one of the 1g things bears R to another one of the 1g things.

Armstrong applies his approach to incompatible masses to other problem cases involving incompatible universals. But other cases introduce new difficulties. Consider incompatible spatiotemporal relations.[12] No two things can be both 5' and 6' apart. So one might expect Armstrong to say that the dyadic universals **being 5' from** and **being 6' from** are overlapping structural universals. But that seems wrong: point-objects standing in spatial relations need not have further parts. A new strategy is needed.

Armstrong should say that the impossibility of being both 5' and 6' apart is not be due to an incompatibility between dyadic universals at all. Armstrong must endorse a *property* theory of distance. Facts about distance consist, fun-

[12]Incompatible determinates of *non*-spatiotemporal relations, if they exist, would create further problems for Armstrong, since Armstrong's approaches to incompatible masses and spatiotemporal relations do not seem to generalize.

damentally, in the instantiation of different structural properties: **being a 5m length**, **being a 5m^2 area**, **being a 5m^3 volume**, and so on. These properties would be properties of regions of spacetime, and would indeed be structural: a 5m line segment in spacetime must contain 5 non-overlapping 1m line segments as parts. This meshes with Armstrong's (1989, p. 80) claim that volumes and durations are structural properties.[13]

There is something unintuitive about this theory. Its claim that spatiotemporal relations derive from structural properties of space and time reverses the intuitive order of dependence. Worse, the account requires substantivalism about space and time — the idea that spatial and temporal points and regions are genuine objects. One's theory of modality should not decide the question of substantivalism vs. relationalism. Still worse, dispensing with spatial relations in favor of spatial properties eliminates certain possibilities. If there is an earlier-than relation, R, then Armstrong can admit a difference between the possibilities aRb and bRa. Armstrong can distinguish these states of affairs since states of affairs are not mereological sums of their constituents; the *order* of the constituents matters (Armstrong 1997, section 8.2). But on the new theory, we no longer have R. We have rather a certain structural property: the property P of **having two parts, *x* and *y*, such that *x*R*y***. The two cases can no longer be distinguished, for in each we have a single object, a+b, and the property P. (Might we distinguish P′, the property **having two parts, *x* and *y*, such that *y*R*x***? No — P′ is the same property as P; their descriptions are logically equivalent.)

Another worry: if we had a binary earlier-than relation, R, and three non-overlapping things, we could construct a world in which aRb and bRc. But once we move to the property theory, how can this world be constructed? We cannot choose our relative atoms to be a+b and b+c, since these overlap. If we choose them to be a+b and c, then we can get the aRb fact by having a+b instantiate a certain structural property P (modulo the worry of the previous paragraph). But how do we get the fact that bRc? If the structure **having three parts, *x*, *y*, and *z*, such that *x*R*y* and *y*R*z*** is actually instantiated, then it could be invoked as a relative atom and held to hold of a+b+c; but if it is not instantiated then it will not exist.

[13] Substantivalists must choose whether to admit objects in addition to points and regions of spacetime. If Armstrong does admit additional objects, he should also admit a binary relation of **occupation**, holding between the additional objects and points of spacetime, facts about which generate the locations of the additional objects. Note that given combinatorialism, the possibility of extended simples and enduring objects would then follow (see Sider (2007).)

Finally, Armstrong's theory of relative atoms restricts possibilities in a quite different, and perhaps unwanted, way. Relative atoms are the elements of Armstrong's combinatorialism, the items that may be mixed and matched at will to generate possibilities. In the simple trickle-down theory, the requirement that relative particular atoms not overlap ruled out construction of ranges of possible worlds in which the properties of a particular vary independently of the properties of its parts; in my modified version of the trickle-down theory this is ruled out as well (see below). In general this is a virtue. The properties of wholes do not in general vary independently of the properties of their parts. But it is not inconceivable that *some* properties do. Perhaps *some* properties are "irreducibly macroscopic" – i.e., are non-structural but are instantiated by mereologically complex particulars. Instantiation of such a property by a particular would be modally independent of the properties of that particular's parts. Armstrong's theory cannot generate all the possibilities involving such a property.

Suppose, for example, that mental properties are in fact irreducibly macroscopic properties of the brain. Suppose further that no brain with exactly 2,000,001 electrons happens to be in pain. Such a brain being in pain should nevertheless be possible, but no corresponding Armstrong world can be constructed. **Being in pain** and **being an electron** do not have a common constituent (the former has no proper constituents, and, we may stipulate, is not a constituent of **being an electron**), so each may be chosen as relative atoms; that is not the problem. The problem is that in constructing combinatorial worlds we cannot apply the first property to an object and the second to its parts. This is clearest on the simple trickle-down theory. On that theory, to construct a world, w, in which a brain has **being in pain** and contains 2,000,001 parts instantiating **being an electron**, we would need to choose some actual object, b, and 2,000,001 of its actual parts as relative atoms; but relative atoms cannot overlap. Neither can w be constructed given the modified trickle-down theory. Suppose for some particular relative atom, a, we include in w the state of affairs ***a*'s being in pain**. Given **step 5**, a will lack parts in this world, since **being in pain** is not a structural universal and therefore does not force the existence of parts of its instances. On the other hand, suppose we include 2,000,001 states of affairs of particulars instantiating **being an electron**, plus relational states of affairs appropriate to those electrons being arranged as a brain. The "trickle-up" **step 7** insures the existence in the world being constructed of an object composed of these electrons, but this object is not one of the relative atoms to which **being in pain** could be applied.

The argument against Armstrong's theory, then, runs as follows. If irreducibly macroscopic properties are actual, certain states of affairs ought to be metaphysically possible, for instance a brain with 2,000,001 electrons as parts instantiating the irreducibly macroscopic **being in pain**. As we have seen, if such properties are actual, Armstrong's theory disallows these possibilities. Armstrong's theory *commits* us, therefore, to the non-existence of irreducibly macroscopic properties. Yet irreducibly macroscopic properties are an open epistemic possibility, an empirical matter even. Armstrong's theory intrudes where it is not wanted.

The objection so far has concerned what metaphysical possibilities exist if irreducibly macroscopic properties are actual. A related objection concedes for the sake of argument that such properties are not actual, but insists that they are nevertheless metaphysically possible, and further that

> (*) it would be possible for there to exist an irreducibly macroscopic property, P, which is instantiated by a brain with 2,000,001 electrons.

This presupposes the possibility of "alien" universals – universals beyond (conjunctions and structural combinations of) those that actually exist. As mentioned in section 1, Armstrong initially denied the possibility of alien universals, then later changed his mind. At any rate, if Armstrong allows such possibilities, and accounts for them using the method sketched in section 1 (modeled on Sider (2002)), he nevertheless cannot accommodate (*): the argument from two paragraphs back goes through, with references to **being in pain** replaced by references to the fictional alien universal P.

4. No account of truth-in for macro-statements

I close with a discussion of one further problem for Armstrong's theory, a problem first raised by David Lewis in his 1992 review of *A Combinatorial Theory of Possibility*.

As noted, Armstrong holds a sparse theory of universals. There is virtue in this; combinatorialism would otherwise generate impossible worlds in which the universal **being a donkey** is not instantiated, but which contain arrangements of micro-particles that would suffice for a donkey's existing. Solution: there is no such universal **being a donkey**.

But this solution to the problem generates another. Following Lewis (1986; 1992, pp. 155–157), consider the possibility of there existing a talking donkey.

Given the Leibnizian biconditionals, it must be *true in* some Armstrong world that there exists a talking donkey. There are certainly Armstrong worlds containing conjunctive states of affairs involving the instantiation of universals by micro-particles that would suffice for there being a talking donkey. But there is no world containing a state of affairs consisting of a particular's instantiating a universal **being a talking donkey**, for there is no such universal. Nor are there universals of **talking** or **being a donkey**. So in virtue of what is it *true in* one of the Armstrong worlds that there is a talking donkey? He might say that it is true in w that there is a talking donkey iff *necessarily*, if w existed then there would be a talking donkey. But given the definition of 'true in' suggested by this move, the analysis of modality would be circular.

Here again, it matters that Armstrong never explicitly defines truth-in-a-world. To analyze necessity and possibility, it is not enough to provide a non-modal account of a possible world, for if necessity and possibility are defined as truth in all and some possible worlds, respectively, a non-modal account of truth-in is required in addition. It is surprising that Armstrong doesn't address this question; the problem here is exactly the problem of implicit representation discussed in Lewis (1986, pp. 155–157).

At the beginning of *A Combinatorial Theory* Armstrong says this:

> …the supervenient is not really a feature of the world distinct from the features it supervenes on. The resemblances of things, for instance, are not really distinct from the properties and relations of things. (p. 7).

He returns to this theme in *A World of States of Affairs*:

> …Whatever supervenes …is not something ontologically additional to the subvenient…What supervenes is no addition of being. (p. 12)

This view of supervenience, which he calls "the ontological free lunch", suggests a solution to the problem of truth-in. After giving facts about particles, we need not say anything further about donkeys, since facts about donkeys supervene on the facts about the particles and so are nothing over and above the facts about the particles.

This doctrine requires clarification. In what sense is the supervenient "nothing over and above" what it supervenes on? One view would be that the supervenient does not exist. There are no composite things, and no structural or conjunctive universals: all universals and particulars are simple. That would

make good sense of "nothing over and above".[14] But then there would be no people, chairs, etc. This is not what Armstrong intends.[15] Moreover, this theory fails in a case Armstrong wants to allow, when there are no non-structural universals at all ("supervenience all the way down").

"Nothing over and above" might mean "is supervenient on", but then the doctrine is trivially correct, and does nothing to solve the problem of truth-in.

The claim might be that the supervenient is identical to the subvenient. If the state of affairs of a donkey's existing is identical to states of affairs involving microscopic particles, then, it might be thought, Armstrong's theory need only say that states of affairs of the latter sort are possible. Armstrong does indeed hold something like the doctrine of "composition as identity", according to which a whole is identical to its parts (Armstrong, 1978*b*, pp. 37–38). But this doctrine, in a strong enough form to be of use here, is the eerily attractive yet scarcely intelligible claim that a *single* thing is identical to its *many* parts.[16]

Composition as identity may not be needed, given further views Armstrong holds. David Lewis (1992, p. 220) suggests that the doctrine of the "thick particular" may come into play here. Where a thin particular is a thing without its properties, a *thick* particular is the thin particular plus the properties, and is identified with the state of affairs of the thing having those properties. Thus, certain states of affairs *are* the things involved in those states of affairs. On this view, the complex state of affairs involving micro-particles arranged so as to compose a donkey would itself *be* a donkey. Thus, Armstrong could say that it is true in a world that there is a talking donkey iff that world literally contains a talking donkey.

But, as Lewis goes on to note (p. 222), this will not do, given Armstrong's views on non-actual states of affairs. If he actually believed in such things, he could straightforwardly make use of Lewis's suggestion. But he does not; instead, he is fictionalist about them. (A good thing, too, given the identification of thick particulars with states of affairs: otherwise Armstrong would be committed to

[14]Compare ?, pp. 11–12.

[15]Nor would it really solve the problem. A sensible eliminativist will admit that ordinary English assertions about tables and chairs are at least appropriate to assert. Though there are no tables, there are "simples arranged table-wise" (van Inwagen, 1990, chapters 10 and 11), which underwrites the appropriateness of ordinary assertions about tables. Surely it is possible that there be simples arranged talking-donkey-wise; but now we need an account of when it is true at *w* that there are simples arranged talking-donkey-wise.

[16]See Baxter (1988*a*,*b*); ?); Sider (2007). A weaker doctrine, Lewis's (1991, section 3.6) claim that composition is analogous to identity, seems not to give Armstrong what he needs.

the existence of talking donkeys!) The issue here is what is true according to Armstrong's fiction. For it to be possible that there exists a talking donkey, it must true according to the fiction that in some Armstrong-world, there is a talking donkey. But all Armstrong explicitly builds into the fiction is that in some world there is a certain arrangement of universals over micro-particles. So even given the doctrine of the thick particular, the problem of truth-in remains unsolved. Similarly, even if composition as identity is a true doctrine about actual things, nothing follows about what is true according to Armstrong's fiction.

To use the Leibnizian biconditionals to analyze modality, one must define 'true in'. Given Armstrong's fictionalism about non-obtaining states of affairs, and given his sparse theory of universals, he needs an account of when statements like 'it is true in world w that there exists a talking donkey' are true according to his fiction. He could stipulate his notion of truth according to his fiction to obey the following law: if his fiction says there is an Armstrong-world w, and if it is necessary that if w existed then P, then it is true according to the fiction that w is a world in which P. But that would again render the analysis of modality circular. No other appropriate stipulations concerning truth-according-to-his-fiction seem available. So Armstrong has not provided a non-circular account of modality.

Perhaps Armstrong does not intend to analyze modality at all. It is consistent with the later presentation of the theory in *A World of States of Affairs*, at any rate, that Armstrong intends only to provide "truth-makers" for modal truths. A truth-maker for a true proposition, P, is an object whose very existence "makes P true". Providing truth-makers is not the same thing as analysis since i) truth-makers need not be propositions, and ii) a truth can have many truth-makers. The truth that there exist some human beings is made true by me, a concrete person rather than a proposition; moreover this truth is also made true by you, and by any other human being. A truth-maker for the truth, TD, that **there might have been a talking donkey** would, perhaps, be a certain mereological sum, S, of various universals and particulars that would constitute a talking donkey if suitably arranged.[17] Perhaps Armstrong is content to forsake analysis and merely seek truth-makers.

Why think that S is a truth-maker for TD? Answering this requires clarifying the nature of the makes-true relation. According to some, truth-making is (modal) entailment: x makes P true iff x exists and P is true and it is necessary

[17] Compare Armstrong (1997, p. 150).

that if x exists then P is true.[18] Now, many believe the S4 and S5 principles, which insure that anything necessary or possible is necessarily so. But then any object whatsoever would be a truth-maker for any statement of possibility or necessity. That trivializes the search for truthmakers for modal truths. Even those who reject the universal validity of S4 and S5[19] may well accept their validity in *some* cases (for example the case of TD); truthmaking would then be cheap in those cases. Armstrong certainly does not write as if just any object is a truth-maker for just any modal truth. He seeks truth-makers that are closely connected to the truths in question. However, he gives us no clue as to just what connection is required. He tends instead to provide a truth-maker "in the neighborhood" of the truth in question without explaining what relationship between truth and truthmaker he is after.[20]

Greg Restall (1996) has proposed replacing the strict conditional in the definition of truth-making with the conditional of relevant entailment: for S to make TD true, the proposition that S exists must relevantly entail TD. This rules out cheap truthmaking since a relevant entailment conditional can be false even when its consequent is necessarily true; its truth requires a *connection* of some sort between its antecedent and consequent. But this just puts more pressure on Armstrong to specify the relation between S and TD. In the absence of an analysis of modality, why think that the existence of certain universals and particulars relevantly entails that there might have been a talking donkey?

Let us take a step back. The point of constructing an ontology is to come up with a believable description of the world and show that it is complete, that it captures everything we believe to be true about the world. The reductively inclined see the possibility for de-mystification: the description of the world will include nothing questionable, and it will be shown that this description really does suffice for all we ordinarily believe about the world. Perhaps Armstrong's ontology really does contain a truth-maker for every truth, under some acceptable conception of truthmaking. Even so, the purpose of constructing an ontology has not been fulfilled until Armstrong *shows* us that his ontology contains a truth-maker for every truth. Without an analysis of modality, he cannot show us this; only with an analysis in hand can he point to the relevant features of the truthmakers and show us how those do indeed make modal truths true. Analysis must remain the goal.[21]

[18] Fox (1987, p. 189).

[19] See, for example, Salmon (1986).

[20] See, for example, his discussion of alien universals in Armstrong (1997, pp. 166–167).

[21] See my (2003) on the analysis of modality.

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