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Armstrong and Tropes

“So the philosophy of tropes is riding high.”

David Armstrong, U 125.¹

Appreciation

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In 1974, while a graduate student at the University of Manchester, I first heard David Armstrong give a talk. It was on various regress arguments against nominalism, later published in *NR*. At that time I was not a nominalist and the arguments seemed sound. What impressed me much more forcibly however was Armstrong’s refreshing direct-
ness in addressing metaphysical issues. At that time, metaphysics was largely still
under the domination of the philosophy of language, and arguments about the nature
of universals tended to go via consideration of predicates, semantics and so on. Armstrong’s rejection of bad old arguments from meaning cut through that tangle like
Alexander’s sword through the Gordian knot, and we were left face to face with the
metaphysical question itself: are there universals, or are there not? Just as in the phe-
nomenological tradition Roman Ingarden had broken away from Husserl’s transcen-
dental anxietizing, so in the analytical tradition Armstrong broke away from Straw-
son’s Aristotelian-Kantian linguistic metaphysics-lite and Quine’s Carnapian insouciance as to ultimates. The idea that metaphysics might regain her status as the Queen
of Philosophy was implanted, and has stayed with me ever since. I owe David a great
intellectual debt for making this clear by living example.

The next time I saw David was in 1990 at Zinal, by which time we and things had both moved on, and this essay is about some of those things. In the meantime I had become a fairly convinced nominalist, but that disagreement aside, we found we had
much in common, not least resembling passions for history: political, military and especially of course naval. Knowing his conservative monarchism did not chime with
my liberal republicanism, I steered clear of contemporary politics, but we had many
heroes in common, notably Winston Churchill. Our most serious disagreement outside
philosophy was over Richard III. While not a full-blooded Ricardian, I had sympathies
with the last Plantagenet, but David considered him an out-and-out villain and murderer,
and the Tudor usurpation fully justified (we both agreed though that Henry Tu-

¹ In what follows, Armstrong’s two major writings dealing with tropes in the theory of universals will be abbreviated as: *NR* for *Nominalism and Realism (Universals and Scientific Realism Volume 1)*; and *U* for *Universals: an Opinionated Introduction*.

dor's granddaughter Elizabeth was England's greatest monarch). It would have been interesting to have had David's reaction to the discovery of Richard's remains in Leicester and their subsequent dignified reinterment. Anyway, on to philosophy.

1 Universals and tropes

5 *Universals and Scientific Realism* appeared in two volumes in 1978. The first volume, *Nominalism and Realism*, is a thoroughgoing critique of all forms of nominalism. The second, *A Theory of Universals*, is Armstrong's constructive alternative: an Aristotelian immanent realism of universals. Unlike nearly all accounts of universals however, Armstrong's is *a posteriori*, in the sense not that arguments for it are *a posteriori* (NR
10 xv), but that it is an *a posteriori*, empirical, largely scientific matter to find out which universals exist (*U87*). That spirit of the *a posteriori* is one which I endorse throughout. Neither language nor thought dictates to us what exists, and that goes for properties and relations as well as anything else. Language and the world have to be in enough
15 harmony for us to be able to speak truly about the latter, but this harmony is going to be extremely imperfect, so that linguistic classification and ontological classification will be considerably skew to one another, to an extent that even Armstrong did not accept. I once asked him whether it concerned him that his fourfold classification of entities into things, properties, relations and states of affairs was not suspiciously parallel to the classification of expressions into names, one- and many-place predicates,
20 and sentences. He was brusquely unamused.

Otherwise however, we are in very close agreement. Just to list some salient metaphysical points on which I see eye to eye with Armstrong, they are: naturalism, mind-body monism, the importance of the theories of universals, the relative impotence of linguistic considerations, and the role of truth-makers both in accounting for truth
25 and in limning ontological commitments.

In 1989 Armstrong published *Universals: An Opinionated Introduction*, a more popular but also updated account of his views, negative and positive. Like *NR*, this contained criticisms of all extant kinds of nominalism. In the meantime however, trope nominalism, of which I was by now a firm advocate,² had emerged as a serious
30 challenger to Armstrong's immanent realism even in his own terms, so that he was prepared to accept both in print and in conversation that trope nominalism was the second best account after his own. I will argue that it is better than that.

In *NR*, Armstrong had not yet adopted the current term **trope** for properties and relations understood as particulars, but I shall employ it throughout, as he then did in
35 *U*. Tropes have had many names, but I shall stick with this one, coined for this purpose by D. C. Williams following a perhaps ironic suggestion by George Santayana.

² Simons 1982; Mulligan, Simons and Smith 1984.

Tropes are particular, localized items that constitute the basis for the many ways in which concrete, substantial individuals may be like or unlike one another. Tropes have a much “thinner” nature than concrete particulars or substances. A snooker ball for example is characterized in many ways: it has such and such a mass, volume, shape, material constitution, colour, and at any time a colour, location, velocity with respect 5 to its surroundings, magnetic and electric charge, and certain distances from other things. It, the snooker ball, is what we may call a substance: its mass, colour etc. are tropes. Suppose it is spherical, red, made of phenolic resin, has a diameter of 5.25 cm and a mass of 142 g, and is currently at 18°C. Assume for now that each of these adjectival phrases picks out a genuine existent characteristic. Whereas a realist like Arm- 10 strong would say that all these characteristics are universal, so shareable and multiply instantiable without detriment to the universals’ identities, a trope nominalist says that each of them is **peculiar** to the ball. Another ball, even if it is exactly like this one in shape, colour, constitution, size and temperature, has its own tropes of shape, colour etc. If the ball changes in any of these respects, whereas Armstrong would say 15 the ball comes to instantiate or exemplify different universals from the same family, a trope nominalist will say that one or more of its tropes ceases to exist in favour of another from the same family.

2 Tropes and substances

Tropes characterize substances (independent individuals) and help to make them how 20 they are. There are two types of accounts as to how tropes relate to their substances, bundle theories and substance-attribute theories. Armstrong prefers the latter (*U* 114 ff.) I prefer the former, because it eliminates one category and one problematic formal relation of inherence or attribution. However, the most common kind of bundle theory, 25 saying that a substance is nothing more than a bundle of tropes, is due to Williams and relies on a relation of *compresence* among tropes to tie the bundle together. If compresence is merely spatiotemporal togetherness, then I think this is wrong, because there is no guarantee that tropes have to be spatiotemporally together to be parts of one and the same substance. In quantum theory, what arrives at a telescope or photographic 30 receptor as a single photon may earlier have been spread as wide as a galaxy, and it has been shown with some plausibility that a trope of a particle such as its magnetic moment may take a different route through experimental apparatus than that taken by other tropes such as the particle’s mass.³ For that reason, and also because in many cases it is important to distinguish a substance’s essential characteristics, without which it would not be the individual it is, from its accidental ones, which it 35 can lose and change, I prefer a double-layered account of bundles, held together by

³ Denkmayr et al. 2014.

formal relations of existential dependence: a tight inner bundle or nucleus of tropes that are mutually dependent and supportive, and a looser outer layer of dispensable tropes that are one-sidedly dependent on the nucleus.⁴

On top of this nuclear bundle account of the simplest individuals one needs to
 5 recognise that very many other substantial individuals are mereologically complex, so that some of their characteristics such as mass are (to a first approximation) the resultants of those of their parts, and others, such as volume, are Gestalt tropes adhering to the complex whole. How this detail plays out in a given case depends very much on what science can tell us, which is a very Armstrongian position.

10 **3 Armstrong’s objections to trope nominalism**

In *NR* Armstrong gives several reasons as to why trope nominalism fails. One is that it fails adequately to account for the resemblance of like tropes, such as the exactly resembling masses of two electrons, or colours and diameters of two snooker balls. Stout had claimed that exactly resembling tropes belong together in a class held together as
 15 a “distributive unity”, a notion which Stout considers fundamental and unanalysable. Armstrong quite rightly rejects this as “a restatement of Stout’s problem rather than a solution of it.” (*NR* 84). It is not clear what such a unity consists in. Clearly an arbitrary class of tropes taken from here and there does not constitute a resemblance class, so we need an account of when a class is a distributive unity, and this Stout does not
 20 have.

The alternative view, due to Williams,⁵ and endorsed by Keith Campbell,⁶ is that it is the resemblance of the tropes one to another that engenders the unity of a class of resembling tropes, and not the other way round. Against this resemblance account, Armstrong has three points. The first is that the nature of resemblance depends on
 25 the nature of the objects that resemble one another, and not the other way around. The second is that resemblance leads to a vicious infinite regress, by an argument made famous by Russell, but anticipated clearly by Husserl and unclearly before him by Mill (cf. *NR* 54 n.) It is that if like tropes are as they are because they resemble one another, then these resemblances are themselves tropes, they must resemble one
 30 another, and so on ad infinitum. The third argument is that it is perfectly possible for a single trope to be of its own sort without there being any other that it resembles, and that the proposed remedy of appealing thomistically to resembling possible but non-actual tropes “is a truly desperate one.” (*NR* 85).

⁴ Simons 1994.

⁵ Williams 1953.

⁶ Campbell 1990.

Finally, Armstrong claims that while it is clear that one and the same particular cannot instantiate a property more than once, the nominalist needs an *ad hoc* principle to block two exactly resembling tropes from inhering in the same substance (NR 86).

In *U*, Armstrong adds a new objection to trope bundle theories. It is that tropes and by extension trope bundles “are not really suited to be the substances of the world” (*U* 114). A mass trope, for example, is very insubstantial, and incapable of independent existence (*U* 115).

By the end of *U*, Armstrong is ready to admit that, in a great many respects, “tropes can fill in for universals.” (*U* 122). Where they fall behind, in his view, is that certain formal properties of resemblance (exact and inexact) are more satisfactorily explained by identity than by resemblance, and so by universals rather than tropes. Let us write ‘ $a \approx_p b$ ’ for ‘ a resembles b to degree p ’, where p is a number in the range $[0,1]$, and the case $p = 1$ is exact resemblance. The formal properties are symmetry and (what I here call) quasi-transitivity:

SYM If $a \approx_p b$, then $b \approx_p a$
 QTRANS If $a \approx_p b$ and $a \approx_1 b$, then $a \approx_p c$

It is Armstrong’s contention that identity of properties accounts for both these more adequately than anything directly to do with resemblance (*U* 103), since trope resemblance nominalism must treat them as a “mere metaphysical coincidence between the properties of resemblance and the properties of identity.” (*U* 137).

All of Armstrong’s objections can be satisfactorily answered.

4 Answers to the objections

Let us be clear that not all versions of trope nominalism can answer Armstrong’s objections easily. Stout’s natural class/distributive unity account cannot. Nor does the fact that Armstrong’s objections can be turned alleviate all pressures on trope nominalism. There are other matters of concern, which we shall mention later. But let us first look at the objections to trope resemblance as an account of what makes tropes as they are.

The first point is that tropes resemble one another because of their natures, they do not have natures because of what they resemble. This is right, but it does not tell against trope nominalism, because a trope is a “thin” particular: it is all nature. Substantial individuals resemble one another in manifold ways, and it is their inherent tropes that account for this. There is nothing more to a trope’s being of this or that kind than that it simply exists. Being the trope it is, it cannot fail to be of that kind. A sphericity trope could not be a cubicity trope, a mass trope of 5 g could not be one

of 10 g: they would just be other tropes, not the same ones with different properties. Hence, if two given tropes exist, their degree of resemblance, wherever it is between 0 (total non-resemblance) and 1 (exact resemblance), supervenes on them. Speaking in truth-maker terms, the two tropes are the joint truth-maker for their specific degree of
 5 resemblance. So if a and b are both tropes, then from the fact that both exist, it follows of necessity that they resemble one another to a certain degree, $a \approx_p b$ for a certain p . From this it follows automatically that trope resemblance of any degree is symmetric, for the truth-maker **a** and **b** just are the same two things as b and a .

Quasi-transitivity cannot be accounted for this simple way. But it is still highly
 10 motivated by the fact that it is *resemblance* that we are considering. Suppose a , b and c are three tropes, that a resembles b to degree p and that b exactly resembles c . The first fact follows from the existence of a and b , the second from the existence of b and c . Given that all of a , b and c exist, naturally both of a and c exist. Could a and c resemble one another to a different degree than a and b do? It appears impossible,
 15 because exact resemblance is precisely what guarantees that in regard to resemblance to third objects, b and c are indiscernible. Another way to put it is to say that quasi-transitivity is analytically contained in the notion of exact resemblance: it is part of what the concept of exact resemblance is there for. This is, I think, hardly an *ad hoc* matter. Its relationship to identity will come up below.

20 The Mill-Husserl-Russell infinite regress argument against trope resemblance is now easily answered. If the mere existence of the terms of a case of exact resemblance suffices for the truth that they resemble one another exactly, then there is no need to invoke an additional entity, a relational trope of resemblance, to account for the resemblance. The resemblance comes automatically, for free, with the terms. With-
 25 out tropes of resemblance, the regress cannot get started. And that is the best way to counter regresses. Another way to put the point is to say that the relation of resemblance (of whatever degree) between two tropes is an internal one. Personally I don't like the terminology of internal relations, since it tends to suggest that there are these items, internal relations. Since truth-making does not require such additional
 30 items, I prefer to say that the two tropes are internally related. For two or more things, being internally related in a certain way is the relational counterpart of having an essential property: they could not exist and not be so. The resemblances among more substantial individuals are not generally internal, since these turn on which tropes the substances have, some of which they may have contingently.

35 The point that a trope may be unique of its kind is well taken, but does not harm our view that resemblance supervenes on tropes: indeed, it is to be expected and welcomed.

Is trope nominalism at a disadvantage vis-à-vis realism in regard to how often a trope of a certain kind may be found in a substance? I think not, for two somewhat
 40 opposed reasons. Firstly, the idea that an individual cannot instantiate the same universal more than once appears to be no less questionable than that it might hold two or more tropes of one kind. The two intuitions appear to be on an even footing. It is

only if tropes are thought of as little thin mini-substances that the idea of their clumping together against the regulations in deviant bundles is at all plausible. But we take tropes not to be arbitrarily recombinable “junior substances” but as dependent moments, whose freedom to wander from one bundle to another is nil and whose freedom to associate is also essentially constrained. Secondly however, the idea of two or 5 more tropes of the same kind cohabiting in the same volume is not so far-fetched as it might appear. The two electrons in an unattached helium atom are not neatly separated into two bundles of tropes, but co-occupy the same region. So there are two mass m_e tropes and two charge $-e$ tropes, in the same place at the same time. True, there are two directionally opposed spin tropes, but no fact of the matter as to which 10 of two electrons has which spin. Electrons are fermions, so two spatially coincident ones must diverge in at least one quantum respect by the Pauli exclusion principle. More extremely, bosons such as photons may occupy the same place at the same time and moreover be in indiscernible quantum states. This happens in lasers. So multiply collocated tropes of a type appear to be commonplace according to fundamental 15 physics. If more than one trope of a kind is not allowed in one bundle, this would entail that such coincident particles are not genuinely distinct individual substances, a view taken by Schrödinger.⁷

Since we do not consider tropes to be substances, or substance-like in general, there is still the question as to how they can clump together so successfully as to constitute regular substances. Here I think it is more a question of getting used to the 20 thought that they do rather than finding any deep metaphysical mystery. The basic constituents of the world are very simple in nature, and thus contain or comprise only a few tropes. Larger individuals are composed of these as parts, and what with their manifold interactions and spatiotemporal relationships, large numbers of these in 25 proximity can plausibly manifest the familiar properties of bulky, substantial things.

5 Some advantages of trope nominalism

Taken together, these responses to Armstrong’s objections at least allow the trope nominalist to breathe more easily. Trope nominalism of the sort outlined also has some genuine advantages over Armstrong’s realism about universals. The principle 30 one is ontological parsimony. All entities are particulars: the categorial division between universals and particulars is avoided. Nor is there a problem of individuation, or particularization, since tropes are particulars from the start. This feature appealed to medieval nominalists such as Ockham. Further, whereas Armstrong needs a third category, that of states of affairs, with which to bind universals and particulars together 35 and to provide the truth-makers for elementary predications, trope nominal-

⁷ Schrödinger 1950.

ists require no such things.⁸ The truth-making role for a great many contingent truths about particular things can safely be assigned to the tropes themselves:⁹ by merely existing, this mass trope of this particle makes it true that the particle has such and such a mass. Since the mass trope cannot exist unless the particle itself exists, of which the trope is a part or in which it inheres, the particle's existence is automatically guaranteed by that of the trope, and the trope's being of this or that kind is given with its mere existence.

The only remaining question is the nature of the relationship between trope and substance, what the medievals called inherence. Here trope nominalism also shows its mettle. A potentially looming regress that it adroitly avoids is the Bradley Regress of instantiation. Unlike realist theories, which must account for the relationship between a universal and the particulars that instantiate it, and tend to tie themselves in knots about it, with foundation or dependence replacing compresence as the glue binding trope bundles we automatically obtain inherence as another case of internal relatedness, in this case one of unilateral or multilateral dependence. This, like resemblance, is a "wireless" relationship, coming for free with the terms as a concomitant of their existence. Like resemblance, it nips the threatening regress in the bud before it can even get started.

Armstrong lays considerable store on explaining resemblance through identity, whether total or partial identity. Some of the aspects of affinity are neutral between a nominalist and a realist point of view. It is very natural to think of identity as a limiting case of resemblance: things resembling one another so closely as to be indiscernible in any respect are identical. This can be encapsulated in the two directions of Leibniz's Law:

25

$$a = b \leftrightarrow \forall F(Fa \leftrightarrow Fb)$$

and may even be construed as a definition of identity. Varieties of resemblance, including the exact resemblance of tropes of a kind, can be viewed as variations on the idea of limited or restricted indiscernibility, with the schema:

30

$$\forall F(\Phi(F) \rightarrow (Fa \leftrightarrow Fb))$$

If the antecedent condition Φ is relaxed so it becomes tautological, we regain identity. This explanation of the relationship is neutral as between nominalism and realism. A more troubled and troubling aspect of Armstrong's affection for partial identity as explicating resemblance is his later adoption in *Truth and Truthmaking* of Baxterism, the idea that the instantiation of universals by particulars consists in partial identity

⁸ Simons 2009.

⁹ Mulligan, Smith and Simons 1984.

of them. But whereas Baxter is a Scotist about partial identity, allowing it to be contingent, Armstrong prefers a Kripkean necessity of partial identity, which threatens to undercut much of the contingency that appears to pervade the world.¹⁰ Since Kripke is right about identity, and the world is replete with contingent things and events, it is better to treat identity as the limiting case of resemblance rather than resemblance as partial identity. Trope nominalists have to do this from the start.

6 Remaining problems for the trope nominalist

It would be disingenuous to claim that trope nominalism is clear of all difficulties simply because it can weather Armstrong's criticisms. No decently worked out position in metaphysics is clear of all difficulties, because metaphysics, when done properly, is fundamental, systematic, coherent,¹¹ and therefore hard. The problem, as Armstrong well recognised, is not one of technical complexity or the need for elaborate formal tools, as in fundamental physics, but of delicately balancing a wealth of competing considerations which are crucially important yet relatively removed from the familiarity of the everyday or the testability of scientific hypotheses. So what problems does trope nominalism still face, and where might Armstrong's realism have the advantage? I shall mention three areas of difficulty: relations, space and time, and laws of nature.

What made it true that the Titanic collided with a certain iceberg on the night of 14 April 1912? Armstrong would say it is a state of affairs. I would say on the contrary that it is the event of their colliding, that specific dated and located occurrence. A collision event requires at least two bodies as participants: it takes two to collide. So a collision depends for its existence (occurrence) on there being two bodies that collide. It thus passes the test for being a trope, but a relational one, that is to say, one dependent on two or more distinct things. This is a good case for there being some tropes that are relational. But relational particulars, unlike this case, and unlike non-relational tropes, cannot in general sensibly be assigned a location, and so their particularity and causal efficacy, hallmarks of the real for a nominalist, are debatable. One prominent trope theorist, Keith Campbell, therefore denies that there are relational tropes, while at the same time upholding the non-reducibility of relational truths.¹² I have some sympathy with this view.¹³ Here is not the place to attempt to resolve the issue.

¹⁰ Simons 2005.

¹¹ Cf. Whitehead 1978, 3: "Coherence' [...] means that the fundamental ideas, in terms of which the scheme is developed, presuppose each other so that in isolation they are meaningless." This is perhaps the hardest desideratum to fulfil.

¹² Campbell 1990, ch. 5.

¹³ Simons 2010.

Let me simply mention that one kind of relations, namely spatiotemporal ones (more below) was cited by Russell as evidence in favour of Platonic realism about universals. Given that Edinburgh is north of London, where is the north of bit? Russell's plausible answer is "nowhere and nowhen".¹⁴ So if there are relational universals, some of them
 5 at least appear not to be immanent in their terms in the way that non-relational universals are, and that is a prima facie problem for an Aristotelian realist of Armstrong's stripe.

Since the time of Leibniz's and Clarke's famous exchange, it has been debated whether space and time (or their unitary descendant, spacetime) are substantial or
 10 relational, Clarke following Newton and taking the former point of view, Leibniz the latter. It would not be anti-nominalist to suppose that spacetime were a single large and substantial particular, the ultimate bearer of all tropes.¹⁵ Whether that is correct or not is another matter.

My own lightly held preference has always been for Leibniz and relationism. At
 15 one time it seemed that the possible existence of spatiotemporal vacua would be a counterargument, but in the light of quantum field theory it now seems that vacua after all do not exist: all parts of spacetime are host to *something*, most likely processes rather than enduring continuants. But relationism makes spatiotemporal relations among the occupants the primary feature, and as we have seen, for a tropist
 20 relations are not straightforward. Suppose the mug and pen on my desk are currently 10 cm apart at their closest points. What makes this true? A realist about universals would say the closest parts instantiate the relation *being 10 cm from*, as do untold many other pairs of things, so the state of affairs of the mug's being 10 cm from the pen is the unproblematic truth-maker. The status of the relation is similar to that of
 25 other universals. A trope nominalist on the other hand is put in the awkward position of considering whether there is a relational trope of the kind *being 10 cm from*. Unlike non-relational tropes, these cannot plausibly be located with their bearers. They are like Russell's *north of*, and even more embarrassingly than for an immanent realist, nominalists by their profession generally expect everything to have a spatiotemporal
 30 location, which in this case would seem absurd.

There is some relief available. Events, processes and other temporally extended items differ from enduring continuants like bodies as regards their location. Where a body is at a given time is a contingent matter. The mug is 10 cm from the pen, but they need not have been. By contrast, events etc. appear to occur essentially where
 35 and when they do. The *Titanic* might have collided with another iceberg, or with the same one at a different place or time, but the actual collision could not have taken place anywhere or anywhen else than where and when it in fact did. If this is right, then the spatiotemporal relationships between pairs of events are internal. Given the

¹⁴ Russell 1911, 56.

¹⁵ Campbell 1990, ch. 6 advocates this.

occurrence of the events, how they are related spatiotemporally comes automatically for free, and does not call out for a species of spatiotemporal trope truth-makers. That does not absolve us of the responsibility to explain how continuants happen to be where they are when, but it shifts the problem to that of explaining how continuants are ontologically related to the events and processes that (in a process ontology) constitute them.¹⁶ If we adopt a process ontology, as I think we should anyway, then the framework of space and time and the manifold relationships in them can be incorporated in a trope nominalist picture. But while this avoids the need for relational tropes as special truth-makers for facts of distance, angle, curvature etc., it does not tell us what such relationships *consist in*, indeed it precisely ducks that question, and I confess that for now I am stumped on how to proceed in addressing it.

In *What is a Law of Nature?* Armstrong proposed that laws consist in relationships of necessitation and probabilization among universals. This account is obviously unavailable to a trope nominalist, so it counts as an advantage of Armstrong's view that he at least has a positive theory of laws of nature, whether or not it is correct. A trope nominalist has to look elsewhere. One obvious solution would be to resort to a Humean regularity account of laws, but this has well known problems. Even if the laws of nature are not immutable, but can vary with conditions,¹⁷ the fact remains that in the universe we can observe, things behave with extreme regularity, and that cries out for an explanation, one which the trope nominalist is at a disadvantage to give.

7 Conclusion

Trope nominalism, of the sparse, *a posteriori* type, combined with a dependence-based bundle theory of more substantial particulars, a process ontology, a non-maximalist truth-maker theory (not here discussed),¹⁸ and a parsimonious account of internal relatedness, is a serious contender for a comprehensive metaphysics to rival Armstrong's immanent realism. It survives his criticisms, it has some advantages and a few disadvantages with respect to his position. It needs more work, but then so does any metaphysics. The ultimate aspiration of the metaphysician, a comprehensive and coherent system, is one towards which David Armstrong worked all his life, and unlike most metaphysicians, he lived to achieve it.

¹⁶ See Simons 2000a.

¹⁷ As advocated in Unger and Smolin 2015.

¹⁸ Cf. Simons 2000b, 2005.

References

- Armstrong, D. M. 1978. *Universals and Scientific Realism, Vol. 1, Nominalism and Realism*. Cambridge: Cambridge University Press. (NR)
- Armstrong, D. M. 1983. *What is a Law of Nature?* Cambridge: Cambridge University Press.
- 5 Armstrong, D. M. 1989. *Universals. An Opinionated Introduction*. Boulder: Westview. (U)
- Armstrong, D. M. 2004. *Truth and Truthmakers*. Cambridge: Cambridge University Press.
- 10 Campbell, K. 1990. *Abstract Particulars*. Oxford: Blackwell.
- Denkmayr, T. et al. 2014. "Observation of a quantum Cheshire Cat in a matter-wave interferometer experiment". *Nature Communications*, 5, 4492.
- Mulligan, K., Simons, P. M., Smith, B. 1984. "Truth-Makers". *Philosophy and Phenomenological Research*, 44, 287–322.
- 15 Russell, B. 1912. *The Problems of Philosophy*. London: Home University Library.
- Schrödinger, E. 1950. "What is an Elementary Particle?". *Endeavour*, 9, 109–16.
- Simons, P. M. 1982. "Moments as Truth-Makers". In W. Leinfellner and J. C. Schank (eds.), *Language and Ontology*. Vienna: Hölder-Pichler-Tempsky, 1982, 159–61.
- Simons, P. M. 1994. "Particulars in Particular Clothing. Three Trope Theories of Substance". *Philosophy and Phenomenological Research*, 54, 553–76.
- 20 Simons, P. M. 2000a. "Continuants and Occurrents". *The Aristotelian Society*, Supplementary Volume LXXIV, 78–101.
- Simons, P. M. 2000b. "Truth-Maker Optimalism". *Logique et analyse*, 169–170, 17–41.
- Simons, P. M. 2005. "Negatives, Numbers and Necessity: Some Worries about Armstrong's Version of Truthmaking". *Australasian Journal of Philosophy*, 83, 253–261.
- 25 Simons, P. M. 2009. "Why there are no States of Affairs". In M. E. Reicher, ed., *States of Affairs*. Frankfurt/Main: Ontos, 111–28.
- Simons, P. M. 2010. "Relations and Truthmaking". *The Aristotelian Society*, Supplementary Volume LXXXIV, 199–213.
- 30 Unger, R. M., Smolin, L. 2015. *The Singular Universe and the Reality of Time*. Cambridge: Cambridge University Press.
- Whitehead, A. N. 1978. *Process and Reality*. Corrected edition. New York: The Free Press.
- Williams, D. C. 1953. "The Elements of Being". *Review of Metaphysics*, 7, 3–18, 171–92.