UNINSTANTIATED PROPERTIES AND SEMI-PLATONIST ARISTOTELIANISM

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Properties have been supposed to exist for several compelling reasons.[1]

They solve the problem of "the one over many": how different individuals can, objectively, resemble one another in some respect, such as color. Two pens may be of exactly the same shade of red, or two electrons may be of exactly the same mass. That is explained by there being something, a universal, that is exactly the same and wholly present in both particulars. It is not just a matter of falling under the same concept: two objects could both be truly "not green" without there being a universal "not-green". Only where there is a genuine shared reality is there a universal in common.[2]

Admitting the reality of properties allows direct and literal talk about them, as seems to be needed to make sense of statements like *"Red resembles orange more than blue."*[3] That is a statement about *colors*, not about the particular things that have the colors – or if it is about the things, it is only about them *in respect of their color*: red things resemble orange things but not blue things in respect of their color. There is no way to avoid reference to the colors themselves.

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[1] Introductions to realist views on universals in Chris Swoyer and Francesco Orilia, "Properties," *Stanford Encyclopedia of Philosophy* (1999, revised 2011), http://plato.stanford.edu/entries/properties/; James Porter Moreland, *Universals* (Chesham: Acumen, 2001), ch. 1; David M. Armstrong, *Sketch for a Systematic Metaphysics* (Oxford: Clarendon, 2010), ch. 2.

[2] Michael Tooley, *Causation: A Realist Approach* (Oxford: Clarendon, 1987), 8-9.

[3] Arthur Pap, "Nominalism, empiricism and universals: I," *Philosophical Quarterly* 9 (1959), 330-40; discussion in Tooley, *Causation,* 10-13.

And in science we quantify over properties (again in ways very hard to paraphrase away) when we say, for example, "No acquired characteristics are inherited" or "Arguments from analogy involve the inference that individuals sharing some properties are likely to share others." Scientific laws are typically expressed as relations between properties, such as the proportionality of gravitational force to mass. Philosophy too often speaks, it seems literally, of a complex realm of first-order and higher-order properties and relations and the relations among those, such as the range of determinates of a determinable.[4]

It was once common to postulate properties also for semantic reasons, to provide person-independent meanings for words. That would make the existence of properties subject to human acts and would result in a huge number of them, as any increase in vocabulary would create more. That is contrary to the sparse conception of properties that arises from a scientific perspective, and for that reason arguments for properties that begin with language have receded into the background. On the other hand, language is part of nature and intended to convey knowledge about nature, so it could still be speculated that, for the example, the subject-predicate structure of basic sentences is useful for communication because it reflects the particular-property structure of reality.

Nominalism denies the reality of properties, holding that they are merely words, or concepts, or classes. Arguments against it are well-developed and will not be repeated here.[5]

Once the reality of properties is admitted, there are two fundamentally different realist theories of properties. *Platonist* or *transcendent* realism holds that properties are abstract objects in the (post-Fregeanly) classical sense, of being non-mental, non-spatial and causally inefficacious.[6] For present purposes, the Platonism meant is the "extreme" or "full-blooded" Platonism normally discussed in the philosophy of mathematics,[7]

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[4] Stephanie Gibbons and Catherine Legg, "Higher-order one-many problems in Plato's *Philebus* and recent Australian metaphysics," *Australasian Journal of Philosophy* 91 (2013), 119-38.

[5] Arguments against various forms of nominalism are given in D.avid M. Armstrong, *Universals and Scientific Realism* (Cambridge: Cambridge University Press, 1978), vol. 1 chs 2-5.

[6] Gideon Rosen, "Abstract objects," *Stanford Encyclopedia of Philosophy* (2012), http://plato.stanford.edu/entries/abstract-objects/

[7] Variously called "objects Platonism" (Geoffrey Hellman, *Mathematics Without Numbers*, Oxford: Oxford University Press, 1989, 3), "standard Platonism" (Colin Cheyne & Charles R. Pigden, "Pythagorean powers," *Australasian Journal of Philosophy*, 74 (1996), 639-45); "full-blooded Platonism" (Mark Balaguer, *Platonism and Anti-Platonism in Mathematics,* Oxford: Oxford University Press, 1998, 3, 5; Greg Restall, "Just what is full-blooded Platonism?," *Philosophia Mathematica* 11 (2003), 82-91); "ontological Platonism" (Mark Steiner, "Platonism and the causal theory of knowledge," *Journal of Philosophy* 70 (1973), 57-66), "traditional Platonism" (Penelope Maddy, *Realism in Mathematics*, Oxford:

according to which Platonic Forms are strictly denizens of an acausal and abstract world outside of space and time. (Plato's own Platonism may have been more nuanced.) We could know about that world, if at all, only by some kind of inference to the best explanation or by a non-perceptual intellectual faculty.[8] Arguments against Platonism have had over two millennia to mature and are also well-developed.[9]

By contrast, *Aristotelian* or *moderate* realism takes properties to be literally instantiated in things (physical particulars or whatever other particular things may exist). An apple's color and shape are as real and physical as the apple itself.

The most direct reason for taking an Aristotelian realist view of properties is that we perceive them. We perceive an individual apple, but only *as* a certain shape, color and weight, because it is those properties of it that confer on it the power to affect our senses. It is in virtue of being blue that a body reflects certain light and looks blue. Since "causality is the mark of being", the properties that confer causal power are real. And that means a reality, not in a Platonic and acausal world of "abstract objects", but in the ordinary concrete world in which we live.[10]

On an Aristotelian view, it is the business of science to determine which properties there are and to classify and understand the properties we perceive (and those which we infer to explain what we perceive), and to find the laws connecting them.[11]

1.

Uninstantiated properties? Of the many puzzles raised by admitting the reality of properties, a particularly intractable yet important one is the status of uninstantiated properties – those properties that could be instantiated, but happen not to be.[12] For the

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Oxford University Press, 1992, 21).

[8] Mark Colyvan, *The Indispensability of Mathematics* (Oxford: Oxford University Press, 2001), ch. 3; Øystein Linnebo, "Platonism in the philosophy of mathematics," *Stanford Encyclopedia of Philosophy* (2009, revised 2011).

[9] Armstrong, *Universals and Scientific Realism,* vol. 1 ch. 7.

[10] This argument is denied in Marcus Giaquinto, "Russell on knowledge of universals by acquaintance," *Philosophy* 87 (2012), 497-508, on the grounds that it would imply that if we feel a table whose roughness is identical to that of Abraham Lincoln's table, we have felt the roughness of Lincoln's table without having felt that table. But the point of universals is that they are multiply instantiated: type-identical roughnesses confer the type-identical causal powers on different particulars, which lead to type-identical perceptions, but of the roughnesses of different objects.

[11] David M. Armstrong, *What is a Law of Nature?* (Cambridge: Cambridge University Press, 1983).

[12] Swoyer and Orilia, "Properties," section 5.

Platonist, they are not a problem: since properties are abstract and pre-exist the physical world in any case, uninstantiated properties are the typical case, and the problem rather is to explain the relation that such distant beings could have to the physical world and to human knowledge. But for Aristotelian realists, who start from instantiated and perceived properties, uninstantiated properties are a serious problem. Should they be granted any sort of reality, or not?

The problem is urgent because science appears to speak freely of very many uninstantiated properties. Contemporary chemistry, in particular, with its focus on design of new compounds, is very interested in the properties of possible compounds that do not and may never exist. The 1700 articles that have so far appeared in the *Journal of Computer-Aided Molecular Design* discuss compounds that may or may not ever be synthesized, while much of the initial research into possible new drugs aims to find those that are suboptimal so as not to waste time on making them.[13]

And mathematics is even more concerned with the uninstantiated, since mathematics regularly advances truths or alleged truths about huge finite and infinite sets and numbers, which are possibly not realized in the physical world and perhaps cannot be realized due to physical limitations. That has often been taken to favor Platonism and to rule out an Aristotelian realist philosophy of mathematics, which would hold that the objects of mathematics – such properties as symmetry, continuity and order – are realized in the physical world, so that mathematics is a science of aspects of the world, as much as biology is.[14] The principal objection to that thesis is, "Some of the objects of mathematics are *not* realized in the physical world, such as large infinite numbers." It may be that the world is finite, in which case infinite numbers and very large lengths are not instantiated in the real world. Even more so the higher infinities: "set theory is committed to the existence of infinite sets that are so huge that they simply dwarf garden variety infinite sets, like the set of all the natural numbers. There is just no plausible way to interpret this talk of gigantic infinite sets as being about physical objects."[15] Or as Stewart Shapiro writes,

[13] Richard B. Silverman and Mark W. Holladay, *The Organic Chemistry of Drug Design and Drug Action* (3rd ed, San Diego: Academic Press, 2014), section 1.3; see also Evan H. Appelman, "Nonexistent compounds: two case histories," *Accounts of Chemical Research* 6 (4) (1973), 113-7. In biology see George M. Church and Edward Regis, *Regenesis: How synthetic biology will reinvent nature and ourselves* (New York: Basic Books, 2012).

[14] Defended in James Franklin, *An Aristotelian Realist Philosophy of Mathematics: Mathematics as the Science of Quantity and Structure* (Basingstoke: Palgrave Macmillan, 2014); Andrew D. Irvine, ed, *Physicalism in the Philosophy of Mathematics* (Dordrecht: Kluwer, 1990).

> It seems reasonable to insist that there is *some* limit to the size of the physical universe. If so, then any branch of mathematics that requires an ontology larger than that of the physical universe must leave the realm of physical objects if these branches are not to be doomed to vacuity. Even with arithmetic, it is counterintuitive for an account of mathematics to be held hostage to the size of the physical universe.[16]

What account could an Aristotelian realist account of properties give of mathematical truths about that vast realm of (probably) unrealized quantities?

The problem of uninstantiated properties needs very careful treatment. It will be argued that Aristotelian realism does have an answer to the problem, but it requires a "semi-Platonist" Aristotelianism which makes some concessions to Platonism. The resulting theory is, however, very far from standard Platonism and cannot be reconciled with it.

2.

A tension: this-worldly and contingent, or semi-Platonist? The reasons advanced above for admitting properties contain a tension, difficult to reconcile, between those which suggest a minimalist, this-worldly, instantiated, sparse and contingent view of properties, and those that point to an opposite, maximalist, near-Platonist conception.[17] In particular, if one relies on the "causal power" argument from perception of properties, then since uninstantiated properties *ex hypothesi* have no effect, is hard to see why they should be believed to be real.[18] For (putative) particulars, if we fail to observe any causal effect of them, we conclude they do not exist; why not the same for properties? From this point of view, properties should be few in number and should be contingent beings, their existence established with difficulty by empirical science.

On the other hand, part of the point of properties is to open our eyes to a world of objective, apparently necessary truths that can go beyond the immediate physical world

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[15] Mark Balaguer, "Fictionalism in the philosophy of mathematics," *Stanford Encyclopedia of Philosophy* (1999, revised 2011), http://plato.stanford.edu/entries/fictionalism-mathematics/

[16] Stewart Shapiro, *Philosophy of Mathematics: Structure and ontology* (Oxford: Oxford University Press, 1997), 86.

[17] The distinction between these two paths laid out in Chris Swoyer, "Theories of properties: from plenitude to paucity," *Noûs* 30 (Supplement: *Philosophical Perspectives* 10) (1996), 243-64.

[18] David M. Armstrong, *A World of States of Affairs* (Cambridge University Press, Cambridge, 1997), 41-3.

(even if they are partially realized in it). The betweenness relations between colors seem to be necessary – surely there is no possible world in which orange is between blue and green? – and the fact of those relations seems capable of surviving the destruction of some, perhaps all, colored things. Consider this thought experiment: all colored things fade to a shade of grey – after a certain time everything is grey. Now suppose that the history of the universe up to that time is deleted. So at no time does there exist anything but grey. Are the betweenness relations between (non-grey) colors still necessary truths in that universe? It seems that they are, since that universe differs from ours only by a succession of contingent events, which should be incapable of changing relations between universals. If we run the thought experiment in reverse, from the grey world to ours, the true counterfactuals about color betweenness would stand ready to be instantiated (and only in one possible way) as things became colored. Similarly with ratios. Even if the world is in fact finite and very large ratios of lengths are not instantiated, it seems that three times *any* ratio would lie between two and four times that ratio. We seem to be dealing with a realm that is, as Plato said, "always one and the same, admitting neither of generation nor destruction".[19] What is the truthmaker, or *fundamentum in re*, of those counterfactuals? A minimalist Aristotelianism[20] such as that of Armstrong, which admits only instantiated, contingent properties, will have difficulty answering that question. (We will look at Armstrong's attempted answer later.)

The tension is visible too in considerations about infinite cardinals, suggesting that while the natural instinct to adopt a fully Platonist account of those massive entities should be resisted, so should the opposite extreme of taking all mathematical properties to be instantiated. It would be too swift to demand, as Platonists do: "Even if the Aristotelian could give an account of small number, ratios etc, how could he deal with the huge and uninstantiated ones?" Compare someone who responded to the claim "Perception gives knowledge" with the objection "Even if perception gives knowledge about some things, how could it explain knowledge of the unobserved?" A fair question, but let us stop and smell the roses first. Small finite structures have plenty to keep the mathematician occupied, and the body of knowledge about them is extensive. If it were admitted that those truths were literally true of mundane reality, then there would be a large body of Aristotelian mathematical knowledge, in no need of Platonist

[19] Plato, *Philebus* 15b2-4.
[20] In the language of Swoyer and Orilia, section 5.

reinterpretation. If then the world did expand so that the boundary between the instantiated and the uninstantiated blew out infinitely, perhaps to the higher infinities, most of mathematical knowledge might be literally true of the (non-abstract) world. Nevertheless, as things stand, many mathematical properties – such as infinite cardinals – could be instantiated but probably aren't, although there are true facts about them. That pushes Aristotelian realism in a maximalist direction, without driving it to full-fledged Platonism.

A semi-Platonist version of Aristotelianism can thus make sense of two conflicting intuitions about the objectivity of mathematics, which create difficulties for other theories. On the one hand, its Aristotelian aspect allows it to connect the objectivity of mathematics with the usual objectivity of science arising from perception and measurement: a mathematical property such as the symmetry of a physical object, for example, can be perceived (even by animals as simple as bees[21]), quantities can be counted and measured, the ratio of your height to mine can be estimated "by eye" if we stand next to each other.[22] That is because symmetry and quantitative properties like length are genuinely instantiated in reality and can cause perceptual and measurable knowledge of themselves in the ordinary way of science. On the other hand, pure mathematics is rightly felt to cantilever our knowledge out beyond perceptible reality, and to give us insight into realms of necessities that may well not be instantiated in the actual world. As Armstrong puts it, "in mathematics, we gain knowledge of entities which are merely possible, and indeed, perhaps nomically impossible … there can be no question of establishing these conclusions *a posteriori* … Mathematical 'existence', then, is the possibility of actual existence."[23]

Those opposing sources of mathematical objectivity must be compatible despite their apparent tension, since sometimes it happens that pure mathematics discovers structures whose applicability is unsuspected, followed by scientists' discovery that those very structures describe some aspect of reality. (Einstein's use of esoteric aspects of differential geometry in general relativity is one of many celebrated cases.[24]) Semi-Platonist Aristotelianism explains the metaphysics underlying these different aspects of

[21] Martin Giurfa, Birgit Eichmann and Randolf Menzel, "Symmetry perception in an insect," *Nature,* 382 (1996), 458-61.
[22] Franklin, *An Aristotelian Realist Philosophy of Mathematics*, introduction.
[23] Armstrong, *Combinatorial Theory of Possibility,* 126.
[24] Abraham Pais, *Subtle Is the Lord: The science and the life of Albert Einstein* (Oxford: Oxford University Press, 1982), 210-213.

the objectivity of mathematics. The same mathematical properties may be instantiated (hence perceptible and measurable) or uninstantiated and merely possible (hence accessible, if at all, by some other, more purely intellectual, method).

Furthermore, as the physical world expands, mathematical necessities constrain what is possible. Although "constrain" cannot be read strictly causally, as if theorems can literally exert force on physical things to behave in certain ways, the "constraints" have visible consequences or "make a difference" in the world of causes, in such a way as to call in question the minimalist's earlier contention that uninstantiated properties have no causal effect. For example, the mathematical theorem that there is no continuous function from the circle to the real numbers that is increasing all the way round the circle means that it is impossible to build a spiral staircase that goes up all the way round and comes back to where it started – at any point, it may go up, but not at all points.[25] The famous Escher drawings that appear to show such things happening are impossible to realize, and no change in the laws of nature would make them possible. The physical, causal world is constrained by the mathematical world. If "causality is the mark of being", power over the causal realm should also be a mark of being. The close link between uninstantiated properties and what can happen in physical reality again suggests a maximalist, semi-Platonist but not fully Platonist view of the uninstantiated.

3.

Determinables and determinates: extrapolating reality A way in to the realm of properties beyond the here and now is provided by the theory of determinables and determinates. The normal reason we know about uninstantiated universals such as huge numbers is that they occur in structured ranges of universals called *determinables*. Color is a determinable, while an exact shade of color such as Cambridge Blue is a *determinate* – a precise way of being a color, among the wide range of possible ways of being a color. ("Blue" is thus a range of determinate colors – color partly but not fully determined.) Similarly with quantities: length is a determinable, 1.57 metres a determinate length.

The way in which determinables are divided into determinates is unlike the way in which classification works via genus and differentia. While (in the traditional example)

[25] James Franklin, Global and local, *Mathematical Intelligencer* 36 (4) (Dec 2014), 4-9.

humans are of the genus animal with the differentia of rationality added, Cambridge Blue is not color with some differentia added (other than Cambridge Blue itself). It is just one of the different ways of being colored.[26]

While it is possible that a determinable should divide into a discrete mass of unrelated determinates – the space of smells has something of that character, though not exactly – in the most important cases such as color and quantity, the determinates are subject to continuous variation. Colors resemble closely or not, and between two colors there is a range of intermediate colors.[27] Similarly for lengths. To all appearances, ranges of colors and lengths are infinitely divisible, although it is for empirical science to say if the appearance corresponds exactly to reality.

Facts about the relations between the determinates of a determinable, such as the betweenness relations holding among the colors or among the ratios in which lengths stand, appear to be necessary. Surely there is no possible world in which a given shade of blue is between scarlet and vermilion, or in which A is twice the length of B, B twice the length of C and A three times the length of C? (It is much harder to say if the nomic connections between properties, such as the proportionality of gravity to mass, are necessary in such a strong sense, or "empirically necessary", whatever that might mean, or contingent.[28])

It would be possible in principle for our perception to register some individual determinates without noticing that they formed instances of the range of a determinable. That is not what actually happens. Our sense organs respond continuously, and no doubt imprecisely, to ranges of colors and lengths, and we recognize the variation explicitly, and that it is variation within a single determinable. As a result, we have an ability to interpolate and extrapolate, to imagine colors and lengths close to but distinct from those experienced. That gives us *prima facie* reason to believe in the reality, in some sense, of colors and lengths other than those we have directly experienced.

That is the epistemology. What of the ontology? To be specific, if some shade of blue were uninstantiated, it would still lie between whatever other shades it does lie

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[26] William Ernest Johnson, *Logic,* Part I (Cambridge: Cambridge University Press, 1921), ch. 11; survey in David H. Sanford, "Determinates vs determinables," *Stanford Encyclopedia of Philosophy* (2002, revised 2011), http://plato.stanford.edu/entries/determinate-determinables/.

[27] The structure of the space of colors surveyed in Jonathan Cohen, "On the structural properties of the colours," *Australasian Journal of Philosophy* 81 (2003), 78-95.

[28] Armstrong, *A World of States of Affairs,* 257-62; Vlastimil Vohánka, "Are standard lawlike propositions metaphysically necessary? Hildebrand vs. Groarke," *Studia Neoaristotelica* 11 (1) (2014), 89-133.

between.[29] It could "make a difference", for example in creating a perceived jump in a smoothly-varying perceived range of blues. What exactly is the Aristotelian account of the reality (if any) of a shade of blue that happens never to have been instantiated?

Brent Mundy argues for the reality of uninstantiated universals by asking how a general theory of quantity relates to empirical evidence about quantities. A nominalist theory faces the problem that standard postulates of the theory of (extensive) quantity such as that the sum of two quantities is a quantity are literally false (for example, if mass means, operationally, measurement in a balance, then two large enough masses may be too large to fit together in a balance, though they do fit individually). That problem is shared by an Aristotelian realism that admits only instantiated quantities: the sum of two instantiated lengths and the average of two shades of blue may not be instantiated. Mundy suggests that for *a posteriori* realism – one which takes it as a matter for science to determine which universals there are – the empirical evidence supports the reality of the determinable as such rather than of the arbitrary collection of those determinates that happen to be instantiated. On grounds of theoretical simplicity, length-in-general is the theoretical entity that makes sense of the empirical evidence, not lengths-in-the-happenstancedly-instantiated-range.[30] To restrict lengths or colors to the instantiated range would be a "simplification" analogous to supposing that only observed bodies exist – it fails to posit the natural range of which the data happen to be a sample. One expects the science of color to be able to deal with any uninstantiated shades of blue that there may be on a par with instantiated shades – of course direct experimental evidence can only be of instantiated shades, but science consists not just of heaps of experimental data but of inference from experiment, so extrapolation (or interpolation) arguments are possible to "fill in" gaps between experimental results. That is in principle no different from using interpolation to estimate the orbit of a planet between observations.

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[29] Hume's example of the "missing shade of blue" (*Treatise of Human Nature,* ed. L.A. Selby-Bigge, 2nd ed revised, Oxford: Clarendon Press, 1975, 6) concerns epistemology (how can our imagination fill in an unexperienced shade of blue which lies between two experienced ones?), but the example is adapted here to ontology.

[30] Brent Mundy, "The metaphysics of quantity," *Philosophical Studies* 51 (1987), 29-54; Mundy calls his position "naturalistic Platonism", but it is identical to the Aristotelian realism with uninstantiated universals that is defended here. It resembles Tooley's "factual Platonic realism" (*Causation,* 119). This is not the same position as "naturalized Platonism", which holds that a naturalized epistemology can allow for knowledge of abstract objects: Mark Balaguer, "Against (Maddian) naturalized Platonism," *Philosophia Mathematica* 2 (1994), 97-108; Bernard Linsky and Edward N. Zalta, "Naturalized Platonism versus Platonized naturalism," *Journal of Philosophy* 92 (1995), 525-555.

Similarly, Brian Ellis points out that laws of nature typically do not connect individual values of "dimensions" or "generic universals", such as mass, but the dimensions themselves. They express "concomitant variation", in Mill's phrase, or "generic relations between the quantitative properties of things", that is, relations between *ranges* of, for example, depth and pressure, or distance and gravitational force, or reflected wavelength and perceived color. So science suggests that it is the determinable rather than the determinates or values that are ontologically prior, since laws connect determinables in the first instance.[31]

The fact that laws typically connect ranges of determinables raises a further problem for minimalist Aristotelianism. That theory makes much of the causal powers of properties as evidence for their existence. It regards laws of nature as connections between properties, that being a prime argument against the Humean regularity theory of laws: the ability of a law, unlike a mere regularity, to support a counterfactual such as "If a new planet were at a certain distance from the sun, it would experience a certain gravitational force" is a reason for favoring a property-connection view of laws. But that means the law itself must have an ability to "project" into the non-existent, or realm of pure possibles, which on a minimalist Aristotelian view it seems not to have. For it seems that if enough values of the determinable ceased to exist, the law itself would go out of existence.[32] If the world consisted of two atoms at a fixed distance, exerting the usual gravitational force on each other, then (on a minimalist Aristotelian view), Newton's law of gravity would not exist in that world and the actual gravitational force would not be an instance of it, as there is no range of values for the law to connect. If there is any gravitational law in that world, it can only connect properties that actually hold in that world: it could at most hold "Any two atoms at that exact distance would exert that exact force." Hence there would be no counterfactuals supported by that law, such as what forces would obtain if there were more atoms or variable distances. That seems counterintuitive, as the proposed world is just a sample of the possible instances of Newton's law.

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[31] Brian Ellis, "The categorical dimensions of the causal powers," in Alexander Bird, Brian D. Ellis and Howard Sankey, eds, *Properties, Powers and Structures: Issues in the metaphysics of realism* (New York: Routledge, 2012), 11-26, section 3.

[32] Swoyer and Orilia, "Properties," section 5.1.2. Similar problems with uninstantiated laws that nevertheless appear to be true are raised in Tooley, *Causation*, 113-20.

Thus, the lack of instantiation of some – even many – determinate values of a determinable does not tell against the reality of the determinable in general.

It is the same with mathematical structures such as the continuum, Euclidean geometry or infinite numbers and idealizations such as perfect spheres. Those can be described as (possibly) uninstantiated structures or as (merely) possible structures, but in either case they are complex forms which *could* be instantiated in reality – forms about which there can be necessary knowledge. They differ from the Forms of classical Platonism which necessarily lie beyond mundane reality and cannot be literally instantiated in it. Aristotelian forms *can* be instantiated, but it is for the contingencies of historical reality (or the will of God, or whatever decides such matters) to determine which are in fact instantiated.

4.

Possibles by recombination? We return to the problem of whether a minimalist, this-worldly Aristotelian realism can provide truthmakers for the objective truths about uninstantiated properties, such as the truth that three times any ratio lies between two and four times that ratio. Because of the tendency of quantity to apply across vast ranges of size, it is particularly difficult to make sense of quantity in terms of an Aristotelian realism that does not in some way admit uninstantiated universals. The challenge is to explain the truthmakers of truths about the world beyond physical actuality, in terms of facts strictly about the instantiated properties (and particulars).

Minimalist Aristotelians such as Armstrong argue that admitting uninstantiated universals in any way at all would be excessively Platonist, as acknowledging a realm of Forms beyond the real world, ungrounded in any true reality.[33] They must say, then, that lengths greater than the diameter of the universe or uninstantiated shades of blue are mere possibilities. The difficulty for that suggestion is that "merely" possible lengths appear themselves to stand in ratios to each other, in ways correctly described by mathematics, and an uninstantiated shade of blue appears to lie between two determinate instantiated ones. The "mere" possibilities thus themselves form a Platonic-like world of forms,

[33] David M. Armstrong, *Universals: An opinionated introduction* (Boulder, CO: Westview Press, 1989), 75-82.

complex in structure, the truths of which have no apparent truthmaker. Our knowledge of ratios, such as that three times a length lies between two and four times that length, applies to lengths beyond the diameter of the universe. Those truths stand ready to be, so to speak, clothed in reality if the universe expands.

One might initially hope to rely on modal logic, with contingent, instantiated properties taking the causal load and the modal tasks being left to logic. But that seems hopeless in the cases at hand, since the necessities of the betweenness relations among colors or ratios appear to be in no way logical. While there is no consensus as to where the boundary between logic and non-logic lies, betweenness relations are far from that boundary, on the non-logical side.

The most determined attempt to meet the challenge of reducing truths of possibility to actualities is the combinatorial theory of possibility of David Armstrong. Armstrong holds that possibilities are recombinations of actual elements in the world – there being a unicorn is possible because it is a recombination of parts of actually existing entities. That is intended as a reductive account of possibility: there is no appeal to other concepts of possibility, such as those of modal logic.

In this theory, combination is to allow addition and deletion of actually existing particulars (though not addition of universals): "Combination is to be understood widely. It includes the notion of expansion (perhaps 'repetition' is a less misleading term) and also contraction."[34] Individuals are to be allowed to clone themselves indefinitely, indeed infinitely often, to create new possibilities.

The difficulty is that the possibility of very large or infinite numbers is then built into the theory, or presupposed by it, rather than analyzed by it. Why are numbers larger than those instantiated in the universe possible? Because the actual individuals in the universe are subject to "indefinite multiplication".[35] (Similarly, the possibility of a length greater than the diameter of the universe is grounded in the possibility of replication of actual individuals to give a body of greater total length: an uninstantiated quantity is "combinatorially accessible from actual" quantities.[36]) But what is the ground of the possibility of indefinite replication of individuals itself? The theory does not say. Instead

[34] David M. Armstrong, *A Combinatorial Theory of Possibility* (Cambridge: Cambridge University Press, 1989), 37.
[35] Armstrong, *Combinatorial Theory*, 125.
[36] Armstrong, *Combinatorial Theory*, 56.

it has to assume that possibility in order to get started.[37] What, for example, is the ground of the possibility of some particular infinite cardinal? It is the possibility that actual individuals should be infinitely replicated at least that many times (a possibility normally regarded as controversial, in view of traditional Aristotelian doubts about actual infinities). That may indeed be the ground, but the combinatorial theory of possibility has not given an analysis of that possibility, only an assertion of it. So the combinatorial theory is not a complete account of possibility. In particular it has not given, as it claimed to do, a reductive analysis of uninstantiated universals in terms of instantiated ones.

That is not the only problem for the recombination theory of possibility. For a start, an uninstantiated shade of blue may be an average of instantiated shades, but an average is not a recombination of existing entities, whether particulars or properties. More importantly, the recombination theory relies on two substantial metaphysical theses about possibility, which call in question its status as a complete, reductive, theory of possibility (as is needed if it is to accomplish the task of providing this-world truthmakers for counterfactuals about uninstantiated properties). If it is asked why *all* recombinations of actually-existing elements should be considered possible, the answer lies in an appeal to Hume's principle of "no necessary connections between distinct existences."[38] That is what licences the compossiblity of any recombination of actuals. But that is a principle doubtfully true – it is very difficult to define an unambiguous version of it that is simultaneously not subject to obvious counterexample, reasonably in accord with intuition, and non-trivial.[39] Indeed, *prima facie*, betweenness relations among colors and among ratios are clear counterexamples, since colors and ratios are existences and betweenness relations are necessary connections. Even if Hume's principle is true, it is a substantial and non-obvious metaphysical thesis about necessity and possibility, hence an obstacle to the claim that a reductive account of possibility has been given.

The second substantial thesis relied on by Armstrong is that existence for a property means timeless existence – a property is said to exist if it is instantiated at *some* time.[40] Without that thesis, Armstrong would have even fewer properties existing, and it would

[37] Armstrong, *Combinatorial Theory*, 58-60.
[38] Armstrong, *Combinatorial Theory,* 115-7; Armstrong actually argues from combinatorialism to Hume's principle.
[39] Jessica Wilson, "What is Hume's dictum, and why believe it?" *Philosophy and Phenomenological Research* 80 (2010), 595-637.
[40] Armstrong, *Combinatorial Theory,* 70.

be very easy for properties and laws to go out of existence, removing even more of the truthmakers needed to support counterfactuals. Yet the thesis of timeless existence relies on a controversial metaphysics of space-time, which contradicts the metaphysics of presentism (the theory that only the present exists) believed in by the folk and some philosophers.[41] Surely it is a weakness for a theory as general as the metaphysics of properties to have to rely on so special a thesis as the negation of presentism.

The discussion has so far been confined to "tame" uninstantiated universals which lie in ranges of partially-instantiated determinates. It is true that there may be uninstantiated properties that are not in ranges of determinables of which some determinates are instantiated. They would be truly "alien" universals, which are like nothing in the actual universe.[42] However, these seem beyond the range of what needs to considered in science and mathematics – for all the vast size and esoteric nature of Hilbert spaces and inaccessible infinite cardinals, they are in some sense made out of a small range of simple properties. Alien universals would be neither ruled in nor out, but as we seem to have no possible knowledge of them, it may be allowable to excuse all sides in the debate from giving an account of them.

5.

Semi-Platonist Aristotelianism The Aristotelian slogan is that universals are *in re*: in the things themselves (as opposed to in a Platonic heaven). For the reasons just given, it would not do to be too fundamentalist about that dictum, especially when it comes to uninstantiated universals such as numbers bigger than the number of things in the universe. How big the universe is, or what colors actually appear on real things, is surely a contingent matter, whereas at least some truths about universals appear to be independent of whether they are instantiated.

At this point it may be wondered whether it is not a very Platonist form of Aristotelianism that is being defended here. It has a structured space of universals, not all instantiated, into whose necessary interconnections the soul has insights. That is so.

[41] John Bigelow, "Presentism and properties," *Noûs* 30 (Supplement: *Philosophical Perspectives* 10) (1996), 35-52.
[42] David M. Armstrong, *Truth and Truthmakers* (Cambridge: Cambridge University Press, 2004), 86-89.

But there are three, not two, distinct positions covered by the names Platonism and Aristotelianism:

- (Extreme) Platonism, according to which universals are of their nature "abstract objects", that is, they are not the kind of entities that could exist (fully or exactly) in this world, and they lack causal power
- Semi-Platonist or modal or maximalist[43] Aristotelianism (the position defended here), according to which universals can exist and be perceived to exist in this world and often do, but it is a contingent matter which do so exist, and we can have knowledge even of those that are uninstantiated and of their necessary interrelations
- Strict this-worldly or minimalist Aristotelianism, according to which uninstantiated universals do not exist in any way: all universals really are *in re*

Those three positions are very distinct. The gap between semi-Platonist Aristotelianism and extreme Platonism is unbridgeable. Aristotelian universals are ones that could be in real things (even if some of them happen not to be), and knowledge of them comes from the senses being affected by instantiated universals (even if indirectly and via inference, so that knowledge can be of universals beyond those directly experienced). By contrast, extreme Platonism calls universals "abstract", meaning that they do not have causal powers or location and hence cannot be perceived (but can only be postulated or inferred by argument, or perhaps communed with by intuition).

It is true that whether the gap between the second and third positions is large depends on what account one gives of possibilities. If the minimalist "this-worldly" Aristotelian were to have a robust view of merely possible properties (for example, by granting full existence to possible worlds), there might be little difference in the two kinds of Aristotelianism. But that would be to adopt Platonism about possible worlds. Supposing a deflationary view of possibilities (as would be expected from an Aristotelian and as is developed in Armstrong's theory), a this-worldly Aristotelian will believe in a much narrower realm of real entities.

A further consideration of mathematical entities will clarify the relation between the second (semi-Platonist Aristotelian) and third (strictly minimalist earthbound

[43] In the language of Swoyer and Orilia, section 5.

Aristotelian) positions, which disagree on whether to admit in some way necessities concerning uninstantiated universals. The discrepancy is not a matter of great urgency in considering the usual universals of science which are known to be instantiated because they cause perception of themselves. It is the gargantuan and esoteric specimens in the zoo of the higher mathematics that strike fear into the strict empirically-oriented Aristotelian realist. Our knowledge of mathematical entities that are not or may not be instantiated has always been a leading reason for believing in Platonism, and rightly so, since it is knowledge that goes well beyond the here and now. It does create insuperable difficulties for a strict this-worldly Aristotelianism. But it needs to be considered whether one might move only partially in the Platonist direction. There is room to move only halfway towards extreme Platonism for the same reason that there is space in the blue spectrum between two instantiated shades for an uninstantiated shade. The non-adjacency of shades of blue is a necessary fact about the blue spectrum (as Platonism holds), but whether an intermediate shade of blue is instantiated is contingent (contrary to extreme Platonism, which holds that universals cannot be literally instantiated in reality at all). It is the same with uninstantiated mathematical structures, according to the semi-Platonist Aristotelian: a ratio (say) whether small and instantiated or huge and uninstantiated, is part of a necessary spectrum of ratios (as Platonists think) but an instantiated ratio is literally a relation between two actual (say) lengths (as Aristotelians think) and is thus something found in the physical world. The fundamental reason why an intermediate position between extreme Platonism and extreme Aristotelianism is possible is that the Platonist insight that there is knowledge of uninstantiated universals is compatible with the Aristotelian insight that instantiated universals can be directly perceived in things.

The slogan of semi-Platonist Aristotelianism is "Instantiation is possible but not necessary."

6.

What reality do uninstantiated properties have? What reality does the semi-Platonist or maximalist Aristotelian attribute to uninstantiated properties? Should they be said to "exist"? The minimalist Aristotelian has a simple answer to that question: they do

not exist at all. The Platonist also has an intelligible though dubious answer: they exist fully, but as abstract objects, which are necessary beings in a different kind of world from the physical one. The semi-Platonist Aristotelian's story is not so clear. Are uninstantiated properties to have a shadowy half-being, somewhere between full being and mere possibility? Or do they need to reside as ideas in the mind of God, as Augustine and Aquinas thought?[44]

Those are not regarded as meaningful questions by the semi-Platonist Aristotelian. When a universal is instantiated by a particular in some state of affairs, a being exists with that universal; when a universal is not instantiated, there are knowable possibilities concerning it and its relations to other universals, but there is no need to grant it an "existence" parallel to that of particulars. That would be to adopt a fundamentalism about properties, reifying them as if they paralleled particulars. As even Armstrong says, "it is wrong to *substantialize* universals;" they are ways things are, not things themselves.[45] (Perhaps it would be better to say "ways of being things", to avoid the apparent existential import of "ways things are" – in the same way as "unicorn" merely describes a kind of animal without implying that such animals exist, so "ways of being things" is intended to describe a kind of reality, prescinding from their existence.) Neither bare particulars nor properties "exist" in the same straightforward sense as do the particulars-with-properties that we come across in our world, even though they are part of the reality of those "substances".

A realist but anti-fundamentalist approach to uninstantiated properties is supported by two thought experiments.

If there were a major ontological difference between a property's being uninstantiated and being instantiated (but not between its being singly and doubly instantiated), then an oddity would arise if a universe were cloned. Suppose a universe in which a certain property is instantiated once. Clone that universe, with the two universes having no causal or other connection. Now delete the instantiation of the property in one of the universes (say, "ours"). The instantiation of the property in the other universe should not be able to do any ontological work in our universe, since that universe is totally disconnected from ours in all ways. For all intents and purposes, our universe is as if the property is uninstantiated; for example, it exerts no causal power in our universe.

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[44] Thomas Aquinas, *Summa Theologiae* bk 1 q. 15 art. 1.
[45] Armstrong, *A World of States of Affairs,* 30.

Is it, in some absolute sense, instantiated? There seems to be no fact of the matter: to claim there is would be to take a fundamentalist view of properties as if they obeyed the same rules as substances.

A second thought experiment is suggested by the theory that properties, instantiated or not, might exist as ideas in the mind of God. If they did so exist, they would be subject to a Euthyphro problem similar to that for moral laws: does God have the idea that orange lies between red and yellow because orange really does lie between red and yellow, or does orange lie between red and yellow because God has the idea that it should? The comparison suggests a parallel between possibly uninstantiated properties and moral laws. Suppose one takes an absolutely objectivist view of moral laws: those laws are true prior to any human (perhaps even divine) choice, action or command, and absolutely constrain all human decisions (constrain them ethically, of course, not causally or logically). Those human actions that are right implement or instantiate the laws; for example, a just action gives to someone what the laws insist he deserves. However objectivist one is about the laws, there is little temptation to reify them, to posit them as substances, to regard the Ten Commandments as written in the firmament, or to wonder about the ontological difference between instantiation and non-instantiation. Their reality, powerful as it is, is not like that.

The laws of morality provide a model for the laws of nature and the properties which the laws connect. They are real and constrain substances, but they are not themselves substances – not physical substances, and not abstract objects either. The reality of the ways things are is not the reality of things. It is the reality of their own kind.

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