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Alexander Bird: *Nature's Metaphysics: Laws and Properties*. Oxford/New York: Oxford University Press, 2007. ISBN 978-0-19-922701-3; $ 70.00, £ 29.00 (hardback); 231 pages

Nature's Metaphysics articulates and defends a view known as dispositional essentialism: the view that the fundamental properties of nature are essentially dispositional. Bird is not the first to hold this view, a situation which he notes in the preface has its advantages, allowing him 'to work at length on the details of a view that is to a greater or lesser degree shared', for instance, by Brian Ellis and Caroline Lierse, Stephen Mumford, and George Molnar (p. viii). And indeed the book provides a wealth of interesting details, helpful distinctions, and valuable clarifications, as well as considered, scientifically informed and in-depth argument. Anyone interested in the metaphysics of dispositions, laws of nature and causation will find the book highly illuminating, whether or not they agree with its main theses.

It is not possible in the scope of this review to do justice to the many contributions made by Bird's book, and for this reason I would like to concentrate on the central claims: what dispositional essentialism is, and why it should be adopted. I will conclude that the case made for dispositional essentialism is incomplete because a crucial feature of properties and laws has not been addressed. Nonetheless, the problem does not seem to affect dispositional essentialism any more than its competitors; and it remains a merit of Bird's book to have made the metaphysics of dispositional essentialism explicit enough for this point to become apparent.

After a useful introduction, Bird begins with an exposition of dispositional essentialism, stating what dispositional properties are (including a fresh look at the debate about conditional analyses of dispositions), and how they can account for the laws of nature (ch. 2–3). He then provides indirect argument for dispositional essentialism: first, by rejecting the rival view of categoricalism (ch. 4); second, by dispelling objections to dispositional essentialism (ch. 5–9). A concluding chapter summarises the argument and outlines further work for dispositional essentialism (ch. 10).

Dispositional essentialism is the claim that '[a]t least some sparse, fundamental properties have dispositional essences' (45). Bird himself subscribes to a stronger view, which he calls 'dispositional monism': *all* sparse, fundamental properties have dispositional essences. For a property to be fundamental is for it to be part of 'the non-redundant basis of causal relations' (14), or to figure in the true fundamental science. (The fundamental properties may not, and as it turns out do not, exhaust the sparse or natural properties.) For a property to be dispositional is for it to relate a stimulus and a manifestation property such that, if an object x instantiates the dispositional property, would yield the manifestation in response to the stimulus (*ceteris paribus*, i.e. in the absence of finks and antidotes).

Unlike Brian Ellis, the originator (with Caroline Lierse) of the term 'dispositional essentialism' (cf. Ellis and Lierse 1994), Bird is not concerned with the essences of objects, or

with natural kinds. His dispositional essentialism is a claim solely about the essences of properties, not about the essentiality of these properties to individuals.

While primarily a view about properties, dispositional essentialism is intimately linked with a view of natural laws as derived from these properties. Roughly, the link established by an essentially dispositional property between itself, its stimulus, and its manifestation condition grounds the law that whenever the disposition and the stimulus are instantiated together, the manifestation will also be instantiated. Bird gives a formal derivation of law statements from the claims of dispositional essentialism, using the conditional analysis of dispositions to derive a statement that expresses a nomic generalization: everything that has a given essentially dispositional property P and is in that property's stimulus condition S has the property's manifestation property too, or $\forall x((Px \wedge Sx) \rightarrow Mx)$. The failure of the conditional analysis in many cases due to finks and antidotes is argued (i) not to affect the fundamental properties, and (ii) to account for *ceteris paribus* laws in the cases of properties which it does affect.

Since it is derived from a necessary truth about properties, the law statement itself is metaphysically necessary. Thus according to dispositional essentialism, at least some laws are necessary. Bird then argues that considerations of metaphysical tidiness should prompt us to take the view that all laws can be thus derived and, as a consequence, are metaphysically necessary.

This, then, is the package of views that Bird defends: dispositional essentialism, the view that properties can have fully dispositional essences; dispositional monism, the view that this is indeed true of all the fundamental properties; and necessitarianism about the laws of nature, the view that laws are metaphysically necessary. The world, according to this view, is a connected world. The crucial opposition is with the Humean-Lewisian 'mosaic of matters of particular fact, just one little thing and then another' (Lewis 1986, ix, quoted on p. 82). Rather than a mosaic, Bird's view gives us a web or structure of properties that are intimately connected – so intimately indeed that all there is to them, their very essence, is nothing but their place in the structure. The identities of the properties (139), as well as the laws governing their interaction (201), supervene on this structure.

The character of these connections is modal. In fact, it is modal twice over, for dispositional essentialism has two distinct modal aspects. One is essentialism: properties have non-trivial essences, certain characteristics that they possess in every possible world, in virtue of being the property that they are. Essentialism is opposed to quidditism, the view that the identity of properties is primitive, and there is no more to be said about a property's identity than that it is the property it is. The other modal aspect is dispositionalism: the view that properties have a dispositional character, involving some kind of relation to a manifestation that need not be actual, or indeed to a stimulus and a manifestation. This second modal aspect can be brought out by the counterfactual conditional I have used to characterize dispositionality: where x has the disposition to M in response to S, x *would* M if x *were* S (*ceteris paribus*). Note that these two modal aspects are relatively independent of each other: either of them could be adopted without the other. On the one hand, one might be a dispositional contingentist, holding that some properties have a dispositional character which they might have lacked. This indeed is one characterization that Bird gives of categoricalism (67). On the other hand, one might be an essentialist about certain properties without holding their essences to be dispositional: one might think, for instance, that it is essential to the property of being a lie that it is morally bad, that it is a non-trivial fact about lies that, in every world, whenever a lie is uttered, a moral offence has been committed. In fact, one might be both an essentialist and a dispositionalist about properties without being a dispositional essentialist: One might hold that certain properties have essences, but not dispositional ones; and that those same prop-

erties are dispositional, but only contingently so. Thus the dispositional essentialist not only whole-heartedly embraces both modal aspects, but combines them in a specific way: holding that the fundamental properties have essences, and that these essences are dispositional.

These two modal aspects are, of course, clearly stated in the very name of the thesis (dispositional essentialism). However, Bird does not always distinguish them very explicitly, and accordingly does not consider all the possible alternatives to his view. In particular, he does not seem to consider the option of a non-dispositional essentialism. I believe that this is a lacuna in his argument against the cluster of views he terms 'categoricalism'; it will emerge in a more concrete form below when I look at his argument against Armstrong's nomic necessitation theory.

Why be a dispositional essentialist? Bird is explicitly not motivated by, and indeed rejects, the more 'ideological' considerations that might be thought to make dispositional essentialism attractive: *pace* Ellis, dispositional essentialism does not reconcile the manifest image with the scientific image by vindicating our feeling that we have powers to do or not to do things, rather than being 'pushed and pulled' around by the forces of nature (129). Nor does dispositional essentialism bridge the gap between the physical and the mental by revealing a type of physical intentionality akin to the intentionality of the mental (120–126). Any appearance to the contrary rests on mere metaphor, a metaphor revealed to be misleading by a less prejudicial attention to detail.

It is not the intuitive appeal of a world-view that motivates Bird's adherence to dispositional essentialism. It is, rather, the failure of the rival views, the different versions of 'categoricalism' about properties and in particular about laws – their failure, roughly, to explain the striking regularity exhibited by nature and captured in successful science.

According to categoricalism (as characterized in the book), properties 'have no essential or other non-trivial modal character' (67). Context makes it clear, however, that the 'categoricalist' here is merely a quidditist, denying the essentialist factor in dispositional essentialism. The categoricalist denies that properties have essences; a fortiori, he denies that properties have dispositional essences. The categoricalist may believe in dispositions (see p. 67), but then he will be what I have called above a 'dispositional contingentist'.

Laws, for the categoricalist, are accordingly not grounded in the essences of properties, but are 'metaphysically contingent relations among categorical properties' (68). What are these relations? According to David Lewis, they are relations of mere regularity: an F is regularly followed by a G, or $R(F, G)$ for short. According to David Armstrong, it is the special second-order relation of contingent nomic necessitation holding between the universals involved: $N(F, G)$.

In agreement with Armstrong, Bird argues against Lewis (roughly) that since the role of laws is to *explain* regularities, they cannot be identical with those very same regularities. Armstrong's own nomic necessitation relation is formulated to avoid this problem while retaining the categoricalist credo that there are no necessary connections between properties. However, Bird now asks: exactly how *does* the 'soft, nomic necessity' (91) of $N(F, G)$ explain the regularity $R(F, G)$? N and R are themselves (relational) properties, though second-order ones, and are thus affected by the categoricalist ban on necessary connections between distinct properties. Hence $N(F, G)$ may not entail $R(F, G)$, on pain of acquiring a 'non-trivial modal character'; it may not be the case, on Armstrong's categoricalist assumptions, that in every world where $N(F, G)$ holds, $R(F, G)$ holds too. How then can N and R be contingently connected? It might of course simply be that $N(F, G)$ merely materially (truth-functionally) implies $R(F, G)$: in every actual case where $N(F, G)$ holds, $R(F, G)$ holds too. This is a mere regularity, however, and indeed the very regularity that is meant to be explained. By the same argument that has been advanced against Lewis, a mere regularity holding between N

and R cannot be explanatory, thus depriving N itself of explanatory power. A last option for the connection between N and R is the nomic necessitation relation itself, or its third-order analogue: $N(F, G)$ contingently nomically necessitates $R(F, G)$, or $N'(N, R)$. It is clear that this leads us into a vicious 'regress of ever higher-order universals of necessitation' (94).

Armstrong's nomic necessitation relation, then, fails to meet the standards he himself has set in rejecting Lewis's view. In order to explain regularity by laws, we need some 'hard' metaphysical modality, akin to the essentialist aspect of dispositional essentialism.

Note that this does not yet go to show that we need *dispositional* essentialism. For instance, Armstrong might accept the conclusion of Bird's argument and endow his nomic necessitation relation, N, with the required modal character. For all that has been shown is that at least one property (or relation), N itself, needs to have some non-trivial modal character. It has not been demonstrated that any *fundamental* property needs to be endowed with an essential character, unless N itself is fundamental; nor has it been shown that N's or any property's essential character is *dispositional*. Here the lacuna that I have diagnosed above is revealed: Bird seems to assume that dispositional essences (for the fundamental properties) are the only essentialist option that can provide the required explanation of regularity. However, a categoricalist like Armstrong may take Bird's point but still prefer to admit into his ontology one, very special, second-order property with a modal character, rather than to endow many or all the fundamental first-order properties with a very special kind of essential character, namely, an essentially dispositional one.

Is this lacuna detrimental to the argument of Bird's book? No. Bird does not pretend to have proved dispositional essentialism. The argument against the categoricalist/quidditist served merely to motivate his own view (see p. 5). It is through its explanatory power that his view is to recommend itself. However, Bird does address the second modal element in dispositional essentialism, though in the course of answering an objection.

The objection is explicitly phrased as a worry about the 'non-trivial modal character' of dispositions – context makes it clear that this time 'modal' is intended not to refer to the essentialist modality but an aspect of the dispositional modality: the possibility of the manifestation that is somehow 'included' in an unmanifested disposition. Bird helpfully distinguishes this general worry into the two objections that dispositions have 'too little actuality' to be real, and that they have 'too much potentiality' to be ontologically respectable ('potentiality' being an unrealized possibility in the actual world). Bird's reply to the second objection is that any categoricalist view short of either Megarian actualism or Lewisian modal realism is no better off in this respect. Anyone who does not either deny modally loaded facts about the world, or outsource them to real other worlds – anyone, that is, who thinks that counterfactual or law-like, counterfactual-supporting statements are true in virtue of something in the actual world – has to include unrealized possibilities in actuality. It does not matter for the present point whether these unrealized possibilities are entailed by the 'being' of a property or, say, by an Armstrongian contingent necessitation. Nor should this be seen as problematic, for our 'most natural system of modal logic' (112) contains the Barcan formula and thereby a commitment to merely possible objects. Bird thus follows Williamson (1998) in accepting the existence of merely possible objects, but stresses that this particular answer to the question of how there can be unrealized possibilities in actuality is not required by, nor specific to, dispositional essentialism.

Most metaphysicians, then, have to accept possibility in actuality (109) – a modal factor akin to the 'dispositional' element of dispositional essentialism. Again, this clearly does not suffice to establish – and is not intended to establish – that what is needed is dispositional essentialism. It has not been shown that the 'potentiality' needs to be part of the being of properties, let alone fundamental ones, nor that it has to take the specific form that characterizes dispositions on Bird's view, connecting a stimulus and a manifestation property.

Again, this is not in itself a problem: it is its explanatory power that is to recommend dispositional essentialism.

The book features several other intriguing responses to objections, for instance a graph-theoretic response to the regress problem and an argument from so-called 'background-free' physics to accommodate apparent counter-examples to dispositional monism, structural (spatio-temporal) properties. There is also much of interest about laws of nature, in particular a defense of their necessity, which argues that and why our intuitions about the modal status of laws are mistaken; and a case for the tenability of 'strong necessitarianism', the view that not only does every law hold in every world where the relevant properties exist, but also that all the nomic properties exist in all worlds. However, if my exposition of the case *for* dispositional essentialism has been correct, then everything hinges on the claim of dispositional essentialism's superior explanatory power, as demonstrated in the exposition of the view in ch. 2–3. It is this claim that I would now like to examine in more detail.

The explanatory power of dispositional essentialism is displayed in the explanation it provides for the laws of nature: the essentially dispositional character of properties explains laws simply by entailing them. Where P is any fundamental property, dispositional essentialism says that P is essentially, and hence necessarily, a disposition to yield a particular manifestation M in response to a particular stimulus S:

(DE$_p$) $\Box(Px \rightarrow D_{(S,M)}x)$

Using, as an approximation, the conditional analysis of dispositions, we can replace $D_{(S,M)}x$ by the counterfactual conditional and get

(I) $\Box(Px \rightarrow (Sx \,\Box\!\!\rightarrow Mx))$,

which in a few steps of first-order modal logic, with modus ponens for the counterfactual – assume $Px \wedge Sx$, derive Mx, discharge the assumption – leads to the statement of a nomic generalization:

(V) $\forall x((Px \wedge Sx) \rightarrow Mx)$.

Note that this derivation crucially relies on the characterization of dispositional properties in terms of a particular stimulus and a particular manifestation. This characterization, to Bird, is part of the very definition of dispositionality; note the formalization of the dispositional essentialist claim that 'at least some (fundamental) properties are essentially dispositional' as (DE$_p$), which transforms it into the claim that at least some (fundamental) properties are dispositions *to manifest M in response to S*. Without this addition, the derivation could not even get started.[1]

To assess the claim of explanatory power, let me begin by asking a simple question. Electric charge is one of the favourite properties of dispositional essentialists (including Bird: see p. 44). Exactly what is the dispositional essentialist account of it?

Bird repeatedly characterizes the essence of negative charge as the disposition to repel other negative charges and attract positive ones (45); its stimulus condition consists, roughly, in being at a certain distance from another charge (22).

This, however, is not quite enough, as Bird himself notes. For the fundamental properties that he deals with are quantities. An object is not merely charged: it must have some determinate charge, say, charge e or charge $2e$. Determinate charges, like determinate quantities in general, are ordered: charge $2e$ is *greater* charge than charge e. Moreover, the properties that function as stimulus and manifestation conditions for charge are quantities

[1] This point, like many other valuable observations, has been made in Carroll 2008.

too, and this is crucial to the law that characterizes electric charge, Coulomb's Law. For Coulomb's Law states not merely *that* an object with a given determinate charge will manifest a certain kind of force (attractive or repulsive) in response to a certain kind of stimulus condition (say, another charge at some distance from it); it states exactly *how much* force the object will exert in response to exactly *how much* charge at *how great* a distance. That is, given any determinate charge, it states the mathematical relation between any determinates of the stimulus and manifestation condition. To be more precise, Coulomb's Law states the relation between any given determinate charge Q and any other charge q_i, the distance r_i between Q and q_i, and the attractive or repulsive force F_i that is exerted:

CL $F_i = \varepsilon \frac{Qq_i}{r_i^2}$

It is Coulomb's Law that on Bird's view should be derivable from the dispositional essence of charge; but it is not at all clear how it fits into the schematic derivation of (V) from (I). Like most (all?) fundamental laws of physics, Coulomb's Law states not merely a relation between properties, but a very special kind of relation – namely, a mathematical function – between properties of a very special kind – namely, quantities. (V), on the other hand, states a much simpler, non-mathematical relation between properties that look rather like qualities. Coulomb's Law is witness that with quantities, 'the simple "on " or "off " of being instantiated or not being instantiated seems to leave something out' (Bigelow and Pargetter 1988, 287). (V) precisely does leave out everything beyond the 'simple "on " and "off " of being instantiated or not'.

How, then, is Bird's derivation to capture these complex relationships between determinates and determinables involved in the seemingly fundamental property of having charge? I am not going to discuss the relation between charge as a determinable and its determinates, but will instead focus on the structure of any one given determinate, using as an example the property of having charge e, the charge borne by an electron.

Bird's solution to this, it would seem, crucial question is indicated in a short section on 'multi-track dispositions' (21–24). There he suggests that charge, or a determinate charge like charge e, is a multi-track disposition – that is, a disposition that has various different stimulus and/or manifestation conditions. The many different stimuli and manifestations of charge e are, of course, the many different determinates of the determinables cited in the informal characterization. For instance, the stimulus of being at a distance of $5.3 \times 10^{-11} m$ from a charge of $1.6 \times 10^{-19}\ C$ – call it S_1 – is correlated with the manifestation of exerting a force of $8 \times 10^{-8}\ N$ – call it M_1. Everything that has charge e, then, has the disposition to manifest M_1 in response to S_1, as well as infinitely many other dispositions parallel to it. Indeed, having charge e is equivalent to having the conjunction of all these parallel dispositions. And are not the conjuncts 'closer to being fundamental' (22) than the conjunction? They are, Bird suggests, and for this reason the multi-track disposition of having charge e is not after all a fundamental property; rather, it is properties such as the disposition to M_1 in response to S_1 and its many parallel dispositions that are fundamental.

Surprising as this may be, it fits nicely with the derivation of laws that Bird offers. Substituting the specific values in (I), we get

(I*) $\Box$ (x has charge $e \rightarrow$ (x is $5.3 \times 10^{-11} m$ from a charge of $1.6 \times 10^{-19} C$ $\Box\!\!\rightarrow$ x exerts a force of $8 \times 10^{-8} N$)),

from which we can derive a law-like statement

(V*) $\forall$x ((x has charge $e \wedge$ x is $5.3 \times 10^{-11} m$ from a charge of $1.6 \times 10^{-19} C$) $\rightarrow$ x exerts a force of $8 \times 10^{-8} N$).

(V*), however, is not Coulomb's Law; it is at best an instance of it. On the multi-track view of charge, we cannot derive Coulomb's Law, but we can derive all of its instances. Let us call these instances the Coulombian laws.

How much explanatory work can any given Coulombian law do? Not much. It explains *some* regularities – the regularity, for instance, that a given object exerts a force of $8 \times 10^{-8} N$ whenever it is $5.3 \times 10^{-11} m$ from a charge of $1.6 \times 10^{-19} C$. But the crucial regularity is the similarity *between* the Coulombian laws: the fact that they all exhibit the same numerical correlations between stimulus and manifestation. And this crucial regularity cannot be explained by any one of the Coulombian laws. The fact that all the Coulombian laws are instances of Coulomb's law is an inexplicable regularity if the only fundamental properties we are given are the parallel dispositions that replace charge *e*.

How, then, can we explain that regularity? The dispositional essentialist's general strategy is to anchor regularity in properties. Thus Bird says that '[w]hile it is possible to gerrymander impure [i.e. conjunctive] dispositions of all sorts, it is clear as regards the cases we are interested in, [such as] charge […], that the conjunctions are natural or non-accidental.' (22) That is clear indeed; but it is far less clear how the dispositional essentialist is to account for the naturalness of these conjunctions. The easiest way of doing so would be to appeal to Coulomb's Law itself: the Coulombian laws and properties are naturally conjoined because they are all instances of, or governed by, Coulomb's Law. This route, of course, is closed to the dispositional essentialist: after all, it is the fundamental properties that are to account for the laws, and not vice versa; we cannot assume Coulomb's law in the very attempt to derive it.

This is a somewhat ironic situation: Bird has posited essentially dispositional properties as providing connections in nature, and accused the Humean picture of 'just one little thing, and then another' of not *explaining regularities*. It now turns out that he himself lacks the resources to connect fundamental properties where he needs to, thus ending up with 'just one specific property, and then another', and unable to explain the regularity between these properties. It was precisely the ability to explain regularity in nature that was to recommend dispositional essentialism. But with Bird's multi-track view of charge, this ability is seriously threatened.

To be sure, the multi-track view is not one of the central tenets of Bird's book – quite the opposite: once suggested, it seems to be forgotten in the remainder of the book, when Bird continues to use charge as an example of a fundamental property. This does not mean, however, that the suggestion is of little significance. It is Bird's only attempt to make sense of the quantitative nature of the fundamental properties he deals with, and it is indeed difficult to see how that quantitative nature might be reconciled with the non-quantitative character of Bird's derivation of laws if not by the multi-track view.

To illustrate this last point, let me briefly look at a first (and probably far too simple) attempt to solve the problem that I have pointed out.

Bird's dispositional essentialism provides connections in nature, but these connections do not seem quite enough to do all the work they are supposed to do. The connection between a dispositional property, its stimulus and its manifestation is one thing, but the connection needed to combine the Coulombian laws into Coulomb's Law is quite another. Why not, then, simply take that other connection on board? This would amount to blocking Bird's argument that the conjuncts are 'closer to fundamental' than the conjunction, and take his suggestion that 'the conjunctions are natural or non-accidental' (22) more seriously than he himself does. It will of course be necessary to work out just what that further connection is which makes the conjunction 'natural', and indeed more so than the conjuncts. Note that, while the apparatus of determinate and determinable may enter in some way or other, it cannot be used to characterize the relation between charge *e* and its many sub-dispositions.

For the determinates of one determinable exclude each other: while having charge entails having some determinate charge, having any one determinate charge entails not having any other determinate charge. In the case I have been discussing, on the other hand, having charge e entails not merely having *some*, but indeed having *all* the many parallel sub-dispositions. It is not at all clear what the metaphysical picture here is supposed to be.

There is another respect in which the metaphysical picture becomes less clear. We can see this by considering a reformulated characterization of charge e on the proposed view, which should go roughly as follows:

(I+) $\Box$ (x has charge e $\rightarrow \forall$ charges q_i $\forall$ distances r_i (x is at r_i from q_i $\Box\!\!\rightarrow$ x exerts force $F_i = \varepsilon\frac{eq_i}{r_i^2}$)

This may require some more reformulation and refinement to be at least a plausible candidate. It is certainly not as nice and tidy as the original formulations (I) and (I*). But more importantly, we should note that while (I+), and plausibly any refinement of it, provides stimulus and manifestation conditions, they are in the range of one quantifier – which they have to be, in order to express the mathematical correlations correctly. On this conception, the stimulus and manifestation of charge e cannot be adequately characterized independently of each other, on pain of losing their correlation. Rather, any characterization of the manifestation has to refer back to the stimulus: charge e, according to (I+), is the disposition to exert a force that stands in a certain correlation to other charges that are present and to how distant these are. (To see this, try to provide independent specifications of stimulus and manifestation. If you specify the manifestation as 'x exerts a force of $F_i = \varepsilon\frac{eq_i}{r_i^2}$', you need to say which q_i and which r_i you are speaking about. They are, of course, the charge and distance that together form the stimulus – they are whichever charge is present at whichever distance.) As a consequence, the very conception of stimulus and manifestation as distinct ingredients in a dispositional property's essence becomes questionable. Why should (I+) still be viewed as a characterization in terms of a stimulus and a manifestation? Had it not better be understood in terms merely of a manifestation: the exertion of a force that stands in a certain correlation to certain features of the environment?

I have not presented insurmountable objections to the (I+) view of charge e (in fact, I am inclined to think that the last point may be an advantage rather than a problem), and that view itself is certainly not the only alternative to Bird's multi-track view. But the points I have made help to highlight the need for further work on the metaphysical character of dispositional properties, once the multi-track view is abandoned. Things may not be as nice and tidy as Bird's derivation of (V) from (I) may have led one to believe; and the superior explanatory power of dispositional essentialism has yet to be demonstrated. It is one of the many merits of Bird's book, and one that we owe to his love of detail, to have articulated the metaphysics of dispositional essentialism clearly enough for the problem to emerge; and any attempt at meeting the challenge will certainly be indebted to his book for its wealth of observations and argument.[2]

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