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BOUNDARIES IN REALITY

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Abstract
This paper defends the idea that there must be some joints in reality, some correct way to classify or categorize it. This may seem obvious, but we will see that there are at least three conventionalist arguments against this idea, as well as philosophers who have found them convincing. The thrust of these arguments is that the manner in which we structure, divide or carve up the world is not grounded in any natural, genuine boundaries in the world. Ultimately they are supposed to pose a serious threat to realism. The first argument that will be examined concerns the claim that there are no natural boundaries in reality, the second one focuses on the basis of our classificatory schemes, which the conventionalist claims to be merely psychological, and the third considers the significance of our particular features in carving up the world, such as physical size and perceptual capabilities. The aim of this paper is to demonstrate that none of these objections succeed in undermining the existence of genuine joints in reality.

1. Introduction

Traditionally, realism attempts to uphold the classifications that we observe in everyday life: apples, cats, mountains and stars are all objects with natural boundaries – they reflect genuine joints in reality. Such joints in reality are supposed to act as the basis of our efforts to classify reality, and common sense suggests that most of these attempts are successful. It is not easy to state the exact identity-conditions of any of the mentioned things though. Mountains do not have a determinate boundary at ground level, and a closer look will reveal that there is even vagueness concerning Tibbles the cat and her hair.[1] However, the problem that we will focus on is not the problem of vagueness. Rather, it is the extreme conventionalist thesis concerning the mind-independence of the identity-conditions of objects and kinds that a realist would

[1] See for instance Michael Tye, 'Vague Objects', *Mind* 99 (1990), pp. 535–57.

consider to 'carve nature at the joints'. The conventionalist thesis is that there are no such mind-independent identity-conditions and that all our efforts to determine natural boundaries are subjective.

Extreme conventionalism may seem like an implausible view, but it has its roots in the influential work of Hilary Putnam and Michael Dummett. More recently, Achille Varzi has put forward a novel conventionalist account, focusing especially on boundaries.[2] More modest versions of conventionalism, i.e. views which take *some* boundaries to be mind-dependent, are fairly common. For instance, John Dupré's species pluralism could be considered a form of modest conventionalism, as it takes 'species' to consist of a variety of different ways to categorize biological organisms.[3] It should be noted though that modest conventionalism is not incompatible with realism. What *is* incompatible with realism is the idea that *all* objects and kinds lack mind-independent natural boundaries, and it is entirely a matter of convention as to how we decide to categorize reality – this is what Varzi's arguments suggest. Note that the problem at hand concerns both individual objects and kinds, but we will focus mainly on individual objects.

Artificial boundaries are quite familiar to us and we seem to have no trouble in admitting that they are indeed artificial while acknowledging their usefulness – borders of countries are one obvious example. We may also express the artificial/natural boundary distinction in terms of *fiat* and *bona fide* boundaries, or *de dicto* and *de re* boundaries, following Smith and Varzi.[4] It is important to recognize here that the *fiat/bona fide* distinction applies equally to the physical boundaries of objects and to the objects themselves: the physical boundary of an apple is, on the face of it, a *bona fide* boundary, and the individual apple is a *bona fide* entity.[5] However, this is exactly what the extreme conventionalist questions: when we look at the apple closely enough, it is

[2] Achille C. Varzi, 'Boundaries, Continuity, and Contact', *Noûs* 31:1 (1997), pp. 26–58; Achille C. Varzi, 'Boundaries, Conventions, and Realism', in J. K. Campbell, M. O'Rourke, and M. H. Slater (Eds.), *Carving Nature at Its Joints: Natural Kinds in Metaphysics and Science* (Cambridge, MA: MIT Press, 2011), pp. 129–53.

[3] John Dupré, *The Disorder of Things: Metaphysical Foundations of the Disunity of Science* (Cambridge, MA: Harvard University Press, 1993); John Dupré, *Humans and Other Animals* (Oxford: Oxford University Press, 2002).

[4] Barry Smith and Achille C. Varzi, 'Fiat and Bona Fide Boundaries', *Philosophy and Phenomenological Research* 60: 2 (2000), pp. 401–20.

[5] Smith and Varzi, 'Fiat and Bona Fide Boundaries', p. 402.

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clear that, far from the smooth boundary that it appears to have, we are in fact dealing with a very loose arrangement of molecules, and further, with a swarm of subatomic particles. Familiar topological problems highlight the problem at hand: when we cut the apple in half, which half of the apple is 'open' and which one is 'closed'?[6] Moreover, problems concerning composition are all grist to the conventionalist's mill: when Tibbles the cat eats some fish, at what point does the fish become a part of Tibbles? Which criteria we apply, the extreme conventionalist will argue, is ultimately a matter of *fiat*; Tibbles may continue to exist, but its identity-conditions are not mind-independent.[7]

Here is how Varzi sees the situation:

> If all boundaries were the product of some cognitive or social *fiat,* if the lines along which we "splinter" the world depended entirely on our *cognitive* joints and on the categories that we employ in drawing up our maps, then our knowledge of the world would amount to neither more nor less than knowledge of those maps. The thesis according to which all boundaries – hence all entities – are of the *fiat* sort would take us straight to the brink of precipice, to that extreme form of conventionalism according to which "there are no facts, just interpretations". On the other hand, to posit the existence of genuine, *bona fide* boundaries – to think that the world comes pre-organized into natural objects and properties – reflects a form of naïve realism that does not seem to stand close scrutiny.[8]

The dilemma that Varzi puts forward here is the primary concern of this paper. Do we have to choose between extreme conventionalism and naïve realism when it comes to the classification of reality? If we go with extreme conventionalism, we end up with a view which is remarkably close to the Dummettian 'amorphous lump' view of reality (even if Dummett was not committed to this view himself).[9] The (extreme) Conventionalist Thesis can be summarised as follows:

[6] The open/closed distinction is a distinction between entities that do not and entities that do have their boundaries among their constituent parts. See Smith and Varzi, 'Fiat and Bona Fide Boundaries', pp. 406–8 for discussion on the open/closed issue.

[7] Cf. Varzi, 'Boundaries, Conventions, and Realism', p. 140.

[8] Varzi, 'Boundaries, Conventions, and Realism', p. 142.

[9] E.g. Michael Dummett, *Frege. Philosophy of Language*, 2nd edn. (Cambridge, MA: Harvard University Press, 1981), p. 577.

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(*The Coventionalist Thesis*) The world is 'dough' and we can cut it in a number of ways. All of these ways to cut are neutral in terms of the structure of reality; we can choose any classificatory scheme we please. How we choose to cut the dough depends on our psychological biases.

In what follows I will offer a realist response to the Conventionalist Thesis. There are three major points that are all crucial to the conventionalist stance. All of these are familiar from more modest versions of conventionalism, but Varzi combines them to produce the extreme conventionalist stance that we saw above.

Firstly, I will consider whether there in fact are any natural, *bona fide* boundaries and suggest that fundamental particles are the best candidate. Secondly, I will attempt to settle why we classify things in the way we do and what our psychological biases concerning our classificatory schemes are grounded in. Thirdly, I will examine the possibility of alternative, alien classificatory schemes and consider whether the manner in which we classify things is unique to us, or at least to beings of roughly our size and with similar perceptual devices and rational capabilities. Finally, the results of the discussion will be evaluated.

2. Are There Any Natural Boundaries?

The most obvious way to challenge the Conventionalist Thesis is to look for natural, *bona fide* entities with mind-independent boundaries. Even a single example would do: it would give us a fixed point that would help in defining other boundaries and hence serve as a basis for the classification of reality. Where might we start looking for natural boundaries given the problems even with biological species? It would maybe be best to look at smaller entities, atoms, perhaps. However, the Conventionalist Thesis applies to physics as well. For instance, different isotopes of the same element could arguably also be classified as different elements.[10] As Varzi suggests, the problem is that there are too many

[10] For discussion, see Robin F. Hendry, 'Elements, Compounds, and Other Chemical Kinds', *Philosophy of Science* 73 (2006), pp. 864–75.

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differences in the world rather than too few, and to choose one over the others is to draw a *fiat* line.[11]

We do not need to stop here though, for there are of course subatomic particles as well. Indeed, quarks and leptons, supposed fundamental particles, might be the best candidates for *bona fide* entities with well-defined boundaries. Admittedly, the concepts that we use to define these particles are perhaps subject to human contingencies as well. There might be limits to the accuracy of our measurements concerning some of the crucial variables, such as charge, that we use to determine the natural boundaries of fundamental particles. Still, it would surely be too strict a requirement to insist that we must be able to *state* the exact natural boundaries of, say, electrons. It is clear that we can determine these boundaries with an incredibly high accuracy. So, even though there may be epistemic constraints in effect here, this does not entail that the boundaries of electrons, for instance, are *fiat* boundaries.

What kind of evidence could we have to the effect that fundamental particles are *bona fide* entities?[12] I think that there is an abundance of such evidence: I contend that macroscopic objects would not be possible if *bona fide* entities did not exist. Hence, the very existence of macroscopic objects speaks in favour of *bona fide* entities. Note that this has nothing to do with whether macroscopic objects themselves are *bona fide* entities; the argument concerns the physical possibility of macroscopic objects. Here is an outline of the argument:

1. There are macroscopic objects.
2. Certain things are physically necessary for the forming of macroscopic objects, e.g. the laws that govern molecular binding.
3. The relevant laws of physics require that fundamental particles have *exact* properties, such as electric charge.
4. Fundamental particles possess these properties by physical necessity.
5. *Fiat* entities could not have these necessary properties.
6. Since there are macroscopic objects, there must be *bona fide* entities. (From 1-5.)

[11] Varzi, 'Boundaries, Conventions, and Realism', p. 142. See also C. Z. Elgin, 'Unnatural Science', *Journal of Philosophy* 92: 2 (1995), 289–302.

[12] The word 'particle' should be considered a place-holder for whatever our best science suggests, e.g. 'particle-like behaviour of the wavefunction'.

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I take it that even the extreme conventionalist will accept the first premise, so I will proceed to analyse the other premises.

2. Certain things are physically necessary for the forming of macroscopic objects, e.g. the laws that govern molecular binding.

In the light of what we know about the forming of macroscopic objects, certain things are physically necessary: molecules must be able to form bonds, atoms must be able to form molecules, and subatomic particles must be able to form atoms. In virtue of what are these things possible? Well, physics tells us that the binding of molecules and atoms is dependent on the electron configuration of individual atoms. The electron configuration depends on the energy levels of specific electrons and is moderated by the Pauli Exclusion Principle.[13] Similarly, the manner in which subatomic particles form atoms is dependent on the individual charges of subatomic particles – the negative charges of the electrons and the positive charges of the protons. Each proton consists of three quarks which make up the total charge of the proton. These are some rudimentary constraints for the forming of macroscopic objects. The physical necessity of these constraints should be evident, although their *metaphysical* necessity is left open.

3. The relevant laws of physics require that fundamental particles have *exact* properties, such as electric charge.

We know that the total charge of stable atoms has to be zero. Unstable atoms undergo radioactive decay and are poor candidates for the sort of binding behaviour required for the forming of macroscopic objects. The picture gets more complicated when details about the underlying fundamental forces are introduced: for instance, the nucleus holds together in virtue of the strong force, which overpowers the repulsive forces between the positively charged quarks. In any case, it is obvious that the forming of macroscopic objects is a delicate matter and would not be possible if subatomic particles were arranged in an arbitrary fashion. Even if we are unable to accurately state the charges of the subatomic

[13] The Pauli Exclusion Principle states that no two identical fermions can have the same quantum number at the same time.

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particles that constitute an atom, we do know that their sum has to be zero, otherwise the atom could not be stable. The upshot of this is that there must be some things, namely electrons and quarks, which possess an exact charge.

4. Fundamental particles possess these properties by physical necessity.

It is already apparent that the forming of any kind of macroscopic objects requires a considerable amount of orderliness on the microphysical level. The laws that govern the forming of atoms and molecules would not work if there were no physical *constants*, such as the charge of electrons. Electrons are ordered into shells and the order of filling of electron energy states is governed by energy and the Pauli Exclusion Principle. Any study of electron configuration will refer to the fact that it is *impossible* for two electrons to occupy the same quantum state, as stated by the Pauli Exclusion Principle.

Everything that we observe in the natural world is dependent on electron configuration, and the ordering of electrons into shells would not be possible if electrons did not have physically necessary properties: exact mass, exact charge, and intrinsic properties such as spin and angular momentum. Furthermore, the charge of an electron, $-1.6021892 \times 10^{-19}$ coulombs, is a fundamental physical constant: the charges of all other freely existing subatomic particles that have a charge are either equal to or an integer multiple of it. Accordingly, it is a feature of the physics of the actual world that electrons have their charge by physical necessity. It may be that this is not *metaphysically* necessary – perhaps the laws of physics are not metaphysically necessary and there are possible worlds with alternative laws of physics – but all that is needed for the argument at hand is *physical* necessity. But how does it follow from this that there must be *bona fide* entities? For this we need the final premise:

5. *Fiat* entities could not have these necessary properties.

Clearly, *fiat* entities as well can possess exact properties. Consider the city of London: it has a number of exact properties at any given time, such as the number of underground stations and an annual budget. There is, however, a difference between the exact properties that the city of London or other *fiat* entities may have

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and the exact properties that, for instance, electrons seem to have. The latter are *necessary*, whereas *fiat* entities can only possess contingent or merely *derivative* necessary properties.

Consider the different zones in the London Underground: there can be as many or as few zones as the underground authorities decide and they may be the basis of all sorts of things, such as ticket pricing. The zone division is nevertheless exact: there is no ambiguity about whether a given station is in one zone or another. At the same time, it is an entirely contingent property of the underground system that it has any zones at all. We might call it a *fiat* property: although the zoning is exact at any given time, it has no fixed requirements. It can change from time to time and we could even have decided not to introduce it at all. But we could not do anything of the sort, say, in the case of the charge of electrons, because if the charge were different then the microphysical orderliness required for the existence of macroscopic objects would collapse. That is, the exact actual charge of electrons is *necessary* for the emergence of macroscopic objects, whereas the zoning of the London Underground is thoroughly contingent.

It could be objected here that, for instance, the *fiat* entity that consists of two electrons in my left hand surely has certain necessary properties, e.g. the sum of the charges of these electrons. However, this will hardly undermine the argument, for the necessity involved here is based on the necessary properties of the individual electrons. Hence, the *fiat* entity will not have necessary properties in its own right – the necessity will have to 'piggyback' on the necessary properties of some *bona fide* entity or other. In other words, the existence of derivative necessary properties like the one described above is dependent on the existence of some primary necessary property. A closer inspection of derivative necessary properties will always reveal a primary necessary property of a *bona fide* entity – we might call it a *bona fide* property. Indeed, *bona fide* properties might be the best indicator of *bona fide* entities.

6. Since there are macroscopic objects, there must be *bona fide* entities. (From 1-5.)

We have now arrived at the conclusion of the argument: because there are macroscopic objects, there have to be *bona fide* entities that instantiate the exact, physically necessary *bona fide* properties that are needed for this macrophysical structure.

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Accordingly, the very existence of macroscopic objects speaks highly in favour of the existence of *bona fide* entities.

The argument has a number of interesting ramifications. Firstly, we can use it in two ways: as a general argument for the existence of *bona fide* entities, or as a more specific argument towards the conclusion that electrons and other fundamental particles are in fact such *bona fide* entities. It could perhaps be extended into an argument for some sort of microstructural essentialism as well, but I will not pursue that line here. I only wish to establish the first point, and I think that the case for it is fairly strong. We must have some entities which uphold the intricate structure required for the forming of macroscopic objects. To do this, these entities must be able to interact in a highly complex and stable manner. This interaction is possible only in virtue of a certain set of *bona fide* properties that these entities possess. *Fiat* entities do not seem to be capable of instantiating properties of the required type – they can only have *fiat* boundaries and properties.

I am not aware of any (extreme) conventionalist discussions of fundamental particles, which is rather surprising given that they are surely the best candidates for *bona fide* entities. Furthermore, even if our current physical theory about fundamental particles is mistaken, the point that was made above would still hold. This is the case even if the particles that we think are fundamental do after all have internal structure, or if they are better understood without using 'particle-talk' at all. Whatever the fundamental constituents of reality are, they must be such that they are able to form stable atoms. More generally, subatomic particles are subject to a well-defined set of fundamental forces and their interaction is based on these forces. For this interaction to result in stable macrophysical objects, it must regularly end up in bonding behaviour. As we have seen, such bonding behaviour requires *bona fide* properties and hence *bona fide* entities with *bona fide* boundaries. This is true regardless of whether we can actually state the identity-conditions of these entities – this is merely an epistemic concern.

The most important ramification of this account is perhaps that it effectively undermines the Dummettian view of reality as an amorphous lump. One cannot accept both the Dummettian picture and the idea that fundamental particles are *bona fide* entities. Perhaps the extreme conventionalist could argue that the existence of electrons or other fundamental particles as *bona fide* entities is not required. Rather, the amorphous lump must contain local variations in such a way that the required *bona fide*

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properties – e.g. negative and positive charges – are present in certain regions of the amorphous lump.[14] However, if the conventionalist concedes this much, then the amorphous lump picture is already undermined: surely a lump with fixed regional variations is anything but amorphous. If the extreme conventionalist thesis suggests that all our efforts to structure reality are based on *Gestalt* factors, then fixed local variations in the amorphous lump are also ruled out. Admittedly, this line would enable the conventionalist to deny the existence of electrons as *bona fide* entities, but it does entail the existence of *bona fide* properties.

There may in fact be *some* support for this type of an approach in current physics. For instance, the GRW interpretation of quantum mechanics suggests that what we have been calling particles may be nothing else than aspects of the behaviour of the wave function.[15] However, as Peter J. Lewis puts it: 'If the GRW theory is true, then particles and elephants are both instantiated by waves, but this provides no more reason to deny the existence of particles than to deny the existence of elephants.'[16] The details are obviously more complicated than this. What is clear is that whatever the fundamental structure of the world is, it contains features which enable the existence of macroscopic objects. Accordingly, the core thesis of extreme conventionalism is already refuted: there is structure in reality and it is according to the *de re* features of reality – be it particles or waves – that we carve it up. Indeed, Varzi claims that 'The conventionalist stance simply entails that which of them [the individuals that we may postulate] come to play a role in our life is up to us.'[17] But it seems to me that it is not: we could try to ignore the structure present in the microphysical, but this would render our physical theories quite unable to do the job they were designed to do, namely, they would fail to be predictive. One central aspect

[14] There are elements for a suggestion of this type in John O'Leary-Hawthorne and Andrew Cortens, 'Towards Ontological Nihilism', *Philosophical Studies* 79: 2 (1995), pp. 143–65; Terry Horgan and Matjaž Potrč, *Austere Realism: Contextual Semantics Meets Minimal Ontology* (Cambridge, MA: MIT Press, 2008); and Jonathan Schaffer, 'Monism: the Priority of the Whole', *Philosophical Review* 119: 1 (2010), pp. 31–76. See also Donnchadh O'Conaill and Tuomas E. Tahko, 'On the Common Sense Argument for Monism', in Philip Goff (Ed.), *Spinoza on Monism* (New York: Palgrave Macmillan, 2011), where Schaffer's view is discussed in detail.

[15] The Ghirardi-Rimini-Weber (GRW) theory is one version of a 'collapse' theory of quantum mechanics.

[16] Peter J. Lewis, 'GRW: A Case Study in Quantum Ontology', *Philosophy Compass* 1/2 (2006), pp. 228–229.

[17] Varzi, 'Boundaries, Conventions, and Realism', p. 148.

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of our physical theories is to predict bonding behaviour, such as the bonding of subatomic particles into stable atoms. Since this bonding behaviour is governed by *de re* features of reality, ignoring these features would produce failing predictions.

3. Why Do We Classify Things in the Way We Do?

We already have a fairly good case against extreme conventionalism, as it appears that fundamental particles are very likely candidates for *bona fide* entities. Now we turn to another serious claim, namely that our classificatory schemes are grounded in our psychological biases, *Gestalt* factors that do not represent the structure of reality in any way:

> Consider the debate on unrestricted composition. There is no question that we feel more at ease with certain mereological composites than with others. We feel at ease, for instance, with regard to such things as the fusion of Tibbles's parts (whatever they are), or even a platypus's parts; but when it comes to such unlovely and gerrymandered mixtures as [Lewisian] trout-turkeys, consisting of the front half of a trout and the back half of a turkey, we feel uncomfortable. Such feelings may exhibit surprising regularities across contexts and cultures. Yet, arguably they rest on psychological biases and *Gestalt* factors that needn't have any bearing on how the world is actually structured.[18]

Is there any connection between how the world is structured and our evaluation of things such as trout-turkeys? Varzi argues that there might not be, as even though we initially feel uncomfortable about strange hybrids, we have nevertheless welcomed a variety of genetically manipulated plant-hybrids, such as orange-mandarins. Indeed, our intuitions and feelings of discomfort should not be relied on if we hope to determine the actual structure of reality; it is true that we are biased in our evaluations. However, psychological biases like these have little to do with scientific practice – the very existence of genetically manipulated

[18] Varzi, 'Boundaries, Conventions, and Realism', pp. 144–5.

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hybrids is proof enough. The actual structure of reality quite clearly *does* have a bearing on our scientific practices though.

The case of the trout-turkey might not seem to be directly relevant here. After all, trout-turkeys are not supposed to be results of genetic manipulation. Rather, they are just mereological sums consisting of two disconnected parts, the front half of some trout and the back half of some turkey. How do we evaluate the case of the trout-turkey in this context, then? The answer depends on our take on unrestricted mereological composition. Examples like trout-turkeys and the sum of one's nose and the Eiffel tower could certainly be seen as a *reductio* of unrestricted mereological composition, but we do not need to pursue that line of thought here. In any case, there may be good reasons for our initial, hostile reaction towards such entities: perhaps in these cases composition does *not* occur, there are no such entities.[19] To settle the issue, a thorough discussion of unrestricted mereological composition would be needed, but this is not the place for it. It might be more interesting to consider an example that is neutral in regard to questions of mereology: consider the possibility of a genetically manipulated trout-turkey hybrid.

When we consider what sort of entities could exist, we do not decide this in terms of which entities we feel comfortable with, but rather in terms of which entities are possible. How do we decide which entities *are* possible, leaving unrestricted mereological composition aside? Well, by examining the relevant sub-categories of possibility. In the case of trout-turkeys we would be interested in the *biological* possibility of these creatures, namely whether there could be a DNA sequence that produces trout-turkeys. This is of course (at least partly if not entirely) a matter for biological research. However, the space of possible organisms is also restricted by *physical* possibility, in other words we can rule out creatures that are not physically viable given the actual laws of physics. Some insects above a certain size, for instance, would be ruled out, because their respiratory system would not be able to function in this super-sized form – a trout-turkey would no doubt encounter similar problems!

[19] For more discussion on unrestricted composition, see Tuomas E. Tahko, 'Against the Vagueness Argument', *Philosophia* 37: 2 (2009), pp. 335–40. There I argue that the vagueness argument against restricted composition fails and that we have some good reasons to prefer restricted composition.

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We are now faced with a question: do we have any reason to believe that the analysis of possible kinds of hybrids is based on *Gestalt* factors rather than the actual structure of reality? Admittedly, this analysis is fallible. Something that we believed to be biologically or physically impossible could turn out to be possible after all. This might even be due to *Gestalt* factors. But to claim that there is *no* structure on which our analysis is based is like claiming that a monkey could have written *The Brothers Karamazov.* If you put the monkey in front of a keyboard and it randomly beats the keyboard, it is possible to produce the book in question, but it is not very likely. Similarly, it seems that our classificatory schemes must correspond to *something*, as otherwise they would just be gibberish. How could we possibly come up with such a sophisticated structure by coincidence?[20] More importantly, our current best scientific classification scheme has enormous predictive power: we can predict a huge range of natural phenomena from chemical reactions to the movement of heavenly bodies. This predictive power must be based on something and the obvious explanation is that our classificatory schemes roughly correspond with the structure of reality. Consider an example: Mendeleev's periodic table.

Mendeleev arranged elements into a table by their atomic mass and their chemical properties, which enabled him to predict the existence of a number of yet undiscovered elements as well as the chemical properties of these elements. To start with, Mendeleev had some established empirical information about certain elements, namely their atomic masses and chemical properties. It was a natural thing to do to examine the relationships between the elements. Indeed, other similar attempts were being made around the same time as Mendeleev published his periodic table. What is interesting to us is how effective this system was in terms of making predictions about future empirical observations, namely undiscovered elements. So, the periodic table can be seen as a description of what is possible given certain building blocks. These building blocks are of course our knowledge about the atomic masses and the chemical properties of certain elements.

The modal basis of Mendeleev's work consisted of the different possible states of affairs that could explain empirical observa-

[20] Compare this with the 'no miracles' argument, e.g. Hilary Putnam, *Mathematics, Matter and Method* (Cambridge: Cambridge University Press, 1975).

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tions.[21] The likeliest explanation for the success of Mendeleev's classificatory scheme would appear to be that it is the *correct* scheme, correct in the sense that it corresponds with the structure of reality. This does not mean that we could not reach similar results with a very different classificatory scheme, but there are certain pragmatic reasons to prefer Mendeleev's scheme, including theoretical virtues such as simplicity. However, any scheme that differs from Mendeleev's so radically that it loses predictive power, never mind theoretical virtues, will simply be an incorrect way to characterize natural phenomena.

So, why do we classify things in the way we do? Certainly, psychological biases play a role here, but only a very modest one: we are quick to abandon them if they lack predictive power. If someone were to create a trout-turkey – let us assume that it is possible – we would soon acknowledge it, regardless of how uneasy we might feel about it. Consequently, our classificatory schemes, although always subject to revision, are fundamentally based on the actual structure of reality. It may be that we are unable to ever accurately state what that structure is, but it is nevertheless the basis of our classificatory efforts. It also seems that we are getting better at classifying things all the time, judging by the increasing predictive accuracy of our classificatory schemes.

Presumably, the conventionalist will deny the inference at hand: from the predictive power of our classificatory schemes to their approximate correspondence with reality as it is in itself. The conventionalist will no doubt acknowledge that it would be absurd to abandon the theories that offer best predictive power, but it could still be insisted that this does not mean that our best theories even roughly correspond with reality. Such a Humean position is difficult to refute. The conventionalist can always fall back to the point that there are no a priori reasons to think that our classificatory systems carve reality at the joints. Perhaps this is an unfair objection, as naturally we classify things with reference to empirical feedback rather than solely on the basis of some a priori principles. But is there nothing else that we can say to convince the conventionalist?

Well, perhaps there *are* some a priori principles that guide our classificatory schemes. Fundamental (logical) principles such as

[21] For a more extensive account on the modal basis of such tools, see Tuomas E. Tahko, 'On the Modal Content of A Posteriori Necessities', *Theoria: A Swedish Journal of Philosophy* 75: 4 (2009), pp. 344–57.

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the law of non-contradiction may be the best candidates. If there are such principles, they must be principles concerning *reality* rather than merely our *thoughts about reality*. The conventionalist will perhaps insist that we have no a priori reasons to think that reality rather than our thoughts about reality conforms to the law of non-contradiction, and perhaps we indeed do not have such reasons.[22] However, the alternative is utter scepticism. If this is the route the conventionalist wishes to take, then so be it.

In defence of the realist position, we could reply that even the extreme conventionalist acts as if reality conformed to the law of non-contradiction. Even if there are no a priori reasons to think that this is the case, we can at least build a case for a high probability. As we saw, it would be miraculous if our scientific theories possessed such predictive power by sheer luck. Accordingly, the choice between extreme conventionalism and realism should be easy.

4. Is Our Classificatory System Unique?

Even if we can dismiss utter scepticism, some doubts about just how accurately our systems of classification correspond with reality may remain. After all, the manner in which we classify things surely has something to do with our particular psychological biases, which depend on our rational capabilities and physical characteristics. We are beings of a certain size, our senses are tuned in a certain way, and our brains have a certain capacity. Accordingly, it may be that beings that differ from us in regard to one or more of these features have a very different way of carving up reality.

Let us start with animals. For instance, we know that dogs can hear frequencies that we are not able to hear, and we can see things that they cannot see, namely certain colours. Presumably our rational capabilities also differ substantially from those of dogs. Naturally, there will be striking differences between how dogs perceive and classify reality and how we do. Just how striking will these differences be? Dogs are unlikely to have any grasp of

[22] For an extensive discussion of the interpretation of the law of non-contradiction and a defence of the idea that it is a principle concerning reality itself rather than our thoughts about reality, see Tuomas E. Tahko, 'The Law of Non-Contradiction as a Metaphysical Principle', *The Australasian Journal of Logic* 7 (2009), pp. 32–47.

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atoms or natural kinds, but they do clearly have some grasp of distinctions like edible and non-edible, friendly and hostile, leader of the pack and member of the pack. In other words, there is some overlap between how dogs carve up reality and how we do, even if there are also major differences. Many of these differences are based on physical factors which cannot be overcome, but some of them could perhaps be mapped to correspond with our framework of classification. For instance, a dog would determine what is edible primarily with his sense of smell, whereas we would often have to rely on taste, but the result might still be the same. In any case, the major problem in mapping the dog framework to ours is that dogs do not possess similar rational capabilities and thus their classificatory framework will necessarily be quite rudimentary compared to ours. An open question is whether the dog framework is based on similar methods of classification, such as predictive power. But whatever the basis of their classificatory scheme, we know that dogs have the capacity for learning. Learning takes advantage of the same features of reality that our scientific theories do: regularities that can be predicted.

Perhaps a more interesting example than dogs would be beings of intellect roughly similar to ours. As there are no obvious examples on Earth, we may take some sort of aliens as an example. Let us assume that they have roughly the same brain capacity and are similarly developed compared to humans. These aliens, although their physical constitution is roughly similar to ours otherwise, have no eyesight. Instead, they use sophisticated sonar.[23] Once again, there will necessarily be major differences between our and the alien framework of classification. For one thing, colour concepts would be quite meaningless to the alien species, as their sonar would be to us. However, the important cases do not concern everyday experiences, but scientific classifications. Consider elements: could the aliens have anything similar to the periodic table of elements which is so familiar and important to us? Their means to acquire information about the elements would certainly be different from ours, given that sight plays a major role for us. But then again, things like colour concepts are completely unnecessary for stating something like 'Hydrogen is the lightest element.' If we assume that the aliens

[23] 'Martian sonar' like this has been discussed in Gregory McCulloch, 'What it is Like', *The Philosophical Quarterly* 38: 150 (1988), pp. 1–19.

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have tools fit for their senses that enable them to examine atoms, then it would be strange if they did not have some grasp of what 'the lightest element' means. It does not matter in what way they come to know that there is a lightest element.

Provided that the aliens are at all scientifically minded, they will want to explain the same natural phenomena that we do. They might not have anything like our periodic table of elements though. Perhaps their information about the elements would be arranged in a table according to the sound output that their sophisticated sonar microscope produces. In any case, whatever the format of their table of elements might be, it would still contain information about the relationships between different elements just as the periodic table does. We can assume this with confidence because the relationships between different elements are crucial for an understanding of chemical reactions, which is what any intelligent being would surely hope to acquire. It would be possible for the aliens as it is for us to arrange elements by their electron configuration, and it is likely that the aliens could also predict still unobserved elements with the help of their table, as Mendeleev was able to do with his.

The upshot is that superficial differences between classificatory systems are not important. These differences could, at least in principle, be mapped to correspond – translated to match each other. This is of course possible because the subject-matter of the systems is the same: the elements are the same for anyone who might wish to observe them. It is not relevant whether we would be able to perform the translation; all that matters is that there is a theoretical correspondence.

One further objection could be raised about both of the previous examples, as they deal with beings roughly the same size as us. An important limitation to the way we perceive the world is indeed our physical size. If there were beings, say, the size of atoms or the size of galaxies, they would surely have a thoroughly different point of view towards reality.

On the face of it, this is correct. Atoms and galaxies differ so radically from us in terms of size that we can barely comprehend just how small and large they are, respectively. Only some hundreds of years ago we did not even know about things like atoms and galaxies, and our system of classification did not, of course, include them. We only classified things that we could observe and understand. In this sense we indeed had a psychological bias dependent on our physical size. However, now we *do* know about

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atoms and galaxies, and even about entities much smaller and larger than these. We may not be able to fully grasp the scale of these things, but we can express it accurately in numerical form and in comparison to our own size. In fact, our most important classifications now arguably concern things that are either vastly smaller or larger than us.

The question is, would beings much smaller or larger than us classify things in the same way as we do? Well, naturally they would face the same initial limitations due to their size as we did, but what if they did have some means to observe the same scale that we do? It seems to me that the answer is very clear: at first any kind of intelligent beings would be most interested in things of roughly similar size to themselves. But if they had the means to observe the same scale as we do, they would certainly wish to classify things falling into that scale. It is obvious that there would be differences in all three systems of classification – ours, the atom-sized beings, and the galaxy-sized beings – but once again it should be at least theoretically possible to map these differences so that the systems would correspond. This is because each system, provided that we could observe the same scale of things, would no doubt have roughly the same number of different *kinds* of entities. Each system would perhaps be more detailed in regard to its own scale, simply because it is easier to observe things roughly of our own size, but we would of course be more than happy to amend our own system of classification to accommodate any details that we might learn from the systems of the atom-sized beings or the galaxy-sized beings.

Yet another concern related to our physical size, and perhaps also to our perception of time, is that our conception of the persistence conditions of certain objects may be very different from the conception of creatures much smaller and larger than us, or creatures much more short- or long-lived than us. For instance, we would perhaps consider a lake to be unable to survive complete evaporation of all the water it is composed of. The lake has dried, even though the water is simply undergoing its natural cycle and will eventually rain down somewhere. But for some very short-lived, microscopic beings, tiny water droplets invisible to the naked eye might be rather similar to how lakes are for us. Yet, we would hardly consider anything to have been lost if such a water droplet were to evaporate – after all, this happens all the time in the natural cycle of water. Similarly, for some extremely long-lived and large creatures lakes might be quite like the tiny water droplets are for us.

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Perhaps there are indeed some psychological biases here which cannot be overcome, as certain objects will simply not have a similar relevance for us and for beings of a very different size or temporal persistence. However, the fact that we might not pay much attention to tiny water droplets does not mean that they are not included in our ontology in some sense. We might not count them as *bona fide* entities, and the argument at hand may be reason enough to dismiss lakes as *bona fide* entities as well. But it is certainly not enough to motivate extreme conventionalism. In any case, I take it that two object-candidates which have the same properties save for size would presumably have the same (or nearly the same) persistence conditions as well. The problem is to produce a plausible story about when composition occurs, but that is something that we cannot settle here.

Admittedly, the whole scenario is rather strange: it does not appear that intelligent beings of the size of atoms or galaxies are possible. Then again, this might just be a psychological bias due to our physical size! At any rate, we do know that there are organisms so small that we cannot observe them with the naked eye. It may also be that, say, for beings the size of atoms, it would be physically impossible to observe anything much larger than themselves. Thus, if they were intelligent, their system of classification would be bound to atom-sized things, rendering it fundamentally alien to us. Nevertheless, although size and perceptual capabilities play a central role in our classificatory schemes, they can at least to a large extent be overcome with the help of tools, such as the microscope and the telescope. So they are nothing more than a hindrance. The list of entities waiting to be classified is the same for everyone – size does not matter.

5. Realism Refuted?

Where do we stand now that we have discussed three major conventionalist lines of criticism against realism about classification? Not far from where we started. The conventionalist will need some fairly strong arguments to undermine realism, for the alternative is not particularly attractive. As Varzi admits: 'Surely the *intuitive* plausibility [of the conventionalist stance] is pretty low, and perhaps also its scientific tenability.'[24] Varzi claims that convention-

[24] Varzi, 'Boundaries, Conventions, and Realism', p. 148.

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alism nevertheless has some philosophical advantages, but these would need to be demonstrated thoroughly to give conventionalism any hope of overcoming its initial implausibility. Furthermore, the arguments that we have discussed appear to be inadequate to undermine the plausibility of realism.

We have seen that our system of classification is fundamentally grounded in reality. We can state this with some confidence, as otherwise this system would hardly be so reliable. It is an open question which entities are genuine, *bona fide* entities; we need philosophical inquiry as well as science to determine this. We saw that fundamental particles, whatever they are, are likely candidates for *bona fide* entities – otherwise macroscopic objects would not be possible. Furthermore, although intelligent beings different from us might have very different systems of classification, their systems as well must share the same basis. In conclusion, realism about classification stands its ground: all major lines of criticism available to the extreme conventionalist can be addressed.

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