

Chemical Kinds: Modal Conventionalists Can't Have Their Cake and Eat It Too

Mary Gwin
San Diego Mesa College

INTRODUCTION

The idea behind modal conventionalism, at least as Alan Sidelle (1989, 2009) sees it, is that linguistic conventions bear the modal responsibility for essences, rather than the more commonly held view that propositions bear this responsibility. To get an idea of what I am talking about consider the following sentences.

- (1) Water is H₂O.
- (2) Water is XYZ.
- (3) L'eau est H₂O.

What I take to be the standard view is that the propositions expressed in either of the sentences bear the modal properties and truth values for the sentences, and sentences merely express propositional content. Thus, (3) expresses the same proposition as (1) with the same truth value, modal properties, and content, and the difference in expression is a matter of convention. However, (2) expresses a different proposition with a differing truth value, modal property, and content. Sidelle, on the other hand, sees it differently. On his view, linguistic conventions play an important role in “[roping] off portions of reality” (Sidelle, “Conventionalism and the Contingency of Conventions” 235), whereby our linguistic conventions determine essences for objects, and therefore determine

modality. So, (1) and (3) are necessarily true on Earth because we have fixed the essence of water as H₂O through both our scientific and non-scientific linguistic conventions. On Putnam's Twin Earth where linguistic conventions differ, (2) is necessarily true because Twin Earthers have fixed the essence of water as XYZ through their linguistic conventions.¹ Both Earthers and Twin Earthers are right about the essence of water, but this is a problem that runs deeper than it might appear at first. Sidelle thinks that Earthers and Twin Earthers are not just right in the sense that their terms refer in their respective worlds, but they are also metaphysically right. That is, neither Earthers nor Twin Earthers are metaphysically mistaken.

The purpose of this paper is to give an argument against Sidelle's conventionalism. Sidelle thinks that our linguistic conventions not only carve nature at the joints, but also determine the joints at which we do the carving, and I think he gives too much authority to linguistic conventions. Kinds in science, though sometimes hard to pin down, resist Sidelle's conventionalist carvings. My argument will proceed in two sections. In the first section, I will briefly give Sidelle's argument for his version of conventionalism. In the second section, I will discuss Hendry's (2006) semantic and historical argument for elements as natural kinds. I argue that considerations of elements as natural kinds show that linguistic conventions cannot carve nature at the joints. While linguistic conventions can "rope off portions of reality" (as Sidelle says) at some macro-levels of description, they cannot do this at the elemental level.

I. Sidelle's Argument

Conventionalism holds that since linguistic conventions are arbitrary, we could have used alternate conventions to generate alternate truth values for the same counterfactual and modal sentences that we actually use and suffered no real gain or loss in our understanding of reality. For example, consider the proposition, "All bachelors are unmarried males." Because we have defined "bachelor" to mean "unmarried male," the sentence, "All bachelors are unmarried males" is a necessary truth that is grounded in our linguistic convention of defining "bachelor" as an unmarried man. This same principle is supposed to apply to all other necessary truths as well, including truths regarding natural kinds and all the other necessary *a posteriori* truths, and I will address specifics about these momentarily.²

The metaphysical commitment behind Sidelle's conventionalism is that "all necessity is *grounded* in our conventions, that there is no necessity 'out there'." (Sidelle, *Necessity, Essence, and Individuation* xi). Alternatively, "what is necessary, or essential, is so because of our conventions, our ways of conceiving and/or talking about the world." (Sidelle, "Conventionalism and the Contingency of Conventions" 224). Meanings that we give terms constrain the application of those terms, and those constraints apply even in counterfactual situations. For

example, part of what it means to be a bachelor is being male. Under our current conventions, “bachelor” only refers to males and nothing else. So, “All bachelors are unmarried men” is true, necessary, and necessarily necessary. Our conventions and rules determine when the term “bachelor” is correctly applied. However, if we were to ask whether or not “All bachelors are unmarried males” is true, necessary, and necessarily necessary under alternate conventions, such as might be the case if women were counted as bachelors, we would answer in the affirmative. This is in part because the application of our term, “bachelor,” is constrained by the meaning that we give it and in another part because the alternate conventions in that situation, the situation in which women can be called bachelors, have no bearing on the truth or modal status of our statements (229-231, 233). Our linguistic convention grounds both the truth and the modal status of the proposition. This is so because according to Sidelle we are not considering irrelevant alternatives that have no bearing on the truth or modal status of the proposition containing the term as we use it, even counterfactually. And, what grounds the conventionalist evaluation of counterfactual situations like the one described is our semantic rules (233). Our semantic rules tell us that only males (and nothing else) are bachelors. When we consider alternate conventions where the extension of “bachelor” includes women, we are, in effect, considering alternate possible worlds. In those worlds, other semantic rules apply and ground those counterfactual situations in those worlds. “Bachelor” in our world and “bachelor” in that other world have different extensions, and are therefore merely homophones (232-233).³

Sidelle’s epistemological commitment is that we can deduce modal truths from non-modal truths in conjunction with *a priori* principles (Yablo 879). “All bachelors are unmarried males” poses no real problem here because this sentence is true by definition. The problematic sentences are *a posteriori* necessities. We cannot know these truths by reflection only. We have to look at the world. But, if there is no necessity “out there” and conventions “rope off portions of reality,” how can we deduce these truths simply from non-modal truths and *a priori* principles?⁴ Here is the general idea behind Sidelle’s commitment (*Necessity, Essence, and Individuation* 30-38). Consider (1) above. The non-modal fact is water is a chemical kind with a microstructure H_2O . The *a priori* principle is a principle of individuation (PI) where x ranges over anything and P-property is a kind of property (e.g. microstructure) of which p is an instance.

PI: $\forall x$ (If x belongs to kind K , then if p is x ’s P-property, then it is necessary that x is p)

To derive that it is necessary that water is H_2O requires a little work, but Sidelle thinks it can be done. Here is how it might look. Assume that to be a member of chemical kind requires a certain microstructure. Then:

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$\forall x$ (If x is a chemical kind, then if x has a certain microstructure, then it is necessary that x is that microstructure).

Assume that water is a chemical kind and has H_2O as its microstructure, instantiating gets us (4):

(4) If water is a chemical kind, then if H_2O is water's microstructure, then it is necessary that water is H_2O .

If we assume that "water is a chemical kind" is an analytic sentence, then using modus ponens we get

(5) If H_2O is water's microstructure, then it is necessary that water is H_2O .

Finally, with another iteration of modus ponens (and the assumption that H_2O is water's microstructure) we get our modal sentence (6)

(6) It is necessary that water is H_2O .

Now with the two commitments laid out we can see that Sidelle thinks that natural kind terms like "water" are arbitrary in the way that all conventions are arbitrary. All conventions are arbitrary in the sense that other conventions would have served our practical interests in the same way, and there is no gain or loss in our understanding of reality by using other conventions. This is because there is no "metaphysical mistake" when other conventions are used (Sidelle, "Conventionalism and the Contingency of Conventions" 234). For example, there is no metaphysical mistake if Twin Earthers use the term "water" to refer to XYZ because "water" which refers to H_2O and "water" which refers to XYZ have different extensions, though the extensions of the terms share common, superficial properties (e.g. the stuff that falls from the sky, fills lakes, is drinkable and life sustaining, etc.) (234). The terms are untranslatable between worlds, so our sentence (1) is true and necessary and (2) is false for us, while for Twin Earthers (1) is false and (2) is true and necessary since Twin Earthers derive their necessary *a posteriori* sentences in the same way that we derive ours.⁵ Additionally, referential intentions matter regarding individuation principles. For those who may think that Twin Earth 'water' is not water, it is because of the intention to refer to "whatever is like *this* (glass of water) in respect of microstructure, or deepest causal features." (Sidelle, *Necessity, Essence, and Individuation* 111).

I find this highly problematic because natural kind terms are special in a relevant way that Sidelle fails to recognize. Natural kind terms are supposed to refer to natural groupings that are independent of human cognition, governed by laws of nature, permit inductive inferences, have intrinsic properties, etc. Since

Sidelle thinks that conventions generate essences, this makes mind-independent reality depend importantly on conventions. Assuming that natural kind terms refer to groupings of things that are mind-independent, governed by natural laws, have intrinsic properties, etc., necessities involving “water” and other terms like it cannot work in the same way that necessities involving terms like “bachelor” do. “Bachelor” denotes an object, the unmarried man, determined by definition. “Water” denotes a substance with an essential feature-H₂O. To be sure, Sidelle thinks that our linguistic conventions determine this essential feature, but I think he is wrong. Natural kinds are things that have if not essential, then necessary properties independent of our linguistic conventions.

III. ELEMENTS, CONVENTIONS, AND LIMITS

I think that the strongest case for the mind independent existence of natural kinds is made for elements as natural kinds via their microstructures. Microstructuralism is the view that membership in a kind is determined by relevant, necessary microstructural properties. In order to be a member of the kind in question, the substance must have whatever microstructural properties are required for membership. For example, in order for a substance to be hydrogen, it must have the microstructural property of having one proton in its nucleus.

Chemistry, the scientific discipline concerned with matter and its components, is somewhat unique as a scientific discipline because of its unity regarding certain classifications. For example, all chemists classify a substance as a particular element by the number of protons in its nucleus (i.e. its actual nuclear charge). This was decided in 1923 by the International Union of Pure and Applied Chemistry (IUPAC) after significant debate. Prior to the IUPAC’s decision, Mendeleev identified the property that determines chemical behavior (and consequently the property that makes an element an element) to be atomic weight (Hendry 867). Even after the 1923 decision, there was debate about classification over nuclear charge vs. atomic weight (Hendry 867), but for now (and for a good while) the discipline is (and has been) unified regarding the issue of element definition. For a substance to be an element of kind K, it must have a specific actual nuclear charge, so having a specific actual nuclear charge is its necessary property. Contrast this unity with biology, for example. Biologists are famously divided about species classification. One group classifies species according to the ability to interbreed with other members of kind and inability to breed with members outside of the kind (Mayr 26-27), while another group classifies species according to common ancestral descent (Mayr 27-28). Leaving aside the issue of whether species are natural kinds and understanding that these are just two ways one can define a species, these two examples alone show the disunity of biology regarding the concept of species.

A good argument for microstructuralism about elements is Hendry’s (2006)

historical and semantic argument. His argument proceeds like this. Lavoisier's 1789 table of binary combinations of substances, which excludes phlogiston and includes oxygen and caloric in its place (along with the accompanying binomial nomenclature of substances), broke away from the common means of the classification of substances at the time. In that table (and the work in which the table is found, the *Traite*), Lavoisier uses two distinct conceptions of "element." The first is explicit and analytic: substances are considered "simple" until experiment and observation show that they are not (Hendry 866). The second, implicit conception is found by analysis of the role of oxygen in his theory of acidity (Hendry 866): substances are considered "simple" when they are a component of other substances, they survive chemical change, and their presence explains chemical and physical behavior of compounds (Hendry 866). Later in the 19th century, Mendeleev made use of both conceptions of "element" in his classification of substances according to atomic weight (Hendry 867). By the time the IUPAC made its decision regarding the definition of "element," the formerly implicit notion of element was now explicit, and the decision regarding how to define "element" came down to what the necessary property was (i.e. actual nuclear charge or atomic weight).

Now, the question for someone defending realism about natural kinds is: was Lavoisier able to determinately refer to the substance that he identified as oxygen? That is, does the issue of semantic indeterminacy arise since the definition of "element" was stipulated by the IUPAC long after Lavoisier named the substance? These questions are important because if Lavoisier was able to refer, then he was referring to a substance with a necessary property that at the time conventions did not designate. The answer to the first question is "yes" and the second question "no" because of Lavoisier's referential intentions. Given his implicit and explicit conceptions of element this is clear. He intended element names to refer to these "simple" substances irrespective of their differing states of chemical combination (Hendry 869). He also assumed that the presence of an element explains the chemical and physical properties of a compound (Hendry 869). Of the properties that are now known about elements, the one that determines chemical behavior of elements and their compounds most significantly is actual nuclear charge via the electron shell (Hendry 869). Hence, given the laws governing the causal processes that Lavoisier was interested in explaining in his theory of acids, his intentions uniquely pick out actual nuclear charge as the significant similarity relation between elements (Hendry 869).

Given Hendry's argument, I think it is difficult to accept Sidelle's metaphysical commitment. If Lavoisier was able to refer only to a substance with a necessary property of which he was not aware (i.e. actual nuclear charge), then what conventions did he have to ground this necessity? One response to this might be that he intended to refer to the substance with the qualitative properties his conventions would allow and not the property, so he had no modal assumptions or

intentions regarding actual nuclear charge. But, this response is more of a response to an attack on Sidelle's epistemological commitment and not his metaphysical commitment, making it an accident that his conventions "roped off" the same portion of reality that we do today. Perhaps another response is to point out that I am begging the question. For nuclear charge to be a necessary, mind-independent property of an element, it is a matter of convention now because this is the twenty-first century. Since Lavoisier we have adopted the conventions that matter is divided into parts, some of these parts are elements, elements as substances cannot be divided into other elements, but can be divided into parts which are not elements, one of the necessary parts of an element is a proton, etc. This is our convention now, and as we know, conventions change. So, though Lavoisier was able to refer to the same "stuff," his conventions were different. The property that we take to be necessary for an element to be of the kind that it is was not necessary for Lavoisier. But, this seems wrong. If it is true that nuclear charge is responsible for the chemical behavior of compounds and Lavoisier was able to refer, then it is clear that the necessary causal property of the compound is present whether I have a convention for it or not. For example, an acid will react with a base whether I have conventions governing the reaction or not as in the reaction between copper oxide with sulfuric acid to produce copper sulfate.

What does Hendry's argument do to Sidelle's epistemological commitment that we can deduce modal facts from non-modal facts plus *a priori* principles? It depends. If you are a Humean about necessity, then nothing. The non-modal fact that oxygen is a simple substance that survives chemical change and is responsible for the chemical behavior of (some) acids plus an *a priori* principle like:

$\forall x$ (If x is a simple substance, then if x is responsible for certain chemical behavior, then it is necessary that x is responsible for that behavior)

can get us a modal sentence if we go through the derivation, and this fits with our conception of where necessity lies. But, I think this is wrong—Hendry's argument shows more. If Lavoisier really did refer to oxygen, prior to the IUPAC's decision, then he was referring to a substance with a necessary property of which he could not be aware. Our conventions were not available to him. Given requirements for what counts as knowledge, Lavoisier may not have known that he was referring to oxygen, but he was referring nonetheless. The property (actual nuclear charge) being necessary for that substance to be the substance that it is (was) is independent of the conventions that we have then and now. We might be able to derive the modal truth according to the fact plus the *a priori* principle, but the fact is modal because modality is in the world. Conventions may help us carve up the world in useful and meaningful ways, but there are limits—physical and causal laws, objects, and substances.

NOTES

1. Cf. Hillary Putnam, “Meaning and Reference.” Twin Earth is exactly the same as Earth, except that the liquid called “water” is not H₂O, but XYZ. XYZ has the same superficial properties (e.g. the stuff that falls from the sky, fills lakes, is potable, etc.). The differences between earthen water and Twin Earthen water are microstructural.

2. Cf. Alan Sidelle, *Necessity, Essence, and Individuation* for a thorough defense of modal conventionalism.

3. S4 is preserved because the terms have different extensions, so the sentences containing those terms represent different states of affairs in different worlds.

4. Here is the relevant quotation from Sidelle:

What is conventional is not “just” what meanings or rules we assign to our terms. It is how, with these terms, we rope off portions of reality, where the boundaries are not, and cannot, be given, aside from our deciding that this term, or concept, applies under these conditions, but not those. It is true enough to say that if we had settled on those boundaries for the extension of our term, we would have designated a different object or property. But, we need not attribute this to the independent existence of such a differently individuated object or property. It is enough that the rules of translation, and our understanding of what “individuation” *means*, tell us that what is differently individuated counts as a different item. Thus, the reason—according to the Conventionalist—that what is essential would not change with different conventions is due to what these conventions *govern*. It may just be the use of words, in the first instance—but in its effect, it governs what portions of possible reality count as single objects, and count as the same ones in different situations. Thus, while the Realist wants to assign the real modal work to mind-independent propositions each with their own mind independent modal status, the Conventionalist sees even the individuation of these propositions—and consequently, their status—as itself not independent of our conventions. And the reason our conventions nonetheless count as *explaining* what is essential, is that there is nothing independent for the conventional choices to answer to. Things could have been just the same aside from our choice of meaning—of how to bound the application or our words—and the same sentences would be modally different, even though they were response to the same reality. (Sidelle 235-236)

5. S4 is preserved because “water” has different extensions in different worlds, and the term is merely homophonic between worlds.

WORKS CITED

- Hendry, Robin Findlay. “Elements, Compounds, and Other Chemical Kinds.” *Philosophy of Science* 73.5 (December 2006): 864-875. Print.
- Mayr, Ernst. *Principles of Systematic Zoology*. New York: McGraw Hill, Inc., 1991. Print.

- Putnam, Hillary. "Meaning and Reference." *Journal of Philosophy* 70.19 (1973): 699–711. Print.
- Sidelle, Alan. "Conventionalism and the Contingency of Conventions." *Nous* 43.2 (2009): 224-241. Print.
- Sidelle, Alan. *Necessity, Essence, and Individuation: A Defense of Conventionalism*. New York: Cornell University Press, 1989. Print.
- Yablo, Stephen. Rev. of *Necessity, Essence, and Individuation: A Defense of Conventionalism*, by Alan Sidelle. *The Philosophical Review* 101.4 (October 1992): 878-881. Print.

