

On the Metaphysical Status of Modal Statements

TUOMAS E. TAHKO (www.ttahko.net)

DRAFT ONLY, PLEASE DO NOT CITE WITHOUT PERMISSION

ABSTRACT

Deflationism about modality suggests that modal statements can be analysed strictly in terms of linguistic content, and that *apriority* reduces to analyticity. Scott Soames is explicitly opposed to this trend and I sympathise with this approach. However, a detailed study of Soames' own account reveals that it has striking similarities with the deflationary account. In this paper I will compare Soames' account of *a posteriori* necessities with the deflationary one, specifically Alan Sidelle's account, and suggest that Soames' account is vulnerable to the deflationist's criticism. I will then sketch a more fine-grained, essentialist account using the case of water and H₂O as a case study. With reference to some recent work in the philosophy of chemistry, I will argue that both the deflationary account and Soames' account fail to fully explicate the metaphysical status of modal statements, partly due to the very simplified manner in which philosophers commonly analyse *a posteriori* necessities such as the ones concerning chemical substances.

1. Introduction

In his *Reference and Description: The Case Against Two-Dimensionalism* (2005), Scott Soames put forward an influential critique of the framework of two-dimensional modal semantics and the interpretation of *a posteriori* necessities proposed by proponents of the framework, especially Frank Jackson (1998) and David Chalmers (1996). While I agree with much of what Soames has to say about the topic, I am concerned that ultimately both Soames and the two-dimensionalists neglect the fine-grainedness of the metaphysical status of modal statements. The origin of the problem is partly due to the short-comings of Kripke's (1980) original treatment of *a posteriori* necessities, and partly due to the recent deflationary trend, according to which the basis, or source, of modality is linguistic or conceptual. The latter is familiar from the work of Jackson and Chalmers, as well as Alan Sidelle (1989, 2002).

On the face of it, Soames is clearly opposed to this trend, as he thinks that Kripke's most important achievement was to break the illusion that the *a priori* can be identified with the analytic, and that modality is merely linguistic:

In my opinion, none of Kripke's many achievements is more important than his breaking the spell of the linguistic as the source of philosophically important modalities. In other work, I have tried to identify significant arguments of leading figures in the twentieth century that come to grief over the implicit identification of the necessary and the *apriori* with the analytic. However, there is more at stake than a collection of particular arguments. As long as these modalities are seen as varieties of *truth in virtue of meaning*, while meaning itself is viewed as essentially transparent to competent speakers, there will be no credible alternative to the old, confining orthodoxy of philosophy as linguistic analysis. (Soames 2006: 307.)

Soames claims that any kind of interesting philosophy will not fit into this deflationary, linguistic model. Hence, there is little doubt that Soames is very much opposed to the deflationary line, and not only on linguistic grounds concerning meaning or content. Soames is explicit in his

commitment both to non-linguistic modalities and the non-linguistic *a priori*. I sympathise with this approach, but it seems to me that Soames fails to fully commit to it himself. E. J. Lowe (2007a, 2007b) has raised similar concerns about the shortcomings in Soames' metaphysical story, but so far Soames has not replied to them in any detail (cf. Soames 2007). The closest that Soames comes to addressing the metaphysical status of modal statements are the last three chapters of his earlier book, *Beyond Rigidity* (2002, ch. 9–11). We are especially interested in his analysis of the difference between the following identity sentences:

[1] For all x, x is a drop of water iff x is a drop of a substance molecules of which contain two hydrogen atoms and one oxygen atom.

[2] For all x, x is a drop of water iff x is a drop of the substance instances of which fall from the sky in rain and fill the lakes and rivers. (Soames 2002: 272.)

Presumably, (1) is metaphysically necessary, while (2) is contingent. Soames takes a point from Nathan Salmon (2005), which I believe to be of crucial importance for this analysis: what makes (1) a *metaphysical* necessity, if anything, is the underlying assumption concerning chemical substances, namely, that they have their molecular structures essentially (Soames 2002: 273). Now, Soames goes on to ask: 'What exactly are substances, and how do we arrive at our modal intuitions (pretheoretic beliefs) regarding them?' (ibid.). This is of course where one ought give the metaphysical story, but, as we will see, the story that Soames gives is remarkably close to the one familiar from his supposed opponents. We will take Alan Sidelle's analysis of *a posteriori* necessities as an example.¹

In addition to an inquiry into Soames' account of modal statements, I will offer a more detailed analysis of the metaphysical assumptions associated with modal statements and argue that the metaphysical story is much more fine-grained than Soames appears to suggest. The elements of the

¹ I will omit a detailed discussion of Jackson's and Chalmers' views, as I hope to avoid the complications introduced by the framework of two-dimensional modal semantics, which both of them rely on.

metaphysical story are indeed already familiar from Salmon (2005), but there is much more to be said about e.g., the status of chemical substances, and it seems to me that Soames does not do justice to Salmon, who *did* recognize the complexity of the underlying metaphysical story (p. 176 ff.). Relying on recent work in the philosophy of chemistry (e.g., Hendry 2006, Needham 2008), I will attempt to show that a more satisfactory account about the underlying metaphysical assumptions concerning chemical substances is available. We will see that there are some good reasons to think that the assumption according to which chemical substances have their molecular structures essentially may even be mistaken. Some of the problems that will be discussed go back to van Brakel (1986), but the metaphysical implications remain to be specified.

The upshot is that although Soames is on the right lines in challenging the conceptualist or deflationary approach to modal statements, his own account also fails to fully explicate their metaphysical status.

2. Soames' account of the necessary *a posteriori*

Consider Soames' reconstruction of the Kripkean picture of the necessary *a posteriori*:

Let p be a true proposition that attributes a property (or relation) F to an actually existing object o (or series of objects), conditional on the object (or objects) existing (while not attributing any further properties or relations to anything). Then, p will be an instance of the necessary *a posteriori* if (a) it is knowable *a priori* that F is an essential property of o , if F is a property of o at all (or a relation that holds essentially of the objects, if F holds of them at all), (b) knowledge of o that it has F , if it exists (or of the objects that they are related by F , if they exist) can only be had *a posteriori*, and (c) knowing p involves knowing of o (or of the objects) that it (they) have F , if it (they) exist at all. (o can be an individual or a kind.) (Soames 2006: 293.)

The key here is condition (a).² Soames says very little about what condition (a) is supposed to

² See also Soames (forthcoming B).

amount to, but if there is to be any genuinely *metaphysical* content in *a posteriori* necessities, then surely condition (a) will be where this content is to be found, as it involves *a priori* knowledge about essential properties. So, if we consider the classic case of water and H₂O, how does condition (a) pan out? Well, suppose that ‘water’ designates an abstract natural kind (rather than any particular instance of water), and we know that water has the property of being a unique substance instances of which are made up of H₂O molecules (if water exists). If it is knowable *a priori* that this property is essential – even though empirical work was needed to determine what the instances of water are made up of – then ‘Water is H₂O’ is an example of an *a posteriori* necessity. This is the Kripkean account of *a posteriori* necessities according to Soames (2006, forthcoming B). In fact, Soames suggests that there are two different routes to *a posteriori* necessities in Kripke’s work, but he thinks that only the one presented above is sound, so we shall focus on this case.

It is not Kripke’s analysis of the necessary *a posteriori* that we are examining though, but rather Soames’ own position. What is his take on the case of ‘Water is H₂O’? From his *Reference and Description*, we find an interesting passage concerning Putnam’s Twin Earth scenarios:³

I don’t know enough chemistry to be able to tell you whether any of the metaphysically possible molecular structures we are aware of—significantly different from H₂O but constructed out of basic elements we know about—could reproduce all the normal observational and functional properties of water. Surely, it can’t be ruled out *a priori* that there are none, and philosophical discussions of this issue never specify empirical reasons for ruling this out. Thus, it is not obvious—to me at least—that Putnam’s familiar scenarios represent genuine metaphysical possibilities. (Soames 2005: 191.)

So, Soames seems to suggest that the existence of metaphysically possible molecular structures that could replicate the chemical properties of H₂O is a question for empirical research, not metaphysical *a priori* work. This is presumably what condition (c) of the previous analysis amounts to, at least on a charitable reading of Soames: if chemists can determine that to produce the

3 See Putnam (1975).

chemical properties of water – which are necessary for the existence of water – it must have the molecular structure H_2O , then ‘Water is H_2O ’ is necessary *a posteriori*. But here Soames emphasises the importance of the empirical part of the story rather than condition (a), where we presumably find the essentialist, metaphysical content of the story. For one thing, chemistry is surely unable to provide us with any definite results about what is metaphysically possible. It is true that we should look into chemistry to aid us in our pursuit of metaphysically possible scenarios – and this is exactly what we will do in what follows – but surely it is only metaphysical *a priori* work which can determine what is *metaphysically* possible, since metaphysical possibility also encompasses non-actual possibilities. However, the passage above suggests that it cannot be ruled out *a priori* that compounds other than H_2O have water-like properties.

There is a risk of confusion here, as the *a priori* content of the story can be understood in two rather different ways:⁴

1. We know *a priori* that chemical substances have only one metaphysically possible instantiation which produces the chemical properties of that substance.
2. We know *a priori* that chemical substance A is identical with chemical substance B iff they share their molecular composition.

Soames clearly thinks that (1) is not correct, as he explicitly states that we cannot rule out scenarios where XYZ produces all the observational and functional properties of water. I actually agree with this, but more on that later. However, the Twin Earth scenarios seem to concern (2) rather than (1), since what is at stake are our intuitions in cases where we *do* encounter substances such as XYZ, which replicate the chemical properties of water. Now, in the Twin Earth scenarios it is assumed that a substance such as XYZ is metaphysically possible – that is, it is metaphysically possible that XYZ produces the chemical properties of H_2O – and the question is simply whether

⁴ I do not mean to suggest that Soames is confused about this, but the distinction will be important in what follows.

we would call this substance water. Soames is right to draw attention to the metaphysical possibility of another compound replicating the properties of water, but this is not simply a question for chemistry, contrary to what he seems to suggest. Because the Twin Earth scenarios are clearly concerned with (2), it may appear that this is all that we need to consider, and the majority of the literature does just that. Soames as well only mentions the other possible reading in passing. However, in section four I will argue that according to the essentialist line that Soames claims to be sympathetic to, the metaphysical status of modal statements such as the *a posteriori* necessity of ‘Water is H₂O’ boils down exactly to *a priori* content in the sense of (1) rather than (2).

First, let us examine in detail how Soames accounts for the *a priori* part of the story. It is in chapters 9–11 of his *Beyond Rigidity* (2002) that Soames pursues this topic. As I mentioned in the introduction, the identity sentence which Soames is analysing is the following:

[WID] For all x , x is a drop of water iff x is a drop of a substance molecules of which contain two hydrogen atoms and one oxygen atom. (ibid., 272.)

Soames describes how we introduce a natural kind term such as ‘water’ with the intention that it is a ‘substance term’, i.e., applies to everything that shares the molecular structure in the original sample that we decided to call ‘water’. However, we do not need to know what that structure is when we introduce the term, all that matters is that we intend to use the notion in a way that respects the original intuition, namely that we are interested in the deep structure of water rather than its contingent features, such as the fact that it rains from the sky. We may subsequently learn more about the substance in question, e.g., that the deep structure of water is H₂O, but this is the point where the metaphysical story ends (cf. Soames 2002: 273–275).

There are some obvious problems with this simplified account, which is why Soames goes on to refine the account somewhat: he suggests that we should not identify natural kinds with properties, but rather with intensions: ‘functions from worlds to extensions’ (ibid., 277). This gives us a revised

account:

[I]t seems plausible to suppose that just as knowing that the F is G is not in general enough to know of the object o that is denoted by the description that o is G, so knowing that x is a drop of a substance molecules of which contain two hydrogen atoms and one oxygen atom is not enough to know of the intension I_w (i.e., the kind water) determined by the compound predicate that x is an instance of I_w . If this is right, then [WID] is both necessary and a posteriori. (Soames 2002: 278.)

This, combined with what Soames calls ‘Extended Millianism’ – namely, the thesis that a simple natural kind predicate’s meaning is the natural kind which it designates – gives us a fairly good idea of Soames’ view of the metaphysical status of modal statements. The key element in his view appears to be that identity sentences like (WID) are *linguistically* guaranteed to be necessary if true, that is, we know *a priori* that if water is H_2O , then water is necessarily a substance molecules of which contain two hydrogen atoms and one oxygen atom. In terms of semantics, there are obvious complications in identifying water (the liquid) with H_2O , since water comes in many forms, such as ice and steam, but these complications can be addressed if we take into account that ‘water’ can be interpreted as referring either to the substance water, i.e., as a singular term, or as a mass term – we are interested in the substance water which encompasses all forms of it (cf. Soames 2002: ch. 11). So, the *a priori* part of the story seems to appeal to our Twin Earth intuitions, as noted in the second interpretation of the relevance of the *a priori* part above. In fact, this is why Soames also thinks that some supposed examples of the necessary *a posteriori*, such as the identity sentence ‘Woodchucks are groundhogs’, and also identity sentences concerning co-referential names, such as ‘Hesperus is Phosphorus’, are in fact examples of the necessary *a priori* (ibid., Soames forthcoming B).⁵ After considering all these caveats, Soames concludes as follows:

[S]ome but not all necessary theoretical identity sentences involving natural kind predicates may be

⁵ But see [Author’s article 2].

regarded as linguistically guaranteed to be necessary if true in the following sense: the claim that they are necessary is a consequence of the assumption that they are true, together with a description of their semantic properties (including the claim that the natural kind predicates they contain have been successfully introduced in a manner fulfilling the semantic presuppositions governing their introduction). (Soames 2002: 306.)

Regarding the case of ‘Water is H₂O’, Soames clarifies that he does not think that ‘water’ and ‘H₂O’ mean the same thing, as the latter is semantically complex and rather means something like: ‘*something molecules of which consist of two hydrogen atoms and one oxygen atom*’ (ibid., 308–309). Accordingly, Soames thinks that the previous analysis does apply to ‘Water is H₂O’ and goes on to give a summary of the relevant semantic presuppositions, as follows (cf. Soames 2002: 310):

- (i) The nondescriptiveness of both the natural kind predicate ‘water’ and the abstract singular term ‘water’.
- (ii) The ostensive stipulation which fixes the predicate to apply to instances of the substance water, and the abstract singular term to designate that substance.
- (iii) The treatment of substances as physically constitutive kinds.
- (iv) The interpretation of predicates concerning chemical substances as specifying possible kinds.

In short, this is a story about how we use the term ‘water’ and how it is related to the empirical finding that the chemical substance water has the molecular structure H₂O. Now, it seems that we could sum up Soames’ account roughly as follows: ‘water’ designates a unique substance, the microphysical structure of which, whatever it is, is shared by the samples of water that we ostensively stipulate to be water. However, this would appear to be an analytic principle concerning the linguistic usage of the term ‘water’ rather than a metaphysical *a priori* truth. Nevertheless, this

is indeed very close to how Soames sometimes puts it:

‘Water’ was stipulated to designate whatever underlying physical characteristic it is that is shared by (nearly) all members of the class of paradigmatic *water*-samples that explains their most salient features – the fact that they boil and freeze at certain temperatures, that they are clear, potable, and necessary to life, etc. (Soames forthcoming A: 7).

According to Soames, when this stipulation is combined with our empirical information about water, it follows that water is necessarily H₂O. The interesting question for us is: does Soames’ account differ from the deflationary one? On the face of it, it seems that Soames has given us little more than what the deflationary, conceptualist picture offers, and hence we are at risk of identifying the *a priori* with the analytic and reducing modality to linguistics – something that Soames wishes to avoid at all costs. Despite this, Soames explicitly opts for a *linguistic* analysis rather than a metaphysical one, although he claims that this helps us to narrow down ‘the range of feasible ontological alternatives’ (ibid., 1).

3. The deflationary account of the necessary *a posteriori*

Let us see exactly how Soames’ account compares with the deflationary approach; Alan Sidelle’s analysis of ‘Water is H₂O’ is a good example here. It is plausible that Jackson and Chalmers share at least some aspects of Sidelle’s view, but I will focus on Sidelle’s analysis to avoid the complications that the framework of two-dimensional modal semantics, which Chalmers and Jackson use, introduce. Here is what Sidelle thinks:⁶

[E]ach necessary a posteriori truth should be seen as derived from a combination of an analytic principle of individuation that has empty spaces to be filled in by empirical findings and a particular empirical finding that of itself carries no modal weight. For example, in the case of water’s being necessarily H₂O,

6 See also Sidelle (1989) for a much more detailed account.

the analytic principle might be ‘Nothing counts as water in any situation unless it has the same deep explanatory features (if any) as the stuff we call “water”’, and the empirical fact, which makes the result a posteriori, is that the deep explanatory feature of the stuff we call ‘water’ is being composed of H₂O. (Sidelle 2002: 319.)

When we compare this passage from Sidelle with the previous passage from Soames, the similarity between the accounts is remarkable. The analytic principle which Sidelle suggests is almost identical to the stipulation which Soames discusses; Soames talks about the underlying physical characteristics shared by water samples, whereas Sidelle talks about the deep explanatory features of the stuff we call ‘water’. In each case, this general principle is augmented by the empirical discovery that water is composed of H₂O. For Sidelle, this process is very simple: each example of the necessary *a posteriori* can be divided into an *a priori* principle concerning the type of empirical fact required to generate a necessary truth – the deep explanatory features – and the empirical discovery of the relevant fact. Quite correctly, Sidelle claims that on this account, ‘the modal force’ of *a posteriori* necessities comes from the *a priori* principles. However, nothing in this story suggests that these *a priori* principles concern metaphysical, essential truths, rather, they are analytic principles which represent our linguistic conventions.

The analysis that Sidelle goes on to give suggests that he understands the issue at hand to concern our semantic intuitions, quite like we saw in the case of the Twin Earth scenarios. That is, just as the Twin Earth scenarios take the *a priori* part of the story to amount to us knowing that it is the ‘deep structure’ of water that makes it the stuff we call ‘water’, Sidelle takes our counterfactual judgements in Twin Earth scenarios to reflect our linguistic conventions according to which it is the ‘deep structure’ of water that makes it water. To clarify: the debate, as Sidelle sees it, concerns the meaning of the term ‘water’, and it is the meaning of the term that determines how we apply it in counterfactual scenarios such as the Twin Earth scenarios. The only type of necessity that Sidelle is willing to admit here is the necessity of the general analytic principle that reflects our linguistic

conventions.

So, Sidelle's account is concerned exactly with the semantic presuppositions governing the introduction of the term 'water' which are central to Soames' account, yet Soames wants to avoid the conclusion that, according to Sidelle, inevitably follows if this line is taken. Unfortunately, it seems to me that Sidelle is right: if we agree that the modal content of *a posteriori* necessities is grounded in a linguistic principle of the form that both Soames and Sidelle seem to suggest, then the only viable conclusion is that this principle is analytic and hence modality is linguistic. Yet, this is the very conclusion that Soames was hoping to avoid. Is there any way that we can avoid it?

4. The essentialist account of the necessary *a posteriori*

If there is any genuinely metaphysical, essentialist content to be found in the *a priori* part of *a posteriori* necessities, it cannot be of the type familiar from the Twin Earth scenarios. However, we have not looked into the alternative interpretation in much detail. In the second section I suggested that it concerns the idea that chemical substances have only one metaphysically possible instantiation which produces the chemical properties of that substance. Or, in other words, all chemical substances have the same molecular structure in all possible worlds.⁷ This is something that is often taken for granted in discussions of the necessary *a posteriori* which concern chemical substances such as water. It is also taken for granted in Sidelle's analysis: even if we were dealing with a strictly linguistic principle here, it appears to be a part of the relevant linguistic convention

⁷ Compare this with Salmon (2005: 166): 'Being a sample of the same substance as something consists in having the same chemical structure'. Salmon is reconstructing Putnam's account here; this characterisation of *a posteriori* necessities has the same elements as the case at hand, the most important of these for our purposes is the definition of a chemical substance with regard to its chemical structure. For some discussion concerning the origin of this idea see Salmon (p. 176 ff.), where he suggests that we are here dealing with a non-trivial essential principle concerning chemical substances, and also claims that this principle is tested 'not by laboratory experiment but by thought experiment' (p. 185). Hence, as Salmon concludes, this is a question for metaphysics, not for philosophy of language.

that the molecular composition of chemical substances does not vary in counterfactual scenarios. But what is the origin of this principle?

A deflationist like Sidelle would presumably suggest that the meaning of the notion of ‘chemical substance’ is such that all substances which it picks out have the same molecular structure in all counterfactual scenarios. But surely we cannot do this just by *fiat*. There are obvious, metaphysically substantial questions that need to be settled before any decisions concerning the meaning of the notion of ‘chemical substance’ can be made. Specifically, if we cannot rule out the possibility that exactly the same observational properties could emerge from two or more different molecular structures – perhaps a different organisation of the fundamental forces would enable this possibility – then we need to have some good reasons to think that molecular structure rather than observational properties are what the notion of ‘chemical substance’ ought to track. So, if this scenario is possible, then it would presumably have implications towards our linguistic conventions as well, since one of the key questions is whether we should define chemical substances in terms of microstructure or macrostructure, i.e. observational properties. It could be suggested that *obviously* should define chemical substances in terms of microstructure, but in fact this is far from obvious; for instance, both Van Brakel (1986) and Needham (forthcoming) discuss this question, and they both lean towards the view that macrostructure is what counts here since defining, say, water in terms of its microstructure appears to be quite hopeless.

We saw earlier that Soames at least thinks that the possibility of XYZ-type scenarios where the functional and observational properties of water are replicated by a molecular structure different from H₂O is something that cannot be ruled out *a priori*. It is primarily a question for empirical research whether this scenario is physically possible, but if Soames is right, then the scenario is at least *metaphysically* possible. I consider this to be an open question, one which requires detailed research concerning the metaphysical status of the laws of nature.⁸ Regardless of the outcome of

⁸ There is of course plenty of literature on this question, e.g. Mumford (2004), but discussing this question in detail is beyond the scope of this paper.

this research, one thing is clear: even if we took the deflationist route, we would not be in any position to decide upon which linguistic convention to adopt before we have mapped our options. To map our options, we need to engage in metaphysical work. If it turns out that two distinct molecular structures cannot produce the same observational and functional properties (in this world or in another metaphysically possible world), then, and *only* then, we would have a good case for the essentialist principle concerning the molecular structure of chemical substances which is generally assumed at the outset. If it turns out that this *is* possible, then we may of course still decide, by *fiat*, that the notion of ‘chemical substance’ is such that all substances which it picks out have the same molecular structure in all counterfactual scenarios. However, this is entirely secondary to the metaphysical questions that would arise, namely, whether this notion picks out a *genuine*, mind-independent natural kind.

Now, if the deflationist is willing to collapse into extreme conventionalism, she might insist that there is no genuine natural kind to be picked out here, but, rather, we *always* define concepts by *fiat*. Sidelle himself seems to be sliding towards this direction, as he thinks that there is nothing substantial at issue beyond our linguistic conventions. Convincing such an anti-realist is a rather large task, but as we have just seen, there would appear to be substantial metaphysical questions even before this impasse is reached. In any case, for those who believe that there are at least some mind-independent, *bona fide* natural kinds, the question of their identity and existence conditions is a crucial one, and Soames certainly claims to be in this group. I should stress that the purpose of this paper is not to convince Sidelle or other deflationists about the truth of essentialism, but rather to convince Soames and those who claim to be realists or essentialists about the need for further, seriously essentialist work.

In the case of chemical substances the exact identity and existence conditions are, it seems to me, still open, and we can determine them only by a thorough analysis of the natural laws that govern the behaviour and formation of chemical substances. Specifically, we must examine whether these

laws are metaphysically necessary. Let it be noted that the latter can only be analysed by *a priori* means. If it were the case that chemical substances have the same molecular structure in all possible worlds, then I would be inclined to think that if we are able to know this at all, we would know it *a priori*. But not everything that is knowable *a priori* can be established merely by conceptual analysis. It is an open question whether there are any *a priori* reasons to think that substances must have the same molecular structure in all possible worlds.

Of course, it appears that the notion of ‘chemical substance’ is generally used in such a way that substances are individuated with respect to their molecular structure, or, at the very least, the sameness of molecular structure is commonly considered to be a necessary condition for being the same chemical substance. In the case of compounds, a further requirement of having the same proportions of the same elements, as the law of definite proportions states, is commonly added. This ‘folk’ conception of chemical substances is presumably why someone might claim that the necessity of molecular structure is built-in in the concept of ‘chemical substance’. The problem with this suggestion is that the ‘folk’ conception does not appear to be strictly true even in the actual world. An obvious complication is introduced by isotopic variations: is heavy water, that is, water with atypically high deuterium-to-hydrogen ratio, water? Joseph LaPorte (2004: 104 ff.) discusses this very example and constructs a Twin Earth scenario from it: scientists travel to ‘Deuterium Earth’, where all water is heavy water, before the discovery of isotopic variations. The scientists discover that despite its apparent similarity with Earth water, the Deuterium Earth water behaves quite differently (e.g., it kills fish), and eventually decide to call this new liquid ‘dwater’. After some time has passed, the scientists return to Earth, taking a sample of ‘dwater’ with them. In the meanwhile, isotopic variations have been discovered on Earth. When Earth scientists examine the sample they discover that they are not in fact dealing with a new liquid at all, but rather an uncommon variety of water. LaPorte concludes that Earth scientists did not discover that water is H₂O, and nor did the scientists who travelled to Deuterium Earth discover that ‘dwater’ is D₂O. Rather, at least on the

face of it, the scenario seems to support Sidelle's conclusion: it is a matter of convention how we label chemical substances and what the extension of certain natural kind terms is.⁹

There is certainly an appearance of conventionalism here. As Robin Hendry (2006: 867) notes, the International Union of Pure and Applied Chemistry (IUPAC) decided to count isotopic variants as the same substance already in their 1923 ruling, but this was hardly an uncontroversial decision and there are those who consider H₂O and D₂O to be different substances (e.g., Needham forthcoming).

Perhaps even more problematic are cases where different samples of what is clearly the same substance vary in terms of the ratios of the elements that are present, thus violating the law of definite proportions.¹⁰ Indeed, if we look at the actual structure of chemical substances, we find that the folk definition of the notion and also the manner in which philosophers commonly analyse it is extremely simplified and strictly speaking incorrect. Of course, already Putnam (1975) suggested that in matters such as this, we should turn to 'experts' and trust that when we use words such as 'microstructure', these experts would be able to fill in all the necessary details. But since examples concerning chemical substances, for instance, are used to argue for strong metaphysical conclusions, we better turn to these mentioned experts sooner rather than later – preferably before using the example in the first place. In particular, we need to turn to philosophers of chemistry if we wish to clarify the situation. For instance, Paul Needham has argued that when we have a body of, say, an inorganic compound like water, it is not correct to view it as a collection of water molecules:

The naive idea that a macroscopic amount of the substance is just a collection of molecules may give a fair account of many organic compounds. But it is not generally true. It is not true of hydrochloric acid and water, whose microstructures must be understood in terms of the dissociation of molecules into ions and the intermolecular forces building complex units larger than single molecules. There are several

⁹ But see Oderberg (2007: 162-66) for a critique of LaPorte's analysis of similar cases.

¹⁰ These are known as non-stoichiometric compounds, or Berthollides. One example is palladium hydride. See Needham (2008) for some discussion. The issue is also noted in van Brakel (1986).

reasons why the molecular paradigm is not universally applicable. (Needham 2008: 928.)

In fact, Needham (forthcoming) thinks that it is not the microstructure of water that makes it water, what is important is how macroscopic bodies of water behave. Hendry (2006) has also pointed out that simply identifying water with H₂O fails to capture the molecular complexity of water, although he thinks that the microstructure of water is crucial for its 'being water': if isolated water molecules were to come into contact and react, the result would be the microstructure of water (p. 871). In any case, the question concerning the identity and existence conditions of water molecules becomes central to anyone who might wish to claim that 'Water is H₂O' is true, not to mention necessary. Here is how Hendry puts it:

In short, macroscopic bodies of water are complex and dynamic congeries of different molecular species, in which there is a constant dissociation of individual molecules, reassociation of ions, and formation, growth, and dissociation of oligomers. Being H₂O, if understood as a molecular condition, cannot capture the molecular complexity of water. (Hendry 2006: 870.)

We will return to the case of water shortly, but what we can already take from this discussion is that the definition of 'chemical substance' in terms of molecular structure does *not* sufficiently explicate the notion of 'chemical substance'; there even seem to be substances that might not fall under this definition at all, or not without major qualifications. At the very least, the question about whether chemical substances have their molecular structures essentially is far from trivial. It is certainly not a question that we can settle strictly in terms of the folk definition of 'chemical substance', as we have just seen that this definition is not satisfactory for philosophical purposes. Accordingly, the notion of 'chemical substance' cannot be simplified in the manner that philosophical examples typically assume. Even though the issue has been well covered in the philosophy of chemistry literature, it is striking that contemporary discussions of *a posteriori*

necessity continue to rely on ill-informed examples, even though all, or most metaphysicians are well aware of these problems.¹¹ After all, many of these problems were pointed out already by van Brakel (1986), who went as far as to say that ‘Because it turns out that no clear meaning, if any, can be given to the notion of molecular structure, it is not possible to specify what the reference and essence of water is in terms of its molecular structure’ (p. 303).

However, I do not fully agree with this conclusion. Van Brakel makes some important points about the difficulty of giving exact definitions in science in general, and especially about the case of molecular structure, but many of them are driven by the idea that further specifications, such as the interpretation of quantum chemistry, are still open to the degree that any stipulations about their outcome as a part of an attempted definition will be inadequate if not misguided. But the upshot of this discussion is not that we should abandon any attempts to define molecular structure unless we can give a fully reductive account of it in terms of quantum mechanics. Not that this is what van Brakel claims, but his conviction is that the questions we have to face will concern the nature of science in general, and one of these questions is whether chemistry is reducible to physics – something that van Brakel has argued against in later work (2010). Now, this is indeed one the foundational questions that needs to be considered, but we can – and in my opinion may – entertain *a priori* arguments to the effect that, say, the essence of water can be explicated in terms of its molecular structure before all of these foundational questions have been resolved. That is to say that someone like Soames is certainly allowed to examine these matters without a detailed discussion of

¹¹ I should note that Nathan Salmon is one of the few exceptions; he has entertained a line of thought relevant to this:

‘Suppose for instance that scientists were to discover empirically that there are very special physical properties which are characteristic of distinct substances but which are scientifically more “fundamental” to substances than is their component structure of elements and atoms of like atomic number’ (2005: 259). Now, if we take the point of the current discussion and acknowledge that there may even be samples of chemical substances which differ in molecular structure but are nevertheless samples of the *same* substance, then something in the lines of what Salmon suggests must presumably be the case, although philosophers of chemistry might be able to offer us a different explanation.

quantum chemistry – not many of us would be able to engage in that discussion in any case. A reasonable familiarity with the foundational questions is of course required though, and any stipulative assumptions about their outcome should be announced at the outset.

Some of these complications might appear to support the deflationary approach. As we saw above, LaPorte's Deuterium Earth scenario certainly seems to emphasise the conventional character of natural kind terms. However, that may be simply because we have been focusing on the wrong features. Indeed, Hendry (2006: 868–869) suggests that the defining characteristic of chemical substances, that is, the feature which appears to be the most crucial one for the chemical properties of substances, is nuclear charge (rather than atomic weight, for instance). Accordingly, hydrogen and deuterium, since they have the same nuclear charge, would be instances of the same element – this is also compatible with the IUPAC's ruling concerning isotopes. But if we use nuclear charge as the defining characteristic of elements, we have a reply to LaPorte's Deuterium Earth scenario:

LaPorte's semantic indeterminacy does not arise for the names of the elements because they were given in a semantic context that was structured by implicit modal assumptions about the elements. Of course, 'heavy water' names a compound rather than an element, but the same factors that make isotopic differences irrelevant to element identity apply also to compounds. As long as the same interests govern the extension of compound names, if deuterium is hydrogen then heavy water is water. (Hendry 2006: 869.)

So, if Hendry is right, we can after all have good reasons to think that there are some objective criteria that can be used to determine when we are dealing with genuine natural kinds.¹² In Hendry's

12 Hendry's use of the term 'interests' in the above passage may appear to be grist to the conventionalist's mill, but, as I see it, the idea is simply that we have the same criteria to define compounds that we have to define elements. It does not seem that this choice can be made by *fiat*, rather, we need some good reasons to think that our analysis of elementhood applies to compounds as well. Hendry clearly thinks that we have such reasons, most importantly the role of nuclear charge in the behaviour of both elements and compounds.

suggestion the key element concerns a natural defining characteristic of chemical substances, namely whatever it is that gives chemical substances the distinct chemical properties that they have. LaPorte's Deuterium Earth scenario neglects the fact that there are certain modal constraints – that is, metaphysical *a priori* constraints – which govern the behaviour of elements, and Hendry identifies nuclear charge to be responsible for the majority of these constraints. We could of course still decide to use the notion of 'element' in such a way that deuterium and hydrogen are distinct elements, but we better have some concept that tracks the similarity between different isotopes of the same element, as the similar chemical properties that these different isotopes manifest seems to strongly corroborate the conclusion that we are dealing with a genuine natural kind. It is perhaps worth noting that this discussion as well does have to make some obvious assumptions about the aforementioned foundational questions. At the very least, the falsity of chemistry's full reducibility to quantum mechanics seems to be required, as otherwise the discussion would be dealing at a level which is bound to be inaccurate. But this does not seem to be an unreasonable assumption, since we would equally struggle to give a full description at the level of quantum mechanics. This may be due to empirical limitations, but given these limitations, the options are either to make some assumptions about the foundations of science or simply to abstain from discussing these matters. The latter option does not seem particularly fruitful, so it makes sense to map our options even with the risk that some of our foundational assumptions turn out to be mistaken. Indeed, this is common practice in science as well.

The problem regarding the defining characteristics of elements and other chemical substances has also been discussed by Nathan Salmon (2005: 258–259), who asks whether the following scenario would constitute an empirical discovery: we discover some further defining characteristic for elements apart from their atomic number, and we then encounter two samples of substances which share this new defining characteristic, but differ with regard to their atomic number, that is, have a different number of protons. Well, to a certain extent, Hendry's suggestion *is* such a defining

characteristic; if we define elements in terms of nuclear charge, a difference in the number of protons in two sample substances would certainly suggest that they are samples of two distinct substances. But what is important is that this is *neither* a mere empirical discovery *nor* a mere linguistic choice: it is, as Salmon puts it, ‘an irreducibly metaphysical doctrine, or set of doctrines, from a *sui generis* branch of philosophy’ (Salmon 2005: 264).

What I believe is missing from Soames’ story about the status of modal statements is this metaphysical part: he gives us the linguistic story, and hints towards the empirical story about the underlying physical characteristics, but something more is needed if we hope to give an essentialist account of modal statements. Whether or not Hendry’s account is correct, it is the kind of considerations that we are dealing with here that are needed. They are scientifically informed, non-analytic, yet *a priori*.¹³ The trouble with these considerations is that they are very difficult, but then again, Kripke’s ‘discovery’ that the identity statement ‘Water is H₂O’ is necessary *a posteriori* did seem much too easy. However, there is a clear methodology that we can apply here. Crucially, we ought to be familiar with all the contemporary science which might be relevant for the topic. If this is the case, we can then proceed to analyse possible candidates for, e.g., the defining characteristics of chemical substances. This will require some assumptions about the foundations of chemistry and science in general, but such assumptions are unavoidable if we hope to make any progress. What matters here is not the semantics of the term ‘chemical substance’, but rather the modal constraints for any microphysical structure; it is the task of metaphysics to map these modal constraints, taking into account also the further constraints introduced by any foundational assumptions that will have to be made.

The meanings of words may change, and scientific theories may change, but we are only looking for metaphysically possible governing principles of the laws of nature. If we find a promising candidate principle which is compatible with current science, then we have means to distinguish

¹³ My understanding of the *a priori* is somewhat unconventional, but this is not the place to defend it (cf. Tahko 2008, 2009). At any rate, the considerations that we are interested in are *metaphysical* rather than *semantic*.

natural kinds according to that principle – if Hendry is right, nuclear charge can be used to distinguish elements in this fashion, and we could develop the idea towards a criterion for distinguishing compounds as well. Of course, it is certainly possible that future science will contradict a suggestion like this, but this is hardly a reason for despair, or support for conventionalism: any metaphysical, essentialist principle that we might discover is subject to revision just like a scientific theory is. But they are not a matter of convention: only a principle which is *not* subject to semantic indeterminacy could possibly qualify, and hence we can rule out scenarios such as LaPorte’s ‘Deuterium Earth’. In the ‘Deuterium Earth’ scenario, Earth water and ‘dwater’ simply reflect different governing principles. It *is* a matter of convention how we decide to use the term ‘water’, or ‘chemical substance’, but once it is made clear which governing principle is being used, we can have objective criteria, as Hendry has demonstrated.

In conclusion, we have seen that Soames’ account of the necessary *a posteriori* bears significant similarity to the deflationist account familiar from Sidelle’s work, while both of these accounts omit a detailed discussion of the relevant science, and, most importantly, the essentialist part of the story.

¹⁴ This leaves the essentialist line open to an attack from the conventionalists, but I have attempted to demonstrate that a scientifically informed, essentialist methodology is available to us. Thus, it appears that Soames is at a crossroads: either he should concede to the deflationist and adopt the view that modality is linguistic and the *a priori* can be identified with the analytic, or he should engage in the type of work that we have seen to be required for a full-blown essentialist approach: a detailed analysis of the underlying essentialist principles. Given that Soames is one of the loudest critics of the deflationary approach, I would hope that he is more tempted by the latter option.

¹⁴ I should add that the full essentialist story will have to include an account about the relationship between essence and modality. My sympathies in this regard are with Kit Fine (1994), see also Lowe (2007b).

References:

- Chalmers, D. (1996) *The Conscious Mind: In Search of a Fundamental Theory* (Oxford: Oxford University Press).
- Fine, K. (1994) 'Essence and Modality', J. E. Tomberlin (Ed.), *Philosophical Perspectives 8: Logic and Language* (Atascadero, CA: Ridgeview), pp. 1–16.
- Hendry, R. F. (2006) 'Elements, Compounds, and Other Chemical Kinds', *Philosophy of Science* 73, 864–75.
- Jackson, F. (1998) *From Metaphysics to Ethics: A Defence of Conceptual Analysis* (Oxford: Oxford University Press).
- LaPorte, J. (2004) *Natural Kinds and Conceptual Change* (Cambridge: Cambridge University Press).
- Lowe, E. J. (2007a) 'Does the Descriptivist/Anti-Descriptivist Debate Have Any Philosophical Significance?', *Philosophical Books* 48, 27–33.
- Lowe, E. J. (2007b) 'A Problem for A Posteriori Essentialism Concerning Natural Kinds', *Analysis* 67.4, 286–92.
- Mumford, S. (2004) *Laws in Nature* (London: Routledge).
- Needham, P. (2008) 'Resisting Chemical Atomism: Duhem's Argument', *Philosophy of Science* 75, 921–31.
- Needham, P. (forthcoming) 'Microessentialism: What is the Argument?', *Noûs*.
- Oderberg, D. (2007) *Real Essentialism* (London and New York: Routledge).
- Putnam, H. (1975) 'The Meaning of "Meaning"', in K. Gunderson (ed.), *Language, Mind and Knowledge*, Minnesota Studies in the Philosophy of Science, vol. VII, (Minneapolis: University of Minnesota Press), pp. 131–93, reprinted in Putnam, H. (1975) *Mind, Language and Reality: Philosophical Papers, Vol. 2* (Cambridge: Cambridge University Press), pp. 215–71.

- Salmon, N. U. (2005) *Reference and Essence*, 2nd ed. (New York: Prometheus Books).
- Sidelle, A. (1989) *Necessity, Essence and Individuation* (Ithaca, NY: Cornell University Press).
- Sidelle, A. (2002) 'On the Metaphysical Contingency of Laws of Nature', in *Conceivability and Possibility*, ed. T. S. Gendler & J. Hawthorne (Oxford: Oxford University Press), pp. 309–336.
- Soames, S. (2002) *Beyond Rigidity: The Unfinished Semantic Agenda of Naming and Necessity* (Oxford: Oxford University Press).
- Soames, S. (2005) *Reference and Description: The Case Against Two-Dimensionalism* (Princeton: Princeton University Press).
- Soames, S. (2006) 'The Philosophical Significance of the Kripkean Necessary *Aposteriori*', *Philosophical Issues 16: Philosophy of Language*.
- Soames, S. (2007) 'The Substance and Significance of the Dispute Over Two-Dimensionalism', *Philosophical Books* 48: 34–49.
- Soames, S. (forthcoming A) 'What are Natural Kinds?', *Philosophical Topics*.
- Soames, S. (forthcoming B) 'Kripke on Epistemic and Metaphysical Possibility: Two Routes to the Necessary *Aposteriori*', in *Saul Kripke*, ed. A. Berger (Cambridge: Cambridge University Press).
- Tahko, T. E. (2008) 'A New Definition of A Priori Knowledge: In Search of a Modal Basis', *Metaphysica* 9: 57–68.
- Tahko, T. E. (2009) 'On the Modal Content of A Posteriori Necessities', *Theoria: A Swedish Journal of Philosophy* 75: 344–57.
- van Brakel, J. (1986) 'The Chemistry of Substances and the Philosophy of Mass Terms', *Synthese* 69: 291–324.
- van Brakel, J. (2010) 'Chemistry and physics: no need for metaphysical glue', *Foundations of Chemistry* 12: 123–136.

