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IS WATER NECESSARILY IDENTICAL TO H₂O?

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The “scientific essentialist” doctrine asserts that the following are examples of *a posteriori* necessary identities: water is H₂O; gold is the element with atomic number 79; and heat is the motion of molecules. Evidence in support of this assertion, however, is difficult to find. Both Hilary Putnam and Saul Kripke have argued convincingly for the existence of *a posteriori* necessities. Furthermore, Kripke has argued for the existence of *a posteriori* necessary identities in regard to a particular class of statements involving proper names. Neither Kripke nor Putnam, however, has argued convincingly that sentences containing syntactically complex terms or descriptive phrases can express *a posteriori* necessary identities. I will argue by way of a hypothetical example that ‘water is H₂O’ does not express a necessary identity. My argument is unique in that it attacks the relevant *sufficiency* claim needed to underwrite this putative necessary identity.¹ That is, even if we grant that water is necessarily composed of H₂O, we should not accept that H₂O necessarily forms water.

I shall not challenge the claim that there are *a posteriori* necessary identities involving syntactically complex expressions or descriptive phrases. (There are rigid descriptions and, hence, true necessary identities expressed with them. First, utterly trivial ones such as ‘the first natural number = the first natural number’. Second, slightly less trivial ones such as ‘Hesperus = the thing with which Hesperus is identical’. Third, nontrivial *a priori* ones such as ‘12 = the sum of 5 and 7’. And, fourth, nontrivial *a posteriori* ones such as ‘the thing with which Hesperus is identical = the thing with which Phosphorus is identical’.) Rather, I wish to stimulate investigation into the *scope* of the relevant scientific-essentialist claims. My argument that ‘water is H₂O’ does not express a necessary identity should call into question, for instance, whether heat is necessarily



identical to the motion of molecules and whether gold is necessarily identical to the element with atomic number 79.

“Don’t eat the water!” shouts your friend, with a grin, as you walk down the gate to your ship. You are taking off on a space-ship for twin earth, the famous hypothetical planet discovered by Putnam. As you are in flight you browse through the following leaflet:

Do’s and Don’t’s On Twin Earth (*A Traveler’s Guide to Twin Earth*)

Do

Make yourself at home. You will notice no difference between twin earth and earth, except, of course, on twin earth there will be someone who appears to be you living in what appears to be your home. We ask that you treat your *Doppelgänger* and his or her spouse with respect.

Drink the “water.” You may already know that the beverage referred to as ‘water’ by the twin earthians is not composed of H_2O but instead of a complex molecular structure known as ‘XYZ’. Scientists have found that XYZ is not only harmless when ingested by earthlings, it is actually beneficial in just the same ways that water is.

Don’t

Don’t eat the “mushrooms.” Scientists have recently discovered the existence of an extremely toxic mushroom-like grocery-store item whose ingestion could prove fatal. Don’t be fooled by your *Doppelgänger’s* fearless indulgence in these morsels; apparently twin earthians have developed a resistance to the toxins. Ironically, these “mushrooms” are composed entirely of H_2O molecules. (For those travelers interested in the chemistry of this toxic H_2O , see the recently published article, ‘Packing Neutrons into Oxygen Packs a Mean Punch into H_2O ’.)

You now see the humor in your friend’s farewell warning. It seemed absurd to be cautioned about the hazards of eating

water; but, by ‘water’, your friend was alluding to the poisonous mushroom-like stuff composed of H₂O – not the stuff we normally associate with the English word ‘water’.

Over twenty years ago Putnam (1975) took us on our first journey to twin earth. He convinced us that XYZ, a kind of stuff which fulfills our intensional notion of ‘water’, is not water – only by *a posteriori* means can we discover the full meaning of ‘water’. Consequently, if it is true that all and only all samples of water on earth are composed of H₂O, then it is an *a posteriori* necessity that water is composed of H₂O. This result came at a time when Saul Kripke (1972) was eliciting our intuitions regarding similar types of alleged *a posteriori* necessities. He convinced us, among other things, that proper names rigidly designate their referents, that empirical investigation is sometimes needed to establish coreference, and therefore that there are certain identities which are necessary *a posteriori*. Philosophers supportive of this “scientific essentialist” doctrine, including Kripke, then generalized this result over natural-kind terms, including syntactically complex terms like ‘H₂O’.² They concluded, in part from Putnam’s twin-earth scenario, that ‘H₂O’ and ‘water’ rigidly designate the same stuff. If ‘H₂O’ and ‘water’ do in fact rigidly designate the same stuff, then, *necessarily*, water is identical to H₂O.

But are the twin-earth “mushrooms” water? It certainly seems counterintuitive to say that the toxic mushroom-like stuff *is* water; it was exactly this point of absurdity on which your friend’s joke rested. It may be the case that water is necessarily *composed of* H₂O, but are samples of H₂O necessarily samples of water? Upon what source of evidence did philosophers conclude that, necessarily, water is *identical* to H₂O? Certainly it was not Putnam’s twin-earth scenario; it only told us that if water is composed of H₂O, then *necessarily* water is composed of H₂O. Maybe philosophers found it natural to make the additional claim because they believed there to be no empirical evidence that H₂O can form anything but water. Let me draw two analogies to show why such an empirical fact would carry little evidential weight.

First, imagine that the conditions necessary for the formation of diamonds had never obtained. Suppose that pure carbon had only existed in the form of graphite. It would still be the case that graphite

is necessarily composed of carbon. But would it follow that carbon necessarily forms graphite? Of course it would not; we are aware that it is physically possible for carbon to form a kind of stuff clearly distinct from graphite – viz., diamond. It is tempting to conclude that ‘graphite’ rigidly designates carbon because in every possible world graphite is composed of carbon. But this is a *non sequitur*. There are possible worlds, e.g., the actual one, in which carbon forms something other than graphite. Graphite is clearly not identical to carbon.

In an analogous vein, consider SiO_2 , the molecular constituent of sand, quartz, and glass. (Notice that these are three different forms, or *allotropes*, of solid SiO_2 , whereas ice, water, and steam correspond to the three basic *states* of matter – solid, liquid, and gas. Whether ice and steam are, strictly speaking, forms of *water* and not merely forms of H_2O is a difficult question. It seems natural to say that ice is frozen water and steam is gaseous water. But is water liquid water? And are the three forms of water water, ice, and steam? There must be some equivocation here; however, my argument does not rest on this matter and so I will not pursue these interesting questions further.) While it may be true that quartz is necessarily composed of SiO_2 , it is not the case that SiO_2 necessarily forms quartz. If both ‘Quartz’ and ‘ SiO_2 ’ are rigid designators, then they do *not* rigidly designate the same thing.

Why, then, should we think that ‘water’ and ‘ H_2O ’ rigidly designate the same thing? Regardless of whether it is physically possible for H_2O to form the previously envisaged toxic mushroom-like substance, it is intuitively possible for H_2O to form *something* other than water. I find it intuitively possible that in some world H_2O could form nasty mushroom-type stuff and that this stuff would not be water, and many people I ask, who do not have a philosophical axe to grind, share this intuition. (Similarly, it may not be physically possible for there to be a liquid, “whose chemical formula is very long and complicated”, which is “indistinguishable from water at normal temperatures and pressures”, which does not form water, but it is intuitively possible for *something* to have the phenomenal properties of water without being water.³) The moral of the story is that ‘water is H_2O ’ does not express a necessary identity.

There are three salient lines of reply to my argument. First, the scientific essentialist might claim to lack the intuition that the toxic mushroom-like stuff is not water. Second, she might attempt to deflate the force of our anti-scientific-essentialist intuitions by implementing one of Kripke's rephrasal strategies. Third, she might modify her claim as follows: necessarily, water = H₂O in @-form, where @-form is the microscopic form of H₂O as it *actually* occurs in samples of water on earth.

Let us consider the respondent who claims to lack the intuition that the toxic mushroom-like stuff would not be water. I suspect that such a person is simply guilty of allowing her theory to influence her response to my hypothetical example. For instance, such a person might find it theoretically attractive to think of ice, steam, sleet, snow, and the nasty mushroom-like stuff as various determinates of the determinable water and come thereby to deny the claim that, intuitively, the envisaged mushroom-like stuff is not water.⁴ However, intuitions relevant to this sort of inquiry are not supposed to be arrived at via a chain of theoretical reasoning – especially one that begins with a theory of the very issue at stake. If this were the standard methodology, Kripke and Putnam would never have gotten their original arguments off the ground. Of course, when Kripke and Putnam first presented their cases for scientific essentialism, their opponents, descriptivists, knew exactly how to respond *as descriptivists*: XYZ is water. Fortunately, sophisticated descriptivists put aside their theory and lent an ear to their naive intuitions. Eventually others caught on to the appropriate methodology and admitted to having the relevant pro-scientific-essentialist intuitions. Most people are convinced by my example, including a class of thirty undergraduate students who, without any cajoling, unanimously agreed that the mushroom-like stuff is *not* water.⁵

Moreover, there are no good *theoretical* reasons to accept the scientific-essentialist claim that necessarily, water = H₂O. This was the point of my counterfactual scenario in which the only form of carbon was graphite. Surely if we were in this sort of situation we might be tempted, as our respondent is in the case of water, to posit a necessary identity between graphite and carbon; but we know that this would be premature and mistaken – graphite is only one of

several forms of carbon. By analogy, we should expect that water is only one of several possible forms of H_2O .

In an analogous vein, if our existence were confined to the surface of the desert, where we were on a daily basis immersed in sand, and where the only SiO_2 we ever came in contact with was sand, we might be tempted to posit a necessary identity between sand and SiO_2 . But surely if we were then to discover quartz we would conclude that sand is only one of at least two kinds of SiO_2 , not that quartz is another kind of sand.

Apparently Kripke was not thinking of these cases when he said,

On the other hand if this substance can take another form – such as the polywater allegedly discovered in the Soviet Union, with very different identifying marks from that of what we now call water – it is a form of water because it is the same substance, even though it doesn't have the appearances by which we originally identified water.⁶

Kripke never argues that being H_2O is sufficient for being water. He begs the question by reasoning as follows: the alleged polywater is identical to H_2O ; H_2O is identical to water; therefore, the alleged polywater is identical to water. Applied to the sand/ SiO_2 case, Kripke's reasoning gives us the following absurd statement: If SiO_2 can take another form – such as quartz or glass – it is a form of sand because it is the same substance, even though it doesn't have the appearances by which we originally identified sand.

Not only is it intuitively compelling that the mushroom-like stuff would not be water, it would be mysterious if this were not so, for the case is structurally isomorphic to the sand/quartz/ SiO_2 and graphite/diamond/carbon cases. There is no reason to think that there is any relevant difference between these cases.⁷ A denial of the claim that the nasty mushroom-like stuff is not water would be a mere dogma backed with no reasons, intuitive or theoretical.

Our second respondent wishes to deflate the force of our anti-scientific-essentialist intuition reports by implementing one of Kripke's rephrasal strategies. Kripke was well aware that some of us have intuitions which, *prima facie*, count as evidence against certain alleged *a posteriori* necessary identities. With respect to the proposal that necessarily, water = H_2O , many of us have (or at least had) the intuition that it could have been the case that scientists discovered that water was composed of something other

than H₂O, or that there might be a puddle of water that contains no hydrogen atoms. Note that these particular intuitions provide *prima facie* support for the claim that there could be water in the absence of H₂O, whereas the intuitions elicited from my envisaged “mushroom” scenario provide *prima facie* support for the claim that there could be H₂O in the absence of water. Intuitions that call into question the necessary or sufficient conditions of an alleged *a posteriori* identity count as evidence against the scientific essentialist’s proposed identity – they are *anti-scientific-essentialist* intuitions. Intuitions in support of the proposed identity, e.g., those elicited in Putnam’s seminal twin-earth case, are *pro-scientific-essentialist* intuitions. Although we will sometimes appear to have both pro- and anti-scientific-essentialist intuitions regarding purported *a posteriori* identities, Kripke suggests that in such circumstances our intuitions are actually in a state of accord but that we have misreported them: we have reported mere epistemic possibility as metaphysical possibility.

Rephrasal strategies, then, fit into the debate over scientific essentialism as follows. The first move in the debate is the elicitation of pro-scientific-essentialist intuitions. The second move in the debate is the elicitation of anti-scientific-essentialist intuitions. Both sides of the debate must then devise a strategy to defuse the counterintuitions invoked by their opponents. George Bealer was the first to clearly recognize two vital constraints on such strategies: generality and asymmetry.⁸ In ‘Mental Properties’ he nicely clarifies the role of such strategies in the debate over scientific essentialism, points out that *Naming and Necessity* contains two very different rephrasal strategies, and effectively argues that while the first strategy succeeds, the second fails due to its lack of asymmetry – i.e., the opponents of scientific essentialism can use it equally well to disarm *pro-scientific-essentialist* intuitions. The presumption, then, is that the scientific essentialists have succeeded in finding an appropriate rephrasal strategy and that the anti-scientific-essentialists have failed. The following passage contains Kripke’s first suggested rephrasal strategy:

Now this seems very strange because in advance, we are inclined to say, the answer to the question whether Hesperus is Phosphorus might have turned out either way ... There certainly is a possible world in which a man should have

seen a certain star at a certain position in the evening and called it 'Hesperus' and a certain star in the morning and called it 'Phosphorus'; and should have concluded – should have found out by empirical investigation – that he names two different stars, or two different heavenly bodies . . . [A]nd so it's true that given the evidence that someone has antecedent to his empirical investigation, he can be placed in a sense in exactly the same situation, that is a qualitatively identical epistemic situation, and call two heavenly bodies 'Hesperus' and 'Phosphorus', without their being identical. So in that sense we can say that it might have turned out either way as to Hesperus's being Phosphorus . . . that is, in a counterfactual world in which the terms 'Hesperus' and 'Phosphorus' were not used in the way that we use them, as names of this planet, but as names of some other objects, one could have had qualitatively identical evidence and concluded that 'Hesperus' and 'Phosphorus' named two different objects.⁹

Let us rephrase our anti-scientific-essentialist intuitions concerning water. When we reported that it was possible for a puddle of water to contain no hydrogen atoms, we actually meant to say that we could have been placed in an epistemic situation qualitatively identical to our own (perhaps before empirical investigation was performed on water) and make a true statement by asserting, "a puddle of water might contain no hydrogen atoms." According to Kripke, such a true statement would issue only in a counterfactual situation where our word 'water' refers to something other than H₂O. In such a situation, the terms 'atom' and 'hydrogen' might also vary in reference from their English counterparts. All other terms and expressions in the asserted statement are "semantically stable", i.e., they could not differ in meaning across populations of speakers in epistemic situations that are qualitatively identical to our own.¹⁰ The rephrasal strategy then successfully conveys the relevant anti-scientific-essentialist intuition report as one merely concerning *epistemic* possibility. Perhaps this same rephrasal strategy can be used to deflate the force of the anti-scientific-essentialist intuitions elicited in my envisaged "mushroom" scenario. Our present respondent acknowledges the presence of intuitions reported by 'the nasty mushroom-like stuff is not water', but maintains that this report is merely an indicator of intuitions regarding *epistemic* possibility. She may further claim that the epistemic nature of the relevant intuition is due to the fact that only in an epistemic sense is it possible for H₂O to form the envisaged poisonous mushroom-like stuff.

Is the possibility of there being a sample of H₂O that is not a sample of water merely one of epistemic nature? The answer is no. Unlike our anti-scientific-essentialist intuitions regarding the proposal that necessarily, every sample of water is a sample of H₂O, those regarding the proposal that necessarily, every sample of H₂O is a sample of water cannot be deflated. (Furthermore, as noted earlier in this paper, Putnam's twin-earth case offers absolutely no evidence in favor of the proposal that being H₂O is a sufficient condition for being water. I.e., in regard to the relevant sufficiency condition, there has been no pro-scientific-essentialist evidence offered.) The reason for this is as follows. We find it intuitive that the twin-earth mushroom-like stuff would not, strictly speaking, be water. This intuition is driven *not* by the empirical fact that water is composed of H₂O, but rather by an *a priori* fact about water. Namely, that, irrespective of the microscopic composition of water in the actual world, the twin-earth mushroom-like stuff would not be water. We have the intuition that for every microscopic substance C, if C is the microscopic constituent of water, it is possible that something has as its microscopic constituent C but not be water. Suppose now that Kripke and the scientific essentialists attempt to deflate the force of this intuition. The standard rephrasal strategy will not work because the variable C is bound outside the possibility operator. In order for the rephrasal strategy to successfully deflate an anti-scientific-essentialist intuition, the intuition must be expressed by a sentence that behaves in a semantically unstable way – i.e., it must be intuitively possible for the sentence to vary in meaning, due to externalist factors, across speaker populations in qualitatively identical epistemic situations. But note the intuitive appeal of the following rephrasal: 'Necessarily, every population of speakers in qualitatively the same epistemic situation as ours would make a true statement by asserting, "For every microscopic substance C, if C is the microscopic constituent of water, it is possible that something has as its microscopic constituent C but not be water."' ¹¹ The fact that 'water', the only semantically unstable term in the rephrasal, might refer to XYZ (\neq H₂O) in populations of speakers in epistemic situations qualitatively identical to ours does not play a role in determining the truth value of the rephrasal. This is, to repeat, because the variable C ranges over the epistemically possible

constituents of water, and C is bound outside the possibility operator. In other words, the environmental factors that serve to fix the content of 'water' do not play a role in determining the truth value of the rephrasal. The rephrasal is intuitively true; it is therefore not tainted with externalist elements; and it entails the truth of the original anti-scientific-essentialist intuition. Our anti-scientific-essentialist intuitions regarding the envisaged "mushroom" scenario are, then, immune to Kripke's rephrasal strategy.¹²

A third response on the part of Kripke and his followers involves a qualification of their claims regarding the relevant types of natural-kind identities. For example, their claim regarding the essence of diamond might be the following: necessarily, diamond = carbon in @-form, where @-form is the tetrahedral arrangement of ^{12}C atoms around other ^{12}C atoms. Their claim regarding water might be modified in an analogous way: necessarily, water = H_2O in @-form, where @-form is the microscopic form in which H_2O actually exists in all and only all samples of water on earth. This would rule out the envisaged hyper-neutron form of H_2O that allegedly forms the nasty mushroom-like stuff on twin earth.

But this qualification strategy will not work. Suppose that the physical laws on a second "twin earth" are quite different from those on earth. On this twin earth, the physical laws are such that H_2O in @-form forms toxic mushroom-like items identical in appearance and toxicity to those found on the first twin earth. Intuitively, this is possible (not to say physically possible), and intuitively these items would not be water.¹³

My argument might be construed as showing either (i) that 'water' and ' H_2O ' rigidly designate distinct kinds of stuff, or (ii) that 'water' is not a rigid designator, or (iii) that, when used to pick out a stuff, ' H_2O ' is not a rigid designator. Each of (i)–(iii) entail the rejection of the scientific-essentialist claim that necessarily, water is identical to H_2O . I do not wish to take a stand on which of the three options is correct. However, since (i) and (ii) are straightforward, I will offer the following comments on behalf of (iii).

The English term 'water', according to Kripke, has its reference fixed via some initial act of baptism (involving either ostension or description). Thereafter, 'water' is allegedly used rigidly to refer to the stuff picked out in the initial baptism. By contrast, the syntactic-

ally complex term 'H₂O' does not have its reference fixed by any act of baptism; it is an abbreviation for a description. Perhaps 'H₂O' abbreviates 'the stuff formed (around here?) when hydrogen and oxygen bond together in the ratio of two hydrogen atoms to one oxygen atom'. On earth, all of the stuff formed upon combining hydrogen and oxygen in this way is water. On twin earth, there is stuff formed upon combining hydrogen and oxygen in this way that is *not* water. This should be no surprise, given that 'H₂O' abbreviates a description, and what is picked out by a description can, ordinarily, vary across possible worlds (or, if there is an indexical involved, across utterances in the same world). According to this line of reasoning, *that water is identical to H₂O* is a *contingent* identity statement. An alternative way of understanding 'H₂O' is to construe it as an abbreviation for a description of a certain type of molecule (contra *stuff*). Perhaps 'H₂O' abbreviates 'the molecule formed when hydrogen and oxygen bond together in the ratio of two hydrogen atoms to one oxygen atom.' According to this line of reasoning, the relevant identity statement is that water is identical to the stuff composed of H₂O molecules. Given that 'the stuff composed of H₂O molecules' can designate various stuffs across worlds, we are left once more with at most a contingent identity statement.

In *Naming and Necessity* Kripke argues convincingly that *proper names* are rigid designators. He also argues that abstract singular terms, including 'water', 'heat', 'gold', 'tiger', and 'cat', are rigid designators and that, as a result, theoretical identities of the following kind are necessary: water is H₂O; gold is the element with atomic number 79; heat is the motion of molecules; etc. However, necessity in regard to these identities obviously does not follow from the fact that 'water', 'gold', and 'heat' are rigid designators. Suppose, as I have argued for the case of 'H₂O', that in the above statements the syntactically complex terms and descriptive phrases opposite the abstract singular terms are *not* rigid designators. Still, it might be the case that water is necessarily composed of H₂O, or that heat necessarily involves the motion of molecules, etc., but it would not follow that necessarily, water is identical to H₂O, or that necessarily, heat is identical to the motion of molecules, etc.

Again, I stand open on (i)–(iii). Nevertheless, I believe there is good evidence to reject the scientific-essentialist claim that neces-

sarily water is identical to H₂O. I recommend that we reevaluate the entire family of alleged theoretical identities to find out whether any of them holds, and if so, whether any of them holds *necessarily*.¹⁴

NOTES

¹ Others have challenged the application of the Kripke/Putnam view to theoretical identifications involving natural-kind terms, including van Brakel (1986), Cassim (1986), Donnellan (1983), Dupré (1981), Johnston (1997), Sidelle (1992), Unger (1983), and Zemach (1976). Donnellan and Sidelle argue that even if we grant that natural-kind terms are rigid designators it cannot be a purely empirical endeavor to then establish the truth of an *identity* statement involving two natural-kind terms. Brakel and Dupré launch interesting investigations into our actual scientific practices, arguing that they are not in accord with the Kripke/Putnam doctrine. Cassim and Unger argue that the principal data upon which the scientific-essentialist doctrine rests, viz., intuitions about hypothetical examples, are theory-laden and interest-relative in the case of natural kinds. Johnston argues that the relation between water and H₂O is constitution, not identity (this conclusion entails, but is not entailed by, my negative thesis regarding the modal claim that necessarily, water = H₂O). Zemach argues that the application of the Kripke/Putnam view to substance-terms presupposes traditional internalism about meaning.

² Kripke (1972), pp. 116–144, esp. p. 128.

³ Putnam (1975), p. 223.

⁴ Anthony Brueckner proffered a theory of this sort in his helpful comments on an earlier version of the present paper (APA Central Division Meeting, 1998).

⁵ Suppose we lacked the intuition that the nasty mushroom-like stuff is *not* water. Still, the scientific essentialists would have to concede, at the very least, that my example demonstrates the absence of a key datum for their argument – namely, firm intuitions that the nasty mushroom-like stuff *is* water. Without this datum, and without an independent argument for the relevant sufficiency claim, the scientific essentialists are not justified in holding that water is necessarily identical to H₂O.

⁶ Kripke (1972), pp. 128–129.

⁷ Unless, of course, ‘water’ is genuinely ambiguous, as evidenced by the naturalness with which it is said that the three forms of water are ice, steam, and water. Perhaps the widespread use of ‘H₂O’ in the vernacular has somehow infected ‘water’ with an ambiguity. If ‘water’ is ambiguous, the scientific essentialists should not use it as the flagship of their program. We would expect them to turn instead to neighboring examples, such as ‘glass’, ‘sand’, ‘diamond’, or ‘graphite’. But we have seen that there are no relevant necessary *a posteriori* identities to be found here.

⁸ Bealer (1994), pp. 193–198.

⁹ Kripke (1972), pp. 103–104.

¹⁰ Note that the possibility of variation in word meaning across populations of speakers in qualitatively identical epistemic situations is crucial to Kripke's rephrasal strategy. The rephrasal strategy presently under consideration is, then, asymmetric in the appropriate way: the *anti*-scientific-essentialist, who is a traditional *internalist*, is unable to appeal to differences in word meaning across populations of speakers in qualitatively identical epistemic situations and therefore is unable to use Kripke's first strategy to disarm pro-scientific-essentialist reports. Bealer (1994, pp. 193–198) effectively argues that Kripke's second, and quite distinct, rephrasal strategy, which rests on a *descriptive* reinterpretation of anti-scientific-essentialist reports, fails due to its lack of asymmetry. I should note that the expression 'semantically stable' is introduced by Bealer in the same paper.

¹¹ The strategy to which I appeal in the text is suggested by Bealer (1996a), pp. 24–26 and note 34. See also Bealer (1996b), 121–142.

¹² The same strategy can be used to defend the original force of our intuition that it is possible for H₂O to form the envisaged nasty mushroom-like stuff. It is intuitive that if C is the microscopic constituent of water, it is possible (not to say physically possible) that something has as its microscopic constituent C but have many of the macroscopic characteristics of poisonous mushrooms. This intuition report is immune to Kripke's rephrasal strategy. Its original force is correct as stated – it concerns metaphysical, not merely epistemic, possibility.

¹³ A minority of philosophers (e.g., Shoemaker (1980) and Swoyer (1982)) dispute that the laws of nature are contingent and would therefore not accept my response to the qualified scientific-essentialist position under consideration. However, the dialectical situation regarding the status of the laws of nature does not require a defense, on my part, of the claim that the laws are contingent. There are strong *prima facie* reasons for holding the dominant position in this debate, viz., that the laws of nature could have been different.

¹⁴ I have profited greatly from numerous discussions of this topic with George Bealer over the past three years. Every draft of this paper has benefited from his clear, careful, and insightful comments. An earlier version of this paper was presented to the 1998 Central Division Meeting of the American Philosophical Association, where I received helpful criticisms and suggestions from my commentator, Anthony Brueckner. The present paper also benefited from several valuable suggestions made by an anonymous referee of this journal.

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