

Realism Without Reference
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1. Introduction.

Scientific realism, normally construed, is a multi-component thesis about the metaphysics, semantics, and epistemology of scientific theories. Roughly speaking, a realist is one who believes that

- a) there is a mind-independent world for theories to be about, partly containing things not directly available to unaided observation
- b) scientific theories are able to represent, correctly or incorrectly, facts about this domain, and
- c) we have reason to believe that our most successful theories are at least approximately true descriptions of these facts.

In this paper the first two claims will not be at issue, and we will assume that they are true. The question under discussion will be how one might argue for the third, epistemological, claim.

Our aim will be to show that a commonly-held view on this issue is incorrect. According to this view, it is crucial to the defence of epistemological scientific realism that particular conclusions about the referential status of theoretical terms be justifiable. In order to show that this view is mistaken, we will suggest a version of the realist thesis to which the referential status of theoretical terms is irrelevant. On our version of scientific realism, the cognitive content of a scientific theory lies in its Ramsey-sentence.

We will then consider whether our alternative realist thesis is equivalent to scientific realism more standardly construed. This raises some complex issues about reference. In the end, we argue that our Ramsey-sentence realism does come to the same thing as standard realism. But this further equivalence claim is independent of our main thesis, which is that Ramsey-sentence realism is a substantial version of realism in its own right, and describes the greatest cognitive achievement we are entitled to expect of our theories.

2. Does Approximate Truth Require Reference?

Let us first see why the referential status of theoretical terms is generally thought to matter to scientific realism. A standard line of thought is that the notion of reference enters the fray through abductive arguments which purport to justify realism. Such arguments work by construing realism as a quasi-empirical hypothesis, justifiable on the grounds that it best explains some independently manifest feature of science. The simplest and most well-known argument of this sort (and the one we will concentrate on in this paper) is the so-called "no miracles" argument. According to this argument the

"observable" fact that certain theories are empirically successful justifies the hypothesis that they are substantially accurate in respect of their unobservable or deep-structural claims, on the grounds that, if this were not the case, their empirical success would be miraculous. Less contentiously, perhaps, one can construe the argument as the claim that the best explanation for the success of successful theories is that they are approximately true. Although one could justifiably question this sort of argument, we will not do so in this paper. Our interest is rather in the way it is generally thought to bring in questions of reference.

Clearly, if you want to argue that "approximate truth" best explains the success of science, the viability of your argument will depend on your notion of approximate truth. It is at this point that referential issues are normally brought in. Consider Putnam:

"If there are such things [as electrons, DNA molecules, curved space-time etc.], then a natural explanation of the success of these theories is that they are partially true accounts of how they behave . . . But if these objects don't really exist at all, then it is a miracle that a theory which speaks of gravitational action at a distance successfully predicts phenomena; it is a miracle that a theory which speaks of curved space-time successfully predicts phenomena . . ." (1978, p.19)

Putnam is saying that successful theories must achieve two things if their success is not to be a miracle. First, the theories must succeed in the identification or postulation of existing theoretical entities, such as DNA or curved spacetime. Second, the theories must give an approximately correct description of these entities. The success of a theory that has failed to achieve either of these would, according to this line of thought, be a miracle. Thus, holds Putnam, we are entitled to assume that successful theories generally achieve both.

Reference gets into the act on the back of the first of these requirements: presumably the entities that a theory "identifies", if it identifies any at all, are the things that its terms refer to. Thus if a theory's terms fail to refer, it fails to identify existing entities, and, so the argument goes, its success would be a miracle. Thus reference appears to be a necessary condition for explaining empirical success via the approximate truth of theories.

Exactly the same point has also been used to argue against realism, the canonical case being Larry Laudan's "Confutation of Convergent Realism" (Laudan, 1981). Laudan concurs with the thought that a realist explanation of empirical success in terms of approximate truth requires that the relevant theory refers, claiming that

"a realist would never want to say that a theory is approximately true if its central terms fail to refer".

But he holds that it is simply a datum that central terms in many successful theories do not refer: "aether", "phlogiston", "caloric" and various others fall into this category on his view. Laudan claims that this evidence of "reference failure" undermines the ascription

of approximate truth to theories. If reference failure is widespread, then by the realist's own lights approximate truth cannot be the correct explanation of empirical success.

The state of play between Laudan and the realist therefore appears to be a standoff; a case of one person's *modus ponens* being another's *modus tollens*. Both parties agree that successful reference is an essential part of what it would take for a theory to be deemed approximately true in a manner satisfactory for a realist explanation of the success of science. The realist claims that the success of successful theories warrants us in claiming that they are approximately true, and thus, that they successfully refer. Laudan, on the other hand, takes reference failure to be an independently established fact, arguing on these grounds the theories which it afflicts cannot be approximately true, and thus, success on its own cannot warrant the attribution of approximate truth to those theories.

3. Can Generous Theories of Reference Save Realism?

Laudan's case against realism rests on his list of putative reference failures in the history of empirically successful scientific theories: "aether", "phlogiston", "caloric" and so on. In response to, (or perhaps in anticipation of) such cases, realists have favoured "generous" theories of reference which are designed to keep such reference failures to a minimum; theories of reference, that is, on which referential success is the overwhelming norm. Canonical in this regard is the so-called "causal theory of reference" of Kripke and Putnam, on which theoretical terms are seen as acquiring referents through "baptisms" or "dubbings", in which referents are identified via ostension, in combination with a small amount of minimally specific descriptive material; later uses of the term refer to the same thing when an appropriate sort of causal connection obtains with the original baptism. By divorcing reference as far as possible from the theoretical beliefs of speakers who use terms, the theory promises to yield the sorts of consequences the realist would want. There are number of variations on the causal theory in the literature, and also other generous theories of reference designed to defend the realist picture in a similar way (e.g. Newton-Smith 1981, Hardin and Rosenberg 1982, Kitcher 1993, Cummiskey 1995 and others).

It seems unlikely, however, that any good theory of reference will be able to deal with all Laudan's cases. Take the nineteenth-century "aether" as an example. As a number of writers have noted (e.g. Laudan 1981, Hardin and Rosenberg 1982, Worrall, 1989), this is a very hard case for the realist. The nineteenth-century theory that explained electromagnetic phenomena as waves in a continuous elastic solid had a welter of notable empirical successes. Yet the received post-Einsteinian view is undoubtedly that no such aether exists.

True, Hardin and Rosenberg (1982) argue precisely that "aether" was genuinely referential, on the basis of a theory of reference which takes terms to refer to that entity, property, or substance which plays a certain "causal role". The aether is thus identified as the bearer of optical phenomena. Unfortunately, Hardin's and Rosenberg's view of reference is far too generous to be plausible. Aside from their non-standard view of the

referent of "aether", they have to wrestle with the fact, pointed out by Laudan in his (1984), that systematic application of the required principle generates even worse cases: if "aether" refers to the electromagnetic field on the grounds that it identifies, but misdescribes, the seat of optical phenomena, why does Aristotle's conception of "natural place" not refer to gravitational attraction on the grounds that it identifies, but misdescribes, the "cause of fall"? A theory of reference with such consequences would seem to violate all the intuitions that are standardly taken to motivate theories of reference in the first place.

4. Ramsey-Sentence Realism

As we stated at the outset, our intention is to propose an alternative realist hypothesis which removes theories of reference from their alleged role in the realist's explanatory scheme. This alternative hypothesis is that the empirical success of scientific theories can adequately be explained by appeal to the approximate truth of their Ramsey-sentences. It is further question whether this Ramsey-sentence realism is the same as standard scientific-theory realism. This depends on whether the approximate of a Ramsey-sentence is the same thing as the approximately truth of the original theory, and we shall discuss this issue in sections 6 and 7. Our first task, though, is to explain Ramsey-sentence realism itself.

The procedure for forming Ramsey-sentences is well-known. In order to form the Ramsey-sentence of a theory, we replace each distinct theoretical term-type occurring in the theory with a distinct variable. We then place a distinct existential quantifier at the front of the resulting expression for each distinct variable.

Thus if the original theory could be expressed,

$T(F_1, \dots, F_n),$

its Ramsey-sentence would be

$(\exists x_1) \dots (\exists x_n) T(x_1, \dots, x_n).$

Whereas the original theory would have said, of the putative referents of its theoretical terms, that those things had certain properties, the Ramsey-sentence just says that there exist unique things with those properties.

The first thing to note is that the referential success or failure of the terms in a theory is irrelevant to the approximate truth of its Ramsey-sentence, since the theoretical terms do not occur in the Ramsey-sentence. For a theory to be approximately true, the referents of its terms must approximately satisfy the properties the theory attributes to them. If there are no such referents, then the theory cannot be approximately true. But for the theory's Ramsey-sentence to be approximately true, we need only require the approximate truth of the existential claim, that there exist things with such-and-such properties, and this claim

could be approximately true even if the theory's terms fail of reference.

For example, suppose "the aether" fails to refer to anything. Then there is no question of the aether possessing any properties, approximately or otherwise. But this does not preclude the assessment of the relevant existential Ramsey-sentence for approximate truth. It could be approximately true that there is an entity which is the seat of electromagnetic phenomena, and involves transverse radiation, and . . . consists of an elastic solid. After all, there is indeed something which is the seat of electromagnetic phenomena, and involves transverse radiation, and so on--namely, the electromagnetic field--even if it is not an elastic solid. Many of the implications of a Ramsey-sentence could thus still be true, even if the original theory's terms fail of reference. We take this to illustrate the way in which a Ramsey-sentence can be approximately true even if its original theory suffers reference failure.

This possibility now offers an alternative way to argue from empirical success to scientific realism. Faced with an empirically successful theory, the realist can argue, not to the approximate truth of the theory itself, but to the approximate truth of its Ramsey-sentence. Maybe Laudan can discredit the approximate truth of theories as the best explanation of empirical success, on the grounds that many empirically successful theories failed to refer and so can't be approximately true. But this doesn't discredit the approximate truth of their Ramsey-sentences as the best explanation of their success. And such explanations do seem highly plausible. Surely the reason nineteenth-century electromagnetic theory worked so well is that its existential claims were approximately true. It would have been a miracle for it to make so many successful predictions unless at least this much were true.

Thus Ramsey-sentence realism. The Ramsey-sentence realist says that we should believe in the approximate truth of a successful theory's Ramsey-sentences, on the grounds that it would be a miracle that the theory were successful, were its Ramsey-sentence not true.

On this conception of scientific realism, debates between "generous" and "stingy" theory of reference turn out to be irrelevant. Suppose we are forced to adopt a stingy account of reference on which successful theories characteristically fail to refer. This won't count against a Ramsey-sentence realist explanation of empirical success. For, even given a stingy account of reference, we can still uphold the approximate truth of those successful theory's Ramsey-sentences.

It is worth being clear exactly what Ramsey-sentence realism achieves in the face of Laudan's "confutation". In particular, note that it does not immunize realism against any historical evidence whatsoever. Imagine a neo-Laudanian argument which adduced a list of examples showing that the Ramsey-sentences of many past successful theories were not in fact approximately true. If this was historically accurate, then it would amount to a successful confutation of Ramsey-sentence realism. It would discredit the inference from a theory's empirical success to the approximate truth of its Ramsey-sentence, by showing that there are many cases where this inference fails.

But this is no objection to what we have argued. Our view that the realist content of a theory lies in its Ramsey-sentence is not supposed to provide a sure-fire method of rebutting any historical evidence. Ramsey-sentence realism is still hostage to the historical claim that there is approximate truth at the level of Ramsey-sentences, at least for empirically successful theories. As it happens, we do think that the history of science displays such approximate truth, but this would have to be defended elsewhere. Our current intention is only to deliver realism from a spurious argument, namely, that it is incompatible with reference failure.

5. Are Ramsey-Sentences Really Realist?

Some readers familiar with Ramsey-sentences may be suspicious of their realist credentials. Exactly what a Ramsey-sentence asserts is sensitive to what counts as a "theoretical" term, since this decides what is to be eliminated from the theory in forming its Ramsey-sentence. The trouble is that some ways of identifying "theoretical terms" threaten to remove any realist content from Ramsey-sentences.

The most familiar way of drawing the distinction between "theoretical" and other terms is that proposed by the logical empiricists. The logical empiricists viewed Ramsey-sentences as a way of expressing the empirical content of theories using only "observational" vocabulary that referred to items or properties that are directly perceivable; thus, all but the observational and purely logical vocabulary in a theory was to be eliminated in forming its Ramsey-sentence.

However, this conception of Ramsey-sentences is unlikely to be helpful to someone who wants to use Ramsey-sentence in a defence of realism. Without going into detail, a now well-known argument shows that Ramsey-sentences as conceived by the logical empiricists make no claims about unobservables. So the claim that such Ramsey-sentences are approximately true can scarcely amount to a version of scientific realism. A detailed discussion of the relevant argument can be found in Demopoulos and Friedman (1985); we will mention it no further here.

Still, there is no need for the realist to be tied to the particular logical empiricist understanding of "theoretical" as "non-observational". Instead, realists ought to invoke the distinction proposed by David Lewis in his article "How to Define Theoretical Terms". Lewis suggests that the "theoretical terms" of a theory ought not to be understood as contrasting with "observation" terms, but with "antecedently understood" terms. The theoretical terms (or T-terms) to be eliminated in forming the Ramsey-sentence of a theory are just those whose meaning derives from their place in the theory, and the antecedently understood terms (O-terms or "old" terms) are those whose meaning is fixed independently of their place in the theory. Thus the process of Ramsification does not explain how theoretical terms depend for their meaning on observational terms, but only how terms newly introduced in a theory depend for their meaning on terms understood independently of that theory.

Lewis puts his distinction forward as a theory-relative one, and claims to commit himself to no absolute distinction between theoretical and non-theoretical terms. However, it is easy to see that this diagnosis of the situation cannot be quite correct. The theoretical terms in any theory T will on Lewis's account have their meanings fixed by their place in that theory and by the meaning of the antecedently understood vocabulary. But that antecedently vocabulary might itself depend in meaning on its place in a further theory T', and on T's antecedently understood vocabulary. Moreover, by conjoining the original theory T with the theory T', and eliminating all of either theory's vocabulary in favour of existentially quantified variables, the original theory T can have its content expressed in O' vocabulary: vocabulary defined in neither T nor T'.

By tracing the relations of definitional dependence backwards in this way, one of three things will happen: either

- a) we get into an infinite regress, each term defined in a further theory
- b) we go round in circles, and every term turns out to be theoretical in the theory in which it occurs, or
- c) we arrive at a set of vocabulary in terms of which any theory can be expressed in Ramsey-sentence form, but which is not defined in any theory.

a) seems absurd if we can only possess a finite number of theories; and b) appears to lead to the conclusion that the content of any theory is expressed by a sentence which eliminates all non-logical vocabulary, apparently rendering every theory trivially true (although Lewis in his 1984 suggests that this might be his own view). Thus a realist would be well advised to accept the third option, on which theories can have their contents specified using a set of vocabulary which is absolutely non-theory-dependent in meaning.

This might seem effectively to return us to the unhelpful empiricist equation of "theoretical" with non-observational. This appearance, however, would be deceptive. The only requirement now being imposed on non-theoretical terms is that they are not understood as denoting just those things which satisfy some particular theory. It would require extra empiricist presuppositions to infer from this that the relevant set of vocabulary must be "observational" in any substantial sense. Without prior empiricist prejudices, why not allow that a term could fail to be defined in a theory, and yet be neither observational nor logical? Antecedently understood terms could thus refer to such substantial non-logical relations as causation or correlation, or indeed to many kinds of unobservable things.

If this is right, then we can evade Demopoulos's and Friedman's argument that Ramsey-sentences cannot make claims about the unobservable. This means that the approximate truth of a Ramsey-sentence can be a substantial realist claim. The Ramsey-sentence of a theory essentially defines its unobservable descriptive content. It specifies in qualitative existential terms how the theory takes the unobservable world to be. So the approximate

truth of this unobservable content can yield a genuinely realist explanation for the the empirical success of the relevant theory.

6. Are Ramsey-Sentences Different From Their Theories?

So far we have defended a version of scientific realism by driving a wedge between scientific theories and their Ramsey-sentences. Scientific theories uses theoretical terms, and cease to be candidates for approximate truth if those terms fail to refer. Ramsey-sentences existentially quantify those terms away, and so their approximate truth does not depend on questions of reference.

In these last two sections we shall consider whether this wedge between scientific theories and their Ramsey-sentences can be removed. That is, we shall consider whether Ramsey-sentences coincide in content with their theoretical originals. If they do, then our Ramsey-sentence realism will be no different from scientific realism as standardly conceived after all. Our argument for the approximate truth of Ramsey-sentences will simultaneously be an argument for the approximate truth of scientific theories.

The point of focussing on Ramsey-sentences has been to free scientific realism from dependency on disputable theories of reference. Since Ramsey-sentences don't use theoretical terms, Ramsey-sentence realism doesn't require any claims about the reference of terms. By the same coin, any argument that scientific theories are equivalent to their Ramsey-sentences will have to involve itself with questions of reference. We will need to show that the referential values of the reintroduced terms are such as to render the term-using theories equivalent to their Ramsey-sentences.

So the arguments in these last two sections will hinge on views about the referential workings of theoretical terms in science. Let us emphasise once more that the rest of this paper is independent of any such views about reference. We need to engage with question of reference in order to argue that Ramsey-sentence realism is the same as standard scientific realism. But Ramsey-sentences realism itself is independent of any questions of reference.

Having focused the issue, we would like to start by observing that it would intuitively seem rather odd if scientific theories said something different from their Ramsey-sentences. We have argued that the best explanation of the empirical success in science is that scientists are characteristically approximately right when they suppose that there exist unobservable entities which bear such-and-such relations to each other and to antecedently available entities. If scientists are nevertheless wrong in their theoretic beliefs, this can only be because their theories are saying something different--presumably that certain other putative entities, so to speak, bear those relations to each other and to antecedently available entities. But why ever should scientists so want to say something different? Surely the whole idea of a scientific theory about unobservables is to posit hidden causes of a certain kind. But that is just what a Ramsey-sentence does. It is thus difficult to see what point there would be to having scientific theories which say

something different from their Ramsey-sentences.

Still, these rhetorical remarks scarcely decide the issue. To clarify the point, note that it is perfectly possible for a term-involving claim to differ in content from its Ramsey-sentence. Suppose I am thinking about the children in a school, and adopt the view "John is tall, thin, and red-haired". The "Ramsey-sentence" of this claim would be "There exists a unique boy who is tall, thin, and red-haired". Now, this "Ramsey-sentence" could be true--there could be a unique tall, thin, red-haired boy in the school--yet my original belief wrong, simply because "John" names some other boy. Clearly here the original theory--"John is tall, thin, and red-haired"--differs in content from its "Ramsey-sentence"--"There exists a unique boy who is tall, thin, and red-haired".

This example shows how a claim can differ from its Ramsey-sentence. At the same time, it indicates a model of reference which would allow scientific theories to be equivalent to their Ramsey-sentences. If the terms in a scientific theory are definitionally equivalent to descriptions, and these descriptions derive from the assumptions in the theory, then the theory and its Ramsey-sentence will be equivalent. Thus, if "John" is equivalent to "the unique tall, thin, red-haired boy", then the original theoretical claim "John is tall, thin, and red-haired" collapses into its "Ramsey-sentence" "There exists a unique boy who is tall, thin, and red-haired". A similar descriptive account of theoretical terms would render scientific theories equivalent to their Ramsey sentences.

How plausible is it that scientific terms are defined descriptively in this way? If the alternative is a causal theory of reference along Kripke-Putnam lines, there are two immediate points that can be made in favour of the descriptive account.

First, the Kripke-Putnam causal account has trouble with terms that are introduced before there is any direct experimental manifestation of their referents. On the Kripke-Putnam view, the referent of a term is fixed via a "baptism" or "dubbing" involving some manifestation of the referent. Thus, for example, "electricity" might be introduced as "the cause of those effects". But this story clearly won't work with terms like "positron", "neutrino", and "quark", since these terms were explicitly introduced to refer to hypothetical entities that play theoretically specified roles, before any direct experimental manifestations were available for any dubbing ceremony. Cases like these seem tailor-made for a descriptivist account, on which scientific terms denote precisely those entities that satisfy some set of theoretical descriptions.

Second, there is the point, mentioned earlier, that causal theories seem overly generous. If we take the Kripke-Putnam approach to reference seriously, then we seem in danger of having "natural place" refer to gravitational attraction, and "phlogiston" refer to absence of oxygen, and so on. Intuitively, it seems wrong to allow that theoretical terms always refer to the causes of the phenomena they were introduced to explain, however mistaken the surrounding theories may have been about the nature of those causes.

Still, even if these two points give us some initial reason to favour descriptivist accounts of scientific terms over causal accounts, we are still some way short of the thesis that

scientific theories are equivalent to their Ramsey-sentences.

One problem is that the specific descriptivist account gestured at above also has highly counter-intuitive consequences. Where Kripke-Putnam causal theories are clearly too generous, the descriptivist account we have offered so far is clearly too stingy. Our suggestion was that the whole scientific theory involving a term should define it. The term thus denotes that unique entity, if any, which satisfies all the assumptions the theory makes about it. But, if we take this seriously, then no scientific term will ever denote anything. For no extant scientific theory has ever been right in all its assumptions about the entities it postulates.

The obvious remedy, if we want to pursue descriptivist accounts of scientific terms, is to suppose that only some of the assumptions in scientific theories contribute to the definitions of their theoretical terms. This then promises to allow that some scientific terms ("natural place", "phlogiston") did indeed fail to refer, without immediately flopping over to the excessively stingy conclusion that no scientific terms ever refer.

But what principles decide which assumptions in a theory contribute to the definitions of its terms, and which do not? The idea of such a division seems dangerously close to an analytic-synthetic distinction. This raises a number of large issues, about which one of us has written elsewhere (Papineau, 1996). Without wanting to go into details, the conclusion there reached is that it is a vague matter, within limits, exactly which theoretical assumptions contribute to the definitions of scientific terms.

If this is right, it is then also a vague matter exactly which past terms succeeded in denoting real entities, and which did not. This conclusion seems to us to accord perfectly well with intuition about the referential success of past theoretical terms. In particular, it seems to avoid both the excessive generosity of the Kripke-Putnam account and the excessive stinginess of total-theory descriptivism.

In any case, our current concern is not to adjudicate on the extent of past referential success, but to decide whether theories are equivalent to their Ramsey-sentences. In this connection, as opposed to adjudicating past referential success, it does not matter too much exactly which assumptions in a theory go into defining its terms. For pretty much any set of assumptions in this role will have the effect of reducing a theory to its Ramsey-sentence.

To see this, return to our earlier analogy. Suppose we define "John" as "the (unique) tall boy". Then the theory that "John is tall, thin, and red-haired" will clearly imply the "Ramsey-sentence" that "There is a unique tall, thin, red-haired boy".

True, there isn't quite an implication the other way round. "There is a unique tall, thin, red-haired boy" doesn't imply "The (unique) tall boy is tall, thin and red-haired", for there may not be a unique tall boy, even if there is a unique tall, thin, red-haired boy.

Still, I think we can reasonably ignore this slight mismatch between a Ramsey-sentence

and its theory, arising from the fact that only some of the theory may be used in defining its terms. The possibility that the Ramsey-sentence will be true, but the original theory false, will only be actualised in those cases where the Ramsey-sentence identifies a unique entity, but the descriptions used in defining the relevant term do not so ensure uniqueness. But such cases are unlikely to be actual. Scientific thinkers may not use their whole theory to define their terms. But they will normally pack enough into their descriptions to pick out a unique entity, whenever the whole theory does so. (Cf. Papineau, 1996. There may well be cases where uniqueness is not achieved. But what we doubt is that there are cases where this failure of uniqueness would be remedied by including the whole theory in place of the defining descriptions.)

7. Names and Descriptions

Let me now consider a different kind of reason for doubting the equivalence of theories and their Ramsey-sentences. Someone may agree that if theoretical terms were equivalent to Russellian descriptions--that is, if they were contextually defined terms to be systematically eliminated in line with Russell's theory of descriptions--then theories would indeed come to the same thing as existentially quantified Ramsey sentences. But they could object that this is not the same as viewing theoretical terms as genuine terms whose referents happen to be fixed by descriptions.

The point is that someone could accept the superiority of a descriptivist view over the Kripke-Putnam causal view, for the reasons given in the last section, and yet insist that this does not show that theoretical terms in science can be eliminated in favour Russellian existential quantifications. For these terms may still be genuine names. The last section only shows that, if so, they are names whose reference is fixed by description, rather than determined causally à la Kripke and Putnam.

If this is right, the objection can then continue, scientific theories are by no means equivalent to their Ramsey-sentences, and Laudan's original objection to realism about scientific theories will stand. For a claim made using an empty genuine term is no claim at all, and a theory formulated using empty scientific terms will be similarly empty, and therefore no candidate for approximate truth.

Moreover, we have been given no reason to suppose that the terms on which Laudan focuses will succeed in referring just because they are introduced via descriptions. On the contrary, the last section advertised it as a selling point of the descriptivist view, over the Kripke-Putnam causal account, that it was not overly generous, and would deny reference to those scientific terms that intuitively seem not to have referred to anything. So it seems that, even if "aether" has its putative reference fixed by description, it will still refer to nothing, with the result that there is no question of whether "that entity" approximately satisfies the properties nineteenth-century electromagnetic theory attributed to "it".

We do not accept this objection. It seems to us to postulate too sharp a dichotomy

between genuine terms and Russellian descriptions. Our view is that a scientific term introduced by a description may behave like a name in other respects, and yet the truth conditions of the sentences it enters into still conform to Russell's analysis of descriptions. Thus we accept that scientific terms may behave rigidly in modal contexts (equivalently--behave like an "actualised" description), and that speakers may build up their understanding of sentences involving them in the same way as they build an understanding sentences involving simple names. But we take this to be consistent with claims involving those terms being truth conditionally equivalent to claims that there exists entities with such and such properties, that is, equivalent to the Ramsey-sentences. (Cf. Sainsbury, forthcoming.) If this is right, then scientific theories will still be candidates for approximate truth, even if their terms fail to refer, since a claim that there exist entities with such and such properties can still be approximately true even if there are no actual entities of precisely those kinds.

There is one very strong argument in favour of this Russellian view of scientific terms--namely, the possibility of true negative existential claims. There is no phlogiston, no aether, and no natural places. Obviously true. But the view that empty scientific terms cannot be used to say anything has trouble accommodating these obvious truths. ("If there is no phlogiston, then how can you say that it doesn't exist?") Our more Russellian view has no difficulty on this point, since it equates the negative existential claims with the negation of an existential quantification. To say there is no phlogiston is simply to say that there is no entity with such-and-such properties.

Let us conclude by considering one further circumstance that might seem to count against the descriptivist view and in favour of the non-Russellian alternative. The best examples of non-Russellian names are names whose understanding does not seem to depend on speakers' grasp of any descriptions. Ordinary proper names which work according to Kripke's causal theory of reference would be the paradigm. In such cases, there is no possibility of a quantificational Ramsey-sentence reading of claims involving the terms, for lack of any associated descriptions. And so here there is no alternative to the conclusion that claims made using empty terms fail to say anything.

Now, so far we have been taking it for granted that the people who use scientific terms will not be short of the relevant descriptions, on the grounds that these are simply the descriptions embodied in the relevant scientific theory. But on reflection this is clearly an idealisation. Plenty of people are competent with scientific terms, and are held responsible for claims they make using them, even though they do not fully grasp the theory in which the terms are used. We have in mind here not only lay people, who have heard the terms in scientists' mouths and intend to use them with the same reference, but also many scientists themselves. Science is a rambling enterprise, whose practitioners include experimenters, engineers, and research students, as well as theoreticians, and by no means all will fully grasp the theories in which the terms they use are embedded.

Because of this, it could well be argued that scientific claims, as constituted in the thinking of the general run of scientists, cannot possibly be equivalent to their Ramsey-sentences, for this equivalence requires a descriptional equivalent for scientific terms, and

no such equivalent is available to the general run of scientists. So, once more, it seems that scientific terms must work as simple non-Russellian names, with the result that claims made using empty terms say nothing, and so a fortiori cannot be approximately true, just as originally assumed by Laudan.

We accept that this may well be the right view of scientific claims as thought by the general run of scientists. Since most scientists won't have any specific descriptions in mind when they use a scientific term, their claims can only be read as about that referent, if there is one, and as saying nothing, if there isn't. We can't equate their claims with Ramsey-sentences, if they don't have the descriptions with which to formulate such Ramsey-sentences.

Still, we don't think this invalidates the position adopted in this paper. For we don't think that scientific claims as thought by the general run of scientists are the right thing to focus on when considering how the history of science bears on scientific realism. When we look back at some past theory, with a view to considering how far it was true, it would clearly be inappropriate to conceive of it in the way it was understood by those who only had a partial grasp of the theory.

For a start, this would stop us concluding that phlogiston doesn't exist. (What doesn't exist, if we aren't allowed to think of phlogiston descriptively?)

And, more fundamentally, it would be very odd to think of past theories in the way they were understood by those who didn't really know them, given that our concern is precisely with how far those past theories were true. Given that we are trying to assess the approximate truth of those theories themselves, we need to focus on the full theories, as articulated by those who did understand them. And there is no need to suppose that these people understood their scientific terms as mere names, divorced from any descriptive content. For, unlike the general run of scientists, they would have grasped the descriptions which were used to introduce the terms, and would have been able to continue understanding the terms in this descriptive way.

So when we consider past scientific theories as thought by the scientists who knew them we can still view the relevant terms as Russellian descriptions, and so view the whole theories as equivalent to their Ramsey-sentences. And if this is right, the defence of Ramsey-sentence realism offered in the earlier sections of this paper will constitute a defence of scientific realism as normally construed.

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