

Some Remarks on Putnam’s Contributions to Semantics

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Abstract: After a critical discussion of Putnam’s early work on the analytic–synthetic distinction, this article discusses seven contributions that Putnam has made to the philosophy of language. These contributions are (1) to understanding the role of definitions in science and in ordinary discourse; (2) to recognizing the role of stereotypes in explaining meaning; (3) to acknowledging the minimal role of explicative understanding in having linguistic competence with natural kind words; (4) to distinguishing sharply between identifying natural kinds and determining their more fundamental natures; (5) to exploring a division of linguistic labour – a role for social interaction in determining reference, especially of natural kind terms; (6) to establishing a broadly unified causal account of the reference of ordinary natural kind terms and scientific physical magnitude terms; and (7) to reviving a conception of scientific language that allows for trans-theoretical reference and one sort of trans-theoretical meaning.

Keywords: analytic, synthetic, definition, natural kind term, linguistic competence, division of linguistic labour, reference, meaning

THIS SYMPOSIUM TO HONOUR Hilary Putnam is centred on his contributions to semantics. The orientation to semantics calls to mind other areas of philosophy that are not the focus of the symposium, but could have been. Putnam has made major contributions to philosophy of physics, philosophy of mathematics and logic, and philosophy of mind, as well as philosophy of language. I bow to the need to be selective, forced on us by the large range of his originality. Even in philosophy of language, I will have to be selective.

In “The Analytic and the Synthetic” (Putnam, 1962),¹ Putnam set out to criticize the letter of Quine’s rejection of any analytic–synthetic distinction, but to defend its spirit. The main point of the article is to show that attempts to explain applications of the notion of analyticity fail, except in the most trivial cases. Putnam backs Quine’s claim that alleged cases of analyticity in science and philosophy commonly turn out to be open to possible empirical refutation, though not by way of any single empirical experiment. Putnam’s criticism of philosophical appeals to analyticity goes beyond Quine’s in considering, in some detail, actual cases from the history of science. He notes that Einstein’s use of the constancy of light velocity to define simultaneity is open to possible empirical threat (Putnam, 1962, p. 38). This point resonates today, given that, recently, it has been claimed by a group of scientists in

1 Citation of pagination to Putnam’s articles will be to the pagination in Putnam’s *Philosophical Papers*.

Switzerland that the speed of light is not the top speed in the universe. Whether or not this claim turns out to be right, its very scientific legitimacy underscores Putnam's point.

Putnam developed the same point, in more detail, by reference to the classical definitions in Newtonian physics of 'kinetic energy' (as $\frac{1}{2}mv^2$) and 'force' (as ma) (Putnam, 1962, pp. 42–46, 50–59). The point is that a given scientific statement is often used both as a definition in a scientific framework and as the statement of a basic law, with systematic empirical implications. The non-arbitrariness of the definition and the fact that it is simultaneously a statement of a putative law, which recognizes the position of a physical quantity in a cluster of laws, make the definition non-conventional, non-stipulative, and in principle open to empirical threat.

The significance of these points lay not only in their validating Quine's rejection of analyticity as an important notion in understanding the structure of science, and indeed knowledge in general; it also lay in Putnam's method of argumentation. By looking at specific scientific theories and practices in order to try to understand scientific language and scientific epistemology, Putnam went beyond Quine and beyond Quine's logical-positivist forebears. They had discussed science almost entirely in the abstract. Putnam's work along with Kuhn's, and followed in great depth by Earman's, helped lead philosophy of science to engage in detailed reflection on specifics in the sciences. Together with other work by Putnam in the same period, this article on semantics helped initiate a sea-change in the way philosophy of science was done.

Putnam's points in "The Analytic and the Synthetic" also laid the groundwork for a deeper understanding of the language of science. In distinguishing between stipulative (abbreviative) definitions and definitions as framework statements of law, and in emphasizing that reference to a physical quantity commonly remains the same through large changes in beliefs about scientific laws (Putnam, 1962, p. 50), Putnam anticipated some of his future contributions to the development of semantics.

I believe that Putnam's criticism of the letter of Quine's rejection of any analytic–synthetic distinction is also successful. But here the success is, I think, more mixed. Both Putnam and Quine tended to take the notion of immunity to rational revision as a notion of analyticity. But although most traditional notions of analyticity were taken to *imply* immunity to revision, the converse does not hold. Many traditionalists, including Kant and Frege, thought that some *non-analytic* propositions are immune to revision. Both took the truths of Euclidean geometry applied to physical space to be synthetic, but immune to revision. These views were, of course, overtaken by developments in science. But Kant took the truths of pure arithmetic as synthetic and immune to revision. This view is not implausible, and cannot be regarded as false simply by reflection on any traditional conception of analyticity.

Traditionally, analyticity was supposed to be primarily a feature of content, not primarily an epistemic notion.² Certainly, the logical positivists conceived of analyticity as a feature of content. The feature of content was supposed to support claims about epistemic status, including claims of immunity to revision.

Showing that a statement or thought is not immune to empirical revision *does* succeed in showing it *not* to be analytic, on all or most traditional conceptions of analyticity and its relation to warrant or justification. But allowing that some statements can be harmlessly taken to be immune to revision does not in itself imply that they are analytic, in any sense of 'analytic'. Some of Putnam's defence of the analyticity of 'Bachelors are unmarried' (or the analogue thought) rests on arguing its immunity to revision and arguing the harmlessness of taking it to be immune to revision (Putnam, 1962, pp. 56ff.). It seems to me that these forms of defence do not really defend any genuine notion, or conception, of analyticity.

On the other hand, much of what Putnam wrote *is* relevant to defending *certain* notions and conceptions of analyticity. Two conceptions that his discussions are relevant to are these:

A statement or thought is analytic in the *derivability-from-logic-plus-synonymies* sense if and only if it is a truth of logic or derivable from truths of logic plus exact synonymies.³

and

2 Kant runs together the three notions of analyticity that I lay out here, or else he mistakenly believes them to be equivalent. The containment notion is the one used in his official explication of analyticity. See *Critique of Pure Reason* A6–7/B10–11. For the derivability-from-logic notion, see *Critique of Pure Reason* A151/B190–191. For the vacuity notion, see *Critique of Pure Reason* A9–10, 258/B13–14, 314. The containment notion and the vacuity notion are clearly notions of content, not epistemic notions. The notion of derivability from logic (with synonymies, for twentieth-century philosophers) is either an epistemic notion or a notion of content, depending on whether one conceives of proof (the idea underlying derivability) as a matter of justification or as a matter of relations among contents. Kant and Frege both conceived of proof as justification. The logical positivists, however, conceived it as a formal relation among contents. On their, and the predominantly modern, notion of proof, not all genuine proofs constitute justifications of the conclusions: proofs can have irrational premises. Kant and Frege do not count derivations from irrational premises as proofs. It is true that Frege's official explication of the notion of analyticity is clearly and emphatically an explication of an epistemic notion. See Frege, *Foundations of Arithmetic* (1884), section 3. He sees himself as following Kant. But I believe that he overlooks the fact that the containment notion is Kant's primary and official conception of analyticity. Kant's official conception is a conception of analyticity as a feature of content. Both probably believed that beliefs in analytic truths are immune to rational revision. However, Frege, no more than Kant, would *identify* the notion of analyticity with the notion of immunity to rational revision. For more discussion of the three notions of analyticity, see Burge (1992). Relevant portions of that article are reprinted in Burge (2007). See also Burge (2003), especially sections I–II.

3 This explication occurs in Quine and the writings of various logical positivists. More traditionally, for example in Kant, the axioms of logic were regarded as neither analytic nor synthetic. They were so regarded because understanding their truth did not derive from either analysis or synthesis. The axioms were regarded as too basic to undergo analysis or to be the product of synthesis. Furthermore, since the tradition was focused less on the analyticity of language than on the analyticity of thought, reference to synonymies

A statement or thought is analytic in the *containment* sense if and only if its predicate concept (or meaning) is contained in its subject concept (or meaning).

Putnam (1962, p. 56) defends, plausibly, the idea that there are a few strict synonymies in natural language, and that recognizing them is epistemically harmless. It follows that, in the *derivability-from-logic-plus-synonymies* sense, there are a few analytic statements or thoughts based on such synonymies. Moreover, the concepts (or meanings) expressed by ‘unmarried’ and ‘female’ are perhaps “*contained*” in the concepts (or meanings) expressed by ‘bachelor’ and ‘vixen’, respectively. Perhaps ‘bachelor’ is strictly synonymous with ‘unmarried adult human male’. Perhaps the meaning of ‘bachelor’ contains the meaning of ‘unmarried’. Putnam made a plausible case that, at the very least, philosophers can take a relaxed, don’t-care attitude toward such cases.

Putnam also suggested a plausible explication of the nature of statements or thoughts that are purportedly analytic in these senses. According to the suggestion, analytic statements are equivalences of the form ‘Something is an *A* if and only if it is *B*’, where *A* is a single word; the statement provides the only generally accepted [and, I add, correct] criterion for determining whether *A* applies to something; and the term *A* is not a law-cluster word (Putnam, 1962, p. 65). I believe that given the complexities of linguistic usage – given the multiple, meaning-relevant pulls that exert themselves on use of any given word – it is not *clear* that there are any exact synonymies in natural languages, or that Putnam’s test isolates any. Lexicographers are certainly fond of denying the existence of exact synonymies. But I agree with Putnam that this is an empirical issue. Perhaps there are a few exact synonymies. If so, Putnam is surely right that their existence is of no great philosophical import.

The primary, traditional philosophical use of notions of analyticity was to mark analytic truths as true in a way that supported some view about how they are epistemically warranted. Both rationalists and empiricists wanted to explain the apparent apriority of analytic truths and their purported immunity to revision. Their content was supposed to connect with and support a view about a special way in which they are known or warranted. Some philosophers – in particular, Kant and the logical positivists – went further. They used a notion of analyticity to maintain that, although analytic truths are warranted apriori, they yield no substantive knowledge – no knowledge of a subject matter.

The *derivability-from-logic-plus-synonymies* and *containment* conceptions just mentioned marked analytic statements as knowable through understanding

is absent in traditional explications: synonymous terms expressed the same concept or thought-component. So the traditional analog of the *derivability-from-logic-plus-synonymies* conception of analyticity is that a truth is analytic in the *derivability-(or proof)-from-logic* sense if and only if it is not an axiom or conjunction of axioms of logic, and is logically provable from the axioms of logic.

concepts or meanings – or through such understanding plus whatever way in which one knows logic. However, these two conceptions do *not* entail any particular epistemology of understanding concepts or meanings, or of knowledge of logic. In themselves, these conceptions do not have deep consequences for epistemology. Neither conception *entails* that “analytic” truths are immune to revision. To make out such a connection, one must say something more specific about how logic, how synonymies, or how containment truths are known. It simply does not follow from a statement’s being derivable from logic plus synonymies that it is immune to revision. It simply does not follow from a statement’s predicate being contained in its subject that belief in the statement is immune to revision.

Nor do these two conceptions, in themselves, make any commitments regarding the substantiveness of “analytic” truths. They say nothing about the role, or lack of role, of such truths in illuminating a subject matter. The *derivability-from-logic-(plus-synonymies)* conception of analyticity is compatible with the view that logic describes necessary features of reality. Frege maintained this view. Kant denied it. Each philosopher’s position is consistent with maintaining the *derivability-from-logic-(plus-synonymies)* conception. The *containment* conception of analyticity is compatible with the view that containment truths describe necessary relations among properties in the world. In fact, many traditional philosophers who believed in containment truths – going back to the Middle Ages – believed that such truths are substantive truths: they describe property relations in the world.

So neither of these conceptions of analyticity, in itself, supports the positivist position that analytic truths are not substantive truths – truths that can be the content of knowledge about a subject matter. Neither conception, in itself, entails that “analytic” truths do not describe or match the world. It is only because the logical positivists thought of analytic truths as non-substantive – as not in any way describing features of reality – that they thought that the apriority and immunity to revision of (beliefs in) such truths constituted no threat to empiricism.

For some philosophers, a third conception of analyticity lay in the background of uses of these first two conceptions. This is the conception that Kant and the logical positivists placed real philosophical weight upon. According to this conception,

A statement or thought is analytic in the *vacuity* sense if and only if it is true, but not in virtue of any relation to a subject matter – not true in the way that ordinary truths are true.

This vacuity conception is, I think, the philosophical conception of analyticity that played the largest role in philosophy.

Kant used this conception to exempt logic from the question that motivated his *Critique of Pure Reason*: how is substantive (synthetic) apriori theoretical cognition possible? He distinguished between logic and mathematics as regards their content and cognitive status. He held that mathematics makes substantive

commitments about (mathematical) objects, whereas logic is a purely formal “canon” of rules for right thinking that makes no commitments regarding how a subject matter is.⁴ Since he maintained that logic is empty of commitments regarding objects of possible knowledge, he thought that one need not explain how apriori cognition of logic is possible. His central question concerned how apriori theoretical cognition of a subject matter – paradigmatically, in mathematics – is possible.

The logical positivists used the vacuity conception to excuse themselves from defending empiricism against the apparent threat that logic and mathematics present to empiricism. Logic and mathematics seem to constitute knowledge that is not warranted empirically. If logic and mathematics were true only in a way that said nothing about a subject matter, empiricism would not need to explain how genuine substantive knowledge, knowledge about a subject matter, is obtained through them. Their apriority would be harmless to the main tenets of empiricism.

Moreover, the logical positivists commonly elaborated the vacuity conception in ways that *do* entail that it is immune to revision on the basis of epistemic considerations. If vacuous-analytic truths were true because of conventional agreement or practically-based stipulation, they would not be subject to revision on theoretical grounds – by reference to evidence or other epistemic considerations. Theoretical grounds for supporting or revising them would be irrelevant. Only practical considerations, not epistemic considerations, would bear on determining their truth.

Although this vacuity conception is the primary philosophical conception of analyticity (certainly for the logical positivists), and although Quine refers to it at the beginning of “Two Dogmas of Empiricism” (1951), he goes on to ignore it in his main arguments in that article – targeting other conceptions. Putnam’s 1962 article does not focus on the vacuity conception either.⁵

Fortunately, Quine gave powerful, never-answered criticisms of this conception in “Carnap and Logical Truth” (1954) and “Truth by Convention” (1936). There is no reason to think that there are two kinds of truth – truth in virtue of reference to or satisfaction by a subject matter, and truth that is somehow free of subject-matter implications. Putnam’s criticism of conventionalism and of stipulative definitions supplements Quine’s fundamental criticisms of the conception of analyticity in the vacuity sense. The demise of this conception is one of the central events in twentieth-century philosophy. Loss of interest in *any* conception of analyticity as a basic philosophical tool is an important corollary.

4 *Critique of Pure Reason*, A52–55/B77–79; *Jäsche Logic*, Introduction, section I.

5 Quine mentions the vacuity notion of analyticity in the second sentence of the article. But he does not return to it in the article for any serious criticism, conflating it mainly with the derivability-from-logic-plus-synonymies notion. Putnam (1962, pp. 38–42) does criticize notions of truth by stipulation. See also Putnam (1976). But he too is mainly focused on the derivability-from-logic-plus-synonymies or containment notions.

Putnam's discussion was central to providing a sound and balanced conception of definition and meaning during this period of ferment in mid-twentieth-century philosophy. He helped banish appeals to analyticity to the backwaters of philosophical discussion, without holding Quine's extreme view that notions of meaning are cognitively worthless.

I turn now to what I regard as the core of Putnam's contributions to semantics. These contributions emerged in the great trio of articles, in the early and mid-1970s: "Is Semantics Possible?" (1970), "Explanation and Reference" (1973), and "The Meaning of 'Meaning'" (1975). These rich articles contain important and lasting contributions to our understanding of language. I will highlight seven contributions to the development of semantics in these articles.

The first concerns our *understanding of definitions*. Putnam extended his points about scientific definitions for law cluster words in "The Analytic and the Synthetic" to more mundane analogues: dictionary definitions for ordinary natural kind words. In discussing a possible definition for the natural kind term 'lemon', Putnam showed that its meaning cannot be given just by citing normal characteristics of lemons – their ordinary colour, size, shape, taste, and so on. Such definitions are not true by convention, not stipulative, and not analytic in any of the senses of 'analytic'. Such definitions are not even *apriori*.⁶ They are based partly on empirical observations of lemons. It is in principle possible that the lemons that we are most familiar with are not normal. Then their familiar features would be abnormal. It is also possible that some natural kind other than lemons might have the same familiar, identifying features. Determining the nature of lemons is not an armchair enterprise. It is a matter of empirical investigation. This line of thought overturned a positivist-influenced view about definitions of natural kind words that had survived the demise of positivism.⁷

As I indicated, this discussion *extends* the points made in "The Analytic and the Synthetic" about definitions of more technical scientific terms for physical magnitudes, like 'kinetic energy' and 'force', to definitions for more ordinary natural kind terms, like 'lemon' and 'water'. In the case of scientific terms for physical magnitudes, the definitions state putative framework-central laws. In the case of ordinary natural kind terms (which can *become* close counterparts of scientific terms, as 'lemon' has), the definitions provide just a handy way of identifying instances of the kinds. In both cases, definitions are empirically based and empirically defeasible claims.

Putnam emphasized similarities between ordinary natural kind terms and more technical physical magnitude terms. In fact, he held that 'natural kind' is itself a

6 Here and throughout I mean by '*apriori*' *warranted through a warrant whose force does not depend on sense experience*. I do *not* mean *rationally unrevisable* or *rationally certain*.

7 Cf. several papers in Katz and Fodor (1964), especially writing by Katz.

theoretical term, a term embedded in scientific theories (see, for example, Putnam, 1970, pp. 140–141). I disagree on this particular point. I believe that the basic notion of a natural kind is not a theoretical term. I think that scientific theories refine and specialize a pre-scientific ur-notion of natural kind. I think that, fundamentally, the concept of natural kind is available to young children (see Gelman, 2003) and part of the intellectual tradition at least since Aristotle, well before the advent of modern science. Still, as Putnam emphasizes, it is an empirical, scientific question whether any given term applies to a natural kind (is in fact a natural kind term). It is also an empirical question whether any properties cited in a definition (except perhaps the very most generic properties, such as *being physical* or *being a body*) are in fact properties associated with the kind.

Putnam showed his characteristic balance and perspective in finding a positive side to his limitative point about definitions of ordinary natural kind words. His positive point is the second of the seven contributions that I am cataloguing. Putnam pointed out how remarkable it is that we can use a *stereotype* – a short definitional summary of stereotypical, superficial properties of instances of natural kinds – *to enable others to quickly gain minimal mastery of the word, and to engage in its normal use in the community* (Putnam, 1970, p. 149). I think that this remarkable fact – the epistemic power of dictionaries – still invites detailed, psycho-linguistic investigation.

Putnam (1970, pp. 150ff.) tried to construct a conception of the meaning of natural kind terms from the stereotype and the extension of the terms. Although I think that the stereotype does enable minimal mastery of a term, and may sometimes be part of what is socially obligatory in explanations of the term, I doubt that it is part of the defined term's meaning, in any serious sense of 'part'. A user of the term 'tiger' who is acquainted only with albino tigers and never learns that most tigers have stripes can use the term 'tiger' competently, and synonymously with our term 'tiger'.⁸ Similarly, when the stereotype for 'tomato' changed from describing tomatoes as vegetables, and not fruits, to describing them as fruits, I think that there was no sense in which the *meaning* of the term 'tomato' changed. We simply discarded a mistaken belief about tomatoes. The mistaken belief was coded in mistaken definitions or mistaken stereotypes. Still, stereotypes are closely associated with meaning. They are powerful ways of enabling one to learn a meaning and to have an agreed upon way of both recognizing referents and coordinating usage in a social, communicative network.

I think that Putnam's work suggests a further insight into meaning, one that is actually at odds with the idea that the stereotype is (strictly) part of the meaning of

8 I think that it would be mistaken to say that the person has an incomplete understanding of the ordinary linguistic meaning of term 'tiger'. The person simply does not know a common fact about most tigers.

natural kind words. The third contribution that I highlight concerns *understanding the meanings of natural kind terms*. Understanding the meanings of such terms should be accounted for in a minimalist fashion. Usually, the only exact meaning explications are of the form 'electricity' means *electricity*; and 'tiger' means *tiger*. (This is not to say that the meaning is identical with the referent.) Putnam's insight is that knowing the full, ordinary linguistic meaning of such natural kind terms is neither a matter of knowing a theory – since the ordinary linguistic meaning (as opposed to the deepest conception associated with the relevant concept) usually does not code a theory – nor a matter of getting superficial features of the relevant natural kind right – since the meaning can survive empirically motivated change in what features are cited in bringing one to understand the term. There are various ways of getting onto the meaning – including learning a stereotype and being shown some examples. But to be able to understand ordinary, (relatively) non-theoretical natural kind terms, it suffices to be able to use the terms to refer to the kinds, to connect the terms with one or two *very* generic properties or kinds, and to be open to a distinction between superficial observable properties of the referent and what the referent really is.

Putnam makes this sort of point with respect to the physical magnitude term 'electricity'. He writes, 'I cannot think of anything that *every* user of the term "electricity" has to know [presumably, in order to know the ordinary linguistic meaning] except that electricity is (associated with the notion of being) a physical magnitude of some sort, and, possibly, that "electricity" (or electrical charge or charges) is capable of flow or motion' (Putnam, 1973, p. 199).⁹ I think that this sort of point applies to 'lemon', 'tiger' and 'tomato'. For example, to understand the ordinary linguistic meaning of the term 'tiger', it is enough to know that tigers are cat-like animals, and either to distinguish them from other such animals – such as lions, leopards and domestic cats – or to be able to recognize some tigers.

The fourth contribution is implicit in the second and third. It consists in Putnam's *distinguishing identification from determining nature or essence* in using natural kind terms. Putnam separated the superficial features of natural kinds, used in identifying instances, from the underlying nature or essence of the kinds. The underlying nature or essence is not immediately available to observation. It is to be found not by linguistic analysis or by understanding definitions, but through theory construction.

Here I think that Putnam was following out the consequences of the pre-theoretical concept *natural kind*. Having a natural kind concept requires being open to a distinction between what a thing is and how it veridically appears. In his brilliant twin-earth thought experiments, as well as in his examples of aluminium

9 The bracketed insert is mine. The parenthetical phrases are in the original quotation.

and molybdenum, Putnam (1970, pp. 150–151; 1975, *passim*) established that sameness of superficial identifying characteristics is compatible with difference of underlying natures. Features that are used to identify a kind provide only a lead-in to investigating the kind's nature. The world does not wear its natures on its sleeves.

The fifth contribution concerns *a role for social interaction in the semantics of natural kind terms*. Because distinguishing and informatively specifying the natures of the referents of natural kind terms require empirical investigation, there is natural scope for relying on others. Others may be necessary intermediaries in determining the referents of one's own terms. And they may know more, even about basic identifying characteristics, of those referents. Putnam described this phenomenon as a *division of linguistic labour*. Both what the referent of the term is and knowledge of a term's referent can depend on how others use their terms and how they are connected to their terms' referents. These dependency relations derive from the fact that one's own usage of a term relies and depends on the usage of others. Depending on others for connection to referents and for knowledge and information cannot be completely separated from depending on others for reference and even aspects of meaning.

The point is sometimes caricatured by critics, who rightly point out that sometimes an individual's usage is not subject to the authority of more scientific expert usage, or indeed any other authority. Sometimes the uses and meanings are just different between lay people and experts, and between one ordinary idiolect and another. As Putnam realized, the patterns of dependency are complex and probably not subject to a formula. Nevertheless, dependence on others to connect one to the referents of one's terms, to correct one on the natures of those referents – including aspects of one's stereotypical characterization of the referents – and even to adjust one's most serious, idiolectic explications of the terms, are real phenomena (Putnam, 1970, *passim*; 1975, pp. 227ff.).¹⁰ One of Putnam's most significant contributions is to sketch some of the main features of these phenomena.

The sixth contribution is the proposal of a *broadly unified causal account of the reference of ordinary natural kind terms and scientific physical magnitude terms*. The idea is roughly that the extensions of these terms – or the kinds that they actually indicate – depend on the preponderance of (or explanatorily central) causal relations between instances of the kinds and an individual's uses of the term (or uses of the term by others on whom the individual depends).

This picture explains how one can refer to some kind, but be subject to correction about the nature of the kind and even about normal identifying characteristics of the kind. Causal connections to instances of the kinds connect one's usage to kinds that one can be wrong about. Most of these causal relations are sub-cognitive in the

10 For further development of these themes see Burge (1979, 1986).

sense that they are not coded in the user's beliefs. Although Putnam did not emphasize the point, the causal relations ultimately go through perception. One can be massively wrong not only in one's beliefs, but even in one's perceptions of an entity, and still perceive it.

Kripke and Putnam, independently of one another, proposed the broad causal account that I have just sketched. Each effectively and insightfully developed different aspects of the account. I think that one of Putnam's distinctive contributions was to connect the points about use of natural kind terms in ordinary language with use of such terms, and similar physical magnitude terms, in science (Putnam, 1973, p. 201). Throughout his career, Putnam illuminated relations between ordinary linguistic practices and scientific practices.

A seventh contribution is an upshot of the preceding six. Putnam provided *a conception of scientific language that allows for trans-theoretical reference* and, I think, at least one sort of *trans-theoretical type of meaning*. Because reference is determined through non-theoretical causal/perceptual relations, and because minimal mastery of meaning requires knowing almost nothing beyond the most generic features of a kind or magnitude, there is a sense in which the reference and meaning of primitive kind and magnitude terms can remain stable through very radical changes in ordinary belief and in scientific theory.

There is no question that through scientific revolutions and scientific refinements, new, more precise concepts of mass, energy, and so on – and, in some cases, new, more precise meanings for the corresponding terms – are developed. Sometimes even the referents or extensions of these new concepts and meanings are not quite the same as those of the preceding concepts or meanings. The new concepts and meanings may mark a distinction not marked by the preceding concepts or meanings. Or they may settle cases that were borderline cases, or otherwise not within the domain of applicability, for the preceding concepts or meanings.

But even in these cases, there is often a trans-theoretical concept, trans-theoretical meaning, and trans-theoretical reference that remains the same through even the most radical theoretical changes. I think, for example, that there is an ur-concept of mass (and ur-meaning of 'mass') that more sophisticated concepts/meanings associated with the term 'mass' refine, precisify and specialize. I think that Newton and Einstein shared this ur-concept. Despite major changes in theoretical definitions and conceptions of atomic structure, Dalton and modern chemists share a concept *atom*.¹¹ Putnam (1981, pp. 192–196) makes similar points about the notions of temperature, electron and plant.

11 The point is developed powerfully in Putnam (1962, pp. 42–54). A similar point applies in mathematics. An ur-concept of derivative or of limit is common to the numerous formulations and refinements of the calculus. I discuss such matters in Burge (2003, 2006) and, in greater detail, in Burge (2012, section III).

An important effect of this seventh contribution is that philosophy of science is freed from the bad theories of meaning that enabled Kuhn, or Kuhn followers, to argue that science never makes rational progress through scientific revolutions. Kuhn relied on bad theories of meaning and reference proposed by the logical positivists. These bad theories were to some extent perpetuated by Quine, who maintained that meaning (insofar as there is such a thing) and reference are determined by method of confirmation, and that there is no difference between change of meaning and change of fundamental confirmation methods.¹² A consequence of these theories of meaning and reference is that, in scientific revolutions, empirical science keeps changing the subject. It keeps throwing up incommensurable theories that share too little meaning or reference to make rational criticism or perhaps even rational comparison possible. Putnam's account of the language of science and the language of the common person provides principled refutation of such theories, and hence of such anti-rational conceptions of science.

The contributions by Putnam that I have cited have been largely accepted in philosophy. Such acceptance is relatively rare, and is often – as it is here – a sign of significance and depth. Philosophy is not science. But like science it can make progress. It can make contributions to knowledge and understanding. The contributions that I have sketched, and their acceptance in mainstream philosophy, constitute genuine progress in philosophy.

It remains for the contributions to be appreciated by the wider intellectual community in such a way as to diminish the mindless, anti-rational, relativistic conceptions of science that continue to dominate much thinking – even at major universities – in the humanities and history. Such conceptions appear sometimes even in the meta-remarks of scientists. Such conceptions are a depressing disease in modern quasi-intellectual life. I am optimistic, however, that in the *very* long run, truth, even philosophical truth, will prevail.

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12 See Putnam's criticism of Kuhn in Putnam (1981, pp. 191–198).

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