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Philosophers in ancient India disputed over whether sentences or words were the primary vehicles of meaning. The argument in favor of words is that they are limited in number and can be learned once for all. Sentences are unlimited in number; we can fully master them only by learning how to construct them, as needed, from words learned in advance. Despite this situation, however, words can still be said to owe their meaning to their roles in sentences. We learn short sentences as wholes, we learn their component words from their use in those sentences, and we build further sentences from words thus learned.

There is one class of sentences that constitutes the interface between language and nature. These are sentences that have come to be associated directly with sensory stimulation. They are activated by the bombardment of our sensory surfaces by rays and particles from external objects. It is through these sentences, which I call by the unjustly controversial name of observation sentences, that language imbibes its empirical content, and so, by my empiricist lights, its meaning.

Observation sentences provide the checkpoints for scientific theory. An observation sentence implied by the theory comes up for testing, and the stimulation of the experimenter’s nerve endings by external forces elicits his verdict on the sentence, true or false.

An observation sentence in my unproblematic sense of the phrase is just any sentence that we have come to associate with some range
of stimulations, and firmly enough to be prepared to accept the occurrence of such stimulation as attesting to the truth of the sentence. It is an occasion sentence, that is, a sentence that is true on some occasions and false on others. Examples are «It’s raining», «That’s a spark coil», «The barometer is falling». What the stimulation decides is the truth of the sentence on the occasion of the stimulation. Some observation sentences, such as «It’s raining», are associated with the appropriate ranges of stimulation in the very learning of language. In other cases the association is established indirectly, through explanation or other training. A sentence qualifies as an observation sentence for a given segment of society, say English physicists for example, if all members will agree in assenting to it, or in dissenting from it, when subjected to the same sensory stimulation.

Observation sentences are where science gets its input of evidence and therewith, as I said, its empirical content or meaning. They are also where empirical content or meaning enters language in the first place, in the speaker’s infancy. The child learns to utter an expression or to assent to it in the presence of appropriate sensory stimulations; also to utter the expression, «Milk» or «Mama» perhaps, as a means of bringing about the associated stimulations.

Commonly the expression will be a noun as in these two examples rather than a sentence such as «That’s milk» or «It’s raining», but at that initial stage they should nevertheless be looked upon uniformly as observation sentences rather than as terms. For, primitively, each is simply associated with a range of stimulatory situations. Whether the stimulation emphasizes a localized source, such as Mama or milk, or is diffuse as in the case of «It’s raining», is a subordinate detail; the essential point of the association is just the binarity of right or wrong, yes or no, true or false. Terms, reference, and reification are a later refinement. It is only later that the infantile observation sentences «Mama» and «Milk» somehow come to qualify retrospectively as terms referring to a woman and a substance.

At what point in the child’s learning of language may some words be said to have attained the status of terms referring to objects? Elsewhere I have suggested a succession of stages. But what I see as the crucial stage, within our own community of kindred languages, is the mastery of the relative clause together with its relative pronoun and the pronouns that direct us back to the relative pronoun. When our language is paraphrased into the form of quantification logic, or the predicate calculus, it is these pronouns that reappear as bound variables. The objects or purported objects that thenceforward refer to are the objects referred to by the bound variables, or by the corresponding pronouns. To be is to be the value of a variable.

It has been felt that I offend against common sense when I suggest that reification has not clearly taken place until after mastery of relative clauses and their pronouns. It is protested that the cat, who never learns relative clauses, should surely be said to have reified the rice that she reacts so distinctively to, and vice versa. Now my response to this protest is that is stress on mice and other palpable bodies is misplaced. The cat’s behavior is describable in terms, more broadly, of her distinctive reaction to various classes of stimulatory situations; the scurrying of mice is one such class, but rain is another, and sunshine, and chill, and sudden noises. The cat’s repertoire of discrimination can be represented by occasion sentences: «It’s a mouse», «It’s raining», «It’s getting cold», all on equal footing. They comprise what I call the cat’s perceptual ideology. An occasion sentence belongs to it if the cat is disposed to react distinctively in situations where assent to the sentence would be appropriate.

This, and not ontology, is the pertinent notion for ethology, or animal behavior, and equally for human behavior below the level of linguistic sophistication that can justly be called ontological or referential. Hence my shunning of the notion of observation terms, even in human contexts, in favor of observation sentences. When at last the referential level is reached, with its relative clauses and pronouns or its quantifiers and bound variables, we are in a position to take account both of palpable bodies and of microphysical particles, abstract entities, indeed anything posited in a theory. It is only in these terms that we make sense of ontological economy, and of Tarski’s satisfaction relation, and of the logical utility of reification in cognitive discourse.

The empirical input to language and scientific theory is through sentences, I have argued, rather than through terms and reference. But the output of theory consists again of sentences, true ones if we can manage it. The intricate relation of theoretical sentences to observation sentences is sustained by a skein of intervening sentences. Terms, reference, and reification contribute only as auxiliaries along the way. Let us now consider how they contribute.

In the hope of isolating the essence of the matter, we may look
to the most rudimentary phase of cognitive language. There we have primitive little observation sentences, learned as wholes by conditioning to episodes of concurrent sensory stimulation. One of them might be «Cat», or «There's a cat», but understood as prior to any reification of cats, as if to say «It’s raining». We learn to join observation sentences by «and» — thus «It’s raining and there’s a cat»; «It’s raining and it’s raining». This construction opens the way to compound observation sentences, but it is of little help toward a complex observation sentence such as this:

1) A white cat is facing a dog and bristling.

We cannot convey this message by just saying that a cat is there, and white is there, and there is bristling, and a dog is being faced. We want the catting, the white, the bristling, and the dog-facing not just to occur in the scene, but to coincide.

The observation sentence (1) could be learned outright as a whole by direct conditioning to the stirring spectacle. But we cannot go on like that, learning each such recital from scratch as an irreducible unit. What is wanted is a connective, tighter than «and», that will tie the observation sentences together as being fulfilled not merely on the same occasion, but within identical limits in the scene. This is what reification accomplishes. It posits a hook, or node, on which to hang any number of characterizations together.

What is achieved is (1), or, in more graphic language,

2) $\exists (x \text{ is a cat and } x \text{ is white and } x \text{ bristles and } x \text{ is dogward})$.

What the child’s way stations and thoughts might be, in the course of learning to construct such sentences as (1), need not concern us here. What we do see is the service that reification renders once it is at hand. At its simplest it is a device for focusing observation sentences convergently. The observation sentences thus focused become predicates of the posited object.

An individual has sometimes been construed, by Russell for one, as the sum of its attributes. My present line is reminiscent of that one, but without reification of the attributes. The individual is posited as a shared satisfier of multiple predicates, by way of tying the predicates together.

For purposes of the example (1), the required reification of cats is of the most superficial sort: nothing to do with recurrence of an identical cat at different times. That is called for only when we have moved from observation sentences to sentences at a distinctly theoretical level. We might want to say that if a cat finds a dead fish, eats it, and sickens, she will not thereafter eat fish. The reification required to bind the antecedent and consequent of this conditional together in the required fashion is reification of enduring cats. The cat of the antecedent must be the same one as the cat of the consequent.

Davidson’s treatment of the logic of adverbs nicely illustrates the focusing effect of reification. What he wanted was a regimentation within predicate logic that would do the work that is done in ordinary language by the accumulation of adverbs as joint modifiers of a predicate. He accomplished it by reifying an event corresponding to the predicate and then treating the adverbs as predicates focused on the posited event.

An important fringe benefit of reification is that it enables us to get increased mileage out of our truth functions. This was evident in the first example, where the four component observation sentences would have been too loosely connected by the mere truth-functional «and». The needed tightening was provided by positing cats and quantifying as in (2). The point is evident again in the example of the cat and the spoiled fish. The mere truth-functional conditional, «If a cat eats a spoiled fish then a cat will not eat fish», leaves the antecedent and the consequent too loosely related. The needed tightening is provided by positing enduring cats and quantifying the whole conditional with a universal quantifier, thereby ensuring sameness of cat.

Russell long ago defended his miscalled material implication, better material conditional, against proponents of modal or relevance logic by noting that tightening could often be gained by quantifying the material conditional universally, getting what he called «formal implication». So it is with this example of the cat and the fish.

Hilary Putnam and Charles Parsons have both remarked on ways of economizing on abstract objects by recourse to a modal operator of possibility. We have just observed the other side of the same coin: the positing of objects can serve to reinforce the weak truth functions without recourse to modal operators. Where there are such trade-offs to choose between, I am for positing the objects. I posit abstract ones grudgingly on the whole, but gratefully where the alternative course would call for modal operators.
My examples offer a crude notion of how it may be that reification and reference contribute to the elaborate structure that relates science to its sensory evidence. What is more significant is the change in status of reference, and of ontology itself: they get relegated to the status of mere auxiliaries. True sentences, observational and theoretical, are the alpha and omega of the scientific enterprise. They are related by structure, and objects figure as mere nodes of the structure. What particular objects they may be is indifferent to the truth of observation sentences, indifferent to the support they lend to the theoretical sentences, indifferent to the success of the theory in its predictions. If to the values of our variable we apply any one-to-one transformation, and then reinterpret all our terms as denoting the new objects instead of the old ones, no visible disturbance takes place. The theoretical sentences and the observation sentences remain as they were letter for letter. The observation sentences remain associated with the same sensory stimulations as before, and the logical interconnections remain intact. Yet the objects of the theory have been supplanted as drastically as you please - so long anyway as the transformation is one to one.

These transformations are what I have called proxy functions, and the moral to be drawn from them is what I have called ontological relativity. My relativistic thought here is that to ascribe an ontology to someone is only to indicate a proposed translation of his terms into one's own.

A notable manifestation of ontological relativity was remarked by Davidson in connection with Tarski's definition of truth. The burden of that definition is borne mostly by the recursive definition of satisfaction, which is a relation borne to open sentences by sequences of objects. It is readily seen that any one-to-one supplanting of those objects by other objects will be indifferent to the output of the truth definition, the class of sentences reckoned as true.

What make for the tenability of a theory of nature, in short, are just these two factors: there are the associations of observation sentences with sensory stimulation, and there is the logical structure that relates the theoretical sentences to the observation sentences. Ontology is indifferent, apart from the structure that it marks.

Russell hinted long ago of structuralism in somewhat this vein, and Ramsey was more explicit about it. But their deflation of objective reference, or Ramsey's anyway, applied only to theoretical objects. What makes for my full coverage of objects is the recognition that observation sentences, not observation terms, are what respond to sensory input. There is no epistemologically privileged class of so-called observable objects.

Truth of sentences, we see, is the principal thing; terms and reference are by the way. We can revise our ontology at will without even falsifying any of our sentences. We preserve their truth by reinterpreting all the names and predicates in conformity with the shift of ontology.

So truth can be held fast, we see, while reference is revised at will. Now what about meaning? The conventional wisdom is that meaning fixes truth value and reference. That is to say, if two sentences are alike in meaning, one of them cannot be true and the other false; and if two terms are alike in meaning, one of them cannot denote or designate what the other does not. Intension determines extension.

This conventional wisdom wants reexamining. First of all we must come to grips with the elusive notion of meaning. What is pertinent to the present question is sameness of meaning; for we are asking whether sentences with the same meaning have the same truth value, and whether terms with the same meaning refer to the same things. As a means of limiting the problem, I shall assume that we want empirical meaning: something in the spirit of a verification theory of meaning.

Now we have seen that shifts of ontology by proxy functions have no effect either on the letter-by-letter constitution of sentences or on the association of observation sentences with the sensory stimulations that afford their empirical support, or on the logical links between observation sentences and others. So it is clear that when we change ontology by reinterpreting terms we do not disturb the empirical meaning of sentences - whatever the further requirements of the concept of empirical meaning might be. But neither do we disturb the meaning of terms; for, as I urged at the beginning of my talk, terms owe their meaning to the sentences that contain them. Reference has changed with the ontology, but the meaning of terms has not.

Evidently then meaning does not fix reference, conventional wisdom to the contrary notwithstanding. Truth values, on the other hand, remain firmer than reference; they are not shaken by proxy func-
tions. Can we continue to hold that meaning fixes truth values? To deal with this question we must get a firmer grip on meaning.

It is a question of empirical meaning. I should be happy to identify the meaning of a sentence with its empirical content, which is to say, the range of sensory stimulations that qualify as verifying the sentence. This line works well for observation sentences, and it defines what I call their stimulus meanings. But the trouble is that when we get beyond observation sentences, less and less can be done in the way of sorting out the empirical content over individual sentences.

When a predicted observation fails, what is refuted is the combination of theoretical sentences that together implied the observation. As Pierre Duhem emphasized, there is in principle no one among the component sentences that must be rejected rather than another. One of the sentences will in practice have been fixed upon in advance as suspect, but in principle any of the others could be sacrificed instead, even some law of logic or mathematics that contributed to the implication. In practice we do choose to safeguard logic and mathematics, because their revision would reverberate excessively through our overall system of the world; and it is merely this strategy, I hold, that accounts for the so-called necessity of mathematical and logical truth. Strategies aside, what stands or falls in the light of an experiment is an interlocking multiplicity of sentences of natural science, along with mathematical and logical auxiliaries.

Duhemian holism, thus moderately conceived, must command pretty general assent. It renders plausible, in turn, the empirical under-determination of natural science. The reasoning, as Fallesdal has pointed out, is simply this. In view of holism, there are multiple choices of revisions in accommodating empirical evidence. These different choices yield different theories that conform to all the same past evidence, and probably some that are empirically equivalent.

This result goes beyond proxy functions. They served to change reference but left truth values undisturbed. The variation of theory suggested by holism, on the other hand, is a variation of the actual distribution of truth values. So we now find ourselves confronting even that second article of conventional wisdom: we conclude that meaning does not even fix truth value. We have reached this conclusion without having had to pin down the notion of meaning, beyond stipulating that it be empirical.

The empirical under-determination of science presents us empiricists with a quandary. If two competing theories of the world are known to fit all possible observations equally well, and are equally simple, are we not incapable as empiricists of choosing between them?

Let me begin with an innocuous case. Suppose the one theory is projected from the other by a proxy function, but with an explicit rewriting of names and predicates this time rather than by mere tacit reinterpretation of fixed names and predicates. Here we have two empirically equivalent theories, but they are readily reconciled. We can simply declare the two formulations to be formulations of an identical theory in distinct languages, and we can translate the one into the other by applying the converse of the original proxy function.

Where quandary arises is in other cases, not generated by proxy functions, but readily imagined in view of Duhemian holism. Rival theories can be empirically equivalent, and equally simple, and defy all efforts at reconciliation by sentence-to-sentence translation. Must we as empiricists reckon them both as true? What if they even contradict each other, as well they may in their theoretical reaches?

We can clear them of contradiction, as Davidson has pointed out. The expedient is as follows. If the theories contradict each other, there is a sentence that is affirmed or implied in the one theory and denied in the other. Since the theories are empirically equivalent, that sentence must contain some theoretical term that is only partially pinned down to empirical criteria. But then we can exploit this empirical slack, by treating that term as two distinct terms. We can change its spelling in one of the theories to mark the difference. The sentence that had been affirmed in one theory and denied in the other gives way thus to two mutually independent sentences. Continuing thus, we can resolve all the logical conflicts between empirically equivalent theories.

This restoration of consistency eases our quandary but does not dissolve it. We remain confronted, let us suppose, with empirically equivalent theories which do not contradict each other but which, still, we see no way of so translating into each other as to make them identical. If we take a naturalistic stance, as I do, and recognize no higher truth than that to which our scientific system of the world aspires, then we can ascribe truth only from within one or other of the competing theories; there is no transcending them. Evidently we must take a sectarian line, reckoning only one of the two theories as true. And yet, if somehow we have persuaded ourselves of their
empirical equivalence despite failure of intertranslation, that sectarian line offends our empiricist sensibilities.

In recent years, I thought I had hit upon an ecumenical, or nonsectarian, resolution of the quandary. Since the two rival systems of the world have been rendered logically compatible, why not accept them as a single tandem theory? If there are discrepancies in their ontologies, we can use two styles of variables. Operating thus in a single inclusive theory, we can ascribe truth across the board without abandoning our naturalism.

More recently, pressed by Dagfinn Føllesdal and by Roger Gibson, I have come to see this line as unacceptable. I now see it as vitiated by what Herbert Feigl once called epistemological danglers. A portion of a theory is a dangler if it contributes none to empirical coverage. The theory minus the dangler is empirically equivalent to the theory including the dangler. In combining two rival theories to form a tandem theory, I admitted danglers. For, the two rival theories were empirically equivalent; hence the tandem theory was empirically equivalent to each of them; and hence each of them, being superfluous in the presence of the other, figured as a dangler in the tandem theory.

Danglers are unacceptable. If we admitted them freely to our scientific theories, we could accord scientific status to any and every arbitrary sort of unempirical fabrication; for the annexation of any such matter would leave the empirical content of our science unimpaired. The shunning of danglers is not a matter of special decree, but simply of a piece with the usual quest for the most economical accommodation of the empirical data. The tandem theory is not one that we should be willing to rest with as our serious system of the world, because it is gratuitously inelegant and uneconomical; either of its component theories is preferable.

So I am now reconciled again to the sectarian line that I had taken a few years earlier: that of not accepting the two rival theories as simultaneously true. If we are persuaded of their empirical equivalence despite knowing no intertranslation, then as empiricists we will indeed rate them as equally well warranted, and we may even subscribe alternately to one and the other for the sake of the deepened understanding or heuristic suggestiveness afforded by the contrast of perspectives. But, whichever theory we occupy at the moment, that and that only is the frame of reference of our truth predicate.

An attractive further alternative, favored by Davidson, is to couch both theories in an inclusive language and let \( \mathfrak{R} \) be the frame of reference of the truth predicate. Then the theories can be accounted simultaneously true but distinct.

Thomas Kuhn, Paul Feyerabend, and others allude persistently to incommensurability of theories. The notion has struck me as empty, but in the present context I seem to make some sense of it: the context of two empirically equivalent but mutually irreducible systems of the world. They are equally warranted, but either of them is true, if at all, only in its distinctive sense of the word.

In the course of these reflections I have taken truth down a peg, and reference down two pegs. And what of meaning, notoriously the dimmest of the whole formidable trinity? In the light of Duhemian holism, it makes clearest sense only at the extremes. Observation sentences have their empirical content, and comprehensive theories have theirs.