# 11
# Events and Reification

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When Frege introduced quantification, he illuminated three subjects: logic, language, and ontology. The bound variable of quantification clarified ontology by isolating the pure essence of objective reference, leaving all descriptive content to the predicates. The quantifiers clarified language by resolving the grammatical anomaly of the false substantives 'everything' and 'something'. And quantification was the very making of logic, rendering it a substantial branch of science.

When Russell defined singular description, he further illuminated those same three subjects: logic, language, and ontology. One logical and linguistic insight was the dispensability of singular terms in favor of predicates and variables, and another was the rich productivity of contextual definition. Furthermore, one saw how singular terms might be legitimized even when shorn of unwelcome ontological commitments.

A third contribution that likewise impinges on those same three subjects – logic, language, and ontology – is Davidson's theory of adverbs, in which he quantifies over events.[1] I shall examine it and consider what lessons can be drawn from it regarding the nature of reification generally and the purposes served by it.

Davidson's problem of adverbs was how to accommodate them in predicate logic. Taking an example of his, we begin with 'Sebastian walked.' It consists of a general or one-place predicate 'walk' and a singular term 'Sebastian', of which the general term is predicated. Or perhaps we should picture a two-place predicate and two singular terms, one for Sebastian and one specifying a time: 'Sebastian walked at $t$'. But then what of 'Sebastian walked slowly at $t$'? Do we need a new two-place predicate 'walked slowly at'? And what if we want to say 'Sebastian walked slowly and aimlessly at $t$'? or 'Sebastian walked slowly and aimlessly in Bologna at $t$'? The adverbs and adverbial phrases can be multiplied and concatenated without end. It would be an abdication of logical analysis to accept every such adverbial modification of every verb as a distinct and

[1] D. Davidson, *Essays on Action and Events* (Clarendon Press, Oxford, 1980), pp. 166ff.



irreducible predicate. A language with a limitless basic lexicon is absurd, as Davidson has stressed. It could not be learned.

Ajdukiewicz presented grammar neatly in terms of categories of functors.[2] A verb is a functor that attaches to one or more singular terms to form a sentence. An adverb such as 'slowly' is a functor that attaches to a verb to form a longer verb. An adverb such as 'very' is a functor that attaches to an adverb or adjective to form a longer adverb or adjective. This is all very well, but it does not contribute to our present project, namely, adaptation to standard predicate logic. Functions can indeed be generated in set theory, and set theory can be formulated in standard predicate logic with membership as the primitive predicate; but the trouble is that Ajdukiewicz's functors do not express functions. A function applies to objects to yield objects. His functors attach to expressions that are mostly not names of any objects, to form expressions which again need not name objects.

There is a premium on providing for the adverbs within the clear and elegant structure of classical predicate logic if we reasonably can. It admits just truth functions, quantification, and predicates of one or more places with variables attached. Identity is accommodated as one of the two-place predicates, and constant singular terms and function signs are easily paraphrased, in context, to fit the scheme. The logic of this close-knit but powerful branch of language is susceptible of familiar proof procedures that are demonstrably complete. Furthermore, thanks to Tarski, the structure lends itself to a straightforward recursive definition of satisfaction and truth. Davidson was concerned to handle adverbs in these congenial terms.

Let me return now to his point about the impenetrability of a language with an unlimited basic lexicon; for he has made it also in other connections.[3] He applied it to something of mine about belief and other propositional attitudes, where I had propounded a series of belief predicates with increasing numbers of places. Along with the dyadic case '$x$ believes $S$', where $S$ is a sentence, I recognized the triadic case '$x$ believes $P$ of $y$' where '$P$ is a one-place predicate, and the tetradic case '$x$ believes $P$ of $y$ and $z$' where $P$ is dyadic, and so on without end. It was a way of separating out the objects that were referred to *de re*, or on their own merits, rather than as a manner of speaking. Davidson saw these as an infinity of belief predicates, and cited the impossibility of an infinite lexicon.

There was really no such difficulty in my belief predicates, for we can construe belief uniformly as a two-place predicate relating believers to sequences of arbitrary lengths. Tarski was confronted with the same situation, in his definition of satisfaction that is dear to Davidson's heart and mine, and his expedient was the same: he treated satisfaction as a two-place relation borne to open sentences by sequences.

As applied to the predicate 'walk' and its modifications, however, Davidson's point about unlimited lexica holds. It cannot be circumvented by resorting to sequences, for there are no appropriate objects to make sequences of. The

[2] Kazimierz Ajdukiewicz, *The Scientific World Perspective and Other Essays* (Reidel, Dordrecht, 1978), pp. 95–109.

[3] D. Davidson, *Inquiries into Truth and Interpretation* (Clarendon Press, 1984), pp. 13ff.

relevant multiplicity now is a matter of adverbs 'slowly', 'aimlessly', 'in Bologna', and so on, and these are not names; there is no talk of corresponding objects.

In this contrast between the two situations there is already a glimmering of what will emerge increasingly as we proceed; namely, the part that reference to objects can play in making structure amenable to standard predicate logic. Because the various complements of my belief construction referred to objects, I was able to make a sequence of them, which, being an object in turn, could figure as one of two arguments of a two-place belief predicate.

In this there is a hint of a solution of the Sebastian problem as well: why not reify? We might reconstrue the adverbs 'slowly', 'aimlessly', 'in Bologna', and so on, as singular terms, each naming a strange new object, and then form sequences of these objects. We would then take 'walks', like 'believes', as a two-place predicate relating men and other animals to sequences. The sequences consist now of these strange new objects, as many or few as desired, along perhaps with the time $t$. Thus 'Sebastian walked slowly and aimlessly in Bologna at $t$' becomes:

Walk (Sebastian, $<t$, slowly, aimlessly, in-Bologna$>$)

relating Sebastian to the sequence of a time and three newly reified objects. But I shudder at the thought of infesting my well-swept ontology with these ugly new objects. Happily there are better ways.

An easy way of eliciting a modicum of standard structure from the Sebastian example has been staring us in the face all along: we can convert the stacked adverbs into an explicit conjunction of sentences.

(1) Sebastian walked slowly at $t$ and Sebastian walked aimlessly at $t$ and Sebastian walked in Bologna at $t$.

Objective reference has contributed here again to the extracting of standard logical structure; for it is thanks to the references to Sebastian and $t$ that we were able to convert here to sentential conjunction. It is only by having tied the three conjoined reports to the same agent, Sebastian, and the same time, supposed short, that we can be seen to have been reporting the same walk in all three clauses.

This step has illustrated once more the contribution of objective reference in exposing standard logical structure, but it does not solve the adverb problem. The third clause of the conjunction could indeed be freed of its adverbial structure by saying simply that Sebastian was in Bologna at $t$, but the adverbs 'slowly' and 'aimlessly' are not thus easily to be dissociated from their verb

It was the fixed reference to Sebastian and $t$, throughout, that enabled us in (1) to resolve 'slowly and aimlessly in Bologna' into its three components, distributed through a conjunction of three sentences. What further fixed reference can we find, or stipulate, that will enable us to split 'walked slowly' in turn into its components distributed through further conjunction? In answer Davidson posited something that could be said to be a walk *and* to be slow.



(2) $\exists x$[$x$ is a walk and $x$ is slow (for a walk) and $x$ is aimless and $x$ is in Bologna and $x$ is at $t$ and $x$ is by Sebastian].

Here is his solution. The threefold conjunction has become sixfold and the adverbs have become predicates. All is resolved at last into lexicon and predicate logic.

The line of reasoning that led him to the solution may not have been what I have been recounting, but I wanted to highlight what it is that objective reference or reification contributes. It contributes the link between clauses, a link that may be needed to reinforce the loose association afforded by mere conjunction and other truth functions.

Let us pause for another example, in which to begin with there is no overt reference to objects, not even Sebastian or Bologna or $t$.

Erupteth brightly, noisily and disastrously.

I mean it as a sentence, but have left the verb without a subject to keep it impersonal, as if to say *erumpit*. Reification of an eruption enables us to adapt the sentence to predicate logic in Davidson's way.

$\exists x$($x$ is an eruption and $x$ is bright and $x$ is noisy and $x$ is disastrous).

The four elements of the original sentence thus fall into four sentences loosely joined by conjunction, but the reference to an eruption, recurring in each component, continues to link them as required.

Adverbs that are modifiers of verbs are thus converted into predicates. 'Slowly' gave way to 'slow', 'aimlessly' to 'aimless', 'brightly' to 'bright'. But what about adverbs that modify adverbs or adjectives? One thinks first of 'very', but it involves an independent problem, not peculiar to adverbs. It is a problem shared by what I have called syncategorematic adjectives[4] and what philosophers now call attributives. They are adjectives such as 'mere', 'would-be', or 'poor' as in 'poor player': adjectives whose attributive use (in the grammarians' sense of 'attributive') cannot be analyzed as conjunction (in the logicians' sense of 'conjunction'). Analysis of syncategorematic adjectives is a large topic, on which I defer to Wheeler and others.[5]

What of further adverbs, likewise modifiers of adverbs or adjectives but free of the syncategorematic character of 'very'? Examples are not easily come by. One example is the parenthetical 'as a walk' in (2). Perhaps they can be adapted to predicate logic by unsystematic paraphrase case by case. At any rate Davidson's analysis pertains specifically to adverbs in their primary and abundant use, namely, as categorematic modifiers of verbs.

In illustration of that analysis we witnessed the positing of a walk and an eruption. They are events, one would say. That category is broad enough to

[4] W.V. Quine, *Word and Object* (The Technology Press of M.I.T., Cambridge, Mass., 1960), p. 103.

[5] Samuel C. Wheeler III, 'Attributives and their modifiers,' *Nous* 6 (1972), pp. 310–34.

cover all the examples that are apt to worry us. It is a familiar category, but still it invites further clarification. How are events individuated? Davidson proposes this standard: events are identical if and only if they cause and are caused by all and only the same events.

(3) $x = y \longleftrightarrow \forall z$ ($z$ causes $x . \longleftrightarrow . z$ causes $y$:
$x$ causes $z . \longleftrightarrow . y$ causes $z$).

He concedes that it has an 'air of circularity,' but protests that it is not a circular definition, since there is no identity sign in the definiens.[6]

True, it is not a circular definition; but its air of circularity does not end there. Thus consider, first, this simpler proposal for the individuation of events:

(4) $x = y . \longleftrightarrow \forall z (x \in z . \longleftrightarrow . y \in z)$.

Again the definiens contains no identity sign, and indeed it justly defines identity, for events and other things too; but it does not individuate them. And why not? Because, in quantifying over classes $z$, it makes sense only insofar as classes make sense, and hence only insofar as classes are individuated. But are classes not individuated to perfection by the law of extensionality, which equates classes whose members are identical? No; this law individuates classes only to the degree that their members are individuated. Since (4) explains identity of events by quantifying over classes of events, it individuates events only if the classes of events are already individuated, and hence only if events are already individuated. Here is the circularity of (4) – not as a definition but as an individuation. The circularity of (3) is similar but more direct: it purports to individuate events by quantifying over events themselves.

An interesting point emerges regarding impredicative definition, that is, definition of something by appeal to a totality that includes or depends on the thing that is to be defined (3) and (4) are examples. There have been mathematicians from Russell and Poincaré onward who espoused a constructivist philosophy and banned impredicative definitions, alleging a kind of circularity. Such was Russell's so-called vicious-circle principle in the early years of his theory of types. Unlike Poincaré and the other constructivists, however, Russell presently found the ban intolerable and eased it with his axiom of reducibility, not appreciating that he thereby lifted the ban altogether.[7]

For my own part, I welcome impredicative definitions. I have remarked that there is nothing wrong with identifying the most typical Yale man by averaging measurements and tests of all Yale men including him. But we now observe that impredicative definition is no good in individuation. Here a difference between the impredicative and the predicative emerges which is significant quite apart from any constructivist proclivities. We can define impredicatively but we cannot individuate impredicatively.

In events as thus far conceived there is also another cause for discomfort, apart from individuation. It is a case of indigestion: events intrude as foreign matter. We are comfortable with our spatiotemporal regions and the stuff that fills them, the bodies and their extrapolations into the gerrymandered, the diffuse, the very large and the very small; but the events are conceived to be none of these.

This is not a fatal drawback. Classes offend in the same way and more so, but we reluctantly tolerate them because of the indispensable role that numbers, functions, and other classes play in natural science. However, I question whether in the case of events we are driven to these two major concessions, one to do with imperfect individuation and the other to do with heterogeneity. I hope we can do better.

A physical object, in the broad sense in which I have long used the term, is the material content of any portion of space–time, however small, large, irregular, or discontinuous. I have been wont to view events simply as physical objects in this sense. If Sebastian chews gum all the way across Bologna, and no longer, that event of his chewing and that event of his walking have been for me identical; they take up the same place–time.

We might break this tie by a spatial narrowing of the events, limiting the chewing to Sebastian's head and the walking to his legs. But Davidson blocks this strategy with another example: a ball that was simultaneously rotating and heating up.[8] The rotating had certain effects on the surroundings, and the heating had other effects. Can we say that its rotating is its heating up?

I am not put off by the oddity of such identifications. Given that the ball's heating up warms its surroundings, I concede that its rotating, in this instance, warms the surroundings. I am content likewise to conclude that Sebastian's gum-chewing got him across Bologna, if it coincided with his walk. These results seem harmless to science, for they imply no causal connection between warming and rotation in general, nor between locomotion and chewing gum. But the ball example raises also a more stubborn problem: if it is rotating rapidly and heating slowly, can we say that the event is both rapid and slow?[9] Perhaps we must retreat after all to a more complex version, construing an event as the pair of a physical object in my sense and a distinctive set of some sort. Jaegwon Kim and Richard Martin have ventured on somewhat such lines.[10] Such a construct could still be accommodated in the ontology that I have accepted, which comprises physical objects, classes thereof, and so on up.

The problem of individuation of events would seem to be dissolved now by the assimilation of events to physical objects or to some sort of constructs upon physical objects. For physical objects are well individuated, being identical if and only if spatiotemporally coextensive.

Yet it has been felt that physical objects, bodies in particular, are poorly individuated. Who can aspire to a precise intermolecular demarcation of a desk? Countless minutely divergent aggregates of molecules have equal claims to being my desk. True enough; but this circumstance attests only to the

[6] *Essays on Action and Events*, p. 179.

[7] W.V. Quine, 'On the axiom of reducibility,' *Mind* 45 (1935), pp. 478–500.



[8] *Essays on Action and Events*, pp. 178ff.

[9] Here and elsewhere I am indebted to auditors at Brown University. A remark by Stanley G. Clarke in Ottawa also prompted an improvement elsewhere, and a critical reading by Burton Dreben led to several.

[10] See Davidson, *Essays on Action and Events*, pp. 129, 170.

vagueness of the term 'desk', or 'my desk', and not to that of 'physical object'. Each of these visually indiscriminable candidates for the status of being my desk is a distinct physical object, individuated by the requirement of spatiotemporal coextensiveness.

Vagueness of boundaries has sparked philosophical discussion in the case of desks because of their false air of precision. Mountains meanwhile are taken in stride; the thought of demarcating a mountain does not arise. At bottom the two cases really are alike; our terms delimit the object to the degree relevant to our concerns. In the case of the mountain we care about the summit, its altitude, its immediate approaches, and perhaps whether to reckon some subordinate summit as part of the same mountain or as a lesser neighbor. We are indifferent to area, population, and the boundary of the base. The mountain is no particular physical object; any one of a vast number would serve. The desk is to be viewed similarly; the cases differ only in degree.

Are we then to withhold the term 'physical object' from the very things that have been its prototypes – desks and mountains? Yes and no. A certain adjustment is required, and the place where I would make it is in the interval between formal logic and the terms to which it is applied. Consider, to begin with, the classical notion of the extension of a general term. The extension of the term 'desk' is conventionally thought of as the class of its denotata, thought of as physical objects. Realistically we may recognize rather an *extension family*, as I shall call it. It is a family of vaguely delimited classes, each class being comprised of nested physical objects any of which would pass indifferently for one and the same desk. When we bring formal logic to bear on discourse of desks, then, we adopt the fiction that the extension is some one arbitrary and unspecified selection class from that family of classes; it selects one physical object from each. Similarly, and more obviously perhaps, for mountains. This strikes me as the reasonable way to accommodate vagueness: not in a logic of vagueness, but in the account of the application of a logic of precision.

These questions of demarcation carry over to events. Sebastian's walk is perhaps to be identified with a pair whereof one component is the temporal segment of his body over the period while he was walking, and there are then the vague limits of his body to reckon with, on a par with those of the desk. The accommodation is the same. Another event, an explosion, is comparable rather to a mountain: the nub of it is well placed, but its perimeter is as may be.

Physical objects, despite the vagueness of terms that denote them, are individuated to perfection by spatiotemporal coextensiveness. No wonder: our conceptual apparatus of space, time, and physical objects is all of a piece. Space–time is a matrix that stands ready to cast objects forth as needed in the course of introducing logical order into one or another branch of science or discourse.

We have examined the workings of reification in the logicizing of adverbs. In the light of those observations, I want now to speculate on the function of reification in general and in principle. I shall begin by considering the relation of scientific theory to sensory evidence.

How do we muster sensory evidence for or against a theory? We formulate a deviously related question as to the outcome of a proposed experiment or observation and then we so situate ourselves that the stimulation of our sensory



receptors will trigger our answer to *that* question – 'Yes' or 'No'. The theory is thereby sustained, for the time being, or shaken.

On the one hand there is the set of theoretical sentences that is under fire. On the other hand there is the observation sentence, as I call it, that is subject to a verdict by dint of sensory stimulation. Where complexity comes is in the relation of the set of theoretical sentences to the observation sentence. They are connected by a network of intervening sentences, variously linked in logical and psychological ways. It is only here that we have to pry into the sentences and take notice of names, predicates, and objective reference, as Davidson well argued in 'Reality without reference.'[11] What are related are sentences first and last; terms intrude only along the way, in the interrelations of the sentences. Sentences, not terms, are the termini – the *termini ad quos et a quibus*. One thinks of Davidson again with his semantical focus on truth conditions of sentences. Terms are the means to a sentential end. I want to see more clearly how terms and objective reference contribute to that end of relating sentences to sentences. What we have seen in connection with adverbs may afford some leads.

Consider, then, an observation sentence. To fit the typical scientific situation it should perhaps treat of a galvanometer, a pointer reading, a blue liquid in a test tube, or the like, but a homelier example will be more convenient:

A white cat is facing a dog and bristling.

The scientific theory that is being tested is perhaps ethological. This observation sentence, true to form, is one that we will directly assent to or dissent from when suitably situated and visually stimulated. It is in its global susceptibility to visual triggering, and not in its mention of two creatures, that its observationality consists. Its referential aspect belongs rather to its devious connections with the ethological theory to which it is meant somehow to bear witness. How the referential aspect contributes to that connection is now the question. Let us begin by so rephrasing the sentence as to mask its referential function. Just as we say 'It's raining' or 'It's getting dark' without meaning to refer to any object, so we might say 'It's catting' in the sensible presence of a cat. Our observation sentence, 'A white cat is facing a dog and bristling', then goes noncommittally into adverbs:

It's catting whitely, bristlingly, and dogwardly,

Reference, then, is what emerges when we regiment the sentence to fit predicate logic, which is the chosen mold of our scientific theory. Analogously to the earlier example of the eruption, our sentence becomes:

(5) $\exists x$($x$ is a cat and $x$ is white and $x$ is bristling and $x$ is dogward).

I am not conjecturing about the genesis of reference, as I have done elsewhere, nor am I proposing a rational reconstruction of its genesis. I am

[11] Reprinted in *Inquiries into Truth and Interpretation*.

concerned rather with scientific theory and observation as going concerns, and speculating on the function of reference in the linking of whole observation sentences with whole theoretical sentences. I mean predicate logic not as the initial or inevitable pattern of human thought, moreover, but as the adopted form, for better or worse, of scientific theory.

Reification of the cat has adapted our observation sentence to predicate logic, but nothing as enduring as a proper cat is needed for that purpose. The briefest stage of a cat will suffice. The identity of a cat over time, in its going and comings, is a further refinement that is called for at the level of scientific theory where causal chains are being traced. Reification of the briefest trace of cat sufficed for adjectivizing the adverbs: extrapolation to proper cats is wanted for further theoretical purposes. But the utility of the reification is basically the same in both cases: a forging of links between sentences or clauses. The effect is visible in (5), in the recurrence of '*x*' from clause to clause, and it is no less evident in the case of the enduring cat. In pursuing causal connections at the crudest level we want to say this sort of thing:

> If something that a cat eats causes him discomfort, he takes increased care to sniff things before he eats them.

The 'if-then' here is truth-functional, as loose as conjunction; and then the required tightness of connection is imposed by the recurring reference to an enduring cat – just as the required tightness of connection was imposed on conjunction, in earlier examples, by recurring reference to a walk or an eruption.

Space–time is the matrix on which we can draw for all our reifications of concrete objects, however small or large, diffuse or irregular. The efficacy of reification in forging links between clauses and sentences has become evident from our examples. In Davidson's case it linked clauses of conjunction to take the place of adverbial connections. In the case of enduring physical objects it links clauses and sentences according to causal connections. It could be said, going a step beyond Voltaire, that if things had not existed they would have had to be invented. And indeed we have found it fruitful to press our reifications beyond space and time. We posit abstract objects – numbers, functions, classes – and our natural science would be a pretty sorry affair without the loyal support of that ghostly host. Here again the utility of the reifications ultimately lies, we may be sure, in superimposing firm connections upon the looseness of truth functions.

Deviant logicians have espoused strict conditionals and various brands of relevance logic to add tensile strength to the truth-functional connectives, but standard predicate logic gains the required strength through reification. Clauses are bound together by shared anaphora to a quantifier. Whitehead and Russell long ago cited the quantified conditional as their defense of the material conditional against its critics,[12] and I am now suggesting that this mode of

[12] Alfred North Whitehead and Bertrand Russell, *Principia Mathematica*, vol. 1 (second edition, Cambridge University Press, 1925), pp. 20ff.



binding the loose clauses of truth functions is the basic technical service of reification itself.

In talking thus of the uses of reification I would not seem to impugn the reality of walks, eruptions, cats, or other physical objects, or even of numbers, functions, and classes. Let us identify our ball game and keep our eye on the ball. It is clear, surely, in the relation of science to sensory evidence, that sentences rather than terms are the gross termini – *ad quos et a quibus*. Objects of reference are invoked in between. In considering how they help to forge links between sentences of high theory and observation sentences, I am no more questioning their reality than I am questioning the reality of the sensory receptors that feed the *terminus a quo*.

There is nevertheless an inescapable methodological lesson here, which has somewhat the air of skepticism or nihilism on first encounter. It is the lesson of what I call proxy functions. It hinges on the fact that scientific theory consists of sentences, presumed true, and that what are contingent on sensory evidence are also sentences. Terms figure only as nodes in the network of sentences and consequently their references could be shuffled or reconstrued at will without disturbing the connections. Thus suppose any arbitrary one-to-one transformation imposed on our ontology, and suppose every term, every predicate, reinterpreted to conform to the ontological shift. No word of any sentence is changed; words are merely reinterpreted. Observation sentences remain associated with the same stimulation patterns as before, and the relations of these sentences to those of the scientific theory remain undisturbed.

This reflection is a reflection on epistemology, or the theory of scientific evidence, and not on the nature of the world. It tells us that scientific evidence is a matter of sensory stimulation and the structure of the network of sentences. The nature of the world is another question, and a no less interesting one. It is to be answered in natural science, not in the theory of evidence for natural science; and robust realism is then the order of the day. In our methodological sophistication we appreciate that a reshuffled ontology would fit all evidence just as well, but it would not fit it any better. Predictions proceed and are confirmed apace, and we cannot ask for more.