

OBSERVATIONAL CONCOMITANCE AND ONTOLOGICAL COMMITMENT

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I

Quine has instilled new life into the old discussion of observation sentences since he took up the topic at the end of the 50s, though he has wavered on their import. A physical element concerned with the homology of sensory receptors which figured in earlier accounts has now been dropped (1996, pp. 160-1). In *Word and Object* he spoke of degrees of observationality with theory and collateral information diluting the pure observation sentences (pp. 42-4). Later, he tells us,

I held observationality as absolute, based on immediacy of assent, and then I accommodated the intrusion of theory by contrasting the *holophrastic* conditioning of the observation sentence to neural intake with the *analytic* relations of the component words to the rest of language. The sentence figures holophrastically both in the infant's first acquisition of it and in the scientist's immediate assent to it when testing a theory. (1996, p. 162)

An observation sentence understood as of 1996 is

simply an occasion sentence that commands the subject's immediate assent, however fallible and revisable. Fallibility is then accommodated in a separate dimension, *theoreticity*, which invests observation sentences in varying degrees. (loc. cit.)

His view now squares quite nicely with that propounded just over 100 years ago by Duhem before the logical positivists introduced their notion of observation sentence which has notoriously gained all the bad press. Duhem describes how the scientist reconciles himself to the fallibility of first impressions by adopting the critical attitude afforded by his analysis of ordinary observation:

If therefore theoretical interpretation deprives the results of an experiment in physics of the immediate and indisputable certitude offered by the data of ordinary observation [données de l'observation vulgaire], it is, on the other hand, theoretical interpretation which permits scientific experiments to penetrate more deeply than common sense into phenomena in the analysis and description of detail. (1894, p. 213)

“The finality of an experiment”, Quine says in near Duhemian idiom, “is historical, not logical” (1996, p. 163). And just as for Duhem,

Physics is a symbolic painting to which continual retouching gradually gives comprehensiveness and unity, which forms in its *entirety* a more and more precise picture of the *entirety* of the facts of experience, while each detail of this picture, cut off and isolated from the whole, loses all significance and no longer represents anything. (1894, p. 197),

so Quine sees increasing depth of analysis as emerging with the linking together of an ever broader range of sentences by shared descriptive terms.

Finer points of difference would arguably emerge on a more detailed comparison, but one in particular leads to my concern in the present discussion. I think it reasonable to see a parallel between Quine’s notion of the emergence of an increasingly sophisticated *ontological commitment* with greater depth of analysis, and the “ontological order” Duhem sees reflected in “the logical order in which theory orders experimental laws” as it approaches the more complete form of a “natural classification” (Duhem 1954, pp. 26-7). Quine has been able to give a clearer general conception of the connection of ontology and logical order, which he has also tried to flesh out with more specific details. But he pays far more attention to the observational end of the spectrum than he does to the filling out of the middle ground and beyond. He wants to claim that observation sentences as such can be understood without recourse to ontology, and that this even applies to compound observation sentences. A special kind of compounding of observation sentences is invoked by Quine to link theory, which comprises standing sentences, with observation sentences which are occasion sentences. This is the *observation categorical*, itself a standing sentence, but one formed by compounding two observation sentences. Even these observation categoricals Quine says *can* be construed without prior ontological commitment. This I don’t understand. Observational compounds are required to report observation concomitance of one sort or another, and this often seems to require ontological presuppositions as far as I can

see. A parallel to this relinquishing of ontological presuppositions is to be found in the way intensional logics are sometimes advanced as an alternative to making certain ontological assumptions. Faced with the challenge to acknowledge either tacit ontological commitments or suppressed intensional structure, however, Quine might well prefer the former.

A fuller exposition of Quine's compounding of observation sentences is given in the next section. A comparison with Hume's notion of constant conjunction is developed in section III to highlight the problem. Several examples involving the observation of concomitance are described in section IV. Finally, attention is drawn to some familiar strategies for capturing concomitance with intensional devices rather than ontological assumptions in section V.

II

Quine illustrates the compounding of observation sentences to yield further observation sentences in *The Pursuit of Truth* with two kinds of construction. *Conjunction* of observation sentences, as in "Rabbit and birds singing", is a looser sort of connection than *predication*, as in "This pebble is blue", or simply "Blue pebble". "The conjunction is fulfilled so long as ... each of the component observation sentences [is] fulfilled somewhere in the scene"—a rabbit here and birds singing over there—whereas "the predication focuses the two fulfilments, requiring them to coincide or amply overlap. The blue must encompass the pebble. It may also extend beyond; the construction is not symmetric" (p. 4). Later on Quine gives an example of a predication involving four observation sentences:

(1) A white cat is facing a dog and bristling,

or "White, dog-facing, bristling cat". This, Quine thinks, could be learnt "by direct conditioning to the situation it reports" (pp. 29-30), but like his example of the chemist's observation sentence "There's copper in it!", it is unlikely to have been learnt in that way, and is illustrative of an unlimited number of comparably complex observation sentences actually learnt by systematic construction on the basis of intersentential relations. Observation sentences as Quine understands them therefore "far exceed the primitive ones which serve as the child's entering wedge" into the language, and "which ones are learned directly by conditioning, and which ones indirectly through higher language, will vary from person to person" (p. 5).

How is such systematic construction possible? Quine talks here of “reification”—in the case of (1), construing the combination more tightly than mere conjunction by introducing existential quantification, thus: “Something is a cat and is white and is dog-facing and is bristling”. An object has been posited, an enduring cat. But an object existing from one time to another is more than is required by (1), taken in isolation as an observation sentence. A momentary conflation of features “all in the same part of the scene, superimposed” (1992, p. 29) is all that (1), considered as an observation sentence, involves. On Quine’s view, the occasion sentences which are observation sentences have a dual role. Considered as an integral part of the language, the same sentence can’t be treated holophrastically. It must be considered analytically, with a structure of parts in common with other sentences, in virtue of which the inter-sentential relations obtain and the systematic construction of complex sentences is possible. This involves the positing of objects, to which predicates can be truly or falsely applied. And of these objects we develop theories in which statements are made going beyond even what *could* be learnt by direct conditioning to the situations they report. Thus, cats as ordinarily conceived are enduring objects, and invoke reference to times and the use of relations of earlier and later. We say of them such things as

(2) If a cat eats a spoiled fish and sickens, then it will thereafter avoid fish, and this cannot be treated as an observation sentence compounded of observation sentences by “if ..., then ...”. The pronoun “it” following “then” in (2) refers to the same thing as does “a cat” in the antecedent, although it is the subject of a description applying at later times in the consequent than the description applying to it in the antecedent.

We have seen how observation sentences can, by Quine’s lights, be compounded to generate new observation sentences. But not all compounds of observation sentences are observation sentences. Quine distinguishes a compound of observation sentences which he calls the observation categorical. These are standing sentences of the kind “Whenever A, B”, where “A” and “B” are observation sentences, expressing “an irreducible generality prior to any objective reference ... to the effect that the circumstances described in the one observation sentence are invariably accompanied by those described in the other”. Their status as standing sentences allows that they are, when construed analytically, the sort of thing that can be implied by a scientific theory. “It thus solves the problem of linking theory logically to observation, as well as epitomizing the experimental situation” (1992, p. 10). Quine (1994, p. 173) reaffirms

that he construes such observation categoricals as assuming no prior ontology, and in particular, none of places and times, only a conditioned association between for example “Here is smoke” and “Here is fire” which a child might be expected to command. In later stages of theory construction we return to these same observation categoricals, as we do with observation sentences in general, and construe them along the lines of sentences universally quantified over places and times in order to establish links with theory.

How reasonable is this contention of Quine’s that complex observation of, let us say several factors together to put it in neutral terms, is independent of ontological assumptions? We can begin by comparing with Hume’s notion of constant conjunction.

III

Hume’s idea was that causation could be understood in terms of constant conjunction. Constant conjunction says something about two kinds of objects, but not merely that there are objects of each kind, nor merely that there are as many objects of each kind. Objects of each kind are paired off with one another in virtue of their *conjunction*. “Conjunction” is to be understood here as the astronomer, rather than the logician, uses the term. The modern logician wants to reserve the term “conjunction” for a sentential connective, and would use some other expression, say “occurring together”, for the relation between objects involved in causation. Hume, it seems, well understood these considerations:

The idea, then, of causation must be deriv’d from some *relation* among objects; and that relation we must now endeavour to discover. I find in the first place, that whatever objects are consider’d as causes and effects, are *contiguous*; and that nothing can operate in a time or place, which is ever so little remov’d from those of its existence. Tho’ distant objects may sometimes seem productive of each other, they are commonly found upon examination to be link’d by a chain of causes, which are contiguous among themselves, and to the distant objects; and when in any particular instance we cannot discover this connexion, we still presume it to exist. We may therefore consider the relation of CONTIGUITY as essential to that of causation; at least may suppose it as such, according to the general opinion, till we can find a more [fn. referring to the later section I.IV.v] proper occasion to clear up this matter, by examining what objects are or are not susceptible of juxtaposition and conjunction. (*Treatise*, I.IV.ii; p. 75 in the

Niddich edition)

Here we see a distinction between mediate and immediate causation, the contiguity requirements applying to the latter with distant causation allowed on the condition that there is a chain of events, in which each is an immediate cause of the next, linking distant cause and effect.

As Hume says, his approach is based on some “relation among objects” pairing off events. Without some such relation of *occurring together* the idea of constant conjunction reduces to the unhelpful statement that events of one kind occur and events of another kind occur. Given a relation of occurring together defined between *particular* events in terms of their spatial and temporal contiguity, a relation of constant conjunction can be defined between *kinds* of events X and Y by saying that each event of kind X stands in a relation of occurring together with an event of kind Y. Asymmetry is then introduced with the requirement that the cause precedes the effect in time. Hume did express doubts about the contiguity condition. In section I.IV.v of the *Treatise* he considers that “Thought ... and extension are qualities wholly incompatible”, and worries about “the soul[’s] ... *local conjunction* with matter”, which leads him to wonder whether “it may not be improper to consider in general what objects are, or are not susceptible of a local conjunction” (pp. 234-5). The absurdities of “endeavouring to bestow a place on what is utterly incapable of it” (p. 238) may have convinced Hume that “our perceptions are not susceptible of a local union”. But he is not then at liberty to conclude that “as the constant conjunction of objects constitutes the very essence of cause and effect, matter and motion may often be regarded as the causes of thought, as far as we have any notion of that relation” (p. 250). For the relation of constant conjunction depends upon a relation of occurring together, and the only interpretation of this Hume has offered is one in terms of contiguity.

One might still wonder what “objects” are “susceptible of juxtaposition and conjunction” and thus capable of sustaining Hume’s causal relation. Davidson (1980, p. 149) suggests that they are events because of the temporal precedence relation they are held to stand in. But what of the contiguity relations? Billiard balls are taken as the paradigm, the white and the red ball being spatially contiguous when they touch. Billiard balls are certainly not events, however, but continuants, and it is difficult to see how temporal contiguity applies to them. The crucial point is that the balls touch at a time, and this time when the balls are spatially contiguous is of some duration—otherwise, infinite forces would be required to achieve instantaneous change of

momentum. Temporal contiguity is reasonably interpreted in the same way as spatial contiguity as exhibited by the colliding billiard balls, namely as juxtaposition or abutment, rather than as simultaneity. But then if what each ball, considered by itself, is doing when they collide gives us the events standing in the causal relation, spatial contiguity excludes temporal contiguity. The situation is not improved by considering an instant of time at the onset of the collision for the problem still remains that at this instant of first touching, the times are simultaneous. Resorting to the device of adding temporal “tails” to the balls’ doings during collision, so that the one event is construed as including the white ball’s sweeping out a region of space up to the collision as well as being in contact at collision, while the other includes the red’s sweeping out a region of space after the collision as well as its being in contact with the white during collision, is ad hoc. Certainly, it is formally possible to construe the “earlier than” relation as standing between such overlapping times, and not only mereologically separate times, so that the event involving the white ball can be said to be earlier than that involving the red on the proposed construal. But temporal contiguity must then be construed differently from spatial contiguity, overlapping being included in the one case and excluded in the other. Davidson was wise not to mention spatial contiguity. It seems that spatial contiguity is intelligibly sustained by continuants, and temporal contiguity by events, but what the “objects” are which occur together in Hume’s sense remains a mystery.

It is interesting to note that Descartes, who wouldn’t contemplate action at a distance, believed that action by contact is transmitted instantaneously. Quine meets the problem by taking constant conjunction as a primitive idea, “an irreducible generality prior to any objective reference ... to the effect that the circumstances described in the one observation sentence are invariably accompanied by those described in the other” expressed by his observation categoricals. “Whenever A, B”, where “A” and “B” are observation sentences, is to somehow capture the idea that each circumstance described by A is accompanied by a corresponding circumstance described by B, where being accompanied by expresses something tighter than conjunction. But this is not to be understood as saying there are such things as circumstances, and so nothing is said to actually accompany anything. Circumstances are not the sort of thing that could be referred to. Responding to the problem of how his earlier dichotomy of stimulation and intersubjectivity conditions go together, in view of the fact that different subjects can’t be said to have the same stimulations, Quine rejected Davidson’s proposal of

accounting for intersubjective likeness of stimulation by locating the stimulus in the nearest shared cause of the pertinent behaviour of the two subjects because of “the awkward heterogeneity of the subject matter”:

Usually it is not so nicely segregated as Mama or rabbits. “It’s raining” and “It’s cold” are more to the point, and I am reluctant to settle for *situations* as points of reference. They are of a piece with facts and propositions, whereas nerve endings afford a clearly individuated, homogeneous domain. (1993, p. 114)

We have seen that Quine now dispenses with homology of sensory receptors. But that doesn’t impugn his rejection of situations as points of reference. He also rejects spatiotemporal coincidence as the basis of a relation of togetherness underlying his observational categoricals, however, and understands “Whenever” as a dyadic sentential connective.

The introduction of the observation categorical at a point where Hume realised, if somewhat faultingly, that there is a problem to be addressed and which required, as he thought, reference to space and time, obscures details we might have hoped would be explicitly elaborated and so seems unilluminatingly ad hoc. It might be said that Quine cannot be faulted merely for taking certain concepts as primitive. On the other hand, mere choice of primitives cannot settle matters of ontological commitment, just as failure to use variables is not itself sufficient to circumvent the need for a Tarski style notion of satisfaction. There is, in fact, a hint of fudging over the distinction between connective and relation in Quine’s explanation of observational conjunction, said to be fulfilled, as we saw, “so long as ... each of the component observation sentences [is] fulfilled somewhere in the scene”, in so far as being part of the same scene suggests temporal proximity. Conjunction, understood as a connective, implies merely that the component sentences be fulfilled, and carries no implication of spatial or temporal proximity or other relation unless implied by references to spaces and times in the component sentences. Since this is just the sort of point Quine has emphasised in his doctrine of ontological commitment, it is tempting to interpret Quine’s explanation so that the suggested implication of temporal proximity is not intended. Otherwise, it is difficult to see that reification over times is not involved in the notion of an observation conjunction. In fact, since scenes are presumably in the same boat as situations, and “fulfilled somewhere” is presumably not to be interpreted literally as “there is some place *p* where the sentence is fulfilled”, the final phrase “somewhere in the scene” can presumably be dropped from the definition of observation conjunction. Observation

conjunction is just conjunction of observation sentences. But this is to repudiate any sense of togetherness, whereas spatiotemporal coincidence seems so clearly to be Quine's intent.

IV

Observational concomitance obviously plays an important role in science, and compound observation sentences must reflect this if observation sentences are to have any relevance to scientific procedure. Noticing the truth of unlikely or unfamiliar compounds is a valuable trait of the "observant" scientist, and the unexpected conflation of conditions may lead to hitherto unformulated hypotheses with fruitful practical applications or theoretical insights. This seems to be well illustrated by an incident in the life of the metallurgist Harry Brearley.

One fine day in 1913, Brearley was out walking in Sheffield when a flash of reflected sunlight from a heap of rusty scrap metal caught his eye. He could hardly have been the only one to notice a flash of sunlight reflected from the heap. But he was the only one to realise that it was unusual for parts of a rusty heap of scrap to shine, and he rummaged around in search of shiny pieces of metal among the rusty remains, analysed them and discovered they were composed of iron mixed with 14% chromium. (Although he didn't know it, the heap contained the remains of gun barrels made of trial-and-error mixtures for new alloy steels and tested to destruction.) His investigations led to the development of stainless steels with 20% chromium and 10% nickel.¹

What kind of compound observation was it that aroused Brearley's interest? It wasn't simply an observation conjunction "Shiny and rusty", because the component observation sentences were connected and not independently fulfilled. The relevant features occurred together, spatially and temporally, although nothing was both shiny and rusty: he set about sorting the shiny pieces of metal from the rusty pieces. It seems that the situation cannot be described by either a simple observation conjunction or an observation predication. But we might try a more complex combination of these. The heap of scrap was partly shiny—heap encompassing, in Quine's words, shiny—and partly rusty. How does an observation conjunction of two observation predications, "Shiny heap and rusty heap", fare? It doesn't fit the bill, unfortunately, because the heap

¹I heard this story in a talk by Michael Akeroyd, who uses it to illustrate Popper's "conjecture and refutation" approach to scientific investigation; see Akeroyd (1992).

is the same in the two cases, and this is not required by observation conjunction. Nor is the situation like that described by (1), because what is shiny is not, as I say, rusty, and conversely. It is difficult to see how Brearley's observation can be accounted for by the resources of Quinean compound observation.

Suppose, on the other hand, that reference of a primitive sort is countenanced to regions of space and time, considered not as sets of points, but as extended "solids" standing in mereological relations of parthood, overlap, and so on. Then the compound observation can be captured by mass disjunction as this is defined in the theory of mass predication (Röper 1983). There are regions, p and q , such that p is shiny and q is rusty and the sum of p and q (i.e. that region whose every part either overlaps p or overlaps q) is a heap of scrap metal. Distinguishing material bodies from the regions they occupy and attributing features to them rather than the regions they occupy might be viewed as a more sophisticated development in ontology which could be traced in more detail.

Concomitance of another kind arises when processes are timed. In former days, timing was often left to the ear because the eyes were too much absorbed by the events in one region to attend to clock readings in another. Problems thereby engendered are vividly illustrated by the tale of Kinnebrook, the Observer Royal at the Greenwich observatory who, "as every psychologist knows" (Boring 1957, p. 134), dismissed his assistant Maskelyne in 1796 because Maskelyne's observed transit times for stars were almost a second later than his own. I will take up an example from the early days of chemical kinetics.

In their pioneering work on the study of the rate at which chemical reactions proceed, Harcourt and Esson followed the course of a reaction in which hydrogen peroxide liberates iodine from hydrogen iodide. Their task was to estimate the amount of iodine released during successive stages of the reaction. The presence of iodine is shown by the familiar blue colour it produces with a starch indicator. Equally sized drops of a strong sodium hyposulphite solution were added in succession. The hyposulphite recombines the iodine into hydrogen iodide at a much faster rate than that of the principal reaction—to all intents and purposes instantaneously—and renders the solution colourless until the hyposulphite is used up and excess iodine suddenly produces the blue colour once more. In the course of a description of the painstaking precautions taken to overcome the many difficulties in making the measurements, Harcourt describes the timing of the successive stages as follows:

an experiment was ... made to date ... from the first appearance of the blue colour

[after mixing the principle reagents]. In order that the second at which this change occurred might be accurately noted, the cylinder [in which the reaction proceeded] was placed on a sheet of white paper, in good light, and opposite to it was stationed a clock, beating seconds. ... The observations were made by looking down upon the column of fluid and watching the appearance of the disc forming its upper surface, listening, at the same time, to the beat of the clock, and counting the seconds. So suddenly does the blue shade pass over the clear and brightly illuminated disc, that a practised observer can generally feel sure as to the second in which the change begins, and where the reaction is proceeding very rapidly it would often be possible to subdivide the second. As soon as the observation had been made, a drop of hyposulphite was introduced, which speedily restores the liquid to its normal colourless condition. (Harcourt 1867, p. 479)

The time that elapses between two successive appearances of the blue colour becomes continually greater as the amount of peroxide in the solution diminishes; and, finally, the last measure of hyposulphite requires for its conversion more iodine than the residual dioxide can furnish, and the blue colour never returns.

The colouring of the disk is observed concomitantly with, say, the ninth beat of the clock, or more precisely (since Harcourt quotes times to two decimal places), the colouring is observed to occur at a point within the interval between the ninth and tenth beats. The relevant notion of concomitance is a temporal one, and would seem to imply the existence of times. There is a time during which the colour change occurs, and this is a part of the time during which the ninth and tenth beats are heard.

Other examples such as the siren of a passing ambulance falling in pitch and decreasing in intensity, or of its getting colder as dusk falls, are not so easily pinned down to definite spatial regions. But they do involve a fixed time; and then it is easily ascertained that people in the neighbourhood agree on the observational concomitance at the time in question, and others don't, which serves to broadly delimit a spatial region. It seems that spatiotemporal reference, or at any rate temporal reference, is a minimum requirement for useful notion of observational concomitance.

V

The idea that two conditions can hold at the same time needn't necessarily be seen as entailing the existence of times has been developed in the discipline of tense logic as originally conceived by Arthur Prior. On Prior's view, a simple past-tensed statement

like “John has gone” should be rendered in the form $P\varphi$, where φ is understood as a present-tensed sentence “John goes” and the past tense of the original sentence is rendered by the application of the sentential operator P read “It was the case that”. A further sentential operator, F , read “It will be the case that”, is introduced to capture future-tensed idioms. The obtaining of circumstances at different times can be expressed by a conjunction with this apparatus. That φ is the case before ψ is expressed by a disjunction of conjunctions:

$$P(P\varphi \wedge \psi) \vee (P\varphi \wedge \psi) \vee F(P\varphi \wedge \psi).$$

Given that sentences are all understood to have an implicit temporal character² within the context of tense logic, a conjunction $\varphi \wedge \psi$ in which no tense operators occur does express a sort of temporal togetherness without resort to a relation.

In the same Priorean spirit, an analogous treatment of “holds somewhere else” as an intensional sentential operator has been proposed by von Wright (1983). He suggests the basic normal modal system K augmented with the “Brouwerian” axiom and $\diamond\diamond\varphi \supset \varphi \vee \diamond\varphi$ is adequate for \diamond interpreted as “holds somewhere else”. An unmodalised sentence in this context can be interpreted as holding here—i.e. nowhere else: putting φ materially equivalent to $\sim\diamond\varphi$ doesn’t lead to a contradiction because the familiar modal axiom $\varphi \supset \diamond\varphi$ doesn’t hold for this interpretation of \diamond . An unmodalised conjunction in this context accordingly expresses the spatial togetherness of two circumstances without resort to a relation.

Now it is well-known that the expressive power of ordinary tense constructions exceeds the resources of Prior’s tense logic and involves the ontological presuppositions of quantification over times. But cases where further expressive power is called for are relatively unusual, and become more so if the addition of certain operators complementing Prior’s original arsenal is allowed. Might not tense logic be suitable for the primitive constructions required for the composition of ontologically non-committal observation sentences, and in particular, observational concomitance?

² Prior expresses this universal implicit temporal character by saying that every sentence can be given a reading beginning with a present-tense expression “It is the case that”. Even $P\varphi$ can be read “It is the case that it *was* the case that it *is* the case that φ ”, and so on.

There are problems with this plan. For one thing, the expressive weakness of tense logic also encompasses absence of spatial character. It would have to be shown that tense logic can be satisfactorily combined with von Wright's language of spatial inflection. Given Prior's own concerns, he might well have been willing to accept a solution whereby explicit reference to space is allowed in the form of variables. But that wouldn't suit Quine's purposes.

An even greater obstacle would be that of explaining the relation between observation and theory. Quine solves the problem of relating the standing sentences of theory to the occasion sentences of observation, we saw, by his device of the observation categorical. Even if Quine were happy with an intensional logic as the vehicle for the expression of the conceptual paucity of the language of observation sentences, how would this be squared with the extensional language of theory? Difficulties aside, the picture may not be altogether unattractive, however. Quine (1994a) presents extensionality as a goal worth striving for rather than an undiscussible dogma, in view of which it might seem appropriate that full-blown extensionality emerges only at the theoretical level where the ontological price for the elimination of intensional operators can be properly assessed.

VI

Quine pictures ontology emerging with an ever more sophisticated and interlocking theoretical framework from the simple beginnings of isolated observations. Reification begins with the use of referential pronouns, and proceeds, via the "intimately interdependent developments" (1994, p. 177) of the framework of space and time and the individuation of bodies across time, to the abstract entities of quantum mechanics and mathematics. I have tried to argue that reification begins a little earlier in this scheme of things than Quine supposes. I would also venture to remark that surprisingly little is said about the middle ground concerned with a variation in middle-sized objects and a variety of observable macroscopic phenomena which Aristotle sought to systematise and even today is approached in terms of macroscopic theories which haven't been eclipsed by small talk about abstruse particles.

Regimentation of theses and theories of this order, promoting what Duhem understood to be the analysis of immediate observation afforded by science, would illuminate the nature of ordinary bodies and the associated ontology. This task is not met by revisionary suggestions that a body be "[v]iewed four-dimensionally ... [as] the

content of a portion of space-time” (Quine 1994, p. 177) and the distinction between events and continuants simply abandoned. Thus, the naive observation that the wooden desktop is warmer than the metal paper-weight. As with the observation of a bent stick half-immersed in water, the judgement is corrected, in this case with the explanation that the two objects have been in the room sufficiently long to have come to thermal equilibrium. The feeling of coldness on touching the metal object is explained by the existence of a noticeable event, namely the heating of the paper-weight by my hand, which body metabolism maintains at a higher temperature. The specific heat and poor conductivity of wood mean that the corresponding heating of the desktop is too small to be noticeable. Having a certain temperature is a macroscopic phenomenon, instantiated by a body occupying a sizeable region of space during an appreciable interval of time. Bodies don’t have temperatures for instants. The simple temporal character of observation is not reflected in the Priorean metaphysics of tensed determinations and the unreality of time, but in the fact that circumstances hold for—during—times which have parts and are parts of others. Similarly for space. The spatio-temporal ontology can be developed within an elementary first-order theory based on mereology, and the basic properties of bodies and processes explored within such a framework. Observation should be properly connected with this end of science, which should be given more attention before rushing off into the realms of space-time and uncertainty.

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