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ONTOLOGY AND METAPHYSICS IN 'WORD AND OBJECT'

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Abstract
An outline and assessment of Quine's main contributions to general ontology and metaphysics is presented. The interplay between his canonical notation and his criterion of ontological commitment is scrutinized. Quine's philosophical positions have sometimes led to interesting scientific results. A few examples are analyzed.

1. *Introduction*

From the very beginning philosophers have raised metaphysical questions such as "What is the ultimate furniture of the world?" Among the various answers offered we find: material bodies alone (Hobbes), minds alone (Berkeley), material bodies *and* minds (Descartes), material bodies, embodied minds *and* universals (Popper). After the formulation by Quine of his famous criterion of ontological commitment, these sweeping questions have received a new formulation. We can ask of a given scientific or philosophical theory T: "which entities is T committed to?". It is tacitly understood that unnecessary commitments should be avoided.

At the end of *Word and Object*, which is the book in which, as F. Rivenc notices, "Quine has spelled out his philosophy in the most global and detailed way", a clear description is given of the ontological work which is incumbent on philosophers [Rivenc 2009, VII]. Mathematicians take for granted, among other things, numbers, classes, vectors and Hilbert spaces. Physicists take for granted physical objects and forces. The philosopher's concern stands in contrast with the scientist's assumptions. Philosophers scrutinize "this uncritical acceptance of this realm of physical objects itself, or of classes, etc. that devolves upon ontology. Here is the task of making explicit what had been tacit, and precise what had been vague; of exposing and resolving paradoxes, smoothing kinks, lopping off vestigial growths, clearing ontological slums" [Quine 1960, 275].

The quotation above is not only a very clear philosophical stance which reflects Quine's conception of ontology in 1960, it is also a *research program* which has guided his past research and will guide his future research. Quine's ontological commitment is designed to apply to theories expressed in a formal or in a semi-formal language in which existence is expressed by existential quantifiers. Hence ontological inquiry requires, as a preliminary step, the choice of a canonical notation. That notation itself can be more or less austere.

In this essay I will illustrate Quine's original contributions to ontology and assess their importance. Next I shall comment on his canonical notation understood as a way of getting access to the true and ultimate structure of reality. By its scope the latter inquiry can be described as a metaphysical enterprise. As we have seen above the two themes *overlap*. There is sometime a *trade-off* between canonical notation and ontology. For instance, a statement about the future can either be formalized with a canonical notation which contains tense operators or by a first-order language which contains variables ranging over events. This is by no means an arbitrary choice [On this see Prior 1968, 2003, chapter XI].

In this essay I will put forward arguments intended to vindicate Quine's parsimonious ontology and austere canonical notation. At some stage however I will distinguish between the ontology of a notation designed to describe the structure of reality and the ontology required by a particular science such as linguistics. I will defend a more liberal position in that context, a position which Quine himself endorsed in an essay devoted to the methodology of linguistics.

2. *Quine's contributions to the ontology of mathematics*

Quine's ontology is two-sorted. It is made up of physical objects and sets. He made that claim for the first time in "The Scope and Language of Science" [Quine 1954, 1974] and stuck to it, with the exception of the purely exploratory paper "Whither Physical objects?" [Quine 1976]. Hence his ontology of mathematics consists of sets only. On his account all other mathematical entities can be defined in terms of sets.

Two examples of Quine's attitude to ontology deserve to be mentioned here. Quine was always at heart a nominalist. Yet his training was in mathematics, and he was driven by the demands of mathematics. For that reason he wanted to limit the ontology by explicitly distinguishing among the various ontological commitments required by distinct parts of mathematics, and practice a kind of methodological nominalism or, to use Alex Orenstein's words, 'reluctant' platonism [Orenstein 2002, 55]. One such limitation is to restrict the use of sets to finite sets, and the first of our examples is connected with the principle of mathematical induction applied to natural numbers.

It is well known that the principle of mathematical induction can be deduced from the Fregean definition of natural numbers under the proviso that we have an infinite set at our disposal to start with [Quine 1982, 296–297]. This kind of observation led Poincaré to grant the status of *a priori synthetic judgment* to the principle of mathematical induction [Poincaré 1902, 1968, 100] and Piaget to state that "Poincaré was certainly right in holding that the number embodies a structure richer than classes taken in isolation or asymmetric relations taken in isolation and in holding that the inductive reasoning is also much stronger than a deduction which does not rest upon the series of integers." [Piaget 1967, 72]

Quine however reformulated Frege's definition in terms of the function symbol "predecessor" instead of "successor". Numbers according to this new account are members of all classes that contain 0 if, besides their members they contain the predecessors of their members [Quine 1963, 76]. This makes it possible to justify the principle of mathematical induction applied to natural numbers by assuming finite classes alone, finite classes which get larger and larger. Admittedly, when we move beyond natural numbers, we have to meet more existential needs. For instance we have to provide for the existence of every ratio x/y thus:

$$x, y\,\mathrm{N}.y \neq \Lambda.\supset.\ x/y \in \mathcal{U}$$

but, as Quine observes "This does assert the existence of infinite classes" [Quine 1963, 131].

Our second example illustrates a case where a nominalistic response is not something which Quine thinks is adequate, and again shows that Quine always required his philosophical position to be subordinated to the requirements of logic and mathematics.

According to the received view, variables admit substituends, i.e. constants which can be substituted for them, and they range over a domain of values. Substituends are linguistic expressions (such as, e.g. numerals). Values are generally non linguistic (e.g. numbers). In any case variables refer to objects and for that reason the standard view is called the objectual interpretation of variables. Some logicians have suggested removing the domain of values from the variables and keeping only the possibility of substituting constants or other variables for them. This interpretation is called the substitutional interpretation of variables. It is clear that variables substitutionally interpreted carry no ontological commitment. The ontological burden has been shifted to the constants, if any, which are substituted for those variables.

One attractive possibility of reducing ontological commitment might be to limit genuine objectual quantification using two sorts of variables: *individual variables*, *objectually interpreted*, which range over a domain of individuals and *class variables* which are *interpreted substitutionally*. Quine however will not follow that route, because he sees the logical pitfalls, and produces what he considers a decisive objection against this policy. Should we adopt it we would incur an intolerable *scientific loss*, we would lose the possibility of proving an elementary law of set theory which states that any class that has members has some unit classes. The proof of this law requires that we commute two existential quantifiers '$\exists w$' and '$\exists Z$', an operation which, as Quine observes, "is eminently allowable in ordinary logic, but not when one quantifier is objectual and the other substitutional" [Quine 1974, 108]. Quine's argument is clear: scientific laws such as the law of commutativity of existential quantifiers should always override philosophical preferences. One should be appreciative of the neatness of Quine's response to the proponents of the hybrid interpretation of quantifiers.

It is worth observing that the two nominalistic policies just described differ fundamentally. None of them helps us do without sets. The former however shows that there are cases in which we can get away with less commitments (prove induction using only finite sets). The latter on the contrary is of no help at all. The lesson we can learn from it is that, as Max Cresswell and Adriane Rini put it, "we should not be hoodwinked into thinking that hybrid quantification is a way of avoiding commitment to classes" [private communication].

3. *Quine's contribution to the resolution of paradoxes*

In "The Ways of Paradox" [Quine 1962, 1976] Quine sheds new light on a whole range of paradoxes. I will however leave that paper aside and concentrate on an earlier contribution of Quine to the theory of paradoxes, namely his theory of stratification which is an alternative to the theory of types. Let me set the stage by briefly recalling the motivation for the theory of types. Some classes are members of themselves, some are not. What of the class of classes that are not members of themselves? Here we encounter Russell's famous paradox: "Since its members are the non-self members, it qualifies as a member of itself if and only if is not" [Quine 1962, 1974, 10]. We get a plain contradiction of the form '$p \equiv \neg p$'.

Russell's solution is well known. He splits the initially unique universe of values of variables into types: i.e. universes U_0, U_1, U_2... by using variables of different categories. Next, use of the membership relation is grammatically allowed only between consecutive ascending types. Hence both "x

is member of itself" and "x is not member of itself" are banned as *agrammatical* since both the first term and the second term of the relations "is a member of" or "is not a member of" belong to the same type. The paradoxical formula which formally reads as follows '$x \in x \equiv x \notin x$' is discarded as *ill-formed*.

In 1936 Quine found, as he himself recognizes, *a middle way* between Russell's use of grammar to rule out certain things which cannot be said, thus linking with the whole idea of a category mistake, and Zermelo's idea that the formulae are all meaningful, but that only in certain cases does an expression define a set. In "New Foundations for Mathematical Logic", Quine isolates formulae for which "it is possible to put numerals for the variables in such a way that '$\in$' can occur only in the contexts of the form '$n \in n+1$'" [Quine 1936, 1963, 91]. He calls them *stratified*. Unlike Russell however, he does not discard *unstratified* formulae as meaningless. He does however prohibit their use inside the comprehension axiom. As Quine puts it: "If φ is stratified and does not contain 'x', $(\exists x)(y)((y \in x) \equiv \varphi)$ is a theorem" [Quine, *Ibid*. 92]. Concretely the unstratified formulae like '$x \notin x$' are meaningful, which respects Zermelo's view, but they do not generate a set. The reason why they do not is very Russellian. What Quine does is "to show how to have the best of both" as Max Cresswell and Adriane Rini put it [private communication].

Future development of set theory showed that Quine was right to acknowledge the meaningfulness of unstratified formulas. In 1968, Maurice Boffa proved that hypotheses could be added to ZF which jeopardize the axiom of foundation without endangering the presumptive consistency of ZF. The first of them reads as follows: '$\exists x(x = \{x\})$'. Formalized in first-order logic with identity it can be expressed by '$\exists x \forall y(x \in y \equiv y = x)$'. The latter formula is verified in a structure if the membership relation is reflexive [Boffa 1968]. Boffa's "extraordinary sets" foreshadow P. Aczel's Non-Well Founded Sets which led to major mathematical applications by J. Barwise and L. Moss [Aczel 1988, Barwise and Moss 1996]. Anti-founded model theory which stems from Non-Well Founded Set Theory studies "reflexive" models, i.e. models that are elements of their own domain. This new model theory allowed Barwise and Moss to develop a new approach to the analysis of the semantical paradoxes of self-reference.

Many philosophers have based category differences upon Russell's type theory. Carnap discards as meaningless "Caesar is a prime number" on the ground that it violates type-theory. Carnap implicitly subscribes to *category distinctions* which enjoy a more important status than *class distinctions*. Ryle is even more keen on the notion of category distinctions. The very idea of category mistake is at the heart of *The Concept of Mind*. Yet, a closer look at the philosophical notion of category used in ontology shows that it lacks the robustness needed to play the role we expect of it. Sentences which seem meaningful within a certain context such as 'x is simultaneous with y' become meaningless in another. In Relativity theory the predicate 'simultaneous' has to be turned into a triadic predicate ('x is simultaneous with y for the observer z'). On this point, let me mention H. Callaway's recent book which shows how much the meaning and the meaningfulness of scientific concepts depends on the context of the theories to which they belong [Callaway 2008].

In *Word and Object*, Quine explicitly gets rid of the notion of category: "But since the philosophers who would build such categorial fences are not generally resolved to banish from language all falsehoods of mathematics and like absurdities, I fail to see much benefit in the partial exclusions that they do undertake..." [Quine 1960, 228]. Admittedly there is a difference between mathematical falsehoods and meaningless sentences. When negated the former become trivial truths whereas the latter remain meaningless. We can however side with Quine when he proposes to drop the use of the philosophical concept of category, a policy which spares him both the settling of categories and the respecting of them. Max Cresswell adopts the same simplifying position with respect to "category mistakes" in Ryle's sense [Cresswell 1985, 67].

The elimination of the notion of category is a significant advance in philosophy which can find support in the theory of stratification spelled out in *New Foundations*. Admittedly, working mathematicians use *ZFC* (Zermelo-Fraenkel set theory with the axiom of choice) rather than *New Foundations*, as Lieven Decock observes [Decock 2002, 136], but this does not forbid us to recognize the merits of the successful combination of Russell's insight with Zermelo's insight achieved in *NF*.

4. *A mature theory which has freed itself of its vestigial growth*

Dispositional predicates such as 'soluble in water' are notoriously difficult to define. 'Soluble in water' does not bring together only things that dissolve in water. It also covers things that if they *were* in water, *would* dissolve. Moving a step further we can say: "Intuitively, what qualifies a thing as soluble is that it is of the same kind as the things that actually did or will dissolve; it is similar to them" [Quine, 1969, 130]. Quine reminds us that the concept of kind and the concept of similarity are expressed by cognate words ('kind' and 'akin'). Yet the situation is not hopeless. The undefined notions of similarity and kind can be rigorously defined in some parts of science. As Quine puts it in his characteristic style, "... man continues his rise from savagery sloughing off the muddy old notion of kind and similarity piecemeal, a vestige here and a vestige there" [Quine, *Ibid.* 135].

Chemistry is the science where the definition of solubility can at last be given in terms of a satisfactory concept of similarity along these lines: "Molecules will be said to *match* if they contain atoms of the same elements in the same topological combination. Then, in principle, we might get at the comparative similarity of objects a and b by considering how many pairs of matching molecules there are, one molecule from a and one from b each time, and how many unmatching pairs." [Quine, *Ibid.* 135] Quine's account of dispositions enables him to remove subjunctive conditionals. It shows how to redefine the mechanism of solubility by describing its structural conditions in such a way that the use of those conditionals can be avoided. Finally, as Quine notes, we can redefine water-solubility by describing the mechanism of solution and by-pass the notion of similarity altogether. This example is not isolated. Quine shows that similar rationalizations of the notions of similarity and kind occur in zoology when a concept of *degree of similarity* is devised in terms of *genes*.

5. *Quine's canonical notation*

Canonical notation, as Quine conceives it, is a semi-formal language which is designed to serve as a framework for a general theory whose aim is to set down "all traits of reality worthy of the name" [Quine 1960, 228]. The notation which Quine adopts is that of first-order logic whose syntactic constructions boil down to predication, use of truth-functional connectives and universal quantification. To fully understand what hinges on the choice of this austere scheme, one has to bear in mind what it excludes. Quine's canonical notation excludes *modalities* such as 'necessarily'. It also excludes *second-order formulae* like quantification over predicates. Finally it excludes variables ranging over *intensions*, such as the variable "p" ranging over propositions as opposed to sentences in "There are some p that John believes and that Mary knows".

These exclusions do not rest on Quine's taste for desert landscapes. They are supported by solid arguments which I shall review briefly. *Modalities* were initially dismissed by Quine because of their connection with the notion of analyticity. Later on, when an interpretation of modalities was given in terms of possible worlds, they were dismissed because a satisfactory account of identification of individuals across possible worlds was not available. *Second-order logic* was rejected because it allowed the proof of formulas such as $\exists G \forall x(Gx \equiv Fx)$ which is a deceptive formulation of the unrestricted axiom of comprehension $\exists y \forall x(x \in y \equiv Fx)$ leading to Russell's paradox. Finally *intensional entities* such as propositions, properties and individual concepts are discarded because, contrary to extensional entities, they lack a *criterion of identification* and violate the principle "No entity without identity".

The following passage expresses in a vivid manner the significance of Quine's austere canonical notation "If we are limning the true and ultimate structure of reality, the canonical scheme for us is the austere scheme that knows no quotation but direct quotation and no propositional attitudes but only the physical constitution and behavior of organisms" [Quine, *Ibid.* 221].

6. *A plea for intensions*

Claire Ortiz Hill who quotes the above-mentioned statement finds it untenable. She claims that propositional attitude constructions play an important role in the physical constitution and behaviour of organisms and offers two examples borrowed from medical science showing how "propositional attitudes bring intensional considerations to the fore in purely physicalistic contexts" [Ortiz Hill 1997, 118]. I will examine her second example which has to do with the conditions under which a successful transplantation of organs can be performed. The immune system of the organism regularly attacks and destroys transplanted organs — for instance a kidney — that are foreign to the recipient. Yet if the donor's kidney is sufficiently similar to the recipient's, the rejection phenomenon does not occur. Hill describes the case in these terms: "the recipient's immune system 'thinks' that healthy kidney x is sufficiently like diseased kidney y not to reject x as foreign" [Ortiz Hill, *Ibid.* 120]. According to Ortiz Hill's analysis, intension enters the picture when the concept of *partial likeness* or *likeness in certain respects*, as opposed to *identity* (i.e. *likeness in all respects*) is used. She suggests that the *extensionalist* who operates with the strongest form of equivalence only — namely identity — cannot account for the kind of discourse where a lesser form of equivalence (likeness in certain respects) is needed. The intensional notion at work here is the relation of equivalence.

I suggest that we can describe the behaviour of the recipient body without using either *intensional notions* such as partial likeness or *quasi mentalistic idioms* such as 'thinks' between inverted commas. Let me recall here how Bergson dealt with a situation analogous to that which is described by Ortiz Hill. It is a well known chemical fact that chlorhydric acid acts in the same way on carbonate of lime (whether it is marble or chalk) [Bergson, 1896, 1949, 177]. One might be tempted to describe this in psychological terms and say that the acid *perceives* in the various species the characteristic feature of a genus. Bergson however refrains from using the word "perceives" and favours a *physicalistic description*. He speaks of "similarity [which] acts objectively like a force, and provokes reactions that are identical in virtue of the purely physical law which requires that the same effects should follow the same profound causes" [Bergson, *Ibid.*]. As far as the immune system's reaction is concerned no reason has been given for preferring the mentalistic and intensional idiom to the physical and causal idiom that Bergson adopted in his account of the chemical reaction he considered.

To do justice to Ortiz Hill's insight, we have to recognize that organisms fundamentally differ from non living beings to the extent that they possess both a *self* and a tendency toward self-preservation, which today is accounted for by positing a *teleonomic apparatus* which Jacques Monod describes in the following passage: "This apparatus is... perfectly adapted to its project: preserve and reproduce the structural norm" [Monod 1970, 32]. The findings of medical sciences, biology and genetics compel us to accommodate *organisms* in our world picture, as Quine does explicitly, but I do not see any conclusive argument showing that we have to go beyond and count *intensions* as pieces of the "ultimate furniture of the world".

7. *The scope and limits of canonical notation*

There is a field where the concept of intension has been widely used: the theory of language. Considering the needs of linguistics, one might feel Quine's flight from Intension proclaimed in *Word and Object* is unduly restrictive. As a reply to that objection I suggest drawing a sharp distinction between two philosophical positions: the position of philosophers who claim that intensions are parts of the furniture of the world and the position of philosophers who use intensions in a scientific account of language. Quine himself came to recognize the difference between the "scientific use of language" and the "scientific study of it" [Quine 1972, 453]. It is clearly within the context of a scientific study of language that Cresswell makes use of the word 'intension'.

Cresswell offers the following way of distinguishing *intension* from *extension*. He considers a setting in which all red things are round and conversely. The predicates 'red' and 'round' have the same extension. This setting does not prevent an organism from *being capable* of detecting perceptually whether something is red or round. All that the organism needs is a pair of devices or algorithms "one of which, when presented with the object in a certain physical situation delivers a yes or no answer depending whether the object is red or not, and the other of which does the same for round" [Cresswell, *Op. cit.* 65]. These devices will give the same result in the given setting, since whatever is red is also round and conversely, but there are possible situations in which they would give different results. Taking these possible situations into account we can illustrate what a difference in intension between two predicates amounts to. At this stage, Cresswell uses the notion of *algorithm* in a thought experiment. Later, taking advantage of Miller's findings published in 1991, Reinhardt Muskens pursued the idea and showed how the idea that the sense of an expression is an algorithm for finding its reference can be formalized [Muskens 2005]. The fined-grained notions of intension which Cresswell and Muskens capture are immune to Quine's objections against intensional notions. They satisfy a clear-cut identification criterion. Hence no reason remains for prohibiting their use *in the field of semantics*.

8. *Conclusion*

Maurice Boudot concluded his long biographical note on Quine published in the *Dictionnaire des Philosophes* with these words: "We are confronted with what is probably the richest and the most coherent system built upon the supposition that nature agrees with what objective representation teaches us about it and on the supposition that philosophers should not go beyond the field of objective knowledge" [1984, 2178]. I think we can still agree with Boudot's assessment today.

The ontology and metaphysics outlined in *Word and Object* have lost nothing of their bite after half a century. They remain a challenge for all workers in ontology and metaphysics as well as a model of clarity which should continue to inspire philosophers.

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