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## LOGIC AND ITS PLACE IN NATURE

What would a satisfying neo-Kantian and neo-Quinean account of logic be like? How should we account for its role as an instrument for acquiring knowledge, and as an instrument for the criticism of theories? How should we account for its special status in the epistemic scheme of things? I intend below to re-apply the distinctions between analytic and synthetic and between *a priori* and *a posteriori* (pace Quine) to answer these questions in what I hope is a novel and interesting way. My answers will put me at odds with both Kantians and Quineans; for I do not think that avoiding disagreements with either camp puts one wholly in the other.

Despite Kant's well-known view that logic has not, since Aristotle, been either required to retrace or able to advance a single step, his characterisation of the sphere of logic is one which many a contemporary philosopher could still endorse:

its sole concern is to give an exhaustive exposition and a strict proof of the formal rules of all thought, whether it be *a priori* or empirical, whatever be its origin or its object, and whatever hindrances, accidental or natural, it may encounter in our minds. (B ix) . . . Pure general logic has to do . . . only with principles a priori, and is a *canon of understanding* and of reason, but only in respect of what is formal in their employment, be the content what it may, empirical or transcendental. . . . There are . . . two rules which logicians must always bear in mind, in dealing with pure general logic:

1. As general logic, it abstracts from all contents of the knowledge of understanding and from all differences in its objects, and deals with nothing but the mere form of thought.

2. As pure logic, it has nothing to do with empirical principles, and does not . . . borrow anything from psychology, which therefore has no influence whatever on the canon of the understanding. Pure logic is a body of demonstrated doctrine, and everything in it must be certain entirely a priori. (B 78)

The following themes emerge:

1. Logic has to do with the *justification* ("proof") of the formal rules of all thought.
2. These rules are indeed *formal*, abstracting away from all content.
3. Logic is normative and a priori.
4. Logic is a "body of demonstrated doctrine" (that is, like a set of

theorems).

Some comments are in order. First, I shall be arguing below that (4) is a source of inadequacy in any conception of logic. It is a feature common to both Kant and Quine. Secondly, when Kant says that logic "has nothing to do with empirical principles", he is *not*, however, advancing anything like a radical Quinean claim to the effect that one might, under the impact of sensory experiences, be able to retract or reject a thesis of logic, provided only that compensatory adjustments are made elsewhere. Rather, Kant is stressing the *normativity* of logical principles<sup>1</sup> and saying that they are not to be construed as descriptive laws of human reasoning. Thirdly, note how Kant stresses the *a priori*ity of logic, rather than its analyticity. (But even if the stress *had* been on analyticity, I believe the view to be set out below could accommodate it — at the cost, however, of some adjustment to the orthodox interpretation of the analytic/synthetic distinction.) Fourthly and finally, note how according to Kant (pure general) logic would have to bear its own justification.) This makes it somewhat different from the modern conception of logic, according to which a body of principles is set forth for an object language, whose adequacy and correctness is then made the subject of some meta-proof in the meta-language.

I want to draw some of these strands together, but subject to the foregoing critical observations, in order to advance a conception of logic that has its roots in this Kantian conception of pure, general logic but which makes some principled departures from it in the light of developments in the theory of meaning and of proof since Kant (and in some cases since Quine's middle period). The conception I shall be recommending has logic consisting in a body of principles, or rules, that are a priori, analytic, and formal; which are moreover normative and non-empirical; and which contain within themselves, as it were, the seeds of their own justification. The striking difference will be that *this conception allows us to consign to the sphere of logic, along with the rules for the standard logical operators,<sup>2</sup> some fundamental fragments of arithmetic.<sup>3</sup> projective geometry<sup>4</sup> and set (or class) theory.<sup>5</sup>* The ontological commitments apparently involved in these bodies of doctrine, I would be prepared to argue,<sup>6</sup> are innocuous insofar as one is concerned with adjudicating the status of logic as analytic and *a priori*. The conception of logic that I wish to ad-

vance will therefore accommodate much of mathematical thought as fundamentally logical. It will not be deterred by the usual objection that logic should not carry any kind of ontological commitments. The reply will be that it matters not if those commitments are to things that exist necessarily anyway, such as the natural numbers.

The conception of logic that I wish to advance will also allow one to argue for revision of classical logic. The correct logic is the one that can be shown to be correct on the basis of a proper meaning analysis. The classical logical principle of bivalence (or law of excluded middle) should be rejected as a *logical principle precisely because it is synthetic* in a non-innocuous way. The principle cannot be justified on the basis of meaning alone. On the contrary, proper meaning analysis reveals it as having a very bold metaphysical status. For it *seeks to constrain the kind of world in which we might find ourselves*. It makes the metaphysical claim that *the world is determinate in every expressible regard*. The claim, which Dummett takes to be constitutive of metaphysical realism, is that every declarative sentence of our language is determinately true or false, independently of our means of coming to know what its truth value happens to be. This claim, despite — nay, *because of* — its level of generality, must be regarded as attempting to say something very informative indeed about the world; hence it is synthetic.

In summary then, the conception of logic that I wish to advance will allow one to argue for revision of classical logic and for the accommodation of much of mathematical thought as fundamentally logical. Most importantly, these developments flow from a conception of logic as consisting of a body of *a priori* and formal rules. I therefore turn my attention now to a discussion of the nature of logical rules.

One might break some logical rules some of the time, and get away with it. One may even break every logical rule some of the time, and get away with it. But what one cannot do is break some of the rules all the time, or all of the rules for any significant period of time. Why would any world strike back at the logical deviant within it? Because reasoning involves representation; and relying on misrepresentations invites disaster.

There are conditions one must meet in order to be entitled to assert; and because of this, one must be prepared to permit others to

take those conditions as met if one's assertion is to be taken seriously. Only in the context of these obligations and commitments can thought represent the world.

Logic involves the transmission of truth from one representation of the way things are to another. The logical thinker avoids lapsing from correct representation to misrepresentation; and in communicating the results, he or she is doing the right thing by other persons in both senses of the word "right". We are beholden to rules of logic as soon as we take the instrument of language into our own mouths, thereby to think and reason for ourselves; just as we are beholden to the rules of ethics as soon as we claim our own personal autonomy. So there is an ethical dimension to logic. This, I think, is the deep affinity between logic and ethics pointed out by Weininger, in a remark that is supposed to have influenced Wittgenstein: Logic and ethics are "fundamentally the same", in that "they are no more than duty to oneself".<sup>7</sup> On the view advanced here, however, the stress would be on duty to *others*, as much as to oneself.

There is also an aesthetic dimension to logic. It is a paradigm of succinctness and conceptual economy. It is concerned with deeply constitutive symmetries and harmonies.

But so too is the natural world, as studied by the physicist. Are these symmetries and harmonies purely conceptual, or tinged with the empirical? We return here to our opening question: is a satisfying post-Kantian (and post-Quinean) account of logic to be had?

Kant agreed with the rationalists about the *a priori* character of certain of the most fundamental tools of thought. These include the categories of substance and causation, and the forms of intuition of space and time. The Kantian mind is configured in such a way that the canons of induction, the laws of logic and the basic principles governing numbers and spatial forms are, if not hard-wired, then at least deep in our operating systems.

But Kant also agreed with the empiricists, by conceding that the categories might have to be awoken in the mind by early sense experience. He is also adamant that nothing gets up and running without some kind of input: "concepts without intuitions are empty".

Logicism challenged Kant's claim that the mathematics of number is synthetic. For the logicist, number theory is *a priori* because it is analytic — that is, it is true simply by virtue of what the number-

theoretic terms mean. It does not tell us anything informative about the world. The standard strategy of logicism is to define numerical notions in terms of logical ones, and to try thereby to derive mathematics as part of logic. Note that, in this project, it is of course assumed that the rules of logic are themselves analytic and thus *a priori*. But the standard way of the logicist need not be the only way of showing that number-theoretic truths are analytic (that is, true simply by virtue of the meanings of the terms involved).

By contrast with logicism, positivism sought to show that geometric truths were not only synthetic but also *a posteriori*. Positivists such as Carnap and Reichenbach made much of Einstein's theory of relativity. For it makes the point that the theorist's choice of physical geometry (Euclidean or non-Euclidean) depends, along with equations of motion, force laws and the rest, on observers' sense-experiences.

So the message of Logical Positivism turned out to be: Arithmetic can be subsumed under logic. It tells us nothing informative about the structure of reality or about the actual or possible happenings within our world. But geometry is to be subsumed under empirical science. It is testable and refutable along with the rest of our high-level scientific hypotheses.

Whatever the fate of arithmetic and geometric truth, however, the logicist and positivist turns did not challenge the *a priori* character and special force of the laws of logic, when these are construed as rules of correct reasoning.

The next post-Kantian turn was the linguistic one. It, too, consisted of contributing bends. First there was the settling dogma that thought requires talk: thoughts must, in the words of Frege, come "clothed in the perceptible garb(s) of . . . sentence(s)". I shall call this the priority thesis. (Dummett gives it the even grander title "the fundamental dogma of analytical philosophy".) Secondly there was the thesis that philosophical problems arose out of misunderstanding the workings of language.

Let me focus on this second bend. It overlapped with late Logical Positivism. In his *Logical Syntax of Language* Carnap emphasizes the importance of linguistic considerations to philosophy. For him, meta-physical questions are pseudo-questions. They have no legitimate

sense and no meaningful answers. They come to be posed by confused thinkers who do not distinguish carefully enough between words in the material mode and words in the formal mode. Do not ask the pseudo-question "Do numbers really exist?". Rather, put your question in the formal mode: "Is there any theoretical utility in adopting number-talk when we try to describe the world?".

Even once one had taken Carnap's advice here, and posed one's questions in the formal mode, there was still much to get clear about. For Wittgenstein, philosophy was a "battle against the bewitchment of intellect by language". Language itself laid the traps, or waved the wands. Thought has to come clothed in words; and words from a language; and it is the logical grammar of the language that puts the pieces of an outfit into a coherent scheme, so that thoughts can be attired in words that suit them. Philosophical puzzles arise out of confusion over the workings of our own language. They arise because we do not get the logical grammar right. They are symptoms of a deep misapprehension about the rules governing the very formulation of sensible thought.

Carnap's and Wittgenstein's linguistic turn, though, like Logical Positivism, did nothing to challenge the a priori character and special force of the laws of logic, when these are construed as rules of correct reasoning. At worst the problem would be to get clear about logical form; having done that, rules would straightforwardly apply.

But Wittgenstein, in the *Philosophical Investigations*, was able to bring about another fundamental change of metaphysical and epistemological perspective from that of Kant. I shall call it the communitarian turn.

The communitarian turn re-focused from the mind of the perceiving subject, in apparent constitutive isolation from other perceiving subjects, to the communal norms underlying our use of language. The linguistic community is the ultimate authority on questions concerning the application of these norms by individual speakers and thinkers. Coupled with the priority thesis, this has an unsettling consequence: it seems to be telling us that, in some important sense, one's thoughts cannot be entirely one's own. Metaphysically, we have, so to speak, to be looking constantly over our shoulders — not because we might not wish to be overheard, but rather because without the constant possibility of our being heard and understood, we would

not be using a meaningful language, hence not thinking at all. (Priority and publicity join forces here.) The communitarian turn is also unsettling insofar as it makes the community the court of highest appeal. For this jars with a deeply ingrained intuition in some, to the effect that the community, far from being the authority, enjoys no more privileged status than any intellectually gifted member of it. [What if they all started "going wrong" in their application of the so-called rules for the use of "our" language? Couldn't you be right (regardless of the difficulties involved in establishing this) in your view that you were the one who "knew how to go on" with certain crucial words, such as the logical operators?]

The communitarian turn has the very nature of representation and informative assertion (and appreciation of the grounds for such assertion) consisting, not in hide-bound facts about a single perceiver and thinker, but in the web of obligation-incurring relationships in which the individual speaker stands to fellow members of the linguistic community. The obligations incurred are to keep faith with the meanings of shared expressions when we use them. The metaphysical challenge is to provide a picture of what, precisely, such an obligation consists in, and how exactly we can ever know that it is being discharged. Such is the challenge highlighted by the deviance *en masse* envisaged above.

If the communitarian is to be believed, there does now seem to be a threat to the claim, thus far not discomfited, that there is nothing to challenge the *a priori* character and special force of the laws of logic, when these are construed as rules of correct reasoning.

The Logical Positivist, linguistic and communitarian turns are well-recognized episodes in the history of twentieth century thought. Underlying all of these turns has been the underlying tendency towards naturalization, towards a more scientific understanding of the problems traditionally addressed by philosophers.

Naturalizing communitarianism now *does* carry unsettling implications for our views about the nature of logical laws and the rules of correct reasoning. We construe mind as our faculty of rules — rules of categorization, investigation, reasoning, communication and understanding. On that construal, we have our problem: what is the place of Logic in Nature?

The naturalizing tendency finds its fullest expression in the writings of that disciple of Carnap who blended Viennese Logical Posi-

tivism with American Pragmatism: Willard van Orman Quine.<sup>8</sup> Quine's system has some peculiar features, which set it apart from those of his predecessors. I shall briefly describe six of these.

Firstly, Quine is austere and sparing when it comes to saying what sorts of things there are in the world. All things are just posits that help to render our experiences more predictable. If good scientific and commonsense explanations of phenomena can make do without reference to entities of a disputed kind, then we need not regard entities of that kind as existing.

Secondly, Quine insists on the need to make behavioural sense of our ability to learn language and communicate our thoughts with it. The assumption is that our grasp of meaningful expressions would have to be capable of being acquired solely from observable behaviour, and of being manifested fully in observable behaviour. This behaviourism is the source of his more unsettling metaphysical theories about meaning: his famous claim that translation, and with it interpretation, hence also meaning, is at root indeterminate. The need to deny determinacy of meaning is generated by his earlier claim that there is no behavioural sense to be made of the distinction between analytic and synthetic truths. For, if meanings were determinate, then, since we identify them simply by grasping them, we would be confident about any number of analytic truths: ones stating implications or equivalences, for example, between sentences which had the same determinate meanings. Let us call this feature of Quine's thought, consisting of the denial of the analytic/synthetic distinction, and his denial of determinacy, his non-factualism about meaning. Note that his non-factualism about meaning is crucially premised on an underlying behavioural assumption.

The third distinguishing mark of Quine's thought is that he conceives of philosophy as continuous with science. Philosophy is just a distributed chunk of the network of sentences. The sole purpose of that network is to be a pliable armour between mind and reality. It smoothes out the jolts that the world deals us, but also adapts to external pressures. Those external and all-enveloping pressures take the exclusive form of impingings on our nerve-endings. Philosophy cannot lay down first principles for science: instead, it has to be consilient with it. This is where the naturalizing tendency finds its fullest expression.

The fourth feature of Quine's thought is that natural science, from

the most commonsense perceptual judgements up to the highest-level hypotheses, and including also mathematics and logic, "faces the tribunal of experience as a whole". Any statement is susceptible to revision, including laws of logic. Any statement could be adopted or rejected, provided that compensatory adjustments were made within the whole to "accommodate" the deliverances of our sensory organs. This feature is well-known by the label (evidential) holism.

A problem I would like to note about this holistic view is that Quine says nothing re-assuring about the rules (if any) that would ideally govern the process of re-distributing truth-values on deciding to hold certain claims true in the face of experience. For Quine, logic is nothing more than a collection of sentences (albeit deep in the network). It is not clear how logic then gets a look-in when this process of re-distributing truth-values gets under way. Suppose some of those logical laws themselves are to have their truth-values revised. Then it is even less clear what wave-equation the ensuing reverberations would, so to speak, satisfy.

The fifth important mark of Quineanism is that language has to be regimented in order to serve science. The language of science should speak only of the whence, where, whither and how of physical things moving around in space, things which can potentially irritate our nerve endings. At best it will speak of causes. But it will stop short of speaking of the reasons that persons may have for acting in the ways they do. In the language of science we cannot ascribe mental states; we cannot report the content of what others have said; and we cannot express necessary as opposed to merely contingent truths about the world. The language of science cannot convey our understanding of persons, their motives, their gossip and their most fervent beliefs. One could read the post-Quinean programme pursued by Donald Davidson as one of trying to put some conceptual meat on the Quinean skeleton. Davidson's method of radical interpretation, his truth-theoretic treatments of *oratio obliqua*, his anomalous monism about the mental, and his conception of reasons as special kinds of causes, is part of a rehabilitation programme aimed at making the Quinean edifice habitable once more, by providing some creature comforts.

Sixthly, and finally — and here's the rub — Quine regards classical logic as peculiarly privileged, and hardly pauses to subject its credentials to critical scrutiny. Moreover, as remarked earlier, he regards logic as a body of sentences, or theorems, rather than as a

canon of permitted moves of inference.

Here, now, is the internal quandary of Quineanism as I see it. Classical logic, for him, is correct by default. But it can't be so on the basis of relations between meanings, or propositions, because the latter, by his lights, do not exist.

Logic is also needed as a constraint on what we can rationally do when re-distributing truth and falsity over all our sentences in order to accommodate the unexpected. But logic too is susceptible to revision in that process, since it consists, according to Quine, of sentences within that very network.

I cannot agree with this aspect of Quine's thought. I think that we have to grant a special, non-revisable (because analytic) status to a privileged collection of rules of inference. These rules govern Quine's re-distribution of truth-values, and should be immune to it. They merely beam truth up (and reflect falsity down).

The rules of inference will also have to be chosen and justified in the spirit of Quine's own behaviourism, which insists that meaningfulness is a wholly public matter. But we will allow ourselves the view, *pace* Quine, that they are the *right* rules because they provide the correct model for the determinate and humanly graspable meanings of the logical operators.

I have tried<sup>9</sup> elsewhere to show where this current of reform bears us. It takes us out of the Sargasso of holism, past the Scylla of non-constructivism and the Charybdis of irrelevance, and into the clear waters of intuitionistic relevant logic. Let me just call it nice logic, which is a lot easier.

Nice logic is adequate for the scientific method. It can uncover all inconsistencies, even though it eschews some of the defining rules of classical and intuitionistic logic. Nice logic is adequate for constructive mathematics. It can uncover any intuitionistic consequence of any consistent set of axioms.

Nice logic is a very beautiful system (but then, I'm biased!). In it, each logical operator is a pearl inside its own oyster. The pearl takes its shape from the clasp of each of two shells: one, an introduction rule; the other, the corresponding elimination rule. They clasp together beautifully to mould the meaning they contain. On proofs, they open, come apart, and reveal exactly the logical content of the operator inside.

But nice logic has a very special feature. As soon as it detects an inconsistency, it clams up. It does not, like the great white sharks of intuitionistic logic and classical logic, go into an inferential feeding frenzy as soon as it draws blood. Logics that clam up in this way are called *relevant*, or *paraconsistent*. They allow for the possibility of distinct inconsistent theories. Such logics eschew the move that says "if you have derived absurdity then you may immediately infer any proposition you like". It yields intuitionistic logic when added to the nice rules.

Another extension would yield classical logic. This requires the move "if you have derived absurdity then you may immediately infer any proposition you like and, in so doing, discharge any application you might have made of the rule that allows you to infer absurdity from that proposition". Logics like nice logic that eschew it are called constructive, or *intuitionistic*. They demand compelling grounds for assertions; and ensure that such grounds will be transmitted to any conclusions which, using the logic, we may wish to derive from those assertions.

To sum up, then: nice logic is *intuitionist relevant* logic.

My choice of expository metaphor is conscious. For I wish to highlight the mystery of logical norms in Nature. The naturalizing tendency makes it *prima facie* mysterious how the so-called logical words of our language could be invested with meanings that dictate certain rules as correct. How can the naturalist cope with the normativity of meaning, especially of the logical operators? How can the naturalist agree with my claim that these are indeed the right rules for the logical operators, insofar as we manifestly grasp their meanings?

I think the answer is that we do not have meanings, of mysterious origin and status, dictating certain rules as correct. Rather, we have certain rules (and only those rules) succeeding in specifying manifestly graspable meanings. The focus of attention shifts, then, to these rules. How do they come to be adopted? How are they maintained? How do they command adherence? Would widespread violation of them be possible without the language ceasing to be a vehicle of survival-relevant information?

In pursuing this inquiry one is drawn to a conception of the rules of inference as transcendental preconditions for the very possibility



of informative communication. From a naturalistic communitarian perspective, there are interesting explanations to be had of how such communication could arise, be selected for, and in turn confer selective advantage on genes that code for organs that code and decode. But those logical constraints in the background are what make the whole evolutionary scenario possible. It might be useful to think of logical norms as marking out a stable attractor in a space of communal linguistic behaviour. The community's aggregate behaviour has to orbit within this attractor in order for the system of communication to be maintained intact. Thus deviations in the form of logical mistakes can be tolerated, provided the gross ones do not become too widespread, causing a catastrophic pilgrimage within phase space. There seems to be a hint of transcendentalism in the view that only that set of norms could form a stable attractor; on the other hand, it may amount to no more than a deep empirical fact about stability of systems of information transfer.

Whether naturalism can accommodate normativity is one of the deepest challenges to philosophy and cognitive science. As we go scientific about cognition, we can be seduced by imagery of mental cogs, or of agitated cascades of ionic concentrations in neural networks. The imagery is of mechanisms, mechanisms that can misfire. These images can subvert our quest for understanding. We are tempted to think only in terms of contingent cause and effect; and at best in terms of the functional, ever prone to malfunction, or the teleological, prone also to the imperfections of evolutionary design and the sacrifices made in satisficing.

These temptations make us lose sight of one of the most pressing issues in our quest for understanding. That issue is: how does the normativity of human reason sit with the sheer physicality of its substrate? Where, in a world of fallible mechanisms, does the "hardness of the logical must", as Wittgenstein called it, get a look-in? How can a transcendently unaided nature select the nice?

Or might we conclude by adapting Kant at B181 of the *Critique of Pure Reason*?

This schematism of our understanding, in its application to [propositions] and their mere form, is an art concealed in the depths of the human soul, whose real modes of activity nature is hardly likely ever to allow us to discover, and to have open to our gaze.

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## NOTES

- <sup>1</sup> Which I wish here to characterize non-committally, as either theses or rules of inference.
- <sup>2</sup> Namely, the connectives, the quantifiers and the identity predicate.
- <sup>3</sup> See my *Anti-Realism and Logic, Volume 1: Truth as Eternal*, Clarendon Press, Oxford, ch. 25, for a purely logical derivation of the Peano-Dedekind rules for zero, successor and natural number.
- <sup>4</sup> In an as yet unpublished work entitled 'Natural Foundations for Projective Geometry', I show how the incidence operators for three-dimensional projective geometry can be furnished with introduction and elimination rules that fix their meanings.
- <sup>5</sup> In *Natural Logic*, Edinburgh University Press, 1978, ch. 7, I show how virtual set theory can be characterized by introduction and elimination rules for the set abstraction operator within a free logic.
- <sup>6</sup> But space prevents me from doing so here.
- <sup>7</sup> As quoted in Ray Monk, *Ludwig Wittgenstein: The Duty of Genius*, Vintage, London, 1990.
- <sup>8</sup> For a fuller account of the relationship between Carnap and Quine, see my 'Carnap and Quine', forthcoming in W. Salmon (ed.), *Logic, Language and the Structure of Scientific Theories*, American Universities Press.
- <sup>9</sup> *Anti-Realism and Logic, op. cit.*