Logical Empiricism Updated

§1 Logical Empiricism ∓

One may characterize a viable position in the analytic tradition as 'Logical Empiricism ∓'. [1] Logical Empiricism has developed over time. It *can* and *has* embraced holism of justification, against early foundationalist verificationism. It *can* and *has* embraced – at least in some philosophers in that tradition – scientific realism in the form of Structural Realism, therefore the "+" in "Logical Empiricism∓".[2] Empiricism as a theory of scientific knowledge can be separated from theories of meaning inspired by empiricism (like verificationism or operationalism). As theories of meaning verificationism and operationalism have failed both for epistemological reasons (in the failure of ultimate verification in some undeniable 'given') as for semantic reasons (in the failure of complete definitional reductions and verification rules not being compositional). They should not be tied to empiricism, therefore the "–" in "Logical Empiricism∓". Empiricism is compatible with externalistic or atomistic semantics, expressed,

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[1] All labels are problematic because of their historical associations, but taking up an approach and label might be more helpful than inventing ever more idiosyncratic labels. 'Logical Empiricism∓' is the specialization to theoretical philosophy of a broader general attitude of 'scientism' with respect to knowing factual truths – where 'the sciences' are not just the natural sciences, but include methodologically explicit approaches in the social sciences and humanities. This orientation on the sciences, further on, can and should acknowledge the irreducible role of practical philosophy, taken broadly, and the arts. The ideological heritage of (early) Logical Empiricism and some current 'scientism' should be abandoned – as 'unscientific' after all. There is some truth in Curtis White, *The Science Delusion*.
Just talking of the 'Analytic Tradition' or 'Analytic Philosophy' would be more misleading (i) because of the differences between Logical Empiricism and Ordinary Language Philosophy (in the Oxford or Wittgensteinian tradition), (ii) because the 'Analytic Tradition' has developed into branches championing metaphysics – contrary to the foundational ideas of Logical Empiricism – and branches which offer theories which should be offered and tested by the sciences.
Logical Empiricism defines an understanding of philosophy as meta-science. This conception of philosophy should allow for other conceptions of philosophy besides it. They may care for themselves, Logical Empiricists set forth their conception and its proper updates and revisions. Neo-Kantians took exception to most of the detailed claims of Kant's philosophy, but considered themselves Kantians in the spirit of their conception of Kant's methodological self-understanding. In the same vein philosophers today can understand themselves as Logical Empiricists∓ without subscribing to most of the detailed claims of early Logical Empiricism (say, in the Vienna Circle).

[2] Even the differences between Structural Realism in Logical Empiricism∓ and van Fraassen's 'Constructive Empiricism' in *The Scientific Image* and *The Empirical Stance* seem to be minor.

say, in some form of a Davidsonian disquotational theory of truth for some language. Rules of justifying or verifying a (scientific) statement are linked to its semantics, but need not be its meaning. Verificationism *in the broad sense* can be understood as the methodological commitment to have one's theories tied to testable predictions and observation requirements. [3] Operationalism possesses some residual adequacy in that theoretical terms of a theory occur in sentences with observational terms ('observational' relative to that theory) which fulfil the function of 'bridge principles', which tie the theoretical core of a theory to testability. This allows to take some claims of, say, fundamental physics with less ontological commitment than scientific realism.

Logical Empiricism – starting already with Carnap in *Logical Syntax* and *Testability and Meaning* – embraced both a holism of justification and a theory of meaning which reject epistemic foundationalism and meaning constitutive verification rules. Carnap refines in *Testability and Meaning* verifiability towards confirmability, and explicitly embraces holistic theory confirmation and comparison in *Logical Syntax*.[4] Even Quine in his late work (like *The Pursuit of Truth* and *From Stimulus to Science*) can be classified as Logical Empiricist in this sense.

Logical Empiricism distinguishes between the (linguistic) framework of theories and their empirical content. The framework set up (axioms and definitions) is pre-given to empirical exploration and thus *a priori*. This *a priori* is in most parts language relative and, as language can be changed, revisable, seen from a meta-perspective. To be distinguished are truths coming with the language frame set up and true sentences contingent with respect to the frame. The latter are the empirical synthetic sentences. The former are *frame truths* and by their semantic constitutive role also *determine the logical space* of semantic modalities. Given a broad definition of "analytic" as 'following from the axioms and definitions' and the fact that the axioms and definitions follow from themselves the frame truth can be taken as 'analytic', which does not exclude that they contain information about the world.[5] Given a

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[3] Carnap in §27 of *Testability and Meaning* states the 'principle of empiricism' thus: "As empiricists, we require the language of science to be restricted in a certain way; we require that descriptive predicates and hence synthetic sentences are not to be admitted unless they have some connection with possible observation, a connection which has to be characterized in a suitable way."

[4] Cf. *Logical Syntax*, §82. This was way before the appearance of Quine's "Two Dogmas of Empiricism"!

[5] "A fox is an animal" is about foxes, and not 'empty' in any useful sense: it is empty of new information, which means it is not synthetic and contingent, which means it is analytic or definitional, which we knew beforehand! Analytic consequences can extend our subjective understanding. In as much as they refer to the world definitions have to be chosen to stand in no conflict with known

narrow definition of "analytic" as 'following from the axioms and definitions and not being an axiom or definition' the frame constitutive axioms and those definitions which are not just nominal definitions introducing a term to express what could be said otherwise are synthetic, even synthetic *a priori*. Partial Meaning Postulates should be considered synthetic *a priori* in this sense as they embed in the language framework conditional dependencies that are taken to be true, i.e. corresponding to facts (like foxes being animals). That axioms should rather be classified as 'synthetic' should not be surprising as many axioms (already in set theory) involve existence claims. Again, this does not exclude the revisability (i.e. change) of the language framework and axioms.[6]

One may use (with respect to a specific language) the distinctions 'synthetic/analytic' and 'necessary/contingent' and abandon the distinction '*a priori/aposteriori*' altogether. Abandoning the distinction '*a priori/aposteriori*' has the advantage of banning an epistemological distinction in favour of proper semantic distinctions. Empirical sentences are synthetic and contingent. Theorems are analytic and necessary. Axioms and those definitions which are not just nominal definitions are synthetic and necessary. To classify a sentence as 'analytic and contingent', on the other hand, might only be used as a shortform for the meta-language statement that a corresponding definition or axiom could have been otherwise in a modified language framework. If one wants to get rid of the epistemologically loaded distinction '*a priori/aposteriori*' and deems the distinction between nominal definitions, partial definitions and axioms cumbersome, and finds re-categorization of sentences like "All foxes are mammals" as synthetic repugnant, then the fallback position is Carnap's broad use of 'analytic' for all sentences following from the axioms and definitions, including the axioms and (partial) definitions themselves. As this again involves categorizing some existence claims as 'analytic' instead of 'synthetic', and still uses the traditional term "analytic" the best and clearest option is to use Carnap's distinction 'L-determined/not L-

scientific truths, otherwise the frame has to be revised. One quality standard for a framework can be how it restricts the alethic possible by adopting corresponding definitions.

[6] The Axiom of Infinity in ZFC, say, is synthetic in the common and Kantian sense, as it postulates the existence of an object (in fact of infinitely many). The aversion of early Logical Empiricism against synthetic *a priori* principles rests on taken such principles to be unrevisable and as expressing the idea that reason can fix and determine basic structures of reality (paradigmatically taken thus and rejected in Reichenbach's *The Rise of Scientific Philosophy*). Giving up these problematic features of synthetic *a priori* principles and corresponding (Transcendental) Idealisms undercuts the opposition to an otherwise useful notion, which might be supplanted by other notions like 'synthetic and necessary' but signals, at least, the meta-linguistic spot where some such a distinction need to be placed.

determined (a.k.a. contingent)'. "L-determined" was introduced by Carnap in the *Logical Syntax* as 'determined (solely) by logic', but it might better be broadened to 'determined (solely) by language' to include any definitions and axioms (existential or not) of the language framework. We then have the distinction between framework truth of the language framework adopted, such sentences being L-true, and sentences being rejected as false by the language framework adopted, such sentences being L-false, these two groups comprising the L-determined sentences, sentences *determined by language* set up alone. Empirical sentences, being contingently true or false, are the other group, again with two subgroups.[7] 'revisable' is another notion to be employed in meta-language statements – leaving open the possibility that a core of logical and meta-linguistic principles, at least, might be 'unrevisable' for any comprehensive language framework. [8] The role of language building is to come up with a most feasible and comprehensive framework which does not get into conflict with theories empirically developed.

This much is already present in early Logical Empiricism, say, Carnap's *Logical Syntax*; Carnap in the *Logical Syntax* – and later in his semantic work, starting with *Introduction to Semantics* – also admitted *the universal perspective* of constructing languages. From this perspective there may be features present in all comprehensive frameworks, such that these, despite the revisability of individual frameworks, are universally L-true and L-constitutive (or *a priori* in the traditional sense) and will not be revised, apart from our coming to a better understanding of these features. Such features provide the foundation for the broadest sense of alethic possibility. [Carnap himself did not develop an explicit meta-theory which recognizes this.]

With the distinction between framework and theories early Logical Empiricism (say, in Carnap and Reichenbach) takes up Kantian themes. Kant's Transcendental Philosophy distinguishes between the framework (the topic of 'Transcendental Logic') and empirical knowledge. Framework principles and concepts are *a priori*, although we know about them only as we gather experience. Thus, Transcendental Logic is compatible with Logical

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[7] Although this classification is clearest and carries the least luggage from philosophical tradition, a regimented and explicit usage of the other distinctions might be employed and will most times be employed here, as, unfortunately, "L-determined" has not been widely adopted. Labels should not be multiplied.

[8] A 'comprehensive' framework is one in which all thoughts can be expressed (like in a natural language or 'regimented' natural language). Special languages/frameworks for some science or other human endeavour (like art) need not be comprehensive. The concept of framework does not exclude the framework coming with no inference rules but the single axiom "Pop goes the weasel".

Empiricism, as Logical Empiricism – even if not always clearly stated – does not subscribe to a simple empiricism which claims that *all* knowledge is gained by experience (inner and outer senses) *only*. The contrast between epistemological analysis in transcendental philosophy and empiricism is overrated .[9]

Assuming innate components of knowledge – once again a conflict much overrated – is also compatible with empiricism in the sense that empirical theories establish knowledge about what has to be assumed as *a priori* or innate (e.g., in linguistics or in computational cognitive science).[10] What is innate is ontogenetic *a priori*, but phylogenetic acquired (i.e. *aposteriori*), and thus revisable. It can also (e.g. concerning our beliefs formed by interaction with middle sized objects) be suspended by scientific theories. Nonetheless it often secures in the mind/brain and human bodies in general knowledge about the world which need not be acquired by experience.[11]

The age of scientific philosophy started with the distinction between the empirical sciences, dealing with factual discoveries, and the reflection on the foundations of science (i.e. meta-science). The best way to understand and undertake this reflection is as a study of the *linguistic frameworks* of the sciences (their forms of arguments, ontologies, basic vocabularies, and axiomatics). Even after this step philosophy can use the discoveries of science in its arguments and expositions. It has to, as the choice of a (better) framework for a field of study will depend on what we already know about this field. An explication of foundational concepts has to consider their usage and proper and improper application conditions of related expressions and employment of methods. Philosophy involves scientific knowledge in reflective equilibrium of conceptual exposition. What philosophy should not put forth are empirical/factual claims. To discover the facts the sciences explore reality (with all the required training and equipment). Simple factual claims, apart from those about using a linguistic framework, will not follow from the linguistic framework and its development. If philosophers proclaim such contingent truth in the field of a science in question, they are almost certainly overstepping their resources of justification, and may have used a bad argument to derive such claims from meta-scientific considerations. Of course, they can

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9 Already Strawson in *The Bounds of Sense* classifies large parts of Kant's 'Transcendental Analytic' as "a truly empiricist philosophy". Reichenbach's praise and criticism of Kant neglects this because of his crusade against Rationalism and the Synthetic Apriori [see note 6].

10 Cf. Chomsky, *New Horizons in the Study of Language and Mind*, esp. chapter 3.

11 Cf. Plotkin, *Darwin Machines and the Nature of Knowledge*; cf. Kornblith, *Scientific Epistemology.*

report any claim established by the sciences, but to derive factual claims from the proverbial armchair, which then turn out to be just wrong or at least questionable, has given philosophy a bad name in some quarters.

A particular source of error can the formulation of a comprehensive philosophical system, which covers several or even all areas of inquiry. The architectonic of the system may invite the philosopher to transfer principles and structures from one realm to the other, postulating on this way elements and facts which owe their existence only to the image imposed by the structures of the system.[12] The amount of effort to make such a system fit reality or the state of the sciences should be a warning sign of philosophical overreach.

A methodology of building language frameworks presupposes – as a kind of 'first philosophy' – a core theory of the main concepts of a theory of language inasmuch as these as these are relevant for the methodology (involving, e.g., 'meaning' 'derivation', 'denote', 'wellformedness' etc.). This theory is the *remainder* of the philosophy of language. Most of the traditional topics of philosophy of language are now dealt with in linguistics. The general core theory of language deals both with formal/artificial and natural languages. Its claims with respect to natural language should be consilient with linguistics, which it does not compete with. It differs also from the philosophy of linguistics, which is one of the branches of specialized philosophy of science on a par with the philosophy of biology and so on. The general theory sets up the methods of philosophy. As philosophy itself it has self-referential features.

The general philosophy of science deals with core concepts present in each specialized branch of philosophy of science (like 'theory' or 'confirmation'). It is meta-scientific and not history or sociology of science. Its most basic concepts and their clarification comprise a *remainder* of (traditional) epistemology (concepts like 'justification', 'evidence', 'coherence' etc.). Clarification of these concepts is continuous to general philosophy of science on the one hand and the core theory of language on the other hand. Most of traditional epistemology is today dealt with in the cognitive sciences.

The combination of a core general theory of language (remnant of the philosophy of language), a core theory of justification (remnant of philosophical epistemology), and the general philosophy of science constitute (what remains of) a 'first philosophy'. What they say

[12] Which might be a more fitting criticism of many features of Kant's theoretical philosophy.

should be consilient with the empirical sciences, which they do not compete with. Therefore – as metaphysics in the traditional sense is handed to the sciences completely – theoretical philosophy has very limited content with respect to the constitution of the world. This is an echo of the old claim of Logical Empiricism that philosophy does not put forth (factual, non meta-scientific) thesis in the way the empirical sciences do.

§2 Structures and Ontological Relativity

Science concerns itself with developing theories to explain and predict *patterns* encountered in experienced reality. Regular patterns supporting counterfactual dependencies are captured in laws expressing dependencies between parameters.

Underlying these patterns are *structures*. They are as real as the patterns are, thus: Structural Realism. Structures are identified functionally, i.e. because of their functional role in patterns. Scientific progress consists in finding more (more detailed) patterns and structures, and finding out more with respect to the already known structures.

The Theory of Relativity and Quantum Mechanics originated at a time when Logical Empiricism and some version of its verificationism and/or operationalism were the accepted view of treating scientific theories. Some theorists themselves expressed their approach in this fashion. Taking some of their claims – especially those couched in terms of expressions borrowed from ordinary language – at face value in a realist spirit they sound strange or outrageous. In the light of a logical empiricist re-construction (like Reichenbach's *The Philosophy of Space and Time*) these claims are the result of respective *conventions* of coordinate definitions or operationalizations of re-defined concepts (say, of 'time' or 'distinct object'). From a Logical Empiricist perspective, we have here axiomatic theories with postulates and definitions which in total account for the observations and are successful in predictions. In their success they have captured some structures and laws of reality. Their general statements about *these* (say, about uncertainty or the existence of entanglement) can be taken literally, the detailed statements involved in calculating predictions and giving explanations might be taken with a pinch of salt as there might be empirically equivalent theories with different calculating devices. These devices (like detailed mathematical theories and models) share their empirical content. We might prefer some theory on meta-theoretical principles (like simplicity or connectedness to other theories), but there seems little benefit in committing oneself to such a *fine-grained* ontology in a realist spirit.

By observational regularities we can fix reference to the structures underlying these regularities. Theory succession substitutes formerly assumed laws about these structures with reformulated laws with respect to the same structures, preserving referential continuity, and thus expressing advancements in theoretical understanding. This may involve changing the detailed ontology (and mathematics) involved in the theoretical apparatus and its explanations and predictions. Referential continuity in structures may come with discontinuity of detailed object ontology (i.e., of the sort of posited items *realizing* the structures).

Structural Realism allows for Ontological Relativity in objects and other ontological categories, not allowing, however, for Structural Relativity in the sense of a general instrumentalism or constructivism with respect to scientific theories. Structural Realism still endorses the argument of Scientific Realism that the best explanation of the success of science rests in its approximate truth with respect to the structures of reality. Structural Realism contracts the realist stance to structures. This fits better to the *functionalist* understanding of theory development and the *plurality* of fine-grained theoretical modelling.

Objects are *derivatively* modelled as the relata of these structures. One can still talk about the same structure – and patterns – although the modelling of the objects has changed. Structures inasmuch as identified functionally have a hidden nature only insofar as more can be learned about them. Objects as introduced as the items related in a structure are not introduced as substances with a hidden nature.[13]

As reality and the models of it come in scales objects of one level may be the structures of a more fundamental level. As reality and theories come in scales ontologies of these theories and levels of reality come relative to theories and levels. As much as these theories are successful and our best theories there is no need for a unified grand ontology of science beyond (i) the occasional reduction between theories, and (ii) the coherence/consilience between our best theories. All cover reality and its structures and (experiential) patterns. Their ontologies are devices to discern certain relevant aspect of these structures in light of the scale or scientific discipline in question.

A *theory* comes with an ontology. Ontologies are relative to theories and kinds of sciences (like sociology or biology). The *language* a theory is expressed in also comes with an

[13] Cf. Ladyman and Ross, *Every Thing Must Go.*

ontology: a formal ontology resting in the *types* of syntactic phrases and variables. The most general ontology of this sort in First Order Logic with no further specified variables. First Order Logic can express any ontology as *predicates* can be introduced for *types* of entities (ranging from general types like 'proposition' to specific ones like 'unicorn').[14] A theory accepts a type of these entities if it existentially quantifies over variables in parameter places of corresponding predicates. So far Quine's famous slogan (most conspicuously developed in *Set Theory and Its Logic*) is quite appropriate. Whether to quantify in such a way is a theoretical and empirical question of respective theories. A linguistic framework (like Second Order Logic or a language of typed/sorted quantifiers or a Free Logic with different types of quantifiers with different ontological impact) can also already come with further ontological commitments beyond the mere presence of variables to be bound. Accepting such a linguistic framework then is a theoretical question itself, one of a background fundamental theoretical outlook above the more specific theories expressed within that language – against the pragmatist conventionalism Carnap proposes on many occasions (most famously in "Empirism, Semantics, and Ontology"). That linguistic frameworks are in most parts conventional is part of Logical Empiricism, but that conventions are beyond theoretical arguments for their adoption need not be.

The most congenial abstract metaphysics fitting Structural Realism is *Neutral Monism*: the basic items/events of the world are neither physical or mental or whatnot in themselves, but can be described as realizing structures described in terms of physics or psychology.[15] Neutral Monism need not commit itself to a metaphysics of item/event *constitution* for the basic type of neutral items/events. Neutral Monism identifies properties as dispositions and generally states that they are founded (somehow) in the nature of the ultimate items/events, the constitution of which in detail is beyond our ken – thus every claim thereof beyond some *general* idea of 'tropes' or 'universals *ante rem*' is metaphysics. This comes close to a nominalist understanding of predicate application, an understanding congenial to the constructive approach to building linguistic frameworks. This property theory is structurally realist inasmuch as it refers to the founding nature of the ultimate items/events, and talks not

[14] By a theorem of Alan Turing standard First Order Logic is as universal as Turing Machines, in the sense of being able to express any explicit/computable semantics or ontology, thus we can make use of the *Church Turing Thesis* or *Hilbert's Thesis* (in mathematics) to express any ontology in First Order Logic.

[15] This was championed by some Logical Empiricists sometimes (say, Russell in his *An Outline of Philosophy*) and rejected by others (say, the physicalism of the Vienna Circle, cf. Carnap, "Die physikalischc Sprache als Einheitssprache der Wissenschaft").

just about predicate application but (real) properties themselves. This property theory is anti-realistic inasmuch as it does not engage in property metaphysics. Neutral Monism is non-reductive with respect to psychology and avoids dualism at the same time. Types of behaviour should not be taken as introducing types of substances, which will for Structural Realists and Neutral Monist forever beyond our ken.[16] As Neutral Monism does *not* state that physical items/events are basic – neither are mental items/events – it need not concern itself with physical-psychological laws to explain the mere presence of the psychological. There may well be discoverable physical-psychological laws as established *correlations* of behaviour, but they are not in themselves reductive or explanatory. For Neutral Monism to speak of 'physical' objects or events is short for 'carriers of structures described according to the laws of physics'. The same holds for psychological events. The same events might realize physical and psychological structures, whether they are *the same* we have difficulty to say because (i) we cannot further access their constitution (i.e. beyond their behaviour), (ii) we may lack a reduction of (some) psychological properties.[17]

With respect to one and the same structure different models of this structure (including a carving up into related items) may be developed. Thus, there can be *Ontological Relativity* with respect to these models. Some models may be discarded because of meta-structural reasons like simplicity and consilience with other models of other structures. Some ontologies fare – *prima facie* – equally well with respect to these criteria. If that happens, we have a case of scientifically acceptable ontological relativity. For a realist with respect to structures this relativity is not as dramatic or anti-realistic as for a realist with a foundation in objects.

The general possibility of ontological relativity does not deliver interesting cases by itself. In mathematics, say number theory, Zermelo's conception of the ordinals and von Neumann's differ set theoretically, but are isomorphic, thus spelling out the same structure. For such a logicist or at least set theoretical foundation of mathematics the question "What are numbers

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16 In this way Neutral Monism accompanied by Structural Realism regains or preserves the idea of (metaphysical) pseudo-problems in philosophy, although not the letter of Carnap's *Scheinprobleme in der Philosophie*.

17 Thus, Neutral Monism disagrees in part with Davidson's Anomalous Monism (cf. Davidson "Mental Events") in rejecting the claim that the ultimate constituents or reality are all and firstly physical. It also disagrees with Nagel's present day Neutral Monism (in his *Mind and Cosmos*) as it (i) comes close to panpsychism, which is constitutional metaphysics, (ii) stresses the urgency of physical-psychological laws, and (iii) confuses the epistemological irreducibility of the 1st person perspective with a semantic shortcoming of a 3rd person world description.

really?" seems otiose. There might be more interesting empirically equivalent ontologically distinguishable theories in the empirical sciences. Also in empirical sciences, however, piped up syntactical variants that just add something to an accepted theory (as often invoked by Quine as arguments for ontological relativity) can be rejected for reasons of simplicity or by requiring that the traditional trajectory of theory successors should not be left without good reason, which in these cases seems obviously missing.

The actual scope of ontological relativity in the sciences can be made out only by detailed analyses of supposed examples and the history of science.[18]

§3 Against Metaphysics, Again

Philosophical conceptual analysis can degenerate into so-called 'intuition mongering': a style of argumentation in which some states of affairs are propounded as 'metaphysically' or conceptual possible, whereas other truths or links between states are propounded as conceptual or *a priori*, on idiosyncratic assessments of intuitions. Done this way, it is not an argumentation with clear standards of quality or empirical (sociolinguistic) backup. What we have here – at best – are proposals for word use and definitions of word meanings or concepts. There are *no* truths about metaphysical modalities to be discovered, all depends on definitions one may endorse or reject. Such proposals of definitions are essential for science, but should be announced and methodologically reflected as being such proposals about linguistic frameworks. Their force derives from both the linguistic support of talking thus as well as from their fruitfulness in describing phenomena, putting them into an explanatory structure of a theory that employs the concepts as so defined.

Because of this connection to theories in the sciences conceptual analysis should be considered as part of the framework building in sciences. Isolated from this embedding it might be difficult to articulate clear quality standards apart from the logical coherence of the proposed definitions and usage. In some fields where we lack developed scientific theories one should at least aim at reflective equilibrium of prior intuitions (personal ones or taken up from tradition), statements of (uncontroversial) facts, and phenomenological descriptions (especially in the philosophy of mind). In these cases philosophy aims at a coherent

[18] Cf. Laudan's explorations in "Demystifying Underdetermination" and "A Confutation of Convergent Realism".

framework of best capturing the area (semantic field) in question. In natural languages and folklore there are established forms of usage and definitions, but – at best – only with respect to some few fundamental (i.e. *a priori* or innate) concepts might we find genuine conceptual discoveries apart from the empirical sciences.

Like sentences knowledge can be analytic or synthetic knowledge. Knowledge of L-true sentences can be gained *a priori*, nonetheless it might be subjectively surprising. Although our framework already contained the content of the L-true sentences, we can subjectively learn about it. Thus, analytic knowledge is no deficient mode of knowledge. Debates about frameworks are also debates about what should be considered L-true – or analytic and synthetic *a priori* [cf. §1]. Synthetic *aposteriori* knowledge and belief stems from experience. Minimally empiricism claims that all *aposteriori* belief and knowledge stems from perceptual experience, and that all a priori knowledge grounds in frame constitutive postulates.

The distinction between *a priori* – and thus in the framework used unrevisable – and *aposteriori* sentences is a *synchronic* distinction. Terms can be re-defined if a definition turned out to be useless or in conflict with empirical results. Definitions should *track* some fundamental constituent properties of the property (term) defined or put in analytic links to other properties (property terms). This spans a net of analytic sentences, a net of semantic necessity stronger than the lawlike connections discovered within empirical theories. Semantic necessity in this way *follows* natural necessity, and *suspends* some connections between properties from revision, *for the time being* of the success of this linguistic framework.[19]

For Logical Empiricism there is *no* further 'metaphysical necessity' beyond or besides this.

Whether some definitions are so fundamental that they can never be successfully re-defined constitutes a question of traditionally called 'Transcendental Philosophy', difficult to settle. Meta-linguistic and logical concepts may belong in this realm.[20] In any case, defined concepts of a specific science can be discarded or re-defined in the light of better theories. Diachronically what was *aposteriori* can be made *a priori*, or vice versa – improperly

[19] This answers to the proper concern and partial truth of Quine's criticism in Quine, "Truth by Convention" and "Carnap and Logical Truth".

[20] For a recent analytic approach towards a (partially) formalized and explicit transcendental philosophy of meta-linguistic knowledge cf. the two volumes of Vanderveken, *Meaning and Speech Acts*. Acknowledging the role of force markers and formal pragmatics beyond formal semantics is also compatible with Logical Empiricism. Formal Pragmatics arrived too late on the scene to be considered by early Logical Empiricism.

speaking as by this the language itself has been changed. In this (limited) sense proper definitions are *discovered*, all this being compatible with the presence of conventions and a distinction between language and theory.

§4 *Meta-Framework Reasoning and Universal Logic*

Building language frameworks and comparing their merits requires a meta-framework able to express the meta-linguistic, meta-logic and meta-semantic concepts needed. Modalities are introduced and discussed in this meta-framework. Ideally the meta-framework should be applicable to all kinds of language frames. Elucidating natural languages, then, leads to the issue of a universal meta-framework able to express even *its own* features and meta-theory. This can be discussed as the question of a Transcendental or Universal Logic. As the principles of language and meta-theory should be feasible for human reasoning they most likely should be computable. Universal Logic approaches, therefore, have to face the question how their elucidation of universal logic relates to universal computability. Universal Logic – it seems – tries to capture all logical reasoning. Universal computation captures all computable algorithms. So, should they coincide?

The first – and short – answer is that the question might rest on an ambiguity in 'universal': universal computation is universal in the sense of comprehensively *capturing all* intuitively algorithmic ('computable') procedures; Universal Logic is universal in the sense of being *applicable in all contexts*, where not every context has to involve the full force of classical logic, on pains of paradox and triviality (making all sentences derivable).

So, even if FOL is tied to universal computation that does not imply that Universal Logic is tied to FOL. So, Universal Logic (in the sense of a paradigm meta-framework) and universal computation need not coincide.

The second – and longer – answer looks closer at the ideas behind the *Church Turing Thesis*, a crucial theorem by Turing, and how all this does not show that some strong Universal Logic programme is in conflict with the *Church Turing Thesis*.

The *Church Turing Thesis* (CTT) can be expressed in different ways, for example:

> *Church Turing Thesis*
> Everything that is computable is computable by a Turing Machine.

The *Church Turing Thesis* is generally seen as outlining an upper limit on computability. Nothing seems to be computable that is not TM-computable. Seen from a naive point of view the existence of super-computability would falsify (CTT). But (CTT) involves a precise and definite notion of an effective procedure (an *algorithm*) and a corresponding concept of computability: (CTT) identifies the *intuitive* notion of computability with a *formally explicated* notion (being computable by a TM). The cornerstone of this is the idea of an *algorithm* on *discrete* symbols, executing steps each of which is mindless, where each (sub-)computation ends after finitely many steps (if defined at all), and is implementable by different devices. [21] Given (CTT), the arithmetization of formal languages and

Montague's Thesis

Natural languages are equivalent to some interpreted formal languages.[22]

we get a version of the *computational theory of mind* with respect to processing language, which is relevant to meta-framework reasoning.

In his classical paper[23] on computing machines Turing constructively proves two sides of an equivalence

(i) If a TM M accepts some input α, there is a FOL axiomatized theory T of the machine table of M such that $\vdash_T \alpha$ (for all and only the accepted input α).

(ii) If there is a FOL axiomatized theory T such that $\vdash_T \alpha$, there is some TM M which accepts α (for all and only the derivable theorems α).

The first part means in the light of CTT

(i) Everything that is intuitively computable can be captured by a derivation in FOL theory.

The second part means in the light of CTT

(ii) Every derivation of a FOL theory is intuitively computable.

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[21] There are machine models that are beyond the power of the (universal) Turing machine, e.g. *Coupled Turing Machines* or Copeland's *Accumulator Machines*, but they do not have finite input, so *are beyond* what is intuitively computable. These machines are notional machines only. Cf. Burgin, *Super-Recursive Algorithms*; Copeland (Ed.), *Hypercomputation*; Siegelmann, *Beyond the Turing Limit*.

[22] Cf. Montague, *Formal Philosophy.* This extends to semantics what has been called *Chomsky's Thesis*: Natural languages are equivalent to some formal language.

[23] Turing, "On Computable Numbers, with an Application to the Entscheidungsproblem"..

So, TMs and FOL (theories) are computationally equivalent. This is the backbone of the idea and claim that everything logical (in the narrow sense of being algorithmically computable) can be captured by FOL. In that sense FOL is the universal logic. Another thesis, *Hilbert's Thesis*, therefore claims that any cogent reasoning anywhere in mathematics can be given a FOL rendering. So, FOL *can* be used universally – but should it?

In cases of semantic closure and self-reference by identifying object and meta-language FOL yields both paradoxes and (by *ex falso quodlibet*) triviality of the meta-theory.[24] In the reasoning concerning the Liar

(λ) λ is not true.

we make use of intuitive principles of semantic self-ascription, the intuitive *Convention T* (Tarski's scheme for "true") and FOL reasoning to derive at "$\lambda \equiv \neg \lambda$" and "$\lambda \wedge \neg \lambda$".

Intuitively valid reasoning leads to the contradiction. By CTT it can be completely rendered in FOL. FOL – and computationally equivalent systems like Lambda Calculus – are consistent in their bare form, not if one *adds* axioms which are inconsistent (like those leading to λ). The Liar reasoning can be formalized in FOL, but is, of course, explosive in FOL (leading to a trivial, all sentences encompassing theory). What is intuitively computable is computable by some formal system S. S need not be *full* FOL to justify the idea behind the reflection on closure given the Gödel sentences (and taking them to be *provable contradictions* in that *universally closed* system S). So, system S will be computable, and the paradoxical arguments do not contradict CTT.

It is possible to have a FOL (classical) meta-theory for any universal logic – but the aspiration of a truly universal logic, of course, must be to be able to express *its own meta-theory*. By *Tarski's Theorem* a FOL theory cannot (without trivialization) contain its own semantics, whereas some paraconsistent logics can formalize semantic closure. So, our universal meta-frame, being its own meta-frame and semantically closed, should be couched in some paraconsistent logic. This looks, *prima facie,* like a massive deviation from the logical work of the early Logical Empiricists. Again, there is no deviation from the spirit of Logical Empiricism, as the very point of this move to paraconsistency is to enlarge the

[24] Cf. Priest, *In Contradiction* for a wider reflection of these issues (including the problem of meta-language hierarchies, set theoretical universality and the accommodation of Gödel's *Incompleteness Theorems* in a universal meta-language). Cf. Bremer, *An Introduction to Paraconsistent Logics* on systems, including system able to be a Universal Logic.

logician's tool box and to extend formal treatment to areas of philosophy – namely universal meta-reasoning – that were opaque beforehand. Universal Logic structures the field of language framework building. Following an approach of this type Logical Empiricism captures its own meta-reasoning and bans appeals to needed intuitions, pragmatic decisions without argument – or whatnot.

§5 Computational Analysis

Slightly later, but almost in parallel to Logical Empiricism the theory of computability developed. It immediately expanded the methods of meta-logic. Computational modelling also allows for a form of more fine-grained analysis. Programs and data structures can be employed for models that simulate or emulate, say, cognitive faculties. Given the equivalence of First Order Logic and Turing Machine Computability [cf. §4] these analyses can be translated into each other.

Computational modelling, however, provides a further quality standard of analysis. With respect to a calculus (say, of epistemic modality) correctness and completeness proofs vindicate the axiomatic approach. With respect to a computational model one can further on test it on examples and in the light of the relation between predicted output and valid or analytically acceptable output. This has been captured in the slogan:

(C) Implementation provides a higher methodological standard than formalization.

Elucidating a concept (in the spirit of Logical Empiricism) thus can proceed – often preferably should do so – by computational modelling.

With the advancement of – nowadays called 'traditional' – Artificial Intelligence (AI) in the 1970s another slogan has been coined: "AI is philosophy."[25] Logical Empiricism was close to the gestation of AI (with the work of von Neumann and Turing) and the Dartmouth and Macy Conferences.[26] The integration of AI into Cognitive Science integrated as well analysis of epistemologically relevant concepts at least in the tradition – if not the letter – of Logical

[25] Cf. for instance: Cummins & Pollock (Eds.) *Philosophy and AI*; Bynum & Moor (Eds.) *The Digital Phoenix. How Computers are Changing Philosophy*. What nowadays mainly is called "AI" is mostly 'Machine Learning', which has little to do with analysis or intelligence – or learning in any non-associative sense either.

[26] Cf. Dyson, *Turing's Cathedral*; Dupuy, *The Mechanization of the Mind.*

Empiricist conceptual elucidation.[27] The connection is obvious in the field of Logic Programming.[28]

[27] One may see examples in early paradigmatic work like Winograd's Procedural Semantics (cf. Winograd, "Towards a procedural understanding of semantics") or Newell's General Problem Solver (cf. Newell, *Unified Theories of Cognition*), and more recent work like Thagard's *Computational Philosophy of Science* and Pollock's *Cognitive Carpentry.*

[28] Cf. the analytic claims of one of the founding fathers of Logic Programming: Kowalski, *Computational Logic and Human Thinking*; on foundations cf. Fitting, *Computability Theory, Semantics and Logic Programming*. A recent philosophical application with respect to belief revision is Tennant, *Changes of Mind*.