Critical Foundations

of the

Contextual Philosophy of Mind

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Wie fremde sprache nicht kennt,
weis nicht von seine einigen.
[Without acquaintance with foreign tongues,
one knows nothing of one's own.]

Wolfgang von Goethe

INTRODUCTION

The burden of my argument is the simple claim that *mind serves to contextualize life*. The contextualizing mind is evidently exceedingly ancient presence in human history. Placement in sacred architecture and the siting of dwellings are treated in the ancient Indian *Vaastu* (Arya, 2000) and Chinese *Feng Shui* (Duane, 1997), respectively. The teaching of the Buddha called psychological situates perception in the relation of subject and object, and in this kind of spirit one should not expect *Vaastu* and *Feng Shui* to address the material environment in a mundane sense, rather the perceived or lived environment, and this in the context of the culture and its traditions. Contextual philosophy can then be expected to arise in reflection on such primordial intuitions, This is much what we see in the *Epic of Gilgamesh*, a saga of reawakening though a return from the city to the country-side.

Contextual reflection is attested in the distinction between *root* and *complement* in grammar: in the paradigm case of verbal roots, this gives just activity and its context. Taking the activity as a medical intervention, one has attention to the patient's response as *complementary*, whence

what is called *complementary medicine.* This complex discourse addresses the organic and personal response to disease and intervention, bearing on nutrition, health education, environmental medicine and nursing. Both Plato and Aristotle contested the medical terrain, but the semantic trail leads rather through the Stoic tradition, whence Kant had the essentials of his logic (Hanna, 2004).

Aristotle used the *logical complement* in his *Prior Analytics* (1.19-22) specifically in analyzing how the *modalities* of necessity and possibility affect the figures of syllogism. He also spoke in *On Generation and Corruption* of the complement in a physical sense with reference to the cycle of the elements and the polarities hot/cold and wet/dry, and in the *Physics* of related difficulties in understanding the complement and the continuum. But the formal analogy is not developed in what we have of Aristotle's writing, and the difficulties in these text reach to questions of translation from ancient Greek, so this is an area requiring intensive and specialist study. Here there remains the theme of analogy as a way with the complexities of ontology, which we encounter below in Kant (1.2).

Aristotle's teaching on logic focused in the main on the forms of statement arranged in syllogisms, and in what is called the Traditional Square of Opposition. The logical complement then appears in modern logic only *after* Kant, in the algebra of Boole, and strictly applies to what are called *abstracts*: formulas by which one can define classes (Quine, 1972; 239). The logic that results runs easily to paradox, which tradition accommodated in dialectic. Asking what else Aristotle excluded from his doctrine of the syllogism, we come again to abstracts, for Aristotle was evidently not interested in a theory of classes, taking the view that it is primarily the individual thing that exists.

In this spirit, Aristotle admitted species only through essences given by definitions, and hence as ideas in a weakly Platonic sense. On this note we find him in the *Metaphysics* (1.5) setting aside both 'so-called Pythagoreans,' and the 'so-called genera' which actually give workable *local contexts* for handling the complement! Modern philosophy has preferred to avoid these difficulties, following Aristotle in relying on ultimate individuals in the form of familiar individuals, atoms, or elements of sensation, but this leaves awkwardly unplaced universals like momentum and force on which so much turns in natural science. In explicit form and modern language this problem can be traced from the work of Francis Bacon, who wished to retrieve all that was found useful in human experience for the advancement of learning, in service of discovery.

Bacon presented his work against a backdrop of tradition variously described as antiquarian, Freemason or Rosicrucian, but in any case palpably reaching into an antiquity greater than Europe's. With an approach properly suited to this burden, *this exercise serves to elucidate the philosophical significance of Kant's dedication of his Critique to Bacon*, and comes in this way to address, with unusual clarity, the difficulty of any approach to knowledge that can properly be called universal. Note that such modesty is specifically required in any quest for

the contextualising mind, so we have here a new venture in critical philosophy.

1 EPISTEMOLOGY

1.1 A False Start. Francis Bacon has long been thought of as the original proponent of induction in science, a position decisively refuted by David Hume (1739). A new study by Howard Jones (1989) shows that Bacon's early position accompanied an enthusiasm for the atomism of Leucippus and Democritus, from which Bacon retreated into a more skeptical reserve, so that his later claims finished knowledge are notably modest. He distinguished between "particular and special habits of nature" and "her fundamental and universal laws which constitute forms," (*Novum Organum*, Aphorisms II, v), yet in establishing this distinction he warned that, "I have no entire or universal theory to propound. For it does not seem that the time is come for such an attempt," (*Loc. cit.*, I, cxvi). His reviews of tradition covered in the main what Ryle (1949) called *knowing how*, techniques found serviceable in specific crafts.

Kant dedicated his *Critique of Pure Reason* to Bacon, and then revised it. New in the second edition is a specific focus on *objective knowledge*, presented in the form Ryle (1949) posed as *knowing that*. This Hume never addressed: as Annet Baier (1991: 3) puts it, "Despite many references to other persons, and occasional rhetorical appeals to the reader to confirm the first-person singular findings, no appeals were made at any point to any pooling of data or to any really cooperative procedures for error detection or error correction." In this respect Hume had not refuted Bacon, but his skepticism was directed at the *possibility* of knowledge, and not any claims for scientific method.

1.2 Kant's Strategy. It remains doubtful whether Kant was successful in replying to Hume's skepticism (Steinhoff, 1989), but there is reason to think that this was not Kant's priority, although the most direct evidence is masked in translation. Kant concluded his *Critique of Pure Reason* with a doctrine of method, in which he addressed the problem of people seeking respectability or the appearance of goodness, rather than goodness itself. Addressing Prietly, a figure of little note in philosophy, he then brings his challenge to a head, on the point rendered by J.D.M. Meiklejohn in his edition of 1854 as *conventionalism*, but obscured by the scholarly Norman Kemp Smith (A748/B776) as mere *duplicity*. The older term addresses the tradition upheld by Hobbes, Lock and Hume alike (Green, 2003, Wilson, 2008), identifying law with the will of the sovereign, and it is clear that Kant's concern to refute this interpretation well preceded what is called the critical period of his philosophy (Kain 1998).

Here is a new view of the continuity in Kant's thought, through a *juridical* line of argument, which is abstract enough to have application both to natural and social law. In the current context, this speaks to the ancient traditions of Egypt and Babylon, mediating between Asia and

Europe, and is interestingly consistent with the Stoic root of Kant's logic. In the distinction between law and will Kant found a plausible analogy distinguishing the *right* to exclude others from one's property from the *value* of the possession itself (Moggach, 1998). This reading clarifies *Kant's way with analogies*, showing that they serve him on the ground called ontological, without requiring an explicit ontological foundation.

In relation to Hume, it is fair to say that Kant accepted the common view that thought is in its broadest characterization an associative process, but examined rather more closely what this entails. Kant's analogies then show how associations can flow between diverse areas of thought. If he didn't take the formal step to analyzing conditions of possible association to match his relentless analysis of conditions of possible experience, it is clear enough that Kant was not interested in psychological investigations, for he thought very little could come of them (Brook, 2004: 3.1; see 3.5 below).

Here it is important to realize that Kant's remarks had reference to psychology as rediscovered for the modern world by the reforming theologian Melanchthon (Sahakian, 1975: 27), envisaged as a 'science of the soul' serving as an adjunct to theology . Such endeavors Kant set aside with the ontological argument in theology, but they return to haunt us through the likes of Heidegger and Gadamer. Importantly, Kant's reserve does not apply to the Arabic psychology, or the work of Hypatia before them, marked by the invention known as the *psychrometer*.

1.3 Operationalism. Accepting Kant's agenda for philosophy and none of his conclusions was C.S. Peirce in the US, following Fichte in taking not pure but practical reason as his foundation. His term *pragmatism* was then appropriated by William James, and for a succession one must look elsewhere. The physicist Henri Poincaré argued that by acting in space and observing movement, the subject constructs a *group of displacements* which then provides the mathematical form in which questions of distance and velocity can be judged (Piaget, 1946: 539). Importantly, Poincaré gave the first formal analysis of what Bacon assumed in his concept of *scientia operativa*, after which P.W. Bridgman (1927, 1945) could speak of an *operationalist* philosophy of science.

Ludwig Wittgenstein (1958) came to view mathematics as procedure, for a kind of abstract operationalism. Specifically, he took mathematics to be a language of pure syntax, and the operationalist implications are then felt in the theory of mind where calculations (Putnam, 1960), or operations over propositional representations (Churchland, 1981), are taken as the general form of procedure in the mind. Wittgenstein is further significant here for insisting that mathematics is a human *invention*, so that Bacon's hesitant approach to universal laws through form (Klein, 2003) falls away. Under Wittgenstein's considerable influence, well predating his books, form collapses into content, and mathematics into science, so that Quine (1953; 1960) could argue that the whole apparatus faces the test of experience, and Kant's distinction between analytic and synthetic judgments must be abandoned.

1.4 The Parting of the Ways. This is not an outcome acceptable to most mathematicians, but it is surely significant here that Kant himself made some non-trivial concessions in this direction. Thus us conjectured that the concept of number could be learned from the intuition of time, and in a consistent spirit, refused all argument with infinities. This position is variously known as intuitionist, finitary or constructive, and has been fashioned into a regular program in mathematics by L.E.J. Brouwer. Yet Kant's intuition of number is strictly an *ordinal* concept, and does not rise to the conception of measure and measurable quantities, which he thought of fundamental significance in natural science.

By convention we speak here of *natural numbers*, which may now be set aside more explicitly as *counting numbers*, regarded at best as sustaining indexing system. In the matter of learning, Jean Piaget (1957) showed in a life-time of experimental work on human cognition that notions of classification and order appear early in development, in the foundation he called sensory-motor, which can reasonably be taken to be native to the functioning of our anatomy (Piaget, 1946; 1967). Yet the concept of measurable quantity he placed as a considerable further attainment, reached only where tradition has the age of reason, at around seven years (Piaget, 1968).

Piaget (1968, 1970) was properly aware of Kant's stature and influence, and specifically interested in his influence on Einstein and Poincaré, but to follow his reading hear is a matter for another occasion. Here it is rather Freud's (1924) response to Kant which is of interest, for he claimed a developmental account of the attainment Kant had as the Categorical Imperative, which is to say, a conceptions of persons as equally and intrinsically worthy. Formally, Freud's account turns on an identity bound under a gender type, which can perhaps serve to found the more abstract concept of a 'one' or 'unit' whereby natural number can be refined into measure! Yet the familiar sense of being 'one of the boys' does not in fact rise to Kant's quite impartial schema of judgment! This surely asks for a properly critical examination of Freud's legacy.

2 CRITIQUE OF LEARNING THEORIES

2.1 The Two-Tier Psyche. Freud came to psychology from neurological research, having investigated the potential for what are called 'nerve-net' models of the brain, and found them capable of demonstrating only aversive learning (Freud, 1850 [1895]). Accordingly, he came to see the psyche averse to the disruptions of need, and hence intrinsically motivated to seek a state of quiescence, following what he called the 'pleasure principle'. Where tradition spoke of the attainment of reason, he allowed a distinct 'reality principle,' which also served as the vantage-point for Freud's own reflections on the psyche. Yet he assumed here nothing more than Piaget's sensory-motor capacity, with a dynamic of identification, whence the 'unit' of the person.

The plausibility of his position was recognized by neurologist Karl Pribram (1954), and as the paradigm learning theory was established at Yale, John Dollard and Neal E. Miller dedicated their two applied texts respectively to Clark L. Hull and William F. Ogburn, and to Pavlov and Freud (Sahakain, 1975: 328). On the research front, O.H. Mowrer (1947), in the same spirit, set out to validate a 'two-tier' model, incorporating the classical or associative conditioning of Pavlov, and the operant or instrumental conditioning of Skinner. Yet a decade later, defeated by experiment, Mowrer (1956) retreated to a 'one-factor' model, confirming the impression Freud recorded in 1895. This Pribram (1954) rationalized in a 'drive reduction' account of the mid-brain.

2.2. Replicating the Crisis. 'Nerve-net' research is now typically traced to McCulloch and Pitts (1943), although Grodzinsky (2002) usefully recalls an 'older connectionism,' rooted in the classic studies in cerebral localization, which we come to shortly (2.3-4). Freud (1891), it is true, reacted against this trend in favor of an holistic view of mental processes, combined with a representational theory of mind, which current connectionism prefers to avoid. Yet the awkward conclusions sketched above have merely been reproduced, so the impasse remains.

There is a specific difficulty with altering *the dimensions in which a problem is stated* (Clark & Karmiloff-Smith, 1993; Karmiloff-Smith & Clark, 1993). It follows that behavior is either directly governed by habit, or must seek recourse to prior experience in some related situation (Clark & Thornton, 1987). In a philosophical perspective, one can say simply that *modern psychology has reproduced Hume's skeptical empiricism*. True to form, Peter Machamer & J. E. McGuire (2009) now wish to present a development in Descartes, leading precisely through skepticism to empiricism.

Here is the ground for Chomsky's well-known critique of Skinner's behaviorism: as Cark and Thornton (1987) found, nerve-net models failed specifically on the linguistic features for which Chomsky (1956) proposed transformational grammar. For Dennet (1991), habituation is the baseline capacity defining animal evolution, while the human advantage depends on language functioning as a repository of past experience, but *the capacity for learning assumed apparently cannot explain language itself*. In the philosophical perspective it is surely significant that Dennet (1993) justified his conclusion in terms unmistakably *nominalist*, reverting to the position of Thomas Hobbes, anticipating physicalism and behaviorism.

2.3 Jakobson's Functions. Yet there remains *the dimension of time* in which applicable experience is sought. Children can readily grasp new dimensions of language, i.e. new classes of words with distinct grammatical functions, provided they are introduced *one at a time* in a graded series of exercises (Ellman, 1991). This is strictly comparable to the situation in a controlled scientific experiment, just the kind of situation which Hume did *not* consider (Baier, 1991). Importantly, for Clark & Thornton (1997) the hard, type-2 problems require *binding a*

variable which specifies the cause sought. Now *temporal logic* was pioneered by A.N. Prior, and has proved directly applicable to *the branching pathways of computer programs*, and hence to the procedure of following rules involving contingencies. Victor Goranko (1994) introduced *reference pointers* in temporal logic, allowing binding in phrases like 'what was said,' or 'what actually happened.'

Allowing a social articulation of experience, such forms extend to pronominal references, and this at last addresses Chomsky's concerns. In a landmark study of current research, incorporating cross-cultural studies, Grodzinsky (2002) focuses on the problem of "the relation between transformationally moved phrasal constituents and their extraction sites," and shows that the capacity to process such relations is specifically impaired in Broca's aphasia, involving damage to the left anterior cortex. Now while Chomsky, and after him Steven Pinker appeal to an unspecified 'language module,' *this specific and well-replicated evidence validates the classic analysis of aphasias by Jakobson and Halle (1956)*. This specifies *two functions* essential to language, the first *concatenation* (in psychological terms, association, lexical and semantic) and the second *substitution*, as in the recovery of a transformed phrase from a trace or pointer.

Taken in the logical sense, with negation, these functions are sufficient to found elementary logic, and where the influences of Chomsky and Jakobson mingled in France, anthropologist Claude Lévi-Strauss (1955) envisaged reducing the phenomena of human meaning to binary oppositions and attaining thereby a 'mathematics of man.' So he marked the high tide of Modernism, and a gathering vogue for 'structuralism,' but in a later and notable return to the work of Marcel Mauss (1925), Lévi-Strauss (1968) confessed that he was merely elaborating a myth of modern times. That we must contend with something of the kind Derrida (1974) also stressed, but here this fatality comes to signify the simple fact that *an act of comprehension is inevitably coloured by the consciousness in which it occurs*, as a text is by the metaphors of its language.

2.4 Generalizing the Functions. The core of my argument here is the observation that *the well-attested capacity first identified by Jakobson is adequate to the binding task in type-2 problems*. Type-2 problems are not, of course, restricted to language, but the analysis of Karmiloff-Smith and Clark (1993) shows clearly enough that they are specifically sensitive to *problem representation*. So we return to the philosophical situation of recent decades: do we retreat from the challenge of universal knowledge into linguistic idealism, effectively identifying thought and language, or can we follow C.S. Peirce in recognizing that unfamiliar information appears as *signs awaiting interpretation*, so posing a *representational* problem which is *not* specifically linguistic?

On the neurological front, one can dispute the idea that the functioning brain is 'built up' from modules, and think rather in terms of *patterns of interaction* in a brain functioning as a whole (Kurt Goldstein; Joseph, 1982). Thus Jakobson's function of concatenation is localized to

Wernicke's area, within what is known as the association cortex, and his substitution in the frontal zones, taken to support planning behaviour (Luria, 1973), where one must regularly substitute performances for strategies. In a word, one can take the classic linguistic zones to be secondary phenomena, actually specializations of two generic functions, specialized in support of language.

3 BINDING

3.1 Semantic containers. Fodor and Pylyshyn (1988) confronted the binding problem in syntax, the assignment of variables to establish reference and semantics. Here syntax is an insufficient guide, and they appealed to *thematic roles* (e.g. agent, patent, instrument) as an additional semantic guide. Thematic roles share critical features with *propositional attitudes* such as belief and desire, in that they demonstrate what Quine (1960: 141ff) called *referential opacity*. To say that 'she intended the insult she delivered' is not quite so say 'she intended the insult he suffered,' for the meaning of 'the insult' may not be transferable between the contexts concerned.

Now these propositional attitudes are just what Fodor (1981) took to supply semantic values to mental states, and the problem of the ambiguous interpretability of semantics in general (Gödel's (1929) theme, from his doctoral thesis) is just a generalization of this phenomenon. Thus in comprehending a conversation, one must consistently distinguish one's own meanings in speaking from those discerned in hearing. Here we return to the problem posed at the outset, with the interesting implication that the ancient impasse in philosophy of mind was occasioned by semantics not adequate to natural language! There is now an expectation that we have risen above such difficulties through the return to ordinary language in Analytical philosophy, but thematic roles are *not* a conception due to this development.

3.2 Psychoanalysis after Freud. It is a consistent finding of the phenomenology of mental life that it is *not* a realm of pristine subjectivity as one might well suppose following Hume: rather *each mind is peopled by the presence of self and others* (Jacobson, 1954: Angyal, 1965; Bianchedi et al, 1984; Sandler & Sandler, 1998). Addressing the semantic problem precisely, Winnicott (1951) proposed a third category of what he called *transitional objects*, palpably modeled on the archaeologist's artifacts, taken as representatives of the culture. In view here is the principal yield of psychoanalysis *after* Freud, starting with Sandor Ferenczi's (1932) concern with 'confusion of tongues,' and developing in the trend known as 'object relations theory,' with special mention for the 'Middle Group' or Independents like Winnicott for their recognition of culture. There is an interesting convergence here with Lacan's (1953) view of language or more generally the Symbolic as the third psychical presence, although André Green (1983) still saw reason to leave Lacan's orbit for the middle ground.

At issue is just the problem of interpretation raised above: 'the insult' can be interpreted from the point of view of speaker, hearer, or the conventions of the language used. Lacan was arguably a conventionalist in the tradition of Poincaré, and accordingly overestimated the dialectical politics of knowledge in proportion as he underestimated the contributions of creative individuals and historical events to language. The theory I pose here as *semantic containment* was perhaps suggested by Wilfred Bion (1965, 1967), who drew Green's interest, and dared to propose an instinct for knowledge which then makes its own contribution to the semantic capacities of mind.

Also suggestive is Jacobson's (1954) concern with the representation of others, but he remains within the confines of representational theories of mind. Here, indeed, lies the rub, for representational theories assume by default that one can represent others and their speech without semantic hazard, when Quine's (1960) analysis shows otherwise. Once mere representation gives way to semantic attribution, the texture of mind taken over uncritically from the old psychology of association must give way to coherent *semantic presences*, and a phenomenology of intersubjectivity.

3.3 Existential Linguistics. Meeting the impasse in the philosophy of language is the recently rediscovered linguistics of Wilhelm von Humboldt (1836), posing language not a *weltanschauung*, a display or presentation of the world, but as a *weltansicht*, a 'point of view' (Cassirer, 1944: 120-1), which can interestingly be parsed as *an existential position or situation*. This concept meets the very contemporary concern with society as a collective facing ecological hazards and constraints on resources, seeking sustainable solutions. Such is arguably the situation in which language must have evolved, but our grave conceptual difficulty arises from the fact that this process is conceived in terms of the expression of genes in the development of upright posture, the larynx and associated neural capacities, severed by the mind/body problem from considerations of meaning!

To say that a process is situated existentially is, in the terms of neurology, to require that it is *oriented* (to time, place, and person, as required in a psychiatric examination). Orientation in this sense is evidently integral to the arousal and continuity consciousness (Luria, 1973); certainly, an experience that is 'disoriented' marks a discontinuity. Dennett and Kinsbourne (1992) showed that the 'now' of this orientation is the moment of stimuli arriving in the cortex, significantly *later* than the reception of stimuli in the sense-organs. Reaction-times must be managed for optimum performance, in the arts as in sport, not to mention combat, so one cannot say these are exclusively modern concerns.

3.4 The Longest of Revolutions. I think it no coincidence that the brain was described as the *seat* of consciousness by Alcmaeon of Crotona, in same era in which Hippocrates registered an impact of gymnastic trainers in medicine, through their innovative ways with diet and

regimen. From this time medicine developed independently of philosophy, and the challenging implications have yet to register there. Not only does consciousness awareness lag behind the flow of events, any conscious intervention must be further anticipated to allow for the inevitable delay in implementing any muscular reaction. It follows directly that an organism can ill afford to simply react to what it experiences: for any fine command of process it must learn to act with or in the flow of events, by anticipation of its course.

Fine command in just this sense becomes a matter of life or death in any encounter between predator and prey, so that there is a presumption that the requisite capacity evolved in animals as soon as there was the capacity to support it. As always in such matters, the underlying capacity is harder to analyse and explain. The strong statement of the case would be that *the primary object of cognition is not the static object, but rather the impulse or momentum that moves it*. There is indeed evidence that the visual cortex detects in the first instance movement rather than static form, but movement is not an impulse or momentum.

To make good sense of this one must dare to look far lower on the scale of organization in life, to the coelenterates like sea anemones near the root of the Animal Kingdom. They live immersed in the sea, and are constantly buffeted by its currents, and are sensitive to touch: here sensitivity emerges *already in the flow of things*. Appreciating this, it is less surprising that creatures as primitive as insects are seen to fly. Looking on from natural history to natural philosophy, we have yet to make good sense of what the ancient Stoics meant by following the Way of Nature, or what inspired and informed the cryptic remarks we have preserved from Herakleitos on flow and process.

3.5. Kant, not Kantian. Against this enigmatic background we find that Kant in his *Critique* presented understanding in the guise of a 'transcendental unity of apperception' which draws together diverse experiences into a concept. The passage in which Kant analyzes this process (A103-110) is notably difficult, and was completely rewritten for the second edition (B130-6), despite which Norman Kemp Smith gave the original pride of place in his translation, and it is still quoted in commentary (e.g. Brook, 2004: 3.3). Turning for once to his considered position, the concept attained in understanding is presented as an *identity*, which interestingly touches the logical difficulty with abstracts and inclusive classes noted at the outset. There is good reason, then, for speaking of a *transcendental* unity, keeping reference to the individual experiences in a distinct register.

Attending simply to the phenomena involved, one can say that a range of appearances *in time* is resolved into an identity grasped in a single moment. Concerning the *phenomenology* of time, Kant's substantial discussion came in *The Metaphysical Foundations of Natural Science*, where he places it as the dimension of the 'inner sense,' and wholly unsuitable for scientific analysis (Brook, 2004: 3.1). Yet for this very reason one can now suppose that this *subjective time stands for the*

unknown variable in a type-2 learning situation. I mean this directly: that the *time of puzzlement ends precisely as the dimension of time is resolved into the continuity of a procedure whereby the puzzle is solved*.

It follows, tellingly, that *solving a type-2 problem induces a discontinuity in subjective time*, and indeed, the mind typically relaxes back into the perspective in which the puzzle appeared, to pick up the continuity of endevour or interest in which it arose. Here is phenomenology of the inner sense of time exceeding what Husserl (1905) achieved, specifically through admitting discontinuity, and thereby a non-trivial *topological complexity* in the continuity of thought.

3.6 Time and Variations. The problem was confronted earlier in science as Newton puzzled over the partial and unresolved findings of Kepler, Galileo and Descartes, and the sorely neglected fact about Newton's work is that it was *not* founded on calculus as now understood, but on what he called *the method of fluxions*, in which the physical variable of interest is always presented as *a function of time*. It is again *not* the case that Newton achieved the decisive conceptual break-through: the law of gravitation as he gave it was familiar to Hooke, Halley and Wren. Newton assumed Kepler's orbits, and derived the law from their geometry, but he did *not* solve the hard problem of taking the law as an hypothesis, and predicting the orbits from it: rather, he covered his weakness by refusing hypotheses!

In sum, *Newton did not solve the type-2 problem, because he failed to transpose the unknown variable out of the dimension of time!* The difficulty lived on, of course, to become known as the 'inverse problem,' found soluble only with the *calculus of variations* developed by Leonard Euler. In the calculus of variations one abstracts from the function sought to a *function type* or *functional*, in which the constants specifying the function sought are replaced by variables. The desired function is then found by a procedure of variation in these parameters, whence the name of the method. It is thus correct to say that *the classical model of problem solving in the more substantial sense is just the calculus of variations*.

4 THE EMERGING PICTURE

4.1 The Universal in Grammar. Addressing a symposium on innate ideas, Chomsky (1967) spoke of his own experience in the study of natural languages and their grammars, found it substantiating a view of language familiar from the classical grammarians, and this view in turn justified in the contemporary philosophies of Descartes and Leibniz. On the first point, he argued that overt similarities between sentences are a poor guide to how we understand them, and stressed the distinction between this 'surface structure' and the 'deep structure' which conforms to the grammatical rules of the language. For Chomsky the competence of a speaker rests on knowledge of these rules, even though such knowledge may only be implicit; and the rules in turn reflect an innate

capacity which extends also to the laws of logical reasoning, and hence the commitment to philosophy called rationalist.

This influential position is widely familiar, and falls close enough to the ideas introduced above to occasion confusion between them. All I have claimed so far is that we recognize words as belonging to syntactical categories, and further constraints on how these categories are conventionally articulated. I do not think that we speak or understand speech by recourse to deep structures in Chomsky's original sense, for people do on occasion violate the conventions, whether for emphasis, in disdain, or in an effort to express unusual or complex ideas. It is also the case that Chomsky's early transformational generative grammar did not live up to his expectations; that on into the 1980s he turned to 'government and binding;' and when in the following decade interest turned to thematic roles, he tempered the claims for his research, envisaging a long road ahead.

Rather obscured in this way is the fact that we can now discern with some confidence what is truly universal in language on a world scale, and the hard fact that this preserves nothing of the subject-predicate form of classical grammar, or, therefore, the venerable Scholastic metaphysics that motivated it. Instead, what is confirmed is the truly ancient distinction between roots and complements, so that the general form of a linguistic constraint governs how they may combine. With this comes a new kind of insight, that *the general forms of sentences are given by the order of the root elements,* which varies with word-order (Green & Vervaeke, 1997).

4.2 Nature and Culture. Here is strong evidence in favor of the contextual mind, for the idea of the complement is the semantic trace with which we started. Secondly, in Jakobson's classic study of aphasias we have substantial evidence that the processing of language encompasses two distinct aspects in sequence, and this view is sufficiently substantiated by Townsend and Bever (2001) and confirmed in experiment by Hagoot (2003). Evidently there is always a question of sequencing in the background, and *one can characterize the general form of a language as a convention governing how this natural sequence is articulated with the root syntactical categories through a conventional expectation of word-order*.

Note the subtle but fundamental divergence from Chomsky and all rationalist linguistics: this convention is *not* a set of rules, but rather an adaptation of a natural capacity by association with syntactical categories. Hence all one can now strictly refer to innate knowledge is categories themselves, and these then fall into place with the critical philosophy of Kant, and not Descartes or Leibniz! Indeed, when Chomsky (1967: 238-9) actually came to Descartes, he cited his appeal to a Platonic idea of mathematical form, so any application to language can only follow if mathematics is regarded as a language, the position taken only recently by Wittgenstein. Not surprisingly, nothing today survives of Chomsky's early ambition for a specifically Cartesian linguistics.

Instead, a new significance is found in the dimension of time. Kant admitted time as the only dimension of psychological phenomena, but to ill-defined for further study; and Bergson (1889) as the dimension in which the mind may intervene through action in the flow of events. Here time emerges in a much more abstract sense as the generic independent variable of all our learning and experimentation. In view of what is now known of language, one can say that a human culture entails a conventional sequence of syntactical roots which then patterns the universal independent variable for a specific domain of linguistic discovery, and expression.

4.3 Feed-Forward. Not since Skinner has a theory of language been so closely integrated with a theory of knowledge, and now addressing precisely and substantially the failure of the conditioning paradigm. Here Domjan, Cusato & Villarreal (2000) offer the important concept of *feed-forward* as a general mechanism providing physiological readiness for generic types of activity. Note the powerful implication that action passes from the general to the specific, as by the binding of categories under specific circumstances and contingencies. Anatomy provides for a typing of activities through the utilities of specific organs and limbs, and there then is an obvious parallel between the articulation of parts of the body in physical action and the articulation of 'parts of speech' in language!

Feed-forward effects a *state* of readiness, but this is not the same as the 'disposition' of the philosophers. There is a subtle divergence here from classical learning theories in the implication that *we do not learn behaviors,* but rather *options for behavior*, a view which importantly opens onto philosophy of freedom. Consistently, where a restricted ranges of performances are required, as in work settings, they are bound in *roles*, which then *bracket* the feed-forward required, possibly at risk to general fitness and health. It follows that any social construction of knowledge must proceed indirectly, through roles and the rules which govern them, which is much how the matter appears in law, in the sociology of Durkheim (1895. 1912), and after him in social anthropology. All of this is of no little practical significance in life, for stress and the hazards it brings is found above all associated with changes in the roles an individual is expected to perform.

4.4 Semantic Context. Applying the logic of feed-forward to the view of language processing that now emerges from Jakobson, Townsend and Bever (2001) and Hagoot (2003), one may say that there is *a semantic feed-forward by association*, whether from the verbal stimulus or the cognitive context of one's will to speak. This establishes a semantic context, outlining what the conversation or address is about, within which the choice of words then traces a path. This purposeful view of language now contrasts rather strongly with the currently authoritative position of Bernard J. Baars (1988, 1997), which relies rather on the logic of feed-back. Baars has consciousness in the guise of an executive authority equipped with a 'global work-space,' modeled on the 'short-term memory'

or 'working memory' of earlier research. In place of a semantic context he has various associative networks recruited to the current task, but remaining unconscious, which then leaves consciousness as his primary interest awkwardly under-explained.

The notion of associative feed-back to the current focus of attention serves in the model to cover the transfer of short-term to long-term memory, but the dynamic and neural supports remain unclear. More to the point, Baars is palpably riding on a long line of research deriving from the classic study of Jacob von Uexküll (1938), which introduced the *funktionkreis*, whence the concept entered cybernetics to become the familiar feed-back. Uexküll's research ranged from muscle tone and biological rhythms (Uexküll, 1904a,b. 1905) through positional cues (*lokalzeichen*) in sensation, to the lived world of an organism (Uexküll, 1909), so that he can justly be claimed as a pioneer of the contextualizing mind.

The *funktionkreis* comes in Uexküll's last work, which founded theoretical biology, in which perspective it states the theme of self-regulation. Yet one must allow that it enters at a much lower level of organization than Baars' concepts. In respect of the intelligence called sensory-motor, feedback is required to maintain balance, and again to adjust the frame of reference for displacement of the visual field, so that stationary and moving entities can be properly distinguished. This is not a trivial problem in physics, and indeed exercised Galileo and Newton at some length; only once it was resolved could the traditional notion of impulse be clarified as momentum.

Much closer to Baars' concerns, C.S. Peirce famously rejected the reflex arc model on which behaviourism was founded as inadequate to psychological understanding, citing something like the 'unconscious inference' of Helmholtz (Hayeck, 1968: 312&n7), which he later clarified as 'background knowledge' supporting judgements of what is improbable (Popper, 1963: 240). Baars (2002) would recover this via feed-back from the store of experience that has lost its autobiographical roots, and is then surprised to find that what emerges is always a personal context, relevant to current concerns. Still relying on a dynamic of feed-back he then runs into a contradiction between positioning and sequence in language processing: "Even the role of consciousness in learning could be a consequence of voluntary attention. Thus conscious access to self-systems of the prefrontal cortex might enable the other functions" (Baars, 2002: 51). Here Baars retrieves the personal context at the expense of *starting* the feed-back loop where the linguistic signal-train *terminates*, which is simply far too late for the comprehension of conversation as we know it.

4.5 The One and the Many. Returning now to the problems stated at the outset, we have in place of any direct sense of the universal in knowledge, the mediate sense of the universality of language, without which we could not communicate our experiences, or accumulate knowledge in the social sense. In a telling extension of Kant's critical

venture in philosophy, it does seem that language would not be possible without categorical structures, the types we recognize as 'parts of speech.' It follows that language is not an aggregate of words and their associations, but involves a logic in which words are bound as instances of these categories. Assumed here is rather more of Plato than Aristotle's followers and latter-day empiricists are wont to acknowledge, but not in the vein of Academic metaphysics, rather the problem Plato had from tradition as the One and the Many.

From what we know, it is reasonable to place in the background here the ancient teachers of language, who first distinguished the root and complement. They should not, as such, be confused with the founders of logic, or mathematics. Indeed, in place of any convergence between linguistics and mathematics on the computational theory of mind, we have uncovered hard evidence that language comprehension proceeds in time with a conventional expectation of word-order specific to the language, so that as in problem-solving the puzzle of a sentence is posed initially in the dimension of time, to be resolved in a moment of comprehension as a unit of meaning.

Far more of the logic of Kant's transcendental apperception is preserved here than in the linguistic idealism of Ernst Cassirer. As Kant left his argument, and specifically his philosophy of mathematics, his system remained open to Quine's challenge, and possible empirical refutation. Here we find empirical grounds for asserting that there are indeed categorical foundations of thought as envisaged by Kant, which then re-opens the critical case in philosophy.

After Kant, Bolzano placed the abstract ideas of mathematics and science in a 'third realm' between subjectivity and the real world, where Popper found them. Cognitive science makes place for such claims in the realm of pure information, traversed by abstract measures of complexity. Here we find that natural language too offers a window on such a world, through the abstractions of syntax. To grant abstraction in nature is not yo concede the ground to academic Platonism: this is rather a Pythagorean idea, again ancient, and for that reason yet poorly understood. Yet such is the implication of admitting universals like energy as a real, so that the challenge is now unavoidable!

4.6. Being and Process. Although only now being rediscovered, Bolzano is a figure of real moment in modern thought. It was he who gave a rigorous mathematical foundation to the calculus (Bolzano, 1817), and his philosophy of science then reinterpreted Kant's quest for objectivity (Bozano, 1837). Bolzano now eclipses Kant as the source of the semantic tradition in logic, and indeed of analytical philosophy, philosophy made over for the era of science. To this end, Bernard Bolzano famously shifted the focus in mathematics from the controversial ground of Academic metaphysics to the new question of how we *talk* about mathematics. Missing here was the prior investigation of what it is to talk about things, and the pragmatic sense that this talk is *not* a mathematical procedure! In the spirit of critical philosophy, we recover here the hard fact that

natural language is not a transparent window on the world, but in important degrees opaque, and faceted by the world's cultures.

It was Ernst Cassirer (1933, 1942) who probed the influence of language in science, and saw the potential for a critical philosophy of symbolic thought (Cassirer, 1944), but with the question posed in this way he was soon eclipsed by Carl G. Jung, all in the shadow of the representational theories of mind. Here we reach behind Jung's psychologised Academic Platonism to the functional anatomy which interested his mentors Carl Gustav Carus and Lotentz Oken, with a new focus on functional abstractions. It is not the case that we have nature imprinting mind with natural archetypes, for the young mind that is learning to articulate its limbs is also negotiating communication and thereby diverse semantic sources, so that the elements of function, relation, and abstraction involved must be grasped as transcendental. Kant was properly aware of the significance of the transcendental in philosophy, but was followed only by Husserl.

The contextual philosophy now offers a way ahead that is not constrained by Husserl's sceptical detachment, rather immersed in the flux of being. This propect was alive at the time, and grasped by A.B. Whitehead, who retains a substantial following in the field curiously termed quantum consciousness. Yet Whitehead's philosophy of process was founded on Medieval mereology, the discourse on parts and wholes; in the wake this foundation proved woefully inadequate, and had to be re-founded on topology (Clark, 1981, 1983; Gerla, 1995). This development now meets the finding above that the creative use of the dimension of time in problem-solving introduces a significant topological complexity (3.5).

There is clearly more involved here than Bergson envisaged in his philosophy of time and freedom, so that the contextual philosophy no emerges as an independent position, although allied to the semantic tradition. Freud's (1891, 1895) original rationale in psychology through neurology was the perception that there must be physical energy involved in the processes of the brain: *this constraint is now reframed in a logical guise as the binding of energy already fed forward, so that it can be deployed to specific ends*. This fresh view of binding falls in besides the traditional puzzle about sensory qualities, and an emerging concern with the binding of time in problem-solving and the flow of thought.

4.7 Heuristics for Further Research. Since topology has already proved a disruptive presence in the wider context, it can be taken here in an heuristic light. I for one do not expect the complexities of neural processes to be resolvable purely in terms of electronic energies, or even nuclear magnetic spins. Here the theme of topology points us on to the Chern-Simons topological charge, which now motivates an impelling holistic view of atoms and their dynamics (Matute, 2004). In this range one must allow also for the non-linear Schrödinger or Klein-Gordon equation, and further the Yang-Mills field governing nuclear interactions,

so that these considerations converge with subtle energy research as now pursued at Caltech.

There attention has been focussed on recent theoretical developments such as string and brane theories, but all such speculation is now interrupted by the experimental program with the Large Hadron Collider CERN, which promises to reduce the viable options considerable. This is a good moment, then, for recovering philosophical foundations. I must emphasise that *the contextual philosophy is not exhausted by the themes reviewed above, for there remains Aristotle's physical investigation of the complement*, and hence his conception of matter as *potentia*. In contemporary terms, this evokes Euler and Lagrange on field potentials as negative energies, and thereby the very difficult problem of the place of gravitation in current field theory.

On this frontier of discovery, the emerging theme of topology highlights the possibility that the creative activity of mind in problem-solving can draw on more than feed-forward, reaching through the topology of biochemistry to the metabolic potential which sustains feed-forward. Here lie also the frontiers of consciousness and comprehension, for we know well enough of chemicals with effects called *psychotropic* in the sense of inducing movement or change in the psyche itself. Here is reason for attending not just to Aristotle's physics, but also to the ancient discourse on psyche, which ranged over the vegetative, animal and rational, in the spirit not of speculation but of natural history.

REFERENCES

Angyal, A. (1965) *Neurosis and Treatment: A Holistic Theory*, New York: John Wiley.

Arya, R. (2000) *Vaastu: the Indian Art of Placement*, Rochester, Vermont: Destiny Books, 2000.

Baars, B. J. (1988) *A Cognitive Theory of Consciousness*. Cambridge: Cambridge University Press.

Baars, Bernard J. (1997) In the theatre of consciousness, *Journal of Consciousness Studies* **4.4**: 292-309.

Baars, Bernard J. (2002) The conscious access hypothesis: origins and recent evidence, *Trends in Cognitive Sciences* **6**: 47-52.

Baier, Annette C. (1991) *A Progress of Sentiments: Reflections on Hume's Treatise*, Cambridge, MA: Harvard University Press.

Bergson, H. (1889) *Essai sur les données immédiates de la conscience*, F.L. Pogson (trans.) *Time and Free Will: An Essay on the Intermediate Data of Consciousness*, London and New York: 1910.

Bianchedi, E.T. de et al. (1984) Beyond Freudian metapsychology, *International Journal of Psycho-Analysis* **65**: 389-398.

Billock VA, Tsou BH. (2004) A role for cortical crosstalk in the binding problem: stimulus-driven correlations that link color, form, and motion, *J Cogn Neurosci.*, Jul-Aug 2004,**16.6**:1036-48.

Bion, W. (1965) *Transformations: Change from Learning to Growth.* London: Heinemann.
Bion, W. (1967) *Second Thoughts*. London: Heinemann.
Bolzano, B. (1817) Rein analytischer Beweis des Lehrsatzes, in *Early Mathematical Works (1781–1848)*, L. Novy (ed.), Institute of Czechoslovak and General History CSAS, Prague, 1981.
Bolzano, Bernard (1837), *Wissenschaftslehre*, trans. Burnham Terrell, *Theory of Science*, edited with an introduction by Jan Berg, Dordrecht: D. Reidel, 1973.
Bridgman, P.W. (1927) *The Logic of Modern Physics*. New York: Macmillan. Reprinted, 1954.
Bridgman, P.W. (1945) *Psychological Review* 52.
Brook, A. (2004) Kant's view of the mind and consciousness of self, *Stanford Encyclopaedia of Philosophy*. http://www.plato.stanford.edu.
Cassirer, E. (1933) La langage et la construction du monde des objets, J*ournal de psychologie* **30**: 18-44.
Cassirer, E. (1942) The influence of language upon the development of scientific thought, *Journal of Philosophy* **39.12**, June 1942: 309-327.
Cassirer, E. (1944) *An Essay on Man*. New Haven: Yale University Press.
Chomsky, N. (1967) Recent contributions to the theory of innate ideas: summary of oral presentation, Robert S. Cohen & Mary W. Wartofsky (eds.), *Boston Studies in the Philosophy of Science* 3. Dordrecht, Holland: D. Riedel. Reprinted in: Harold Morick (ed.), *Challenges to Empiricism*: 230-240. London: Metheun, 1980.
Churchland, Paul (1981) Eliminative materialism and the propositional attitudes. *Journal of Philosophy* 78: 67-90.
Clarke, Bowman (1981) A calculus of individuals based on 'connection'," *Notre Dame Journal of Formal Logi*c 22: 204-18.
Clarke, Bowman (1985) Individuals and points, *Notre Dame Journal of Formal Logic* 26: 61-75.
Clark, A. and Karmiloff-Smith, A. (1993) The cognizer's innards: a psychological and philosophical perspective on the development of thought. *Mind and Language* 8.
Clark, A & Thornton, C. (1997) Trading spaces: Computation, representation, and the limits of uninformed learning, *Behavioral and Brain Sciences* **20.1**: 57-92.
Dennett, D. & Kinsbourne, M. (1992) Time and the observer: The where and when of consciousness in the brain, *Brain and Behavioral Sciences* **15**: 183-247.
Derrida, J. (1974) White mythology: Metaphor in the text of philosophy, *New Literary History* **6.1**: 11.
Dollard, John & Miller, Neal E. (1950) *Personality and Psychotherapy: An Analysis in Terms of Learning, Thinking and Culture.* New York: McGraw-Hill.
Domjan, Michael, Cusato, Brian & Villarreal, Ronald (2000) Pavlovian feed-forward mechanisms in the control of social behavior, *Behavioral and Brain Sciences* **23.2**.

Duane, O.B. (1997) *The Origins of Wisdom: Feng Shui*, London: Brockhampton.
Durkheim, E. (1895) *Les régles de la méthode sociologique*, Sarah A. Solovay and John H. Mueller (trans.), *Rules of the Sociological Method*, Chicago: University of Chicago Press, 1938; Illonois: The Free Press of Glencoe; London: Routlege and Kegan Paul, 1951.
Durkheim, E. (1912) *Les formes élémentaires de la vie religieuse*. Paris. Joseph Ward Swain (trans.), *The Elementary Forms of Religious Life: a Study in Religious Sociology*. New York: Allen and Unwin; London: Macmillan, 1915.
Elman, J. (1991) Incremental learning, or the importance of starting small. San Diego: University of California, Center for Research in Language, Tech. report 9101. *Cognition* **48**: 71-99, 1993.
Ferenczi, S. (1932) Confusion of tongues between the adults and the child, *International Psycho-analytic Congress*, Weisbaden, 1932; *International Journal of Psycho-Analysis* **30**, 1949: 225-230.
Fodor, J.A. (1981) Methodological solipsism considered as a research strategy in cognitive psychology, *Representations*: 225-253. Cambridge, Mass.: The MIT Press.
Fodor, J.A., Pylyshyn, Z. (1988) Connectionism and cognitive architecture: a critical analysis, S.Pinker and J. Mehler (eds.), *Connections and Symbols*: 3 – 71. Cambridge, MA. MIT Press.
Freud, S. (1891) On Aphasia. London and New York, 1963.
Freud, S. (1950 [1895]) A project for a scientific psychology, The Origins of Psycho-Analysis. London and New York: 1954. Standard Edition 1: 175.
Freud, S. (1924) The economic problem of masochism. *Standard Edition* 19: 155-172.
Gerla, G. (1995) Pointless geometries. In: F. Buekenhout & W. Kantor (eds), *Handbook of Incidence Geometry: Buildings and Foundations*: 1015-31. North-Holland.
Green, A. (1977) Conceptions of affect. International Journal of Psychoanalysis 58: 129-56.Green, Leslie (2003) Legal positivism, *Stanford Encyclopaedia of Philosophy*. http://www.plato.stanford.edu.
Gödel, K. (1929) I, Dissertation, University of Vienna. Reprinted in S. Feferman, S. Kleene, G. Moore, R. Solovay, and J. van Heijenoort (eds.), *Collected Works. I: Publications 1929–1936*: 60–101. Oxford: Oxford University Press, 1986.
Green, Christopher D. & John Vervaeke (1977) What have you done for us lately? Some recent perspectives on linguistic nativism. D.M. Johnson & C.E. Erneling (eds.), *The Future of the Cognitive Revolution*: 149-163. Oxford: Oxford University Press.
Goranko, V. (1994) Temporal logic with reference pointers, D. Gabbay & H.-J. Olbach (eds.), *Temporal Logic*: 133-148. Springer-Verlag, Lecture Notes in Artificial Intelligence 827.
Hagoort, P. (2003) How the brain solves the binding problem for language: a neurocomputational model of syntactic processing, *Neuroimage* 20 Suppl. 1: S18-29.

Hanna, R. (2004) Kant's theory of judgement, *Stanford Encyclopaedia of Philosophy*. http://www.plato.stanford.edu.
Hayeck, F.A. (1969) The primacy of the abstract, A. Koestler and R. Smythies (eds.) Beyond Reductionism: the Alpbach Symposium: 309-333. London: Hutchinson.
Humboldt, Wilhem von (1836) *On Language. On the Diversity of Human Language Construction and its Influence on the Mental Development of the Human Species* (ed. Michael Losonsky, trans, Peter Heath), Cambridge: Cambridge University Press, 1999. Cambridge Texts in the History of Philosophy.
Hume, David (1739) *A Treatise of Human Nature*. London: Oxford University Press, 1973.
Hummel, J. E., & Biederman, I. (1992) Dynamic binding in a neural network for shape recognition, *Psychological Review* **99**: 480-517.
Husserl, Edmund [1905] Vorlesungen zur Phänomenology des Inneren Zeitbwussteins. *Jahrbuch für Philosophie und phänomenologische Vorschung* **9**, 1928: 367-498. J.B. Brough (trans.), *On the phenomenology of the consciousness of internal time (1893-1917)*. Dordrecht: Kluwer, 1991.
Jacobson, E. (1954) The self and the object world, *Psycho-Analytic Stud. Child* **9**: 75-127.
Jones, H. (1989) *The Epicurean Tradition*. London: Routledge, 1992.
Joseph, R. (1982) The neuropsychology of development: hemispheric laterality, imbic language and the origins of thought, *Journal of Clinical Psychology* **38**.1: 4-33.
Kant, I. (1781/7) *Kritik der reinen Vernuft*. Riga. 2nd. ed., 1787. N. Kemp Smith (trans.), *Critique of Pure Reason*. London: Macmillan, 1970.
Kant, I. (1786) *Metaphysische Anfangsgründe der Naturwissenschaft*. J. Ellington (trans.), *Metaphysical Foundations of Natural Science,* New York: Bobbs-Merill, 1970.
Karmiloff-Smith, A. and Clark, A. (1993). What's special about the development of the human mind/brain? *Mind and Language* **8.4**: 569-581.
Klein, Juergen (2003) Francis Bacon, *Stanford Encyclopaedia of Philosophy*. http://www.plato.stanford.edu.
Lacan, J. (1953) The function and field of speech and language in psychoanalysis, Alan Sheridan (trans.) *Écrits: A Selection*: 30-113. London: Tavistock, 1977.
Luria, A.R. (1973) *The Working Brain*, Harmondsworth: Penguin.
Lévi-Strauss, C. (1955) The mathematics of man, *International Science Bulletin* **6.4**.
Lévi-Strauss, C. (1968) Introduction a l'oeurve de Marcel Mauss, *Marcel Mauss, Sociologie et Anthropologie*. Paris: PUF, 1968.
Machamer, Peter & McGuire, J.E. (2009) *Descartes' Changing Mind*. Princeton: Princeton University Press.
Matute, E.A. (2004) *Proceedings of Institute of Mathematics of NAS of Ukraine* 50: 873.

Mauss, M. (1925) *The Gift: Forms and Functions of Exchange in Archaic Societie*s, London: Routledge & Kegan Paul, 1966.
McCulloch, W.S. and Pitts, W., (1943) A logical calculus of the ideas immanent in nervous activity, *Bulletin of Mathematical Biophysics* 5: 115-33.
Mowrer, O.H. (1947) On the dual nature of learning - a reinterpretation of 'conditioning' and 'problem-solving', *Harvard Educational Review* **1**7: 102-148.
Mowrer, O.H. (1956) Two-factor learning theory reconsiderd, with special reference to secondary reinforcement and the concept of habit, *Psychological Review* **63**: 114-128.
Newell, A. (1982) The knowledge level, *Artificial Intelligence* **18**: 87-127.
Newell, A. (1990) *Unified Theories of Cognition*, Cambridge, Mass; London: Harvard University Press.
Newell, A. (1993) Reflections on the knowledge level, *Artificial Intelligence* **59**: 31-38.
Piaget, J. (1946) *Les notions de mouvement chez l'infant*, Presses Univeristaires de France. G.E.T. Holloway & J.M. MacKenzie (trans.), *The Child's Concept of Movement and Speed*, London: Routlege & Kegan Paul, 1970.
Piaget, J. (1957) *Logic and Psychology, with an introduction to Piaget's logic by W. Mays*. Basic Books.
Piaget, J. (1967) The various forms of knowledge seen as differentiated organs of the regulation of the functional relation with the external world, *Biology and Knowledge* (trans. Beatrix Walsh). University of Chicago Press. Reprinted in H.E. Gruber & J.J. Voneche (eds.) The Essential Piaget: 842-860. London: Routledge & Kegan Paul, 1982.
Piaget, J. (1968) *Le Structuralisme*. Paris: PUF. Chaninah Maschler (ed. & trans.), Structuralism. New York: Basic Books.
Piaget, J. (1970) *Psychology and Epistemology* (tr. P.A. wells). Harmondsworth, Penguin, 1972.
Popper, K.R. (1963) Truth, rationality and the growth of knowledge, Conjectures and Refutations (4th ed.): 215-250. London: Routledge and Kegan Paul, 1972.
Pribram, K.H. (1954) Towards a science of neuropsychology, Current Trends in Psychology and the Biological Sciences (ed. R.A. Patton). University of Pittsburgh Press.
Putnam, H. (1960) Minds and machines. In: Hook, S. (ed.) *Dimensions of Mind*, New York, New York University Press.
Quine, W.V. (1953) Two dogmas of empirisicsm, *From a Logical Point of View*: 20-46,Cambridge, Mass.: Harvard.
Quine, W.V. (1960) *Word and Object,* Cambridge: MIT Press.
Quine, W.V. (1972) *Methods of Logic* (3rd. ed), New York: Holt, Reinhart & Winston.
Ryle, G. (1949) *The Concept Of Mind.* London, England: Penguin Books.
Sahakian, W.S. (1975) *History and Systems of Psychology*, New York: Wiley.

Sandler J., Sandler A.-M. (1998) *Object-Relations Theory and Role Responsiveness,* London: Karnac Books.
Steinhoff, Gordon (1989) Kant's reply to Hume in the second analogy, *20th World Congress of Philosophy*. http://www.bu.edu/wcp/Papers/
Townsend, David J., Bever, Thomas G. (2001) S*entence Comprehension: The Integration of Habits and Rules*. MIT Press.
Uexküll, J. von (1904a) Studien über den Tonus II. Die Bewegungen der Schlangensterne. *Zeitschrift für Biologie* 46: 1-37.
Uexküll, J. von (1904b) Die ersten Ursachen des Rhythmus in der Tierreihe, Ergebnisse der Physiologie 3(2. Abt.): 1-11.
Uexküll, J. von (1905) Studien über den Tonus III. Die Blutegel. *Zeitschrift für Biologie* 46: 372-402.
Uexküll, J. von (1909) *Umelt und Innwelt der Tiere*. 2nd. ed.: Berlin, 1921.
Uexküll, J. von (1938) *Theoretische Biologie* (2nd. ed.). Berlin.
Wilson, Catherine (2008) Kant and Leibniz, *Stanford Encyclopaedia of Philosophy*. http://www.plato.stanford.edu.
Winnicott, D.W. (1951) Transitional objects and transitional phenomena*, Collected Papers: Through Paediatrics to Psycho-Analysis,* London: Tavistock; New York, Basic Books, 1958; London: Hogarth Press; Toronto: Clarke, Irwin & Co., 1975.
Wittgenstein, L. (1983) *Remarks On The Foundations Of Mathematics*. Cambridge, MA: MIT Press.