EXPLORATIONS

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1 TURING AND AUTOMATED TEXT PROCESSING

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Abstract: Turing's contention that all mental functions can be reduced to computable operations seems to be questioned precisely by applied computation to text processing. Criticisms have been addressed to the test proposed by Turing for an empirical verification of his conjecture, both from an objective and a subjective point of view, namely by Penrose and Searle. Automated text processing allows us to transpose Searle's objections into a linguistic context and to show that they raise the same questions as those brought up by Penrose, i.e. the problems of computability and indeterminacy. These very questions were among Turing's last concerns and he seemed to envisage a coupling of indeterminate descriptions of physical phenomena with scientifically computable predictions of their objective states. A proper discussion of these problems requires however, as S. Barry Cooper suggests, a full recognition of the new scientific paradigm emerging from the advancement of physics in the 20th century. In this respect, both Merleau-Ponty's epistemological reflections and, on a more formal level, the foundational implications of the new calculus of indications introduced by the English mathematician George Spencer Brown, prove themselves to be highly relevant suggestions.

1 MIND, LANGUAGE AND THE TURING MACHINE

By general consent Alan Turing's seminal paper on the 'universal machine',[1] is now recognized as 'the founding work of modern computer

1 Cf. Turing (1936-37). 'Th[is] paper [...] gave a definition of computation and an absolute limitation on what computation could achieve' (Hodges 2013).

CONSTRAINTS THEORY AND THE ROTATION OF GALAXIES 2

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0 CONCEPTS

Constraints Theory (CT) is a branch of theoretical physics. It begins with Quantum Mechanics (QM) but has connections with Classical Mechanics (CM) and Cosmology. Its original purpose was to explain why certain structures appear in CM; and why these structures are often successful as a basis for predictive/ descriptive quantum calculations about the real world. But the applications of CT may be even wider.

CT is based on a formulation of QM that replaces scalar observables by Hermitian operators. It thereby uses the Schrodinger [1] method rather than the path integral method developed by Feynman [2]. But CT does not use the structures found in a Lagrangian or a Hamiltonian formulation of CM to construct QM; a method used originally, in different ways, by both of those authors. One has sympathy with them: For how are they to inform the problem unless they impose structure? Where is the structure to come from apart from classical Lagrangians or Hamiltonians? After all Lagrangian mechanics and Hamiltonian mechanics have been very successful in predicting/ describing how the medium to large scale Universe works.

In CT the structure comes from something *inevitable*; the quantisation of an hierarchy of *differential identities*. We quantise these by methods which are roughly what Schrodinger did with his famous hydrogen model. We thereby bring in all the baggage (of coordinates and time etc.) associated with that model. In doing so we bring in half the assumptions of CM. We can be criticised for this; but we must start somewhere! In CT we then look for recognisable structure in the relations between various operators.

CT assumes Cartesian coordinates and conjugate momenta of particles in a flat, continuous space. The space, here denoted $\mathcal{P}$, may be the ordinary 3-dimensional space of Euclid or it may be the 4-dimensional

SELF-REFERENCE, BIOLOGIC AND THE STRUCTURE OF REPRODUCTION 3

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ABSTRACT: In this paper we explore the boundary shared by biology and formal systems

KEYWORDS: Logic, algebra, topology, biology, replication, cellular automaton, quantum, DNA, container, extainer

1 INTRODUCTION

This paper concentrates on relationships of formal systems with biology. In particular, this is a study of different forms and formalisms for replication. The paper is based on previous papers by the author [24, 23, 22]. We have freely used texts of those papers where the formulations are of use, and we have extended the concepts and discussions herein considerably beyond the earlier work. We concentrate here on formal systems not only for the sake of showing how there is a fundamental mathematical structure to biology, but also to consider and reconsider philosophical and phenomenological points of view in relation to natural science and mathematics. The relationship with phenomenology [36, 34, 35, 9, 1, 38] comes about in the questions that arise about the nature of the observer in relation to the observed that arise in philosophy, but also in science in the very act of determining the context and models upon which it shall be based. Our original point of departure was cybernetic epistemology [43, 42, 40, 33, 12, 13, 14, 15, 16, 17, 18, 23, 22, 24] and it turns out that cybernetic epistemology has much to say about the relation of the self to structures that may harbor a self. It has much to say about the interlacement of selves and organisms. This paper can be regarded as

FORMAL NATURAL PHILOSOPHY: TOP–DOWN DESIGN FOR INFORMATION & COMMUNICATION TECHNOLOGIES WITH CATEGORY THEORY 4

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Abstract: Information and Communication Systems are part of process in the natural world. Natural as formally defined in category theory needs to be satisfied to provide a full and faithful representation of communication in information systems. Current approaches of translating Information and Communication Technologies into objects and arrows do not compose naturally as categories. Such categorification that loses the naturality of the real world information systems is a major case in point.

The early attempts by Ehresmann to devise types of Sketches and Diskin's later development of his Unified Modelling Language both relax the rigour of category theory. Categorification of the entity-relationship model by Rosebrugh and more recently of Codd's relational model by Spivak show that the real world does not fit a category of sets: rather the identification should be within the well-established natural category of the topos. The topos of the Cartesian Closed Category with naturality provides a formal representation without loss of rigour for the necessary component of a modern information system: formal structuring capability, searching, query symmetry, transaction processing, query closure, transactions and interoperability. The approach from metaphysics includes the future potential for the quantum processing of data.

1 BACKGROUND

About a quarter of large projects in information technology fail. The cost of failure is difficult to assess but exceeds many billions of euros

5 NONLOCALITY

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Abstract: Though sometimes considered to be a 'problem', for quantum physics, nonlocality is rather a fundamental aspect of the way *local* interactions actually operate. Locality and nonlocality can be seen as the two components of a dual system in which each determines the behaviour of the other. The defining characteristics of the weak, strong and electric interactions can be shown to be completely determined by the nonlocal vacuum structures with which they are associated, while gravity provides a nonlocal dual to the combined interactions, which has inertia as its local manifestation. An integrated description of local interactions and nonlocal vacuum structures is derived, based on nilpotent quantum mechanics and its unique algebraic structure.

1 LOCAL AND NONLOCAL

How do we account for the nonlocality or instantaneity of quantum correlations, when all direct physical measurement or observation must be local, or confined to information transmitted at the speed of light or less? Nonlocality is now demonstrated by the experiments of Aspect (1982), and many others, but is often still regarded as a problem. Nonlocality supposedly defies 'common sense' and our expectations. That 'information' cannot be transmitted faster than c is taken as 'fundamental'.

In fact, the fundamental duality of nature, as evident from the nilpotent universal computational rewrite system (Rowlands and Diaz, 2002,

Note: Submitted 2011

REDUCING THE NUMBER OF FREE PARAMETERS 6

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Abstract: A major problem in the search for a truly foundational theory of physics is the relatively large number of seemingly free parameters generated by the current theories. Their values cannot be arbitrary in a genuinely unified theory but there are few convincing explanations of how they are derived. Here, we investigate a variety of strategies aimed at reducing their number to a minimum which can then be derived on fundamental grounds.

1 THE FINE STRUCTURE CONSTANTS

This is essentially the eleventh lecture in my series *The Foundations of Physical Law*. The first ten are now available on Youtube and soon to be published as a book by World Scientific (Rowlands, 2014).

> This principle of nature being very remote from the Conceptions of Philosophers I forebore to describe it in that Book leas[t it] should be accounted an extravagant freak & so prejudice my Readers against all those things wch were ye main designe of the Book...
>
> — Isaac Newton

Probably the most difficult problem relating to the Foundations of Physics is the number of apparently free parameters. The logic of our position is clearly that they are not free. Nothing can be arbitrary. So each of them ultimately has to have an explanation. Some of them have been accounted for in one way or another. The question is: how do we account for the rest? Some aspects of the problem involve complexity, and the explanations, this time, might not always be simple.