Incorporating Meaning into Fundamental Physics

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Incompleteness of present day physics

Present day physics is seriously incomplete because it ignores meaning.

Leaving meaning out of account in our understanding of nature is like leaving atoms out of consideration, or not taking into account the lattice when trying to understand crystals: a proper understanding of physics at a fundamental level is not possible without including it.

Physics does not currently understand the subtleties of the cooperative processes leading to the building of *complex organised structures* on the basis of mechanisms involving *meaning*. Reality resembles an orchestrated dance, more than it does something constrained by the rigid equations that are the norm in the physics paradigm.

The key to taking meaning into account is to include in analyses the concept of *sign* (as in Peirce's *semiotics*, known as biosemiotics in the context of biology). This has the potential for a radical advance in science.

Signs vs. information

Signs are more than information

and cooperation involves more than simply interaction.

‘Signs serve to mediate between information as a whole and the needs of the organism. This is exactly what distinguishes living systems from non-living ones: the presence in the former of semiotic interaction mechanisms, which have no counterpart in the latter’ (adapted from Hoffmeyer).

Examples of the utility of signs

- Swimming bacteria, where a complex mechanism interprets specific information in such a way that the bacteria can access food.
- Language as system: the speaker produces information related to a goal, followed by its *interpretation* by the listener, resulting in the goal being achieved.
- Such a system acts as scaffolding, upon which can be constructed a world of meaningful activity (semiosphere).

More on incompleteness of physics

Physics and biology involve radically different situations (Dyson). Physicists like to deal with regularities that can be fitted to a formula, but biology is less regular. It deals more with processes (e.g. specific chemical reactions) and organisation (e.g. catalysis) than with precise numbers.

In physics, only what can be quantified is deemed worthy of attention. Ignoring meaning has driven QM to the erroneous conclusion that theory can address only statistical outcomes.

Bohr: observations in physics are to some extent complementary to those made in biology (quantity vs. process), implying that physics experiments can destroy biological information.

Basic hypothesis

The processes studied in physics today, based on quantum mechanics, derive from an underlying *biological* substrate, with properties of mind as well as matter.

Biology is more fundamental!

In biology, component systems ‘fall into place’ through semiotic processes, just as individual constituents fall into place through interactions in regular physical systems such as ferromagnets. Regular physics lacks appropriate tools to investigate such processes, so fails to take into account their important influence.

The pieces of the puzzle

semiotics	*physics*	*intuition*
theory of signs (Peirce)	Locus of control Instability, edge of chaos, gestalts (Hankey)	Circular Theory (Yardley) Oppositional dynamics Circles and Circling Triadic organisation
biosemiotics: structure ↔ process Scaffolding ↔ semiosphere (Hoffmeyer)	Entanglement of matter and meaning Constructive 'intra-actions' (Barad)	
	Transactions involving possibilities (Kastner)	

Barad: active matter

Strange behaviour in the the quantum domain resembles some familiar behaviour in the human domain. Barad's basic picture involves *agencies* that cooperate through 'intra-actions' to produce manifest *phenomena*.

How? With specialised apparatus, such cooperation can constrain possibilities, with manifest consequences.

Familiar example: 'collapse of the wave function'. More dramatic case: the way interference patterns that have been destroyed by a 'which way' observation can be recreated by erasing the information that has been registered in the observation.

Conclusion: under some conditions, matter is able to shape reality in precise ways, similar to what happens with life. Hence it is claimed by some that 'Matter feels, converses, suffers, desires, yearns and remembers' (interview with Adam Kleinmann).

Levels of semiotic behaviour

Reciprocally interrelated units in semiosis:

Sign ↔ object

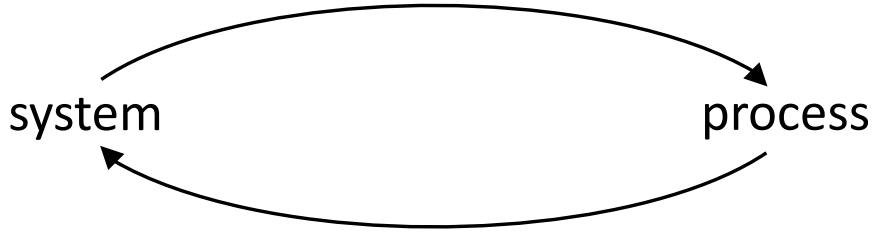
System ↔ process

Scaffolding ↔ semiosphere

Signs and systems

As previous: ‘signs serve to mediate between information as a whole and the needs of the organism. This is exactly what distinguishes living systems from non-living ones: the presence in the former of semiotic interaction mechanisms, which have no counterpart in the latter’.

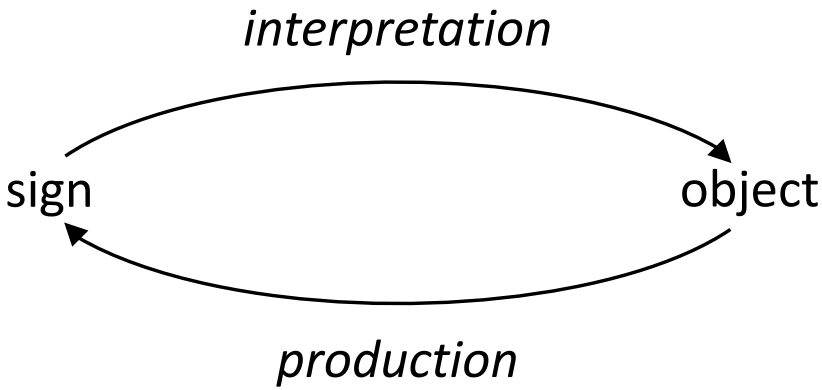
Sign usage develops within a system as part of the development of a process:



e.g. a specific language

Signs and their objects

Signs and objects are related by *interpretation* and *production*:

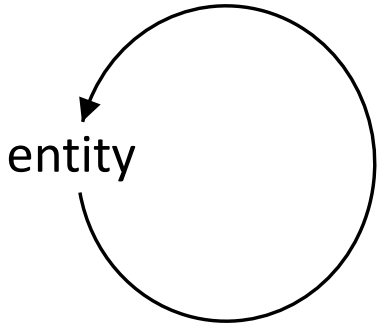


These connections develop as a system develops, and play an essential role in the execution of a process.

Instability, signs and edge of chaos

Alex Hankey, in *Complexity-Biology Based Information Structures* ...

Behaviour of feedback loop:



Code duality

Entity 'echoes back' and can serve as an identifier for the whole process.
Modifying feedback can place a system at the 'edge of chaos' for optimal evolution:
'this term is used to denote a transition space between order and disorder, a region of bounded instability that engenders a constant dynamic interplay between order and disorder'.

Communities: scaffolding and semiosphere

A collection of entities may share the same code system (i.e. the same sign may relate to equivalent objects for all members of the collection), and the same *communicative protocol*.

Thus comes into existence a world of shared meaning (a semiosphere).

The shared mechanisms that develop in a community underlie this shared meaning, and constitute a *scaffolding* that supports all its activities.

(details in Hoffmeyer, *semiotic scaffolding*)

Scaffolding ↔ semiosphere

Mankind, the symbolic species (Deacon)

Signs are of three types: iconic, indexical and symbolic.

The *symbolic* use of signs involves the systematic use of signs in situations where the corresponding objects may be *absent*, a specifically human process associated with its own specialised organising mechanisms, e.g. working in conjunction with long-term memory.

From descriptions to physics via maths

The analysis of behaviour is complicated because performance over a period is obtained by *iterating* shorter-timescale steps.

Consider driving a car: the driver controls just three parameters: the angle of the steering wheel, and the depressions of the brake and accelerator.

Assume these to be determined by some computation *f*(relevant input); then trajectory over time will be got by iterating the influence of *f* that obtains over short periods. Then *f* is constrained by the requirement that this trajectory be consistent with demands such as making progress, and not suffering a collision.

Thus *f* is seen to be a solution to a well-defined problem, and learning is a matter of finding solutions to this problem over a range of situations.

Example of application of maths (Osborne 1995)

5.3 A Mathematical Formalisation of the 'Emergence Relative to a Model' Model

A mathematical formalism has been proposed by Nils Baas[32, 33] in an attempt to define emergence from the 'emergence relative to a model' approach. This may be summarised as follows:

Consider a set of primitive objects - 'first-order structures' - denoted $\{S_i^1\}$, and an observational mechanism, Obs^1, to 'evaluate, observe and describe the structures $\{S_i^1\}$'.

A general procedure is then required to construct a new set of structures - second-order structures - $\{S_j^2\}$ from $\{S_i^1\}$. To this end, the observation mechanism is applied to the members of $\{S_i^1\}$.

Using the properties derived from the observations, $Obs^1(\{S_i^1\})$, a set of interactions Int^1 may be defined. By subjecting members of $\{S_i^1\}$ to Int^1, a new structure is obtained:

$$S^2 = R(S_i^1, Obs^1(\{S_i^1\}), Int^1) \tag{5.1}$$

where R is the construction process resulting from the interaction Int^1 and S^2 is a second order structure. Second order structures may be observed by a new observational mechanism Obs^2 (it may be equal to, overlap, or disjoint from Obs^1). According to Baas, emergence may now be defined thus:

P is an emergent property of S^2 iff

$$P \in Obs^2(\{S_i^2\}) and P \notin Obs^2(\{S_j^1\}) \tag{5.2}$$

Computer simulation of balance

The Logical Structure of the Cognitive Mechanisms Guiding Psychological Development

by George Osborne
Wolfson College
Cambridge

https://philarchive.org/rec/OSBTLS-2

Program structure

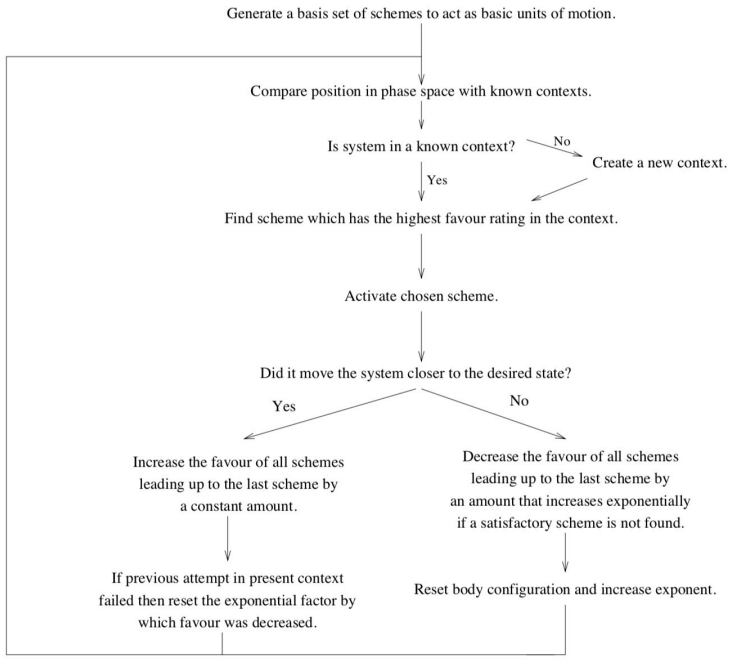
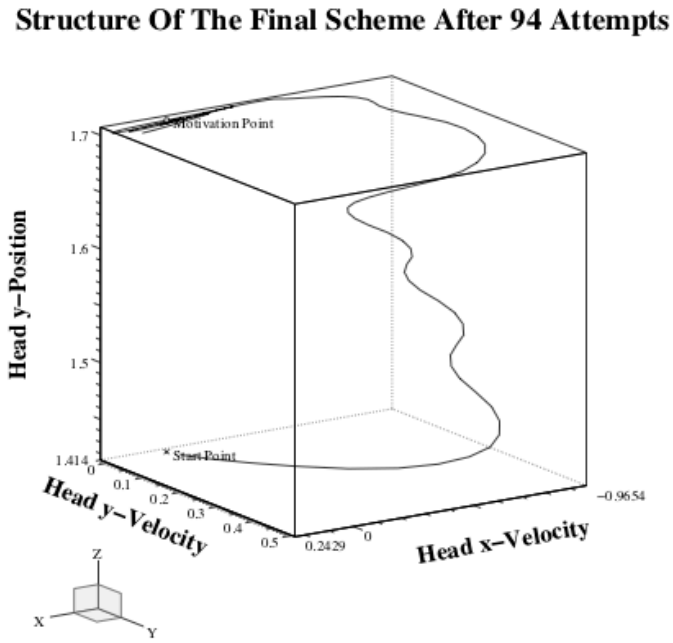


Figure 10.1: Flowchart Representation of the Second Program

Output of program



When progress and politics collide

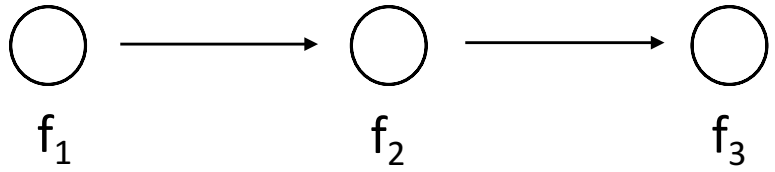
Despite this work meeting the approval of two senior members of the theory group, the department considered it inappropriate, and pressurised the student into discontinuing the work.

This illustrated well ‘The remarkable hostility sometimes encountered by those who venture into unconventional areas’ (from the abstract of my historical review *Coupled superconductors and beyond,* at arXiv:1206.5850).

Stepping stones

‘New emergent scaffolding devices (unknowingly) function like stepping stones in a river, leading evolutionary processes forward one step at a time and — on average — farther away from the bank at each step’ (Hoffmeyer)

Signs serve to mediate between information as a whole and the needs of the organism: new types of sign are relevant at different stages and can ensure a further step of progress — but the signs need to be relevant ones.



1976 paper on ‘one step at a time’

Multistage acquisition of Intelligent Behaviour

B.D. Josephson and H.M. Hauser

Kybernetes, 10, 11-15 (1981)

http://cogprints.org/813/

Human skills are acquired not by a single uniform process, but in a series of stages. We have investigated such a sequential process by taking as an illustrative example the game of table tennis. The aims in each stage of learning are qualitatively different, and we show in detail how knowledge gained during one stage provides essential information for subsequent stages.

Stepping stone mechanism constraints

The stepping stone concept requires the following, in order for such a mechanism to be able to manifest:

- Stepping stones must exist
- Stepping from one to the other must be achievable (S. Kauffman's 'adjacent possible')
- Process needs to be at the edge of chaos so can alternate between stability and change

Language illustration

It is a confusing situation: we know about parts and how parts fit together, but there is no clear picture of the whole as we expect in fundamental physics. Language in particular illustrates the situation. It involves a highly complex system, which can express deep ideas, and somehow 'just works'. This must be because from time to time parts get added on to the scaffolding, and may be retained when they fit in well with existing state of affairs.

The stepping stone picture demonstrates the relevance of *history*: how things are today depends on steps that were taken in the past, each of whch steps led in due course to regained stability that could form the basis for reliable new developments.

Mathematics may apply locally, but the history dependence of a given system means that no formula for behaviour at any given time is possible.

Does this matter for physics?

Whether it matters depends on whether this kind of thing happens at a fundamental level, as in Barad's picture, or the orthodox statistical picture is all that is possible. How can the biosemiotic analysis be applied at this fundamental level? Yardley proposes the following: 'An entity is always part of a process, a process always part of a system, which is always part of an entity, process and system, ad infinitum'.

The 'ad infinitum', if valid, has the immediate implication that biology does not stop with regular physics and chemistry: similar phenomena happen at all scales, a feature common to a number of systems.

Oppositional dynamics

A key role in Yardley's analysis is played by 'oppositional dynamics', or 'two acting as one', particular forms of which we have already met under the name 'reciprocally interrelated units':

Sign ↔ object

System ↔ process

Scaffolding ↔ semiosphere

In circular theory there is more:

Mind ↔Matter

Pairing and reproduction

Simple patterns coexist with complex ones in an approximation to equilibrium. It is a constrained process where parts can nevertheless move together on the basis of intercommunication (cf. Barad).

Linkage between two parts, say X and Y, can account for reproduction:

X Y X

Relationships and scaffolding

A third element Z is involved in relating X and Y, and can develop into a complex scaffolding-type ordering mechanism. In its simplest form, Z is a combination xy, and x and y individually pair with X and Y, determining their relationship.

This picture is a single entity indicating the relation between two, rocks and car. With language, phrases do something similar.

How it starts

Only a very basic structure is needed to start all of this off, avoiding the complexities of the origins of conventional life. One entity (circle) separates into two (line), while a third entity, playing the role of mind, encodes the relationships between any two, and forms the start of a community that can organise matter.

A key insight: ‘any idea is connected to a counter-idea (an opposite, or its object), or else the idea cannot exist’, characterising what a valid idea must consist of.

Triads and contexts

Idea
(mind)

unfolding of idea
(matter)

context
linked to symbol

Many ideas may apply to a single context, regulated as a unit by a ‘foundational computer’ pi that brings all the ideas together.
‘Pi produces stability and reliability for reality, which, in and of itself, is, markedly, unstable and unreliable’.

Mind, the universe and everything

In this picture there can exist ‘global scaffolding’, corresponding to a semiosphere or sphere of action consisting of the totality of activity.

Mind ↔ Matter

This *field of mind* could be the origin of the cosmos, of life, and the direction of evolution.

‘There is a symbolic man in mind which is the idea of man which had to be present somewhere hidden (imaginary, an idea) before man could appear’.

In other words, evolution led to man because the endpoint of the process already existed as an idea that could direct what happened during evolution.

Links with physics

The idea that biology extends to all scales legitimises Barad's approach, and motivates the attempt to link this with quantum physics.

- QM describes the linear aspect of nature involving vibrations.
- Observers build up structure through apparatus that has evolved to deal with this, based on filtering and interference. Cutting a unit into two constitutes measurement, with one part ending up with a mark correlated with the state of the other. Apparatus and part are correlated (from Barad's *Meeting the Universe Halfway: the Entanglement of Matter and Meaning*).

Homeopathy

I include this slide as a result of a plea, by Peter Adams, author of 'Homeopathy: Good Science', who remarks that 'The campaign against homeopathy is gathering force', simply to note that this approach supports Benveniste's idea of biological signal (see *From high dilutions to digital biology: the physical nature of the biological signal* by Yolène Thomas).

The idea is just that in biology we know that signals are used to denote particular concepts (e.g. cries of animals), and water might be used as a carrier for such signals, with biologically active molecules being their source. Dilution would eliminate the molecules, but not the signals.

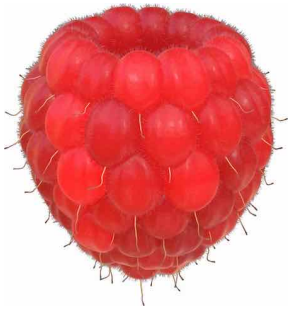
Conclusions

Physics was driven into its current position by a materialistic ethic to which all members of the club were compelled to subscribe. The kind of alternative discussed here is much more appealing.

Biosemiotics took the Peirce's concept of sign and applied it to biology, introducing during the process a number of radically new concepts which have the potential to revolutionise science. Such concepts can be formulated mathematically, making them relevant to physics, including fundamental physics if the idea that biological function happens at all scales is correct.

Acknowledgements

Thanks to Ilexa Yardley and Alex Hankey for deep discussions.

(and a  to the physics department).

And thanks to the audience for your attention!

THE END