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Biological Information, Biological Interaction and Anticipation

Understanding biological organisations and interactions is becoming ever more important. In this talk, a concept of information designed to handle information conveyed by organizations is introduced. This concept of information may be used at all biological scales: from molecular and intracellular to multi-cellular organisms and human beings, and further on into collectivities, societies and culture. This concept is based on whole-part graphs, a mathematical model for biological organization introduced earlier [1]. This model supports the formal investigation about properties of biological organisations, allowing for mathematical proofs and the definition of organisation transformations [2].

Another concept, necessary for developing the definition, will also be introduced. It is the concept of synexions, or organisations immersed in space-time. The definition of information also formalizes perception, observers and interpretation; although observers appear just as acknowledgers of changes. In this setting, information and interpretation stand as seminal elements of (biological) interaction and of transformation of organisations. Some aspects of these concepts will be clarified while arguing why the immersion of whole-part graphs in (the physical) space-time is needed. This immersion connects the definition of information to issues related to anticipation.

Methods for identifying organisations in biological data may be derived based on whole-part graphs. However, methods for inspecting and identifying organisations in bio-chemical networks grounded solely on network information and not considering interactions with the environment do not work satisfactorily [4] for the following reason. It can be proved that de-organizing things into their interconnected parts is a deterministic process, while re-organizing associated parts into wholes is a non-deterministic process. This implies that raw relational data [6], like bio-chemical networks, is insufficient to determine their natural organisation and how biological organisations come to be, indicating the importance of neatly considering interactions in the organisation process.

It has been suggested that information exchange is the distinctive mode of interaction in biological phenomena [5]. The arguments presented in support to this claim are grounded on Shannon's information, what keeps information more as an investigatory aid than as something intrinsically entailing the phenomenon. Shannon himself called attention to the fact that his definition of information-contend precludes meaning and interpretation, addressing only the communication (signal transmission) aspect of information exchange [7].

The present definition of information ties interpretation to changes in organisation [3]. Therefore, information-grounded biological interactions mold organisations. The fact that the definition is grounded on synexions rather than whole-part graphs intertwines anticipation to information recognition. Indeed, the perception of an interpretation event relies on the violation of the anticipation by an observer

about propensities in the behaviour of the interpreter of a signal. In this sense, biological information and anticipation are at the very core of biological interactions and the consequent formation and transformation of biological organisations.

References

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