ON THE ROAD TO CYBERNETIC IMMORTALITY: A Report on the First Principia Cybernetica Workshop

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Received July 31, 1991

Abstract. *Principia Cybernetica* is an attempt to unify cybernetic philosophy based on harmonizing systems theory and cybernetics. The ontology recognizes meta-system transitions which lead to higher level of organization and evolution. One of the emergent aspects of meta-system transitions, when human society is viewed as a whole, is the human "superbeing" or "metabeing" characterized [among other attributes] by "cybernetic immortality". The metabeing hypothesized by this meta-system transition may share characteristics of a posited *homo trans-sapiens*. In the context of cybernetic immortality, what survives is cybernetic organization [which may be embodied in a variety of media including organic tissues or electronic networks, rather than strictly biological media]. The practical aspects of the first workshop of the Principia Cybernetica Project, and its main philosophical themes, were concerned with means with which to amplify the spontaneous development of knowledge. Idea memes were discussed as some of the fundamental building blocks which when subjected to mutations and recombinations lead to knowledge amplification. A report is given on papers presented at the workshop.
Keywords: systems, cybernetics, meme, immortality, computers, ontology, emergence, epistemology, ethics, evolution, knowledge.

I. Introduction.

Principia Cybernetica is an effort to build a unified cybernetic philosophy based on unifying systems theory and cybernetics. The goal is patterned to some extent after the goals of unification of mathematics undertaken by Whitehead and Russel [1925]. The first workshop of the Principia Cybernetica Project [Principia] took place in Belgium from July 2 through July 5, 1991, and was attended by researchers from Europe, Mexico and the United States. The workshop was chaired by Francis Heylighen. The focus for the meeting was provided by Heylighen, Valentin Turchin, and Cliff Joslyn. [Heylighen, Turchin and Joslyn form the Principia editorial board]. This report aims at capturing some of the points discussed at the Workshop and presented in formal and informal presentations.

The formal program included talks by Heylighen, Joslyn, Turchin, McNeil, Lofgren, Pask, Moreno, Moritz, Glanville, Van de Vijver, Caravallo, Glueck, Henry, Elohim, and Kenis. Computer demonstrations were given of decision systems, music synthesis, and Principia software. The meetings took place at the Free University of Brussel's Alumni Center [Union de Anciens Etudiants - Campus Plaine, Universite Libre, Brussels]. An excellent reception was arranged at Toone [home of the famous puppet theater]. On Wednesday, a lively workshop dinner was held at the Alumni Center.

The overall goals of the Principia Cybernetica Project were described in an earlier issue of this Journal [Heylighen, Joslyn, and Turchin, 1991]. The workshop's announcement statement below captures some of these goals.

> *Principia Cybernetica is an attempt by a group of researchers to collaboratively build a system of cybernetic philosophy, moving towards a transdisciplinary unification of the domain of Systems Theory and Cybernetics. This philosophical system will be developed as a network, consisting of nodes or concepts, linked by different types of semantic relations. The network will be implemented in a computer-based environment involving hypermedia, electronic mail, and electronic publishing. The project naturally splits into two issues:*
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> *1) development of the philosophy itself, which is systemic and evolutionary, emphasizing the spontaneous emergence of higher levels of organization or control through variation and natural selection. It includes: a) a metaphysics, based on processes as ontological primitives, b) an epistemology, which understands knowledge as constructed by the subject, but undergoing selection by the environment; c) an ethics, where survival and the continuance of the process of evolution is taken as supreme value.*

1049-6335/91/0200-054 $3.00 © 1991 IMR

2) development of computer-based tools and methods for collaborative theory building (CSCW, groupware, SGML, knowledge acquisition...): Many participants with different backgrounds and working in different places exchange knowledge and opinions about a common problem; their different contributions and reactions must be integrated and structured, in order to form a coherent system of concepts and values, transparently modelling the problem domain.

Both issues are united by their common framework based on cybernetical and evolutionary principles: the computer-support system is intended to amplify the spontaneous development of knowledge which forms the main theme of the philosophy.

Heylighen's lead paper, *An Evolutionary System Modelling Evolutionary Systems: Introducing the Principia Cybernetica Project* set, the stage for the workshop. In this paper, the current fragmentation of knowledge coupled with other 'confusions and complexities' drive the need for integration. A cybernetic philosophy is offered as a means to search for and achieve integration based on applying cybernetic methods to systems theory and cybernetics. This procedure is argued to provide an evolutionary cybernetics where organization is the fundamental structure. This organizational principle is based on being independent of substance and applicability in different domains. Emergence is also a fundamental systems principle where there exists a hierarchy of organizational levels and where control is a hierarchical constraint leading to emergence. Heylighen introduces evolutionary principles at this point to provide spontaneous self organization and 'blind variation and selective retention'. The blind variation and selective retention is argued to be generally applicable, and in particular, applicable to systems of ideas. The evolutionary aspect of evolution of idea systems [such as Principia Cybernetica] is shown to allow enhancement of natural development [lower requirements for trial and error development, avoidance of dead-ends]. Heylighen concludes by describing the venues of information technologies [storage, multimedia, man-machine interfaces] allowing an efficient approach to form networks of concepts with ideas represented as nodes and links in the network.

Joslyn's paper, *General Notes about the Principia Cybernetica Project and Related Initiatives*, and Turchin's paper, *A Tentative Sketch of the Starting Nodes of PCP*, completed the normative discussions starting the workshop. These first three papers provided a review of terminology, goals, approaches, and sketches of status of the Principia Project and illustrated examples of specific Nodes.

II. About Cybernetic Immortality

The foundations of Principia Cybernetica rest on an ontology starting with elementary processes leading to stable "systems" through mechanisms of variation and selection. With it, it is argued that complex organizations emerge such as human society and culture. The events of emergence are regarded as "quanta" of evolution which lead to new systems with new identities possessing different properties. A particularly fundamental category of emergence is the "meta-system transition" (Turchin, 1977) which yields a different level of control that increases the adaptivity of a system (e.g. the emergence of human intelligence).

In the Principia Cybernetica's epistemological framework, knowledge is understood as consisting of models that allow the adaptation of a system by anticipation of possible perturbations. Models which generate inadequate predictions are likely to be eliminated. While there are no "absolutely true" models of reality, different "adequate" models may exist for solving particular problems. The epistemological framework leads to an evolutionary ethics in which the fundamental "good" is the continuation of the process of evolution, and avoidance of extinction. An extension of the epistemology and ethics suggests that there is currently a new meta-system transition in process. This meta-system transition is leading to a yet higher level of evolution: the human "superbeing" or "metabeing" characterized [among other attributes] by "cybernetic immortality". The metabeing hypothesized by this meta-system transition may share characteristics of what Moritz posited and described as *homo trans-sapiens* [Moritz, 1990b]. In the context of cybernetic immortality, what survives is cybernetic organization [which may be embodied in any type of media including organic tissues or electronic networks], rather than strictly biological media. Issues associated with such ethics are raised by Turchin [1977] and others [Heylighen, Joslyn, and Turchin, 1991]

The concept of cybernetic immortality is a consequence of the cybernetic meta-system transition framework crafted by Turchin [1977]. Joslyn discussed this in his review of control theory and meta-system theory. Turchin's original framework may be synopsized as:

Culture is control of thought;
which is control of associating;
which is control of complex reflex;
which is control of simple reflex;
which is control of movement;
which is control of position.

Turchin noted that over a period of time, the ratios of population growth:production growth:science growth are in the proportion 1:2:4. These he compared to growth of body mass, muscle mass, and brain mass demonstrating an implicit requirement for better information distribution and control. In considering the above with the role of will

55

and the fact of human mortality, Turchin crystalized the recognition that "the protest against death, against disintegration of one's own personality, is common to all people". Furthermore, the act of "*the will to immortality*" is one of the "*Supreme Values*". In Turchin's analysis, it is this will to immortality that drives towards an integration of individual awareness, and in turn can result in a synthetic consciousness which may have the attributes of [cybernetic] immortality.

In the workshop, the concept of "will to immortality" has been elaborated by Heylighen in his *Evolutionary Foundations for Metaphysics, Epistemology and Ethics* paper where cybernetic immortality emerges as a result of cognitive development contingent on immortal meme systems, metarational consciousness, and limitless variety of available knowledge. Heylighen's construction of cybernetic immortality makes use of Moritz's [1990a,b] meme formalism. [In Moritz's meme formalism, memes are informational replicators with principal attributes of pattern and meaning where certain theoretical and empirical combinatorial attributes may be observed; successful memes can be characterized by their high fecundity, fertility, and fidelity indices].

The main points of Heylighen's program is that while in biological organisms genes are immortal, in cultural evolution memes take the place of genes and that cultural evolution is ultimately more efficient with "immortal memes". Heylighen directly recognizes the potential for eliminating the boundary between brain and machine which allows memes [and ideas] to survive outside the brain. Cybernetic immortality is associated with the potential of dynamic survival of memes outside the brain. Furthermore, Heylighen observes that cybernetic immortality can motivate individuals.

While this has not been spelled out directly at the conference, it is clear that the discussion of cybernetic immortality leads directly to the questions of coding of memes and their relationships and their instantiations in non-biological devices, as well the questions of the generated trajectories of memes and their combinations.

III. Program of the Workshop.

The following discussions/papers, presented at the workshop, are listed in their approximate order of presentation. The abstracts of these papers were published as a workbook [Heylighen, 1991].

FRANCIS HEYLIGHEN (Free University of Brussels): *An Evolutionary System Modelling Evolutionary Systems: Introducing the Principia Cybernetica Project.*

CLIFF JOSLYN (State Univ. New York at Binghamton): *General Notes about the Principia Cybernetica Project and Related Initiatives.*

VALENTIN TURCHIN (City University of New York): *A Tentative Sketch of the Starting Nodes of PCP.*

DONALD H. MCNEIL (Philadelphia, Pa): *The Principia Project*

LARS LOFGREN (Lunds Universitet,Sweden): *Foundational Issues Addressed by Cybernetics.*

GORDON PASK (London and University of Amsterdam): *The Foundations of Conversation Theory, Interaction or Actors Theory.*

ALVARO MORENO, ARANTZA ETXEBERRIA & JON UMEREZ (University of the Basque Country, Spain): *Biological Information: The Causal Roots of Meaning*

LUIS ROCHA (Instituto Superior Technico, Lisbon): *Fuzzyfication of Conversation Theory.*

VALENTIN TURCHIN (City University of New York): *Metasystem Transition as the Quantum of Evolution.*

RANULPH GLANVILLE (Southsea Hants, UK): *Excavation and Underpinning, Foundation and Building.*

GERTRUDIS VAN DE VIJVER (RUG, Gent): *Error: Epistemological Options in Cybernetics*

ELAN MORITZ (The Institute for Memetic Research): *The Case for Imperfect Machines.*

CLIFF JOSLYN (State Univ. New York at Binghamton): *Control Theory and Meta-System Theory.*

FRANCIS HEYLIGHEN (Free University of Brussels): *Evolutionary Foundations for Metaphysics, Epistemology and Ethics.*

ELAN MORITZ (The Institute for Memetic Research): *Memetics: Introduction and Implication to the Evolution of Knowledge.*

MARC E. CARVALLO (State University of Groningen, Netherlands): *Self-organization, Evolution, and Religion: Some Notes on Erich Jantsch's Theory of Religion.*

ROBERT GLUECK (Technical University of Vienna): *Metasystem Transition in the Machine and its Application to Knowledge Systems.*

CHARLES HENRY (Columbia University, New York): *Non-Verbal Aspects of Language and Knowledge Structuring.*

J.L. ELOHIM (Col. Condesa, Mexico): *Culture, Cybernetically Interpreted, is a Cybernetic Reflection of Nature Altered by Culture.*

PETER BEYLS (Gent, Belgium): *Cybernetic Concert.*

CLIFF JOSLYN (State Univ. New York at Binghamton): *Software Support for Principia Cybernetica Development*

DIRK KENIS (Free University of Brussels): *MacPolicy: Delphi and Group Decision Support Ideas for Computer Supported Cooperative Working.*

FRANCIS HEYLIGHEN (Free University of Brussels): *Structuring Knowledge in a Network of Concepts.*

Other participants that contributed to lively and thought provoking discussions were J.P. Van Bendegem (Free University of Brussels), G. de Zeeuw (University of Amsterdam), and J. Ramaekers (Int. Assoc. of Cybernetics).

IV. A Sampling of Papers.

While all the papers and discussions at the meeting were of high quality and interest, space considerations prevent us from describing each in the detail it deserves. Thus only a sampling of papers is presented [in no special order]. Readers interested in more details are encouraged to contact the authors directly, or contact the workshop chairman [Dr. F. Heylighen, Systems Researcher, PO, Free University of Brussels, Plienlaan 2, B-1050, Brussels, Belgium, email: fheyligh@vnet3.vub.ac.be].

Glueck presented the paper *Metasystem Transition in the Machine and its Application to Knowledge Systems*. The main thrust was a practical one of applying metasystem transition formalism to the design of program specializers and supercompilers. Glueck makes use of partitioning knowledge schemes into a knowledge base [structured according to some knowledge representation schemes such as semantic networks] and a mechanism for maintaining the knowledge base. When applying multiple metasystem transitions coupled with binding time analysis he finds significant improvements possible and is able to track deficiencies to improper self-applications of program generalizers. Glueck noted the potential for new self-application products such as compiler generators with arbitrary language generators.

Moreno, Etxeberria, and Umerez contributed the paper *Biological Information: The Causal Roots of Meaning*. They begin with the notion of Life involving two processes a) the process of materially causing an effect (representable by laws of physics and chemistry), and b) the processes of controlling processes (representable by cybernetic laws). Typically these are considered irreducible to each other. They argue biological systems are of a "mixed" nature and require concurrence of a third element that may be viewed as an "interpreter". It is viewed that causality between different levels of organization are characterized in terms of emergence that may take either ontological, epistemological or methodological form.

Moreno et al attribute generation of non causal dynamical or physico-material discontinuities to acts of observation. They view that there are two types of information 1) self referential information, and 2) epistemic information. The self referential information can give rise to functional causality. This causality is different from classical causality in that it creates [new] links between components but does not preserve distinctions. This leads to a partial causality from which Moreno et al hypothesize that "natural meaning in biological systems has to do with cause/effect at a certain level of organization that revert to 'emergent' configurations at a higher level that, on the one hand, fulfill some functional action and, on the other, are unpredictable from the lower level". The interest here is to try to simulate such biological systems in symbol systems that would give rise to *autonomous, non programmed symbol systems.*

Roca presented the paper *Fuzzyfication of Conversation Theory* where extensions of Pask's conversation theory are aimed at developing a conceptual network based on resemblance between concepts. The work rests on nodes representing concepts and properties, and concept-property links that attribute a property to a concept. Links between concept-concept nodes form the resemblance links between concepts. A metric is provided for resemblance between concepts while the distance between concepts is taken as the inverse of their resemblance. With the aid of Fuzzy Logic properties, it is possible to form notions of neighborhoods of concepts and then move on to retrieval. Roca then introduces Pask's entailment mesh structures as clusters of concepts. Control of spreading of the conversation domain is achieved by pruning to yield limited associative chains. These form the control of the conversational domain. Finally, Roca concludes by introducing means with which to move from hierarchical to non-hierarchical domains [non-hierarchical are designed to simulate associative mental processes while hierarchical are designed to simulate deductive processes].

Moritz presented two papers. In *The Case for Imperfect Machines* I explored the connectivity of the Principia Cybernetica program and memetics as they relate to the use of machines. In particular, the cybernetic immortality of PC was posited to require two types of immortality: Type 1 immortality is identified with *concept immortality* [e.g. immortality of memes] and is best associated with static machines. Static machines may be hieroglyphics, books, permanent markings, and their generalizations. Type 2 immortality is *process immortality* which may be captured in dynamic machines.

Discussion of imperfect machines included classifications of different hierarchies of machines and in particular man-made and machine-made machines with a focus on computers. Perfect machines were argued to require a) perfect knowledge, b) perfect structure, c) perfect process [instructions], and d) perfect I/O. It was argued that in reality one cannot achieve these perfections. For example, knowledge can be considered as consisting of collections of facts, relationships, theories, speculations, beliefs, etc., and the rules for their application. Human history has shown that all these are functions of time [contrast for example the Ancients' theory of matter consisting of four elements with present theories of chromodynamics and superstrings].

In considering perfect processes the issues such as fixed vs. adaptive goals, content modifiable programs, notions of proofs and extra-machine knowledge were raised. Regarding I/O the importance of 'private thoughts' or computations vs. 'public thoughts' was highlighted. In I/O exchanges, one only sees 'public' processes, whereas much of the creativity and innovation in machine processes may in fact be resident in 'private' or privileged segments. Consideration of processing element numbers, densities, connectivities, scales of evolution, and the fluidity of truth were argued to support the conclusion that *perfect machines are abstractions.*

Given that real machines are argued to be inherently imperfect, three categories of imperfect machines can be formed a) immature machines that are limited by [age dependent] shortages of experience or resources, b) un-capable machines constrained by similar limitations [but now due to injury, design insufficiency, etc.], and c) unstable machines. Unstable machines are a special category of imperfect machines. The source of imperfections may reside in unpredictability of the machines [varying responses to identical inputs], positive disorders [e.g. proclaiming absence of input when real input is provided], and negative disorders [output in the absence of any input or programmed instruction].

I argued that there are several domains of concern. One is the *critical domain* where immediate life-death decisions and activities are involved. The *non-critical domain* is the complimentary domain which may consist of support activities, energy and knowledge gathering, exploration, etc. In the critical domain one may further consider MacroCriticality [i.e. decisions that may be critical to all life forms, e.g. global nuclear warfare, ozone depletion, ...] and MicroCriticality [decisions that may cause death to a limited number of individuals, but not to an entire species].

Meme passing between replicated machines was offered as a means to exploit capabilities and avoid disasters. Meme sharing provides means of resource pooling and experience passing. Network averaging is a means to avoid instabilities. Culture and Trans-Culture were explored in terms of these concepts. The potential of large number of machines, connections and man-machine interactions [and melding of man and machine cultures] were argued to provide the potential for cybernetic immortality as well as an accelerative framework for the emergence of a viable *Trans-Culture.*

In the second paper, *Memetics: Introduction and Implication to the Evolution of Knowledge* I reviewed some of the foundational material of memetics [Moritz, 1990a,b] and demonstrated examples of visual memes and emergence events as a result of hyper-replication of visual memes. Specific attention was given to 'ideas' as a special type of meme. I argued that exploration of empirical memetic regularities provides a means with which to understand limitations of cognitive processes and representational frameworks.

I outlined a memetic simulator, *LockeStep*, being developed at the IMR. *LockeStep* is a rudimentary knowledge evolution simulator and new meme generator which supports modeling of multiple knowledge agents, memetic rules, and time stepped interactions. *LockeStep* simulations indicate that a) consistency is a more powerful notion than truth, b) too many knowledge agents lead to early saturation of the 'memetic universe' - it is better to start off with few generators of knowledge and then codify knowledge in new standardized memes, c) large vocabularies are more 'interesting' than smaller ones, d) many nonsense memes emerged [i.e. weeding out of nonsense memes is useful], e) quite a few memes emerged that made more sense than initially expected, and f) linguistic and other memes may carry a kind of 'potential energy' that is 'released' when memes bind into a higher level meme. This 'potential energy' may be viewed as 'meaning' [this is a tentative identification]. Other insights were obtained with *LockeStep*; these will be discussed elsewhere.

The recommendations for Principia Cybernetica as a result of memetic considerations and *LockeStep* simulations included the urging to:

* *obtain 'a lot of knowledge' at low cost,*
* *replicate pockets of knowledge in several connected machines,*
* *generate many meme combinations and track unusual memes,*
* *partition knowledge into dynamic and static domains, and*
* *establish census, consensus, and credit assignment and tracking mechanisms.*

The workshop concluded with a panel discussion chaired by Heylighen, Joslyn and Turchin. The panel reviewed the week's meeting and the way ahead. Future meetings and goals were discussed with a general aim of reconvening again in about a year's time.

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58