

Foreword: Re-discovering and Re-inventing Heinz von Foerster

Karl H. Müller¹ & Albert Müller²

Heinz von Foerster (November 13, 1911 – October 2, 2002) was a master in inverting and subverting established forms of meaning. Sentences like “The map is the territory” or “Truth is the invention of a liar” have become classical examples of such an inversion and have won considerable popularity. With respect to the word pair of discoveries and inventions Heinz von Foerster pointed out that many instances of discoveries in scientific domains like mathematics or chemistry should rather be qualified as inventions. Inventions place an observer into the center of operations and hold her or him fully accountable whereas discoveries leave an observer largely out of the picture and separate her or him from the results of the discovery-process. Re-discovering or re-inventing seem to be second rate operations at best and reduce the originality and accountability of an observer even more. So why then re-discovering and re-inventing Heinz von Foerster?

Using Heinz von Foerster’s subversion and inversion strategy, re-discoveries and re-inventions, much more than discoveries and inventions, produce genuine novelty since they transform a familiar object into a new one. In this sense, the process of re-discovery turns a well-established and embedded domain into something effectively new which is full of potential surprises and unexpected aspects. Similarly, re-inventions open up significantly new forms of utilizations which were inaccessible under the old invention configuration. In fact, one could even propose two innovation theorems (Müllers’ theorems):

- Re-discover and you will find radical novelty! (Nr.1)
- Re-invent and you will move to genuinely new application fields! (Nr.2)

Re-discoveries in science, because of their estrangement of too familiar contexts, transform well-known authors and texts into new challenges for our interpretative understanding. In our view, many articles and research papers by Heinz von Foerster from the late 1950s to the early 1980s have the quality that they are worth to be re-discovered. Three of the articles in Part I date from this period and the fourth

1. Karl H. Müller is head of the Wiener Institute for Social Science Documentation and Methodology (WISDOM) in Vienna, Liechtensteinstraße 22a/2/17, 1090 Vienna and editor in chief of a book series on *Complexity, Design, Society*. He is also President of the International Heinz von Foerster Society. E-mail: mueller@wisdom.at

2. Albert Müller works at the Institute for Contemporary History at the University of Vienna (Spitalgasse 2 – 4, 1090 Vienna) and is responsible for the Heinz von Foerster Archive. He is also Secretary General of the International Heinz von Foerster Society. E-mail: albert.mueller@univie.ac.at

contribution is a reflection by Heinz von Foerster on his ways of thinking and on his typical research heuristics.

Likewise, the thirteen contributions by friends, relatives and colleagues of Heinz von Foerster are focusing on an astonishing diversity of aspects and facets of Heinz von Foerster's impact and legacy today. These small articles make it clear that Heinz von Foerster can be re-invented in a rich manifold of ways and along multiple dimensions so that the present selection is far from exhausting the potential scope of re-inventions.

In this way the present CHK issue on the occasion of Heinz von Foerster's 100th birthday avoided, at least from our editorial point of view, the nostalgic sentiment of a purely commemorative volume full of anecdotes and personal recollections of a charismatic researcher, friend, and magician. Instead, the two parts of this volume can be seen as an invitation for re-discovering and re-inventing Heinz von Foerster. It might well be that the Heinz von Foerster from the 1980s onwards with his dense schedule of magic lectures and conversations around the world, but outside the contexts of his Biological Computer Laboratory (BCL), became the most significant barrier to his research work in the previous decades.

The entire CHK issue is composed of two parts. The first part presents Heinz von Foerster directly with four largely inaccessible or unpublished texts and the second part offers thirteen re-inventions of Heinz von Foerster by friends and colleagues. Together, both parts underline the high relevance of Heinz von Foerster's work for contemporary contexts and its wide scope which was genuinely transdisciplinary at a time where the term transdisciplinarity was almost unknown.

Introduction to Part I: Re-Discovering Heinz von Foerster

The 100th birthday of an eminent scientist is not only a good reason to celebrate and commemorate the person, but also to draw our attention once again to his work, especially since there is the obvious problem with classical authors that many people keep their texts in the shelves but only seldom take them out and read them.

The core of Heinz von Foerster's work which comprises approximately 200 entries in his bibliography³ is scattered across a larger number of journals and books and is quite well documented in two English and three German volumes (von Foerster, 1982, 1985, 1992, 1993, 2003) and, therefore, easily accessible for any potential reader. It is clear that a selection process comes before the publication of such anthologies, a selection which might be—and often indeed is—influenced by authors, editors, and publishers in the same way. Pieces which for whatever reason do not belong to such a selection often become less well known and even forgotten, especially if the place of the first publication is somehow remote, and the publications is not well represented in academic libraries. History of science abounds with cases in which the non-reception and the final forgetting of papers is not a result of the quality

3. See, e.g., the bibliography <http://www.univie.ac.at/heinz-von-foerster-archive/>

of a paper but due to different contexts or seemingly external dimensions like the place of a publication, its language, the trajectory of its reception, the inclusion in or the exclusion from citation networks of citations, and so forth. All these factors cannot be significantly influenced by either the author or the wider audience. This commonplace in history of sciences has many examples, one of the best known now is the case of the Polish physician Ludwik Fleck (1896-1961) whose German book (Fleck, 1935) on scientific thought styles and thought communities seemed to be written in vain when it came out in a Swiss publishing house in the 1930s, more or less cut off from the then Nazi-dominated German market. It took decades until author and book had been rediscovered, translated and made known to the public (Fleck, 1979). Nowadays Fleck is at the center of discussions in history and theory of science and to study his work became compulsory.

When it was suggested to select some of von Foerster's articles and pieces less or not known for (re)publication, it was not easy to decide upon such a selection since the material available for such a purpose turned out to be larger than assumed⁴ although there have been considerable republications until now (Pias, 2003; Grössing et al., 2005; Müller, 2008; von Foerster, 2010). Finally, we decided upon the following criteria: The selected pieces should document von Foerster's early ambitions to work in the direction of a transdisciplinary research program on cognition which was to be classified later as second-order cybernetics. Moreover, there should be elements in the selected pieces, which make them fit together coherently, for instance by varying a certain theme or argument or varying the deployment of certain examples or experiments. Finally, the pieces should be representative for von Foerster's style of thought and his typical way to approach and present problems.

In the end we came to the following selection:

- Perception of Form in Biological and Man-made Systems (von Foerster, 1962)
- Logical Structure of Environment and Its Internal Representation (von Foerster, 1963)
- Formation, and Neural Organization of Perceptual Spaces (unpublished).

An additional element was added, namely a translation of a chapter from a German book with and about Heinz von Foerster which was published in German already in 1997 and which will be made available in its English version in 2012.

- Heinz von Foerster on Heinz von Foerster: Experiences, Heuristics, Plans, Futures (von Foerster, 1997).

4. The selection was based on material kept in the Heinz von Foerster Archives at the Dept. of Contemporary History, University of Vienna (Müller, 2003).

Perception of Form in Biological and Man-made Systems

Heinz von Foerster grew up—he did not become tired of mentioning it (von Foerster, 2003)—in a specific cultural and social ambience which was able to encourage strongly his interest not only in the sciences but even more in arts, music, design and performance. Between the normally separated fields of (globally speaking) the arts and the sciences he probably saw less differences and less separating or dividing barriers than most other scientist of his generation. It seems to be not by accident that other actors in the field of cybernetics shared such a position. Although Heinz von Foerster did not become part of contemporary arts directly—as his colleague and friend the British cybernetician Gordon Pask eventually did⁵—he sought regular contacts with artists and furthered the readiness for dialogue between artists and scientists in many ways. This position, by the way, was held by Heinz von Foerster since the time when he worked as a radio journalist in Vienna from 1946 to 1948.⁶

In the beginning of the 1960s Heinz von Foerster appeared on several occasions before audiences which had a relationship to the field of design. In 1962 there have been at least two such occasions: at the I.D.E.A (Industrial Design Education Association) and at the International Design Conference in Aspen. (There are further contributions in the design context [von Foerster, 1964]). Both lectures are characterized by the fact that their author presented latest results of research from the Biological Computer Lab (he was its director [Müller, 2007a]) which were without doubt on the frontiers of the whole field of cognition processes. On the other hand the author longed for and found a language by which it was possible to present quite complex results from cognition research to a lay audience. This language in combination with a special form of presentation by visual means still makes the articles so understandable until today. In the 1980s and 1990s von Foerster brought his ability to talk to a lay audience to perfection. The examples of 1962 seem to be the first documents where this ability became clearly visible. But this is only one dimension for selecting these articles.

The other dimension is that both articles address basic problems of design, namely form problems and the problem of perception, the problem of environments and their structures, and again perception, this time coined as “internal representation.” It seems to be a clear decision not to speak of *pattern recognition* (which could have been a justified alternative) but of *form perception*, a more general and non-technical phrase. Among the many examples and experiments the author offers one finds a demonstration of the Numa-Rete, a computing machine constructed at the Biological Computer Lab by Paul Weston; a machine which was able to “count” objects on grounds of discerning their edges (Weston, 2007). Closely connected with this experimental device was the concept of property filters where the Biological

5. Gordon Pask participated in a now world famous computer art exhibition (Cybernetic Serendipity, organized by Jasia Reichardt) in London, 1968 (Rosen, 2008).

6. Well documented by notices Heinz von Foerster made during this period kept in Heinz von Foerster Archives, Vienna.

Computer Lab invested considerable work during the early 1960s, although this term was not used in all four selected articles.

The first article in our selection was published in a brochure, but not by a publishing house but by means of I.D.E.A and the University of Illinois and was completed mainly for internal purposes. The brochure was edited by Edward J. Zargorski, then vice-president of the I.D.E.A. Further contributors to the brochure have been Serge Chermayeff, planner and architect, Sibyl Moholy-Nagy, designer and architect, and Ralph Caplan, writer and editor. The four presentations are augmented by a panel discussion. By far the longest contribution is the one by Heinz von Foerster.

Logical Structure of Environment and Its Internal Representation

As in “Form and Perception” the author of “Logical Structure” anchors his theme in the field of mathematics. In “Form and Perception” the main mathematical formalism was group theory whereas “Logical Structure” operates with the help of game theory and probability theory in which the cognitive problems were embedded. Playfully von Foerster reminds the audience on some basics and simple rules. At the same time he tries to make his audience familiar with his interpretation of self-organization by demonstrating experiments. Again the Numa-Rete is presented.

When von Foerster comes up with game-theoretical elements he holds that a “coalition structure” is “much stronger” than a “competitive structure.” It took decades until such an assumption was validated by Robert Axelrod’s famous competition of game strategies (Axelrod, 1984).

The Lecture of 1962 (and the publication of 1963) on the logical structure of environment serves as a bridge between two other articles by von Foerster which were focused on the environment in different ways. In a lecture from 1959 and a publication of 1960 (von Foerster, 1960) which would become one of the most famous von Foerster publications the author makes use of the concept of environment in order to build a system which is able to organize itself by assimilating energy and order from its environment.⁷ In a second and equally famous article from 1973 environment is used again as an argument in the context of constructing realities, this time as an environment computed by an observer. This marks one of the breakthroughs to von Foerster’s form of constructivism which coincided with the end of the BCL (Müller, 2007b).

In 1962 von Foerster comes up with the following equivalences:

1. environment = Together-knowledge = conscientia – and
2. “I = Thou” (citing Genesis 2:23-24).

It seems clear that the parole from 1973 “reality = community” is derived directly from the equivalences of 1962. Apparently von Foerster developed a social theory of

7. Niklas Luhmann would later radicalize the separation between system and environment and make it the core of his theory of social systems (Luhmann, 1995).

perception in a stepwise fashion which functions as a basis of von Foerster's constructivism in general and of his second order cybernetics in particular (Müller & Müller, 2011). The article itself has been published as part of the less known volume of conference transactions (von Foerster, 1963).

Formation, and Neural Organization of Perceptual Spaces

As in "Perception of Form," the perception of four-dimensional objects plays an important role in the third piece of our selection. "Formation, and Neural Organization of Perceptual Spaces" falls somehow apart from the first two articles. It was indeed never published not even as grey literature or in a remote place.⁸ Moreover, this piece does not have the structure of a lecture or an article, it is a research proposal which apparently was not successful. The proposal is not dated but it seems clear that it was written in summer or autumn of 1970. Moreover, the research proposal has a co-author, Humberto R. Maturana, although there are some reasons to suppose that the main portions of the text came from von Foerster. The core of the proposal focuses on two different sets of experiments dealing with perception. On the one hand animal experiments were suggested in order to trace individual cell behaviour. On the other hand experiments were proposed with adult humans as test subjects who were to be given the task to regulate a machinery in a way that they were able to "see" four-dimensional geometrical objects. The latter set of experiments had a successful fore-runner at the BCL. PhD student Phyllis Arnold worked for several years on experiments with four-dimensional perception.⁹

It is a pity that the project did not succeed and the experiments could not be implemented. We can only speculate why it was not funded. Of course there are several elements which situate the project outside the mainstream of the year 1970. There is extensive reference to authors which might have been regarded as outdated by some referees, such as Johannes Müller, Henri Poincaré, and even Jean Piaget. Another argument to reject or postpone the project could have been that no direct applications were named. The major goal seemed to remain in the sphere of basic research, with a special aim at going deeper into problems of Piaget's theory of sensorimotoric closure.

Heinz von Foerster on Heinz von Foerster: Experiences, Heuristics, Plans, Futures

A final offer or invitation to read and re-read von Foerster is made in form of a chapter from a book, published for the first time in German in 1997.¹⁰ The version presented here has been translated into English by Michael Kasenbacher and Elinor Rooks. It takes the form of a conversation between von Foerster and two visitors who happen to be the editors of this issue. Here, von Foerster critically reflects on his research

8. The only exemplar we know was found in a volume Heinz von Foerster prepared for his wife Mai von Foerster.

9. There is a letter exchange between Heinz von Foerster and Phyllis Arnold held at the University Archives of the University of Illinois, Urbana, documenting several steps of this work.

10. The book *The Beginning of Heaven and Earth Has No Name* will be published 2012 under the auspices of Bruce Clarke by Fordham University Press.

strategies and practices. Invited to help building a man-made Foerster machine he declares that such a thing would be impossible in principle. Nevertheless, the topics covered and the density of heuristic rules and strategies makes this text a rare second-order document where Heinz von Foerster talks predominantly on Heinz von Foerster.

Conclusions for Part I

This little bouquet of *Foersteriana* is intended to further stimulate the reception of von Foerster. The four articles are vivid examples for a rather under-valued aspect of von Foerster's research agenda which was predominantly research-driven and which focused mainly on empirical problems of cognition. Within the BCL environment all the necessary elements for a radical revolution of science had been developed which was to be launched under the name of second-order cybernetics. Unfortunately for Heinz von Foerster and, I should add, for us, this new research program could not be implemented, due to the downfall of the BCL from 1970 onwards. In this sense, the overall title for Part I on re-discovering Heinz von Foerster is, at least in our judgement, not primarily linked with a nostalgic sentiment of publishing mostly unknown materials from an eminent scientist at the occasion of his 100th birthday but has significant amounts of novelty and fresh insights to offer.

Introduction to Part II: Re-Inventing Heinz von Foerster

Part II comprises thirteen contributions on Heinz von Foerster which attempt to address one or two of the following issues, namely either the question of the high importance of Heinz von Foerster's oeuvre today for one's own field of investigation or the issue of relevant aspects of Heinz von Foerster's work which so far remained largely unrecognized.

An Overview of Thirteen Contributions

In this section a short overview will be given on the thirteen short articles on Heinz von Foerster which were ordered in a purely alphabetical manner.

Bruce Clark focuses on Heinz von Foerster and his relationships with Niklas Luhmann who became the champion of social systems theory from an autopoietic point of view. In Clark's assessment Niklas Luhmann provided a general framework for social systems autopoietic style, but was confronted with a deep-seated problem. The central authors of the autopoietic approach, namely Humberto R. Maturana and Francisco J. Varela, were both opposed to Luhmann's expansion of autopoietic theorizing to the domain of human societies. In this conflict, Clark sees Heinz as an important mediator between Luhmann's approach and the autopoietic framework.

Ranulph Glanville reminds us of an unusually dense network of scientific and artistic relations which was characteristic both for Wittgenstein's Vienna and for Foerster's Vienna. Glanville establishes several links between Heinz von Foerster's scientific work, art and design, emphasized the artistic and the design parts of

Foerster's oeuvre and places Heinz von Foerster firmly in the world of designers and of artistic performers as well.

Louis Kauffman offers a summary on "Eigenforms and Eigenvalues—Cybernetics and Physics" and elaborates on the central von Foerster notion of Eigenforms which arise in any recursively closed and self-referential configuration. Kauffman explores the relevance of Eigenforms and Eigenvalues in the domain of quantum mechanics where he is able to provide a new interpretative understanding of the basic formalisms of quantum mechanics.

Robert Martin focuses on the importance of Heinz von Foerster's principles and rules for the field of teaching. He stresses phenomena and processes like circularity, the non-transmission of meanings, an emphasis on invention and not on discovery, responsibility, desire and choice and an appropriate gesture by which Robert Martin refers to the ability to respond "to each situation by identifying the appropriate gesture needed to avoid being controlled by that situation."

Humberto R. Maturana provides a vivid account of the system of dense relationships which he developed with Heinz von Foerster from 1962, their first encounter at a conference in Leiden, up until close to Heinz von Foerster's death in October 2002. Despite their intensive friendship they never produced a joint article, although Part I of the current issue contains a joint research proposal which needs still to be implemented and which in all probability would yield highly relevant results for the domains of the cognitive sciences. Nevertheless, Humberto R. Maturana and Heinz von Foerster managed to learn significantly from each other and this contribution offers some hints on major areas of these mutual learning processes.

Karl H. Müller places the notion of self-reflexivity at the center of his contribution on the neglected and insufficiently received parts of Heinz von Foerster's work. Müller provides a sketch of the comprehensive research program which Heinz von Foerster developed in the course of the 1960s and 1970s and which runs under the label of second-order cybernetics. Müller emphasizes especially the research-driven type of this research program which was revolutionary in the context of the 1970s and which still can be considered as revolutionary today.

In his artful dedication to Heinz von Foerster Paul Pangaro emphasizes the notions of recursion and learning, second-order cybernetics and ethics as expressed and embodied by von Foerster. These notions act as constant clarifiers in the daily efforts of the author to design software applications or to support others as they steer their own design processes.

Bernhard Poerksen emphasizes that the work of Heinz von Foerster on ethics can be read from a double perspective: first as an attempt to create a transcendental ethics; second as an attempt to warn of the abyss of the merely well-intentioned, which does not recognize its own self-constraining structure. Poerksen's article addresses the fascinating question how an ethics (of the second order) can be constructed that makes for transparency and contains the proclamation of its own goals-emphasis on freedom of choice, recognition of responsibility, avoidance of force-in all its differentiations, and yet refers back to the central figure of constructivist thought, the observer.

S. J. Schmidt emphasizes the importance of observers, who over past decades, at the instigation of Heinz von Foerster, have been brought from behind the scenes to the central stage of epistemological issues and discussions. Schmidt's article discusses the multiple dimensions of observers and the consequences of a fully-developed observer story for the status of scientific knowledge and for the social system of science in general.

Paul Schröder, together with Marilyn and Andy von Foerster, provide an interesting personal account on the intricacies of perception and observations and their relations with undecidable questions. Starting from a common experience during a ride with the Vienna S-Bahn they provide their individual accounts of observing a particular event and continue with a deeper discussion on shared assumptions, surprising moments and the emergence of undecidable problems in such a context.

Bernard Scott offers a very comprehensive account of Heinz von Foerster as a psychologist and his lasting contributions to the field of psychology. Scott separates his article into the domains of foundations, epistemology and ethics, the human being as a self-organising system, cognitive architecture, the human being as a learner, and the dynamics of self-observation communication and provides interesting observations of Heinz von Foerster's role and contributions in each of these areas.

In his very short contribution Robert Trappl looks for the contemporary relevance of Heinz von Foerster's oeuvre and is unable to find any significant traces in contemporary science landscapes. Under the slightly provocative title "Heinz, Where Are You?" Robert Trappl sees the impact of the work of Heinz von Foerster for contemporary research as marginal at best.

Stuart A. Umpleby stresses the relevance of Foerster's second-order cybernetics for contemporary modeling in economics. Second-order or self-reflexive modeling includes the observer both as economic actor and as model-builder into an economic model. Umpleby discusses the relevance of such a self-reflexive procedure with special reference to George Soros's modeling frameworks and points to some of its implications in the analyses of the current financial crisis.

Conclusions for Part II

The thirteen contemporary re-inventions of Heinz von Foerster have been undertaken independently from each other, and an author usually was not aware of the contents of the other contributions. Such an open procedure usually leads to high redundancies because these re-inventions focus on a single or two central aspects in the oeuvre of a particular author. Surprisingly, such an almost natural convergence did not occur in the case of Heinz von Foerster because the thirteen short articles stress a large number of different aspects of his work.

In this sense, a highly selective and contingent overall picture of Heinz von Foerster emerges which contains only a vanishing amount of repetitions or duplications. Moreover, due to the highly selective topics, the current selection of relevant aspects points implicitly to other areas which have not been covered in the present set of re-inventions. For example, the central domain of Heinz von Foerster's

BCL work was located in the cognitive neuro-sciences and in new cognitive technologies which were not part of the current re-inventions by thirteen authors.

In the final article to this CHK issue “Designing a Living Heinz von Foerster Network” it will be shown, then, how the current set of independent re-inventions of Heinz von Foerster can be transformed into a living Heinz von Foerster network which could drift to theoretical insights on both Heinz von Foerster and on the network participants which, in addition, have the strange property of writing themselves.

Columns

Our regular column is this time written by Louis H. Kauffman. It is called *Virtual Logic—Number and Imagination* and demonstrates how to pull numbers out of the fullness of the void. It has a clear Spencer-Brown inspiration but also goes back to Warren McCulloch’s reflections on the relation between man and numbers.

The ASC-column, *Hermeneutics of the Listener*, is written by Miguel Francisco Maliksi and addresses von Foerster’s philosophy of listening. Maliksi compares Heinz von Foerster with Richard Rorty in terms of his declaration not to have an epistemology at all and therefore not to see himself as a constructivist as so many researchers have classified him. Labels kill ideas. Instead we have to listen and dialogue.

Artist

The artist for this issue is Madeline von Foerster, Heinz’s granddaughter. Through her application of the techniques of the Flemish masters to modern subject matter she challenges the ironic detachment of much contemporary art in favor of intimacy, knowledge, and connection. She has provided the following statement:

My grandparents Heinz and Mai were always my greatest artistic supporters, and were a huge reason why I have become a painter today. Pope Julius II could scarcely have made a bigger fuss over the finished Sistine Chapel ceiling, than those two made over my most insignificant doodle or drawing! Heinz in particular, not only gave me much encouragement (including sharing paintings and stories about famous women from history, as if he had no doubt I would become one), but also, I believe, cultivated to a great extent my tastes. In Heinz’s library I discovered alchemical illustrations, Albrecht Durer, Leonore Fini, and Hans Bellmer—all of whom influence me still today. My artistic passions and preoccupations are my own, but my aesthetic sensibilities and visual nomenclature are inherited directly from Heinz.

The painting “Lusus Serius,” on the cover of this issue, holds a particular poignancy for me. The painting was completed about ten years ago, at the beginning of my career, and was reproduced in one of my very first magazine interviews. I brought a copy of the magazine to Heinz, who was at that point bedridden. He had stacks of important-looking books and papers surrounding the bed like a fortress, waiting to be read, but every time I came in the room to visit with him, over the course of several days, I found him reading and re-reading my interview, the proud grandfather. It is one of my dearest memories of him. He asked if he could buy the painting, and I told him I’d happily give it to him. Sadly, he died before I managed to send it.

Here is a short description of the painting, which comes from that 2001 interview: This work shows the caprices of fate, and the opposing forces of creation and destruction, but with triumph given to neither. The pregnant queen represents potentiality and promise. The Sphinx symbolizes obstruction and ruin. I have always loved the Sphinx, formidably guarding her path by means of riddles issued on carrion-scented breath. Mythologically, I think this kind of creature represents the need for us to confront our own most ugly selves, our own unanswerable questions, on our journey of life. At the stage of the chess game in which my painting is set, the outcome is not yet certain. Both players have a chance yet to win the match, though the final victor, of course, is Saturn (Father Time), whose image is carved under the chessboard.¹¹

Acknowledgments

At this point it seems appropriate to acknowledge the support and the help of a small circle of indispensable good spirits.

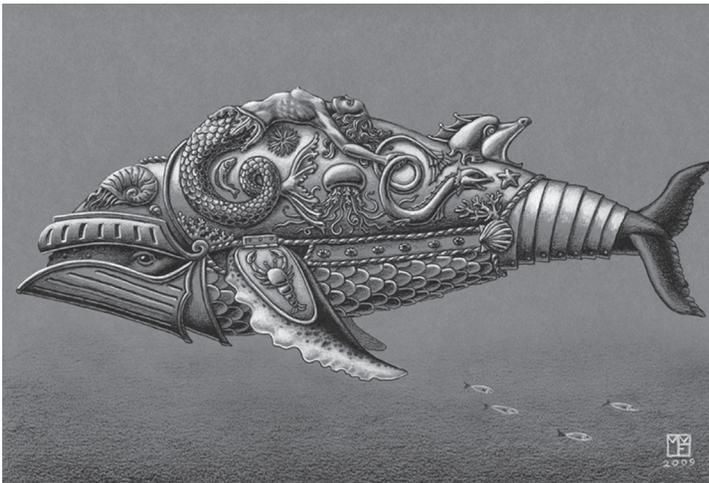
- In terms of initiating this special edition, special thanks go to Pille Bunnell and to Søren Brier who acted as the prime movers towards this centenary issue on Heinz von Foerster.
- Gertrud Hafner, Armin Reautschnig and Michael Eigner from WISDOM and Werner Korn as our publisher provided the necessary assistance in compiling this Heinz von Foerster centenary volume.
- Jeanette Bopry acted in a heroic manner in order to transform a very large group of manuscripts Vienna style into the appropriate CHK form within a minimal amount of time.
- The thirteen contributors to Part II of this CHK edition created a significant variety in topics and aspects which should offer significant guidance for successful and fruitful re-discoveries and re-inventions of Heinz von Foerster.
- Finally, Heinz and Mai von Foerster as well as their sons Tommy and Andy acted and act in a mode of friendship and support without which this volume would not have been possible at all.

References

- Axelrod, R. (1984). *The evolution of cooperation*. New York: Basic Books.
- Fleck, L. (1935). *Entstehung und Entwicklung einer wissenschaftlichen Tatsache. Einführung in die Lehre vom Denkstil und Denkkollektiv*. Basel: Schwabe Verlag.
- Fleck, L. (1979). *Genesis and development of a scientific fact*. Chicago: University of Chicago Press.
- Glanville, R., & Müller, A. (Eds.) (2008). Pask Present. An exhibition of art and design inspired by the work of Gordon Pask (28 June 1928 to 28 March 1996), cybernetician and artist. Vienna: edition echoraum.
- Grössing, G., Korn, W., Müller, A., & Umpleby, S. (Eds.) (2005). *Heinz von Foerster: The Stanford lectures on constructivist epistemology*. Vienna: edition echoraum.
- Luhmann, N. (1995). *Social systems*. Stanford: Stanford University Press.
- Müller, A. (2003). Heinz von Foerster's archives. *Cybernetics & Human Knowing. A Journal of Second Order Cybernetics, Autoopoiesis and Cyber-Semiotics*, 10 (3-4), 67-72.
- Müller, A. (2007a). A brief history of the BCL. Heinz von Foerster and the Biological Computer Laboratory. In A. Müller & K. H. Müller (Eds.), *An Unfinished Revolution? Heinz von Foerster and the Biological Computer Laboratory | BCL 1958-1976* (pp. 277-302). Vienna: echoraum.

11. Gilles de Montmorency's interview of Madeline von Foerster appears in *The Sentimentalist*, in the Winter 2001/2002 issue.

- Müller, A. (2007b). The End of the BCL. in: Müller & Müller (2007), A. Müller & K. H. Müller (Eds.), *An Unfinished Revolution? Heinz von Foerster and the Biological Computer Laboratory | BCL 1958-1976* (pp. 303-321). Vienna: echoräum.
- Müller, A. (Ed.). (2008). Computing a reality. Heinz von Foerster's lecture at the A.U.M. conference in 1973. *Constructivist Foundations*, 4 (1), 62-69.
- Müller, A., & Müller, K. H. (Eds.) (2007). *An unfinished revolution? Heinz von Foerster and the Biological Computer Laboratory | BCL 1958-1976*. Vienna: echoräum.
- Müller, A. & Müller, K. H. (2011). Systeme beobachten. Über Unterschiede und Gemeinsamkeiten von Kybernetik zweiter Ordnung und Konstruktivismus. In B. Pörksen (Ed.), *Schlüsselwerke des Konstruktivismus* (pp. 564-582). Wiesbaden: VS.
- Pias, C. (Ed.). (2003). *Cybernetics Kybernetik. The Macy Conferences 1946-1953*, Vol I Transactions/Protokolle. Zürich: diaphanes.
- Rosen, M. (2008). The control of control – Gordon Pask's kybernetische Ästhetik. In R. Glanville & A. Müller (Eds.), *Pask present. An exhibition of art and design inspired by the work of Gordon Pask (28 June 1928 to 28 March 1996), cybernetician and artist* (pp. 131-191). Vienna: edition echoräum.
- von Foerster, H. (1960). On self-organizing systems and their environments. In M. C. Yovits & S. Cameron (Eds.), *Self-organizing systems* (pp. 31-50). London: Pergamon Press.
- von Foerster, H. (1962). Perception of form in biological and man-made systems. In E. J. Zagorski (Ed.), *Transactions of the I.D.E.A. Symposium* (pp. 10-37). Urbana: University of Illinois.
- von Foerster, H. (1963). Logical structure of environment and its internal representation. In R. E. Eckerstrom (Ed.), *Transactions of the International Design Conference* (pp. 27-38). Zeeland, MI: Aspen, H. Müller, Inc.
- von Foerster, H. (1964). Form: Perception, representation and symbolization. In N. Perman (Ed.), *Form and meaning* (pp. 21-54). Chicago: Society of Typographic Arts.
- von Foerster, H. (1973). On constructing a reality. In W. F. E. Preiser (Ed.), *Environmental design research* (Vol. 2, pp. 35-46). Stroudberg: Dowden, Hutchinson & Ross.
- von Foerster, H. (1982). *Observing systems*. Seaside, CA: Intersystems Publications.
- von Foerster, H. (1985). *Sicht und Einsicht: Versuche zu einer operativen Erkenntnistheorie*. Braunschweig: Friedrich Vieweg und Sohn.
- von Foerster, H. (1992). *Wissen und Gewissen: Versuch einer Brücke* (S. J. Schmidt, Ed.). Frankfurt: Suhrkamp.
- von Foerster, H. (1993). *Kybernethik*. Berlin: Merve Verlag.
- von Foerster, H. (1997). Sechster Tag: Ergebnisse Heuristiken Pläne Zukünfte. In A. Müller & K. H. Müller (Eds.), *Heinz von Foerster, Der Anfang von Himmel und Erde hat keinen Namen. Eine Selbst-Erschaffung in 7 Tagen* (pp. 213-254). Vienna: Döcker Verlag.
- von Foerster, H. (2003). *Understanding understanding. Essays on cybernetics and cognition*. New York: Springer.
- von Foerster, H. (2010). Zipf's law. In L. Kajfez-Bogataj, K. H. Müller, I. Svetlik, & N. Tos (Eds.), *Modern RISC-societies. Towards a new paradigm for societal evolution* (pp. 119-135). Vienna: edition echoräum.
- Weston, P. (2007). A walk through the forest. In A. Müller & K. H. Müller (Eds.), *An unfinished revolution? Heinz von Foerster and the Biological Computer Laboratory | BCL 1958 –1976* (pp. 89-115). Vienna: echoräum.



von Foerster, M. (2009). *Whale Drawing*. Colored pencil on paper; 9 x 12 in.