

# 5

## Cybernetics of Cybernetics

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## Introduction

I have for a long time felt great sympathy with Margaret Mead's position, that a cybernetic society should behave in a cybernetic manner. I have also found it strange how cybernetic societies are so conventional. For me, Mead's request is that we are consistent: "Do as you would be done by" as I was told, as a boy. I see consistency as a quality central to cybernetics, at least in the way I am interested in it. I had wanted (and tried) to persuade those in positions of power to support a competition that would generate examples of how a society might behave in a cybernetic manner. When I was elected president of the American Society for Cybernetics (ASC) I sought an opportunity to run this competition. The opportunity came out of the C:ADM conference and its post-conference workshop, to which this book bears testimony. With the agreement of the Executive Board of the society, we set up and publicised our competition. The web site from which the material below is taken can be found at [www.asc-cybernetics.org/CofC](http://www.asc-cybernetics.org/CofC), as can all the entries.

The judging process was rigorous and prolonged. There were 2 stages: the first chose a short list of 3 entries to consider, and these were passed on to the final judges, who included the most prestigious people imaginable: first, Mary Catherine Bateson, a leading feminist anthropologist, and honorary fellow of the ASC, she is also the daughter of both Mead and Bateson; second, Humberto Maturana, whose neurological work led to one of the most known of second order processes (autopoiesis) and whose work is generally recognised as central; and third, Ernst von Glasersfeld, who worked with the pioneering Italian cybernetician Sylvio Ceccato and developed Radical Constructivism. Sadly, Glasersfeld died and was replaced by Karl Mueller, president of the Heinz von Foerster Society and trustee of the ASC, who writes extensively on the new science of cybernetics. The judges panels were chaired by me.

We, the judges had no idea who had entered. The winning entry was submitted by Stella Octangula, who turned out to be Mick Ashby, grandson of Ross Ashby and the person most responsible for getting Ashby's work available online.

Ashby's proposal is included at the end of this piece, and others can be found online at [http://www.asc-cybernetics.org/CofC/?page\\_id=99](http://www.asc-cybernetics.org/CofC/?page_id=99).

The question can be asked: has this competition had any effect on how the ASC runs itself. The answer is a bit. We have taken some of the ideas, and others were already in effect before the conference was announced. Many, including the winner, require a resource and man-power that a small society just doesn't have. What I think the biggest effect has been is to remind us of the need to behave in cybernetic manner, to bring this to mind. It has even been suggested that maybe the best entry was the entry that was never submitted, but which made the other

entries possible: the competition itself.

What you can find in the rest of this chapter is the competition description and conditions, and the winning entry.

## The Competition

### Context

In 1967, Margaret Mead, one of the original attendees at the Josiah Macy Jr. conferences and the founding mother of cybernetics, presented a paper (published in 1968) called “Cybernetics of Cybernetics” to the American Society for Cybernetics (ASC). Following on from a suggestion by Gregory Bateson<sup>1</sup>, Mead proposed that the ASC should consider itself as a cybernetic body, and apply cybernetic insights and techniques to its own organisation and operation.<sup>2</sup>

Although Mead proposed a number of specific questions the ASC could ask about how it might be run (see full quote below), her suggestion received little attention. Rather, the title of her paper (given to her by Heinz von Foerster) became used more generally in the application of cybernetics to cybernetics, or second order cybernetics.<sup>3</sup>

The “Cybernetics of Cybernetics” paper thus leaves two legacies. The ASC has come to recognise the need to take up Mead’s original challenge and address the conflict and inconsistency that occurs when a cybernetic society is not run according to cybernetic principles. The ASC can be seen as convention-bound in its operation, which is particularly odd for a cybernetic society.

The ASC (as, no doubt, other societies) needs ideas and renewal, and we are

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1 In a conversation between Stewart Brand, Gregory Bateson and Margaret Mead, Mead recalls “I went back to the correspondence, Gregory, where you had proposed that we plan an organization in relation to its purposes. This was before the cybernetics meetings, while you went overseas”. Quoted from: For God’s Sake, Margaret. Conversation with Gregory Bateson and Margaret Mead. Originally published in the CoEvolutionary Quarterly, June 1976, Issue no. 10, pp. 32-44.

2 Mead had earlier made a similar suggestion to a meeting of the Society for General Systems Research (now the International Society for Systems Science), where she was “slapped down without mercy.”

3 According to von Foerster, consideration of the cybernetics of “observing systems” was what distinguished second from first order cybernetics, which was concerned with the cybernetics of “observed systems”. See, for instance, Foerster, H von et al. [1974] *The Cybernetics of Cybernetics*, Champaign-Urbana, Biological Computer Laboratory, University of Illinois. Republished as Foerster, H von, et al (eds.) [1995]. *Cybernetics of Cybernetics or the Control of Control and the Communication of Communication*, second edition, Minneapolis, Future Systems, Inc.

looking to competition entries for inspiration and direction according to cybernetic principles. As the established home of second order cybernetics, these cybernetic principles should reflect, preferably, second as well as first order cybernetics.

*Excerpt from Margaret Mead's 1968 paper Cybernetics of Cybernetics*

"In conclusion I should like to tell you a story which I think may be useful to our new society. I went to the organizational meeting of the Society for General Systems Theory that was held in connection with a meeting of the American Association for the Advancement of Science in Atlanta. The audience was typical, a few old men and women, five or six people who had arranged the meeting and knew exactly what they wanted to do, and a few diverse and unidentifiable characters. They were going through a perfectly stereotyped, conventional, and uninspired rigmarole. As no one knew who I was, I had an opportunity to see how cranky a new idea seems unless it is advanced by a well-known person. I suggested that, instead of founding just another society, they give a little thought to how they could use their theory to predict the kind and size of society they wanted, what its laws of growth and articulation with other parts of the scientific community should be. I was slapped down without mercy. Of all the silly ideas, to apply the ideas on the basis of which a society was being formed to ITSELF!

It seems to me that in a new organization, centered upon our knowledge and interest in circular self-corrective systems and our capacity to deal with the situations to which they may be productively applied, it might be worthwhile for this combination of old and new to really consider, technically and carefully, what in thunder we are founding. How many members do we want and from what groups should they be chosen? Maybe it would be well to consider from what groups they should not be chosen. How are we going to keep from getting steadily older, so that ten years from now young men will not want to join a society of people with whom they can't communicate? How are we going to keep our communication system alive? Or should we plan for the society to die in ten years? Recognizing that one is working in new and possibly transient fields, one can set a terminal date even at inauguration. (Like any contract, of course, such a date can be extended.) It is possible to say: let's aim at a short, definite period. We know what we want to do now and we think we can do it. The membership that we are going to bring in are the people to do what needs to be done. We are certain that we are not leaving out any of the people who ought to be here now. Why can't we look at this society systematically as a system with certain requirements, certain possibilities of growth, and certain constraints, in a world which is making demands, to some of which this society is to be responsive. If this society is to pay attention to the way cybernetics is developing in other countries, especially in the Soviet Union and other countries of the Eastern European block, what are the devices for adequate cross-national and cross-ideological communication? Do we have the right people? Do we have the necessary techniques? When are we likely to need either death or transformation?

I think these are questions which the American Society for Cybernetics should ask, and, as I am not disguised as a casual crank in Atlanta, I commend them to you.”  
[Mead 1968]

### Judging Criteria

This is an open competition. Anyone and any collective may participate (using a pseudonym to ensure anonymity in the judging process).

This is an ideas competition. We are interested in ideas pertaining to cybernetic practices that may bring about, inform or transform cybernetic practices. Entries in text or image format are preferred. They are to be formulated as addressed to the ASC and its Executive Board with a view to bringing about, informing or transforming the Society’s practices. However, ideas by themselves will not suffice: we are looking for viable ideas, that is, ideas that come with a viable means of implementation.

These ideas will reflect the suggestion of Margaret Mead, that a society for the promotion of cybernetics should recognize and act according to cybernetic understandings.

We are looking for originality, to find ourselves interested and intrigued: in other words, for the sorts of ideas that will inspire and will renew. And we are looking for means of implementation (feasibility) that are clear and direct. All entries must be made under a pseudonym.

### Judging Process

Judging will happen in two stages. A preliminary panel will select the best proposals for consideration by a second panel, which will choose the winners.

The preliminary panel will consist of:

- Phillip Guddemi
- Michael Hohl
- Allenna Leonard
- Elizabeth Simpson
- Janet Singer
- Lee Worden

The final panel will consist of:

- Mary Catherine Bateson
- Humberto Maturana
- Ernst von Glasersfeld<sup>4</sup>

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4 Ernst von Glasersfeld died on 12.11.10, and, although the competition organisers have decided not to replace him, during the judging process it became apparent that a third external judge was needed, and Karl Mueller was appointed in the place of Ernst von Glasersfeld.

Both panels will be chaired by Ranulph Glanville, President of the ASC. Membership may be changed, due to circumstances. The judges' decision is final and no correspondence will be entered into.

## The Winning Entry

### Structure, Environment, Purpose, and a Grand Challenge for the ASC by "Stella Octangula"

#### Introduction

This proposal is based on a view of the ASC as a system that consists of an organism that exists in, and operates purposefully on an environment. We propose changes to the organism and its environment. Our first proposal changes the structure of the ASC organism to make it explicitly and functionally second-order cybernetic. The second proposal changes the environment of influence of the ASC organism.

FIGURE 5.01. The ASC System

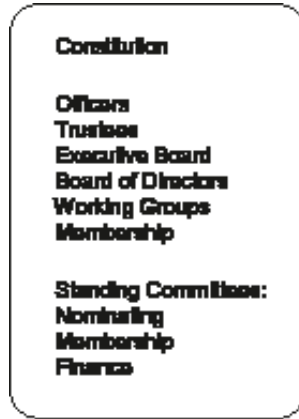


#### PART I: Changing the Structure of the ASC Organism

The ASC Organism figure illustrates some of the "Organs" that are explicitly defined in the ASC Constitution.<sup>5</sup> The preamble of the constitution already recognizes the need for the ASC to occasionally self-reorganize, and rewrite the constitution. That is already a second-order cybernetic feature, and it has clearly functioned, more or less, for 30 years, but instead of being reduced to a preambular appendage, we'd like to recode the Constitutional DNA so that the resulting ASC Organism has a structure that is explicitly, and functionally second-order cybernetic.

<sup>5</sup> See <http://www.asc-cybernetics.org/organization/constitution.htm>

FIGURE 5.02. The ASC Organism

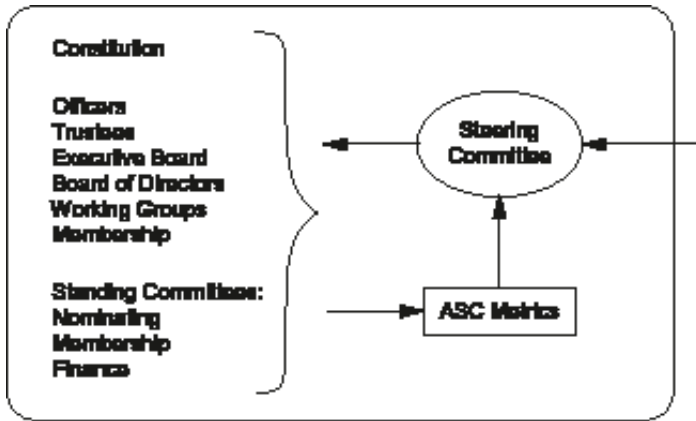


Specifically, we propose adapting the Constitution to require a new Organ; a fourth standing committee, named the “Steering Committee”. We expect it to maximally organize itself, define the key metrics (such as vitality, relevance, and effectiveness) that it will periodically evaluate, and propose appropriate corrective actions if any metrics deviate from their comfort zones. The actions could, for example, include creating a new workgroup, organizing a conference, or making a change to the Constitution. The concept of an organization having a Steering Committee is not new, yet the ASC conspicuously does not officially have one. Presumably, until now, one of the existing ASC boards has assumed such responsibilities.”

The diagram of the Second Order Cybernetic ASC Organism, is intended to convey how the Steering Committee is driven by feedback about the ASC and its environment, and that it can propose any change or activity to any part of the ASC Organism, including constitutional changes.

That might sound disconcertingly omnipotent, however the Steering Committee is not a new dictator, it does not actually have the power to change the Constitution or to issue commands to the other ASC Organs, because, like the other standing committees, it is bound by article 8.1 of the Constitution, which restricts it “... to develop proposals and prepare suggestions for decisions to be made by the Executive Board or by the Membership.” Thus, the Steering Committee is a benevolent overseer that initiates redirective actions by communicating proposals and suggestions for democratic consideration.

FIGURE 5.03. The Second-Order Cybernetic ASC Organism



OK, that was Part I, the structural reengineering of the society. From a theoretical viewpoint, that is sufficient to transform the ASC to become cybernetically second-order, but in reality, all we have done is to solve a problem by delegating it to an as yet, non-existent committee. We need something more, something that will inspire people and increase the vitality of the ASC Organism. And that's where Part II comes in.

In Part II, we will propose a subtle, yet radical, repurposing of the scope of the society, including a grand challenge proposal, to revitalize and inspire members and non-members alike.

## PART II: Changing the Environment and Purpose of the ASC Organism

Environment and purpose are closely bound by the fact that our actions on objects are normally associated with an intention. Our use of the term "environment" is intended to refer narrowly to the entities to which our "purpose" actually applies. In essence, everything that the ASC organism can act upon or affect directly, that is to say, its sphere of influence.

To determine what the ASC environment is, we look to the Constitution again: Paraphrasing articles 2.1 and 2.2 of the ASC Constitution, the purpose of the society is "The advancement and promotion of cybernetics as a science, a discipline, and a meta-discipline." The membership may or may not agree whether that is an accurate description of what the society actually does, but it clearly defines a limitation on the possible sphere of influence of the ASC Organism.

FIGURE 5.04. The ASC Environment



The trivially obvious fact that the immediate environment in which the ASC operates is “Cybernetics” is of absolutely no surprise to anyone. And yet, it is easy to overlook that this is a limitation. And it seems that all areas in which cybernetics can be applied in practice, for example, in economics, electrical engineering, and psychology, already have their own own specialist communities. And, for example, where there is an explicit cybernetic specialization, such as socio-cybernetics, it is correct that that domain belongs to the sociologists rather than the cyberneticians. Of course an individual can belong to both camps, but the ASC can’t. What is left behind might be summarized as “pure cybernetics plus examples”. It is as if the very universal utility of cybernetics condemns the ASC to existing one step removed from affecting the real world. This awareness is also not new. The ASC, like pure mathematics, is well insulated from the real world. That is OK, and is the stated purpose of the society, but having no real-life target for practical application is self-limiting in both scope and vitality. Somehow, the magnificent visions and hopes of the founders of the society are not being realized. Their hopes and dreams were not simply for the ASC to flourish on cybernetic principles, but for the World and Society too. Surely what really matters is not the power or intellectual beauty of our theories, techniques, or technologies, but how they are applied in the real world. In particular, whether their application is for the good of the planet and people, or not. Now this is finally starting to sound more like a Grand Challenge :-)

We would like to see a new emphasis on making the world a better place. Wasn’t that the essence of the founders’ hopes? With hindsight, we can see that their assumption that the world would eagerly adopt cybernetics for the greater good, naïvely underestimated the power of greed and selfishness. We could argue whether such idealistic goals belong in the realm of second-order cybernetics, general systems theory, sociocybernetics, politics, or something else, but we’d rather use our hindsight and energy to purposefully re-accept the challenge to be relevant and make a difference.

### **Extending the Purpose of the ASC:**

Firstly, we require the ASC to open up more to having a closer involvement with the real world:

- II/1: We suggest augmenting the ASC Constitution with a third purpose, with the following flavor: “The facilitation, promotion, and application of cybernetic principles for the advancement of the World and Society.”—where cybernetic principles is understood to include second-order cybernetics.

That change is intended to expand the sphere of influence of the ASC. Perhaps some people will claim that this “new” purpose is already implicit in the existing purpose statements, but we feel that it must be stated clearly.

### **Enabling and Requiring a Grand Challenge:**

We want to go beyond mere statements of intention or purpose by proposing a vehicle for activity. An ideal vehicle would be a Grand Challenge<sup>6</sup> that rallies interest and participation:

- II/2: We propose including a constitutional requirement that the Steering Committee should seek, define, and maintain a Grand Challenge that infuses the society with vitality and purpose.

These two steps are still not sufficient. And we’ve just delegated even more to the as-yet non-existent Steering Committee, which is a questionable technique for solving problems. But so that the committee can make a running start, we would like to propose the first Grand Challenge.<sup>7</sup>

### **Selecting the First Grand Challenge:**

To talk of requiring a Grand Challenge without proposing one would be cheating; like providing a short-cut to nowhere. But how should we select a suitable Grand Challenge from all the problems that exist in the World and Society? Ideally, a Grand Challenge has the potential to become a rich field for theoretical and practical exploration. In our case, something that second-order cybernetics can help to solve, that is multidisciplinary, and isn’t already owned by an existing discipline.

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6 The need for a Grand Challenge was inspired by Johann Eder’s “Grand Challenges for Computer Science Research” presentation at the 20th European Meeting on Cybernetics and Systems Research, organized by the Austrian Society for Cybernetic Studies, Vienna, 6-9 April 2010. *Cybernetics and Systems 2010* (ed. Robert Trappl), pp. xix-xxv.

7 We can’t expect a fully mature grand challenge at the first attempt. Let’s start somewhere, and trust self-organization, the workgroup, and steering committee to refine and formulate as necessary to get a well-formed Grand Challenge.

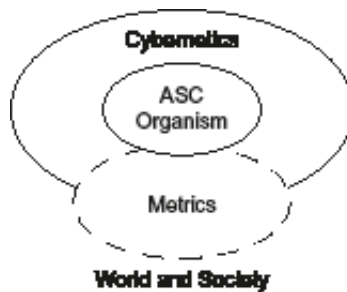
To kick things off, we must be pragmatic and start with something that can provide a starting impulse to make the ASC system dynamic again and to attract participation in making something new and exciting happen. After much thought and reflection on the problems that face us today and the opportunities that exist for us to make a difference helping to solve them, we are ready to propose our final concrete action:

- II/3: We propose establishing an open workgroup that will focus on the first Grand Challenge of studying world metrics and social indicators.

The “Open Metrics” project will promote research, standards, and the effective definition, measurement, and publication of reliable feedback for the World and Society. A good metric can change the world by influencing awareness and perception of priorities and behaviors of politicians, corporations, and individuals.

Currently, such measurements are defined, measured, and published by many different organizations, ranging from governments and special interest groups to international charities and the United Nations. Metrics range from standard government statistics to hybrids such as the “Quality of Living Survey”,<sup>8</sup> which has been successful at causing the residents and politicians of bad scoring cities to seek to emulate more successful cities. However, it doesn’t help if each city or country has its own way of measuring national, social, or environmental indicators. Comparisons require standardization. Establishing standards for the field of metrics will improve transparency, decision making, and improve the predictive powers of simulations that consume the metrics.

FIGURE 5.05. The ASC Organism + Metrics Grand Challenge



8 Mercer’s annual hybrid metric ranks 221 cities based on criteria such as safety, education, hygiene, health care, culture, environment, political-economic stability, and public transportation.

Good progress is being made in some specific areas, such as standardizing the definition of the Ecological Footprint,<sup>9</sup> yet other areas and higher theoretical levels need more work. Some metrics are manipulated for political and financial reasons. Others cause unforeseen counter-intended effects as a direct side-effect of people becoming aware of the metric. There is no doubt that this problem area is fundamentally second-order cybernetic, and multi-disciplinary in nature. In Figure 5, the dashed line around “Metrics” conveys the new expanded boundary for the ASC Organism that, via the multi-disciplinary Grand Challenge, becomes highly permeable to ideas and people, and brings an end to the isolation and impotence from which the old ASC Organism suffered. Over time, the “Open Metrics” project can grow organically to encompass more aspects at different levels of the World and Society.

This is an area in need of standards, research, and publicity. And no existing group is charged with herding all those cats into providing ordered and trustworthy feedback to the World’s leaders, organizations, and people, who collectively, are the feedback-driven controllers of the World and Society. By focusing on metrics, we can gain the chance to make a significant contribution to helping provide the World and Society with the means to make better informed decisions.

### **Why Metrics?**

Our use of the term “metric” includes concepts such as social indicator, key performance indicator, essential variable, and environment variable, however we believe that metrics deserve to be recognized as a new class of feedback.

Well-defined metrics are not just numerical measurements, they are complex entities that can have an underlying purpose, preferred direction of change, comfort zone, alarm levels, and short/medium/long-term target values. Each metric, has a known history, and comparable sampling locations (set of other cities, schools, hospitals, countries etc. that use the same metric).

A controller’s effectiveness depends heavily on the quality of his, her, or its feedback. Metrics can be powerfully influential, in decision making, financial rewards, and elections, and are the subject of both intentional and unintentional distortion. A good metric should be tamper-resistant. Whenever a performance metric is defined, some parts of the system might adapt and distort around it. Absurd examples are plentiful.

Traditionally, we think of feedback as being a one-dimensional signal, such as voltage, temperature, or employee turnover rate, that is measured, and travels a well-defined path in the system to a limited number of known recipients, which

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9 Defined as a standard by the Global Footprint Network, this is the source of the better known Carbon Footprint.

tend to be the decision making subsystems or people responsible for steering the system, achieving targets, and avoiding disasters. Early cyberneticians were concerned about the capacities of feedback channels, which were a significant limitation at the time. Now, primarily through advances in microelectronics, bandwidth and measurement precision are no longer the limiting factors that they used to be.

In contrast to traditional feedback signals, which are effectively hardwired for limited distribution in the system, public metrics are broadcast. Defining a metric, measuring it, and publishing it is a second-order cybernetic act that amplifies a deliberately selected feedback signal by making it available to anyone who can make good use of it. Everyone in the World with an Internet connection can access any public metric. The field of metrics is a powerful point of leverage that can benefit greatly if we direct our attention and efforts to it.

## **Conclusion**

These proposed changes in structure and purpose are designed to engineer, promote, and refine second-order cybernetic principles, activities, and emergent altruistic behavior, that benefits the health and vitality of the ASC, the World, and Society in general.

To be bold enough to consciously and deliberately reach beyond ourselves, to accept a Grand Challenge for the greater good, would be an act of self-actualization. The alternative is to shrink back into the safety of our shell as non-participating observers.

## Bibliography

- Acham, K. (1974), *Analytische Geschichtsphilosophie. Eine kritische Einführung*. Freiburg:Alber.
- Agre, P. (1995), "The Soul Gained and Lost: Artificial Intelligence as a Philosophical Project", *Stanford Humanities Review*, 4(4), 1–19.
- Ampère, A.-M. (1843), *Essai sur la Philosophie des Sciences: ou, exposition analytique d'une classification naturelle de toutes les connaissances humaines, Volume Part II*. Paris:Bachelier. The book is available online at: <http://books.google.de/books?id=ltAEAAAAYAAJ>. Accessed: September 2012.
- Anderson, C. (2007), "The End of Science: Will the Data Deluge make the Scientific Method Obsolete?", *Wired Magazine No 16*.
- Ashby, W.R. (1956), *Introduction to Cybernetics*. London:Chapman & Hall.
- Baecker, D. (2007), *Form und Formen der Kommunikation*. Frankfurt:Suhrkamp.
- Baecker, D. (2008), *Wozu Systeme?* Berlin:Kulturverlag Kadmos.
- Bateson, G. (1972), *Steps to an Ecology of Mind*. New York:Ballantine. 2<sup>nd</sup> edition (2000) With Foreword by M.C. Bateson. Chicago:University of Chicago Press.
- Bateson, G. (1972), *Steps to an Ecology of Mind*. New York:Ballantine Books, 1–8.
- Bateson, G. (1974a), A Review of the Confusion. Untranscribed tape of a course session at University of California, Santa Cruz, Ecology of Mind. Bateson Archives, Special Collections, U.C. Santa Cruz.
- Bateson, G. (1974b), "DRAFT: Scattered Thoughts for a Conference on 'Broken Power.'" *Co-Evolution Quarterly* 4, 26–27, 27.
- Bateson, G. (1979), *Mind and Nature: a necessary unity*. New York:E. P. Dutton.
- Becher, T. (1989), *Academic Tribes and Territories. Intellectual Enquiry and the Cultures of Disciplines*, Milton Keynes:Open University Press.
- Beer, S. (1966), *Decision and Control: The Meaning of Operational Research and Management Cybernetics*. London:John Wiley & Sons.
- Beer, S. (1974), *Designing Freedom*. London:John Wiley & Sons. (Text of six radio broad-casts given in 1973 as the thirteen series of Massey Lectures with the Canadian Broadcasting Corporation.)
- Beer, S. (1975), *Platform for Change*. London and New York:John Wiley & Sons.
- Beer, S. (1979), *The Heart of Enterprise*. London and New York:John Wiley & Sons.
- Beer, S. (1993), "Easter", *Systems Research* 10(3), 13–17.
- Beer, S. (1994), *Beyond Dispute: The Invention of Team Syntegrity*. Chichester:John Wiley & Sons.

- Beer, S. (2012, May), What is cybernetics? – conference by Stafford Beer. Published on Youtube, May 16, 2012. <http://www.youtube.com/watch?v=JJ6orMfmorg>. Accessed September 2012.
- Boden, M. (2004), *The Creative Mind: Myths and Mechanisms*. London: Routledge and Kegan Paul.
- Borenstein, M., Hedges, L.V., Higgins, J.P.T., Rothstein, H.R (2009), *Introduction to Meta Analysis*. Chichester: Wiley Blackwell.
- Brooks, R. (1991), Intelligence without Reason, MIT AI Memo 1293. Retrieved March 20, 2011, from <http://www.ai.mit.edu/people/brooks/papers/AIM-1293.pdf>
- Brotchie, A., Gooding, M. (1992), *Surrealist Games*. London: Redstone Press.
- Brotchie, A., Gooding, M. (1995), *A Book of Surrealist Games*. Boston: Shambhala Redstone.
- Brün, H. (2003), *Irresistible Observations*. Champaign, IL: Non Sequitur Press.
- Brün, H. (2004), *When Music Resists Meaning: the major writings of Herbert Brün*. Middletown, CT: Wesleyan University Press.
- Carroll, L. (1871), *Through the Looking-Glass, and What Alice Found There*. London: Macmillan & Co.
- Couffignal, L. ([1956] 1958), Essai d'une définition générale de la cybernétique. In The First International Congress on Cybernetics, Namur, Belgium, June 26–29, 1956, 46–54. Gauthier-Villars. Publication of the essay from 1956 only in 1958.
- Cross, N. (2007), *Designerly Ways of Knowing*. Basel, Switzerland: Birkhäuser.
- Davis, W. (1998), *Shadows in the Sun: Travels to Landscapes of Spirit and Desire*. Washington, D.C: Island Press.
- de Vries, M.J., Cross, N., Grant, D.P. (eds.) (1993), *Design Methodology and Relationships with Science*. Dordrecht: Kluwer Academic Publishers.
- Dilthey, W. (1981), *Der Aufbau der geschichtlichen Welt in den Geisteswissenschaften*. Frankfurt: Suhrkamp.
- Dugas, A.F, Hsieh, Y-H., Levin, S.R., Pines, J.M., Mareiniss, D.P., Mohareb, A., et al. Google Flu Trends: Correlation With Emergency Department Influenza Rates and Crowding Metrics. Clin Infect Dis [Internet]. 2012 Jan 8; Online first. Available from: <http://cid.oxfordjournals.org/content/early/2012/01/02/cid.cir883> accessed
- ESFRI (2006), European Roadmap for Research Infrastructures. Report 2006. Luxembourg: European Commission.
- Etzkowitz, H., Leydesdorff, L. (1995) (eds.), *Universities and the Global Knowledge Economy. A Triple Helix of University-Industry-Government Relations*. Amsterdam: Science & Technology Dynamics.

- Feigl, H., Brodbeck, M. (1955)(eds.), *Readings in the Philosophy of Science*. New York:Appleton Century-Crofts.
- Fleck, L. (1979/1935), *Genesis and Development of a Scientific Fact*. Chicago: University of Chicago Press
- Foerster, H.v. (ed.)(1974), *Cybernetics of Cybernetics*, BCL Report 73.38. Urbana, IL: Biological Computer Laboratory, Dept. of Electrical Engineering, University of Illinois. Republished by Future Systems Inc., Minneapolis, 1995.
- Foerster, H.v. (1991), "Through the Eyes of the Other", in: F. Steier (ed.), *Research and Reflexivity*, London:Sage Publications, 63–75.
- Foerster, H.v. (1995), "Ethics and Second-Order Cybernetics", *SEHR*, 4(2), *Constructions of the Mind*, Updated 4 June 1995
- Foerster, H.v. (1995), *Cybernetics of Cybernetics*, second edition. Minneapolis: Future Systems.
- Foerster, H.v. (2003), *Understanding Understanding. Essays on Cybernetics and Cognition*. New York:Springer.
- Foerster, H.v. (2003a), "Cybernetics of Cybernetics", in: *Understanding Understanding: Essays on Cybernetics and Cognition*, New York:Springer, 283–286. Originally published in: K. Krippendorff (ed.)(1979), *Communication and Control*, New York:Gordon and Breach, 5–8.
- Foerster, H.v. (2003b), "Ethics and Second-Order Cybernetics", in: *Understanding Understanding: Essays on Cybernetics and Cognition*, New York:Springer, 287–304. Originally published in French in: Y. Ray et B. Prieur (eds.)(1991), *Systemes, Ethique, Perspectives en thérapie familiale*, Paris:ESF editeur, 41–55.
- Foerster, H.v. (2003c), "Perception of the Future and the Future of Perception", in: *Understanding Understanding: Essays on Cybernetics and Cognition*, New York:Springer, 199–210. Adaptation of an address given on March 29, 1971, at the opening of the Twenty-fourth Annual Conference on World Affairs at the University of Colorado, Boulder, Colorado, U.S.A. Reprinted from *Instructional Science*, 1 (1), 31–43 (1972).
- Foerster, H.v. et al. (1974), *The Cybernetics of Cybernetics*. Champaign-Urbana, Biological Computer Laboratory, University of Illinois. Republished as Foerster, H. v., et al. (eds.) (1995), *Cybernetics of Cybernetics or the Control of Control and the Communication of Communication*, second edition, Minneapolis:Future Systems, Inc.
- Foerster, H.v., Schmidt, S.J. (1993), *Wissen und Gewissen: Versuch einer Brücke*. Frankfurt, a.M.:Suhrkamp Taschenbuch Wissenschaft.
- Foerster, H.v., Müller, A., Müller, K. H. (1997), *Der Anfang von Himmel und Erde hat keinen Namen: eine Selbsterschaffung in 7 Tagen*. Vienna:Döcker.

- Foerster, H.v., Müller, K.H. (2003), "Action without Utility. An Immodest Proposal for the Cognitive Foundation of Behavior", in: *Cybernetics and Human Knowing* 3-4, 27-50.
- Foerster, H.v., Müller, A., Müller, K.H. (2013), *The Beginning of Heaven and Earth Has No Name: Seven Days with Heinz von Foerster*. New York:Fordham University Press. Translated from the German by Michael Kasenbacher and Elinor Rooks.
- Gardner, H. (1985), *The Mind's New Science. A History of the Cognitive Revolution*. New York:Basic Books.
- Gibbons, M. et al. (1994), *The New Production of Knowledge. The Dynamics of Science and Research in Contemporary Societies*. London:Sage Publications.
- Glanville, R. (1975), A Cybernetic Development of Theories of Epistemology and Observation, with reference to Space and Time, as seen in Architecture. Ph D Thesis (unpublished). Brunel University.
- Glanville, R. (1990), The Self and the Other: the Purpose of Distinction in Trapp, R Cybernetics and Systems '90 the Proceedings of the European Meeting on Cybernetics and Systems Research, World Scientific.
- Glanville, R. (2006), "Construction and Design", *Constructivist Foundations*, 1(3), 103-10.
- Glanville, R. (2007a) "Designing Complexity", *Performance Improvement Quarterly*, vol 20 no 2, 75-96.
- Glanville, R. (2007b), "Try again. Fail again. Fail better. The cybernetics in design and the design in cybernetics", *Kybernetes*, vol 36 nos 9-10, 1173-1206.
- Glanville, R. (2009a), "Black Boxes," *Cybernetics and Human Knowing*, 16, 1-2, 153-168.
- Glanville, R. (2009b), "A (Cybernetic) Musing: Design and Cybernetics", *Cybernetics and Human Knowing*, vol 16 nos 3-4, 175-186.
- Glanville, R. (2009c), *The Black Box, Volume III: 39 Steps*. Vienna: echoraum.
- Glanville, R. (2010a), "A (Cybernetic) Musing: Architecture of Distinction and the Distinction of Architecture", *Cybernetics and Human Knowing*. vol 17 no 3, 95-104.
- Glanville, R. (2010b), "Doing the Cybernetics of Cybernetics", *Cybernetics and Human Knowing* vol 17 nos 4-4, 107-115.
- Glanville, R., Riegler, A. (2007), *The Importance of Being Ernst - Festschrift for Ernst von Glasersfeld*. Vienna:edition echoraum.
- Glanville, R., Sweeting, B. (2011)(eds.), *Kybernetes* vol 40 nos 7-8, 945-1222.

- Glaserfeld, E.v. (1992), "Declaration of the American Society for Cybernetics", in: C.V. Negoita (ed.), *Cybernetics and Applied Systems*, New York:Marcel Dekker, 1–5. The article is available online at: <http://www.vonglaserfeld.com/065>. Accessed: September 2012.
- Glaserfeld, E.v. (2007), "How did Pythagoras do it?", in: *The Importance of Being Ernst. Festschrift for Ernst von Glasersfeld*, Vienna:echoräum, 279–283. Revised version of: The "truth" about Pythagoras, Problem Solving, 1981, 3 (5/6), 1–11. Also available online at: <http://www.vonglaserfeld.com/071>. Accessed: September 2012.
- Glaserfeld, E.v. (2010), "Troy Dinner Speech", *Cybernetics and Human Knowing*, vol 17, nos 3–4, 105–6.
- Gray, J. (2009), "Jim Gray on eScience: A Transformed Scientific Method", in: Hey, T., Tansely, S., Tolle, K. (eds.)(2009), *The Fourth Paradigm: Data-Intensive Scientific Discovery*. Publisher: Microsoft Research, xviii.
- Griffin D. (1958), *Listening in the Dark: the Acoustic Orientation of Bats and Men*. Newhaven, CT:Yale University Press, 61.
- Griffin, D. (1985), "Recollections of an Experimental Naturalist," in: Dewsbury, D. (ed), *Leaders in the Study of Animal Behavior*, Lewisburg Pa.:Bucknell University Press, 127.
- Guarineri, G., (1974), "Experience of Tactile Vision", *Perception*, (3), 101–4.
- Guddemi, P. (2012), Peer-Review Feedback, [letter] (Personal communication, 28 July 2012).
- Günther, G. (1972), "Cognition and volition: a contribution to the theory of subjectivity", in: *Collected Works of the Biological Computer Laboratory*. Urbana, IL: University of Illinois. Available at <http://www.vordenker.de/ggphilosophy/c> and v.pdf. Accessed September 2012.
- Hayles, K.N. (1999), *How We Became Posthuman. Virtual Bodies in Cybernetics, Literature and Informatics*. Chicago:University of Chicago Press.
- Heaney, S., Hughes, T. (1982), *A Rattle Bag*. London:Faber and Faber.
- Heims, S.J. (1985), *John von Neumann and Norbert Wiener. From Mathematics to the Technologies of Life and Death*. New York:McGraw Hill.
- Heims, S.J. (1991), *The Cybernetics Group*. Cambridge:MIT Press.
- Hewlett, R.G., Anderson, O.E. (1962), *The New World, 1939–1946*. Pennsylvania:State University Press.
- Hey, T., Tansely, S., Tolle, K. (eds.)(2009), *The Fourth Paradigm: Data-Intensive Scientific Discovery*. Publisher: Microsoft Research.
- Heylighen, F., Rosseel, E., Demeyere, F. (eds.) (1990), *Self-Steering and Cognition in Complex Systems. Studies in Cybernetics*. New York:Gordon and Breach Science Publishers.

- Hofstadter, D.R. (1982), *Gödel, Escher, Bach. An Eternal Golden Braid*. Fourth edition. Harmondsworth:Penguin.
- Hofstadter, D.R. (1985), *Metamagical Themas. Questing for the Essence of Mind and Matter*. New York:Basic Books.
- Hofstadter, D.R. (2007), *I am a Strange Loop*. New York:Basic Books.
- Hollingsworth, J.R., Müller, K.H. (2008), “Transforming Socio-Economics with a New Epistemology”, in: *Socio-Economic Review* 3 (6), 395–426.
- Hunter, J.E., Schmidt, F.L. (2004), *Methods of Meta-Analysis: Correcting Error and Bias in Research Findings*, second edition. Newbury Park:Sage Publications.
- Ingold, T. (2000), *The Perception of the Environment: Essays on Livelihood, Dwelling and Skill*. London:Routledge.
- Jantsch, E. (1972), Towards Interdisciplinarity and Transdisciplinarity in Education and Innovation, in: *Interdisciplinarity. Problems of Teaching and Research in Universities*, Paris:OECD, 97–121.
- Kajfež-Bogataj, L., Müller, K.H., Svetlik, I., Toš, N. (2010)(eds.), *Modern RISC-Societies. Towards a New Paradigm for Societal Evolution*. Wien:edition echoraum.
- Kamvar, S., Harris, J. (2011), We feel fine and searching the emotional web, in WSDM ‘11 Proceedings of the fourth ACM international conference on Web search and data mining, ACM New York, NY, USA available at <http://kamvar.org/assets/papers/wefeelfine.pdf>
- Kauffman, L.H. (1966), “Virtual Logic”, *Systems Research, Vol. 13* (Festschrift for Heinz von Foerster), No. 3, 283–310
- Kauffman, L.H. (1987), “Self-Reference and Recursive Forms”, in: *Journal of Social and Biological Structures* 10, 53–72.
- Kauffman, L.H. (2003), “Eigenforms – Objects as Tokens for Eigenbehaviors”, in: *Cybernetics and Human Knowing* 3–4, 73–90.
- Kauffman, L.H. (2005), “Eigenform, Kybernetes”, *The Intl J. of Systems and Cybernetics* 34, No. 1–2, 129–150.
- Kauffman, L.H. (2009), “Reflexivity and Eigenform – The Shape of Process”, in: *Constructivist Foundations*, 3, 121–137 and *Kybernetes, Vol 4. No. 3*, July.
- Kauffman, L.H. (2010a), “Virtual Logic – Circularity, Knots and the ASC”, *CHK, Vol. 17, No. 1–2*, 157–164.
- Kauffman, L.H. (2010b), “Virtual—The Square Root of Two”, *Cybernetics & Human Knowing, vol 17 no 4*, 81–88.
- Kauffman, L.H. (2012), Eigenform – An Introduction. Unpublished manuscript, retrieved from <http://journals.iss.org/index.php/proceedings51st/article/view/811/295>, March 13, 2012.
- Keeney, B. (1983), *Aesthetics of Change*. New York:The Guilford Press.

- Keeney, B. (2009), *The Creative Therapist: The Art of Awakening a Clinical Session*. New York:Routledge.
- Knorr-Cetina, K.D. (1984), *Die Fabrikation von Erkenntnis. Zur Anthropologie der Naturwissenschaft*. Frankfurt am Main:Suhrkamp.
- Knorr-Cetina, K.D. (1999), *Epistemic Cultures. How the Sciences Make Knowledge*. Cambridge:Harvard University Press.
- Knorr, K.D., Krohn, R., Whitley, R. (eds.)(1980), *The Social Process of Scientific Investigation. Sociology of the Sciences Yearbook*, vol. 4. Boston: D. Reidel Publishing Company.
- Knorr-Cetina, K.D., Mulkay, M. (eds.)(1983), *Science Observed: New Perspectives on the Social Study of Science*. London:Sage Publications.
- Koestler, A. (1964), *The Act of Creation*. New York:Macmillan, 331.
- Korzybski, A. (1933), *Science and Sanity, Institute of General Semantics*: Englewood, NJ: Prentice-Hall, 747–761.
- Krippendorff, K. (1986), *A Dictionary of Cybernetics*. American Society for Cybernetics. Published digitally online at: [http://asc-cybernetics.org/publications/Krippendorff/A Dictionary of Cybernetics.pdf](http://asc-cybernetics.org/publications/Krippendorff/A%20Dictionary%20of%20Cybernetics.pdf). Accessed: September 2012.
- Krueger, T. (2000), *Consciousness Reframed III: Proceedings of the Third International Research Conference, On the Design of Organisms*. Center for Advanced Inquiry into the Interactive Arts at the University of Wales College, Newport, Newport, Wales, UK.
- Kuhn, T.S. (1970/1962), *The Structure of Scientific Revolutions*, 2<sup>nd</sup> ed., Chicago:University of Chicago Press.
- Kulinskaya, E., Morgenthaler, S., Staudte, R.G. (2009), *Meta Analysis: A Guide to Calibrating and Combining Statistical Evidence*. Chichester: Wiley Blackwell.
- Lakatos, I. (1967)(ed.), *Problems in the Philosophy of Mathematics. Proceedings of the International Colloquium in the Philosophy of Science*, London 1965, volume 1. Amsterdam:North-Holland Publishing Company.
- Lakatos, I., Musgrave A. (1968)(eds.), *Problems in the Philosophy of Science. Proceedings of the International Colloquium in the Philosophy of Science*, London 1965, volume 3. Amsterdam:North-Holland Publishing Company.
- Levy, S., (2011), *In the Plex: How Google Thinks, Works, And Shapes Our Lives*, New York: Simon & Schuster.
- Luhmann, N. (1984), *Soziale Systeme. Grundriss einer allgemeinen Theorie*. Frankfurt.:Suhrkamp.
- Luhmann, N. (1997), *Die Gesellschaft der Gesellschaft*. Frankfurt:Suhrkamp.

- Manovich, L. (2008), Cultural Analytics, Analysis and Visualization of large cultural data sets, available at <http://lab.softwarestudies.com/2008/09/cultural-analytics.html>
- Maslow, Abraham H. (1966), *The Psychology of Science: A Reconnaissance*. New York: Harper & Row.
- Maturana, H.R. (1988), "Reality: The Search for Objectivity or the Quest for a Compelling Argument", *The Irish Journal of Psychology* 9 (1), 25–82. This paper has been made available online by Randall Whitaker at: <http://www.enolagaia.com/M88Reality.html>. Accessed: September 2012.
- Maturana, H.R., Varela, F.J. (1980), *Autopoiesis and Cognition: the Realization of the Living*. Dordecht:D. Reidel Publishing Co.
- Maturana, H.R., Varela, F.J. (1988), *The Tree of Knowledge: The Biological Roots of Human Understanding*. New Science Library. Bosten:Shambhala. 1st edition in Spanish in 1984.
- Mead, M. (1968), "Cybernetics of Cybernetics", in: Foerster, H. v., White, J., Peterson, L., Russell, J. (eds.), *Purposive Systems*, New York:Spartan Books.
- Moskvitch, K. (2011), Online game Foldit helps anti-Aids drug quest <http://www.bbc.co.uk/news/technology-14986013>
- Mowery, D.C.(1994), *Science and Technology Policy in Interdependent Economies*. Boston:Kluwer Academic Publishers.
- Mowery, D.C., Nelson, R.R. (1999)(eds.), *The Sources of Industrial Leadership*. New York:Cambridge University Press.
- Müller, K.H. (2007), "The BCL – an Unfinished Revolution of an Unfinished Revolution", in: A. Müller, K.H. Müller (eds.), *An Unfinished Revolution*, op.cit., 407–466.
- Müller, K.H. (2009), *The New Science of Cybernetics. The Evolution of Living Research Designs, vol. I: Methodology*. Wien:edition echoraum.
- Müller, K.H. (2011), *The New Science of Cybernetics. The Evolution of Living Research Designs, vol. II: Theory*. Wien:edition echoraum.
- Müller, A., Müller, K.H. (2007), *An Unfinished Revolution? Heinz von Foerster and the Biological Computer Laboratory, BCL, 1958–1976*. Complexity, design, society. Wien:edition echoraum.
- Müller, K.H., Müller, A. (2011)(eds.), *Re-discovering and Re-Inventing Heinz von Foerster*. Special Issue of Cybernetics and Human Knowing, 3–4.
- Mumford, L. (1934), *Technics and Civilization*. London:Routledge & Kegan.
- Nagel, E., Suppes, P., Tarski, A. (1962)(eds.), *Logic, Methodology and Philosophy of Science*. Stanford:Stanford University Press.
- Natures Tech: The Magic of Motion (2006), [TV program], ARTE/ORF, 3.–5. March 2008.

- Nelson, R.R. (1993)(ed.), *National Innovation Systems: A Comparative Analysis*. New York:Oxford University Press.
- Neurath, O., Carnap, R., Morris, C.W. (1970)(eds.), *Foundations of the Unity of Science, 2 vol.* Chicago:University of Chicago Press.
- New Oxford American Dictionary (2005), 2<sup>nd</sup> edition, Version 1.0.2, Apple Computer, Inc.
- Nowotny, H. (1999), *Es ist so. Es könnte auch anders sein*. Frankfurt:Suhrkamp.
- Nowotny, H. (2005), *Unersättliche Neugier. Innovation in einer fragilen Zukunft*. Berlin:Kadmos.
- Nowotny, H., Scott, P., Gibbons, M. (2001), *Re-Thinking Science. Knowledge and the Public in an Age of Uncertainty*. Cambridge:Polity Press.
- NSF (2003)(ed.), *Revolutionizing Science and Engineering through Cyberinfrastructure*. Report of the NSF Blue-Ribbon Advisory Panel on Cyberinfrastructure. Washington:NSF.
- Oyama, S. (1985), *The Ontogeny of Information: Developmental Systems and Evolution*. Cambridge, New York:Cambridge University Press, 69.
- Papert, S. (1988), "One AI or many?" *Daedalus, Journal of the American Academy of Arts and Sciences*, 117(1), 1–14.
- Pask, G. (1975), *Conversation, Cognition and Learning. A Cybernetic Theory and Methodology*. Amsterdam:Elsevier.
- Pask, G. (1975), *The Cybernetics of Human Learning and Performance: A Guide to Theory and Research*. London:Hutchinson Educational. (The text has been made available online by Paul Pangaro at: <http://www.pangaro.com/pask/index.html>. Accessed: September 2012.)
- Pask, G. (1976), *Conversation Theory. Applications in Education and Epistemology*. Amsterdam:Elsevier.
- Pask, G. (1987), *Conversation and Support: inaugural address presented November 30, 1987 at the occasion of assuming responsibility as guest professor in general andragogological sciences*. Amsterdam: University of Amsterdam. (The text has been made available online by Paul Pangaro at: <http://www.pangaro.com/pask/index.html>. Accessed: September 2012.)
- Pask, G. (2011), *The Cybernetics of Self-Organisation, Learning and Evolution. Papers 1960–1972, selected and introduced by Bernard Scott*. Wien:edition echoraum.
- Pask, G., Curran, S. (1982), *Micro Man. Living and Growing with Computers*. London:Century Publishing Co.
- Pias, C. (2003) (ed.), *Cybernetics–Kybernetik: The Macy-Conferences 1946–1953, Volume 1, Transactions*. Zürich, Berlin:Diaphanes. Reprint of the conferences originally edited by Heinz von Foerster 1949–1953.

- Plato ([380 BC] 1997), "Gorgias", in: *Plato: Complete Works*. Indianapolis and Cambridge:Hackett Publishing Group, 791–869. (The translation of the cybernetics passage in square 22 was slightly amended. The original Greek source can be found at Gorgias 511d: <http://www.perseus.tufts.edu/hopper/text?doc=Perseus>)
- Polanyi, M. (1958), *Personal Knowledge: Towards a Post Critical Theory*. London:Routledge. 55.
- Raxworthy, C., Martinez-Meyer, E., Horning, N., Nussbaum, R., Schneider, G., Ortega-Huerta, M., Peterson, A. (2003), "Predicting Distributions of Known and Unknown Reptile Species in Madagascar", *Nature Publishing Group*, 426, 837–841. at <http://www.nature.com/nature/journal/v426/n6968/full/nature02205.html> accessed March 2012
- Reil, T. (2011), Slide presentation at 'Casual Connect 2011' conference, at <http://www.slideshare.net/naturalmotion/torsten-reil-casual-connect-keynote-2011> accessed March 17, 2012.
- Rosenberg, N. (1994), *Exploring the Black Box: Technology, Economics and History*. Cambridge:Cambridge University Press.
- Russell, K. (2002), Why the culture of academic rigour matters to design research: or, putting your foot into the same mouth twice. Working Papers in Art and Design 2, Accessed accessed January 27th 2011 from [http://sitem.herts.ac.uk/artdes\\_research/papers/wpades/vol2/russellfull.html](http://sitem.herts.ac.uk/artdes_research/papers/wpades/vol2/russellfull.html) ISSN 1466–4917
- Sabeti, P.C, Varilly, P., Fry, B., Lohmueller, J., et.al. (2007), "Genome-wide detection and characterization of positive selection in human populations", *Nature*. 2007 Oct 18, 449(7164):913–8.
- Schmidt, E. (2011), Interview in Wall Street Journal on August 14th 2010 accessed January 27th 2011 from <http://online.wsj.com/article/SB10001424052748704901104575423294099527212.html>
- Schmidt, S.J. (2003), *Geschichten & Diskurse. Abschied vom Konstruktivismus*. Reinbek:Rowohlt.
- Schmidt, S.J. (2010), *Die Endgültigkeit der Vorläufigkeit: Prozessualität als Argumentationsstrategie*. Weilerswist:Velbrück.
- Scott, B. (2011), *Explorations in Second-Order Cybernetics. Reflections on Cybernetics, Psychology and Education*. Wien:edition echoraum.
- Segal, L. (1986), *The Dream of Reality: Heinz von Foerster's Constructivism*. New York and London:W.W. Norton and Co., 33–34.
- Sennett, R. (2005), *The Craftsman*. New Haven, CT:Yale University Press, 190.
- Shaffer, M. (1967), *Ear Cleaning: Notes for an Experimental Music Course*. Don Mills, ON:BMI Canada Limited, 8.

- Snood, N., (2005), *The Study of Sonar for Imaging of the Solid-Liquid Interface Inside Large Tanks*. Masters Thesis at Florida International University, 5.
- Soete, L, Arundel, A. (1993)(eds.), *An Integrated Approach to European Innovation and Technology Diffusion Policy*. Maastricht:European Commission.
- Solla Price, D.J. de (1974), *Little Science, Big Science. Von der Studierstube zur Großforschung*. Frankfurt:Suhrkamp.
- Spencer Brown, G. (1969), *Laws of Form*. London:George Allen and Unwin.
- Stadler, F. (1997), *Studien zum Wiener Kreis*. Frankfurt:Suhrkamp.
- Stichweh, R. (1991), *Der frühmoderne Staat und die europäische Universität. Zur Interaktion von Politik und Erziehungssystem im Prozess ihrer Ausdifferenzierung*. Frankfurt:Suhrkamp.
- Sutton, A.J. et al. (2000), *Methods for Meta-analysis in Medical Research*. Chichester:John Wiley.
- Swoboda, W.W. (1978), "Disciplines and Interdisciplinarity. A Historical Perspective", in: J. Kockelmans (ed.), *Interdisciplinarity. Reflections on Historical, Epistemological, Educational and Administrative Issues*. Penn:University of Pennsylvania Press, 49–92.
- The Secret Life of Chaos, (2010), [TV program], BBC, BBC 4, 14. January 2010, 21:00
- Trappl, R. (2010)(ed.), *Cybernetics and Systems*, xix–xxv.??? Originally published in the *CoEvolutionary Quarterly*, June 1976, Issue no. 10, 32–44.
- Turing, A. (1950), "Computing Machinery and Intelligence", *Mind*, 59(236), 433–60.
- Uebel, T. (1991)(ed.), *Rediscovering the Forgotten Vienna Circle. Austrian Studies on Otto Neurath and the Vienna Circle*. Dordrecht:Kluwer Academic Publishers.
- Umpleby, S.A. (1989), "Strategies for Regulating the Global Economy", in: *Futures*, December, 585–592.
- Umpleby, S.A. (1990), "The Science of Cybernetics and the Cybernetics of Science", in: *Cybernetics and Systems*, 1, 109–121.
- Umpleby, S.A. (2007), "Reflexivity in Social Systems: The Theories of George Soros", in: *Systems Research and Behavioral Science*, 24, 515–522.
- Umpleby, S.A. (2010a), "From Complexity to Reflexivity: Underlying Logics Used in Science", in: *Journal of the Washington Academy of Sciences*, 1, 15–26.
- Umpleby, S.A. (2010b), "From Complexity to Reflexivity: The Next Step in the Systems Sciences", in: R. Trappl (ed.), *Cybernetics and Systems 2010*, Vienna: Austrian Society for Cybernetic Studies, 281–286.
- Umpleby, S.A. (2010c), "Science 2: Is a Broader Conception of Science Still Science?" (unpublished paper, available at <http://www.gwu.edu/~umpleby/>, long list of publications)

- Virillio, P., (1999), "Surfing the Accident", in: *Art of the Accident*, Netherlands Architecture Institute, Rotterdam, NL, 30–35.
- Watts, A. (2006), *Eastern Wisdom, Modern Life: Collected Talks 1960–1969*. Novato, CA:New World Library, 115.
- Weinberger, D. (2011), *Too Big to Know: Rethinking Knowledge Now That the Facts Aren't the Facts, Experts are Everywhere, and the Smartest Person in the Room is the Room*. New York:Basic Books.
- Weschler, L. (1982), *Seeing is Forgetting the Name of the Thing One Sees*. Berkeley, CA:University of California Press, 86.
- Wever, E., Lawrence, M. (1954), *Physiological Acoustics*. Princeton, NJ:Princeton University Press.
- Wiener, N. (1948), *Cybernetics – or, Control and Communication in the Animal and the Machine*. New York:John Wiley & Sons.
- Wiener, N. (1948), *Cybernetics*. Cambridge Mass.:MIT Press.
- Wiener, N. ([1954] 1988), *The Human Use Of Human Beings: Cybernetics and Society. Da Capo Series in Science*. Boston:Da Capo Press.
- Wiener, N. (1954), *The Human Use of Human Beings* (2<sup>nd</sup> edition). Boston, Houghton:Mifflin.
- Wissenschaftsrat (2011), *Empfehlungen zu Forschungsinfrastrukturen in den Geistes- und Sozialwissenschaften*. Berlin:Wissenschaftsrat.