

The Bearable Unbearability of the Rational Mind

1. A changing world. What else is new?

Take some examples: In a virtual reality scenery, where everything has its own way of generating music, a performer brings to life instruments that do not compare to our pianos (including Cage's well-prepared instrument) and violins, trumpets and drums. Each virtual instrument is a "soft" reality, ready to generate sounds related to the world in which the performer is placed. I am describing a concert by Jaron Lanier, one of the inventors of virtual reality.

Or: Harold Cohen brought his program to the stage where it not only "knows" how to draw, but also "understands" color. *Aaron* is on its way to producing aesthetically relevant large compositions that complete the artist's body of work before he discovered the computer. It should be possible to extend the program for evaluating the outcome by introducing selection criteria.

Or: Large distributed interactive multimedia configurations provide an environment for syncretic forms of aesthetic interaction among artists working at remote locations, and a wide audience eager to co-participate in the *sui generis* performance.

Or: The telecomputer, a hybrid of the analog world of television and digital universe of computer graphics, makes each and every receiver of messages a potential generator of new forms of expression. Public access to cable television channels has already resulted in artwork of extreme transience, but also of extreme impact.

Or: Craig Reynold's flocking "boids" – birdlike constructs – whose local behavior is controlled by simple logical rules, "miraculously" duplicate the behavior of large groups of birds. This artificial life animation technique was used to animate flocks of bats in *Batman Returns* with impressive gain in the verisimilitude of the images.

The list will make some wonder ("Where is this leading us?"), a few smile ("Oh, I know of things a lot more interesting"), and irritate others ("Where machines take over, art ends!"). After all, we live in an age of change and challenge. To keep up with the news is already an art in itself, not to mention understanding what is going on, even less being part of the change, triggering it in some way. Can we, in good faith, take yesterday's tools, philosophical theories, aesthetic concepts, interpretive methods, sociological or psychological models, political notions, and anthropological findings and apply them usefully to the new developments? And if we can, what results can we expect? Some go ahead without much hesitation. Books and articles are written, classes are given, symposia take place in which speculative theories and teleological perspectives are applied to developments for which they are simply inappropriate. This is why, parallel to the indiscriminate dissemination of new technologies, we hear and read voices of confusion, misleading explanations, false conclusions.

After 30-plus years of involvement in the process to which the examples given above pertain, I can only say that voices of doom never cease to accompany change. Neither do they contribute anything to better understanding that change. Max Bense and the brilliant students and colleagues he had made a difference during these years insofar as they tried to comprehend the nature of the change and the obligation to keep pace with it. But if we want to understand and value their contribution, we need to put it in perspective. It is an attempt towards a trans-classic model (in the sense described by Siegfried Maser in his *Grundlagen der Allgemeinen Kommunikationstheorie*, Stuttgart, 1971). The goal is not to mediate knowledge, but to apply it, not to pursue an overly specialized path, but to open the perspective of multi- and interdisciplinarity. It should surprise no one nor disappoint anybody that the neat measurements (inspired by von Ehrenfelds and Birkhoff) introduced by Bense and his followers would miserably fail if applied on the examples given at the beginning. The information paradigm and semiotics at work in Bense's aesthetics were probably appropriate under the circumstances. Many call this the information age, but unless dynamically applied, the term is a bit too narrow and restrictive. Everything actually measured (by Bense, Maser, Nake, Nees, Gunzenhäuser, Franke, von Cube, Alsleben, Fuchs, et al [1]) revealed to the speculative mind or the intuitive eye and ear characteristics otherwise hidden. Why is it that the fundamental thought embodied in the theory we celebrate today passes the test of time with flying colors, while the actual notions (aesthetic information, aesthetic measure, aesthetic redundancy, and many more) fail? And why is the powerful notion of generative aesthetics still rooted in a

mechanistic horizon while it addresses a totally new form of human experience that actually negates any previous paradigm? I recently had a captivating discussion with one of Bense's students and closest assistants. We tried to figure out whether the fundamental thought of his aesthetics was structural or functional in nature. Judging by Bense's own words – in his writings or in discussions this colleague and I had with him – Bense acknowledged change and function, and became an agent of change and renewal (of both art and philosophy). However, judging by the outcome of Bense's captivating analysis, he remained captive to a structural obsession. Witness how he turned Peirce's semiotics into a gear for generating classes of signs instead of realizing how semioses take place. Witness too how his generative thought is one of order, or negentropic action, not one that is aware of the dynamics of chaotic processes or of high-level organization. In the words of Erich Kästner:

Aestheticians are odd people. They love the arts and love order and accordingly bring order into art. They attack culture like Linnaeus did in his time with flowers and trees. One would do injustice to such fanatics of order in considering them pedantic. No, they know the world's original secret of orderly activity, and this secret is: Who creates order, creates! [2]

The world of today is characterized by mediation, segmentation, heterogeneity, non-linearity, decentralization, parallelism, networking, and globality. These characteristics are not the result of our individual choices; they never made it into political programs. Some people don't even know what integration means and how globality is reflected in their lives. And yet they are integrated in practical experiences of high efficiency and live in a world that, despite its tremendous segmentation (along ethnic, racial, religious, economic, and political lines) shares more than ever its economic, communication, and financial infrastructure. The characteristics mentioned correspond to a pragmatic framework determined by the new scale of mankind and brought about by the need to meet this new scale by higher efficiency. The implications that this scale and drive for efficiency have for our self-constitution as human beings in a world of increased self-determination reach into the sphere of artistic praxis as well. A discussion of each of the characteristics mentioned is beyond the scope of this paper. But the fundamental thought – the pragmatic self-constitution of the human being – is by no means obvious. What we do, why we do, and how we do all we actually do, art included, expresses our biological, social, and cultural condition. An elaborate historic account can show how the emerging human species constituted itself within circumstances of direct action [3].

Once the need for mediation was realized, and thus the semiotic identifier *zoon semiotikon* made part of the pragmatic framework, the human being constituted itself as such (with all its requirements for survival) and as sign. This should be enough to state that the entire cognitive dimension of the human being is semiotic. Within this dimension, the aesthetic component eventually assumed a relative autonomy, in many ways evident in the variety of aesthetically motivated forms of human experience. But what concerns us here is not history. The subject is the present and the future, and as such this subject is telling for our own new condition. We live in a world of accelerated rhythms of change. In this world, eternities last as long as in Warhol's description of celebrity. (Was it 15 minutes or 15 seconds?) Determinism, whether mechanic (the cause-and-effect sequence) or electronic gives way to non-deterministic forms of human activity. Sequentiality – of language, particularly writing, work on a production line, functioning of a serial computer, etc. – is, if not replaced, at least complemented by parallel modes: visual communication, distributed concomitant activities, parallel processing, collective behavior. The ideal of permanency, constitutive of a pragmatic paradigm resulting from a rather humble human being who questions its role in the universe, was replaced by that of transient processes. This applies to machines – their life cycle is shorter and shorter – and programs, to religion (new gods appear as frequently as do predictions in horoscopes), to art (less obsessed with eternity and more with immediate success), to science (where not only do theories succeed each other faster than ever, but also where contradictory scientific explanations are simultaneously entertained). The dualism of power – from a global level to a societal one – is replaced by the vagueness of human interactions within changing national and social boundaries. With particular reference to art, we do not really know, as we used to, the distinction between the work and the process, between value and worthlessness, between artist and public, not to mention distinctions of form and content, media, meaning. We do know that cooperative efforts, within the networked world, make possible interactions at the global level. We also know that the aesthetic dimension of human praxis extends well into all other human experiences (science, work, politics, economics).

With all of this in mind (i.e., defining the pragmatic perspective), it should be a little more obvious why a syntactic approach – after all, Shannon’s model of communication that inspired Bense’s school is syntactically defined – or even a semantic approach to art, including the art generated in a computational environment, could not provide answers beyond the very surface of the phenomena under discussion. That it was necessary is hardly to be doubted; that it is insufficient is probably one of the assertions made here, worth detailing if indeed alternatives are proposed.

2. From order to chaos

“...wie das Vergessen im
Schutzschild der Schönheit”[4]

But it is an old cry, as old as theory, that the new cannot be explained from the perspective of the old. Bense, and implicitly his students and colleagues, lived by the axiom that there is no *a priori* aesthetics. He defined his aesthetics as *Konstatierungsästhetik* (an aesthetics of verification or ascertainment), a condition that it fulfilled, at times admirably, at other times quite naively, and more recently, not at all. And here we face another intrinsic contradiction of the aesthetics Bense and his school pursued. It should be scientific, but it fulfilled only an analytic function – at best a generative function, if the analytic project was reversed – and its findings made into molds for artifacts of a similar nature. It suggested: “If you have a good representation of a problem, you are guaranteed a solution.” But science is not only descriptive; it is also predictive. Nevertheless, predicting the behavior of a physical device is not the same as predicting or generating art. This contradiction is of extreme significance for the entire approach. Nake, Nees, Alsleben, Franke, Maser, and Gunzenhäuser had problems with this model, but like myself they were able to use it either to generate aesthetically relevant images or to build theories that integrated the generative thought. In itself, it was a revolutionary thought, an *avant-garde manifesto*. Many had previously attempted to rationalize the production of artifacts with aesthetic characteristic. (Mozart [5] is the example *par excellence*, but the combinatorial thought goes well back to Leibniz, Pascal, Raimundus Lullus, and Kircher.) Bense’s notion extends the permutational aspect, well into understanding one important component of the practical experience of human self-constitution through art: the algorithmic. He wrote [6] before anyone else came with this thought:

Under generative aesthetics one has to understand the inclusion of all operations, rules, and theorems through the application of which a set of material elements, which can act as signs, aesthetic states (distributions, i.e., gestalts) are obtainable in a conscious and methodic manner.

We infer from the definition that the function processed needs to be computable, and that the procedure implies the algorithmic description.

Nake, in his remarkable *Ästhetik als Informationsverarbeitung*, discussed Bense’s notion in detail. He astutely noticed weaknesses of all kinds, not the least the model’s rather static nature. He also pointed to Nees’ practical contribution (in the 1965 show of computer-generated images), to Helmar Frank’s philosophy (as in *Kybernetische Analysen subjektiver Sachverhalte*), to Maser’s attempt to establish a foundation for the “measuring” of art and for generating the reverse, generative function, to Herbert Franke’s position. It should be noted that Frieder Nake actually elaborated, with the encouragement of Rul Gunzenhäuser, effective procedures and wrote a theory of generative aesthetics rooted in the information processing paradigm, a field within which he continued his academic career.

All this being said – not without a feeling of frustration, since during the same years I worked on my own generative aesthetics, a time of programming without access to a computer, but probably more exciting since the virtual computer I programmed was a theoretic machine – it is time to return to the question of aesthetic knowledge. Indeed, algorithmic procedures, by their nature, follow the acquisition of knowledge in a given domain. Algorithms are translated into programs. When we need to do ray tracing, for instance, we go back to optics and translate laws of physics into computable functions. This corresponds to the paradigm of science that marked human experiences of self-constitution until recently. The emergence of computational knowledge, for instance, of new methods for modeling and simulation reverses the process in some way. To be more exact: we are able to acquire computational knowledge by visualizing

phenomena, or by simulating the behavior of complex systems, or even by triggering phenomena of artificial life, characterized by lifelike behavior: learning, growth, adaptability, self-organization, reproduction, self-identification, optimization, and the like. This complements our past model of science and suggests that more efficient forms of processing and manipulation of data allow us to “see”, to “hear”, to “smell”, or to “taste” what our senses could not. The non-algorithmic dimension of computation, along with its extension into artificial intelligence procedures, could not be part of Bense’s model because it corresponds to a view of the world of a dynamic never before experienced and which did not concern him. As a subset of our new generative procedures, combining algorithmic and non-algorithmic elements, Bense’s generative aesthetics, limited to algorithmic procedures, comes to us with a well-deserved aura of anticipation, but also with the faint smell of fading roses.

The epistemological consequence of this new development is telling in many ways. Indeed, discontinuity – cultural, economic, political, artistic, scientific – in respect to the past dominates the dialectics of change. This is a pragmatic characteristic resulting from a context for human self-constitution subject to a dynamic best captured, until now, in chaos theory. If no better generative model were available to replace or complement the algorithmic model, a chaos modeling of art would probably come close to what art processes are. Indeed, art is not a state of order and does not proceed from it. Order is its absolute opposite. Art experiences proceed from very complex states of chaos, taking the path towards attractors (mainly the category called strange attractors). This should surprise nobody since our minds, as I tried to prove (cf. *Mind Anticipation and Chaos*, Stuttgart, Belser Presse, 1991) are chaotic in nature. Human minds exist only in relation to other minds. The relation is of the order of one (the brain dissipating entropy) to many (the negentropic impact) and thus results in self-configuration. Minds are in anticipation of events in the sense that they help us operate in an enormous space of possibilities, the majority of which we have not experienced before. The artistic experience is but one of the many through which anticipation comes to expression. So is the scientific experience. In other words, the a priori nature of the aesthetic self-constitution of humans is ascertained on the ground of acknowledging our biological reality, with its inner clock, senses, neural endowment, and the ability to enter into dynamic relations whose output is not simply processed information but actually added information, or better yet, self-organization. It should be pointed out at this juncture that information is a weak description of organization; messages of high information are rather disorganized. (The relation between information and organization will come up again soon.) The dynamics of modern art, i.e., non-representational, is indicative of this assertion. Moreover, what counts is not the amount of data, but the infinity of possible and actual relations established within a set of data or within different sets. The relational nature of cognition, in particular aesthetic cognition, is the significant aspect. While missed in information-based measurements, this relational nature is captured in the reality of the sign. Although Bense and his school rarely, if ever brought informational and semiotic aspects together, they looked into both with various degrees of accomplishment.

3. Art sets signs/Kunst setzt Zeichen

Jedes Zeichen scheint allein tot Was gibt ihm das Leben? Im Gebrauch lebt es.

L. Wittgenstein

To know means to embody knowledge in the experience of self-constitution. This applies to the farmer working his fields or controlling genetic production mechanisms, to the laborer on the assembly line or in charge of highly automated processes, to the researcher, the doctor, the artist of yesterday but even more of today. Yes, art, like everything else, is in anticipation of the work in which it is embodied. It incorporates everything that pertains to the individual: how well one sees, hears, commands a brush or a chisel; how well one thinks; how well one connects to the immediate environment, to remote phenomena, to the past, the present, and, more important than anything else, to other human beings. Nobody is an artist until and unless self-constituted as such in the experience of doing, which is, simultaneously, always an experience of minds interacting. That some artifacts originating in experiences hard to identify as artistic – action painting, happening, appropriation of forms and motives from others – are sometimes celebrated as art does not change the expectation of artistic intentionality. For that matter, some artifacts were celebrated as scientific hypotheses – some read petroglyphs as theories of the cosmos or as

number systems – while other artifacts – the theory of relativity – were read as aesthetic accomplishments of exceptional significance.

Human self-constitution in practical experiences (from mytho-magical experiences to the exploration of the micro- and macro-universe) results in explicit or implicit knowledge. Artistic knowledge is but one form of knowledge. It regards everything that makes art possible, moreover necessary, as in the case of the artistic experience as a form of discovery. The obstinate focus on the artifact/object in Bense's aesthetics can be well understood. He and members of his school defended the position of exclusive focus on the artwork quite effectively. But no matter how much one empathizes with the position, it will never lead to anything but the understanding of the object according to its assumed artistic condition. Nevertheless, art negates the artifact in which it is incorporated and becomes recognizable only after it is freed from the cage of its material embodiment. Meaning is not dependent upon the type of marble a sculptor uses, a musical instrument does not change the art of a composition, a dancer's hair color or height is not what gives life to a choreography. To see the container in the work, as information aesthetics ultimately does, is to miss the fact that art is alive only in those interacting with it, questioning it, knowing it. There is no life in the canvas covered by paint, even if the painter is a celebrated artist. That the artist literally puts his or her own life into the work might sound romantic, but it corresponds to the pragmatic definition of art that we follow. Does this life suffice to maintain the work over time? Obviously not. It takes the literal life of those self-constituted as viewers, listeners, readers, etc. to acknowledge and resuscitate the art. For those who understand the philosophic foundation of Peirce's semiotics, this is obvious: We are the sign. This has always been so, but what differentiates our age from past ages is the awareness of this fundamental condition. Many arguments rooted in this observation—in particular the observation that the pragmatics of our age is one of generalized and multi-layered mediations speak in favor of defining the pragmatic framework of the present as one of semiotic praxis. Semiotization defines a practical experience intent upon finding the best semiotic means for achieving its goals.

Increased mediation, as a necessary strategy for the increased efficiency of human activity, is accomplished by sign-based systems. After all, computers are semiotic machines, if indeed we understand semiotics as logic of sign functioning (logic of vagueness, in particular). But not only computers embody the semiotization of the practical experiences of human self-constitution. The entire genetic project is semiotic in nature insofar as it addresses genetic codes, their change over time, and genetic inheritance mechanisms. The ubiquity of sign processes in all forms of human practical experiences – in the realm of politics, of social relations, in the semiosis of the market, in communication, to name only a few – extends well into the aesthetic experience, in particular into the art experience. Ritual-based art was not semiotic; it could be (and was) interpreted in semiotic terms after the experience. But the ritual trance does not stand for something else; it is existence in its direct, unadulterated form. A layer of mediation is progressively added as people distinguish between the existential level and their own awareness, particularly in language, of how they become what they are, projecting their biological, cognitive, aesthetic, and other characteristics in the world with which they interact. The phase of generalized semiotization comes about as the meaning of the biological fabric itself is revealed beyond the chemical and physical phenomena affecting the organic and anorganic matter. The genetic revelation is by no accident synchronous with the computational paradigm and with progress in the research of dynamic systems.

Among the many consequences of this change in the nature of human praxis is the fact that rationality, celebrated as the universal answer to everything that pertains to the human being, simply no longer returns the expected knowledge. We rationalize production, medical care, education, art, and market processes; that is, we applied our *ratio* as measure of all things, and we embodied it in institutions and regulations of various kinds. And so we know by *law* what AIDS is and adopted measures to help those affected by it. But when an AIDS-like disease with no HIV comes about, our ability to deal with the new situation ceases. To the question "What does AIDS have to do with art?" (besides the relatively high incidence of AIDS among artists), the answer is relatively simple: Applying rationality to what are known as art objects – the Bense project – returns knowledge not so much about the object as about our own preconceptions: Art is what one sees at the museum; art is what critics call art; art is what media tell us; art is what the law states; art is what foundations fund; etc. This affects the claim of objectivity, or even *scientificity*, of those who thought that quantitative analysis of art saves it from subjectivity, in

particular from the speculative gurgle of logocratic modes of explanation. The fact that we can all measure something only speaks about the objectivity of measuring, not about the objectivity of what is measured, under which circumstances, and in disregard of what elements constituting the pragmatic context.

Again, this should not surprise anyone who is aware of semiotics. Signs do not exist independent of us. Moreover, in the context of change that I present here, we really no longer know what is and what is not an art object, as we do not know what AIDS is, even less what is right and what is wrong. The relativization of value corresponds to the semiotization of human activity and thus embodies the logic of vagueness governing semiotic processes. Looking back at my personal relation with Bense, I understand that exactly the logic of vagueness, which I introduced to the discussion of sign processes, separated us. Where his system effectively generated typologies, my concern was with dynamics and the nature of change. Knowledge as part of the experience of change is less stable, less adapted to neat classification, such as Bense wanted to produce. The science of this age of generalized semiotic praxis is less concerned with the *relata* and more with the relation, especially with its qualitative aspects, difficult to capture in the terms of information theory.

All the measures proposed by Bense and his school reveal some characteristic of the object subjected to the rationality of information aesthetics. But when information itself is not always and universally a measure (of organization, for instance), measuring it as accurately as possible will only tell about information aspects, not about the many other aspects of a work of art.

4. How do we know what we know?

For fools rush in where angels fear to tread.

Alexander Pope

The aesthetic component of the practical experience of human self-constitution is present in everything. It projects the human biological substratum insofar as this is the vortex of rhythm and harmony resulting from our interaction with the world in which we live. Anthropologists were quite convincing in their argument that the most effective known human experiences were at the same time aesthetically relevant. Does the same apply to experiences that are more and more disconnected from nature? Is the writing of a computer program or the genetic manipulation of a chromosome as much dependent on the aesthetic component as agriculture, hunting, or the crafts? Moreover, is art, as a particular form of the practical experience of human self-constitution, in extension of the implicit aesthetics of individual existence or an independent component of it? Bense would, I'm afraid, qualify such questions as belonging to speculative philosophy. But we now have the means to quantify them, no less precisely than with his own measurement, and simulate the philosophic component in a very precise computational environment. We are, for instance, in the position to train a neural network so that it can recognize artifacts labeled as "successful art" or "good design," moreover so that it can produce similes and even affect their change with some innovation reflective of a state of knowledge of aesthetic relations. We can also look into the genetic making of the being and find out what it is that projects into works of art or other artifacts as golden sections (which neither artists nor craftsmen measure but come upon, intuitively as some claim), or Fibonacci series (the genes do not "know" that a mathematical equivalence of the two was given), or harmonies, etc. Of course, this raises questions regarding the relation between unity and variety, the finite and infinity, and even about such polar categories as *light* and *heavy* [7]. Knowing what is bearable is part of the practical experience of knowing oneself by knowing others.

But this brings up the more important issue of how do we know what we know, in particular, how do we know art when we see it, hear it, or interact with it? The assumption of aesthetics is that sensorial perception has its own logic. (This is Baumgarten's definition of the field.) In other words, we see beauty when we are presented with it. In contradistinction to this aprioristic conception (consolidated as such not only by Kant, but also by the many followers to the left and the right of the philosophic spectrum) is the expectation that we make things to be whatever we want them to be, as the context requires, affords (as Gibson puts it), or makes possible (positions expressed by philosophies as different as deconstruction, ecology, Marxism, and functionalism). And so it goes that we find beauty in ugliness and ugliness in

beauty, that we make art from everything and everything from art, and that relativity (of judgment, value, function) is intrinsic to aesthetic interactions.

In some works inspired by Bense's approach, artist and viewer are seen as complementary, irreducible poles of aesthetic processes of art perception, understanding, interpretation, and valuation. I specifically refer to Nake's model of aesthetic processes, as well as to Frank's attempt to build on the cybernetic model, and moreover to Maser's powerful communication diagrams extended into the realm of aesthetics. Such models definitely helped us to better understand how artists, the public, and the work participate in various forms of interaction. Nevertheless, expressed in diagrams, such models were quite static. They made assumptions – such as the existence of a common repertory, or the dominance of semantic aspects – that simplify away the problem they represented. In short, they originate in a pragmatic context of dualism (Descartes' territory), and while they are quite adequate in this context as instruments of rationalization, they simply cannot be applied to experiences non-dualistic by their nature. Furthermore, dualism embodied in computer graphics programs leads to what I labeled (and the terms was widely adopted) "canned art." (The definition of "canned art" was given *en avant la lettre* in the generative aesthetics whose formulation by Bense I already quoted.) The alternative is represented by the open-ended interactive environments never intended to lead to that ideal of the past known as the "finished" product, but to instigate newer and newer interactions. It is also embodied in the multivalued logic or fuzzy logic of aesthetic decision-making, in the virtual reality experience that unveils knowledge as it takes place. The direction of change is from things, objects, impressions to relations, processes, to new states of minds. When Charles Morris, this unfortunate popularizer of Peirce's semiotic doctrine, spoke of semiotics as a universal discipline, as the unified science, many smiled. In fact, this is probably the only original thought Morris had, and quite courageously in a time of specialized knowledge and extreme labor division. Indeed, through the doctrine of sign, and more through the science of sign processes, we reconstruct the unity of the being and affirm it as the universal. Bense's genius consisted in understanding the semiotic nature of aesthetic practical experiences and deriving from this understanding the thought of generative processes applied to a new cognitive condition. He stopped short of formulating the cognitively relevant questions that were made possible in the digital environment, furthermore in the semiosis of artificial intelligence, virtual reality, and artificial life (ALife). Computer-supported art generation is still art made by artists. In some cases, the fortunate result is the "disappearance" of the computer, its total integration in the aesthetic project (the work of Manfred Mohr is but one example in this category). In other cases, what is ascertained is the computer signature, the digital fingerprint (in the form of rasters, jaggies, color combinations, limited resolution, etc.). Artificial intelligence programs generate images, sounds, or a variety of aesthetically relevant artifacts that are machine made under the guidance of encoded knowledge and heuristic procedures. Helmar Frank, in his repeated attempts to discuss the art generated by devices – what he called *apparative Kunst* – was setting a much more interesting context for a discussion of what art is; so did Nake in defining the high abstraction notion of aesthetic space. In fact, Harold Cohen's artificial intelligence program – a non-human autonomous painter – is in some way a generalization of this space. But the more advanced the notions we identify at the fringes of Bense's information aesthetics, the more evident that an inherent limitation to the system marks its epistemological, cognitive, and practical boundaries.

5. Metaphors and art knowledge

Progress is a comfortable disease.

E.E. Cummings, *One Times One 1944*

Chaos, attractors, virtual reality, artificial reality, molecular computation—these are concepts on which knowledge and practice focus today. Information processing, aesthetic measure, aesthetic redundancy, generative aesthetics these are concepts originating from theories and practices of the relatively recent past and appropriated in Bense's aesthetics. During the time of change captured here, Quine appropriately observed:

Along the philosophical fringes of science, we may find reasons to question basic conceptual structures and to grope for ways to refashion them. Old idioms are bound to fail us here, and only metaphor can begin to limn the new order. If the venture succeeds, the old metaphor may die and be embalmed in a newly literalistic idiom accommodating

the changed perspective. [8]

It is obvious that Bense's metaphors and those of our days are witness to the process of better understanding something – art in this case – which has been obscured in many ways by metaphors originating in past human experiences. As a juxtaposition of the familiar and the less familiar (unexplained, challenging), the metaphor of art as information carrier (one among many) helped us understand how within very strictly defined contexts – such as the context of information theory – we can infer from works of art to their intrinsic aesthetic qualities as information characteristics. Gestalt psychologists anticipated the move. (One of them, Arnheim, even managed to botch a concept of information theory, namely entropy, in giving it a post-Gestalt reading [9].) Obviously, the analogic thought that art can be seen from an information processing perspective was meant to explain the nature of what constitutes the aesthetic, reducing it to the explained elements of information theory. Asserting similarities, the metaphor evidently omitted dissimilarities. It is not very clear whether what is similar in an information process and a work of art identifies its aesthetic quality, or, to the contrary, whether the aesthetic qualifier does not emerge in the realm of what the two do not have in common. The speculative nature of the use of information theory concepts in aesthetics is after the fact, i.e., after Bense's attempt, more evident than it appeared to Bense and his followers. This is not at all surprising. Cognitive science already acknowledged that metaphors are taken literally at the initial stages of an endeavor. The procedure, as we now know, looks like a computer program that starts with IF (i.e., art is an information carrier) and continues with a sequence of THEN statements. The data inputted as program can only generate an infinity of sequences, in particular, variations with some degree of aesthetic relevance. In order to break the vicious cycle of rediscovering in the output what we provided as input, randomness, meant to stimulate inspiration (or something of a surprising nature, the "accident") is introduced. (Nees made his own contribution to this.)

The same discussion holds true for the semiotic perspective. Calling the work of art a sign (or supersign, as Bense liked to do) is in itself irrelevant as long as our definition of the sign precludes a departure from the literal – the inventory/repertory of signs – to the metaphoric. Actually, nothing is a sign unless interpreted as a sign; and for that matter, nothing is information unless interpreted as information and relevant as such. When computer scientists or artificial intelligence researchers define symbolic computation or symbolic procedures, and indeed think that the silicon chip really processes symbols, they do exactly what Bense did, as well as many before him did and many after him will continue to do, i.e., they take a metaphor literally. Evidently, all that is in the chip are electrically charged particles moving in some direction, affecting some physical phenomena that simulate either a Boolean logic or some heuristic logic. Computation taken as mind activity is another example. It could be seen as information processing, even as chaotic process; or it can be designed so that it displays characteristics of virtuality or of life. Susanne Langer, who believed that "A symbol is any device whereby we are enabled to make an abstraction," [10] was looking at semiotics (which, in Cassirer's tradition – the book is dedicated to his memory – she calls the theory of symbolism) as a foundation of art criticism. She was hoping that a "critique of art" based on the theory of symbolism can be "as serious and far reaching as the critique of science that stems from the analysis of discursive symbolism," [11]. Bense, who broadened the perspective, identifying as components of his aesthetics not only mathematics and semiotics, but also physics and information, communication, signal and system theory, formulated (evidently more sharply) his credo: "Only such a rational-empiric, objective-material aesthetic conception can remove the general speculative twaddle of art critics and make the pedagogical irrationality of our Academies disappear," [12]. Why did such a program, which many others besides Langer and Bense articulated over the years, not succeed, or at least not as much as its proponents hoped or wished?

I already discussed in some detail the inherent limitations, as well as virtues, of an object-based aesthetics. It is time to suggest alternatives to it, since what definitely brought me closer to Bense and his school is the shared goal of a scientific aesthetics. A theory of art, and more broadly an aesthetics, should aim at understanding, not description, at organization, not information. It should deal with art as a multifunctional process to which works of art are only a witness, not the product. Assuming that someone could, *ad absurdum*, collect all that is identified as works of art, that person, or museum, or institution would not own art, but pieces of marble, canvas, wood, chemical substances used as colors, etc. The

processual nature of art is not captured in the work, but continuously extended in the reconstitution of the work by the human being self-constituted in the practical experience of interaction with it.

The metaphors of information processing and semiotics replace the creationist metaphor. This is quite acceptable, and even necessary. But once this is accomplished, we still don't know what art is. Langer, who almost lifted Cassirer's words, thought that "Art is the creation of forms symbolic of human feeling," [13]. Frank, in the spirit of Bense's aesthetic thought, defines art "as a message, whose source is connected to human consciousness," [14]. The metaphor of the theory is still taken literally. The viewpoint I am representing – hopefully as a further development of the school of thought we celebrate today – is that only the pragmatic dimension of art allows us to know what art is, and thus suggests what kind of means for its better understanding we need. As a particular form of the self-constitution of the human being, art makes possible human interaction in a realm governed by expectations of knowing ourselves as sensitive beings capable of emotion, laughter, and grief. As such, art, as Langer described it, is "a purely virtual 'object' " [15]. Surprisingly, the claims of virtual reality technologies are exactly the same: experiences in the real world are different from those in virtual reality. Definitely, in the virtual reality experience, Occam's razor cuts more to the point than in a symbolic painting or musical composition: things should not be multiplied beyond the minimal necessity. As an experimental space, virtual reality treats symbols as gadgets. Its focus is on experience, not on representation. This applies even more so to artificial life.

But before providing some ideas about how an artificial life perspective would continue Bense's thought while transcending the limitations of his aesthetics, one has to ask a simple question: To which extent is the information theoretic approach valid to aesthetics, to art, in particular? This question needs to be addressed, not because the answer seals the destiny of the entire Bense approach, but rather because all the hopes ingrained in the powerful generative aesthetics concept are dependent upon the perspective from which they are implemented. Information measures of communication design are definitely revelatory, but the same cannot be said about information characteristics of art *per se*. We already stated that information is a rather weak instrument for description of organization. This would mean very little if indeed it could be proven that art is ultimately an information processing activity and only such an activity. This would imply that everything defining an artifact as a work of art is reducible to information theory terms, or derived from such terms. For a while, this assumption was not only acceptable, but probably necessary. From among all works ever produced, we could very well find out that what makes something function as art – when the experience of art understanding takes place – are properties very similar to those of what we define as properties of the living. Such properties are not the result of additive interactions (of the paint, brush, canvas, marble, steel, or whatever else defines the material substratum of the work). They are relational, in the sense that not the constitutive elements define them, but rather the interplay of such elements, the non-additive interaction among factors and components involved in the practical experience of art. In short, the identifier of something as art, in the process of human self-constitution as maker of the artifact or as viewer, is an *emerging* property, irreducible to components, but dependent upon their interaction, while not necessarily inherent in the components taken separately.

Emergency occurs at the level of organization and not at informational levels. The intellectual task assumed by Bense, that of discovering definitory measures of artworks, is continued in its spirit when, instead of dealing with a level of relative significance – information – we adapt the dynamic viewpoint, implicit in artmaking as organization, which better reflects the nature of aesthetic processes and the functionality of art. One important consequence is the need to reassess the very promising – indeed groundbreaking – concept of generative aesthetics, and root it rather at the level of the practical experience of aesthetic organization than in information focused processes. Suddenly, what was "packaged" as an aesthetic program for computer generation of images or music becomes a principle of organization designed with the expectation of providing interactions leading to the emergence of aesthetic properties. These properties are no longer "canned" for a user of a program but provided as a framework for an artist aware of what it takes to organize extremely heterogeneous elements. I remember asking, at an international conference on computers and art, the question: What would happen if someone would suddenly become the owner of all the tools and materials Picasso used? Well, buy yourself the newest program, Fractal Design Painter, and you can own a van Gogh brush, for example, and everything you paint will have the look of a van Gogh. Obviously, the generative aesthetics captured in this program is

adequate from an information theory viewpoint. What does not come about in the process of using the program is the emergence of art, because the elements involved in the generative aesthetics used are only subject to additive interaction.

A level of organization, at which non-additive interaction of a nature not inherent in the properties of the many features the program makes available, would require elements of self-organization, learning, even evolution and self-knowledge – all part of artificial life techniques (to which we shall soon return) – which probably could lead to creative interactions between artists and such non-deterministic programs. As a highly hierarchical system, the aesthetic system displays properties that are often confusing. It seems that everything disturbing the hierarchy reflects upon all the elements on the lower level, while usually leaving the higher level (where understanding takes place) relatively unaffected. The many paintings of the Renaissance, the late Baroque, even modern paintings, cut into smaller pieces and sold, the sculptures with cut arms and bruised noises, the many attempts to repaint a canvas are all testimony to this. In strict information terms, this would simply be an aberration; in the terms of emerging aesthetic properties and the role of artistic organization, they are intrinsic to the practical experience of art. Applied now to computer-based exercises, it is clear why the endless massacre of the *Mona Lisa*, why the reprocessing of past art and imitation of past styles produced only sad testimonies to their misunderstanding in the first place.

Intent on properties of organization, which are relatively independent of information, ALife models lifelike behavior through iterative optimization, learning, growth, adaptability, self-organization, reproduction, and self-identification. Intrinsic to such organizations, frequently applied with aesthetic purposes in mind, are evolution and diversity. Accordingly, the work of art thus defined is able of coevolution. Quite naturally, ALife techniques proved very well adapted to dynamic works of art: animation, design by modeling and simulation, scripting of interactive multimedia events. All these expand and multiply our notion of experimental aesthetics, of art knowledge in computational form, of generative aesthetics beyond the boundaries of the algorithmic. Although they do not fit in the mold Bense and his school created, they need to be addressed if we want to do justice to the thought they embody. There is in defeat so much to learn that the best homage is not in memorializing but in continuing the effort, even if within a new framework.

6. Gliders on the aesthetic sky

With these remarks, we are already at the border between present and future. We have yet to build a better “computer” than the human being. We know that the creative possibilities of the human brain, in art as well as in mathematical creation or scientific discovery, cannot be matched by the machines and programs we’ve created in the last 30-40 years. Nevertheless, with the advent of molecular computing, drawing on biological, chemical, physical, and mathematical knowledge, a new border is traversed. Molecular computing applies to sign processing (in particular, information processing) in natural biomolecular systems (such as the brain) and to sign processing in artificial systems that use biomolecular or biometric materials, techniques, or principles. Where speed and memory were suspected of limiting our ability to perform efficient pattern and object recognition, or to achieve some other qualities (initiative, for instance), in fact something else was missing. The relation between structure and computational function seems more critical than anything inherent in the hardware. In the silicon chip, we isolated structure from function, and this epistemological decision is exactly what defines Bense’s original place in contemporary aesthetic theory. Hardware and software were separated, and so was behavior and theory of automata. Even Turing’s discovery of universal computation, to which Bense’s system belongs in spirit if not in letter, celebrates this division. Provide data (in this case, the quantifiers for a work of art) and there must be a possibility, i.e., an algorithm, to design a program that will process it effectively. This is how the entire emulation paradigm works: account for human intellectual capabilities by abstracting programs from the material structure and porting these to computers.

My concept, widely accepted today, is that we seek hardware configurations suited to the functions performed. Parallel computing, neural networks, and virtual reality exemplify this new direction, each in its specific way. Task distribution and connectionism suggest that relations are more important than the terms related (*relata*). Real-time vision, a critical component of any artificial intelligence program and a

constitutive part of art generation and evaluation, involves not only general computation, but a level at which material characteristics of the processing medium become important. Applied research already proved that non-discrete biomolecular information processing can effectively approach high complexity tasks such as contour enhancement and line extraction in image processing (cf. research at the International research Institute for Management Sciences, Moscow; see also Nikolai B. Rambidi, "Non-discrete Biomolecular Computing," *Computer*, November 1992).

The light-harvesting protein bacteriorhodopsin supports attempts to provide protein-based optical computing and optical storage. The examples do not stop here. What is important is the spirit of the experience, not the details, still in a fast state of flux. All these can be called semiotic machines, and along this metaphor we can talk of them as manipulating all kinds of signs, allowing for an infinity of semioses (sign processes), some aesthetically relevant, others relevant to different practical experiences of human self-constitution. This brings us to the new fringes of the computational sciences, to the new metaphors and a new cognitive horizon. Von Neumann anticipated our generalized notion of computation as the unity between interactive signals or patterns and a lattice structure (a large number of identical cells connected in some coherent patterns). His cellular automata – probably best known indirectly through Conway's *Game of Life*, which is one of its embodiments – have some well-defined features:

- a) Each cell can be one of a finite number of states (two actually, in digital environments)
- b) Interaction takes place with adjoining cells.
- c) A universal clock oversees the change of state of a particular cell.

The so-called neighbor transition rule for interaction (i.e., change of state) can lead to very complex patterns manifesting properties we associate with chaos, fractal dimension, computation, and in general with processes defining the activity of the mind. In this theory, patterns that move through the lattice unchanged are called *gliders*. Von Neumann provided the mathematical proof that gliders traveling through a sufficiently large cellular automaton can solve virtually any problem. If we take a work of art as a pattern that can move unchanged through the lattice, the glider artwork could, in principle, solve any problem, of an aesthetic or any other nature.

This sentence has the old romantic ring of art as universal, but its meaning needs to be assigned in a cognitive context, not a context of emancipation through art (the old programs of the Enlightenment, of the avant-garde art, etc.). Molecular computing provides internal connections intrinsic to the material, while external connections can be limited to small regions (e.g., where seeing, hearing, or touching is possible).

Computation at molecular levels occurs by local interactions and is dependent upon the "natural" clock. Real-time control, self-organization, communication in living organisms, such as those of artists and of molecular computing, bring to mind the expectation articulated at the fringes of Bense's aesthetics. However, " 'Artworks' that an automaton produces are not ... artworks since we are not, at least for now, able to assign a conscience to their source, the automaton," wrote Helmar Frank [16]. Nake, in commenting upon Frank (in 1974), is less optimistic. Nevertheless, molecular computing, whether metaphorically understood or literally considered, is far more complex than digital processing or connectionism. If indeed minds exist only through interaction with other minds (as some researchers at Brown University have recently discovered, confirming my viewpoint set forth in 1988), the element of conscience, which figures so importantly in the aesthetic equation, is part of that interaction. What I ascertain here is the thought that gliders on the aesthetic sky reverse the expectation of powerful machines driven by generative aesthetic programs. We literally abandon the Cartesian kingdom of representation and place ourselves in the territory of configurational knowledge. Here configurations succeed one another as the pragmatic context requires. Their functioning is the experience, i.e., knowledge. Peirce was unequivocal. "Being a convinced Pragmaticist in Semiotic naturally and necessarily, nothing can appear to me sillier than rationalism," (cf. Letters to Lady Welby, 23 December 1908). The meaning of this powerful statement, which Bense by no accident placed on the frontispiece of his book on gnoseological semiotics (*Vermittlung der Realitäten*, Baden Baden: Agis Verlag, 1977) is still to be realized. To be aware of something, or to make that something, i.e., the dynamic thought of semiotics, part of the experience of self-constitution in a new aesthetic theory or in aesthetic praxis are two different things. If I may paraphrase Bense: "An der Spitze der Feder nicht an Worte, und nicht an Gegenstände denken, sondern an Bewegung. Immer Dynamik an der Spitze der Feder haben" [17].

References

1. Precursors of Bense's attempt to quantify aesthetic characteristics are many. One can start with Pythagoras, continue with the many "mathematicians" of the beautiful (be this of images, architecture, music, or poetry), arrive at this still little known geometer of the aesthetic form who was Matila C. Ghyka (intent on rhythms and proportions), George D. Birkhoff, Edgar Allen Poe, Pius Servien (who compared scientific language to poetic expression), and Christian von Ehrenfels. His two concepts introduce qualitative distinctions: "Grad der Gestaltung (bzw. Höhe der Gestaltung), Reinheit der Gestaltung" (cf. "Höhe und Reinheit der Gestalt" in *Kosmogonie*, Jena, 1916, S. 93-96). In regard to the various contributions made by Bense, his students, and his colleagues, the most can be derived from reading the works they published:
 - Max Bense. *Aesthetica. Metaphysische Beobachtungen am Schönen*. Stuttgart:Deutsche Verlags-Anstalt, 1954.
 - Rul Gunzenhäuser. *Maß und Information als ästhetische Kategorien. Einführung in die ästhetische Theorie G.D. Birkhoffs und die Informationsästhetik*. Baden Baden: Agis Verlag, 1968.
 - Kurt Alsleben. *Ästhetische Redundanz*. Abhandlungen über die artistischen Mittel der bildenden Kunst. Quickborn: Verlag Schnelle, 1962.
 - Felix von Cube. *Kybernetische Grundlagen des Lernens und Lehrens*, Stuttgart: Ernst Klett Verlag, 1965.
 - Helmar Frank. *Grundlagenprobleme der Informationsästhetik und erste Anwendung auf die Mimesis pure* (Dissertation). Stuttgart, 1959.
 - Kybernetische Analysen subjektiver Sachverhalte*. Quickborn: Verlag Schnelle, 1964.
 - Herbert W. Franke. *Phänomen Kunst*. München: Heinz Moos Verlag, 1967.
 - Wilhelm Fuchs. *Nach allen Regeln der Kunst*. Stuttgart: Deutschland Verlags-Austalt, 1968.
 - Siegfried Maser. *Numerische Ästhetik*. Stuttgart: Institut für Grundlagen der Modernen Architektur, 1970.
 - Georg Nees. "Computergraphik", *Rot 19*. Stuttgart, 1965.
 - *Generative Computergraphik*. Berlin/München: Siemens A.G., 1969.
 - Frieder Nake. Computer-Graphik, *Exakte Ästhetik*, 5. Stuttgart: Verlag Nadolski, 1967. pp. 21-32.
 - *Ästhetik als Informationsverarbeitung*. Vienna/New York: Springer Verlag, 1974.
- Independent of this, one has to mention the work of Abraham A. Moles, *Théorie de l'information et perception esthétique*, Paris, 1958, as well as *Art et ordinateur*, Tournai, 1971.
2. Ästhetiker sind seltsame Leute. Sie lieben die Künste und die Ordnung und bringen deshalb Ordnung in die Kunst. Sie rücken der Kultur zu Leibe wie Linné seinerzeit den Blumen und Bäumen. Nun täte man solchen Fanatikern der Ordnung schweres Unrecht, wenn man sie für Pedante halten wollte. Nein, sie wissen um das Urgeheimnis der ordnenden Tätigkeit und das lautet: Wer Ordnung schafft, schafft. (Erich Kästner, *Der Zauberlehrling/ The Sorcerer's Apprentice*). [Aestheticians are strange people. They love the arts and order and thus bring order to art. They do this for the sake of culture, as Linné did in his time for the sake of flowers and trees. Now one would do such fanatics of order a great injustice if one takes them for pendants. No, they know the age-old secret of orderly activity, and that is: Who creates order, creates. Trans. Nadin].
3. Some, in particular Maturana and Varela, spoke in this respect of the autopoietic function of the human being, cf. *El Árbol del conocimiento*, 1984; translated into English as *The Tree of Knowledge*, Boston/London: Shambala, 1987.
4. Max Bense. "Texte wie Rauchfahnen" *Poetische Abstraktionen* (Gedichte und Aphorismen). Stuttgart: Manus Presse, 1990.
5. T.H. O'Beirne commented upon dice music scores (cf. "From Mozart to the Bagpipe, with a Small Computer" in the *Bulletin of the Institute of Mathematics and Its Applications*, vol.1, No. 1, January 1971). Before Mozart, Kirnberger, C.P.E. Bach, and Maximilian Stadler attempted to use permutational techniques for composing Mozart's KV516 Anh. c 30.01 waltzes and contradances are based on variation from throws of a pair of dice. A table provides information as to which score corresponds to each throw of the dice for each bar position.

6. "Unter generativer Ästhetik ist nun die Zusammenfassung aller operationen, Regeln und Theoreme zu verstehen, durch deren Anwendung auf eine Menge materialer Elemente, die als Zeichen fungieren können, in diesen ästhetische Zustände (Verteilungen, bzw. Gestaltungen) bewußt und methodisch erzeugbar sind." ("Projekte generative Ästhetik," *Rot 19*, Stuttgart, 1965). [With generative aesthetics, one should understand the summation of all operations, rules, and theorems, through whose application to a set of material elements, which can function as signs, and in which these aesthetic objects (distribution, creation) that can be consciously and methodically produced. Trans. M. Nadin].

7. In regard to the terms *light* and *heavy*, after Milan Kundera's novel, *The Unbearable Lightness of Being*, in which he quotes Protagoras, they became so fashionable that even our symposium was labeled in reference to them. *Nesnesitelná Lehkost Byti* (1984) is translated into French as *L'insoutenable légèreté de l'être*, and in German as *Die unerträgliche Leichtigkeit des Seins*. It should also be noted here that Protagoras first stated, "Man is the measure of all things." Bense's obsession with *Maß* must originate in Protagoras' thought (via Hegel).

8. "A Postscript on Metaphor," *On Metaphor*, S. Sacks (editor). Chicago: University of Chicago Press, 1979. pp. 159-160.

9. Rudolf Arnheim. *Entropy and Art*. Berkeley/Los Angeles: University of California Press, 1971.

10. Susanne Langer. *Feeling and Form. A Theory of Art*. New York: Charles Scribner's Sons, 1953, p. xi.

11. *Op cit.*, p. vii.

12. Nur eine solche rational-empirische, objektiv-materiale Ästhetikkonzeption kann das allgemeine spekulative Kunstgeschwätz der Kritik beseitigen und den pädagogischen Irrationalismus unserer Akademien zum Verschwinden bringen. *Einführung in die Informationstheoretische Ästhetik*. Reinbeck bei Hamburg: Rowohlt, 1969. p.8.

[Only such a rational-empirical, objective-material concept of aesthetics can do away with the general speculative twaddle of art critics and clear away the pedagogical irrationality of our academies. Trans. Nadin.]

13. Langer, *Op. cit.*, p. 40.

14. Helmar Frank. *Kybernetische Analysen subjektiver Sachverhalte*. Quickborn: Verlag Schnelle, 1964. p. 28.

15. Langer, *Op. cit.*, p. 48.

16. Helmar Frank. " 'Kunstwerke' jedoch, die ein Automat produziert, sind ... kein Kunstwerke, denn wir sind zumindest heute noch unfähig, ihrer Quelle, dem Automaten, ein Bewußtsein zuzuschreiben." (*Op.cit.*, p. 40).

['Artworks' produced by a machine are not works of art, because we are at least to date incapable of ascribing conscientiousness to their source, to the machine. Trans. Nadin.]

17. *Manifest einer neuen Prosa und Poesie*, 7. "An der Spitze der Feder an Worte, nicht an Gegenstände denken" [At the penpoint, think about words, not objects]; and *Aufzählung der Leichtigkeiten*, 7, "Immer Welt an der Spitze der Feder haben" [Always have the world at the tip of your pen]; cf. *Poetische Abstraktionen*, pp.22-23.