



On the relationships between philosophy of technology, cybernetics, and aesthetics with their impacts on Latin America

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Abstract

There had been interesting interactions between philosophical reflections, technical developments and the work of artists, poets and designers, starting especially in the 1950s and 1960s with a stimulating cell in Stuttgart and Ulm in Germany spreading mutual international interactions. The paper aims to describe the philosophical background of Max Bense with his research on the intellectual history of mathematics and the upcoming studies on technology and cybernetics. Together with communication theories and semiotics, new aesthetics such as cybernetic aesthetics had been worked out, based on the notions of information and sign. This background stimulated international students, artists and researchers from different creative disciplines for methodical approaches leading to first computer art experiments. The interrelations in these fields with Latin America are in the focus of these studies. Students, artists, and poets from Latin America, especially Brazil, came to Germany for studies and exhibitions in the creative scientific cell around Max Bense. Some of them stayed in Europe, but the exchange developed also in the opposite direction, traveling to and working in Latin America. Some of those fruitful international interrelations will be described and reflected.

Keywords Meta-technics · Aesthetics · Information · Cybernetics · Max Bense · Ulm School of Design

1 Introduction

Developing philosophical theories and methods on a mathematical background had been the aim of Max Bense from the very beginning. He succeeded in combining mathematics, natural sciences, and aesthetics in his philosophy. Already in his first publication, *Raum und Ich* (Space and Ego), 1934, as a 24 old student of physics, mathematics, geology and philosophy at the University of Bonn, Germany, Bense combined there theoretical philosophy on an existentialistic basis with mathematics, semiotics, and aesthetics, the main topics of his further work. His programmatic text *Manifest des existenziellen Rationalismus* (Manifesto of Existential Rationalism) 1951 (Bense 1951b) described his philosophical fundamental position which he held on to all his life. He tried to combine rationality and human existence. He wrote in the manifest initially:

“Wir beziehen uns auf Descartes; auf seine Methode, weniger auf seine Ergebnisse, und unterscheiden in ihr eine negative und eine positive Denkbewegung: den Zweifel und den Beweis.” (Bense 1951b, p 1)
“We refer to Descartes; to his method, less to his results, and distinguish in it a negative and a positive thought movement: doubt and proof.” (translated by the author)

The reference to Descartes’ methodical thinking will be also the background of his later published booklet *Brasilianische Intelligenz. Eine cartesianische Reflexion* in 1965, where he reflects his experiences and encounters in Brazil (cf. paragraph 4).

After working as a physicist, then after the second world war 1945 as curator and professor at University of Jena, Max Bense fled in 1948 from the development of the Soviet occupation zone from Jena to West Germany. He was appointed as professor for philosophy and theory of science at University of Stuttgart in 1950, since 1949 already as a visiting professor. He worked additionally as lecturer at the newly founded Ulm School of Design (Hochschule für Gestaltung—HfG Ulm) in 1953, engaged by the founding director, artist and architect, Max Bill. The crucial foundation for

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the new school had been bringing design into relation to the technical, industrial and information age. Bense accompanied the general education in philosophy at HfG and became the first director of the Information Department in 1954 (Wachsmann and Oswald 2015, p 3).

Ulm School of Design (HfG Ulm) existed for only a short time (1953–1968) but had a tremendous influence on the further development of design disciplines (cf. Leopold 2013), first through the introduced theoretical background, and second through the personal influences all over the world, but particularly in Latin America.

Bense's spheres of activity evolved as a creative inspiring cell for mathematicians, architects, artists, poets, and the upcoming computer scientists, and many more (cf. Büscher et al. 2004). Bense's students had been stimulated and encouraged for innovative experiments combining the philosophical theories with technics and art. A doctoral student of Max Bense for example had been Helmar Frank, later Professor for Cybernetics in Berlin. He defined cybernetics as the theory of perceiving, processing and spatio-temporal transmission of information (Frank 1962). The notion of information got crucial for cybernetics, aesthetics, and its philosophical approaches.

2 Philosophy of technology and cybernetics

Max Bense formulated 1949 in his essay *Technische Existenz* the connections between mathematical structures and technical innovations and the resulting new human-world relationship as an important step for the recent developments.

“Wir bewohnen keine Landschaften und Gärten, keine Häuser am sanften Hang oder auf der leichten Dünung, wir bewohnen ein Netz von sichtbaren und nicht sichtbaren Funktionen und Relationen, Strukturen und Aggregaten aus Metallen und künstlichen Gesteinen, die sie Dörfer, Städte, Staaten und Kontinente genannt haben. Uns betrifft die Technik.” (Bense 1949a, p 122)
 “We do not occupy landscapes and gardens, no houses at a smooth hillside or on a light groundswell, we occupy a net of visible and invisible functions and relations, structures and aggregates of metals and artificial rocks, which they have called villages, cities, countries and continents. We are concerned with technology.”
 (Translated by the author)

This citation describes Bense's philosophy of a technical existentialism related to rationalism. He expressed that all designed objects or environments have to be seen as part of larger mathematical structures. In reference to the technological world, rationality and clear methodological thinking are the pre-conditions for him. In many writings, Bense analyzed the relationships between art and mathematics. As a

result of his research on the history of ideas in mathematics and art, he came to the conclusion that every appearance of a new style in art was linked to the introduction of mathematical methods and theorems on which the formal elements of that style could be traced back more or less constantly and completely (Bense 1949b, p 207). He argued that from this result the connections follow between social, economic, and political processes, on the one hand, and on the other hand intellectual and mental procedures. At this point he refers to Leibniz with his reduction of first type as the reduction of scientific languages to mathematical and formalized languages and the special reduction of second type with the reduction of artistic forms to mathematical forms of geometric or arithmetic character.

These studies had been the foundation for a cybernetic approach in aesthetics, applicable in all creative disciplines. The reduction of mathematical language and forms with regard to logic led to applicability for machines, where logical and mathematical processes are translated in technical procedures. Referring to propositional logic, where a proposition is either true or false, Bense reflected in 1951 *Kybernetik oder die Metatechnik einer Maschine* (Bense 1951a) this application of logic in technology, where logical principles are converted into technical ones. To emulate mathematical thinking in a technical way to execute it through machines, goes for him at least back to Blaise Pascal. Coming from the philosophical background of Pascal and Leibniz, Bense refers here to Norbert Wiener's *Cybernetics—or Control and Communication in the Animal and the Machine* (1948). Important for him was Wiener's new cybernetic extension of modern technics which he described as *Meta-technics*.

“Dieses Eindringen der Technik in Zonen, die bisher unerreichbar waren, und ihre Umwandlung in Metatechnik, die beständig die Grenzlinie zwischen den sog. materiellen und nichtmateriellen Bereichen verwischt, kann durch die Tatsache belegt werden, dass die kybernetischen Maschinen, von denen Norbert Wiener spricht, nicht nur, (...), in beständiger Zusammenarbeit von Logikern, Mathematikern und Technikern geschaffen wurden (...), sondern Funktionen aufweisen, die gewissen charakteristischen Fähigkeiten des menschlichen Bewusstseins, etwa dem Gedächtnis, entsprechen. (...) Durch die Technik schafft sich der Mensch eine ‚Umwelt‘, die seiner Doppelrolle als naturhaftes und geistiges Wesen angemessen ist.” (Bense 1951a, p 54–60)

“This penetration of technics into zones that were previously inaccessible and its transformation into metatechnics, which constantly blurs the line between the so-called material and non-material realms, can be demonstrated by the fact that the cybernetic machines

of which Norbert Wiener speaks are not only, (...), created in constant collaboration between logicians, mathematicians and technicians (...), but have functions that correspond to certain characteristic abilities of human consciousness, such as memory. (...) Through technology, man creates for himself an 'environment' appropriate to his dual role as a natural and mental being." (translated in by the author)

Bense defined cybernetics (cf. Walther 1999) as meta-technics of a machine in comparison with the description of philosophical sciences as meta-sciences under various aspects, like meta-physics and meta-mathematics. The recent developments of technics would require a philosophical construction of a meta-technics. He evaluated the book of Wiener as the fundamental book of a modern nature and technics philosophy as a paradigm of meta-technics. In the new developments, technics would penetrate all fine structures of the world:

“Die kybernetische Erweiterung der neuzeitlichen Technik bedeutet also ihre Erweiterung unter die Haut der Welt.” (Bense 1951a, p 54)

“The cybernetic expansion of modern technics means its expansion under the skin of the world.” (translated by the author)

3 Concept of Ulm School of Design and interrelations with Latin America

This characterization of the actual time as the technical and industrial age had been the fundament of the new founded HfG Ulm/Ulm School of Design in 1953. The concept had been worked out by Inge Scholl (sister of Sophie and Hans Scholl, murdered by the Nazis), Otl Aicher, and Max Bill between 1945 and 1952. With Max Bill, student at Bauhaus in Dessau, and his contacts to former Bauhaus professors, references to the Bauhaus concept had been brought in the new concept of Ulm School of Design. But the analysis of the requirements for the new technical and industrial period had now changed basis. We can read in the abstract for the School of *Geschwister-Scholl-Stiftung* 1951:

“School of Design: Its range of activity consists of those areas of design which largely determine the way of life of our technical and industrial age. The form of the instruments we use, our dwellings, the plan of a housing development, city, or region, the printed and spoken word in the press and radio, the effect of images in publications, advertising, exhibitions, and film constitute crucial foundations for the mentality of our society.” (Ulmer Museum/HfG-Archiv 2003, p 12)

The concept of Ulm School of Design was guided by the Bauhaus principles, but the design of industrially produced objects and buildings as well as the design of products of mass communication became the main fields. Max Bill described in an interview (Krampen and Hörmann 2003, p 39): “... and we understood the needs of this task as if the Bauhaus had developed further during the whole Nazi period.”

Max Bense’s philosophical background with his reflections on the new technical age fit perfectly to the school concept. Inge Scholl invited Max Bense already before the start of the school in 1952 for a lecture in Ulm with the title “Technology, Tradition, and Revolution”. She “was interested in his ideas on art, technology, and aesthetics, offered him a teaching position at the newly founded School of Design”, Elisabeth Walther, assistant professor of Max Bense at that time, later lecturer at Ulm School of Design and Professor of philosophy at University of Stuttgart, wrote in her memories about their early visits in Ulm (Ulmer Museum/HfG-Archiv 2003, p 90ff.). Besides his involvement in the foundation course for all students, Max Bense developed the idea and a program for an Information Department, even before the official opening of the school and became the head of the information department. He divided the main topics in theoretical information, which includes logic, information theory, communication theory and technics, perception and representation theory, semiotics, aesthetics, ..., and experimental information with experiments in classical information forms but also attempts in new forms using natural, artificial, and precision languages (Bense 1956).

The educational program, as shown in Fig. 1, had been described in 1951 as follows:

“After the one-year Foundation Course, the students choose from among the disciplines of information, visual design (later visual communication), product design, architecture and urban development. These departments are supplemented by theoretical instruction in sociology, economics, political science, psychology, and philosophy.” (Ulmer Museum/HfG-Archiv 2003, p 12)

Bense started his teaching at HfG Ulm in 1954 with lecture series on *introduction to philosophy, semantics, and cybernetics*, then *philosophy and methodology, worldview forms and systems*, courses on *general aesthetics, theory and methods of communication and information* as well as *theory of aesthetics and information* (Walther 2003, p 90). Guest lectures and visiting professors had been very important in the international HfG concept, which had been based on the international contacts of the professors. In 1955 Bense invited Norbert Wiener for a lecture at University of Stuttgart and Ulm School of Design with the title *Artificial*

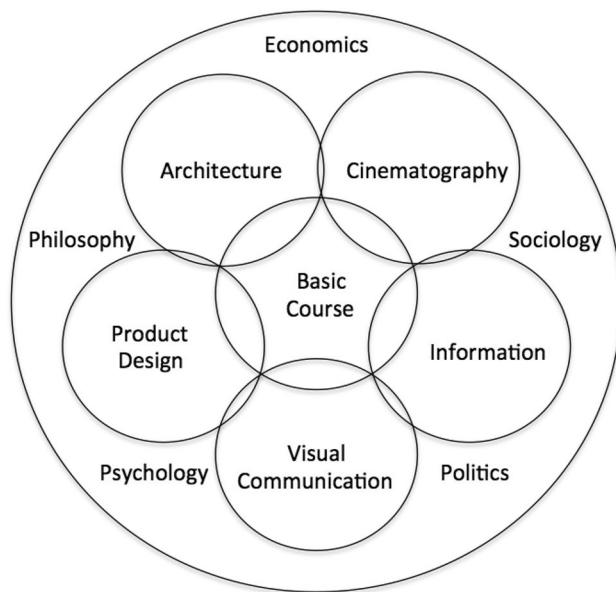


Fig. 1 Concept of Ulm School of Design, 1951—Schematic teaching of HfG Ulm (Wallace 2012)

Grammars for Universally Applicable Languages. The development of universally applicable languages had been the basic idea going back to Leibniz to formalize processes and make them programmable, the background for cybernetics and self-organized systems. Cybernetics and system theory had been integrated in the HfG curriculum as basic scientific disciplines.

Throughout its existence, the school attracted students from all over the world, 639 students from 39 countries, 21 professors and 216 guest lecturers from 15 different countries. The proportion of foreign students was 44% overall (Spitz 1997, p 12; 2002). There had been no fixed quote for foreign and German students. But the concept of HfG Ulm had been spread and met with great international interest in this new design school in Germany. With the founding director Max Bill an internationally known personality with a politically unimpeachable past had been found and contributed strongly to the positive reputation of the school worldwide. The selection process of students was based first on submitted documents and following a 14 days trial school visit. Previous practical experiences had been considered essential whereas no value was placed on the previous educational background, in particular a maturity examination was not required. Already in 1955, the selection of the students had been mainly based on the written submitted documents with a questionnaire of 20 questions and photos of their own practical works. The questionnaire asked for personal interests, personal opinions on designated problems of politics and economics, the evaluation of cultural achievements and illustrated works

from the field of the arts. Some examples show the characteristics of this questionnaire with its political focus after the end of the Nazi era in Germany (Seeling 1985, p 82):

- Name 10 public figures alive today who are significant to you.
- How do you assess the impact of television on social life?
- What does it mean to you to be successful in life?
- Which brand of car do you prefer and why?
- What do you think are the causes of the emergence of fascist forms of government?

Besides the questionnaire from 1955 on, there had been department-specific entry requirements as far as previous vocational training und studies had been concerned.

According to the investigations in the school's archive by Silvia Fernández (2006), there had been thirty-one students from Latin America: ten from Brazil, nine from Argentina, three from Chile, five from Mexico, two from Colombia and one each from Venezuela and Peru. The contacts to Latin America had been especially initiated by the Argentinian Tomás Maldonado. In 1954 Max Bill brought him to Ulm as a lecturer. The two got to know each other while he researched for a book about Max Bill, published 1955 in Buenos Aires. In 1957 Maldonado got the chair of the governing board of HfG and remained as director of the school until 1967, nearly until the end of the school in 1968. The curriculum changed to a more theoretical scientific background with a focus on methodology by integrating innovative approaches like cybernetics, not yet well-established at that time. Maldonado commented in an interview:

“It was the feverish insatiable curiosity directed especially toward some disciplines which were at the time in an upward phase: cybernetics, theory of information, systems theory, semiotics, ergonomics. Disciplines like philosophical theory of science and mathematical logic. The main spring of our curiosity, of our studies, and our theoretical efforts was our desire to give a solid methodological foundation to the working of design.” (Krampen and Hörmann 2003, p 85)

Maldonado worked out a new concept of the foundation course on the background of theoretical knowledge in perception theory and mathematics. The new foundation course, taught by Maldonado, later called *Ulmer Modell* included: (1) Perception and Gestalt theory, (2) Symmetry concepts, (3) Topology (cf. Leopold 2015). Max Bense, Horst Rittel, and Abraham A. Moles collaborated with Maldonado in this program (Ulmer Museum/HfG-Archiv 2003, p 82). They worked on a rational foundation of design. Maldonado and Bonsiepe wrote in the article *Wissenschaft und Gestaltung*:

“Die These von der durchgehenden mathematischen Gliederung eines Entscheidungsraumes für eine Gestaltung besagt nichts Geringeres, als dass alle Gestaltungsaufgaben sich algorithmisch lösen lassen, d.h. durch die Verwendung einer mathematischen oder logischen Konstruktion, die als Vorschrift oder Gebrauchsanweisung fungiert. Ein solcher Algorithmus müsste mit Hilfe folgender von Fall zu Fall variierender mathematischer Disziplinen aufgestellt werden: Kombinatorik, Spieltheorie, Informationstheorie, mathematische Logik, Schaltalgebra, Linearprogrammierung, System- und Regeltheorie, Theorie der Warteschlangen und kombinatorische Topologie.” (Maldonado and Bonsiepe 1964, p 20)

“The thesis of the continuous mathematical structure of a decision-making space for design says nothing less than that all design tasks can be solved algorithmically, i.e. through the use of a mathematical or logical construction that functions as a regulation or instruction manual. Such an algorithm would have to be set up with the help of the following mathematical disciplines, which vary from case to case: combinatorics, game theory, information theory, mathematical logic, switching algebra, linear programming, system and rule theory, theory of queues and combinatorial topology.” (translated by the author)

The importance of mathematical disciplines in the cybernetic modeling of a design task have been described by them, here embedded in a complex probabilistic system.

The role of semiotics for design was a shared concern of Bense and Maldonado, who both taught semiotics at HfG. The concept of information is important in the formation of signs. Max Bense founded the Information Department at Ulm School of Design and directed it from 1955 to 1958. The aim of this department had been to educate publicists for the press, radio, television and film, the means of communication in modern industrial society (Rosen 2010). One of the guest lecturers there had been the author of concrete poetry Eugen Gomringer, Swiss father and Bolivian mother, born in Bolivia, before secretary of Max Bill and later professor at the Arts Academy Düsseldorf, Germany.

4 Cartesian reflexions in Brazilian intelligence

Through the contact with Eugen Gomringer, Max Bense got in contact with the Brazilian writer Haroldo de Campos and the group of concrete Brazilian writers in 1959. In the same year he made an exhibition with works of the Brazilian group at *Studiengalerie des Studium Generale* (study gallery of the general study program) of *Technische*

Hochschule Stuttgart (Walther and Döhl 2005), later called University of Stuttgart since 1967, which is considered as the first exhibition of concrete poetry in Germany at all. The intensive exchange of ideas led to the result that Max Bense and Elisabeth Walther had been invited by the Brazilian government through Haroldo de Campos for giving lectures on aesthetics and to get in contact with Brazilian artists. Their first journey to Brazil and Latin America happened in 1961, just 18 months after the inauguration of Brasilia as the new capital, others followed in 1962, 1963, and 1964. Inspired by four journeys to Brazil Max Bense wrote the small book *Brasilianische Intelligenz* in 1965 with the subtitle *Eine cartesianische Reflexion* (cover in Fig. 2), presented in short paragraphs like a travel diary. There exists also a Portuguese translation, published in 2009 “*Inteligência Brasileira: uma reflexao cartesiana*” by Cosac Naify in São Paulo, edited by Haroldo de Campos.

On the first page he wrote *For Bruno Giorgi, Aloisio Magalhães and Wladimir Murtinho*. The book is dedicated to Brazilian friends. The first two had been presented with



Fig. 2 Aloísio Magalhães, “Brasilianische Intelligenz” (Cover), 1965. Max Bense: *Brasilianische Intelligenz*, Limes Verlag Wiesbaden 1965. ZKM | Center for Art and Media Karlsruhe, estate Elisabeth Walther-Bense/ZKM-01-0129-02-1107, © Aloísio Magalhães, © Limes Verlag Wiesbaden

their works in exhibitions in the study gallery of Technische Hochschule Stuttgart in 1965 and 1966. Wladimir Murinho had been Brazilian cultural attaché in Bern. Bense explained in the preface that intelligence relations are of interest for a progressing civilization instead of power relations. Not economic relations with this country are decisive, but intellectual ones. He found a progressive Brazilian intelligence which he experienced as a Cartesian one. That means for him the decision for conscious clarity by formulating a question and describing the method of the solution (cf. Wrobel 2019). Compared with the historically burdened Europe he saw the chance in the new developments in Brazil, especially with the new designed capital Brasilia, for methodical and creative outpourings, not looking back, but rather looking forward. He concludes that the relationship to history determines the nature and degree of the mind. He said:

“Das Methodische und das Schöpferische, gleichgültig, ob es sich gelegentlich in Improvisationen und Antizipationen verspielt, sind in erster Linie Ausflüsse eines nichthistorischen Bewusstseins, das nicht zurückblickt, sondern Ausschau hält.” (Bense 1965, p 12)

“The methodical and the creative, regardless of whether it is occasionally lost in improvisations and anticipations, are primarily outflows of a non-historical consciousness that does not look back, but looks forward.” (translated by the author)

The foundation of the city Brasilia incarnates for him the city as continuation of emancipated intelligence, whereas Rio would incorporate the city as continuation of habitable nature (cf. more details in Gianetti 2018). Bense found in Brasilia a city to be thought of as relations and structures as he formulated it already in his essay *Technische Existenz* 1949 (p 122) as cited in paragraph 2. In Brasilia, he saw an example of a cybernetic design, a city as a self-organizing system. This interpretation of Brazil is in complete contrast to Max Bill's statement in his article *Report on Brazil* (Bill 1954, p 238), where he condemned the direction of Brazilian architecture of that time as “utter anarchy in building, jungle growth in the worst sense”. Bill evaluated Brasilia as a designer whereas Bense experienced the city under his cybernetic approach.

The preference in the facades and blocks of houses for polygons and polyhedra already indicates for Max Bense a certain anticipation of the mathematical-constructive world of ideas of the concrete style of an almost Platonic architecture. The sculptures of Bruno Giorgi, for example the two figures *Os Candangos* (Figs. 3, 4, 5), would combine the geometric with the organic, which Bense related to the language of Desargues, who connected the mathematical language with a botanical one, for example branches and knots. For Bense, the Brazilian intelligence shows two structures



Fig. 3 Bruno Giorgi, “Os Guerreiros (Os Candangos)”, 1959. Max Bense, Elisabeth Walther-Bense, “Brazil”, 1963. Photographs from the estate of Elisabeth Walther-Bense/ZKM-01-0129-02-0250, ZKM | Center for Art and Media Karlsruhe. © ZKM | Center for Art and Media Karlsruhe

and signs forming components, two methodical principles of extension, space filling and shape development: the organic and the geometric or the morphological and the topological or the vegetative and the structural which are in dialectic relation. He was especially interested in the shadows of the sculptures, where the projection brings them back to the structural understanding (Fig. 4). Bense applied the semiotic theory to the sculptures, the geometric system carries an aesthetic message, but the aesthetic message requires also a semantic one, thoughts about people. Those sculptures remaining structural, represent for Bense the aesthetic message especially strong, then the semantic carrier of aesthetic messages has been overcome like in modern paintings and sculptures. Bruno Giorgi played for him between separation and adjunction.

Bense separated the artificial objects of art as constructive and non-constructive ones. A constructive object is defined as an object that can be methodically produced in a precisely finite number of conscious steps of decision-making and manipulation. The non-constructive object is the result of a non-decomposable and non-repeatable act.



Fig. 4 Studio visit with Bruno Giorgi, 1963. Photo: Elisabeth Walther-Bense. ZKM | Karlsruhe, Elisabeth Walther-Bense estate ZKM-01-0129-02-1112. © ZKM | Center for Art and Media Karlsruhe



Fig. 6 “Lygia Clark. Variable Objekte”, Studiengalerie der Technischen Universität Stuttgart February 4–18, 1964, exhibition view, photo: Elisabeth Walther-Bense, ZKM | Center for Art and Media Karlsruhe, estate Elisabeth Walther-Bense/ZKM-01-0129-02-0432. © Lygia Clark © ZKM | Center for Art and Media



Fig. 5 Architectural view Brasilia, collection Max Bense and Elisabeth Walther-Bense, Photo: Marcel Gautherot, ZKM | Center for Art and Media Karlsruhe, estate Elisabeth Walther-Bense/ZKM-01-0129-02-0252. © ZKM | Center for Art and Media Karlsruhe

He classifies Lygia Clark’s artificial objects as intermediate objects. He appreciated her as founder of the neo-concrete group with painters, sculptors, and writers in 1959 and exhibited her works (Fig. 6) in 1964 in Stuttgart (Clark and Bense 1964). Examples of her works of that time, probably in that exhibition are seen in Figs. 7 and 8.

“Lygia Clarks veränderliche künstlerische Objekte enthalten mathematische Elemente in dem Maße, wie sie den Charakter konstruktiver Objekte annehmen, und nur sofern sie mathematische Elemente enthalten, sind sie konstruktiv; und sie enthalten kinetische Elemente, sofern sie improvisiert werden können und sich der Idee nichtkonstruktiver Objekte nähern.” (Bense 1965, p 54)

“Lygia Clark’s mutable artistic objects contain mathematical elements to the extent that they take on the character of constructive objects, and only insofar as they contain mathematical elements, they are constructive; and they contain kinetic elements insofar as they can be improvised and approach the idea of non-constructive objects.” (translated by the author)

Another mentioned artist is Almir da Silva Mavignier, whose images and posters represent for Max Bense the necessary balance of theory and beauty, of creativity and aesthetics, of pleasure and intellect in the realization of a work of art. His work inspired Bense in his aesthetical theory as we will see later (cf. paragraph 6). Max Bense dedicated the first art exhibition in Stuttgart 1957 (Fig. 9) to Mavignier’s work (Fig. 10).

Besides concrete artists, he evaluated the powerful group of concrete poets in Brazil as very important. The movement

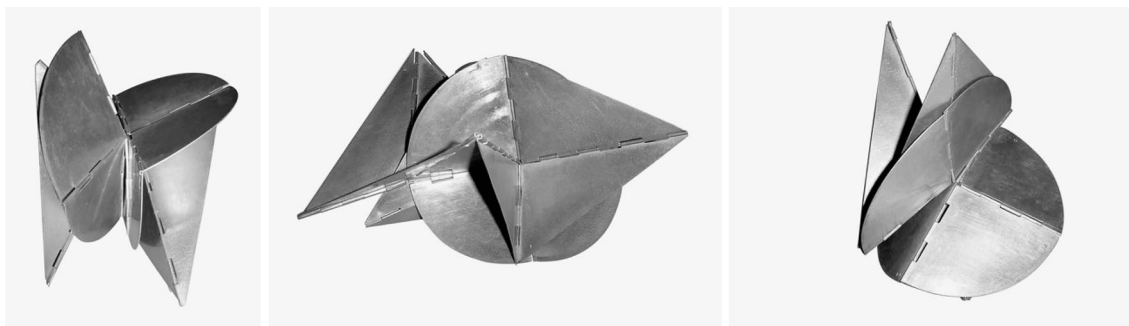


Fig. 7 Lygia Clark—“Bicho—1960”—(Creature), Ref. No. 00449a, 00449b, 00449c; Number of Archiving 471/Certificate Number 000477, Photographer: Marcelo Ribeiro Alvares Corrêa; Courtesy of “The World of Lygia Clark” Cultural Association

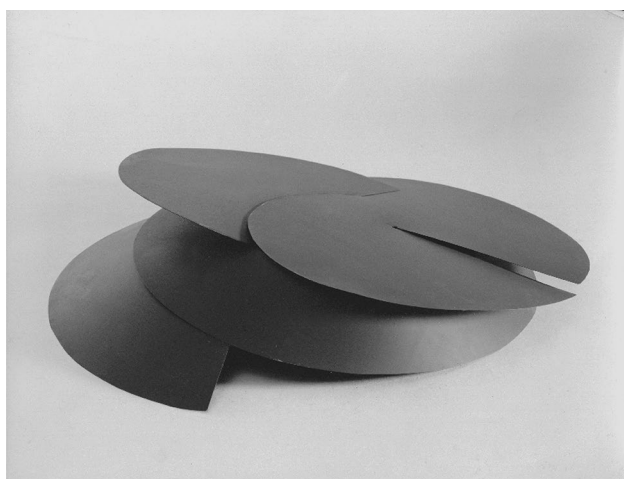


Fig. 8 Lygia Clark—“Abrigo Poetico—1964”—(Poetic Shelter), Ref. No. 20221; Photographer: unknown; Courtesy of “The World of Lygia Clark” Cultural Association



Fig. 9 Exhibition “Almir Mavignier: Bilder und Plakate, Galerie Gänsheide 26”, 1957. ZKM | Center for Art and Media Karlsruhe, estate Elisabeth Walther-Bense/ZKM-01-0129-02-0973, © Elisabeth Walther-Bense

of concretism covers concrete poetry as well as concrete painting and sculpture, which developed in Brazil since 1922 as an international oriented modernism, became a supranational movement. For Bense, concrete poetry was especially interesting under semiotic aspects, because it works on the level of being signs, not semantically on the level of statements, therefore with a direct aesthetic message. Concrete poetry is based on a methodical creative principle, working with words as signs, not as conventional meaning bearer but as constructive, visual or vocal bearer of gestalt.

In relation to architecture Bense had been fascinated by buildings of Affonso Eduardo Reidy besides the architecture of Lúcio Costa and Oscar Niemeyer. The garden and landscape architecture by Roberto Burle Marx had been described by him as oriented at ideas of concrete painting and sculpture, dynamic moments in a Cartesian imagination of nature.

Bense’s book shows his interest in rational art, poetry, architecture and design approaches, which he found in these

movements of concretism. Therefore, the architecture, city planning and art, which he experienced in Brazil, had been fascinating manifestations of cybernetic design and art.

5 Communication theories, semiotics, cybernetics and their impacts on aesthetics

The upcoming new technologies and studies on Charles S. Peirce’s sign theory, semiotics, gave the background for research on communication theories, especially the mathematical theory of communication by Shannon and Weaver (1949). According to the reflections of Max Bense,



Fig. 10 Almir Mavignier “Deformed Square” 1954/55 © atelier mavignier: delmar and sigrid mavignier

coding, digital coding, and copulative or compositional coding, which, for example, changes the presentation of a fact by rearranging the words or sentences (Walther 1979, p 114–115).

The sign itself as a triadic relation and rule scheme would give the rules for sign intern interaction systems and the creative realizations processes by signs. Bense described the relations between semiotics and cybernetics as essential for the foundations of cybernetics as a system of sciences, where besides semiotics also logic, linguistics, theory of theories and technological system theory form the fundamentals (Bense 1975, p 59–63).

Together with the understanding of mathematics as a structural science, a new aesthetics based on the notions of information and sign had been introduced in Bense’s book *Aesthetica* (1965). At the same time mathematicians, artists and poets had been stimulated for computer art experiments with exhibitions for example *Cybernetic Serendipity* 1968 in London, initiated by Max Bense and curated by Jasia Reichardt. She wrote in a letter to Max Bense 1967: “We have been following in the footsteps of your original suggestions, and quite clearly cybernetics and computers are taking

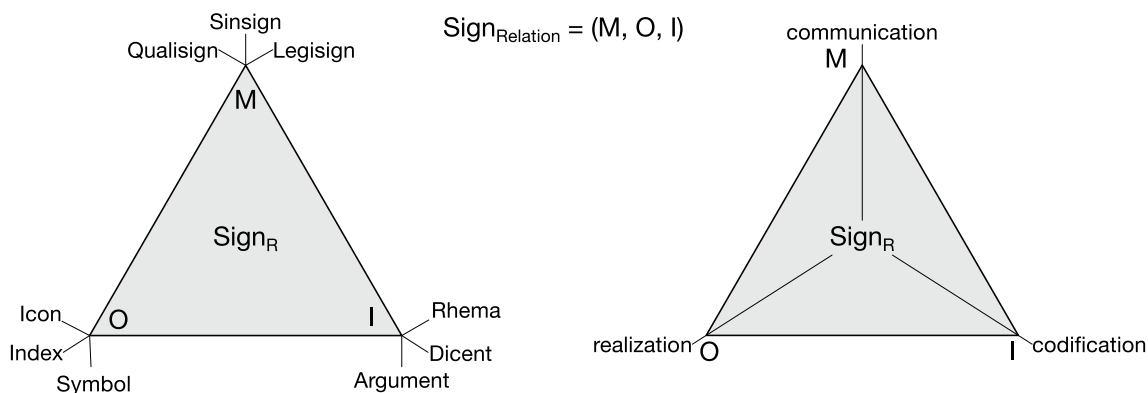


Fig. 11 Triadic sign relation with subsigns and sign functions according Peirce, Bense and Walther (Walther 1979, p 86, 115)

information and sign processes go ahead of each communication process. Information is based on representations by signs (Bense 1982, p 208). Max Bense and Elisabeth Walther refer to Peirce’s sign theory and develop it further. A sign is understood as a triadic relation between medium, object and interpretant. It is seen in three sign functions: communication, realization and codification (Fig. 11). The functional concept of the sign relation had been explained by Walther (1979, p 113ff.): The communication function of the sign relates to the communicability, the transmission of the sign as mean. The realization function refers to creation processes of objects by signs, because all objects are only realized by signs, that means transmitted by signs. Finally, the codification function refers to the interpreter of the sign. Walther differentiates three possibilities: analog

over”. (Vrachliotis 2012, p 143, 253). The exhibition later toured to the USA. In 1971 a related exhibition was organized by Cordeiro (1972a, b) *Arteonica* in Sao Paulo, Brazil.

Aesthetics had been seen by Max Bense as the fundament for structuring the world, therefore important for technics, architecture, art and literature, for creative disciplines. The theories became effective for creators of art and literature as well as designers and architects around the philosopher. The early computer experiments had been exhibited at the *Studiengalerie at University of Stuttgart*, called as *künstliche Kunst* (artificial art) by Bense to overcome the critics of art scientists and to relate art to technology (Nake 2012).

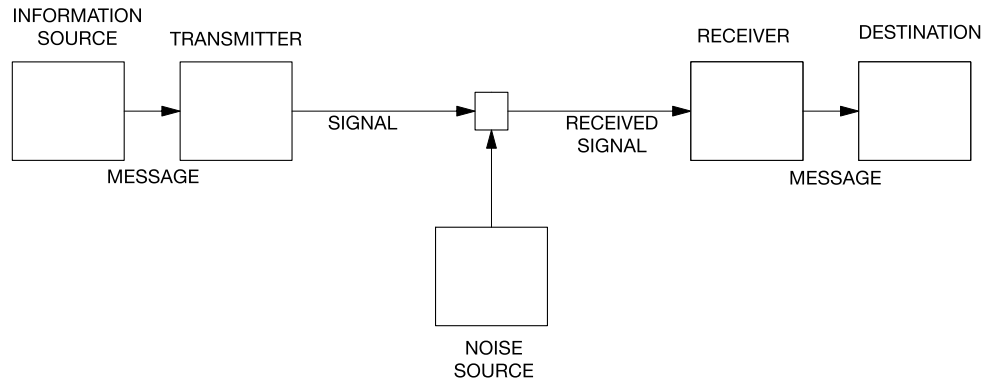


Fig. 12 Communication diagram according Shannon (1948, p 7)

Elisabeth Walther (2000) characterized the aesthetics of Bense which combines the mathematical concept of Birkhoff with Shannon's information theory and Peirce's semiotics:

“Max Bense completes the old concepts of ‘content’ and ‘form’ with the concept of ‘medium’, ‘material’ or ‘means’. They are the elements of complexity distinguished by Birkhoff. ‘An aesthetical information rests on its means, on its singular realization’, he writes. But to connect Birkhoff's measure with information theory, Max Bense transforms his formula into the informational measure: redundancy divided by statistical information. Redundancy is obviously the same as order by which the elements are connected.” (Walther 2000)

The notion of information on the basis of statistics introduced by Shannon (1948) during the rise of communication theory and communication technology had been integrated in the semiotic theory by Bense, because communication is possible only through signs. Figure 12 shows the communication diagram by Shannon, which remains on a technical level and Fig. 13 the communication scheme by Bense/Walther with the integration of the repertoire of signs, based on the diagram of Meyer-Eppler (1959). The repertoire of signs is related to all kinds of signs, languages, drawings, visuals, etc.

Bense applied Shannon's information theory to aesthetics. From unstructured material successive emergence of structures is achieved by stochastic selections. By these stochastic selections concrete, perceivable realizations are created which are able to transmit information (cf. Leopold 2019, p 20). Shannon and Weaver introduced the thermodynamical notion of *entropy* in their information theory. Entropy is seen as a measure of the degree of randomness with the tendency of physical systems to become less and less organized (Shannon and Weaver 1949, p 12–13). Entropy is used as the measure for information. *Relative entropy* is defined as the

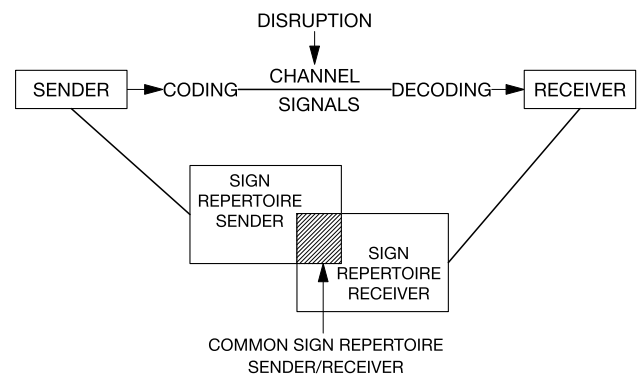


Fig. 13 Communication scheme according Bense/Walther (Walther 1979, p 132)

ratio of the actual to the maximum entropy of the source and one minus the relative entropy is called *redundancy*. This concept had been applied by Bense to aesthetics:

“Sucht man nun nach einem Gegenprozess zu diesem so beschriebenen physikalischen Prozess mit seiner Richtung auf den wahrscheinlicheren Zustand der gleichmäßigen Verteilung, die als Unordnung interpretierbar ist, so stößt man auf den ästhetischen Prozess. Denn es ist klar, dass in dem Maße wie physikalische Vorgänge auf ‘Mischung’ aus sind, die das Kennzeichen der Unordnung aufweist, sich ästhetische Vorgänge gerade als ‘Entmischungen’, als Gliederungen darstellen, die als ‘Anordnung’ deutbar sind. In diesem Sinne tendiert also der ästhetische Prozess nicht wie der physikalische auf einen wahrscheinlichen, sondern auf einen unwahrscheinlichen Zustand.” (Bense 1982, p 264).

"If one now looks for an opponent process to this physical process thus described, with its direction towards the more probable state of uniform distribution inter-

pretable as disorder, one comes upon the aesthetic process. For it is clear that to the extent that physical processes tend towards 'mixture', which has the characteristics of disorder, aesthetic processes present themselves precisely as 'segregations', as structures, which are interpretable as 'arrangement'. In this sense, then, the aesthetic process tends not, like the physical, towards a probable state, but towards an improbable one." (translated by the author)

The concept of *Information Aesthetics* is that the aesthetic object functions in communicative processes where aesthetic information is transmitted. The aesthetic object is arranged as a complex *super-sign* by the selection from a repertoire of elementary signs according to probabilities. Finally, the aesthetic object has a low probability (Bense 1979). An objective measure of aesthetics had been introduced by Max Bense and Abraham Moles (1966), also teaching at Ulm School of Design (profound detailed description of information aesthetics by Nake (2012)). A second root for information aesthetics was found by Bense and his scholars in the work of the US-American mathematician George David Birkhoff (1933). He defined an objective aesthetic measure by taking the degree of order relative to the degree of complexity in an object. Order (O) and complexity (C) were defined as numeric quantities and the aesthetic measure (M) then calculated order (O) divided by complexity (C).

$$M = f(O, C) = \frac{O}{C}.$$

There had been several studies and advancements by scholars of Max Bense and Abraham A. Moles to combine Birkhoff's theorem with Shannon's stochastic approach. Bense supplemented the numeric aesthetic of Birkhoff by an information aesthetic by defining the aesthetic state as the relation of an ordered to a non-ordered state. The artwork gives an aesthetic information and information means its always news and innovative. Therefore, the information is the original moment in an order scheme. The *order relations O* of Birkhoff correspond to *redundancy* and *complexity C* to *innovation*. According to this concept, redundant features are necessary so that innovations become recognizable:

“Eine vollkommene Innovation, in der es wie im Chaos nur neue Zustände gäbe, wäre auch nicht erkennbar. Ein Chaos ist letztlich nicht identifizierbar. Die Erkennbarkeit eines ästhetischen Zustandes benötigt nicht nur die Erkennbarkeit seiner singulären Innovation, sondern auch deren Identifizierbarkeit an Hand ihrer redundanten Ordnungsmerkmale.” (Bense 1982, p 356)

“A perfect innovation in which there were only new states as in chaos, would not be recognizable. A sort of chaos is ultimately unidentifiable. The recognizability of an aesthetic state requires not only the recognizability of

its singular innovation, but also their identifiability based on their redundant order characteristics.” (translated by the author)

In the discipline of applied cybernetics, works of art are seen as special messages, containing aesthetic information. The information is transmitted by the artist to the recipient as part of an aesthetic communication process. In this way Shannon's concept of information had been applied in the information aesthetic concept and combined with the underlying semiotic theory. Information aesthetics is seen as a sub-branch of the general communication technological information theory by Wiener, Shannon, and Weaver (Bense 1982, p 265). Claudia Gianetti (2004) explained and summarized the cybernetic aesthetic approach in relation to communication theory. She criticized it as concentrating on transmission of information instead of also paying attention to the subjects involved and the context of the communication process. Later on, Bense combined more in detail the information aesthetics with the semiotic concept of art (Bense 1979). The semiotic concept is able to take into account these missing aspects.

The various aspects and approaches in his aesthetics had been summarized by Bense in a condensed way in *Kleine abstrakte Ästhetik*, first published 1969 in *rot* #38 (Bense 1982, pp 345–367). This is one of the few works of Bense which was also translated in Portuguese language (Bense 2003).

6 Cybernetic approaches in art, design and architecture—interrelations with Latin America

Cybernetics, understood as a general theory of regulatory processes by Max Bense such as message transmission and information processing, became essential for biological and technical foundations and particularly the upcoming computer technics. The relation between information and aesthetics offered the chance for applications of cybernetics in art, design and architecture. Early algorithmic computerized experiments in art had been stimulated through this approach.

There had been especially fruitful interrelations with Latin America. Silvia Fernández explained in her analysis about the origins of design education in Latin America the interest of Latin American countries in design education:

“During the 1960s and 70s, the economies of Latin American countries, whether socialist, liberal, or conservative, generally reoriented themselves towards a policy of import substitution and industrial development. Design was placed within this overall industrial policy.” (Fernández 2006)

During their work at University of Stuttgart and HfG Ulm Max Bense and also Elisabeth Walther had stimulated many artists, poets, designers, architects, ... in their experiments and works through theoretical inputs in the field of information theory, aesthetics, and semiotics, which had been in close relationship to mathematical and cybernetic methods as described. One of the backgrounds of the founded *Studiengalerie* at University Stuttgart had been the wish to establish a demonstration forum for the aesthetic studies and research in the institute of Max Bense. An aesthetic colloquium at the institute followed to discuss those approaches. Intensive international contacts and exchange with scientists, artists and poets, especially with Brazil as reported in Bense's book *Brasilianische Intelligenz*, had been established which found their expression in exhibitions there. The Brazil artists Almir Mavignier, Alfredo Volpi, Mira Schendel, Lygia Clark, Bruno Giorgi, and Aloísio Magalhães had been exhibited in the study gallery of University Stuttgart by Max Bense.

The gallery started with the exhibition of books by Gertrude Stein in 1957 (Walther and Döhl 2005). The first art exhibition in December 1957 had been stimulated by encountering the art work of Almir Mavignier at HfG Ulm. Almir Mavignier from Rio, later Professor of Art in Hamburg, Germany, had been a student of Max Bill at HfG Ulm. Mavignier determined Max Bense as his most important teacher through his theory. Mavignier expressed in an interview (Hoffmann and Schmidt 2002):

“Besonders wichtig für mich war der Unterricht von Max Bense. (...) Max Bense hat mit seiner Informationstheorie einen großen Einfluss auf meine Plakate und auch meine Malerei ausgeübt. Was ich bei Bense gelernt habe ist, dass Information direkt gegeben werden muss, ohne Störung, ohne Zutaten.”

“Especially important for me was the teaching of Max Bense. (...) With his theory of information, Max Bense had a great influence on my posters and also my painting. What I learned with Bense is that information must be given directly, without interference, without additions.” (translated by the author).

His information theory influenced and solicited Mavignier's working with deformations in his art. Works like “deformed ring” and “deformed square” (Fig. 14) tested the possible reduction for the transmission of information.

“An dem wöchentlichen Seminar habe ich von 1953 bis 1958 teilgenommen. Bense war zunächst die Person, deren Sprache unverständlich blieb. Seine Worte “flogen”, die Kollegen waren begeistert aber hilflos, seine Theorien zu deuten, sie waren nicht zu übersetzen. Um 1954 begann ich zu verstehen. Max Benses Seminar war anregend für neue Konzepte in

der Malerei. Begriffe wie Signal oder Störung habe ich durch Bilder wie “punkte als signal” oder “störung auf schwarz” visualisiert. Punktstrukturen in Progression haben in meiner Malerei geometrische Formen verfremdet—um neue Darstellungen von geometrischen Gegenständen zu entdecken. Bildtitel wie “deformierter ring”, “deformierte linie” oder “deformiertes quadrat” weisen darauf hin. Reduktion hat die Gestaltung meiner Plakate bestimmt. Redundanz war tabu.” (Mavignier 1998)

“I participated in the weekly seminar from 1953 to 1958. Bense was initially the person whose language remained incomprehensible. His words “flew”, the colleagues were enthusiastic but helpless to interpret his theories, they could not be translated. Around 1954, I began to understand. Max Bense's seminar was stimulating new concepts in painting. I visualized concepts like signal or disturbance through paintings like “dots as signal” or “disturbance on black”. Point structures in progression have alienated geometric forms in my painting—to discover new representations of geometric objects. Picture titles like “deformed ring”, “deformed line” or “deformed square” refer to this. Reduction has determined the design of my posters. Redundancy was taboo.” (translated by the author).

Max Bense wrote in the catalog of the exhibition in 1957 that Mavignier's works show the balance between theory and beauty, creative ability and aesthetics, enjoyment and intellect as it is necessary in the realization of an art work (Bense 1970, p 99). His works would manifest very well Bense's aesthetic theories. Bense's texts in reference to later exhibitions 1966 in Köln and 1968 in Hannover show more detailed theoretical aesthetic analyses. The aesthetic state of his sheets owes its creation to a principle that creates order. Here, Bense refers to Birkhoff's studies to relate aesthetic states to order and complexity. Mavignier's aesthetic families are predestined to describe them by the repertoire of the concrete material elements as well as the abstract schemata creating orders.

“Ich kenne niemanden unter den ‘konkreten Malern’, der sichtbarer als Mavignier den ästhetischen Zustand auf seinen Blättern über der Dualität von Reinheit und Gestaltung, von wahrscheinlicher Ordnung und unwahrscheinlicher Komplexität entwickelt hat.” (Bense 1970, p 104)

“I know of no one among the ‘concrete painters’ who more visibly than Mavignier has developed the aesthetic state on his sheets above the duality of purity and design, of probable order and improbable complexity.” (translated by the author)

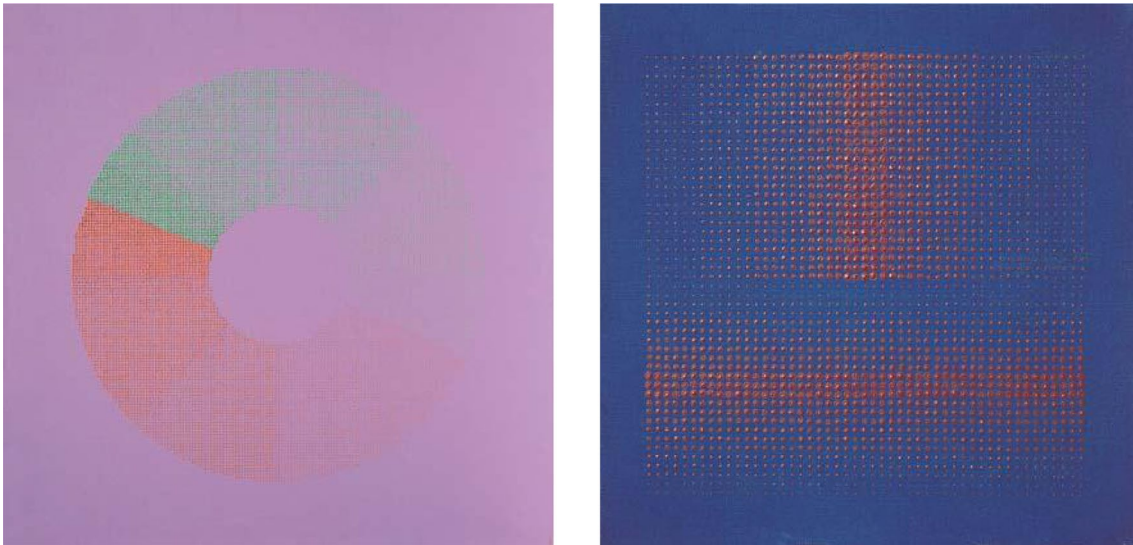


Fig. 14 Almir Mavignier “Deformed Ring” 1957, “Deformed Square” 1957. © atelier mavignier: delmar and sigrid mavignier

Redundancy (order) and information (complexity) had been calculated with the help of Shannon’s formulas by Bense’s scholar Siegfried Maser in their different aesthetic measures (Bense 1970, p 105–108, 181). These are examples to demonstrate the expressiveness of the aesthetic measures. Siegfried Maser, philosopher, mathematician and physicist, earned his doctorate and habilitated under Bense about numeric aesthetics. He worked especially on communication theory (Maser 1971), had been professor for design theory and later rector of the University of Wuppertal, Germany.

The book *Brasilianische Intelligenz* had been dedicated to Aloisio Magalhães, as mentioned already, with his design of the symbol for the 400th anniversary of the foundation of Rio de Janeiro in 1965. It is not further described and analyzed in the book. But in June 1965 the development of this design had been exhibited in photos with the title *Wege eines Zeichens* (Ways of a sign), published 1969 in *rot #39* with an introduction by Aloisio Magalhães and an epilog by Max Bense. Magalhães explained in the introduction that the choice of his project met with strong rejection in certain circles because the people were incapable of understanding abstract signs without direct meaning. His idea was based on the idea that a sign as a convention, does not need a direct meaning, but that it gains meaning through use, if it is a clear and readable sign. The acceptance and use of the sign then had been surprising and very impressive for him, what he documented in the photos. His three designed fundamental versions as linear sign, in colors with the Brazilian flag and as three-dimensional objects were able to endure transformations and changes without losing their recognizability. This experience with the sign had been a suitable object for Bense’s semiotic analysis. Bense explained in this epilog some important

points of semiotics and especially the differentiation between the creative, communicative and transportive way of a sign. The sign, selected out of the repertoire of geometric forms (Fig. 15, right) and constructed as a semiotic gestalt with an aesthetic character, became a medium of visual communication which is transportable in many ways. Bense ended his epilog with:

“Glänzendes Beispiel von der Entstehung, dem Leben und dem Absterben eines Zeichens in den vielfachen humanen und urbanen Kommunikationskanälen einer tropischen Weltstadt.” (Magalhães, Bense 1969)

“Shining example of the emergence, the living and the dying of a sign in the multiple human and urban communication channels of a tropical metropolis.” (translated by the author)

Magalhães is considered as one of the key pioneers of modern design in Brazil. He was part of the foundation commission of the first industrial design school in Brazil, the Escola Superior de Desenho Industrial (ESDI) in Rio de Janeiro in 1962. Contacts with Tomás Maldonado led to the result that he formulated the first pedagogical plan for the industrial design school in Brazil based on that of Ulm School of Design (Fernández 2003, p 118).

The book series *edition rot*, where several catalogs, related to the exhibitions in the *Studiengalerie*, had been published, was founded by Max Bense and Elisabeth Walther in 1960 and published until 1997 by Elisabeth Walther, alone after the death of Max Bense in 1990. The cover design (Fig. 15, left) had been created by Walter Faigle. He had been student at HfG Ulm in 1955, worked as architect and designer in Germany, before he went to São Paulo, Brazil

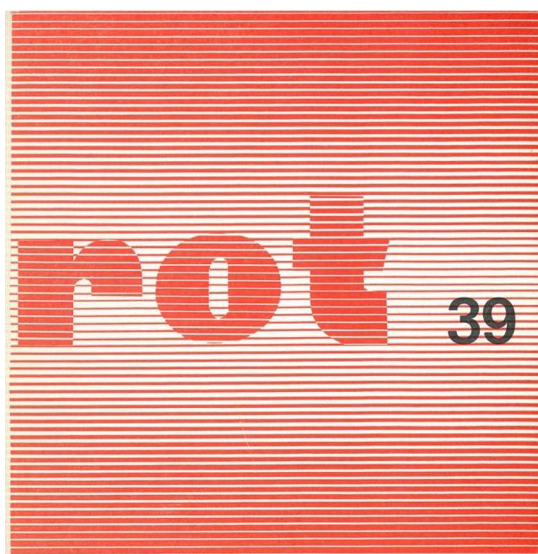
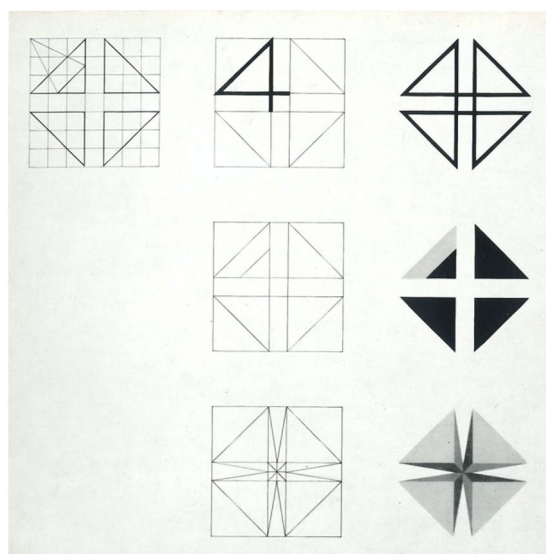


Fig. 15 Cover of *rot* #39, designed by Walter Faigle and design of a sign in drawings by Aloisio Magalhães. (Magalhães and Bense 1969), Aloisio Magalhães, “rot 39—Der Weg eines Zeichens”, Stuttgart,



1969. ZKM | Center for Art and Media Karlsruhe, estate Elisabeth Walther-Bense

end of 1960s, where he continued his work (Jost and Stürzebecher 2011, p 169f; Merklinger 2013, p 195).

Bense not only brought the Brazilian artists in exhibitions to Germany, he also accompanied exhibitions in Brazil with his theoretical inputs, here shown with a text of Bense about Waldemar Cordeiro, published in Portuguese in the catalog of an exhibition in “Galeria atrium” in São Paulo 1964 (Bense 1964). It had been published in German in the book *Artistik und Engagement* (Bense 1970, pp 112–114). Bense was referring to their meeting in Brazil, remembering their debate about *Popcret*, title of Cordeiro which describes the combination between Pop-Art and concrete painting. Bense reflected this combination as “Dinge des praktischen Gebrauchs und Dinge des theoretischen Gebrauchs, sagen wir Stuhlbeine und Polygone” (things of practical use and things of theoretical use, let's say chair legs and polygons) (Bense 1970, p 112). Bense's evaluation of “Popcret” that “the idea of banal junk is liquidated by the idea of arrangement or order” (Bense 1970, p 113) characterizes Bense's aesthetic position. Cordeiro's art would challenge new views, new categories of things would arise which have to be seen as signs, accessible by the senses. Waldemar Cordeiro, born 1925 in Rome, Italy, resettled 1949 from Rome to São Paulo after living in Brazil already between 1946 and 1948, worked as journalist and art critic. His first art works originated in these years. In 1949 some of his works had been shown in the opening exhibition of São Paulo Modern Art Museum, entitled “Do Figurativismo ao Abstracionismo” (Schenberg 1963). Afterwards, he took part in the Biennale of São Paulo. At a Venice Biennale in 1964 Waldemar Cordeiro became acquainted with American

Pop Art, which fascinated him immediately. Afterwards, in collaboration with the Brazilian poet and representative of Concrete Poetry, Augusto de Campos, he created a series of *Do Concreto ao Popcret* works—“from Concrete to Pop Concrete” (Cordeiro). The discussion with Max Bense about these works led him to a dialectical approach in art. At the end of the sixties Waldemar Cordeiro then began to deal with computer art. In 1971 he organized the exhibition and conference *Arteônica* (Cordeiro 1972a, b), which dealt with art and technology and became something like the beginning of computer art in Brazil. The reflection on the concept of information aesthetics led many artists directly to computer art, where order structures and deformations are transposed in algorithms.

These are some examples of the fruitful interrelations between Brazilian artists and designers with the group around Max Bense. Some students of Ulm School of Design with the respective philosophical, cybernetic and aesthetic background influenced also the developments in Latin America by their translocation. Very important had been the impacts of Gui Bonsiepe. He was born in Germany, studied Graphics and Architecture in Munich until 1955. Afterwards until 1959, he studied at Ulm School of Design in the Information Department. Between 1960 and 1968, he worked as an Assistant Professor at Ulm School of Design in close contact with Tomás Maldonado. After closure of the Ulm School of Design in 1968, Bonsiepe relocated to Latin America, working as a design consultant and counselor of an UNO project. From 1968 until 1987 he worked on educational concepts for design in Chile, Argentina, Brazil. Bonsiepe reflected in an interview:

“When I came to Chile in 1968 (...) I very soon noticed that I had to radically change my ideas and that I had to set other priorities. (...) But I believe that this Ulm heritage, this set of instruments which I had gotten from the school, proved flexible enough and I could enter into a relationship with this context (...). I learned to put design in a direct relationship with liberation, with autonomy, with overcoming dependency. (...) I ask myself today why Ulm was so interesting for Latin Americans—and not only for Latin Americans, I saw it later on in India, too. Why was it so fascinating for the peripheral countries, and why were they recipients of this and interested in it? (...) My interpretation is that Ulm, in the wake of the project of enlightenment, which it was, promised independence to these people. Only through an industrialization in which the design dimension is integrated do we get something done like an identity of one’s own, a culture of one’s own, one’s own industrial culture. And this promise—as well as the instruments to fulfill this promise—that came from Ulm, and therefore it had such a resonance.” (Krampen and Hörmann 2003, p 221–223).

Bonsiepe’s roots in the information studies with background in communication theory and semiotics led him to research on interface design. He participated in the interface design of the transaction room in the project Cybersyn in Chile from 1971 to 1973, a distributed decision support system to manage the national economy. His main activities concentrated in the following years on the new upcoming discipline of interface design, working in a software company in the United States and back in Germany as Professor for Interface Design at Köln International School of Design from 1993 to 2003.

Another two persons should be mentioned with their impacts from Ulm to Latin America. Cornelia Koch had been a student in the department of information 1955–1958 at HfG Ulm. The Chilean architect Eduardo Vargas studied as a postgraduate at HfG Ulm 1957–1958. Both had been school fellows of the mentioned Almir Mavignier and Gui Bonsiepe. Cornelia Koch and Eduardo Vargas married and worked 1958–1959 in the atelier of Max Bill in Zürich, when he resigned from HfG Ulm, before they decided to move to Chile. Between 1960 and 1966 they built around 2000 houses in several Cooperatives in Valparaíso in direct dialogs with the future residents and the upcoming building industry. Both became professors in Chile, before they went into exile in Germany in 1975. Eduardo Vargas became professor at the University of Hannover. Although they had been only short at Ulm School of Design, the influences can be still seen especially in the *experimentos concretos* by Cornelia Vagas Koch (Vargas 2020). Because design was understood as a tool of emancipation at HfG (Fernández

2006) and integrated in the industrial possibilities, the concept of Ulm School of Design was perfectly suitable for critical applications in architecture and design. Vargas had been still in contact with Max Bill and asked him to plan a cultural center. Bill said that the economic situation only allowed for the most essential things, what was even more interesting for him. At the beginning of 1965, Eduardo Vargas went to Zurich with a DAAD scholarship to work out the preliminary project for the community center for Valparaíso under the direction of Max Bill. The center was planned for a population of 30,000 inhabitants as a center for the cooperative villas whose construction had begun in 1960. The community center was conceived as the culmination of a process of self-construction of housing, but finally it had not been completed (Vagas-Koch 2015). So, the exchange in architectural design with Max Bill had been still alive in Chile. Eduardo and Cornelia Vargas turned towards a participative approach in architecture. These routes can be also seen in the very first aim of Ulm School of Design creating a center of active contemporary culture and democratic education of the German society after World War II, developing a democratic society (cf. Leopold 2013).

7 Conclusions

The research on the interrelations between Max Bense’s philosophical concept and cybernetic design approaches in Latin America show many bidirectional interrelations. Ulm School of Design related design to industry and technical developments as well as society. Scientific background and research had been seen “as a central point of reference for design and design education” (Bonsiepe 2003, p 125), as Gui Bonsiepe characterized the relevance of the school for today. Herbert Ohl, one of the teachers in the architecture department of HfG and also rector 1965–1968, described the overall social importance of Ulm School of Design:

“Die HfG Ulm war mehr als eine Schule, sie war das einfache, vernünftige und praktische Modell, wie man Wirklichkeit, unvoreingenommen, als Ganzes, ihren innewohnenden Kräften folgend, durch kritisches Erkennen und methodisches Handeln ordnen und gestalten kann.” (Ohl 1975, p 19)

“The Ulm School of Design was more than a school, it was the simple, reasonable and practical model of how to order and shape reality, impartially, as a whole, following its inherent forces, through critical recognition and methodical action.” (translated by the author)

The concept of HfG had been picked up in Latin America for founding design institutions in the 1960s. Former lecturers and graduates from Ulm School of Design, with or

without routes in Latin America, worked at those institutions, stayed there or came back to Germany and Europe.

The design approaches based on cybernetics with the theoretical background in system theory, information and aesthetics, developed at Ulm School of Design but also at University of Stuttgart, gave important impacts in art, literature and architecture. Scientific disciplines had been integrated in the design education and research, which did not exist before. Especially, the exhibitions in *Studiengalerie* in Stuttgart, founded by Max Bense, caused international exchanges, most of all with Brazilian artists, designers and poets. Experiments in computer art had been stimulated with international effects. Therefore research, experiments, and practice in interdisciplinary dialogs had been in close relationships.

Around middle of the 1970s, the Enthusiasm for cybernetics had come to a halt, because then research and education at universities and industry changed mainly to practice-oriented applications as it had been analyzed by Georg Vrachliotis (2012, p 232). With the digital innovations the interest came back. The methodological design approach gets a new relevance today in reference to rule-based or parametric designing with digital tools, but also in refer to the environmental aspects where the cybernetic thinking in systems are important (cf. Medina Warmburg and Leopold 2012). The methodological procedures, combined with the research on material and environmental aspects, lead to a new importance of cybernetics. Therefore, it is worth reflecting and remembering the background. The methodological, mathematical, and technical interrelationships met with incomprehension in part at that time. The new relevance in our digital time helps to study and evaluate these early cybernetic approaches.

Acknowledgements Although I had no personal experience with Ulm School of Design, my studies of Philosophy and Mathematics at University of Stuttgart between 1975 and 1981 and later at lectures and conferences enabled manifold meetings and discussions with Max Bense and Elisabeth Walther as my professors in seminar, lectures, and personal visits. The described early exhibitions of Brazilian artists at the study gallery happened before my study time, but the study gallery had been still active. I visited for example the retrospective exhibition in 1979 (*Studiengalerie 1957–1979 im Rückblick*) and the exhibition of paintings by the French/Brazil artist Solange Magalhães in 1980. There had been stimulating lectures, meetings, and conferences with international guests. Several contacts with former students and teachers of Ulm School of Design influenced my interest and research on HfG Ulm. The summer school “Estructura—Escultura” (Structure—Sculpture) 2012 in Buenos Aires, initiated by Joaquín Medina Warmburg, enabled me to have my own experience in Latin America and gave me the impetus for my research about HfG Ulm. Many thanks for all these inspiring encounters. I would like to thank Fabiane Moraes from the Associação Cultural “O Mundo de Lygia Clark”, Felix Mittelberger from ZKM | Center for Art and Media Karlsruhe—Archive Bense-Walther, and Delmar Mavignier, atelier mavignier: delmar and sigrid mavignier, for the kind permissions to use the images in this article.

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