Michael Hellgardt

Architectural theory and design grammars

The idea of artificial brains and artificial intelligence (AI) has been subject to criticism. The objection of J. Searle [1] for instance, which has been published in 1984 and which was partially directly addressed to one of the centres of AI, the Carnegie Mellon University in Pittsburgh, is mainly based on two points:
1) interactions between physiological and mental functions, and
2) the intentionality and context-relatedness of meaning.

With an emphasis on architectural design, this paper is about the second point, because the problem of meaning is a neuralgic point in the discussion of "artificial intelligence in design" (AID). Technical parameters are incompatible with mechanisms of meaning in any field of artistic, cultural or non-technical expression. This point, that is the relation between acts of meaning and acts of technical problem-solving and, connectedly, the relation between technological and architectural design, has been widely ignored in the discussion on AID. The development seems to be dominated by the tacit assumption that architecture can be articulated and generated purely in technical and formal terms of information processing beyond the field of architecture itself.

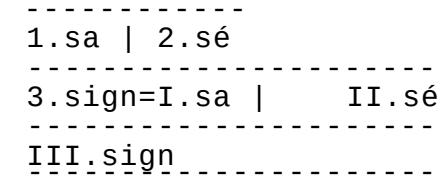
Design and shape grammars have become a well established field in the discussion of AID, also with respect to architecture. But questions of architectural history and theory are touched on only incidentally and not sufficiently in this discussion. The problem is not, in other words, simply to include more or less unrelated cases of architecture, or architectural concepts -even if these are famous ones, such as Laugier’s origional hut for instance [2] -but to establish structural relations between arguments of architectural theory and arguments of AID.

The issue of meaning is not only an issue of architectural design, but one of design in general. Architecture, at the other side, is a peculiar field of design, charged with its own problems and legacies. Part of this burden is the relation between architectural and engineering design. The development of AID defines a historically new, but actually unexplored situation in this regard. My plea in this situation is not to continue the tradition of an unreflected reconciliation of architecture and technology, but to consider the emergence of artificial intelligence in architectural design as a challenge to explore in both fields, architectural theory and AID, mutual relations between technical and non-technical, that is cultural and artistic conditions.

In the literature on AID we find statements like this: "a design is an object that satisfies given performance re-

quirements", a paraphrase of Sullivans "form follows function". We can resume this statement in the form (RP) : a relational object R is examined by a test operation and associated with a predicate P correspondingly. This formulation sounds harmless, but with regard to the problem put forward here it is not harmless.

In order to clarify that I am confronting the expression (RP) with a doubled system of signification as it has been articulated by R. Barthes [3].



The mechanism represented by this scheme has been widely addressed to in cultural anthropology and in cultural criticism, for instance with regard to literature or everyday culture. The relational object R is substituted in this scheme by the signifying (sa, signifiant), and the predicate P is substituted by the signified (sé, signifié). Then there is a third entity which is the act of signification, the sign itself, combining sa and sé. This third entity becomes the sa, the signifying of another act of signification based on a new signfied.

To fill that with an example: there is the starry sky. That is the signifying (sa) revealing certain similarities with terrestrial appearances. These similarities define the signified (sé). The result is a sign, a star sign in our case, based on perceptional performances of a 11first system11 of signification. Now there is a second level of meaning based on alledged cosmic effects of star signs. This kind of meaning makes use of the perceptional performances underlying the 11first system11 of signification producing star signs. Important is that this second operation is not only a simple association of alledged cosmic effects, or meanings, and referential objects, the star signs, but a formal operation too: the identification of certain star constellations at given points of time to which "degrees of cosmic effects" are associated. This second operation can work, in the extreme, with an empty semantic content (sé). This is a mechanism widely discussed in criticism on literature for instance: the mechanism that 11language speaks itself11, a mechanism that can be applied to all kinds of cultural phenomenae, such as architecture as well.

(Another field to discuss the scheme of Barthes is provided by Martini’s analogies between the human body and various species and parts of buildings.)

The second signified (sib) in the scheme is a second predicate. To add this simply to the first one in the form ((P) . (RF)) is the form of a technocratic misunderstanding

reducing semantic values to technical factors. The already mentioned unreflected reconciliation of architectural and engineering design is a consequence of such a misleading conclusion.
The scheme of Barthes represents a fundamental different approach: the association of the second predicate F with the referential object of the entire "fist system" (RP) in the form ((RP) F). In this form we find the same scheme in Searle's investigation of speech acts [4]: the (RP) ist a proposition, a sentence, to which a certain value of meaning F is associated in the context of an activity, a speech act. The explanation of the formula ((RP) F) by Searle is exactly the same as the one given by Barthes to the scheme described above: the (RP) is a matter of linguistics, or the science of language, fields dealing with methods. Searle contrasts this with the philosophy of language dealing with living speech acts (Barthes constrasts object- and meta-language; the meta-language in the case of Barthes is myth).

This distinction, the one between object- and meta-systems, applies in the field of architecture too. In order to discuss this I am referring to another conceptual pair, discussed by Searle too: the distinction between analytic and synonymous terms. I am emphasising only on one criterium in this regard, the one of behaviour. Analytic expressions of the kind "rectangles are four-sided" are unrelated to behaviour. This kind of "meaning" is based on an unequivocal and context-independent relation between referential objects and predicates, whereas synonymous expressions can have various or "shifting" (a term of some importance in semiology) meanings under varying conditions. Architecture as a matter of analytic expression is an object of science. In order to label the counterpole I avoid to say architectural philosophy, or the philosophy of architecture. I would rather call it architectural theory. But I read this term analogue to what is meant by language philosophy in contradiction to language science by Searle: a discipline dealing with synonymous expressions under varying, that is "living" conditions of cultural expression, such as building and architectural history.

Formalised linguistics, according to Searle, produce correct syntactic expressions, but no living speech acts and performances of thought, because the apparatus of rules involved in semantic performances is ambiguous generally. This is the limit of artificial intelligence, but we can think of, as Searle argues, extended syntaxes "miming" acts of meaning syntactically. In other words, the F in ((RP) F), which actually represents semantic, not syntactic values, is substituted by syntactic devices "miming", or simulating, "as if" semantic operations and behaviour.

F in the scheme of Searle represents "illocutionary force" (concerning assertions in contradiction to questions for instance). In the perspective I am pursuing in this paper it represents explanatory force. Explanation in this regard is

related to phenomenae of building performances ("building behaviour", "building acts") and of architectural history as a matter of architectural theory. Actually this is a kind of a "second semantic explanatory force", when we take Chomsky's explanatory adequateness, enabling generative structural descriptions, as a kind of 11primary syntactic explanatory force".
F can be discussed as a function operating outside or inside of formalised design-procedures.

Explanation outside formalised design-procedures

I am referring to an experiment under development which is focussed on the work of a single architect: H. Scharoun. This work is related to the Scharoun exhibition Sept./ Oct. 1993 and to research of a group in Berlin working on Scharoun. My experiment has been incorporated in the exhibition, and is described in some detail on this behalf [5] and in [6].

There are two answers to the question "why Scharoun?". The first is biographic. I have been working for about ten years for this architect and -in contradiction to a commonsense misunderstanding of "organic architecture"- I have been noticing soon that the work of Scharoun is geared by a rigorous method. This opens the second answer. I guess that the work of architects as B. Goff, F.L. Wright, A. Aalto or Scharoun, is particularly appropriate to investigate formal structures of design procedures.

In the work of Scharoun a certain way of operating with "spaces-between" is of fundamental importance. Fig. 1 shows some examples of his early period, read as space-between structures. The right floor plan represents a 4-dimensional system, the rest 2-dimensional ones. Ths space between, in other words, is defined by two or more coordinate systems defining clusters of rectangles which, in the work of Scharoun, usually become partially deformed in the course of the design procedure.

Fig. 2 shows output configurations of a package of functions called the space-between-generator which is restricted to two-dimensional systems until now. The output of fig. 2 is related to only one design function: the disposition of furniture-mats (which are similar to the "matjes" used in Dutch housing design). Fig. 3 shows output examples including an elaboration of the space between. This is based on certain models taken form Scharoun's work (fig. 3, Haus Möller, Baensch and Moll), generated by a mechanism of analogy, another design function, which later on is referred to, but not discussed in this paper.

The layout variants of fig. 2 can be considered as alternative fillings of a wedge (or fan) shaped load bearing structure which is typical for Scharoun, his Salute block in Stuttgart for instance (fig. 4). On the base of this picture one might conclude the space between-mechanism to be Scharo-

un-specific. This can be refuted easily, for instance by layouts of other exponents of "organic" architecture, or by more recent examples of deconstructivist architecture, or by vernacular layouts, for instance [7] medieval or Arab settlements. Fig. 5 gives an example . I do not think it is necessary to extend that in order to defend my assertion that the space between principle is not Scharoun-specific but observable in various building cultures.

At the other side we find in the history of architecture layouts which are obviously "fu11", that is without any remaining space between. Moreover, the whole history of cultivated architecture, in contradiction to vernacular or natural architecture, tends to eliminate and to control spaces between as an uncultivated element. This can be read as the repercussion of the Cartesian space concept on architecture. A examination of enlightenment architecture and architectural theory would prove that.

We can resume such observations in the form of a polar conceptual model:

configuration	
Gestalt	tabula-rasa/white sheet...
pre-defined image of the whole	calculus
space	
spatio	extensio
alluding	"full"/saturated
space-between	space-between
target	eliminated
generative	resulting
object	
historic	a-historic
empirical/real	technical-functional
application-specific	application-neutral

The distinction between spatio and extensio is discussed in Heidegger's "Bauen Wohnen Denken" [8] ("Building Dwelling Thinking"). We can paraphrase that in terms of the conceptual pair analytic-synonymous introduced above. Extensio defines space in terms of analyticity, spatio in terms of synonymy. Space in terms of extensio is "full" of, or saturated with, meaning, and can be expressed in quantifiable data concerning shape and content. Space in terms of spatio, in contradiction, is only alluding to possible shapes and contents. As a design-objective space-between is cultivated, deliberately elaborated, a target-entity in the space-spatio-approach, whereas the space-extensio-approach tends to eliminate undefined spaces-between.

The LOOS-approach [9], for instance, is a case of a space-extensio structure, a mechanism to reduce spaces-between to unevitable "non-trivial holes". As a contrast model this

mechanism provides a good frame of reference for the discussion of features of the space-between concept.

The space-between-generator operates on the base of an input defining a topological (zone-) model ot mat-distribution which allows certain exchanges of mats, but which contains also a prefiguration of the shape of the ultimate result. I call this a gestalt-configuration, a Leitfigur or Leitbild which to some extent is abstract, not yet developed, but which is also concrete in terms of a pre-defined reference model.

The counter model of the space-extensio structure is an abstract formula corresponding to a white sheet of paper, a kind of an empty image, or tabula-rasa, in terms of human perception and image-making. Consequently, as is emphasised by the authors themselves, the LOOS-approach is neutral with respect to its application. It is an a-historic, technical model, in contradiction to the space-between model which is intended to model historically and empirically real performances of image- and space-configuration.

Layout generators play a prominent role in the literature on AID. The first question, on the background of problems put forward in this paper, with respect to such layout generators is: can we imagine a layout generator which allows to describe real, or historical, phenomenae only by means of varying inputs. Could a generator as the LOOS-system for instance do that. I assume: no. In order to identify real, or historical, phenomenae within a reference frame as discussed above we need contrasting models of mechanisms of spatial organisation to which certain patterns of thought correspond in varying situations of perception and expression.

The idea of such a contrast-model corresponds to the distinction between the actually spoken language and the cristalline-clear language of formal logic as it is a subject matter of Wittgenstein's Philosophical investigations [10].

To such contrasting models, now, we have to apply the same question: can historical/real phenomenae be explained merely by means of varying inputs? Again I guess the answer to be: no. This opens the perspective of explanation inside formalised procedures.

Explanation inside formalised design-procedures

The following remarks are not based on any experimentation with formalised procedures, and consequently are abstract, provisional and, to some extent, only vague.

I guess that the question: can control mechanisms inside formal procedures serve as non-technical interpretative devices is of some importance on the background of architectural theory.

Fig. 6, left represents a layout defect, the passage right to the bathroom is too narrow. The rest of fig. 6 may represent a groop of possible solutions. In the case that rotations of coordinate systems and breaks within coordinate systems are excluded, the groop of possible solutions is reduced on the base of technical selectional criteria. If a groop of alternatives is remaining, we can think of associating these with particular historical, or real, phenomenae. Referring to biographical conditions of a particular architect, as Scharoun for instance, we could probably say that each alternative of a given groop can appear only after certain (biographic) key-examples in the context of which it has been applied first, or origionally. Probably such influences can be traced further back in the history of the architectural idiom under concern.
Such references may cause further mechanisms of selection within formalised procedures. A certain impulse might be continued in terms of a given related "style". This might cause later layout modifications, or -with respect to the space-between-generator- it might determine the later configuration of the space-between in a particular way.

The whole is a stratified selectional mechanism evaluating varying mat-constellation in varying contexts. This can be resumed as follows, again following a hint of Searle (speech acts): (X counts for Y in the context C).

X represents a control function corresponding to a particular layout constellation which is defined by pairs of mats and connected contexts. In the most simple, that is univocal case a single production rule is addressed by this operation which is one of classification. In ambiguous constellations a whole package of rules is addressed. This happens by means of the same mechanism which can be imagined to be multiplified recursively:
((X counts for Y in contect C) counts for Y’ in context C’).

This scheme can be read as a completion of the scheme ((RP) F), that is as a scheme distinguishing "pure" syntactic operations from syntactic operations "miming", or simulating, semantic performances. In the context of a simply doubled scheme the first operation counts as a technical control function, and the second one as a control function corresponding to historical, or real, conditions or hypothetic assumptions, and a re-assessment of the context according to these standards.

If and to what extend such a procedure can be really implemented presumably can be investigated only by means of experimentation. In contradiction to design-grammars aimed at applicability, formal mechanisms, in the first instance, have no value of their own in this context. They serve mainly to search for hierarchies of mechanisms of relatively universal validity, as for instance a general-space-between-mechanism with connected technical control functions, and of relative specific mechanisms such as the allocation of

alternative performances under varying historical, or real, conditions within the overall mechanism.

These levels could correspond to terminological subdivisions of architectural history and theory separating building languages or -idioms of relatively universal validity from architectural schools or "styles" on a lower level of universality; the modernist movement, for instance, from sub-movements in it, such as the "organic" deviation. Finally the uniqueness of performances and architects, as Scharoun for instance, cannot be explained without reference to subdivisions on a higher level of validity.

Concluding remarks

Combinatorial explosions, on the background referred to in this paper, have to be aimed at, and matched against, standards of synonymy, not analyticity. This start situation may open perspectives of design grammars different from approaches aimed at technical targets, or the structure of which is not explanation in terms of architectural theory.

The intention of my paper was to outline research strategies in this regard; strategies for the simulation of cartesian and non-cartesian mechanisms of genesis in both, the natural built environment and the history of cultivated architecture. It is not difficult to imagine the benefits of such an endeavour for architectural education.
one primary condition, however, in order to investigate mutual relations between architectural theory and design grammars is not to confuse cultural and technical conditions inadequately. The conclusion of this is to establish a discussion in a sub-wing of AID, a kind of artificial intelligence in architectural design or “AIAD”.

References

1. J. Searle, Minds, brains and science, British Broadcasting Cooperation 1984, in particular part 2.

2. W.J. Mitchell, R.S. Ligget, S.N. Pollalis, M. Tan, Integration shape grammars and design analysis, in: CAAD futures ‘91, Braunschweig/Wiesbaden 1992.

3. R. Barthes, Mythologies, Paris 1957.

4. J. Searle, Speech acts, Cambridge 1992.

5. M. Hellgardt, Syntaktische Aspekte der Arbeit von Hans Scharoun, edited by: Akademie der Künste, Abteilung Baukunst on behalf of the Werkschau Hans Scharoun, Berlin 1993.

6. M. Hellgardt, Von Scharoun lernen: ein gestaltorientierter Ansatz des automatisierten Entwurfs, paper presented at Denkmal und Computer, international conference at the Technical University Berlin, oct. 1993 (proceedings forthcoming).

7. from: H. et J.-M. Didillon, C. et P. Donnadieu, Habiter le désert, les maisons mozabits, Bruxelles 1977.

8. in: M. Heidegger, Vorträge und Aufsätze, Pfullingen 1985.

9. See for instance: U. Flemming, C.A. Baykan, R.F. Coyne, Hierarchical generate-and-test vs constraint-directed search, in: Artificial intelligence in design 192, Dordrecht 1992.

10. L. Wittgenstein, Philosophische Untersuchungen, Frankfurt/M. 1971.

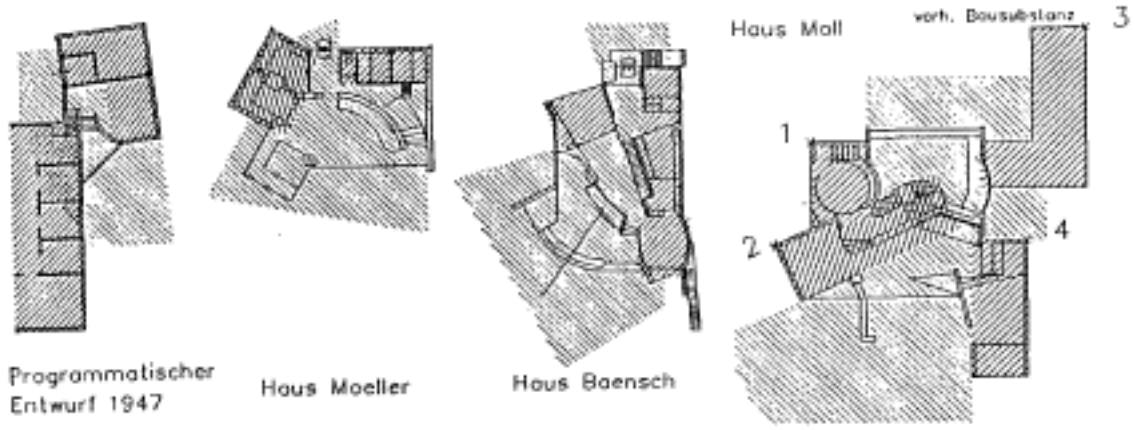


Fig. 1

Fig. 2

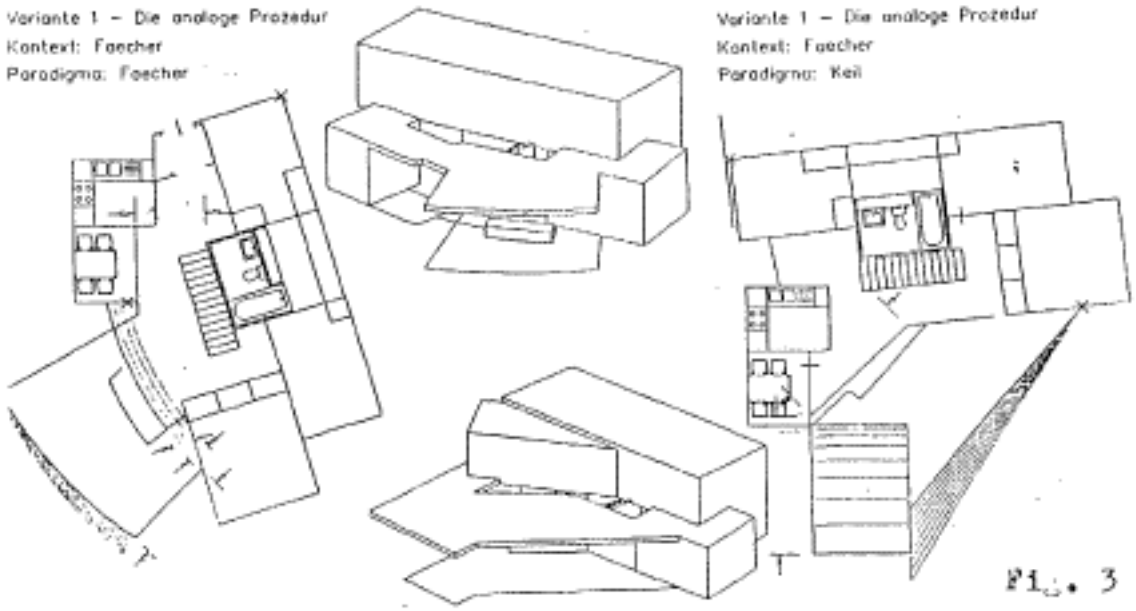


Fig. 3

Fig. 4

Fig. 5

Fig. 6