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The Repertory of Signs

I. Every sign is "connected with three things, the ground, the object, and the inter-pretant."[1]

II. In *Morris'* analysis of the dimensions of semiotic[2] we find the semantic, pragma-tic and syntactic associated respectively with the object, the interpretant and the "sign verhicle" of a sign.

III. *Bense* and *Walther*[3] consider the sign as a triadic relation, the mean (Mittel), the object (Objekt) and the interpretant (Interpretant) considered as domains opening the perspective to a system-theoretical approach to the sign.

It is quite evident that *ground (Peirce)* and *sign vehicle (Morris)* are not identical, but related. The same goes about the mean *(Bense).* In the first case we had the division into three branches: pure grammar, logic proper and pure rhetoric[4]; in the second, the "dimensions of semiotic" (semantic, pragmatic, syntactic); in the third: *repertory* (Repertoire), *sphere of objects* (Bereich) and *field of meanings* (Bedeu-tung)[5].

A strict semiotical approach should consider both the historical developement *(Peirce,* 1897; *Morris,* 1938; *Bense* et al. 1971. — I did not mention *F. de Saussure,* who con-sidered the sign from a different perspective) and the systematical. The decision to restrict the analysis of sign from the perspective of the set theory only to repertory[*] will at least prevent several possible misunderstandings.

No matter how disputable this could be, the sign is represented by a relation such as

$$S = R(M, O, I) \qquad\qquad (\alpha)$$

according to *Bense,* or by a graphical representation such as
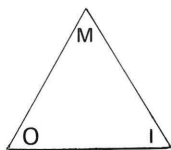

fig. 1

according to *Walther.*

At least in principle the relation R might be considered, up to a point, an intersection in the terms of set theory or, rather fuzzy set theory, so that a given sign expresses the relation between a mean (m), an object (o) and an interpreter (i). This can be shown through a pictorial representation (the *Venn* diagram). Of course, restricting ourselves to the repertory the sign should be considered as

$$s = (m, o, i) \; \epsilon M \times O_M \times I_M \qquad\qquad (\beta)$$

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in which case we are directed to consider also the set

$$M_m = (m, o, i): o \epsilon O, i \epsilon I) \qquad (\gamma)$$

i.e. the set of all signs with a common mean.

In *Peirce's* conception the mean (i.e. representamen) is the sign *per se,* an idea which lead *Bense* to what he calls[6] the abstract conception of the sign (Die abstrakte Konzeption des Zeichens). In this case the sign is "presented" as a mean (M), which stands for a "represented object" ("repräsentiertes Objekt") (O_M) and a "representing interpretant" ("representierender Interpretant") (I_M). The presented mean has an *external* sign nature per se, while as a represented object and as an representing interpretant it has an *internal* sign function.

Reiterating these observations it becomes possible to develop in the terms of the set theory a model of a semiotic of the mean, or what will be called here an S_R, i.e. semiotic of repertory. Among other specialists I emphasized[7] that repertory is a concept belonging to the domain of the mean, and that the strict term will be repertory of means and not repertory of signs. In spite of this, "repertory of signs" is in current use, a fact which entitles one to refer to an S_R semiotic.

The sets represented by M, O_M, I_M are univocally determined. The dynamic condition which the basic triadic function presupposes in *Peirce's* concept, that is, though the direction of the generation from firstness, to secondness and thirdness, was pictured in graphs[8]; in the same manner, the semiotic matricial applications[9] *(E. Walther)* established by the use of arithmetic notation *(M. Bense)* yield a similar result.

The representation I propose retains the three above mentioned sets and implies the two operations which this envisions (denomination and signification). But S_R appears on the proposed scheme together with other fields of interference such as:

$$M \cap O_M \backslash I_M; \quad I_M \cap O_M \backslash M; \quad I_M \cap M \backslash O_M;$$

or even $\qquad\qquad\qquad\qquad (\delta)$

$$M \backslash O_M \cup I_M; \quad O_M \backslash I_M \cup M; \quad I_M \backslash M \cup O_M.$$

They all belong to repertory, but cannot represent it except in the case the three sets are identical. This leads us to the idea that proposing a sign means to propose the *relation* between its three elements, and that every analytical or synthetical approach has to consider their obligatory relation. No other relation between two of the three elements can represent the sign (considered as belonging to a sign-repertory), or permit its accomplishment. If, for example, as it is a common practice, the sign is confused with its mean, we rediscover the set of all signs with a common mean (M_m, see γ). In the same way we might rediscover the set of signs representing the same object or the set of signs related to one and only one interpreter:

$$M_m = (m, o, i): o \epsilon O_M, i \epsilon I_M$$
$$O_m = (m, o, i): m \epsilon M, i \epsilon I_M \qquad (\epsilon)$$
$$I_m = (m, o, i): m \epsilon M, o \epsilon O_M$$

The product of these three sets in precisely set S_R (repertory). They are corresponding, symmetrical, and reflexive and therefore equivalent sets. The power of each of these sets is in the category of the power of natural numbers ($\aleph_0$). The expressions (ϵ) are also definitions of the operations within a sign repertory (adjunction, superi-

zation, iteration). In this way it results that the introduction of a sign in fact means the opening towards the *sequence of signs.*

The formalization of a repertory's sign operation in the terms of the set theory (after it has been reproduced in graphic representations[10] or in matricial calculus[11]) has the advantage of proposing a link between semiotic as a method of analysis — or what I shall call in this case *analytical R* (repertory) *semiotic,* S_{Ra} — and the *synthetic semiotic* referred to repertory (S_{Rs}), contributing to the extrication of a suitable model of *generative semiotic of repertory* (S_{Rg}). If we consider the repertory as a given nonempty set S_R (signs in a given domain, therefore a type of applied semiotic) and

$$C \subseteq S_n, \text{ with } n > 0 \qquad (\zeta)$$

is a field of criteria (example: the criteria for discerning vowels from consonants in the repertory represented by the Roman alphabet), then an analytical R semiotic is endowed with the function

$$S_{Ra}: S_R \longrightarrow C \qquad (\eta)$$

that is, S_{Ra} is defined on the set S_R with values in the field of criteria C.

It can be seen that through the criteria of relating the sign to the constituent elements of the sign function, *Peirce* imposed a type of semiotic, but in fact he did not exhaust all the types (the analysis, even restricted to repertory, can also be of the form of the sign, types of communication to which it is suited, of the form-function relation, etc.). The consistency of a sign theory becomes evident through the way it defines the types of signs. In a broader sense the entire triadic-trichotomic sign relation could be expressed as such

$$S = R(M(Qu, Sin, Leg), O_M(Ic, In, Sy), I_M(Rhe, Dic, Arg)).[12]$$

The analysis of a given repertory in terms of semiotic can not avoid the consequences of the above mentioned expression, which is the definition of the *Peirce* analytical semiotic (n=3, the criteria being that of relating the sign to M,O,I). It must be here recalled that *Morris'* analysis, which forms the basis of the trichotomic model, has affected *Peirce's* model of semiosis (sign processes). As it is known, he abstracted three kinds of two-place relation for study: between sign and interpreter (pragmatics), sign and 'designation' (object denoted, semantics), and sign and sign (syntactics). He was correct in relating the trichotomic distinction to fundamental aspects of communication. But for a real fruitful formulation of the distinction, it is necessary to develop much more elaborate theories of communication, an attempt which should start from the observation that the sign enters into communication processes as a mean (from a repertory). An analytical R semiotic determines the place of any type of sign from a repertory in the space of the proposed criteria. It is evident that sometimes two different signs deal with the same object, without being necessarily identical because of this. Of course, analysis restricted to repertory is not the same with analysis of the sign as an triadic function. This should be underlined before examining the question whether function S_{Ra} (or application S_{Ra}, which we call analytical R semiotic) is reversible. In the affirmative case, we have

$$S_{Rs}: C \longrightarrow S_r \qquad (\theta)$$

that is, that which we shall call *synthetic R semiotic.*

A function is reversible if — and only if — it is bijective, that is, injective and surjective[*]. In this case the demonstration is simple: for the function $S_{Ra}: S_R \longrightarrow C$, we have $S_{Ra}(s') = S_{Ra}(s'')$ only when $s' = s''$ (I) because the repertory set is defined through $S_R = M \times O_M \times I_M$ so that every sign is given as $s = (m, o, i)$ $M \times O_M \times I_M$; then, $c = S_{Ra}(s)$ (II), because each criterium is a coordinate in the space S_{Ra}. Being bijective the sets S_R and C are *equipollent*. Since conditions I and II are fulfilled, it follows that the application (function) $S_{Rs}: S_R \longrightarrow C$ also exists: $S_{Rs} = S_{Ra}^{-1}$ (t), corresponding to the attachement of a coordinate in the space of criteria of one or more signs ("classes", in *Peirce* terminology). This takes us back to the possibility of the synthesis of a sign with prescribed properties, or more precisely, the synthesis of a group of signs (repertory) with given property or a set of properties (the typical case in problems of design or in visual communication).

Analytical R semiotic is univocal. In relation to an adopted system of criteria, a sign (or an ensemble) presents itself as having a determined quality (see analysis of aesthetics made by *Th. Schulz*; of literature by *E. Walther-Ponge*, or by *Marlis Gerhardt-Kafka*; of engraving-*Dürer*-by *Hans Brög*; of architecture-by *Kiefer, Kiemle*, etc.).

Synthetic R semiotic is equivocal. Its definition presupposes rules of formation, from the triadic basic sign relation to the three fundamental operations (adjunction, superization, iteration) as well as to their possible combinations. In fact, an equivalent exists between the synthetic function and the graphs of the generation of a sign, the function being, even if restricted to repertory, more enveloping. Finally, *Bense's* concept[14] concerning the distinction between internal and external semiosis is implied in the proposed synthetic function applied to repertory.

If we could imagine a sign 'device'[15] (not necessarily the type represented by a computer), all that would remain would be the consideration of a generative semiotic (perhaps considered even as a cybernetical system). The problem is reduced to the determination of the succession of the operations through which we could generate a set $C' \supset C$ so that $S_{Rg}: C' \longrightarrow S_{Ra}$ (κ), where S_{Rg} (c) ϵ S_{Rg} (c), that is, an indeterministic algorithm. In this case, S_{Rg} is a *generative R semiotic*.

The need for a subset $C' \subset C$ stems strictly from practical reasons. If the device is ideally workable, the generative R semiotic is identical with synthetic R semiotic. The generation of signs could imply also an aleatorical (random or quasirandom) element. A computer texttransformation (like exemplified by *F. Nake* and *M. Gardner*: Abstrakte Semiotik", starting from the beginning of *Bense's* "Semiotik") might use such a quasi-random basis.

The set of signs such as represented by the repertory is not homogenous. Of course we can introduce rules for ordering, or we can focus our attention on very determined subsets (like an alphabet). The power of set S_R is the same with the power of set S (this determined by *Hermes* and *Scholz*) and is in the category of the power of natural numbers $(\aleph_0)$. The power of the set of criteria is finite and determined through the particular definition of every semiotic. (Without entering into details I

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[*] The mapping $\alpha: M \longrightarrow L$ is called surjective if each element y from L has a pre-image. In this case, it is also said that M is mapped onto L.

The mapping $\alpha: M \longrightarrow L$ is called injective if each element $y \epsilon L$ has at most one pre-image. If the mapping $\alpha: M \longrightarrow L$ is simultaneously surjective and injective, it is called bijective. (cf. 13)

mention that *Peirce's* semiotic is defined through C = 3, while *Hermes'* and *Schröters'* through C = 2, or *Klaus'* through C = 4, not to speak about such hazy systems like some worked out by semiologists.) The higher the power of the set of criteria is, the more determined the signs become, and at the extreme $C = S_R$ (i.e. the power of the set of criteria equals the power of the repertory set) every sign ceases to exist. At the other extreme, the signs become less and less determined. In a way this is the case in such a sign reality as art's. Otherwise, this defines also the situation of semiology.

From the repertory set, one can always separate a suitable subset, according to which, as the case requires, one can determine the power through diagonal processes (cf. *Cantor*). This fact should be retained. In general, any synthetic semiotic (restricted or not to repertory) is a semiotic of finite power. Semiotic analysis (restricted or not to repertory) also requires a reduction from the infinite (or the power of continuum) to the finite.

The repertory of signs could be analysed from the point of view of ordering (order relation which is antireflexive and transitive and also symmetrical), and we could also propose operations and order relations. In this case, it opens a possibility of proving the classification by means of combining various order relations.

The signs belonging to a repertory are not independent. If an analytical R semiotic has to find the types of their interdependence, a synthetic R semiotic should generate not only signs but also rules for their association. Every sing, in order to accomplish its function, must be related to other signs. Even the act of explaining one sign, isolated from a repertory, imposes the use of other signs. I call this the integrating character of the sign. It follows that no matter what its type, a sign's principle function is to integrate. Analysis and semiotic synthesis (generation) expresses, even if restricting to repertory, nothing other than the degree of integration.

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Zusammenfassung

Die hauptsächliche Funktion des Zeichens, von welcher Art es immer sei, ist eine integratorische. Indem es zeigt, zeigt es nicht nur, sondern es definiert sich auch selbst im Kontext seiner Beziehungen. Die Repertoire-Relationen, die hier analysiert werden mit Hilfe der mengentheoretischen Konzeption, beziehen sich auf ein Triplet und können durch die Formel $Z = R(M, O_M, I_M)$ ausgedrückt werden. Von diesem Standpunkt aus lassen sich günstige Definitionen sowohl der analytischen, synthetischen als auch generativen Semiotik in Beziehung zu dem Repertoire (S_{Ra}, S_{Rs}, S_{Rg}) ins Auge fassen. Dabei ergibt sich, daß das Kriteriensystem der analytischen R-Semiotik gleichzusetzen ist mit der Definition der besonderen Semiotik etwa bei *Peirce,* die rigoros von *Bense* und der *Stuttgarter Schule* weiterentwickelt wurde. Mathematisch faßbar wird gleichzeitig die Determination der Mächtigkeit der Menge von Zeichen (Repertoire), aber auch der von Kriterien, wobei diese Zeichen, als Ausdruck der Wahrheit, daß es nichts gibt, was nicht zeigt, nie unabhängig auftreten können, so daß jedes Zeichen sich präsentiert und existiert als in einem Repertoire integriert. Deswegen wird die Repertoire-Abhängigkeit untersucht und festgestellt, wie sie sich in der Struktur des S_{Ra}, S_{Rs} und S_{Rg} wiederspiegelt. Die Einschränkung auf Mittelbezüge beweist, daß das Mittel (wie *Peirce* und *Bense* formulierten) letztlich das eigentliche "Zeichen" sei.

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