XIV. Semiotik und Einzelwissenschaften
Semiotics and Individual Disciplines

132. The semiotic reconstruction of individual disciplines

1. The task of Chapter XIV of this Handbook

Chapter XIV of this Handbook is designed to specify the semiotic aspects of major academic disciplines. The task is not to prescribe each discipline what it has to accomplish but to describe its actual domain, perspectives, methods, theories, means of presentation, forms of communication, and history from a semiotic point of view (cf. Art. 123 § 2.). If one studies an object from a semiotic point of view (cf. Art. 123 § 4.), one must ask:

a. Are sign processes necessary for its existence?
b. Is its existence necessary for sign processes?
c. What kinds of sign processes are involved?

The questions of what sign processes are and how they can be classified are treated in Articles 1–5 and 16 of this Handbook.

2. The contents of the articles in Chapter XIV

In Article 30 § 3., Umberto Eco discusses the importance of the historical stages of a discipline for its present activities. He argues that an adequate reconstruction of the natural sciences can be achieved on the basis of their present state only, whereas a reconstruction of the human sciences must also take into account their history. But even for the natural sciences the changing historical goals form an interesting background for the introduction into their present objectives. In designing Chapter XIV it was therefore suggested that each of its articles contain a short survey of the past developments which led to the present activities of the discipline concerned. This survey can be given from the perspective of today since history is treated in its own right in the comprehensive historical section (Chapters V–XI) of the Handbook.

In the exposition of a discipline's present activities, each article of Chapter XIV can take the questions discussed in Article 123 as a guideline. The task is

1. to characterize the vocational and the scientific goals of the discipline,
2. to give a realistic account of each component of the discipline,
3. to specify how it can be construed on the basis of semiotic concepts and theorems,
4. to present a detailed example of such a semiotic reconstruction for an appropriately chosen part of the discipline,
5. to state what is required for a similar treatment of the other parts of the discipline.

The authors of Chapter XIV are free to choose appropriate semiotic concepts and theorems on which their discipline's reconstruction can be based. However, since a number of disciplines have given rise to the development of specific traditions in general semiotics, they were invited to analyze the discipline with reference to such a tradition wherever possible. Examples are the semiotic conceptions elaborated

- for logic by Frege 1879 and Carnap 1942,
- for linguistics by Saussure 1916 and Hjelmslev 1943,
- for anthropology by Cassirer 1923–29, Lévi-Strauss 1958, and Lotman et al. 1973,
- for biology by Jakob von Uexküll 1920 and 1940 and Sebeok 1972,

- for psychology by Bühler 1934, Piaget 1946, and Morris 1946,
- for literature by Jakobson 1960 and Jakobson and Lévi-Strauss 1962, Greimas 1970, and Lotman 1970,
- for the arts by Arnheim 1954, Goodman 1968, and Eco 1976.

Of course, these traditions need not themselves be given an extensive exposition, since they are all treated in their own right in Chapter XII of the Handbook.

The types of sign processes to be taken into account differ from discipline to discipline and from component to component within a discipline. Where there are sign processes in the domain which is studied by a discipline (cf. Art. 1 § 3.4., Art. 110 § 3.1., and Art. 123 § 3.4.), it must be specified whether the discipline's central perspective is

- syntactic, in that it concentrates on the signs and their structure (cf. Art. 2),
- semantic, in that it concentrates on the signifieds and their codification (cf. Art. 3),
- pragmatic, in that it concentrates on the interpreters and the ways they use signs, signifiers, and signifieds to construct messages (cf. Art. 4).

Thus psychology is more concerned with the interpreters in exosemiosic processes and investigates endosemiosic processes only insofar they occur in connection with exosemioses. Sociology is concerned with the relations among living beings and their organization; it treats institutions as collective sign users and deals with the sign processes that are constitutive for each institution. Neurophysiology focuses on endosemiosic processes of living beings. Linguistics investigates verbal signs with respect to their linguistic codes and has traditionally emphasized their syntactic and semantic dimensions. Literary studies are more concerned with the unique syntactic and semantic structure of the individual text than with that of the language used in it; they concentrate on pragmatic processes of meaning production in verbal signs. Analogous specifications can be made for art history and musicology. This list of example cases is incomplete and only considers the domain and perspectives of the disciplines concerned. Similar considerations have to be made with respect to methods, theories, and means of presentation of each discipline.

3. Procedures of semiotic reconstruction

Once the author of an article has found out which are the relevant semiotic aspects to be taken into account in the reconstruction of his discipline, he has to decide which procedures should be used in the reconstruction process. Within epistemology, few approaches have been developed which explicitly account for a discipline's methods (cf. Art. 123 § 2.3.) and means of presentation (cf. Art. 123 § 2.5.). Most epistemologists have concentrated on the question of how to structure its theoretical results (cf. Art. 123 § 2.4.). Of course, this issue must be investigated in connection with the question of which means of presentation are available in a given discipline. Here are some of the possible choices:

1. An *unmodified natural language* is used in history and many literary studies.
2. The lexicon of the language is extended through the introduction of special technical terms. Taken together with the rest of the language, they constitute a so-called *technical language*, which allows more concise formulations. Technical languages are used in botany, zoology, and in most other disciplines (cf. Schnelle 1973: 82 ff and Kittredge and Lehrberger 1982).
3. The syntax of the language is standardized so that logical inferences can be controlled more easily. This so-called *regimentation* of a discipline's language is practiced in logic, linguistics, arithmetic, and most other disciplines that make use of logic (cf. Quine 1960: 157–190 and Schnelle 1973: 84 ff).
4. Artificial symbols are substituted for some of the expressions of the technical language. This *symbolization* process eliminates intuitive meanings of the original technical terms and regimented constructions that are potentially misleading (cf. Blanché 1962: 45 ff).
5. A discipline's language of theory is formalized through the explicit specification of a sign repertoire as well as formation and transformation rules. For regimented technical languages *formalization* is possible without symbolization. But usually a fully formal system is constructed with artificial symbols. This is the best guarantee that no undetected implicit information is used (cf. Carnap 1958 b: 171 ff, Blanché 1962: 47–50, Suppes 1968, Przełęcki 1969: 6 ff).

6. While the introduction of technical terms, regimentation, symbolization, and formalization serve to structure the language of theory used in a discipline, *axiomatization* serves to structure the theory itself. Axiomatization consists in the specification of a set of logically independent statements (the axioms) from which all other true statements of the theory (the theorems) can be logically derived. Since the decision as to which statements should function as axioms is often arbitrary when viewed from an immanent perspective, one and the same theory can have a number of alternative axiomatizations which are logically equivalent because statements that are theorems in one occur as axioms in the other and vice versa. The axiomatization of a theory is the best way to ensure that the theory is not inconsistent (i. e., does not permit the derivation of a statement as well as of its negation). It also facilitates the examination of whether the theory is complete (in which case it specifies for each possible sentence of the language either that it is true or that it is false). Although axiomatization can be accomplished without formalization and even without symbolization (cf. Lieb 1970: 78 ff), it has its full effect only when an artificially constructed formal language is used (cf. Woodger 1939, Carnap 1958 b: 171–225, Ajdukiewicz 1960, Blanché 1962: 49 ff, Przełęcki 1969, Simon 1970, Lieb 1983: 445 ff).
7. Once a constructed language has been introduced and an axiomatic theory formulated in it, the terms of the natural language used in the discipline can be explicated by translation into terms of the constructed language. In this way a vague presystematic notion (the explicandum) can be replaced with a precise concept (the explicatum) which functions in a systematic context. Often a constructed language is only introduced in order to make such an *explication* of central notions of a discipline possible (cf. Carnap 1950). In order to be useful, an explication must fulfill correspondence conditions of some sort, which secure that the explicatum does not differ from the explicandum in aspects which are essential from the point of view of the discipline (cf. Carnap 1950: 3–18, Carnap and Stegmüller 1958: 12–20, Hanna 1968, Poser 1971, Schnelle 1973: 85–114, Pawlowski 1980: 157–198). Ideally, a semiotic reconstruction of a scientific discipline would provide explications of the discipline's central terms by translating them into an axiomatized semiotic theory. Since theories of the latter kind exist only in very limited areas, e. g., within logic (cf. Hermes 1938, Carnap 1958 b, Martin 1959 and 1979), the authors of Chapter XIV mostly have to restrict themselves to preparing the ground for such a procedure. Nevertheless it may be useful to have the procedure of explication in mind and to consider in the context of each article what is required for making it feasible in the future.
8. Since there are few disciplines whose results have already been presented in one comprehensive axiomatic system, it has been suggested to reconstruct a discipline's results not as a homogeneous theory but as a set of *theory elements* (cf. Sneed 1971 and 1976, Stegmüller 1973, 1979, and 1980, Diederich 1981, Balzer 1982; see also Art. 28 §§ 3. and 4., Art. 30 § 1.9.2., and Art. 124 § 4.). A theory element is a smallest part of a theory for which an interpretation is possible that does not require recourse to the rest of the theory. The theory as a whole is reconstructed as a network in which theory elements are connected through relations such as that of specialization, expansion, reduction, etc. (cf. Diederich 1981: 64 ff). The networks of different disciplines can be compared with respect to the number of theory elements involved and the types of relations that hold among the theory elements. This approach affords more flexibility both in reconstructing a discipline's latest theoretical results as well as their antecedents from previous historical stages (cf. Balzer, Moulines, and Sneed 1987 and Balzer 1997).
9. While structuralist epistemology (cf. Sneed 1971 and Stegmüller 1979) defines theory elements and does not postulate any constraints on the order of their reconstruction, constructivist epistemology (cf. Lorenzen 1974 and Schwemmer 1976) tries to specify an *order of constitution* for each member in a given set of theory elements. It views the reconstruction of science as rational action that leads to increasing complexity in the pursuit of knowledge. The place of a theory element in that genetic process is regarded as significant for its function in the system of

the scientific disciplines. Within a constructivist approach the question must be answered which place a general sign theory can have among the scientific disciplines. The editors of this Handbook assume that this place must be so fundamental that the construction of the individual disciplines can build on it (cf. Barth and Wiche 1986 and Art. 123 § 4.).

The authors of Chapter XIV in the Semiotics Handbook are free to decide in favor of or against any of the nine approaches mentioned. They were asked to state that decision explicitly and to perform according to it throughout their article. Thus a semiotic reconstruction of a discipline's results may be anything from a systematic exposition of its basic statements in a natural language to a fully formalized axiomatic system in a constructed language, which lists all primitive terms and axioms and specifies the most important definitions and theorems. What is important, however, is that a connection is drawn to the primitives, axioms, definitions, and theorems of a general sign theory wherever this is possible.

4. Selected References

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133. Semiotische Aspekte der Mathematik

1. Einleitung und vorgreifende Übersicht

Die Mathematik läßt sich auf verschiedene Weisen semiotisch betrachten. Ein erster Gesichtspunkt ergibt sich aus der Frage: Welches sind die gängigen Meinungen zum mathematischen Abbild-, Wahrheits- und Beweisbegriff und zum Verhältnis von Syntaktik, Semantik und Pragmatik in den Zeichensystemen der Mathematik? Was leistet eine semiotische Reflexion für deren rechtes Verständnis? Ein zweiter und dritter Gesichtspunkt interessiert sich für konkrete Details des mathematischen Zeichengebrauchs, für die pragmatische Bedeutung spezieller Notationen und Darstellungssysteme und für den Gebrauch, den wir von mathematischen Theorien und Begriffen in anderen Wissenschaften machen. Die Semiotik und linguistische Semantik (vgl. Art. 2 und 3) bedienen sich zum Beispiel selbst der mathematischen Begriffe der Struktur und Funktion bei ihrer Beschreibung der Beziehung zwischen Zeichen (Symbol) und Bezeichnetem, bzw. zwischen Satz, Äußerung und deren Bedeutung. Wie weit dies aber gerechtfertigt oder bloß eine mehr oder weniger oberflächliche Metapher ist, sollte eigentlich zuvor durch eine (semiotische) Reflexion auf die mathematischen Begriffe geklärt werden.

Üblicherweise gliedert man die Mathematik nach traditionellen Inhalten (vgl. Art. 123 § 2.2.), zum Beispiel in die Bereiche der (reellen, komplexen und abstrakten) Analysis und der (allgemeinen) Algebra. Der erste (zu seiner historischen Entwicklung vgl. Art. 78 § 3.) umfaßt dann unter anderem Teilbereiche mit Titeln wie: „Differentialgleichungen", „Maß-, Integrations- und Wahrscheinlichkeitstheorie", „Funktionentheorie" (deren Thema die Differenzierbarkeit komplexzahliger Funktionen ist) oder auch „Topologie" und „Funktionalanalysis" (wobei die letzteren schon weitgehend axiomatisch verfaßte Theorien sind; siehe Art. 78 § 4.). Zur Algebra zählen etwa Disziplinen mit den Titeln „Gruppen- und Körpertheorie" sowie „lineare Algebra" oder dann auch die abstrakten Darstellungssysteme der sogenannten Kategorientheorie (vgl. Art. 78 § 2.).

Methodologisch wäre hier anders zu unterscheiden (vgl. Art. 123 § 2.3.), nämlich