XIII. Semiotik und andere interdisziplinäre Wissenschaften
Semiotics and Other Interdisciplinary Approaches

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When one looks at the names of research institutes, at the subjects listed in university syllabi, at the areas studied in academies of sciences, at the specializations taught in schools, one is confronted with a confusing wealth of topics, which seem to have no evident systematic order. Even the simple question of which topic belongs to which discipline and, indeed, which is to be regarded as part of a discipline and which as interdisciplinary seems in many cases to be undecidable (cf. Hagstrom 1965, Rochhausen 1968, Kedrow 1975–76, Weingart 1995, and Nicolescu 2002).

The situation does not improve when one takes a historical point of view. Astronomy, the world's oldest scientific discipline, is today regarded by many as a mere subdiscipline of physics: astrophysics. Physiology, formerly a subdiscipline of medicine, became a discipline of its own in the second half of the 19th century. Dialectics, one of the seven disciplines taught as liberal arts in medieval schools, is today an interdisciplinary field, including issues from logic, theory of argumentation, philosophy of science, and history. Sociology and anthropology, which used to be considered two different mixtures of fragments from history, economics, biology, and philosophy, are now well established as independent disciplines.

Thus, it seems not only appropriate to state, in the words of J. R. Glass (in Apostel et al. 1972: 9): "the interdiscipline of today is the discipline of tomorrow", but also: the discipline of today may tomorrow be seen as a subdiscipline or an interdisciplinary field.

But what is a discipline? Do we have to infer that the decision whether a given set of activities is a discipline or not is totally arbitrary? The following considerations will show how such a conclusion can be avoided without doing an injustice to the historical development and the present state of the arts and sciences.

As a first step in tackling the problem let us distinguish the substantive question, "should certain given sets of activities be re-

garded as disciplines?" from the formal question, "what should the criteria for considering any set of activities a discipline be?" While the answers to the substantive question vary considerably from culture to culture and from epoch to epoch within a culture, the claims of what the necessary and sufficient conditions are for considering a set of activities a discipline have remained relatively stable, at least as far as European history and Western culture go.

Thus there are well established questions which can be posed in order to define an individual discipline and in order to distinguish it from other disciplines as well as from subdisciplines and interdisciplinary activities. To be sure, the concepts used in these questions are not historically invariable either; but if taken as they are commonly understood today, they can also be employed in distinguishing disciplines from subdisciplines and interdisciplinary activities for other historical periods. In what follows, we will formulate and justify the most important of these questions and apply them to the arts and sciences as they present themselves today.

The general aim of the present Article is to introduce a number of epistemological terms, offer definitions for them and use them to clarify the relations between the various academic activities with respect to the role which semiotics can play in them. These clarifications were originally formulated to guide the Handbook authors in their work (cf. Art. 1 § 1., esp. § 1.8.), and they can be helpful for the users of the Handbook as an introduction to the epistemological articles in Chapters XIII and XIV of the Handbook.

1. A check list for the detection of vocational disciplinarity

Two sets of questions must be distinguished in the explication of the term "discipline". One is profession-oriented and the other epistemological (cf. Duguet 1972: 12).

As a basis for either line of questions we introduce the term "*field*", which denotes any set of recurring activities, notwithstanding whether they have a specific goal, lead to specific results, or follow a specific method.

People talk of the fields of

- philately, i. e., the activities involved in the collection and study of postage stamps,
- bell ringing, i. e., the activities of boy scouts in England who go from church to church and ring their bells according to certain patterns,
- aerobics,
- drug abuse,
- city renewal,
- decolonization,
- East-West relations.

Popular fields within the academic sphere are

- environmental protection,
- women's liberation,
- Latin-American studies,
- comparative literature,
- artificial intelligence.

If a set of activities is carried out by a person in order to make his living, it is regarded as *work* (cf. Art. 161).

Complex societies divide the necessary work according to certain principles so that different types of work are carried out by different persons, who are then said to belong to different *professions*.

Each profession requires specific knowledge and skills which can be passed on through observation and imitation or through teaching and learning. If a profession is taught in an institution, it is called a "*discipline*". A discipline in this sense is the set of activities involved in (a) carrying out a profession or (b) teaching and learning the knowledge and skills required by the profession (cf. Apostol 1972, Weingart 1972–74, Whitley 1975, Woolgar 1976, Larson 1977, and Schurz 1992 ff).

In the vocational context it is thus possible to decide the problem of whether a given set of activities should be considered a discipline on the basis of a few questions:

(1) Are these recurring activities? If so, they are a field.
(2) Is the field used to earn one's living? If so, it is work.
(3) Is the work assigned to a specific group of persons? If so, it is a profession.
(4) Is the profession taught in an institution? If so, it is a discipline.

Disciplines defined via professions should not be confused with academic disciplines, which are based on epistemological criteria. Thus one may go to a college and make accounting one's discipline in order to become a bank accountant. However, accounting is not an academic discipline, and what is taught in an accountancy course consists of several areas such as financial accounting,

managerial accounting, and book-keeping, which involve a variety of academic disciplines such as economics, law, information science, and arithmetic. So let us now consider the relevant epistemological criteria for the definition of academic disciplines.

2. A check list for the detection of epistemological disciplinarity

When the performance of an activity has to be justified, one usually points out which goals are to be achieved through it. Thus, a set of activities may be carried out in order to improve one's skills; then it is called "*practice*", as when people practice playing the piano, or flying an airplane, or solving mathematical equations. If someone carries out a set of activities with the goal of obtaining knowledge, then it is called "*study*", as when one tests an instrument, or analyzes a plane crash, or reads about the properties of mathematical equations.

Like other activities, those performed in a study may be unusual and subject to sudden intuitions, as when a boy catches a fly in a glass and watches how it tries to escape; or they may be repeated, recur in other persons and other contexts, and thus reach a certain degree of conventionalization. Applying the above definition, we say that a study which consists of recurrent activities belongs to a *field*. Cases in point are the academic fields mentioned above.

Humans try to obtain knowledge about many things and in many ways, and so each study can be examined with respect to the following questions (cf. Bolzano 1829–31, Dilthey 1883, Jevons 1892, Wundt 1893, 1895, Windelband 1894, Stumpf 1906, Heath 1918–19, Rickert 1921, Becher 1921, Popper 1935, Hanson 1958, Kuhn 1962, 1976, Landau et al. 1962, Jones 1965, Hermes 1968, Suppes 1969, Stegmüller 1969–73, Lakatos and Musgrave 1970, Heckhausen 1972, Bunge 1974–85, Pawlowski 1975, Laudan 1977, Chalmers 1978 and 1982, Oeser 1979, Latour and Woolgar 1979, Knorr-Cetina 1981 and 1991, Krohn and Küpper 1989, Balzer and Moulines 1996, and Balzer 1997).

2.1. Domain

Is the study about a specific *domain of objects*? This question concerns the segment of reality about which one wants to increase one's knowledge. It may be incoherent and heterogeneous, like the ensemble of an astronaut's souvenirs explored by a psychologist, or incoherent and homogeneous like the sediments of a metal found in the earth and studied by geologists; it may be coherent but heterogeneous, like the materials occurring in industrial artifacts such as pianos and airplanes analyzed by a work ecologist, or coherent and homogeneous, like the water in the sea investigated by oceanographers. Further, the study of a domain may be intended to provide results about the domain in its totality or it may cover only part of it. In what follows, any study which covers a fixed domain of objects in its totality is said to be an *exploration* of it; if, in addition, the domain is homogeneous or coherent, the study is called an "*investigation*".

The domains of a field of study are usually specified in terms of everyday language: thus

- physics and chemistry study material objects,
- botany studies plants,
- zoology, anatomy, physiology, psychology, and sociology study animals,
- anthropology studies humans,
- linguistics and literature study verbal texts.

To the extent that these domains are regarded as homogeneous, one may speak of physical, chemical, … linguistic, or literary investigations.

As shown by the examples, many fields of study have overlapping domains: humans are animals of a specific type and therefore occur also in the domain of zoology; texts and animals are material objects and therefore occur also in the domain of physics. For certain fields the domains not only overlap but are identical, as in the cases of physics and chemistry and of linguistics and literature. No study, however, is interested in all properties of the objects in its domain. Depending on the specific goals of the study, a severe selection takes place among them (cf. Weingartner 1969, Frey 1973, Holton 1973, Canguilhem 1979, Lieb 1983: 15 ff, and Posner 1989). Thus, the next criterial question concerns the perspective from which the study is made.

2.2. Perspective

The *perspective* of a study depends on its goals and determines which properties of the objects studied are relevant and which are not. The perspective may be value-oriented

(i. e., determined by particular interests), as when the study of the earth is restricted to prospecting for precious metals, or it may be value-free (i. e., predominantly determined by the quest for knowledge), as when the sediments of all metals are explored. The studies in a field may be performed from many different perspectives, or they may all have one and the same unified perspective. Any study which is an investigation of a homogeneous domain from a unified perspective is called an "*inquiry*". A field of study which has a fixed set of mutually related perspectives is called a "*subject*", and the set of properties of the objects in its domain that are relevant according to its perspectives constitutes its *subject matter*. Therefore, the question of whether a study has a specific perspective can be reformulated: Does the study belong to a field with a specific subject matter?

While the domain studied in a field is generally characterized in terms of everyday language, its perspective and subject matter can often only be specified by the technical terms developed in the field itself. Thus

- physics studies material objects with respect to movement, mass, and energy,
- chemistry studies material objects with respect to their composition and the structure of their molecules,
- botany studies plants with respect to their classification,
- zoology studies animals with respect to their classification,
- anatomy studies animals with respect to their body structure,
- physiology studies animals with respect to their body functions,
- psychology studies animals with respect to their individual behavior and experiences,
- sociology studies animals with respect to their social relations,
- anthropology studies humans with respect to their society, civilization, and culture,
- linguistics studies verbal texts with respect to the language used in them,
- literature studies verbal texts with respect to their aesthetic form and function in the culture in which they occur.

2.3. Method

The properties belonging to the subject matter of a study are not all accessible in the same way. Some of them can be directly observed through the senses, others only indirectly, with the help of special instruments, through which they are transformed into directly accessible properties. Then there are many relevant properties whose occurrence cannot be observed at all, but is assumed or postulated. The properties that are directly or indirectly observed are called the "*data*" of the study; the others are *constructs*. A subject whose subject matter includes observable properties (as, e. g., in physics and chemistry, linguistics and literature) is called an "*empirical* subject". If the subject matter is only composed of constructs (as in logic and arithmetic), we are dealing with a non-empirical subject.

As a subject develops, its specialists devise procedures for making data available, for analyzing and systematizing them, for generating constructs and for examining these constructs by confronting them with data and/or other constructs (cf. Bochenski 1954, Thiel 1967 ff, Essler 1970–79, Bunge 1974–85, Oeser 1979, Canguilhem 1979, Danneberg 1987, Kosso 1989, Krohn and Küpper 1989, Hilpinen 1999, and Pape 1999, as well as Art. 29 of this Handbook). Thus, the next question to be asked is: Does the study have *methods* for the production and analysis of data and/or the generation and examination of constructs?

Many studies are performed with methods that are chosen *ad hoc* and applied without control, which makes them unrepeatable. If, however, a study is an inquiry that can rely on repeatable methods, it is called "*research*".

The various academic fields differ considerably with respect to the methods they use in their research. Thus

- observation is characteristic of astronomy, geology, and botany, of sociology, literature, and the arts, but not so much of mathematics and logic;
- laboratory experiments are characteristic of physics and chemistry, of biology and psychology, but not so much of sociology, literature, or the arts, and not at all of mathematics and logic;
- questionnaires and polls are characteristic of sociology, psychology, and economics, but not so much of literature and the arts, nor of jurisprudence;
- interviews are characteristic of psychology, medicine, and political science, but not so much of geography, physiology, or biology;
- interpretation is characteristic of history, jurisprudence, literature, and the arts, but

not so much of physics, chemistry, or mathematics;
- inductive proofs are characteristic of mathematics and logic, but not so much of zoology, psychology, or sociology.

The methods practiced in a field are often considered to indicate its epistemological status and stage of development (cf. Art. 28).

2.4. Theory

As stated above, a study is a set of activities that are performed with the goal of increasing one's knowledge. If a study is successful, it will have results that need to be incorporated into the previously available knowledge (cf. Diderot 1780 and Dahlberg 1974). Knowledge can be regarded as a set of propositions; a set of propositions held to be valid in a given field is called its "*doctrine*".

A doctrine may contain propositions of various kinds. They may be

- statements claiming to be true, as in the Christian doctrine about the creation of the world,
- instructions advising to do or not to do certain things, as in military doctrines and in legal systems,
- appreciations expressing some attitude, as in doctrines of literary criticism or art appreciation.

If a doctrine does not include instructions and appreciations, but only propositions which are meant to be true, it is called a "*theory*".

Thus, for any given study it is possible to ask: Is the study performed as a contribution to a specific *theory*?

A theory may be structured and used in various ways (cf. Ramsey 1931, Woodger 1939, Heisenberg 1948, Carnap 1956, 1958 b, Hempel 1958, Ajdukiewicz 1960, Nagel 1961, Montague 1962, Przełęcki 1969, Stegmüller 1969–73, Bunge 1974–85, Glymour 1980, Kuipers 1987 and 2000, as well as Art. 30).

The propositions it contains may be *logically independent* from one another, or there may be specific logical relations holding among them.

The theory may be just a list of propositions, or it may be a *logical system* which includes all propositions that follow logically from any of its propositions.

The set of propositions in a theory may be *consistent* in that none of them follows from the negation of another; or it may be inconsistent.

A theory with a consistent set of propositions may contain a subset of logically independent propositions from which all other propositions in the theory follow logically. The elements of this subset are then called the "*axioms*" and the other propositions the "*theorems*" of the theory.

A theory may contain only finitely many propositions (as when it is not a logical system but just a list of propositions), or it may be associated with a system of rules which make available *infinitely* many propositions (as in arithmetic and in linguistics). The prototypical theory is a consistent logical system with infinitely many propositions. As such it can embody complex and comprehensive knowledge.

Not only the theory as a whole, but also each proposition has a structure which determines its use.

Thus, a theory may include general propositions which contain quantifiers, or it may only have unquantified propositions. While theories of the second type can be used for *descriptive* purposes only, theories of the first may serve to make *explanations* and *predictions*.

The propositions of a theory may also be classified into those which refer to observable properties and those which do not. This classification is important because the patterns of occurrence of the observables can serve as indicators of the fruitfulness of theoretical constructs which are then hypothetically assumed and used to describe, explain, or predict further occurrences of these and other observables. Thus, psychological theories construe animals with respect to their behavior as molar systems dealing with a perceived environment. Observed behavior of such animals is taken as an indicator of the fruitfulness of constructs such as drive, motive, adaptation level, or cognitive dissonance. These constructs then serve to describe, explain, or predict further observable behavior of the (type of) animals in question.

Since sets of propositions are of use only when they are consistent, theories have to be changed when they give rise to contradictions. Contradictions may be derived either within a given theory, or from the theory in conjunction with other theories, or from the theory in conjunction with statements about observed properties which do not agree with those made in the theory. In each of these

three cases we can say that the theory in question is falsified (through itself, through another theory which has more credibility, or through the data). Research that aims at a consistent theory is called "*science*".

Few subjects have developed theories that account for all relevant properties in their subject matter. However, each is geared toward the elaboration of such a theory. This goal can be reached on the basis of partial falsification and extension of given theories.

Theories are the output of research, but they are not produced for their own sake. They are to be applied in order to describe, explain, predict, or change the properties of specific objects in their domains, and they can serve as a basis for further research, since they provide analytical tools for the definition of new research goals. In this second function, theories may be employed as *models*, i. e., as sets of propositions which are supposed to be good approximations to the complex subject matter, but not necessarily true. In their role as models, theories are not falsified but judged according to their fruitfulness and practicability (cf. Black 1962, Hesse 1966, Suppes 1969, Sneed 1971, 1976, Stachowiak 1973, Stegmüller 1973, 1979, 1980, Moulines 1976, Chalmers 1978, 1982, Balzer and Moulines 1980, Glymour 1980, Balzer 1982, 1997, Pähler 1987, Kuipers 2000, Saint-Mont 2000, as well as Art. 29).

2.5. Means of presentation

If a study is intended to make a contribution to a given field, its design and its results must be fixed so that they can be controlled and communicated to the other persons working in the field.

This requires formulations about the study's domain and subject matter as well as about the methods applied and the theory involved. Any sign system can be utilized for this purpose as long as it is intersubjectively comprehensible. It may be

- an unmodified natural language, as in history and many literary studies (cf. Rodingen 1984),
- a natural language extended through the introduction of special technical terminology, as in botany and zoology (cf. Schnelle 1974),
- a natural language regimented through the standardization of some of its syntactic forms, as in logic, linguistics, and arithmetic (cf. Quine 1960),
- a constructed language, as in logic and parts of mathematics and physics (cf. Carnap 1958 a).

Many fields, such as chemistry, use a mixture of these devices. The means of presentation need not be confined to verbal sign systems, but may include

- sets of diagrams (as used in geometry, linguistics, and architecture),
- maps (as in geography, archeology, and astronomy),
- matrices of symbols arranged in columns and rows (as in economics, sociology, and political science),
- one-dimensional formulae (as in physics, psychology, and economics),
- two-dimensional formulae (as in chemistry).

Some of these means of presentation are semantically equivalent and may be substituted for each other, such as diagrams and formulae in analytic geometry, or formulae and graphs in infinitesimal calculus, or graphs and matrices in vector analysis. Even these, however, depend on various conditions of use which give them different advantages and disadvantages in different contexts. Other devices, such as geographical maps and formulae, cannot be transformed into each other without loss of essential information and are therefore never substituted for each other, but used to supplement one another (cf. Bertin 1967, Moles 1968).

As these considerations show, it is highly diagnostic for the epistemological status of any study to ask:

Does the study have a specific *means of presentation*?

Even fields that have not agreed on a complex body of knowledge may develop a terminology or a conceptual framework of their own, which are used as generally accepted tools in their studies.

In such cases scholars and scientists tend to identify

- the conceptual tools used within the process of research,
- the conceptual tools used within the competing theories of the field, and
- the conceptual tools used in the communication among those working in the field.

These tools are taken together and regarded as the *theoretical apparatus* of the field. For the sake of clarity, however, it is advisable to

keep the three types of tools apart and to distinguish systematically between

- procedures of research,
- propositions of theories, and
- presentations of theories and research.

In fields which have developed complex methods and theories, it is important to remember that these methods and theories need not be spelled out in detail every time they are applied. Often, a general formulation, a summarizing remark, or a selective reference contribute more to an understanding than a repetition of the standard ways of presentation. So even where a constructed language and a full-grown mathematical formalism is available, scholars and scientists are free to

- characterize the relevant properties of the objects concerned with less rigid statements in a *natural language*,
- survey the most essential properties by means of *tables and matrices*,
- make various qualities, amounts, and relations of the objects synoptically available by means of *graphs*,
- enumerate relevant factors by means of *lists*.

How appropriate the various ways of presentation are depends on the goals of the presentation. Each has specific merits in the process of cognition, and each is suitable for different types of addressees and different communication situations (cf. Bunge 1974–85 I: 99 ff, Bungarten 1981, Lynch and Woolgar 1990, Kretzenbacher 1992 and 1997, Hoffmann, Kalverkämper and Wiegand 1998).

2.6. Forms of communication

The knowledge produced in a field of study must be integrated into the knowledge that was previously available. Since the undisputed unit of knowledge processing is the individual person, this can only be accomplished through communication among the individuals working in the field. The way they communicate with one another is also characteristic of the field. Thus we may ask: Are there specific *forms of communication* used in a given field?

This question has many aspects which can be made clear by formulating further questions:

(1) *How many* persons are working in the field and what is the pattern of information exchange among them?

(2) Do they work alone or do they form *social groupings* characterized by especially intensive communication, such as local discussion circles, special-interest groups, research teams, scholarly traditions, and academic institutions? What are typical forms of internal communication in such groupings?

(3) Are there institutions that organize *global communication* among all individuals and groups working in a field, such as professional organizations, societies, and associations?

(4) Do the individuals and groups of a field convene at regular intervals to exchange *oral information* in lectures, workshops, conferences, congresses, and summer schools?

(5) Are there well defined channels of *written communication*, such as web sites, newsletters, specialized journals, reviews, book series, and reference books in the field?

(6) Is there a *specialization* with respect to communication content among those working in the field so that different persons take over different roles as, e. g., empirical scientists, theoreticians, research administrators, teachers, school administrators, publication managers, funding agents, public-relations experts? How does communication take place among persons with similar or different roles?

(7) What forms of communication occur between participants in a given field and persons in *other fields* of studies? How do they differ in intensity and content from communication occurring within the field?

(8) What forms does communication take between participants in the field and individuals and institutions of the *state and society* in which it is practiced? How do the latter influence the content, form, or size of the studies undertaken in the field? What are their attitudes toward its activities and results? Is work in the field regarded as important or socially useless (helpful or dangerous, reliable or unsound, realistic or beside the point)?

Fields develop, and nothing characterizes better the stage of development reached by a given field than the forms of communication practiced in it (cf. Kuhn 1962, Lakatos 1970, Mullins 1975, Bourdieu 1975, 1977, Whitley

1975, 1978, Lemaine et al. 1976, Woolgar 1976, Young 1977, Laudan 1977, Knorr 1977, Knorr et al. 1981, Knorr-Cetina 1981 and 1991, Bärmark and Wallén 1981, Weingart and Winterhager 1984, Stichweh 1984, Guntau and Laitko 1987, Schwartzman 1989, Krohn and Küpper 1989, Pickering 1992, and Pörksen 1998). During the earlier stages of a field's development, workers at different places often take up closely related problems without being aware of similar work proceeding elsewhere. The lack of communication leads to multiple discovery, anticipation of results, and open competition. Early successes may create scientific reputation, a symbolic capital which can then be used to gain access to such resources as research funds, technology, graduate students, and publication outlets.

Initial results tend to be scattered among various general-purpose journals. As some of those previously working independently on similar problems become aware of their common interests through such publications, they establish informal contacts which then lead to an increasingly complex communication network. As the network grows, research teams and clusters of collaborators form who recruit new entrants to the field and train them from the perspective of an increasingly firm scientific consensus. Both research groups and individual scientists take up specialist lines of inquiry, which are chosen so as to minimize overlap and, consequently, the likelihood of competition. This process ensures that a relatively wide range of issues is explored more or less systematically by the *scientific community* of the field.

At this stage an all-encompassing communication network has become indispensable. It spreads important research information throughout the field, but with significant differences. Those central to the network receive valuable information sooner because they are closer to a greater number of potential innovators. They are thus in a better position to combine discoveries into major developments in the field. The average probability of a given researcher passing on new information determines the rate of progress in the field.

The borderlines of a field tend to be demarcated by its participants in response to major innovations that appear early in its growth sequence. Subsequent work tends to consist primarily in elaborations upon these central contributions. Consequently, a major proportion of what participants see as innovative work is completed before the field has begun to acquire a significant proportion of its eventual membership. This has the consequence that the perceived interest in the field falls sharply after the initial period. Opportunities for making what will appear to be a notable scientific contribution decline. When this becomes evident to participants and, more slowly, to potential entrants to the field, the rate of growth decreases.

To this picture must be added the various kinds of communication with individuals and institutions outside the field. When ideas, skills, or techniques that originated in other fields become known to participants in a given field, they may have consequences for their further course of research. An example was the invention of the steam engine, which stimulated the scientific study of heat and energy in physics and thus even contributed to the later emergence of a new field, that of thermodynamics. When results coming from a given field arouse public interest, political institutions may intervene by creating new research facilities with additional researchers and by shifting points of emphasis. Twentieth century examples of the first kind are oncology and space research, examples of the second occurred in biology, which modified its outlook and developed new research interests such as genetics, ecology, immunology, and ethology in order to satisfy public needs.

In conclusion, we can say that a field's development is influenced through both internal and external communication. Both are necessary in order to relate every given study to other studies of the field and the entire field of study to other fields and to the rest of society.

2.7. History

Intensive communication in a field results in shared notions of its past and future which facilitate further communication. Thus it is relevant to ask:

Does the field have a *history*?
Especially:

- Is there a set of events in its past which can be taken as common points of reference?
- Is there a consensus in the field about its date of inauguration and the early stages of its development?
- Are there classics in the field, whose work is part of the shared background knowledge?

– Does the field have a firmly established definition and a generally accepted name introduced by one of these classics?

The conceptions developed of a field's past may differ from how it really evolved, but they play an important role in its self-understanding.

As Kuhn (1962 and 1976) and Lakatos (1970) pointed out, a field of study tends to be structured with reference to a small set of paradigmatic problem-formulations and problem-solutions from its past, which are the basis of its *research programs* for the future. When one such formulation achieves a monopoly, then a period starts which Kuhn calls "normal science". Examples are the approaches taken to the physics of motion by Aristotle, to mathematical statistics by Archimedes, to chemistry by Boyle and Boerhaave, and to geology by Hutton.

The shared view that a certain problem-solution is paradigmatic encourages those working in related areas to see similarities, draw analogies, and discover valid generalizations which make the field progress. "Scientists solve puzzles by modeling them on previous puzzle-solutions […]. Galileo found that a ball rolling down an incline acquires just enough velocity to return it to the same vertical height on a second incline of any slope, and he learned to see that experimental situation as like the pendulum with a point-mass for a bob. Huyghens then solved the problem of the center of oscillation of a physical pendulum by imagining that the extended body of the latter was composed of Galilean point-pendula, the bonds between which could be instantaneously released at any point in the swing. […] Finally, Daniel Bernoulli discovered how to make the flow of water from an orifice resemble Huyghen's pendulum" (Kuhn 1970: 183 f).

In such a way a tradition is formed which allows the individual scientist to do creative work without having to formulate an entire theory or specify all his methods. Instead, he can build on shared intuitions and tacit knowledge not only in his research but also in his attempts at communicating it.

This situation changes only when new problem-solutions become paradigmatic, fostering new research programs and intuitions. The new situation appears to obliterate the old problem-formulations and criteria of good work. The previous developments are either forgotten or reinterpreted so that they fit in the new conception of scientific progress. Thus the history of a field is written with the double bias of leveling the smaller changes and stylizing the bigger ones into "scientific revolutions".

In conclusion, it may be said that a field is generally regarded as established to the degree that it has created its own paradigms, undergone repeated paradigm change, and survived major changes in the surrounding society and culture without losing its identity (cf. Diederich 1974, Laudan 1977, Rescher 1978, Canguilhem 1979, Bayertz 1981, Hall 1988, Donovan et al. 1988, Thagard 1992, Inhetveen and Kötter 1994, Poser 2001, as well as Art. 34 and Art. 35).

2.8. Identity conditions for scientific disciplines

If we now look back at the questions and concepts introduced and call

– a set of recurring activities a "field",
– those activities performed with the goal of increasing one's knowledge, "studies",
– studies covering a homogeneous domain, "investigations",
– investigations performed from a unified perspective, "inquiries",
– inquiries based on repeatable methods, "research",
– research aiming at consistent theories, "science",
– intersubjective means of presentation and other instruments used in a science, a "theoretical apparatus",
– the set of individuals that communicate with each other in practicing a science, a "scientific community",
– and the conceptions they share about their science, a "scientific paradigm",

we may ask once more: What is a *discipline*?

The first answer was given above in § 1. on the basis of the vocational check list: A discipline in the vocational sense of the word is a set of recurrent activities involved in (a) practicing a profession or (b) teaching and learning the knowledge and skills required by a profession.

The second answer can now be approached on the basis of the criteria in the epistemological check list given in §§ 2.1.– 2.7.

A look into the relevant literature shows that each of the seven criteria has been picked up by some epistemologists and pro-

posed as essential feature in the definition of a discipline.

(a) Ontologically oriented philosophers from Christian Wolff (1726) to Nicolai Hartmann (1935) regarded the world's structure as given and declared each of its segments to be the *domain* of a different discipline. However, as indicated in §§ 2.1. and 2.2., this approach does not differentiate enough and has to be supplemented by recourse to specific *perspectives*, which then give it so much flexibility as to make nearly every field of study a possible discipline.
(b) The epistemological discussions in the idealist philosophy at the turn from the 19th to the 20th century (cf. Dilthey 1883, Windelband 1894, Rickert 1921, and Becher 1921) tended to make the *methods* the decisive criterion. But they could not explain how one and the same discipline can be built on a great variety of methods, some of which would assign it to opposite types of inquiry.
(c) The logical empiricists (Wittgenstein 1922, Carnap 1937 and 1958 a, Woodger 1939, Naess 1953) regarded *theories* and their *presentations* as decisive. But they could not account for the fact that there is hardly any discipline which has a unified theory that can be used to define its boundaries.
(d) Present-day sociological approaches to epistemology (like those of Bourdieu 1975, Knorr 1977, Knorr et al. 1981, Whitley 1975, 1978, Woolgar 1976, Knorr-Cetina 1981 and 1991 and Krohn and Küpper 1989) investigate the problem with respect to existing scientific communities (cf. Hagstrom 1965) and their forms of *communication.* But scientific communities are too complex and intertwined to be usable as bases for the definition of separate disciplines.
(e) Genetic approaches like that of Popper (1935), Kuhn (1962 and 1976), Lakatos (1970) and Laudan (1977) look for the *historical identity* of a discipline as implied by shared acceptance of a paradigm or of a small number of research programs. But they fail to answer the question of whether a field remains a discipline when it ceases to follow part or all of its previous research programs.

It emerges that none of the seven epistemological criteria, if taken alone, is sufficient for the definition of a discipline. We have to combine them. This consideration leads to the following requirement.

R1: A discipline in the epistemological sense is a field of study that has

(1) a fixed domain of objects,
(2) a specific set of perspectives,
(3) a specific set of methods,
(4) a specific body of knowledge, and
(5) specific means of presentation.

The presence of these five components is a necessary condition for a field to be a discipline in the epistemological sense.

But does it also suffice to distinguish one discipline from another and to determine their borderlines? This is not the case. If R1 were the only requirement for a field to be considered a discipline, then the decision of what to include and what to reject as part of its domain, subject matter, methods, body of knowledge, or means of presentation, respectively, would be rather arbitrary. Although there is in fact considerable fluctuation in the handling of this problem, it can be said that each historical discipline is organized around some point of integration which may lie either in its domain or its subject matter, methods, body of knowledge, or modes of presentation. This is why we add the requirement

R2: A discipline in the epistemological sense is characterized at least through

(1) a homogeneous domain, or
(2) a unified perspective, or
(3) a central method, or
(4) a core body of knowledge, or
(5) dominant means of presentation.

The way this works is shown by the following examples:

(1) Astronomy has a homogeneous *domain* (all material objects in the universe), but employs a variety of perspectives (their origin, evolution, composition, distance, and motion), a great many different methods (spectroscopy, photography, light-amplification, radio waves, radar), various theory fragments, and varied modes of presentation.
(2) History has a heterogeneous domain (events, artifacts, institutions, systems of ideas, etc.), but a unified *perspective* (their developments and influence upon each other), a great many different meth-

ods (of dating documents, e. g., through dendrology, pollen analysis, or the C16-method, proving their authenticity through microchemical procedures, and determining their relevance through cause-effect considerations), a number of competing theories about the course of history, and a variety of means of presentation (documentary, descriptive, narrative, etc.).

(3) Anatomy is defined through the *method* of dissecting corpses, which determines its domain (everything thus dissectible), its perspective (the composition of living beings from dissectible parts), its theories about the body structure of living beings, and its means of presentation (morphological sketches, diagrams, photos, natural language descriptions).

(4) In physics, *theories* such as Newton's mechanics and Einstein's relativity theory determine not only the subject matter (moving bodies as against matter in all its forms), but also the methods of research (mechanical laboratory experiments vs. big science), and the means of presentation (infinitesimal calculus vs. statistics, etc.).

(5) In logic, the introduction of a *conceptual script* ("Begriffsschrift") by Frege 1879 led to the re-definition of the subject matter (logical inferences, instead of ways of thinking or methods of research), of the methods (logical analysis of texts, instead of psychological introspection), and of the theories (axiomatic theories of propositional and predicate logic, instead of systems of heuristic maxims).

Taken together, requirements R1 and R2 are necessary and sufficient for a field to be considered a discipline. But they do not include the conditions on domains, perspectives, methods, bodies of knowledge, and means of presentation that are necessary for a field to be considered a science as discussed in §§ 2.1.–2.7. They leave open the possibility that the discipline's knowledge pertains only to a small number of the objects in the domain; that they are selected from a particular group's evaluative perspective; that the methods are clandestine operations which are not generally repeatable; that the body of knowledge contains propositions other than statements, is inconsistent, and unfalsifiable; and that the modes of presentation are part of a secret code which is accessible only to specially selected persons. In order to exclude this, we formulate the further requirement

R3: A discipline in the epistemological sense is a scientific discipline if

(1) its domain is studied in its entirety,
(2) its perspectives are value-free,
(3) its methods are repeatable in principle,
(4) its body of knowledge is intended to be a theory that can be falsified, and
(5) its means of presentation are intersubjectively comprehensible.

Fields of study that violate requirement R1 in that they lack either domain, subject matter, methods, body of knowledge, or modes of presentation do not qualify as disciplines in the epistemological sense for being incomplete. Fields of study that violate requirement R2 in that they are not organized around some point of integration in at least one of the five components do not qualify as disciplines in the epistemological sense for being amorphous, i. e., having arbitrary boundaries. Fields of study that violate requirement R3 in that one of their components lacks the requisite property do not qualify as scientific disciplines.

As a result, we may assemble the three requirements in the following definition:

A field of studies is a *scientific discipline* if and only if it has

(a1) a fixed domain of objects that is studied in its totality, as well as
(a2) a specific set of value-free perspectives,
(a3) a specific set of methods that are repeatedly applicable,
(a4) a theory intended to be falsifiable, and
(a5) means of presentation that are intersubjectively comprehensible,

and if its borders are determined with respect to either

(b1) the homogeneity of its domain, or
(b2) the unity of its perspectives, or
(b3) the central role of one of its methods, or
(b4) a core theory, or
(b5) dominant means of presentation.

This concludes the explication of a discipline in the epistemological sense. In discussing it, one may ask why it is only based on the first five of the seven criteria of the epistemological checklist (§§ 2.1.–2.7.). This is not done to deny that scientific disciplines have specific forms of communication or a specific history of their own. On the contrary, those

aspects follow from the definition as it is and therefore need not be specified explicitly: Having means of presenting messages implies that a discipline includes communication since that is one of the main functions of presentation. Being a field of activities implies that a discipline develops over time, i. e., has a history. However, the communicative and the historical aspects of a discipline are not relevant for the discipline's identity to the same degree as the other aspects.

This claim can be justified on the basis of the fate of many scientific disciplines. Linguistics is one of them. Several times in history, the scientific community of linguists was split in two for political reasons, but this did not lead to two different disciplines. Between 1945 and 1989, for instance, when the iron curtain divided Europe in two, hardly anyone claimed that linguistics practiced by East Europeans and linguistics practiced by West Europeans were separate disciplines. Similarly, when in the 1960's traditional linguists and linguists of the generativist school turned their backs on each other, no one claimed that they were active in two separate disciplines. Even paradigm shifts do not lead to discipline changes as long as they leave the field's domain and perspective untouched (cf. Bayertz 1981). Thus, books on the history of linguistics tend to present the development of linguistics in the 20th century in a sequence of chapters each devoted to a different paradigm, such as "Positivist Linguistics", "Pragmatist Linguistics", "Idealist Linguistics", "Functionalist Linguistics", "Structuralist Linguistics", "Poststructuralist Linguistics", but they do not draw the conclusion that each chapter treats another discipline.

Based on the criteria of domain, perspective, method, theory, and means of presentation, the explication of a discipline allows scientific activities carried out during different historical epochs, in different geographical regions, and with different research programs to be attributed to the same discipline. This is why one can successfully compare ancient, medieval, Humanistic, Enlightenment, Romantic, and modern linguistics with respect to their domains, perspectives, methods, theories, and means of presentation. The same holds for French, German, Polish, Russian, Danish, Italian, English, American, etc. linguistics (where "French linguistics" has to be distinguished from "linguistics of French", and so on), as well as for European, Arabic, Indic, Chinese, etc. linguistics. Research programs also normally compete within the borders of given disciplines and are rarely intended to change the system of academic disciplines as a whole. Therefore there is sufficient ground, for instance, to compare the Aristotelian, Platonic, and Stoic approaches to language in Antiquity and nominalist vs. realist approaches to language in medieval times as linguistic enterprises.

Many languages have conventions for the sequencing of the attributes in noun phrases which can be applied in giving complex characterizations of scientific activities within an academic discipline: In English, when introducing such a characterization in standard situations (excluding prior mentions of the constituent attributes) one speaks, for instance, of "ancient Greek Platonic linguistics" and "medieval British nominalist linguistics", but not of "*Greek ancient Platonic linguistics", or of "*Greek Platonic ancient linguistics", etc. and not of "*British medieval nominalist linguistics" or of "*British nominalist medieval linguistics". It is only after the attributes specifying time, place, and research program that one mentions specifications of the criterial components, as in "twentieth century Prague neo-functionalist formal categorial syntax of Polish" or in "modern French structuralist field morphology of Swahili". It is not claimed that these expressions are often used in their full complexity; what is claimed is that no matter how many attributes are dropped from them, the result will be an acceptable expression if the order of the remaining attributes is preserved: e. g., "Prague formal syntax" or "twentieth-century categorial syntax of Polish", etc. and "structuralist morphology of Swahili" or "French field morphology", etc. Note that the standard sequence of specifications for the criterial components tends to go from means of presentation (as in "formal") via theory (as in "categorial") and method (as in "field" linguistics) to perspective (as in "syntax" and "morphology"), with a genitive noun phrase added to specify the domain (as in "of Polish" and "of Swahili"). This shows that in the verbally articulated conception of a scientific discipline the domain counts as essential, with the perspective, the method, the theory, and the means of presentation following in relevance (for a general analysis of the principles governing the sequencing of attributes in noun phrases cf. Posner 1982: 49–86).

As defined above, every discipline in the epistemological sense essentially is a set of activities with five components. Each discipline, however, is composed of them in different ways. In English, one prefers to say:

(1) a discipline, or rather a person working in it, *studies its domain* (not its perspectives, methods, body of knowledge, or means of presentation);
(2) a discipline *construes its perspectives / subject matter* (not its domain, methods, body of knowledge, or means of presentation);
(3) a discipline *follows its methods* (not its domain, perspectives, body of knowledge, or means of presentation);
(4) a discipline *results in / produces as a result its body of knowledge* (not its domain, perspectives, methods, or means of presentation);
(5) a discipline *employs its means of presentation* (not its domain, perspectives, methods, or body of knowledge).

Thus, a discipline stands in a different relation to each of its components, and it is only when we abstract from these differences that we may call them "components" and say that they are "part" of it.

Nevertheless, it is convenient to admit this *façon de parler*, as long as it does not mislead. For simplicity's sake one can even go one step further and regard each component as a set:

(1) the domain as a set of objects,
(2) the subject matter as the set of relevant properties of these objects,
(3) the methods as a set of rules,
(4) the body of knowledge as a set of propositions,
(5) the presentation as a set of means of presentation.

Of course, the elements of these sets are entirely different entities, and thus no confusion can occur.

3. Academic disciplines, subdisciplines, metadisciplines and interdisciplinary approaches

3.1. Academic disciplines

Let us now revert to the fields listed as disciplines in the research institutes, university syllabi, academies, and schools. Do these so-called academic disciplines fulfill the three requirements for a scientific discipline given above? In many cases, the answer is no. But this does not invalidate our approach; rather it says something about academic life. Wherever research is practiced in connection with professional training, there is a tendency to combine the scientific aspect with the vocational aspect. Psychology may be practiced with an eye to the utilization of its methods and results in the training of school teachers; chemistry may be practiced with an eye to its utilization in food technology; geography may be practiced for the purposes of geodesy; etc. This tendency can lead to unclear compromises, but it can also promote mutual criticism and stimulation.

In many institutions the borderlines of a discipline which differ when conceived from the two different points of view are forced to coincide through the addition of complementary subject matter (as in oceanography, which studies all animals living in the sea, not just those in the domain of ichthyology), through the admission of additional methods (as in geography, which includes not only the procedures of geology but also practices landscape appreciation), and through the introduction of certain means of presentation (as in literary studies for school teachers, which describe verbal texts not only with the usual technical terms of literature but add political surveys, paraphrases, summaries, schematic tables, and lists for pedagogical purposes).

As a rule, academic disciplines which correspond to well-established vocational fields are more eclectic from an epistemological point of view than those which are not utilized by any one special profession. Medicine is a case in point (cf. Schaefer 1975): Its subject matter is organisms, studied with respect to illnesses and possible cures. However, the term "illness" is not applied univocally and so there can never be a consistent theory of illness. But instead of sacrificing part of the domain or perspective, one sticks to them and pays with an accumulation of varied perspectives, heterogeneous methods, and incoherent theory fragments. Nevertheless, medicine continues to be regarded as a single discipline because there is a medical profession. Seen only from an epistemological point of view, this would appear as paradoxical: psychotherapy and brain-surgery, which are both part of medicine, have less in common with each other than sociology, psychology,

and biology, which are generally recognized as different disciplines.

The assimilation of vocational and epistemological disciplines within academic practice need not lead to epistemologically hybrid superdisciplines; it may also have the opposite effect. This occurs in fields which have reached a broad theoretical integration while being applied in a host of more narrowly defined professions. A case in point is physics, which continues to be taught as mechanics, optics, acoustics, etc., just because society needs mechanical, optical, and acoustical engineering as separate professions. The same holds within philology for Germanic philology, Romance philology, Slavic philology, etc., which are taught to future teachers of German, French, and Russian language and literature, respectively. From a purely epistemological point of view, it would be more adequate to call them subdisciplines of philology than to list them as separate disciplines.

3.2. Subdisciplines

It was pointed out in § 2.8. that each component of a discipline in the epistemological sense can be regarded as a set of elements of a certain type. If two disciplines D1 and D2 are identical with the exception that one component of D1 is a subset of the corresponding component of D2, then D1 is a *subdiscipline* of D2.

Subdisciplines are not epistemologically deficient; on the contrary, they fulfill requirements R1 and R2 just as well as their source disciplines. Distinguishing subdisciplines within a given discipline may serve to structure the discipline with respect to developments taking place in its components and to single out fields for special purposes.

By definition, there are five possibilities for generating a subdiscipline from a given discipline. For the discipline of linguistics they can be exemplified as follows.

(1) With respect to the domain, *linguistics of French* is a subdiscipline of linguistics since the objects in its domain are French texts and the set of French texts is a subset of the set of all verbal texts, which constitutes the domain of linguistics. This is the only systematic difference: linguistics of French has the same perspectives, methods, and means of presentation as linguistics in general and contributes to linguistic theory.

(2) With respect to perspectives or subject matter, *phonology, morphology*, and *syntax* are subdisciplines of linguistics. They all study the same domain (verbal texts), but have different perspectives, which are specializations of the perspectives of linguistics. While linguistics studies verbal texts with respect to the language used, phonology studies them with respect to the system of sounds of that language, morphology with respect to the system of minimal signs and their combinations into word forms, and syntax with respect to the system of rules for the formation of sentences (i. e., minimal texts). Thus, the phonological (morphological, syntactic) properties of verbal texts, which constitute the subject matter of phonology (or morphology, or syntax, respectively), are a subset of their linguistic properties, which constitute the subject matter of linguistics. Phonology, morphology, and syntax all follow the methods and employ the means of presentation of linguistics, and contribute to one and the same integrated linguistic theory.

(3) With respect to methods, *field linguistics* is a subdiscipline of linguistics. Its methods are a subset of the methods of linguistics, since field linguistics does not rely, e. g., on laboratory experiments, but on observation of daily language use to gain its data and to prepare them for further analysis. In principle, field linguistics can apply its methods to the same domain and subject matter, contribute to the same theory, and employ the same means of presentation as linguistics in general.

(4) With respect to the body of knowledge, *categorial grammar* is a subdiscipline of linguistics, since it systematizes a set of propositions concerning the structure of verbal texts, which is regarded by all linguists as a necessary subset of the set of propositions belonging to a linguistic theory. As a partial systematization of linguistic knowledge, categorial grammar competes with phrase structure grammar and with dependency grammar, but each of these theory fragments deals with morphological as well as syntactic subject matter, and can be combined with various linguistic methods and means of presentation.

(5) With respect to the means of presentation, *formal linguistics* is a subdiscipline of linguistics, since it describes verbal

texts by means of formalized languages, which are a subset of the means of presentation used in linguistics. Formal linguistics has not only the same domain and subject matter as linguistics, but also relies on linguistic methods and formulates linguistic theory.

A more formal treatment of the subdiscipline relation can be found in Lieb 1971, 1976, and 1979. Illustrations of the subdiscipline relation are provided by Tables 123.1 and 123.2, which list the components of physics and of linguistics, respectively, and give component-based examples of subdisciplines for each.

Table 123.1: Some subdisciplines of physics

according to domain	according to subject matter	according to methods	according to theories	according to means of presentation
geophysics	micro-physics	vacuum physics	basic theories	formal physics
atmospheric physics	meso-physics	reactor physics	vector and tensor mathematics	diagrammatic physics
solar physics	macro-physics	thin-layer physics	differential math.	3-d-model-based physics
astrophysics	gas kinetics	high-energy physics	integral math.	with still models
galactical physics	acoustics	high-frequency physics	differential geometry	with moving models
interstellar-matter physics	⋮	short-time physics	numeral math.	with acoustic models
⋮	fluid physics	⋮	⋮	with haptic models
	solid-state physics		complex theories	⋮
	mechanics		thermodynamics	verbal physics
	⋮		fluid mechanics	⋮
	radiation physics		Newton's mechanics	
	optics		field theory	
	⋮		elasticity theory	
	plasma physics		electrodynamics	
	⋮		physical kinetics	
			relativity theory	
			quantum mech.	
			⋮	

Table 123.2: Some subdisciplines of linguistics

according to domain	according to subject matter	according to methods	according to theories	according to means of presentation
linguistics of	syntactics	field linguistics	phrase structure grammar	formal linguistics
	phonology			
Indo-European texts	graphematics	laboratory linguistics	dependency grammar	diagrammatic linguistics
Romance texts	grammar			
Latin texts	morphology	corpus linguistics	categorial grammar	map-based linguistics
French texts	syntax			
⋮	textsyntactics	constructive linguistics	case grammar	verbal linguistics
Rumanian texts		⋮	⋮	⋮
⋮	semantics			
Germanic texts	morphosemantics			
German texts	sentencesemantics			
⋮	textsemantics			
Slavic texts				
Bulgarian texts	pragmatics			
Russian texts	phonopragmatics			
⋮	morphopragmatics			
Caucasian texts	sentencepragmatics			
⋮	textpragmatics			
Semitic texts				
⋮				
Uralic texts				
⋮				

It often occurs that a discipline D1 is a subdiscipline of a discipline D2, which is itself a subdiscipline of a discipline D3. In this case, D1 is also a subdiscipline of D3; i. e., the subdiscipline relation is *transitive*. An example from biology is ornithology, which is a subdiscipline of zoology, while zoology is a subdiscipline of biology, making ornithology also a subdiscipline of biology. In this example the component with respect to which the subdiscipline relation is defined is the same for D1 and D2: it is the domain of ornithology (birds), which is a subset of the domain of zoology (animals), and it is the domain of zoology which is a subset of the domain of biology (organisms).

The transitivity and the set-theoretical basis of the subdiscipline relation gives its application great flexibility. This can again be shown for linguistics. Linguists regard linguistics of French as a domain-based subdiscipline of linguistics of Romance languages/texts, which is a domain-based subdiscipline of linguistics (cf. Table 123.2). For special purposes, however, there are further domain-based subdisciplines conceivable and, in fact, constructed, such as linguistics of Western Romance languages/texts and linguistics of Indo-European languages/texts. Thus, one arrives at a hierarchy of linguistic subdisciplines which comprises

(1) linguistics of French (compared with Spanish),
(2) linguistics of Western Romance languages (compared with Eastern Romance languages),
(3) linguistics of Romance languages (compared with Germanic languages),
(4) linguistics of Indo-European languages (compared with Caucasian, Dravidian, Semitic, etc. languages),
(5) linguistics proper.

The subdiscipline relation thus permits the construction of hierarchies of subdisciplines all based on subsets of the same component.

In addition to hierarchies of subdisciplines which are all based on set-theoretical relations within the same component of a discipline, one can also construct hierarchies of subdisciplines based on set theoretical relations occurring within changing components. Thus, linguistics of French is a subdiscipline of linguistics with respect to the domain, and morphology is a subdiscipline of linguistics with respect to the subject matter (i. e., perspectives; cf. Table 123.2). Morphology of French is then a subdiscipline of linguistics of French with respect to the subject matter and a subdiscipline of morphology with respect to the domain, i. e., morphology of French is a subdiscipline of linguistics which is both subject-matter-based and domain-based. This three-level mixed system of subdisciplines can be presented by graphs such as the one in Fig. 123.1, where the nodes are labeled with the names of disciplines and the edges with those of relevant components.

As Fig. 123.1 shows, there are two ways to derive morphology of French as a subdiscipline of linguistics. One applies subject-matter-based specialization to (the domain-based linguistic subdiscipline) linguistics of French, the other applies domain-based specialization to (the subject-matter-based linguistic subdiscipline) morphology. Both options are admissible, and the result is the

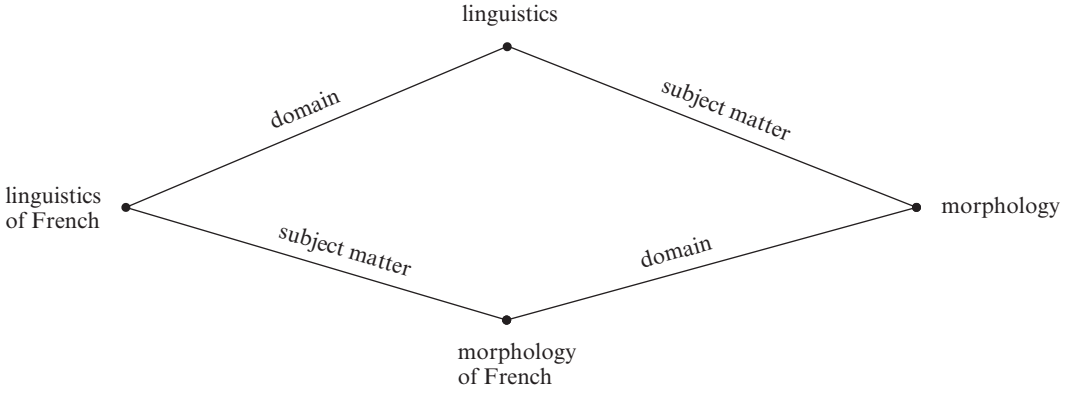


Fig. 123.1: A three-level mixed system of linguistic subdisciplines.

same, i. e., the subdiscipline relation is *associative*.

This leads to an increasing number of options for the generation of subdisciplines as specialization grows. Thus, for a subdiscipline which is at the same time domain-based, subject-matter-based, method-based, theory-based, and presentation-based, one arrives at a six-level mixed system of subdisciplines with ten possible ways of derivation, three of which are shown in Fig. 123.2.

As a rule, subdisciplines based on different components of the same discipline can be freely combined to form a new subdiscipline with a higher degree of specialization. However, this is not true with respect to subdisciplines based on the same component: Taking the domain-based subdisciplines of linguistics listed in Table 123.2 as examples, a term such as "linguistics of Romance Indo-European texts" would be redundant and "linguistics of Romance Semitic texts" contradictory.

Subdisciplines are produced not only by specialization within a component of a discipline, but can also arise when a particular component is given a dominant role with respect to the others. In this case, no subset is constructed, but the weight which the components have in a discipline is differentiated. This happens in response to the need for a division of labor, so that some linguists concentrate on empirical research, others on theory formation, and still others on writing text books. Understood in this sense, *theoretical linguistics* is that subdiscipline of linguistics which emphasizes its theoretical component while presupposing the others. Its primary objective is the elaboration of theories about verbal texts with respect to their languages, and it gives less attention to the methods which provide the knowledge that is being systematized by means of these theories.

Another example is *descriptive linguistics*, which emphasizes the subject matter of linguistics, presupposing the other components. In it the focus lies on describing linguistic properties of objects in the domain of linguists and not on elaborating explanatory theories.

A more complicated case is *comparative linguistics*. Historically, it was introduced as a method-based specialization of linguistics of Indo-European languages, which is a domain-based subdiscipline of linguistics. Today, however, it is often taken to be a method-based subdiscipline of linguistics proper, which compares not only Indo-European languages with each other but also the Indo-European language family as a whole with other language families such as the Caucasian, Dravidian, and Semitic one.

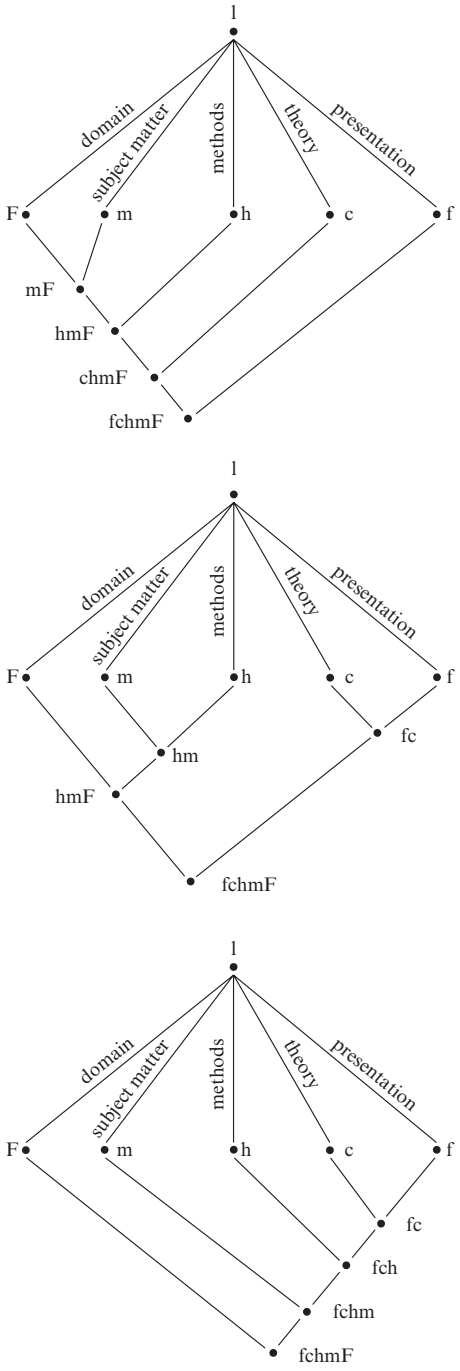
The generation of subdisciplines by specialization and by emphasis can also be combined within one and the same subdiscipline. One such mixed case is *empirical linguistics*, which is a linguistic subdiscipline by emphasis, focusing on methods as against domain and theory, but also a linguistic subdiscipline by specialization, choosing empirical methods and abstracting from nonempirical (i. e., constructive) ones.

In contrast to all these subdisciplines, *general linguistics* elaborates results which are generally valid for the languages of all texts, without particular emphasis on special subsets of the domain, or the perspectives, or the methods, or the theory, or the means of presentation.

Everything said with respect to examples from linguistics in this section was meant to be generalizable for all disciplines in the epistemological sense. It is valid not only for the humanities but also for the natural and social sciences.

3.3. Auxiliary disciplines and applied disciplines

A controversial case in the spectrum of specializations in a given academic discipline is what is generally called an "applied discipline". While some epistemologists regard it as a type of subdiscipline, others do not construe it on that level, arguing that the activities within an applied discipline include more than just subsets of the component-specific sets of activities which constitute a discipline. This can again be elucidated with reference to linguistics (cf. Abraham 1970, Wunderlich 1976, Spillner 1977, Kühlwein and Raasch 1980). Applied linguistics investigates the linguistic properties of texts in the context of nonlinguistic activities. When a person involved in a political dispute describes linguistic properties of texts used in this dispute, when a literary critic describes linguistic properties of texts used as poems, when a scientist working in a certain discipline describes linguistic properties of scientific texts used by his colleagues, then they may offer their linguistic descriptions as instruments to achieve a certain nonlinguistic goal such as influencing that political dispute, judging the



„l“	:	linguistics	„hm“	:	historical morphology
„f“	:	formal	„fc“	:	formal categorial (linguistics)
„c“	:	categorial	„fch“	:	formal categorial historical (linguistics)
„h“	:	historical	„fchm“	:	formal categorial historical morphology
„m“	:	morphology	„fchmF“	:	formal categorial historical morphology of French
„F“	:	of French			

Fig. 123.2: A six-level mixed system of linguistic subdisciplines.

aesthetic quality of that poem, or clarifying the ideas of other scientists. While describing the linguistic properties of a text is a linguistic activity, influencing a political dispute, judging the aesthetic quality of a poem, and clarifying other persons' ideas are not. They are motivated by particular interests from outside linguistics and are therefore not performed from a value-free perspective in the sense of § 2.2. In conclusion, applied linguistics is a field of activities which is broader than linguistics. As such, it can neither be regarded as a subdiscipline of linguistics nor, indeed, as a scientific discipline.

This is not to say that applications of scientific disciplines are epistemologically irrelevant. On the contrary, all scientific disciplines are developed with the intention of being applied, i. e., of being useful for nondisciplinary activities. This is their *raison d'être*. However, for a discipline to provide results that can generally be used as reliable instruments for nondisciplinary purposes, it must concentrate on research conducted from a value-free perspective. This does, of course, not free researchers from observing general ethical norms. In this view, activities belonging to a given scientific discipline must be distinguishable from other activities supported by them. These other activities can themselves belong either to a nonscientific field of activities or to another scientific discipline.

As a result of this discussion, the concept of an applied discipline can be explicated as follows: A field of activities F which is partially or totally used to help achieve the purposes of a field of activities G is called an "*auxiliary field of G*". If F is a discipline in the epistemological sense, then F is called an "auxiliary discipline of G", and F and G taken together are designated as "*applied F*". This makes it clear that if F is a discipline, applied F cannot be a subdiscipline of F nor of G.

What is interesting in our context is the situation when G is a discipline in the epistemological sense. In linguistics, for example, geography is used to help structure its domain, as manifested in maps called "language and dialect atlases"; systems theory is used to help organize its subject matter into phonemes/graphemes, morphemes, lexemes, etc.; philology is used to help secure and select the written texts to be analyzed with corpus-linguistic methods; algebra is used in the formation of linguistic theories; and graph theory is used to help design phrase-structure trees as linguistic means of presentation. Geography, systems theory, philology, algebra, and graph theory are all auxiliary fields of linguistics. Those of them which are disciplines, namely geography and philology, may be called "*auxiliary disciplines*" of linguistics.

Geography is one of the domain-related auxiliary disciplines of linguistics and studying the domain of linguistics may therefore be regarded as part of applied geography. Systems theory is one of the subject-matter-related auxiliary fields of linguistics and organizing the subject-matter of linguistics may therefore be regarded as part of applied systems theory. Philology is one of the method-related auxiliary disciplines of linguistics and following some of the methods of linguistics may therefore be regarded as part of applied philology. Algebra is one of the theory-related auxiliary fields of linguistics and elaborating certain linguistic theories may therefore be regarded as part of applied algebra. Graph theory is one of the presentation-related auxiliary fields of linguistics and employing certain means of presentation of linguistics may therefore be regarded as part of applied graph theory.

A nonlinguistic example is botany. History and archeology rely on it as a method-related auxiliary discipline when applying the procedures of dendrology and pollen analysis in the dating of cultural artifacts. Following some of the methods of history and archeology may therefore be regarded as part of applied botany.

3.4. Metadisciplines

As shown above in § 2.8., a discipline in the epistemological sense is a set of activities with a domain which is studied, a perspective which is constructed, methods which are followed, a theory which is elaborated, and means of presentation which are employed. But what if someone studies not the domain but another component of that discipline, i. e., its perspectives, methods, theories or means of presentation? Then this set of activities is called a "*metastudy*" with respect to (studies performed in) that discipline. If it is recurrent, it is a *metafield*, and if it also possesses the five components required by R1 and R2, it is a *metadiscipline*.

Examples of a metadiscipline are methodology, which investigates the methods followed by studies within a given discipline, the logic of science, which investigates the structure of the theories elaborated by studies within a given discipline, and the didactics of

science which investigates the efficacy of the means of presentation employed by studies within a given discipline.

A discipline which studies not only one but all components of scientific disciplines is called "*metascience*" (cf. Price 1964, Radnitzky 1968, Dobrow 1970, Laitko 1979, Pearce and Rantala 1983, and Suppes 1993). "Science" is an ambiguous term; in the broad sense, it is used to designate all disciplines which are scientific in the sense of requirement R3 (see § 2.8.); in the narrow sense, it is used to designate only the natural sciences. Metascience in the narrow sense thus is a domain-based subdiscipline of metascience in the broad sense. In what follows, "metascience" will be understood in the broad sense (cf. Art. 1 § 1.4.).

The individual scientific disciplines belonging to the domain of metascience are called its "object-sciences". Besides the metascience of the natural sciences the metascience of the social sciences (including biology and medicine) and the metascience of the humanities are domain-based subdisciplines of metascience.

The components of scientific disciplines form the subject matter of metascience; i. e., they can be regarded as relevant complex properties of the disciplines viewed from the perspective of metascience. Therefore, methodology, the logic of science, and the didactics of science are subject-matter-based subdisciplines of metascience. To do their work, methodology, the logic of science, and the didactics of science use specific subsets of the methods of metascience. Therefore, they can also be classified as method-based subdisciplines of metascience.

Not only the term "science" but also the "meta"-relation is used in two different ways. Taken in the strong sense, it has a peculiar reflexive quality: A study can be a study of entities of any type, a metastudy must be a study about studies, a text can be about anything, a metatext must be a text about texts (cf. Art. 80 § 4.2.), an interpretation can be about any type of sign, a metainterpretation must be an interpretation about another interpretation (cf. Art. 110 § 3.1.); the same is true of metalanguage (cf. Rey-Debove 1978 as well as Art. 3 § 2.1. and Art. 106 § 3.3.) and of metacommunication (cf. Art. 85 § 5.). In this sense, a term such as "metalinguistic study" would have to be understood as designating a linguistic study about linguistics (i. e., about linguistic studies), and not, for example, a sociological study about linguistics or a linguistic study about, e. g., sociology. But being scientific as well as about science (in the broad sense), all of these studies can be called "*metascientific studies*".

However, in the philosophy of science the "meta"-relation is often understood in a weaker sense: "metaphysics" may be about physics, but is certainly not physics itself; metamathematics is about mathematics, but need not itself elaborate a mathematical theory; metapsychology is about psychology, but need not itself use psychological methods. This is why one can distinguish linguistic metapsychology (studying psychological studies from a linguistic perspective and with linguistic methods) from sociological metapsychology (studying psychological studies from a sociological perspective and with sociological methods), etc. and psychological metalinguistics (studying linguistic studies from a psychological perspective and with psychological methods) from sociological metalinguistics (studying linguistic studies from a sociological perspective and with sociological methods).

When semioticians speak of "*metasigns*", they understand the "meta"-relation in the strong sense: Metasigns are signs about signs. This makes it possible to construct a subject-matter-based hierarchy of scientific disciplines. Physics and chemistry have objects in their domains which are not signs, and they study them from a perspective different from that of their functioning in sign processes (semioses). All natural sciences can be characterized in this way. Therefore, the domain-related languages of physics and chemistry consist of what Charles Morris (1938: 15) calls "*thing-sentences*": they do not contain metasigns since their designata do not contain signs. Of course, all physicists and chemists speak about signs when they introduce their technical terminology, and they may even speak about signs of signs, i. e., metasigns, when they discuss the best ways of introducing that terminology. This is something all academic disciplines must allow for.

Biology, the social sciences, and the humanities all have objects in their domain which are signs or at least are involved in sign processes, and they approach them from the perspective of their functioning in sign processes (semioses). This is why their domain-related languages contain metasigns. The signs studied by biologists occur in the metabolism of unicellular beings (microsemio-

sis), the processes connecting the organs within an organism (endosemiosis), the parasitic processes in which fungi involve their host organisms (mycosemiosis), the stimulus-response patterns in the life of plants (phytosemiosis), and the interactions of animals (zoosemiosis). However , since all these signs are nonliniguistic, the domain-related language of biology cannot be said to be a metalanguage in the strong sense, but a metacode. This also applies to the other social sciences insofar as they study bodily human interaction, and to the humanities insofar as they study nonlinguistic signs such as painting, music, or architecture. Only linguistics, literary studies, and the other humanities which study verbal texts, such as history, political science, and theology, can be said to have domain-related languages which are metalanguages in the strong sense.

Can subdisciplines of metascience (metascientific disciplines) be regarded as auxiliary disciplines and as constituents of applied disciplines? The answer depends on whether the metascientific discipline in question is of use for the work done in at least one component of its object-discipline. Ideally, this should always be the case: Since metascientific disciplines make the perspectives, methods, theories, and means of presentation of a discipline the object of their study, their results should be of help in improving the discipline's perspectives, methods, theories, and means of presentation. And this also holds for metascientific disciplines involved in studying the noncriterial components of a discipline, i. e., the communication taking place within the scientific community of that discipline and the historical paradigms of that discipline. Relying on the definition of an applied discipline given in § 3.3., one can conclude that every scientific discipline should be part of applied metascience.

The question of whether a metadiscipline can be regarded as a subdiscipline of the discipline it studies (its object-discipline) is more difficult to answer. It is clear that methodology, the logic of science, and the didactics of science are not subdisciplines of the disciplines they study since they have components which are neither identical with nor subsets of the components of their object-disciplines, and insofar as they study components of their object-disciplines they are not related to them in the same way as the object-disciplines. But the case can be different with metamathematics (cf. Art. 66 § 5.) and with metalogic (cf. Art. 76 § 4.1.3.).

Metamathematics can be regarded as a subdiscipline of mathematics insofar as it conceives of mathematics as a mathematical object and construes a mathematical perspective on it, follows mathematical methods, elaborates mathematical theories, and employs mathematical means of presentation in studying it. Metamathematics, then, is a domain-based subdiscipline of mathematics, since the domain of mathematics contains mathematical objects of many kinds while the domain of metamathematics only contains mathematics itself (transformed into a mathematical object). Similarly, metalogic can only be regarded as a subdiscipline of logic insofar as it turns the syntactics and semantics of logical expressions into complexes of logical expressions, construes a logical perspective on it, follows logical methods, elaborates logical theories, and employs logical means of presentation in studying them. Having done so in the 20th century, metamathematics and metalogic have had strong impacts on the further development of their object-disciplines.

3.5. Multidisciplinarity

As pointed out in §§ 2.1. and 2.2., a discipline in the epistemological sense may overlap with other disciplines in one or more of its components. When this is the case, one speaks of multidisciplinarity (cf. *Multidisciplinary Research* 1973–79). More precisely, a set of entities which belongs to a component of one discipline is called "*multidisciplinary*" if it also belongs to the corresponding component of one or more other disciplines and these disciplines are not subdisciplines of each other. This applies to the domain as well as to the perspectives, methods, theories, and means of presentation of a discipline.

When several disciplines share a domain fully or in part while their perspectives, methods, theories, and means of presentation differ, that domain is called a "*multidisciplinary domain*". Thus, the set of material objects is a multidisciplinary domain, since it is studied by physics with respect to their movement, mass, and energy and by chemistry with respect to their composition and the structure of their molecules. And the set of verbal texts is a multidisciplinary domain since it is studied by linguists with respect to the language used in them, and by students of litera-

ture with respect to their aesthetic form and function in the culture in which they occur.

When several disciplines share a perspective while their domain, methods, theories, and means of presentation differ, that perspective is called a "*multidisciplinary perspective*". Thus, the perspective of development is a multidisciplinary perspective since it is applicable to organisms as well as to institutions, artifacts, and mentifacts (cf. Posner 1989) and thus occurs in biology as well as in sociology, the arts disciplines, and linguistics, which not only have different domains but also different methods, theories, and means of presentation.

When several disciplines share a method while their domains, perspectives, theories, and means of presentation differ, that method is called a "*multidisciplinary method*". Thus, statistics is a multidisciplinary method since it is used in quantum physics as well as in economics, psychology, sociology, and linguistics, and these disciplines have different domains, perspectives, theories, and means of presentation.

When several disciplines share a theory while their domains, perspectives, methods, and means of presentation differ, that theory is called a "*multidisciplinary theory*". Thus, propositional logic is a multidisciplinary theory since it occurs in the theories of all disciplines.

When several disciplines share a means of presentation while their domains, perspectives, methods, and theories differ, that means of presentation is called a "*multidisciplinary means of presentation*". Thus, flow diagrams are a multidisciplinary means of presentation since they are employed as presentation devices in chemistry and geology as well as in sociology and economics.

Since it occurs in several disciplines, a multidisciplinary set of elements within a discipline component is easily identified. Regarded together with the other components of a discipline, it is often mistaken for a subdiscipline. Thus, economists speak of statistics as a subdiscipline of economics, sociologists speak of it as a subdiscipline of sociology, linguists as a subdiscipline of linguistics. However, statistics can be taught independently of the other components of economics, sociology, and linguistics. Only when statistics is applied to the domain of, e. g., economics and used as a method to study that domain from the perspective of economics with economic results and means of presentation is it justified to see it as part of a subdiscipline of economics: statistical economics. And the same holds true of statistical sociology and statistical linguistics, which are method-based subdisciplines of sociology and linguistics, respectively.

Regarded separately, statistics can be used as a means of bringing together all those disciplines which use it as a method. This is what justifies calling statistics a "*multidisciplinary field*".

Multidisciplinary fields differ from disciplines in that they lack one or more of the five components which are required to form a discipline. Thus, information theory is a multidisciplinary field which has a specific perspective, method, and theory but lacks a domain fixed independently of its research perspective, since it is applied to anything which can be regarded as carrying information (cf. Art. 125). The same is true of systems theory (cf. Art. 126), synergetics (cf. Art. 127), gestalt theory (cf. Art. 129), and catastrophe theory (cf. Art. 129 § 6.).

Examples of multidisciplinary fields lacking a specific perspective are the so-called regional studies, such as Latin-American studies, Southeast-Asian studies, or French studies, which are identified via their (geographic) domain, but allow it to be treated from any scientific perspective as well as following any method and employing any means of presentation suitable for that perspective. Regional studies therefore group together the geography, biology, and history of the region, the psychology, sociology, and political science of the region's population, as well as the study of its literature, art, music, architecture, film, etc.

An example of a multidisciplinary field lacking a specific method is scientific futurology (cf. Art. 160), which makes predictions about possible changes in the contemporary world and is defined via this perspective. The predictions, however, concern the domains of a wide spectrum of scientific disciplines and must therefore follow their methods. In this way, scientific futurology groups together astronomy, geology, biology, and sociology as well as political science and the study of literature, art, music, architecture, film, etc.

A multidisciplinary field lacking specific means of presentation is psychoanalysis (cf. Art. 130), which studies persons with respect to their mental health, utilizes a special type of conversation as a method, and develops theoretical terms such as "unconscious", "su-

per-ego", and "Oedipus complex", but makes use of any means of presentation, including those developed by poets. This makes psychoanalytical studies appear as medicine, psychology, sociology, or even literary studies or philosophy, depending on which means of presentation they employ.

3.6. Interdisciplinarity and transdisciplinarity

Many publications, including this Handbook, treat multidisciplinary fields as interdisciplinary approaches (cf. the other articles of Chapter XIII). However, to do so is to use the term "interdisciplinarity" in a rather weak sense (cf. Weinrich 1974, Kocka 1987, Parthey 1988, Mittelstraß 1989, Klein 1990, Reinalter 1990, Schurz 1992 ff, and Klein 1996; for a bibliography of interdisciplinarity see Brandl 1996). Multidisciplinary fields are interdisciplinary by grouping a set of disciplines together which share part of a component. If one takes any of these disciplines as a basis, one reaches the multidisciplinary field in question by abstracting from everything that is not shared by the other disciplines of the group. Therefore, one can call this "*interdisciplinarity by abstraction*".

A stronger type of interdisciplinarity can be designated as "*interdisciplinarity by extension*". This is what happens when one or more components of a given discipline are extended by addition of parts of the corresponding components of one or more other disciplines.

Examples include the psychology of language and the sociology of language: The prototypical discipline dealing with languages is linguistics. It studies verbal texts with respect to the phonological, graphematic, morphological, syntactic, semantic, and pragmatic properties of their language, uses field work, laboratory experiments, and corpus analysis as its central methods, elaborates theories of languages as systems of conventions, and employs formal, diagrammatical, and map-based means of presentation in addition to verbal ones (see above Table 123.2). To do justice to this subject matter, the psychology of language must include all these components and add a psychological perspective which then also entails the addition of psychological methods, theory fragments, and means of presentation. Therefore, the psychology of language studies verbal texts with respect to their language, but it does so by investigating the behavior and experiences of their producers and users. It takes special results about language use such as speech deficiencies, language acquisition and language loss as an additional basis for conclusions about the structure and function of languages. In order to achieve such results, it must follow psychological methods, formulate psychological theory fragments, and employ psychological means of presentation. This practice can be described by saying that the psychology of language is an interdisciplinary approach to language which has the same domain as linguistics but extends the subject matter, methods, theories, and means of presentation of linguistics by adding psychological elements.

The situation is analogous in the sociology of language, which also studies verbal texts with respect to their language, but does so by investigating the structure and dynamics of the language communities using such texts. Thus, the sociology of language takes results about the social stratification of language communities as well as language maintenance and language split within these communities as an additional basis for conclusions about the structure and function of their languages. In order to achieve such results, it must follow sociological methods, formulate sociological theory fragments, and employ sociological means of presentation. This practice can be described by saying that the sociology of language is an interdisciplinary approach which has the same domain as linguistics but extends the subject matter, methods, theories, and means of presentation of linguistics by adding sociological elements.

The situation in the psychology and sociology of language is parallel to that in the psychology and sociology of literature, art, music, theater, religion, etc. Psychology of literature, for example, studies verbal texts from the perspective of literary studies, but does so by investigating the behavior and experiences of persons writing and reading, uttering and listening to such texts. Thus, the psychology of literature uses not only literary analysis to study the aesthetic form and function of verbal texts but also applies psychological techniques of observation and interview, psychological theory fragments, and psychological means of presentation. Examples are provided by the work done in aesthetics of literary reception by Riffaterre, Jauss, and Iser in the 1970s and 1980s (cf. Posner 1982: 128–160).

When an interdisciplinary approach by extension is practiced long enough, the contri-

butions to it provided by its source disciplines tend to become more and more integrated, so that one can no longer easily distinguish between them. A process such as this took place in the transition from the psychology of language to psycholinguistics in the 1960s and 1970s (for a similar process in musicology cf. Art. 152 § 5.2.1.4.). This became obvious in the way psycholinguists re-defined the domain and perspective of the work done by psychologists of language. Instead of studying verbal texts with respect to their language and asking which conclusions can be drawn from language behavior to the structure and function of a language system, they made language behavior their central object and studied it with respect to the implicit knowledge required for a person to execute it. Thus, the domain shifted from texts to language behavior and the subject matter from phonological, morphological, etc. competence to any implicit knowledge that must be assumed in the explanation of language behavior. Concerning methods, text-analytic procedures based on the shared intuitions of linguists were no longer accepted as explanatory arguments; they were now regarded as a part of language behavior, which must itself be explained. Theorizing concentrated on the postulation and systematization of concepts of knowledge processing.

This development exemplifies a third type of interdisciplinarity: *interdisciplinarity by integration*. It takes place when an interdisciplinary approach leaves the stage of a multidisciplinary conglomeration of elements from various disciplines and gives itself a domain and perspective which is no longer identical with that of one of the contributing disciplines. In the realm of language-related interdisciplinary approaches, the sociology of language and the neurobiology of language are on the verge of transforming themselves in similar ways into sociolinguistics and neurolinguistics, respectively, at the beginning of the 21st century.

The history of the natural sciences is also full of such developments. Thus, organic chemistry had reached a high level of achievement without using any methods of physics at the end of the 19th century. Today, chemical research is hardly feasible without theory fragments and methods that were first developed in physics. Nuclear physics and physical procedures such as infra-red spectroscopy and paramagnetic resonance have proven their usefulness in chemistry, which created physical chemistry as an interdisciplinary approach by extension. But there was also influence in the reverse direction. Physicists started using chemical conceptions of molecular structures and enriched their theories with them, which led to what came to be called "chemical physics". Reorganized in these ways, physics and chemistry invaded biology, creating physical and chemical biology. By the end of the 20th century, these interdisciplinary approaches by extension reached the stage of interdisciplinarity by integration, which led to their re-definition as biophysics and biochemistry.

Interdisciplinarity by integration is often named "*transdisciplinarity*" (cf. Piaget 1972, Jantsch 1972, Kocka 1987, Mittelstraß 1989, Arber 1993, Huber et al. 1994, Weingart 1995, and Nicolescu 2002). This is justified insofar as an integrated interdisciplinary approach crosses the borders between the participating disciplines. In doing so, it makes new problem formulations available that had been suppressed or marginalized by exaggerated orientation towards intradisciplinary research perspectives. This is why integrative interdisciplinarity is particularly successful on the research front.

However, instead of advocating the integration of existing academic disciplines wherever useful, some epistemologists go further and propose replacing the existing system of academic disciplines and interdisciplinary approaches by a loosely connected set of transdisciplinary approaches. Trying to realize such a proposal would be short-sighted because it does not take into account that integrative interdisciplinarity functions only if there is something that can be integrated, i. e., if it can build on a well-established system of academic disciplines. Only if at least the research perspectives and methods of the contributing disciplines remain identifiable can interdisciplinary approaches which integrate them into new research contexts fulfill their role. Otherwise, the interdisciplinary approaches would develop in the same way as the traditional academic disciplines, draw new borderlines, and reproduce the old problems on a new level. These problems would then have to be overcome by introducing inter-interdisciplinary approaches (and so on). Such considerations lead to the conclusion that there is nothing better available than a two-level system of disciplines and interdisciplinary approaches.

Another idea propagated by some advocates of transdisciplinarity is a conception

formulated most explicitly in the "Charter of Transdisciplinarity" of Nicolescu (2002: 147–152). It suggests relaxing the standards of science formulated in requirement R3 (see above, § 2.8.) with the effect that scientific disciplines become indistinguishable from movements of science, religion, and art. If this proposal were realized, however, scientific disciplines would lose all the qualities that have made their results unique instruments of human action and interaction.

Since the term "transdisciplinarity" is too much tied to such intentions, it will not be used as a synonym of "interdisciplinarity by integration" in what follows.

As can be inferred from the definitions given, interdisciplinary approaches by abstraction must be distinguished from interdisciplinary approaches by extension and by integration. The latter have themselves all the properties of a discipline in the epistemological sense. That is why they are often designated as "*interdisciplines*". This raises the question of what is basic in a two-level system of disciplines and interdisciplines: Can the traditional academic disciplines be replaced by a system of interdisciplines the domains of which cover more or less the same segment of the world? The answer is obvious: The difference between a set of disciplines and a set of interdisciplines covering the same segment of the world in their domains lies only in the perspectives taken on these domains and in the methods, theories, and means of presentation developed to realize these perspectives. In principle, nothing hinders substituting one for the other, thus turning into disciplines what used to be interdisciplines and into interdisciplines what used to be disciplines. The history of the European universities knows many cases in which such a substitution took place (cf. Kuhn 1978 and Stichweh 1984; see also Apostol 1972).

This important historical topic cannot be dealt with further here. But there is a conclusion to be drawn from it which must be taken into account when one discusses academic activities: The question whether a certain field of activities is a discipline or an interdiscipline cannot be answered in a context-independent fashion; it makes sense only when considered relative to a given system of disciplines.

With this in mind, one can examine the question of the relationship between the concepts of interdiscipline, subdiscipline, auxiliary discipline, and metadiscipline.

If a discipline in the epistemological sense does not function as an interdiscipline in a given system of disciplines, then its subdisciplines also do not function as interdisciplines in that system. This is because all their components are subsets of the components of one and the same discipline. Likewise, if two subdisciplines of the same discipline which does not function as an interdiscipline in a given system of disciplines combine to form a more specialized subdiscipline, the latter will not function as an interdiscipline in that system.

If a discipline which does not function as an interdiscipline in a given system of disciplines has an auxiliary discipline backing one of its components or a metadiscipline studying it, it cannot form an interdiscipline together with them. This is because its components do not stand on the same level with the corresponding components of the auxiliary discipline or of the metadiscipline, so that they cannot merge with them.

However, an auxiliary discipline of a given discipline can itself well be an interdiscipline in the system of disciplines in question; examples are the psychology of language being applied as an auxiliary discipline of history to help date historical documents, and psycholinguistics being applied as an auxiliary discipline of medicine to help establish diagnoses of aphasia.

A metadiscipline of a given discipline can itself have the structure of an interdiscipline with respect to a given system of disciplines. For psychology, sociolinguistic metapsychology would be an example within the discipline system of contemporary Western universities.

In particular historical circumstances an interdiscipline can become part of a system of interdisciplines with respect to the established system of disciplines, and this is a context in which it can develop its own subdisciplines, or become itself a subdiscipline of another interdiscipline. An example is cognitive science, which emerged as an interdisciplinary approach within Western universities in the 1970's, when philosophers, linguists, psychologists, neurologists, and computer scientists joined forces to study cognition. Using the computer metaphor, they investigated perception, language use, reasoning, and imagination as achievements of the flow of information through a cognitive system (based on a human brain, a social institution, or a computer). This joint work led to cognitive science as an interdiscipline by inte-

gration. Its domain is cognition; its perspective is information processing; its methods are a mixture of philosophical reflection, linguistic analysis, psychological input-output experiments, neurological lesion experiments, and computational modeling; its body of knowledge consists of integrated theory fragments on the information flow in perception, attention, memory, reasoning, the generation of ideas, as well as language production and comprehension; and its means of presentation include devices of all five contributing disciplines. This research program proved so successful that it had repercussions in the contributing disciplines. As a result, normal philosophers became increasingly involved in what they called "cognitive philosophy", linguists in "cognitive linguistics", psychologists in "cognitive psychology", neurologists in "cognitive neurology", and computer scientists in "cognitive informatics". These are all subdisciplines of cognitive science and therefore themselves interdisciplines. However, many universities organize them not as parts of an institute for cognitive science, but of institutes for philosophy, linguistics, psychology, neurology, and computer science, respectively. These contexts make them appear to be subdisciplines of traditional academic disciplines although they are interdisciplines. It remains to be seen how this confusion will contribute to paradigm changes in their source disciplines philosophy, linguistics, psychology, neurology, and computer science.

4. The role of semiotics in the context of contemporary academic disciplines

In which way can the concepts of a discipline, subdiscipline, auxiliary discipline, applied discipline, metadiscipline, and interdisciplinary approach be applied to semiotics (cf. Nöth 1990)? This question must again be considered with respect to a given system of disciplines and with reference to the five criterial components of disciplines. In answering it, semiotics is conceived as the set of activities described in Chapter I of this Handbook (Articles 1–4 in Volume I) and viewed in relation to the traditional academic disciplines in contemporary Western universities. The answer is given in the form of a set of theses.

4.1. Semiotics as a scientific discipline

Semiotics studies all objects from the perspective of their functioning in sign processes (semioses). It thus has a value-free perspective which also determines a domain that is studied in its totality. As methods semiotics uses the procedures of syntactic, semantic, and pragmatic analysis of sign processes, which are all repeatedly applicable. As results semiotics has produced various falsifiable theories on the structure and function of sign processes (which are presented in Chapter XII of this Handbook). The means of presentation of semiotics (as applied in every article of the Handbook) are intersubjectively comprehensible. Last, but not least, there are well-defined borders distinguishing semiotics from other kinds of academic activities. They are determined with respect to the unity of its perspective. With these properties semiotics fulfills all requirements formulated in § 2.8. for being a scientific discipline.

4.2. The social sciences and the humanities as subdisciplines of semiotics

Given these characteristics of semiotics, its relationship with the traditional academic disciplines can now be specified on the basis of their components. The domains of all disciplines treated in § 2.2. are included in the domain of semiotics. However, physics, chemistry and the other natural sciences do not study their domain from a semiotic perspective. The social sciences (including biology and medicine) and the humanities study subsets of the domain of semiotics from perspectives which are specializations of the semiotic perspective. The methods of these academic disciplines can all be explicated as specializations of syntactic, semantic, and pragmatic methods. Analogous statements hold for their theories and their means of presentation. What follows is that the natural sciences are not subdisciplines of semiotics whereas the social sciences (including biology and medicine) and the humanities are.

4.3. Semiotics as a metadiscipline of all academic disciplines

Even if the natural sciences are not subdisciplines of semiotics, all of their activities, however different they are from those of semiotics, are sign processes. The natural sciences follow repeatable research methods, and all research methods are ways of organizing sign processes; they elaborate theories, and every

theorizing is a sign process; and they employ means of presentation, and all means of presentation are signs. However, the methods followed by the natural sciences are not studied as sign processes by them, theorizing in the natural sciences is not studied as sign process by them, and the means of presentation employed by the natural sciences are not studied as signs by them. All this is done by semiotics or its subdisciplines. In conclusion, semiotics can be said to be a metadiscipline of all the natural sciences. And this is also true of the social sciences and the humanities.

4.4. Semiotics as an auxiliary discipline and the academic disciplines as applied semiotics

Insofar as the semiotic analysis of methods, theories, and means of presentation of an academic discipline has results which are helpful for the work done within these components of that discipline, semiotics can be used as an auxiliary discipline of that discipline. Therefore, semiotics can be regarded as a potential auxiliary discipline of all academic disciplines.

When an academic discipline makes use of an auxiliary discipline F, then F taken together with that academic discipline can be called an "applied F" (see above, § 3.3.). Therefore all academic disciplines can be conceived as being applied semiotics.

4.5. Metascience as a metadiscipline as well as subdiscipline of semiotics

In § 3.4. above, metascience was also characterized as a metadiscipline and a potential auxiliary discipline of all academic disciplines. Hence, the question of the relationship of semiotics with metascience arises (cf. Art. 124). Metascience studies the academic disciplines from the perspective of their functioning as sciences, and semiotics studies all objects from the perspective of their functioning in sign processes. Since sciences are activities involving signs, i. e., sign processes, metascience follows semiotic methods to study them, elaborates semiotic theories to formulate its results, and uses semiotic means of presentation. However, there is more in the domain of semiotics than academic disciplines; they are studied from a wider perspective in semiotics than with respect to their functioning as sciences; there are methods used in semiotics which are not applicable to the study of something as a science; there are specialized theories elaborated in semiotics which do not take account of the sciences; and there are means of presentation employed in semiotics which are not used in the presentation of research results about the sciences. Therefore, metascience must be classified as a subdiscipline of semiotics. This does not contradict the statement that semiotics is among the disciplines studied by metascience, i. e., that metascience is also a metadiscipline of semiotics.

4.6. Metasemiotics as a domain-based subdiscipline of semiotics

The reason why metascience is both a metadiscipline and a subdiscipline of semiotics lies in the structure of semiotics. Being a scientific discipline, semiotics falls into the domain of metascience even if metascience has a more narrow perspective than semiotics. When semiotics itself studies the domain, perspectives, methods, theories, and means of presentation of semiotics, then it evidently functions as a metadiscipline of itself: metasemiotics. In a similar way as in metamathematics and metalogic (see above, § 3.4.), metasemiotics conceives of semiotics as a semiotic object and construes semiotic perspectives on it, follows semiotic methods, elaborates semiotic theories, and employs semiotic means of presentation in studying it. Metasemiotics is then a domain-based subdiscipline of semiotics. Metamathematics and metalogic, studying special aspects of particular disciplines, can themselves be classified as subdisciplines of metasemiotics.

4.7. Semiotics as an interdisciplinary approach

Among the components of semiotics, the domain and perspective have historically been more controversial than the methods, theorizing, and means of presentation (cf. Art. 35). This is because the domain of semiotics does not appear to be homogeneous (cf. Clarke 1987: 36–42). It comprises objects produced by intention to make a recipient interpret them, but also objects which happen to be interpreted as signs without having been intentionally produced for that purpose. Objects of the former type can be called "sender signs", objects of the latter type "recipient signs" (cf. Posner 1993: 230). The production and reception of sender signs is often determined by systems of conventions such as languages, codes of emblematic gestures, coats of arms, or styles of art, music, and literature. Any object which conforms to such

conventions tends to be taken as a sign, even if there is no recipient interpreting it, while objects which do not conform to such conventions are only taken as signs if there is a recipient interpreting them. Conventional sender signs are artifacts and can therefore be easily distinguished from their senders and recipients as well as from unmodified natural objects (cf. Posner 1989: 254–364 and Posner 1994). This is not true of recipient signs because anything can happen to be a recipient sign: inanimate matter as well as plants, animals, or humans; unmodified natural objects as well as human artifacts; things as well as properties, relations, events, processes and states of affairs. Epistemologists who conceive of the system of academic disciplines as segmenting the world into a set of specific domains are reluctant to accept as an academic discipline a scientific approach which studies everything there is.

Two options have been elaborated for overcoming this situation. Many semioticians insist that everything can be a sign and therefore conceive of semiotics as a discipline which studies everything there is from the perspective of its functioning in sign processes. They tend to divide the world into segments such as inanimate matter and the realms of bacteria, algae, fungi, plants, nonhuman animals, humans, and machines and assign the study of sign processes involving these types of entities to different *regional semiotics* such as microsemiotics (Art. 20), mycosemiotics (Art. 22), phytosemiotics (Art. 23), zoosemiotics (Art. 24), anthroposemiotics (Art. 25), and machine semiotics (Art. 26), as well as endosemiotics (Art. 21). All regional semiotics are domain-based subdisciplines of semiotics. Of course, this proposal does not take care of the ontological distinction between signs which are things and those which are properties, relations, events, processes, or states of affairs.

Other semioticians prefer a smaller domain which can be specified independently of the research perspective to be taken on it in semiotics. They either propose studying only sign processes involving animate matter, or only sign processes involving animals, or only sign processes involving humans. For them the domain of semiotics as a whole is identical with what for the others is the domain of biosemiotics (Art. 19) or zoosemiotics (Art. 24) or anthroposemiotics (Art. 25). As a research perspective they propose the study of the objects in the domain chosen with respect to the role they play in conventional sign systems (e. g., Saussure 1916, Lévi-Strauss 1958, and Barthes 1964 and 1970) or in processes of communication (e. g., Buyssens 1943, Prieto 1968, and Mounin 1970).

However, there is also a third option, which is to leave the question concerning the domain of semiotics open. Viewed in this way, semiotics becomes an interdisciplinary approach by abstraction. It studies everything which can be approached from the perspective of its functioning in sign processes.

4.8. Semiotics and other interdisciplinary approaches

The roles of semiotics characterized in §§ 4.1.–4.7. are not mutually exclusive. So everyone dealing with semiotics is free to choose the role which is appropriate in a given circumstance. It will depend on the purpose of a study whether it is most useful to conceive in it of semiotics as an academic discipline, an auxiliary discipline, an applied discipline, a metadiscipline, or an interdisciplinary approach. All these aspects of semiotics are discussed in this Handbook, but different aspects are presented in different chapters. For the treatment of the relation between prominent interdisciplinary approaches and semiotics, it is useful to conceive of semiotics itself as an interdisciplinary approach.

This is especially fruitful in the cases of information theory (Art. 125), systems theory (Art. 126), synergetics (Art. 127), the theory of developmental processes (Art. 128), gestalt theory (Art. 129), and psychoanalysis (Art. 130), which are all interdisciplinary by abstraction. Approaches which lack a domain specifiable independently of their perspective, can be compared with respect to how their perspective structures the world. Approaches which are characterized by other components can be compared with respect to the question of what is achieved if the objects in their domain are approached from a semiotic perspective. What makes interdisciplinary approaches by abstraction fascinating for epistemologists is the fact that they are easily combinable with full-grown academic disciplines and with other interdisciplinary approaches. This may lead to mutual enrichment and even fusion of perspectives, methods, theory fragments, and means of presentation. The reader is encouraged to approach the articles in the rest of this chapter in this spirit.

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