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Dynamic system theory and the history of (language) philosophy

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1 Introduction: Philosophy and (new) mathematics

Mathematics have played since Plato's Timaos a prominent role in philosophical thinking due to the simple fact that the search for very abstract and cognitively appealing principles in mathematics fits the basic philosophical motivation of unveiling the deepest enigmas in nature and man. There exists, therefore, a basic brother- and sistership between mathematics and philosophy. Nevertheless, it is immediately clear that the philosopher must resent mathematical structures as restrictive. His/her theoretical intuitions, his/her reflections on fundamental questions cannot accept the rigidity of mathematical concepts; but if this rigidity (or precision) is given up another danger creeps up; uncontrolled speculation, or ideological framing of philosophical enterprises. The basic problem for all rational endeavors in the realm of science is how to find a common language which allows to assemble the experiences of a multitude of rational individuals. René Thom made the provocative statement:

> „One can say that the laws of physics do not describe the phenomena, they describe the laws which allow the comparison of the points of view of two observers."[1]

The standard technique for the comparison of two points of view is discourse and its tool is language. In philosophy different types of „languages" may help to establish a common ground for the integration of the „insights" of individual philosophers:

1. *Religion as common language*. After the victory of Christianity against antique religions and philosophies, the independence of philosophy from myth and religion in Greece was lost.[2] It was partially recovered in Renaissance philosophy (cf. on Giordano Bruno, Wildgen, 1998) but again lost in the 17th century. Western philosophy was therefore (at least until the French Revolution) framed by theology.

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[1] Thom (1978: 101): „On peut dire que les lois physiques ne décrivent pas des phénomènes, elles décrivent les lois qui permettent de comparer les visions de deux observateurs."

[2] The conflict between philosophy and religion was also prominent in Greek philosophy. Socrates had been accused and sentenced for lack of religiousness and in the later academy and specifically in the neo-platonic school the interdependence between religion and philosophy was renewed.

2. *Scholasticism*. Common intellectual traditions may function like a holy text. In this sense myths and rituals are followed by religious systems and by canonical scientific and philosophical texts. In the 16th century, this line was already criticized as scholasticism. Nevertheless, the 19th century witnessed again the establishment of a type of scholastic tradition: Neo-Kantianism, Marxism, and other schools.
3. *Political systems* (e.g., absolutism) or constitutions may frame philosophical thinking and allow an easy but severely limited communication between philosophers. Geographical and political provinces of philosophical thinking were the outcome (cf. Wundt, 1907, on French, English, German philosophy).

With these normative contexts of philosophical communication in mind the restrictions imposed by mathematics appear as rather harmless. The basic advantage of a mathematical framing of philosophical thinking lies in the fact that mathematics develop rather freely and this process cannot be easily controlled by political or ideological forces. Thus the mathematical type of frame is probably the most rigid one, but it is politically/ideologically/-religiously neutral *and* it has a natural drive towards further development, which diminishes the danger of scholasticism. A central feature of the evolution of mathematics is that the pace of evolution is (at least historically) much slower than the rapidly changing demands to which philosophical thinking has do respond.

These introductory remarks motivate my basic assumptions:

- Philosophy should make use of developing mathematics, i.e., it should not wait for some „final“ consolidation but should experience the possibilities of new mathematics. They constitute possible languages into which new philosophical insights may be mapped (it may not directly create the insights, it rather provides a proper place for them).
- As an immediate consequence the usage of mathematics in philosophy must evolve in time, i.e., no single tool should acquire a kind of scholastic authority (this seems to be the case for logic in analytical philosophy).

One very prominent type of new mathematics is catastrophe theory, which belongs to the domain to dynamic system theory. Catastrophe theory is basically the application of the classification theorem of Thom (proved by Mather in 1964). In the period since 1964 the field has further evolved. I will, therefore, include:

- Bifurcation theory (cf. Guckenheimer and Holmes, 1983)
- Theory of strange attractors and chaos theory (cf. Peitgen a.o., 1992)
- Stochastic dynamical systems as applied in synergetics (cf. Haken, 1983)

In its current state, the field may be organized around two basic topics:

- The typology of catastrophes (in deterministic systems) and the fractal character of iterated bifurcations leading to chaos.
- The stochastic attractors and the slaving effect of basic parameters in synergetics.

These basic dynamical structures explain the emergence of order in general and, therefore, create a framework, into which theoretical intuitions about possible laws or regularities in nature and mind may be integrated.

2 The evolution of philosophy analyzed as the unfolding of a morphodynamic field

The following reflections refer to western philosophy in their examples; I guess similar gradients, catastrophes and fractal patterns will show up if we analyze other philosophies (Indian, Chinese, Japanese) and corresponding intellectual frames in non-written traditions (American Indian, Inuit, Aboriginal cultures).

The traditional starting points of philosophy: Plato and Aristotle exhibit already two concurring syntheses based on the pre-Socratic tradition.[♠] In synergetic terms a synthesis is basically the reorganization of a set of partial systems in strong interaction by the choice of very few slaving parameters. It would be a tempting task to assemble the Pythagorean, atomistic, naturalistic forces of pre-Socratic philosophy, and to relate them to Plato's system (which has itself evolved in his lifetime). For our purpose it is significant that we can distinguish three phases of this process:

1. A differentiated and distributed set of philosophical positions evolves. The interaction is rather low due to geographical heterogeneity (in the ethnically and linguistically subdivided mainland of Greece and in the Greek colonies around the Mediterranean and the Black Sea area).
2. A concentration in Athens due to political and (slightly later) cultural dominance. The slaving force may be located in the intellectual singularity of Socrates and the life-long development of his teaching in the work of Plato. The metastable character of the synthesis is shown by the work of Aristotle and the followers of Plato in the Academy. It is characteristic that the content of the philosophical teaching changed with every successor (at least in the first cycles); nevertheless the stability of the Platonic synthesis was inherited by the Hellenistic Academy, which was only destroyed in the campaign (529) of emperor Justinian (482-565 AD) against pagan religions and philosophies. The Florentine

[♠] Cf. Wildgen (1985b) for a description of this development (new footnote, 2005).

Academy and the academies of the 15th and 16th century have tried to continue this tradition.

3. The *desagregation* of the Greek line of philosophy had many stages (transfer to Alexandria as center, influence on India, Persia and the Arab sciences). In the main line, the rise of Christian and later Islamic nations created a new synthesis based on the Bible and the Koran and, thereby, replaced the anti-mythic Greek philosophy by religious philosophies. Philosophy became „ancilla theologiae“ (the servant of theology). Several new syntheses fostered this role of philosophy:
   - The philosophy of Augustinus which was revived several times (e.g., by the Port-Royal Jansenists).
   - The philosophy of Thomas Aquinas, which became the official philosophy of the Roman church.
   - A third line which tried to incorporate structures from the two concurrent monotheistic religions: Judaism and Islam was opened by Lullus but remained controversial (at the edge of heresy).

   The strongest force in this evolution was surely the philosophy of Thomas Aquinas, which was able to govern philosophical thinking until Leibniz and even later in different forms of Christian Aristotelicism. All three philosophies had the ultimate aim of fostering Christian faith or even of demonstrating its superiority against the Judaic or Islamic traditions.

4. The Renaissance philosophers like Marsilio Ficino and later Giordano Bruno successively broke the link between (Christian) religion and philosophy. Bruno tried to reconstruct some kind of basic Mosaic religion as the ultimate metaphysical root of philosophy. This return to an independent philosophy was destroyed by Christian reforms (Calvinism, Lutheranism) and by the catholic counter-reform in the 16th and the 17th century. Finally, the philosophy of Enlightenment took up this line. In order to replace the biblical (or other traditional) roots, the natural sciences were taken as stable reference points for truth. This reference point became very strong after the acceptance of Newtonian physics by Condillac and Kant.

5. The new creed of Enlightenment, which was motivated by the astonishing successes of modern science and the need for new frames of intellectual orientation (in the context of political and social reorganization) was slowly destroyed by a process we could call „disciplinary fragmentation“. The big theory (Newtonian physics) was broken from within as new paradigms evolved in physics and its role of orientation was overtaken by other disciplines like: biology (Darwinism, molecular genetics), chemistry, psychology,

linguistics, etc. In dynamical terms we could call this stage, the fractal stage of modern philosophy.

This very rough picture of three millennia of philosophical evolution fits a dynamical schema in which specific parameters are able to slave and order the dynamics which in principle tend to be chaotic.

In terms of dynamical systems stage (1) corresponds to spatially separated modes of a system. It can be compared to those of the Belousov-Zhabotinsky-reaction,[♠] which shows periodically changing colors (red if the C_e^{3+} is produced at a high rate, blue if C_e^{4+} is produced). It creates a stationary distribution with red (above) and blue (below). In a similar vein (albeit metaphorically) the dominance of philosophical modes in certain geographical or cultural areas may be explained by a temporally dominance of a philosophical position which eliminates (via social selection) all other modes.

The most miraculous happenings are the big syntheses (stage 2), they ask for very specific conditions. The picture of a singularity in catastrophe theory may illustrate this point. In the elementary catastrophe called „butterfly“ we find a singular point leading to three modes. The basic equation is

(1) $V = x^6/6 + tx^4/4 + ux^3/3 + vx^2/2 + wx$

(2) Partial differentiation (relative to the variable x, called internal variable) gives as the equations (2) and (3).

(3) $V' = \delta V/\delta x = \quad x^5 + tx^3 + ux^2 + vx + w$

(4) $V'' = \delta^2 V/\delta x^2 = 5x^4 + 3tx^2 + 2ux + v$

The bifurcation point is defined by the zeroing of the first and the second partial derivative. $\delta V/\delta x = \delta^2 V/\delta x^2 = 0$ (cf. Wildgen, 1985a: 170) shows the bifurcation lines in the two dimensional space of external parameters (v, w); the other two parameters u and t have fixed values in a specific domain of values.

[♠] For the historical contexts and the application of dynamic systems theory in chemistry cf. Plath, 1977.

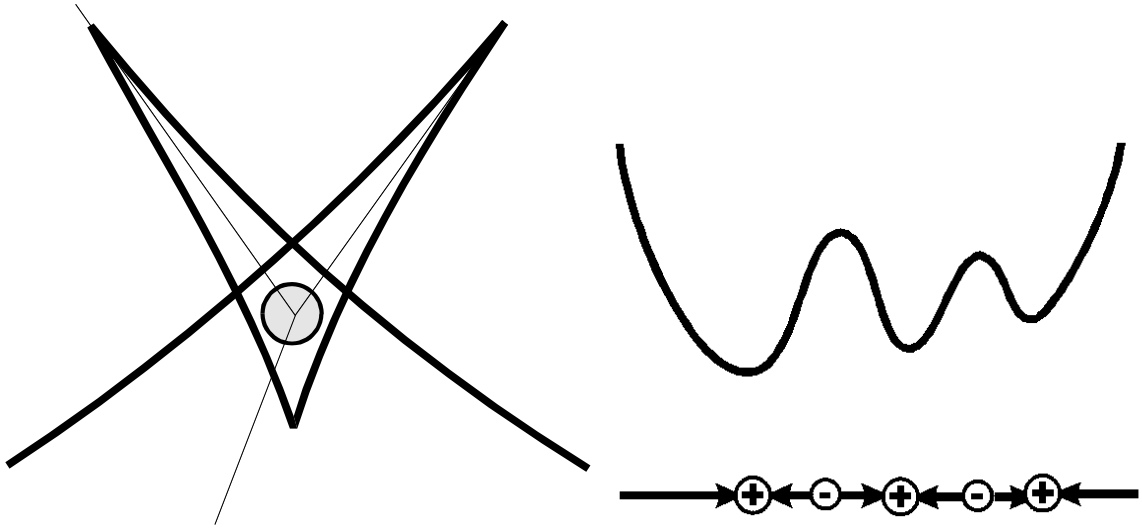


Figure 1: **a)** *The bifurcation space represented by a picture of (u, w) at specific points in (u, t) and* ***b)*** *the potential function V (on x) and the Dynkin-diagram of attractors, repellors and vector-flows*

The most complicated and compact picture is the one in the central area of Figure 1 (left). Here we find a singularity which can split-up into an system of two or three attractors (minima). Figure 2 shows the splitting in the neighborhood of the singularity.

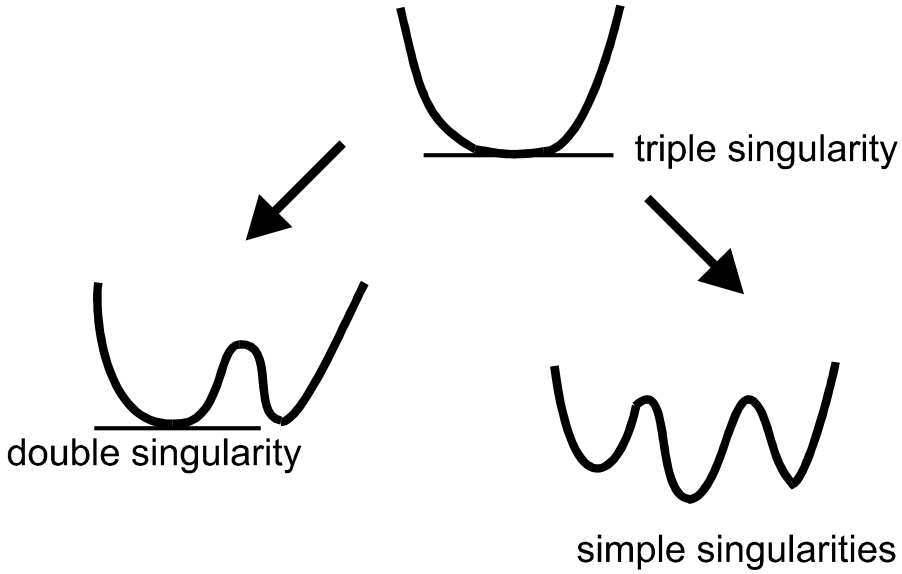


Figure 2: *Triple ($V = x^6$), double ($V = x^4$) singularities and simple (stable) minima ($V = x^2$).*

A big (temporary) philosophical synthesis could abolish the differences between three (in principle n) attractors (= philosophical positions) and create a very complex singularity. The basic prediction is that this synthesis will be unstable, and the interesting questions are:

- How long can such a solution persist (under which condition)?

– What is the gain in the long run of such a synthesis?

I think that very specific historical, social, and intellectual conditions are necessary to give access to a philosophical synthesis (stage 2) and that the extremely low probability of such a singularity makes that its information is very high (if we apply basic intuitions of information theory).

The big points of syntheses, e.g., Plato, Aquinas, Kant are singular events and linked to singular personalities. In the singularity of a (philosophical) mind a particular balance between rather incoherent modes of philosophical explanation is created. This singularity cannot be explained by general mechanisms but one can find specific lines which form the organizing center of such a synthesis. In the case of Plato some amalgam of Pythagorean credo in mathematics and an oriental view of the soul which is independent of the individual body may have been such centers of organization. In many cases the synthesis contains a balance between basically contradictory positions, e.g., rationalism and empiricism in Kant's synthesis. The bimodal character of this synthesis could be related to the bimodality found in modern quantum physics (e.g., light as wave and particle) or in chemistry (multiple chemical reactions described in terms of a Boole algebra; cf. Plath, 1988 and 1997).

The chaotic nature of „normal" evolutions in the domain of philosophy may be due to an iterative, self-similar process of mapping. This can occur in the transition from one school to the next one or in a partial mapping between parallel and concurrent schools. Such a „mapping" by the reformulation of traditional positions, by their citation, comment etc., is always open to deformations (simultaneously on different parameters) and, therefore, open to chaotic dynamics.

Dynamically the self-reference or auto-similarity of a philosophical system is a phenomenon which may be observed in any intellectual system transmitted from generation to generation. It applies a general mechanism of cultural transmission and shows the stability/instability of cultural traditions.

In order to analyze the formal features of such a process we may throw a look at the logistic mapping in dynamical systems theory.[♠]

(1) $y \rightarrow kx\,(1-x)$ (logistic mapping)

The iteration takes y as the new value of x and thus produces an infinite series of new values of y (in time t):

(2) $x_{t+1} = kx_t\,(1-x_t)$

[♠] Cf. Wildgen and Plath (forthcoming 2005) for a more explicit introduction into chaos theory and its application to semiotics and linguistics.

The parameter k controls the stability of the mapping. If k = 2 we get a steady state after 7 steps of iteration. If k = 3 the steady state is replaced by two alternative states, this constitutes a bifurcation. Between k = 3 and k = 4 chaos appears (and disappears) by period-doubling (chaos breaks down to periodicity and reappears, etc.).

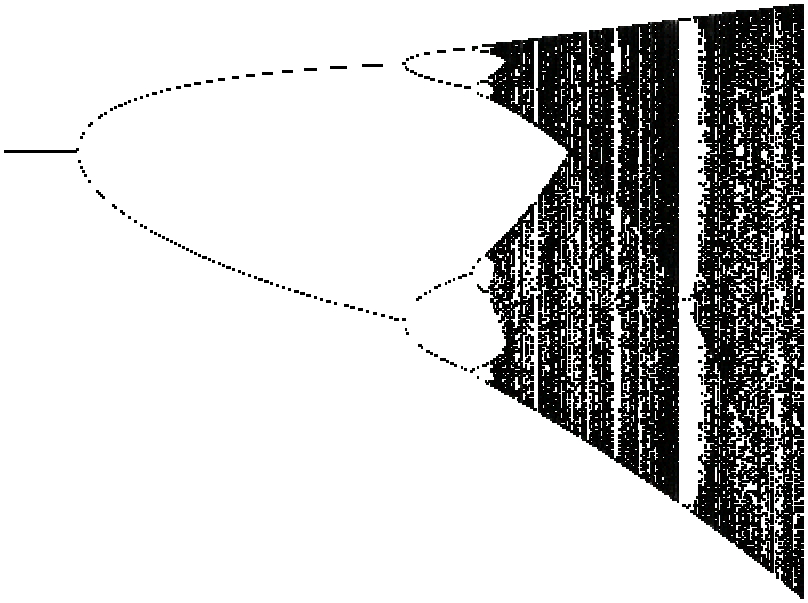


Figure 3 shows the Feigenbaum-tree of an iteration of this type.

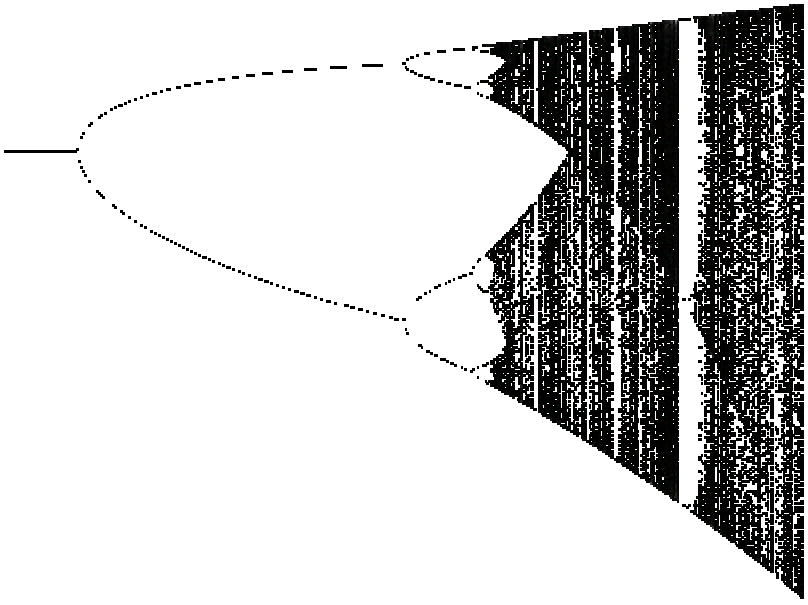
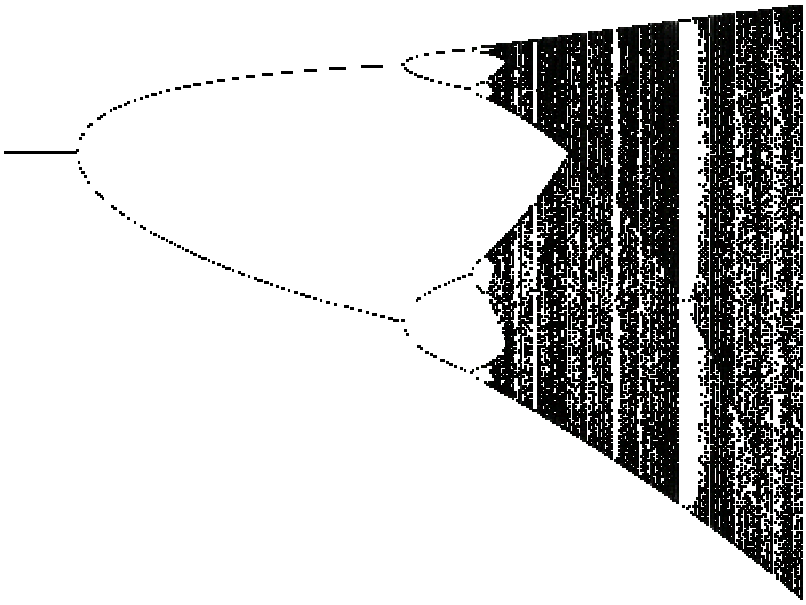


Figure 3: *Bifurcation diagram of the logistic mapping (for different values of k).*

The transfer to my argument on the evolution of philosophy exploits a structural analogy. The relevance of this analogy is based on the fact that the characteristics of the logistic mapping have been shown to constitute a formal schema applicable in many different domains. In the following this schema and not the formula itself will be applied.

In the history of western philosophy Plato and Aristotle reflect already a late period of self-similar mapping (since ca. 600 BC). The first stages of bifurcation are inaccessible. What may be observed are zones of stability in the domain of chaos, i.e. the small bands of



stability (cf.

Figure 3) correspond to periods of philosophical synthesis. In many cases they have period 2. Thus, Platonism and Aristotelicism, rationalism and empiricism are subsystems with period 2. As the philosophical evolution is spatially distributed, different branches can occur simultaneously (in different cultural areas or in different persons).

The forces which could control such a synthesis are not part of the schema. We need a more complicated theory in order to schematize this aspect of the story. In a future perspective one could conceive a model which exploits the results of the history of philosophy as a kind of empirical basis and designs an explanatory model using these data.[3]

3 The dynamics of philosophical discourse

Philosophical texts from the Greek tradition on have in general three kinds of textual organization.

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[3] Philosophers in a hermeneutic tradition will probably doubt the feasibility of such a program, but I consider any knowledge system as in principle similar and of a general type to which languages and other semiotic systems belong. Either all these systems are rationally inaccessible (in this case linguistics and semiotics are impossible) or philosophical systems can be modeled in the same way as languages are. (addition 2005) A philosophical background for this argument is furnished by the "Philosophy of symbolic forms" of Ernst Cassirer; cf. Wildgen 2001c, 2003a and 2004a (Bibliography in Chapter 10) for further elaborations.

(1) They are *aphoristic.* The aphoristic discourse of the pre-Socratics is partially due to lost traditions and to short citations or comments recovered in later periods. In the case of Heraclit, philosophical research has assumed that his writings had originally the form of short locutions (gnomes). His aphoristic style was later imitated by other philosophical authors in order to avoid the impression of a rigidly fixed canon of knowledge.
(2) They are *literary* (or exoteric). Plato's dialogues are similar to scenes played on stage. (They point to real or fictive dialogues with Socrates.) This style imitates the oral style preferred by Plato's teacher Socrates and is adapted in its written form to larger non specialized audiences. In scholasticism and humanism philosophical dialogues mirror the highly formalized debates which were part of the curriculum.
(3) The are *systematic* (esoteric). Aristotle's lectures establish the ideal of this very compact style. The logical or axiomatic style was a further development in the same line. Its standard format was established by Descartes and Pascal in the 17th century (a philosophy „more geometrico").

All three types of philosophical discourse and many mixtures coexist today and they have an impact on the content-level of philosophy (or are adapted to it).

A recent style of philosophy has been shaped by scientists working in mathematically elaborated disciplines and treating question of philosophy. Thus, Prigogine (dissipative systems), Mandelbrot (fractal geometry of nature), Thom (morphodynamics and semio-physics), Haken (synergetics) have contributed to intellectual enterprises, whose goal is a new philosophy of nature and man. In this move they produced a semi-formal type of discourse which sometimes comes near to literary discourse.

The different philosophical styles mentioned may be ordered along a scale:

1. The *systematic* (or mathematical/logical) style presupposes an artificial language with fixed rules. By this choice it enforces a kind of (artificial) semiotic stability corresponding to the ideal of eternal laws and well established truth. Nevertheless, semiotic stability (by a conventional choice of rules) is not causally linked to the stability of the knowledge expressed in this language. We could call this enterprise the search for stable knowledge via a stable language (a precursor of this style in medieval times was Ramòn Llull).
2. The *literary* (dialogue) style is ideally meant for readers/hearers just equipped with common sense, but it may be adapted to rather formal laws of argumentation (as in the scholastic dispute). In this case it looses its exoteric character. Many innovators like Bruno and Galilei chose this style in specific phases of their career. In the same move they decided to write in their national language and thus liberalized the stylistic conventions of philosophical discourse. The spontaneous, almost oral style of philosophy (in the tradition of Socrates) can only be found in private correspondence between

philosophers (in the case of Leibniz his correspondence contains major parts of his philosophy).

In general, the literary style with its dramatic (sometimes comic or satiric) components transports its message on different levels: common sense intuition, current imagery, comic and satiric effects, aesthetic values, etc. The cooperative effect of these different stylistic devices is very communicative and tuned to the complex mental world of normal audiences.

3. The *aphoristic* style which has puzzled so many readers of Wittgenstein's „Philosophical Investigations" is basically chaotic, insofar as it prefers to move around a central topic and thus to negate the existence of a (final) solution. In terms of dynamical systems we could say that it moves on a limit cycle (its center is a repeller) or even on a strange attractor. This avoids the impression of a rigid canon of knowledge and allows the reader to travel in his own mental world just under the impulse of a sequence of aphoristic statements. This style also negates the „ceremonial" character of many philosophical disputes and foregrounds the reflexive process of thinking (and the image of a relaxed philosopher).

The first philosophical style is a static sign-construction comparable to a public *architecture* which is meant to evoke admiration in the citizens, the second style is like a stage-play or like a trial in court. The third style takes the audience along in a „journey" of philosophical thinking.

The different styles of philosophical discourse mirror different views of the relation between the (intellectual) society and the (intellectual) individual.

- The systematic style creates (seemingly) permanent structures (almost the myth of an independent philosophical reason).
- The discursive style mirrors the struggle of opinions in the institutions, basically the fight for dominance and power in an ideal community of philosophers (cf. Plato's utopia of the state).
- The aphoristic style shows the philosopher as an (ideally isolated) individual arguing with himself (or with his doubt as in the case of Descartes).

The heroic individualism of Giordano Bruno is characteristic for the last attitude, and even Descartes, who was so methodical in his scientific writings points to the isolation in which he first conceived his new philosophy (in the introduction to his: Discours de la méthode, 1637).

In reality every philosopher is involved in all three styles:

- if he aims at the establishment of *his* own philosophy (a system, a school),

- if he tries to persuade his audience and argue against his opponents and
- if he struggles with the flow of his reflexive thought.

The basic schemata of order, conflict and chaos coexist in every single philosophy, but they do not show up simultaneously in every philosophical text.

4 The emergence of language philosophy from a general dynamical schema of communicative transfer

In the medieval university the „artes liberales“ prepared for the specific disciplines: theology, law and medicine. The seven „artes“ contained two subclasses. The *linguistic* ones (artes sermonicales): grammar, logic, rhetoric (the trivium), and the *mathematical* ones (artes naturales): geometry, arithmetic, music, astronomy (the quadrivium).[4] The philosophical problems related to language and communication were considered either as a transitory area to natural philosophy (in Plato's dialogue *Kratylos*), or as philosophical propaedeutic stage as in Aristotle's books on categories, or simply as a kind of interpretation, translation into other terms etc. Language philosophy became a specific chapter of philosophy only since Locke's „An Essay on Human Understanding“ (1690) and Leibniz' reply in his „Nouveau Essais sur l'Entendement Humain“ (written around 1704, published in 1765). Both wrote a major chapter on „Words“. Since the Port Royal logic and grammar, rationalistic theories of language resulted in a critique of natural language and in a project for the design of a better (even a universal) language (for international communication or for science).[♠] We can summarize: Since antiquity language philosophy had two sources:

1. natural philosophy; its central concern lies in the non-conventional, iconic and causal aspects of sign-behavior;
2. artificial languages; they exploit the conventional aspects by defining new norms for the design of linguistic systems.

The key question of language philosophy and semiotics are:

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[4] The more technical fields like astronomy and (later) physics began to be separated in the 16th and 17th century, geometry and arithmetic, i.e., in modern terms mathematics were separated from philosophy in the 18th century (the philosophers Descartes, Pascal and Leibniz had been important mathematicians in the 17th century), psychology was still part of philosophy at the end of the 19th century. Thus, the domain of philosophical disciplines is shrinking constantly to the profit of separately constituted disciplines.

[♠] Cf. Umberto Eco's book: La ricerca della lingua perfetta nella cultura europea, Laterza, Rome,1993.

- How are natural laws of sign-behavior (if they exist) interlaced with norms of usage (conventions)?
- What are the limits of our semiotic capacity and the conditions for its stability?

Most modern philosophies of language neglect the questions of natural laws in semiosis and the links to natural philosophy. They concentrate on the design of different "systems" or they reject any kind of formalism and develop a specific type of hermeneutic understanding of language. It was the merit of René Thom in the 60s of the 20th century to propose a new synthesis called „semio-physics" (cf. Thom, 1988, and Petitot, 1992). It aims at the formulation of general laws of semiosis based on a natural philosophy. He argued that semio-physical and semio-biological „laws" predict qualitatively linguistic structures like valence pattern, case-structure, the organization of noun-phrases, etc. I will come back to Thom's theory in the last section of this paper (cf. Section 5.1); in the present context I will only use one of the morphodynamic schemata he has proposed in order to „explain" (qualitatively) the emergence of different types of language philosophy.

The basic dynamic schema of communication has three centers of stability:

– the sender (speaker, writer),
– the addressee (hearer, reader),
– the message (the sign adapted to a channel which links sender and addressee).

These centers are integrated by a schema derivable from the elementary catastrophe called butterfly (cf. Figure 4):

– A fourth center is necessary in order to coordinate and specify the schema of transfer (cf. Figure 4) to a schema of symbolic transmission, communication. It can be derived from a catastrophe with two internal variables, the elliptic umbilic (cf. Wildgen, 1982: 85-92, and Wildgen, 1985a: 201-222). Figure 4 shows the three-agent schema of transfer and the four-center schema of symbolic transmission (communication) in Figure 5.

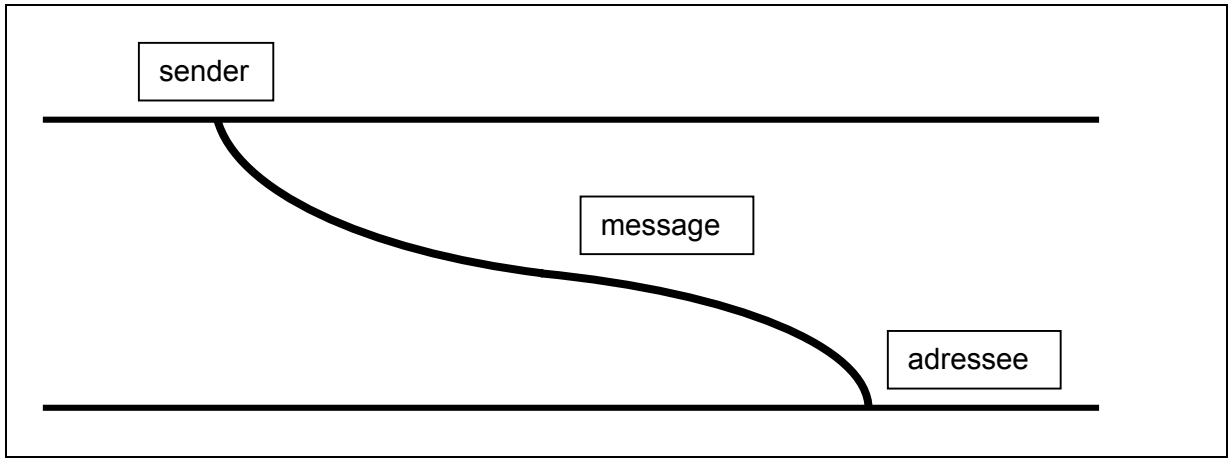

Figure 4: *Schema of transfer (derived from the butterfly).*

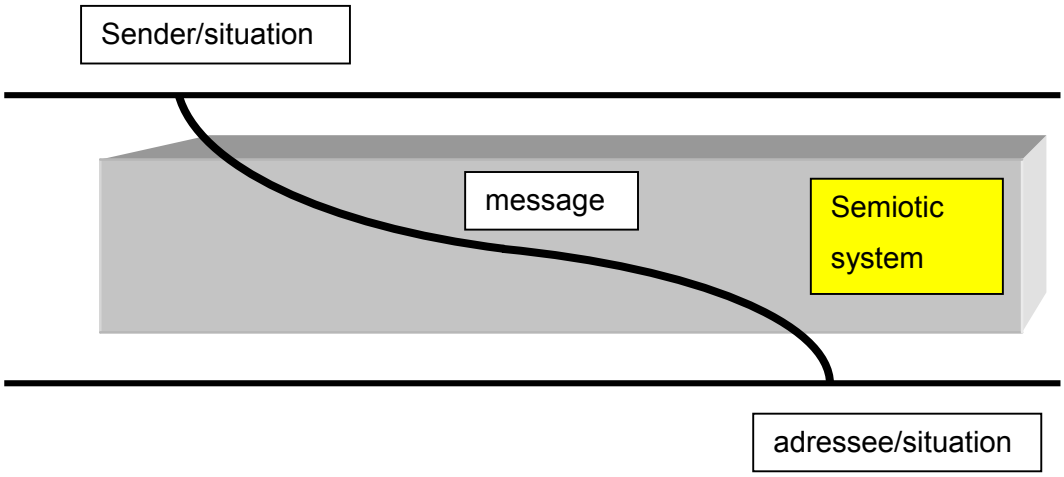

Figure 5: *Schema of symbolic transmission (derived from the elliptic umbilic).*

The world outside the sender and addressee is not part of these schemata. We, therefore, need a process by which the categorical appropriation of the external world emerges from the schema of transfer/communication. Laurent Mottron has proposed a model of language development in which the infant first cuts out parts, aspects, features from the care-giver, associates objects/persons with the care-giver (cf. Wildgen and Mottron, 1987: part 2). His/her utterances establish the link between the (perceivable) outer world and the cognitive representations in the baby. The iterated processes of transfer and symbolic transmission can thus constitute the external world as cognitively and linguistically apprehended by the child. The "world" is a fifth center which emerges from the apprehension by the sender/addressee of the situations associated with sender/addressee. One could say that the atlas of the world is assembled by putting together situations and recurring aspects of them (cf. comparable views in Barwise and Perry, 1983)

The primary duality sender-addressee in Figure 4 is unfolded to the triadicity: sender — ambient world —addressee, in which the ambient world partially intersects with the sender and the addressee. Even the message may be indexically „cut out", insofar as the care-giver *transfers/gives* care (food) and *produces* perceivable gestures and sounds. The basic scenario is one of catching parts (aspects, features) of the addressee. These parts may be food (milk for the suckling baby), odors, gestures or sounds. In the first stage the infant is just absorbing; the care-giver is just providing parts to be absorbed.

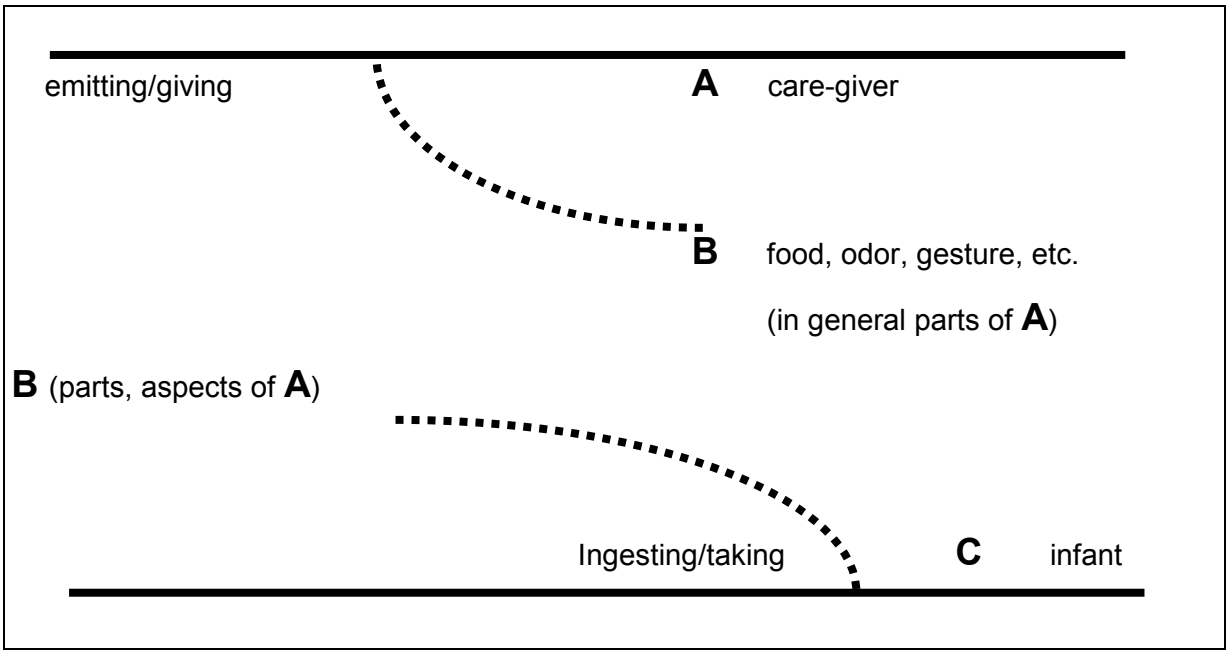

Figure 6: *Basic (partial) scenarios.*

In this phase the transferred entities (food, odors, smells, gestures, sounds) are iconically and indexically related to their source. If we return to the historical perspective prominent in this paper, Kratylos (in Plato's dialogue) focuses on the causal relation of the sign to a basic non-sign environment. We could say he reads the schema starting from the basic constituents, i.e., from the catastrophes called „emitting" and „taking" (see Figure 6).

Aristotle (and the sophistic tradition) starts from the other extreme, the dynamically complex fourth attractor: the semiotic system (code), and views it under the aspect of optimal adaptation to specific purposes (scientific discourse, rhetoric persuasion, aesthetic pleasure, etc.). The basic three-valent schema becomes the background of his enterprise.

Language philosophy in the Academy of Athens can be described as two ways of focusing the scenario described in Figure 5. Plato's focus enables a link to natural philosophy but it makes it difficult to conceive linguistic categorization which emerges in later stages by the iteration of the processual schema and its relation to the world (ontology). Plato's philosophy of ideas (mainly its interpretation in the neoplatonic tradition) might be a consequence of this type of focus. Aristotle starts from linguistic classification and grammar and in the end he believes that ontology is inscribed in language and that by the invention of proper norms we may even get a better knowledge of the world.

The concentration on problems of grammar in Stoic language philosophy and the importance of the Roman grammatical tradition for humanism and philology has fostered this perspective and has separated the grammatical system from its dynamical links to actual

communication and to the bodies of the sender and the addressee. If this abstraction was natural in the context of a dead language like Latin, its transfer to the grammars of Italian, French, German, English etc. produced an inadequate theory of language.

Modern positions (since the rise of philology) reflect this restricted focus of grammarians:

- August Schleicher (1821-1868) considered languages as organisms; i.e. as a kind of supra-individual “body”,
- de Saussure (1857-1913) considered language as a system of collective representations (in the sense of Durkheim) and as a treasure accumulated by the linguistic community.

In both cases the background of communication (the fourth center in

Figure 5) is ontologically separated and considered either as a natural object (Schleicher) or an abstract (idealistic) „object“, a system. The separation allows for a positivistic analysis of the objects into parts (constituents), relations between parts, functions, etc. In Figure 7 this new focus in the tradition of structuralism (in a large sense beginning in the second part of the 19th century and well documented in Saussure’s textbook) is illustrated.

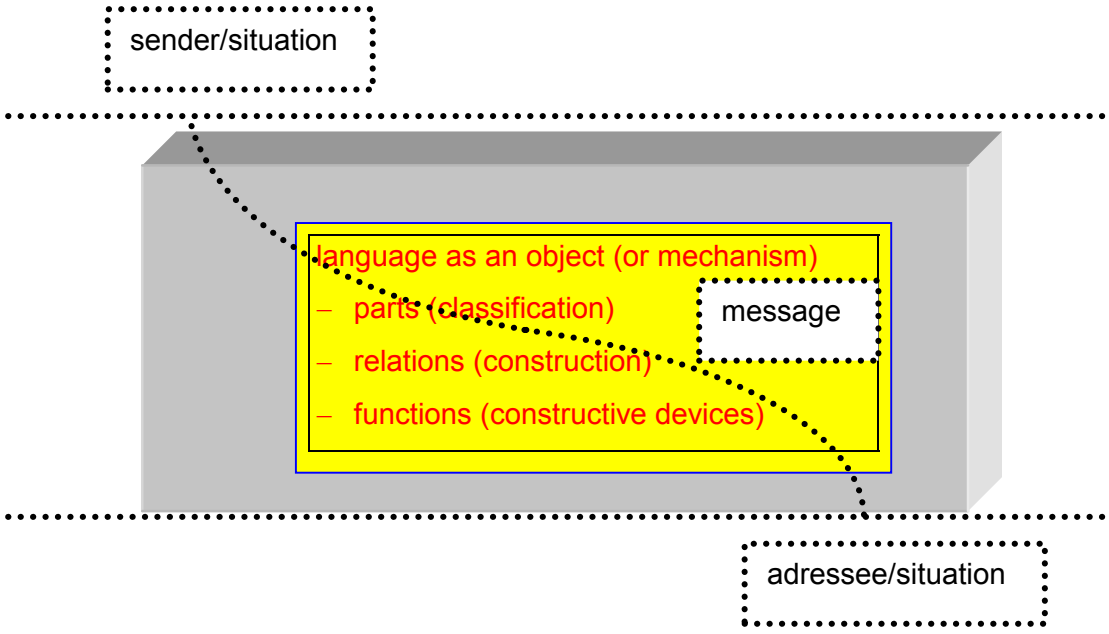

Figure 7: *Language as a natural or abstract (collective) object.*

Linguistic structuralism with its programmatic independence from bodily conditions and social processes is the typical outcome of this kind of focus which tends to eliminate everything which is dynamic, form-giving, etc. The notion of „generativity“ interpreted as creativity by followers of Chomsky is only an inadequate surrogate for the dynamical contexts of language usage which have been lost (given up).

The focusing on specific domains of the whole schema and even the elimination of dynamical aspects is legitimate insofar as it helps to solve specific problems. Therefore, structuralism cannot be criticized in general for its narrow focus. But if the act of focusing is forgotten and the restricted results under the chosen focus are generalized, a false totality is created, an illusion of global knowledge.

The illusionary character of "law and order" in language becomes evident if we look closer to:

- the constitution of the individual competence (in language learning),
- the historical development of languages in a linguistic community or a set of such communities in a geographical or cultural area.

In each case millions of mappings occur and (individual, collective) memory selects specific outcomes of these mappings. One type of mapping can be observed in the development of neologisms. Figure 8 depicts the basic dynamical schema.

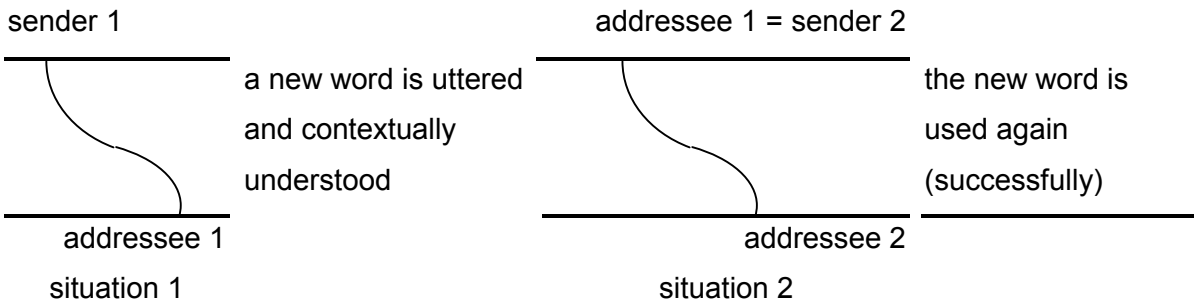

Figure 8: *The basic mapping of a neologism from situation 1 to situation 2.*

The mapping may decay (by memory loss), be strengthened (by a preference for new words): eventually the neologism may become a part of the lexicon.

This simple type of mapping shows three basic problems:

- Loss of stability in a series of mappings (this is the general case predicted by the second law of thermodynamics).
- Gain of stability (far from thermodynamic equilibrium) under specific conditions.
- Transformation in the process of mapping; thus, the information may change, e.g. in a sequence of textual transmissions (cf. the experiments analyzed in Stadler and Wildgen, 1987). Possible outcomes are homonymy, polysemy, blending etc..

If we were able to observe the mapping in a precise way (isolating specific effects), we could distinguish dissipative processes (as those described by Prigogine and Nicolis, 1989) and chaotic processes due to iterated mappings. A theoretical account of these mapping processes is a precondition for an adequate dynamical account of language. As long as these processes are not systematically observed, only preliminary sketches of a theory of language are possible.

My proposal is that first the topology of the problem should be analyzed, then a complex strategy of philosophical/scientific research should be formulated which instead of oscillating between preferred perspectives investigates the different sub-areas in their dynamic interaction.

5 Dynamical Systems as basic inventory of possible schematisms

In the following I will give a short description of semio-physics and morphodynamic semiotics based on work of René Thom, Jean Petitot, Per Aage Brandt, and myself. Later I will discuss the relation of these proposals to the philosophical extensions of dynamical systems theory by Prigogine, Mandelbrot, Penrose, and Haken.

A *schema* in Kant's sense is an intermediary structure which makes the link between pure forms of perception („reine Anschauungsformen") related to space and time („äußere vs. innere Anschauungsform") and categories of thinking („Denken", „Verstand"), which are

- quantity (unity, multiplicity, allness),
- quality (reality, negation, limitation),
- relation (inherence and accidence; lat. substantia et accidens, causality and dependency, relation between agent and patient),
- modality (possibility, existence, necessity).

If the system of categories is the conceptual architecture underlying language and if "pure perception" is the basis for empirical perception, memory and imagination, we need a mechanism which can map pure perception (the basic cognitive level) to the conceptual level underlying language. Catastrophe theory and other mathematical tools abstracted from space and time conceptualizations may help to fill this gap and to construct the basic conceptual domains rooted in pure perception. This is in fact the program of Petitot's „Physique du Sens" (cf. Petitot, 1992: XXII). He calls the corresponing function „eidetico-constructive". As an immediate consequence one should acknowledge that (morpho-dynamical) schematization has to precede any categorical and logical analysis as they

presuppose conceptual domains and describe their organization. In the following, I will sketch several modes of dynamical schematization starting from the work of René Thom

5.1 René Thom's theory of „prégnance" and „saillance"

The term „prégnance" was first introduced by René Thom (originally published in 1972, translated in chapter 12 of Thom, 1983). He writes:

> „Thus there are certain types of morphology (those defined in a structurally stable manner) which behave in a very resilient manner in the couplings between extended systems. These morphologies — that we can style *pregnant* in a mathematical theory of symbolism — are associated with the stable catastrophes in the Euclidean space of the dimension being considered." (Thom, 1983: 224).

In Thom (1973, translated in chapter 14 of Thom, 1983) a distinction is made between

- *"physical pregnance* of a form meaning to have the capacity to withstand communication noise",
- *"biological pregnance* defined as the capacity of a form to evoke other important biological forms and thus to be easily recognized and classified in the field (perceptive or semantic) of inquiry" (ibidem: 265).

The physical *pregnance* could be linked with schematisms which map pure perception to categories of objects, events and qualities, whereas the biological *pregnance* presupposes a survival function in a biological framework and controls the semantic filling of schemata. This component of Thom's theory goes beyond the pre-Darwinian ideas proposed by Kant. In the domain of physical pregnancies, Thom introduces fields (cf. light and gravitation) and a separation between the quantum level and the macro-physical level. Thus his mathematical theory of symbolism goes beyond Kant's epistemology and also beyond Neo-Kantianism in the 19th century. In our context it is relevant that both theoretical physics and theoretical biology are taken as disciplinary background of a mathematical schematization of semantic categories of objects, events, qualities, etc. In the simplest case, a physical object has a center of gravity and it has contours which depend on perspectives. The center of gravity is schematically a stable attractor, the contour is modeled as the stretching of a transition point (fold-singularity) to a line. The event may consist in a singularity of separation or union; a quality may be characterized by its prototype (= center) or the frontier-lines in a semantic field.

Table 1 shows the topological-dynamical shape of these very different phenomena.

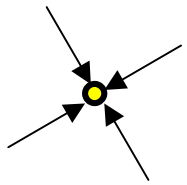	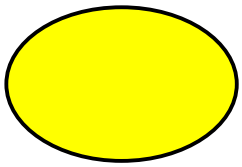	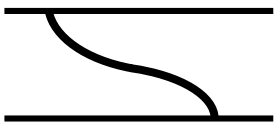
center of gravity of an object	contour of an object	singularities in a process
prototype (for a quality)	border of a quality	verbal meanings

Table 1: ***Three topological-dynamical forms.***

In order to interpret these forms, we must give a specific meaning to the mathematical spaces (and its variables). If forces are considered, then the simple events, their singularities and vector-flows are insufficient, we need notions like energy, energy flow, etc. In its consequence, physical, biological, sociological and other empirical concepts are introduced in order to complete the interpretation of the formal schema.

5.2 Generalized bifurcation and complex causality in nature and language

A simple type of relation between cause and effect, e.g., the mechanistic relations between billiard balls, demands for a schematism which respects the direction of time and reflects the punctual transfer of momentum. Causality in language (and linguistic cognition) goes beyond mechanical interactions between solid bodies, it involves dynamical subsystems in interaction; in many cases we have to consider intelligent agents acting on other intelligent agents. The notion of mechanical causation is therefore insufficient, but logical notions like logical inference (→) lack the necessary kinematics and dynamics. A proper approach could start from complexity theory as proposed by Prigogine and Nicolis (1989) and use the specific tools of this mathematical theory as constructive devices (cf. above).

Two „archetypes of complexity“ are:

- the symmetric or pitchfork bifurcation (first derivative: $- x^3_s + \lambda x_s$),
- the limit point bifurcation (first derivative: $- x^2 + \mu$).

Figure 9 illustrates these archetypes of complexity (cf. Prigogine and Nicolis, 1989: 95).

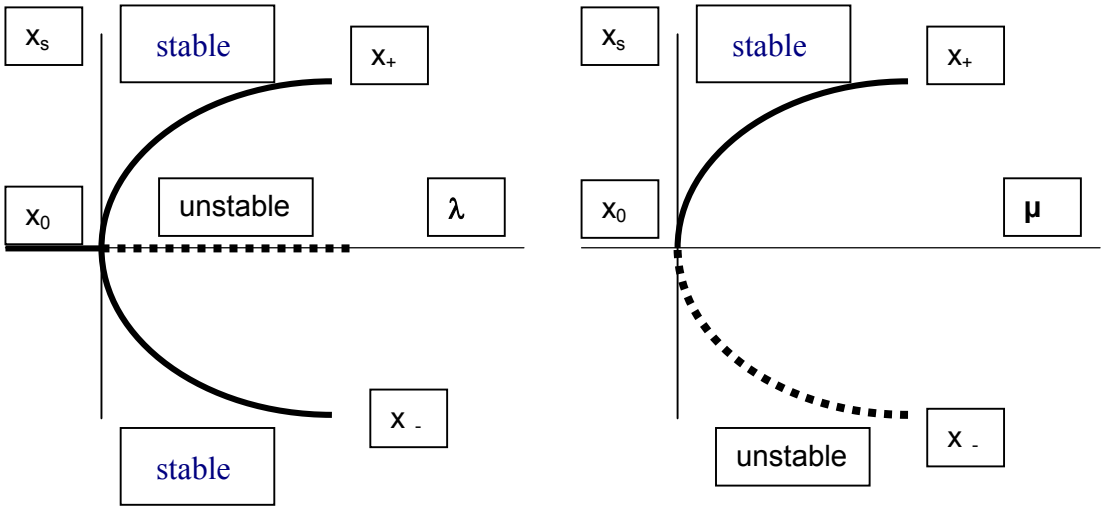

Figure 9: *Two examples of „archetypes of complexity": symmetric (pitchfork) bifurcation (left) and limit point bifurcation (right)*

The asymmetrical archetype (at right) may be iterated and we get a generalized bifurcation exemplified in

Figure 9 (cf. Wildgen, 1994: 151). If we eliminate the unstable branches, we get the evolution of a choice situation. Many causalities involving intelligent agents are comparable to a scenario of repeated choice with corresponding information gain. Figure 6.6 shows the bifurcation diagram of new solutions(cf. Prigogine, 1980).

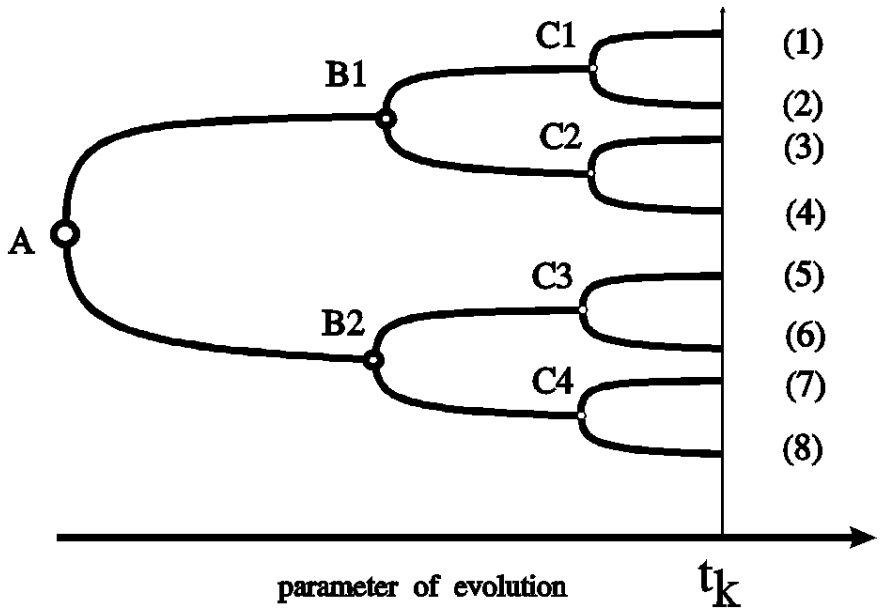

Figure 10 *Bifurcation diagram of a dynamical system*

The members of the set: {1, 2, 3, 4, 5, 6, 7, 8} are possible states of the system at a fixed time t_k in the evolution. One may say that the set of alternatives is identical to this set as long as the factual evolution is not known. In the real evolution of the system stochastic fluctuations decide which alternative is actually chosen by the system. If all choices are made we get the situation shown in Figure 11.

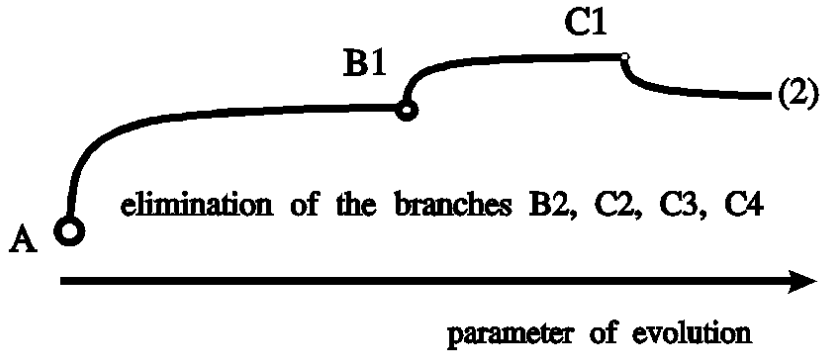

Figure 11 **Evolution with choice of branches**

At time t_k in the evolution only one state of the system (2) exists and it is the result of specific choices (bifurcations with choice) at the points A, B1 and C1. The whole process may be modeled following Carnap and Bar-Hillel (1952) as an information process with information = 0 at the start and information = Id8 = 3 in the final state.[5] If the process chooses the path to

[5] At each point A, B, C the system offers two choices and can eliminate half of the alternatives (in A first the alternatives 5, 6, 7, 8, were eliminated). In total 2^3= 8 choices were possible. The probability of each choice (in relation to the totality of choices) is p = 1/8 (if the states are equi-probable in

B1 at bifurcation A, then it restricts all further evolutions to the set B1 and thus it is richer in information.

5.3 Routes to Chaos

I have already discussed iterated logistic mappings in chapter 1. Feigenbaum was able to show the universality of this type of route to chaos (it has a constant ratio of geometric progression δ= 4,669201609102....). Another route was shown by Ruelle and Takens who proved that the structural stability of trajectories breaks down if the attractor has three or more dimensions. This means that the addition of some complexity can produce chaos; chaotic scenarios must therefore be systematically considered in systems with more than two dimensions. Chaos can coexist with order; Prigogine and Nicolis (1989: 132) state that „disorder in a certain range is perfectly compatible with order at a different range". Causality (mainly if iterated or occurring in multi-modal systems) should show chaotic scenarios or even have a trajectory showing chaotic *and* order phases. As the thermodynamic concept of causality implies possibility *and* necessity, the fourth category in Kant's table is subjected to the same argument. In short the chaotic scenario is also a schematism although it does not fit the original ideals of order in a Kantian epistemology. As a schematism it can be interpreted in specific phenomenological domains and lead to specific types of categories.

5.4 Synergetics of very complex systems

The thermodynamic schematism of Prigogine fits chemical reactions and patterns of chemical self-organization, but it is not evident how the domain of complex systems, like biological systems, ecosystems and symbolic systems (in human societies), can be described in this fashion. These systems are often characterized by the cooperation of many subsystems. In this cooperation, new phenomena of order appear, i.e., specific dominant modes tend to slave an enormous multitude of subsystems, such that their freedom is dramatically restricted and a collective mode of self-organized order is reached (which may be stabilized by selective advantages and thus be inherited). The underlying schematisms are statistical flows; i.e., the dynamics of the systems operate on statistical distributions and their evolution in time. Order is possible if the statistical flow reaches a sharp peak in a specific area. Thus the choices of individuals relative to a specific language (cf. Wildgen,

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themselves). If finally *one* branch is chosen from 8 possibilities, the information value is one to eight. The information is a measure of the reduction on the universe of possible solutions. Information = ld (dual logarithm) 1/p. In our case: p = 1/8 = ld1/1/8 = ld8 = 3.

1986), or a linguistic variable can fluctuate over individuals, situations, localities, in time. If a slaving parameter arises, the causally operative factors loose their impact and significance to the profit of one or two, which „slave“ the whole system. This may be repeated and if cultural memory conserves the different modes of order, very complex ordered systems may appear (emerge). A model of synergetic self-organizations in the linguistic (semiotic) system could be conceived along these lines. Such a model is relevant for a philosophy of language insofar as linguistic conventions formed by social self-organization could influence our ways of perceiving and understanding the ambient world (cf. recent work in cognitive anthropology). This gives a new dimension to the conflict between Herder and Kant in the late 18th century (in current cognitive linguistics the conflict is called linguistic relativism vs. objectivism, cf. Lakoff, 1987).

5.5 Consciousness and computability

If the collective and historical process of language „making“ is described by a schematisation of statistical flows, one could object that the description is only valid for the domain of complex but unconscious processes. What about conscious operations of the mind, human will, etc.? What about Descartes' „Cogito ergo sum“? Penrose (1994) warns us that „the strait-jacket of an entirely computational physics or of a computational cum random physics“ cannot explain the phenomena of „intentionality and subjective experience“ and he advocates a new cognitive science based on quantum dynamics. Such a theory could define a new type of schematism which covers the transition between pure perception and linguistic categorization taking account of the non-computable factors called intentionality and subjectivity. This line of research has not yet been considered in linguistic philosophy and I can only point to it as a possible future development.

6 Summary

The dynamical and topological conceptualizations proposed in this contribution introduce a new basic tool complementary to the use of formal logic in philosophy (e.g., analytical philosophy). It puts the Cartesian strategy, which starts with a schema of the whole dynamical configuration and focuses down to sub-parts of the schema „from the head to its feet“. This allows an integrative view of a multitude of coexisting theoretical issues. The dynamical and topological character of the schemata we have used has the advantage that time (evolution, process) and space (spatial structure) can be conceptualized and that dynamical and causal explanations become accessible.

Several families of schemata were proposed:

- Schemata of structural stability (applying catastrophe theory),

- schemata of chaotic attractors (applied to self-referential processes and period-doubling),
- schemata of order far from thermodynamic equilibrium (dissipative structures),
- schemata for the slaving in complex interactive systems (synergetics),
- finally, quantum models of consciousness and subjectivity have been roughly sketched.

These schemata are helpful in the overall organization of a philosophical paradigm and in the interpretation of large scale historical processes.

In the case of language philosophy I showed how the hierarchy of catastrophes can be further exploited. The schema with four components describes the totality of the problem. Specific traditions focus on dynamical components of the total schema. In further elaborations chaotic, thermodynamic and synergetic processes could be schematically described.

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