

Vegetative, Animal, and Cultural Semiosis: The semiotic threshold zones

The paper develops the concept of a "semiotic threshold zone" and a classification of major levels of semiotic systems, looking at this as both a theoretical and an empirical problem. The concept of a semiotic threshold zone both specifies and generalizes the notion of a semiotic threshold and is necessary in order to describe and understand the events that enable a system in its evolution to cross the threshold between the levels, and also at the same time to maintain it. The existence of systems based on different types of semiosis leads to secondary and tertiary semiotic threshold zones, in addition to the lower (primary) one that distinguishes semiotic and non-semiotic systems. We argue for the secondary threshold zones being the indexical and symbolic ones, which correspondingly separate the vegetative and animal semiosis (at the indexical threshold zone), and animal and cultural semiosis (at the symbolic threshold zone). We also argue that indexical semiosis is responsible for spatial representations and symbolic semiosis for temporal representations, which means that the vegetative *unwelten* are both non-spatial and non-temporal, the animal *unwelten* being spatial but non-temporal, and the cultural *unwelten* (*Lebenswelten*) being both spatial and temporal. Within these types of semiosis, the tertiary threshold zones could be found.

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1. Introduction: The birth of the concept

Despite the fruitful development, and the already quite extensive bibliography of biosemiotics, there is no general agreement yet among semioticians themselves on the scope of applicability of semiotics, or, in other words, on the placement of the lower semiotic threshold (e.g., Short 2007, Deely 2008, Nöth 2001).¹ The basic features which go together with semiosis include the possibility to make mistakes (or fallibility), and an intentionality in a very broad

sense.² Thus it is worthwhile, when speaking about semiosis in organisms, to demonstrate as clearly as possible the existence of these features. The controversies stemming from the different views concerning the minimum features for semiosis can then be solved by determining the secondary semiotic thresholds. This will allow us to map these different definitions onto the ladder of thresholds.

The concept of a *semiotic threshold zone* came up in the process of jointly writing a manifesto of biosemiotics with Jesper Hoffmeyer, Terrence Deacon, Claus Emmèche and Fredrick Stjernfelt in Saka, Estonia, August 2–5, 2008. When trying to formulate once again our understanding of the precise conditions for semiosis to appear, i.e. the lower semiotic threshold, we listed a series of specific characteristics of the mechanism that brings semiosis into existence. These characteristics may include memory,³ self-replication,⁴ recognition,⁵ agency,⁶ inside-outside distinction,⁷ codes,⁸ semiotic controls,⁹ etc. Evidently, these characteristics in many cases support each other or (sometimes perhaps mutually) presuppose each other, most of them appearing closely together with the first cell; however, there is no reason to assume that they appear at exactly the same time. Before the life process or semiosis (that has lasted and functioned uninterruptedly for about two billion years) started, there could have been an intermediate series of events, which brought together the necessary components of the entire semiotic machinery. This view is close to a contemporary common understanding of the beginning of life, according to which life did not take its origin through a single unique step, but through a multitude of steps (and possibly several branches, some of which were temporal and later disappeared entirely). As such, the border between life and non-life turns quite fuzzy in principle. This is why we need to speak about *threshold zones* instead of just *thresholds*, which have been treated as univocal qualitative jumps by the

- 2 On intentionality as a general feature of life, see also, e.g., Kull, Emmèche & Favreau (2008: 46), Zlatev (2003), Deely (2007). "The perception by organisms of their surroundings is, from the beginnings of life, already embedded in [...] their corporeal intentionality" (Hoffmeyer 2008: 311).
- 3 Memory of any form (e.g., genetic, epigenetic, neural, social) by definition assumes oblivion; see, for instance, Neuman (2008: 229ff).
- 4 An ability to make a copy of itself; see Sharov & Kull (1990), Kull (1993).
- 5 An ability to identify a pattern or to distinguish between patterns on the basis of memory; see, e.g., Paterson (1993).
- 6 A unit system with the capacity to generate end-directed behaviours; see Hoffmeyer (2008: 13, 32).
- 7 See Emmèche et al. (2002: 17).
- 8 See Hoffmeyer & Emmèche (1991), Barbieri (2003).
- 9 See Pattee (2007).

1 See also discussion in Nöth (2000), Santarla (2001), Schonauer (1998), Jungberg (2001), and the thematic section on "Semiotic thresholds" in *Sign Systems Studies* 34 (1), 2006.

major tradition in semiotics up to now. Evidently each semiotic threshold is, upon a closer look, rather a semiotic threshold zone; each semiotic threshold implies a threshold zone.

Thus, for instance, Terrence Deacon and Jeremy Sherman (2008) have developed a model of the autocoell, which possesses several important features of the cell, basically autocatalysis and self-assembly, that together give the possibility for a mutation-based evolution, still without any process of translation or any codes involved. The appearance of autocoells, according to Deacon, could take place repeatedly, in most cases without continuous life resulting.

Such a series of closely connected circumstances that together form the transition process from non-semiosis to semiosis is what we call the lower semiotic threshold zone. Analogously, the transitions from one qualitative level of semiosis to another (in the cases which are step-like and therefore could be called semiotic thresholds) would presumably, when considered more closely, be semiotic threshold zones. Accordingly, attempting to solve the problem about the lower semiotic threshold at once raises the problem about the secondary semiotic thresholds – first of all, perhaps, between vegetative and animal, and between non-human and human.

2. The lower semiotic threshold zone

The concept of lower semiotic threshold was introduced by Umberto Eco in his book *A Theory of Semiotics* (1976: 6, 19–22). Eco described the lower semiotic threshold as follows: “By *natural boundaries* I mean principally those beyond which a semiotic approach cannot go; for there is non-semiotic territory since there are phenomena that cannot be taken as sign-functions” (Eco 1976: 6). At that time, Eco was relatively certain about where this threshold was situated. He stated: “One must undoubtedly exclude from semiotic consideration neuro-physiological and genetic phenomena, as well as the circulation of the blood or the activity of the lungs” (Eco 1976: 21). He added, however, “that one should consider this lower threshold more carefully and with greater attention” (Eco 1976: 21).¹⁰

A few years later, a group of six leading semioticians published a collective work in which they argued for the placement of the lower semiotic threshold at the boundary of life (Anderson et al. 1984). Accordingly, the whole of biology was included into the semiotic realm.

¹⁰ In our recent conversation (August 2008), Eco has accepted a possibility of the existence of semiosis at the cellular level.

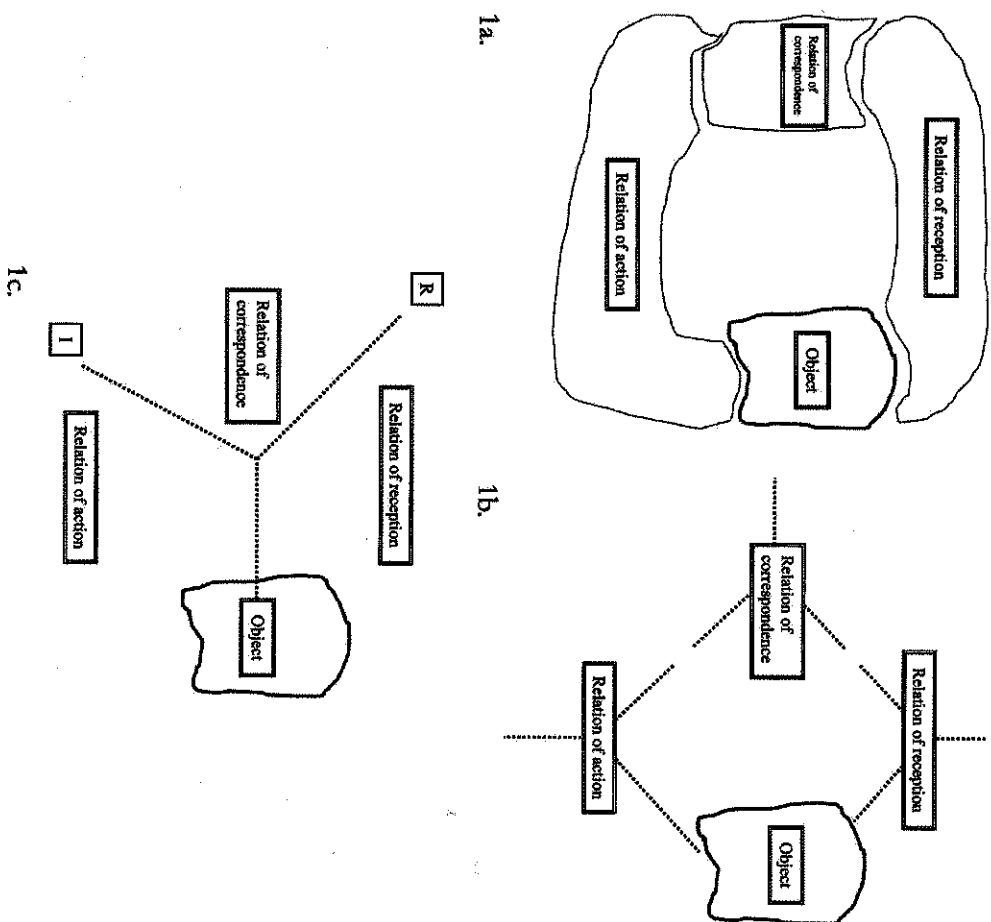


Figure 1. Functional cycle, (a) close to the representation given by J. Uexküll (1928), indicating its relational structure; (b) a version demonstrating that functional cycle consists of triadic relations; the open lines of triads indicate the relations to memory; (c) modelled as a single triadic relation (R – *representamen*, I – *interpretant*).

Thomas A. Sebeok has repeatedly stated that semiosis and life are coextensive. “Because there can be no semiosis without interpretability – surely life’s cardinal propensity – semiosis presupposes the axiomatic identity of the semiosphere with the biosphere” (Sebeok 2001: 68).¹¹ Biosemiotic studies, in

¹¹ Another formulation is in Sebeok (1996). For more details about Sebeok’s Thesis see Kull et al. (2008: 43).

their further development, have argued for the lower semiotic threshold to occur at the appearance of a living cell with its agency, memory, inside-outside and self-other distinctions, functional cycles¹² (Fig. 1), and perhaps *umwelt*.¹³ Martin Krampen (1997) has identified Jakob von Uexküll's concept of functional cycle as a model of semiosis. Due to its operational characteristics, the existence of a functional cycle has been used as a criterial feature for the identification of semiosis, particularly in the discussions on the existence of semiotic behaviour in plants, tissues, and single cells (Uexküll et al. 1993, Kull 2000).

Research on biological sign processes has been growing quickly (for a review, see Kull 1999, Kull et al. 2008). Within the last two decades it has become widely accepted within biosemiotics that the semiotic approach is an appropriate tool to describe all living systems, down to the first cells. There are many works in which the semiotic phenomena at the cellular level have been analysed (Emmeche 1998, Emmeche et al. 2002, Hoffmeyer 1996, 2000, 2008, Kawade 1996, Barbieri 2003, etc.).

With the introduction of the concept of the lower semiotic threshold, certain problems involving its correspondence to C. S. Peirce's approach appear. For Peirce, semiosis starts from the situation of lawless chaos; laws then develop as habits. Thus Peirce does not accept universal laws in the sense that modern physics does – since the latter assumes something which in principle (by definition) can never err. The universal physical laws (like the conservation of energy and the conservation of momentum) are described in contemporary physics as certain fundamental symmetries (according to Noether's theorem) that are strict and unavoidable conditions for all processes. These symmetries determine what may happen. Within the framework of these symmetries, certain regions (combinations of processes) exist, which result on the one hand in autocatalytic feedback, and on the other hand in stochastic indeterminacy, an example of which is a dissipative system. Certain situations in these (quite chaotic) systems can be seen as corresponding to the Peircean assumptions of the primary appearance of habits, or rules of mind, or semiosis. These are the conditions where relations¹⁴ may appear. A relation is anything that cannot by itself affect, neither be directly recognized by, anything except another relation. This is exactly what is true for a meaning – meaning exists only for another meaning, or a sign only for another sign. Or, as Jakob von Uexküll once

(slightly sarcastically) remarked:¹⁵ “those who cannot see the meanings seemingly lack the appropriate organ [...]” Or, with another formulation: a sign is anything that requires for its detection a living device; whereas in order to recognize it *as a sign*, to recognize a relation as a relation, no less than a semiotic animal¹⁶ (= a human) is needed.

The pre-biological indeterminacy of dissipative and chaotic systems (the Firstness) is the condition for dyadic relations (Secondness), whereas it is only with triadic relations (with Thirdness) that life, the plural world,¹⁷ starts. From that moment on true signs and semiosis exist, from which different types of signs can evolve.

3. The secondary semiotic thresholds

Once inside the world of semiosis, the question of further classification naturally arises. This is connected to the question whether the large variety of types of semiosis in different organisms, from a cellular to a self-conscious human communication, presents a variability that is entirely gradual, or whether it may include sharp qualitative changes. Here at least three main (alternative) approaches exist:

- (a) Once there is a sign (in the Peircean sense), it always has its three facets, and thus any sign process includes its Firstness, Secondness, and Thirdness, or, in a simple formulation, its iconic, indexical, and symbolic sides. However, these may not be expressed to an equal extent. This means that it is impossible to have a sign that would entirely lack, for instance, symbolicity, or indexicality (as, on the contrary, is assumed by approach (c)). Perhaps one of T. Sebeok's descriptions (particularly in some of his earlier writings) of biosemiotics can be interpreted in this manner. Thus, Sebeok points to “[...] the remarkable parallelism between [...] systematists' P-A-F [plant-animal-fungus] model and the classic semioticians' O-S-I [object-sign-interpretant] model” (Sebeok 1997: 441). This is because “on this macroscopic scale animals can be catalogued as intermediate transforming agents between two polar opposite life forms: the composers, or organisms that ‘build up’ [plants], and the decomposers, or organisms that ‘break down’ [fungi]” (Sebeok 1988: 65, see also Sebeok 1988: 72n1). “According to this, in general, a fungus/interpretant is mediately determined by an animal/sign, which

¹² See Uexküll (1982 [1940]: 32, fig. 1).

¹³ See, e.g., the chapter “Umwelt theory” in Hoffmeyer (2008: 171ff).

¹⁴ See a review on the concept of relation in Bains (2006).

¹⁵ Uexküll used the word *Bekannungsstadium* (Uexküll 1940).

¹⁶ In the sense of Deely and others (Deely et al. 2005).

¹⁷ On semiosis as the process that makes the world locally plural, see Kull (2007).

is determined by a plant/object (but plant/fungus are likewise variant life forms, of course, just as object/interpretant are both sign variants)” (Sebeok 1999: 391). This could give a preliminary idea for semiotic modeling of trophic cycles in ecosystems,¹⁸ but it can barely serve as a basis for sharp distinctions; in a further inquiry, all organisms both decompose and produce, and all are intermediates in the trophic cycles.

(b) The taxonomic classification of the types of semiosis follows the division of organisms into kingdoms of bacteria, protista, fungi, plants, and animals. From these, the terms bacterosemiosis, protistosemiosis, mycosemiosis,¹⁹ phytosemiosis, and zoosemiosis have been derived.²⁰ These largely genealogical distinctions, if continued, have to include then as a first distinction the separation between the archbacterial and eubacterial semiosis, according to our knowledge about the major evolutionary groups of cells. The analysis can, of course, be done in this way if it is to follow the attempts at a phylogenetic classification. However, since the main power of semiotic modeling concerns the differences in the logical functions of semiosis, such taxonomical classifications based on historical (phylogenetic) divergences may not result in any profound functional typology.

(c) The distinction between the types of semiosis corresponds to the levels of logical complexity of semiosis. If the growth in complexity is not what always takes place in evolution, then this is where the concept of semiotic thresholds may be applied with profit. For instance, T. Deacon (1997) has given a detailed account of the symbolicity threshold – the one that distinguishes human language from other sign processes.²¹ Accordingly, there can be more semiotic thresholds.²² Assuming the symbolicity threshold zone is placed and characterised correctly by T. Deacon, it is reasonable to ask whether there are additional thresholds between the lower and the symbolicity threshold zones. If we assume that the threefold classification of semiosis into iconic, indexical, and symbolic has an ontological status, the lower

threshold is also the iconicity threshold zone, and there is evidently an indexicality threshold zone existing in-between.

In the latter (c) sense of the distinction between the levels of semiosis, quite often the terms phyto-, zoo-, and anthroposemiotics have been used. However, since “phyto” directly refers to plants (with a flavour of an archaic classification between the kingdoms which included bacteria, protists, and fungi under botany), it is certainly better (i.e. as corresponding to the levels of complexity), instead of speaking about phytosemiotics as the study of phytosemiosis or the semiosis in plants, to use the term *vegetative semiosis* that will include the cellular and tissue level of most groups of organisms, but not limiting it to plants on a phylogenetic basis.

In this case,²³ the major types or levels of evolutionarily or ontogenetically established²⁴ relations, i.e., of the sign relations that life can create – will be,

- (1) Vegetative, which is capable of recognition – iconic relations;
- (2) Animal, capable for association – indexical relations;
- (3) Cultural, capable for combination – symbolic relations.

A history of this typology ultimately goes back to the classical Aristotelian distinction between *anima vegetativa*, *anima sensitiva*, and *anima rationale*. The doctrine of Thomas Aquinas, similarly, included the view that in the first stage of embryonic development, the vital principle has merely vegetative powers; then a sensitive soul comes into being, and still later this is replaced by the perfect rational soul (Kull 2000).

Stjernfelt (2003: 488–489) characterized (not without his good sense of humour) the iconic threshold (in the sense we use it here) as “the Sebeok threshold”, the indexical threshold (in the sense of the current study) as “the Merleau-Ponty or Lakoff threshold”, the symbolic threshold as “the Eco threshold”, and the lack of the lower threshold as “the Peirce threshold”.²⁵

More recently, Jablonka et al. (1998, 2005) distinguished between four major inheritance systems: epigenetic, genetic, behavioural, and language-based/symbolic. As it is based on different types of memory, this typology has

18 Cf. Krampen (2001).

19 Krampen (1997).

20 See e.g., Brier (2008: 46).

21 See also the discussion on Deacon’s arguments, e.g., Lumsden (2002), Cowley (2002), Sonesson (2006), Villers (2007).

22 The importance of defining more semiotic thresholds has been emphasized also by Frederik Stjernfelt (2003) and Göran Sonesson (2006: 203).

23 Accepting (c), together with Deacon’s (1997) approach.

24 Including evolutionarily or ontogenetically learned relations.

25 Stjernfelt (2003: 489) also discusses the possible existence of an “Uexküll threshold” (related to functional cycles), a “threshold of diagrammatic representation”, a “Husserl threshold” (related to consciousness), and a “Searle threshold” (related to conscious linguistic acts of communication).

to be in a certain correspondence with a semiotic classification.²⁶ Since epigenetic and genetic memories are both features of almost any cell and are thus always found together (an exception would mean a complete lack or non-activity of chromosomes), these two may concern one and the same (i.e. vegetative) level. Thus the result is the analogous classes (vegetative, animal, and cultural) as described above.

Here, we follow a Peircean-like triadic classification. However, this has to be taken as a (first) model, whereas the development of a more adequate typology is evidently an empirical problem.

Accordingly, the main types of *unwelten* as distinguished on the basis of different types of semiosis involved, may be separated by semiotic threshold zones, because the *unwelt*, as a general characteristic of all living beings, is not only individual and species-specific, but also varies considerably as to its type between different forms of living systems. A most general typology would distinguish between three major types of *unwelten*: vegetative (non-spatial and non-temporal – solely iconic), animal (spatial and non-temporal – exclusively iconic and indexical), and cultural (spatial and temporal – iconic-indexical-symbolic).

If so, then the two main *secondary threshold zones* lay between (a) vegetative and animal life (the indexical threshold zone), and (b) animal and human life (the symbolic threshold zone).

Tertiary semiotic thresholds (and accordingly, threshold zones) may have a bearing, e.g., on the appearance of eukaryotic cells (or sex), of emotions, of mimetic capacity,²⁷ etc. The only way to find these thresholds is on the basis of a combination of semiotic modeling and empirical studies.

An additional point is needed here on relating the levels to logic, learning, and the major sign types.

Semiotics is logic – so understood already by both John Locke and Charles Peirce.²⁸ If so, then the various types of semiosis can be characterised in terms of differences in logic. Since we are dealing here with the main typology, these can be the main logical levels.

Gregory Bateson (2000 [1972]) has related logical levels with the levels of learning.²⁹ He has distinguished between the following levels of learning:

- Zero learning – no corrections;
- Learning I – correction of errors of choice within a set of alternatives;
- Learning II – corrective change in the set of alternatives from which a choice is made;
- Learning III – corrective change in the system of sets of alternatives from which a choice is made
- Learning IV – a change in learning III.

I would define learning simply as an establishment of new sign relations together with accompanying habituation. This would include both ontogenetic and phylogenetic learning. This definition is seemingly only slightly more general than that of used by G. Bateson, but, as a result, it shifts his types of learning into a quite good correspondence to the levels of semiosis.

When “naturalizing” semiosis, i.e. analysing the mechanisms that work as sign processes (this is what biosemiotics mainly does), we can observe that semiosis is always based on mechanisms that can learn, which would include both the establishing of new relations, and the modification of existing relations.

From this, we can infer that Bateson’s zero learning is a characteristic of the dead – i.e., of many machines and other mechanical artefacts, where the relations are built in, but unable to be modified by learning. Accordingly, Learning I is what is available for all living organisms – if not within a single life cycle, then at least during many – they can change their relations, i.e. change the specificity of response. Furthermore, one may wonder whether we can say that Learning II is a characteristic of animal semiosis, whereas Learning III is available only to cultural beings. According to Bateson, this is not quite so. I guess the difference comes from the fact that he uses a slightly narrower definition of learning. However, learning IV, as he says, “probably does not occur in any adult living organism on this earth” (Bateson 2000: 293). But here I want to stress a more general consequence from this.

The consequence is – which is at least interesting – that the sequence icon-index-symbol is also a sequence of levels of learning. This would correspond well to the understanding that the symbol’s capacity for growing is richer than that of the index (before it grows into a symbol, of course), and so on.

The simplest semiosis means that relations are in a sequence – and not just in a sequence, but in a recursive sequence – in a circle. The recursive sequence of relations is equivalent to functional cycle, as Uexküll has described it. This simple type of semiosis can be identified with iconic semiosis.

26 Further details see in Kull (2005).

27 See Zlatov (2003).

28 Detailed references see in Daledalle (2000: 78).

29 Cf. Goldammer (2007).

In a sequence, however, the relations follow each other, but the relations do not yet relate relations as such. In the case of associating functional cycles a further level will be reached.

In order to establish relations between functional cycles, a functional cycle as a whole has to become somehow recognisable. A relation that is just branching out from a sequence of relations does not yet make a real difference – it would be simply a branched functional cycle. At any point of a functional cycle, it is as yet only such a point, and not a cycle as a whole.

Categorisation is different – it provides a new level of semiosis. A category is a self-maintaining communicatory unit. A common example of it is a perceptual category. The relations established between categories (via a functional cycle) create indices.

While indices are available, they can build maps, which form complex icons (from which most of human semiosis starts out, because for a human eye these can be very simple indeed), which is necessary in order to allow symbolic relations to grow.

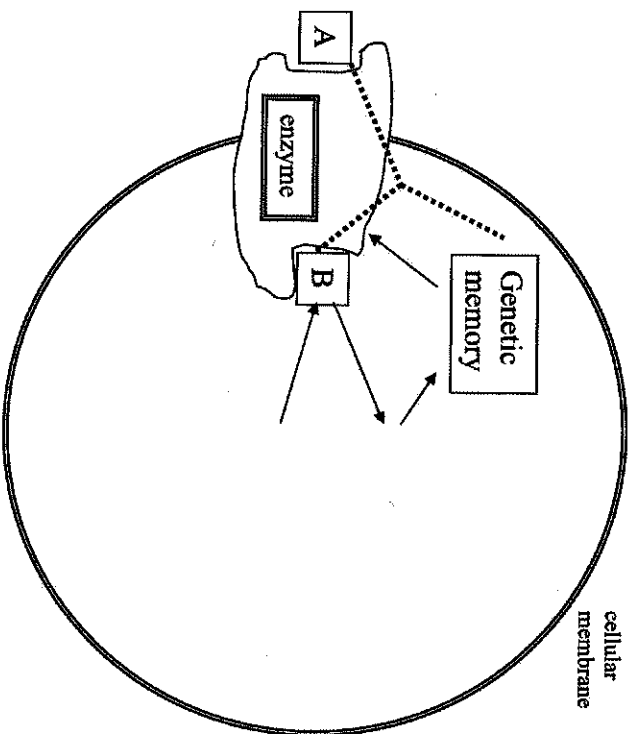


Figure 2. A relationship between the molecules A and B via a memory-bound enzyme as a triadic relation (see the explanation in text). The arrows indicate a (possibly indirect) influence of a product of B on the gene expression and the synthesis of the enzyme.

4. Vegetative semiosis

All living cells have some specialized enzymes in their outer membrane that selectively recognize substances in the environment and convey the signal to the cytoplasm. These are signal transduction systems which perform a code-based mapping: this means that an enzyme that has an affinity to a certain molecule A (that happens to be a signal due to the cyclic process – a functional cycle) at its outer end (at the active site) relates that A to the entirely different molecule B on the inner side of the membrane (at the other active site of the enzyme with its specific affinity to B) (Fig. 2). The molecule A outside of the cell, which is in this way put into a correspondence to a molecule B inside the cell, may not have the slightest chemical relationship to the latter. This is not a chemical reaction between A and B, despite the fact that both the reaction of A with the enzyme and the reaction of B with the same enzyme are chemical. This is so because the relation between A and B is based on the link (between two active sites of the enzyme) which is not chemical – since it has to be remembered: the link is made by a polypeptide chain of amino acids in the enzyme molecule – i.e., by a particular chain or sequence which is as it is not due to chemical but due to historical reasons. The sequence is kept stable via its reproduction with the help of DNA, the sequence of which, in a memory function, is regularly used to restore the membrane enzymes. The same sequence cannot be repeatedly formed on the basis of chemical affinity between the neighbouring amino acids in the chain, because there are many possible next amino acids which all perfectly fit (at a given level of thermal fluctuations), and therefore a chain that would have been rebuilt in a chemical way would never repeat the sequence of the earlier chain. In the living cells the enzyme structures are remembered, and due to this, A is not only a molecule with its chemical relationships, but A becomes a sign-vehicle, a signal, due to its inclusion in a code-relation.

In addition, many cells have light-sensitive enzymes, which not only transfer the assimilated energy, but can also convey the sensed environmental change to other systems in the cell via a code-based sequence of events.

Under the influence of a substance A, a living cell has several ways to act. This includes, for instance, changes of permeability of its membrane for certain substances, changes in production or conversion of some structures, and various types of movement – amoeboid or flagelloid or cilioid. These actions often have a feedback via the recognition of a change in the environment by the sensory enzymes in the membrane.

