The End of *Capurro's Information Trilemma?* (A Proposal of an Evolutionary-Ontological Solution)[1]

Konec Capurrova informačního trilematu? (Návrh evolučne ontologického řešení)

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Abstract:
In this paper, the author pursues an analysis and interpretation of the concept of information from the perspective of evolutionary ontology in connection with the ambition of information science (and philosophy of information) to create a so-called unified theory of information. He draws attention to the problem of Capurro's information trilemma, which is unsolvable in the context of traditional approaches to information in information science, or leads to various paradoxes. Hence, the author suggests an evolutionary-ontological solution to this problem based on the definition of information as an evolving (ontically creative) process.

Key words: *Unified theory of information, Capurro's information trilemma, evolutionary ontology, information, structural and semantic aspect of information.*

Abstract:
Autor článku se zabývá analýzou a evolučně ontologickou interpretací pojmu informace v souvislosti s ambicí informační vědy (a filosofie informace) o vytvoření tzv. jednotné teorie informace. Poukazuje na problém Capurrova informačního trilematu, který je v kontextu tradičních přístupů k informaci v informační vědě neřešitelný, resp. vede k různým paradoxům. Autor proto navrhuje evolučně ontologické řešení tohoto problému, které vychází z definice informace jako evolvujícího (onticky kreativního) procesu.

Key words: *Jednotná teorie informace, Capurrovo informační trilema, evoluční ontologie, informace, strukturní a sémantický aspekt informace.*

[1] The following text is founded on a lecture given on 28 March 2014 at a multidisciplinary (international) conference held at the Faculty of Social Studies of Masaryk University in Brno titled *Evolutionary Ontology and Social Sciences*. This paper has been published – in a slightly different form – also in the conference proceedings to commemorate 75th anniversary of the birth of Josef Šmajs. See TIMKO, Marek. Návrh evolučně ontologického řešení Capurrova informačního trilematu. In TIMKO, Marek, Vratislav MOUDR a Bohuslav BINKA (eds.). *Evoluční ontologie a společenské vědy: sborník k 75. výročí narození Josefa Šmajse*. 1. vyd. Brno: Masarykova univerzita, 2014, s. 29–40.

One of the main aims of information science is to analyse information as a phenomenon, that is, to provide a description of its creation, dissemination, receipt, storage or interpretation (and the associated issue of information process and communication). *Philosophy of information*, as the fundamental theoretical prerequisite for information science, strives to characterize information in its broadest meaning and in a wide range of contexts of reality. It aims at interpreting information in the context of traditional philosophical disciplines, such as ontology (*What is information?*), epistemology (*How do we interpret information?* or *What knowledge does information transmit?),* or ethics and axiology *(How is information related to goodness? Does information have value in itself?*)

It has been a great challenge – but at the same time a long-standing ambition – for the philosophy of information (and thus also for information science) to create a so-called *unified theory of information*, which seeks to provide a unified, unambiguous and universal understanding of the meaning of the category of information within all levels of reality (physical, biological, social, technological, etc.). [2] This conception shows a certain degree of affinity with the broader view of information science according to Jiří Cejpek, who characterizes it as a science *"...about diverse phenomenal forms of information, about information flows, processes and systems, as a science about intermediation of information in society and about psychological and social effects of these phenomena and processes."*[3]

Capurro's Information Trilemma

The German philosopher and information scientist of Uruguayan origin Rafael Capurro points out that the conception of *unified theory of information* is in connection with the meaning, character and use of the notion of information in different domains of reality studied by individual scientific disciplines confronted with serious problems. Capurro pays attention to the fact that we understand the category of information and use it in a different way when we talk about genetic information that is contained in DNA, when we talk about physical (e.g. quantum) information, or when we talk about information in the usual communicative sense (information as the content/meaning of a particular communication).[4] This situation when the same term information is used for different contexts of reality is described by Capurro in three possible situations; therefore the notion of *Capurro's trilemma* has been established. The first situation is that information is for all levels of reality the same phenomenon, which is designated by Capurro as *univocity*. The second possibility is a situation in which there is a significant similarity, but not identity, between individual levels of reality. Capurro calls this situation *analogy*. The third possibility is a situation when information is something different, distinct, separate and thus incommensurable for each sphere of reality; hence designation with the same linguistic expression – "information" is only a matter of linguistic (and not a very practical) convention or consensus. This situation is designated as *equivocity*.[5]

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[2] See WERSIG, Gernot and Ulrich NEVELING. The phenomena of interest to Information Science. *The information sciencist*. 1975, **9**(4), p. 139.

[3] CEJPEK, Jiří. Co je to informační věda: stručný nástin. *I´93*. 1993, **35**(3), s. 61. Let us add that in a more narrow sense, J. Cejpek understands information science as a discipline dealing with sociocultural and technical information. See CEJPEK, Jiří. Vymezení oboru knihovnictví a informační věda pro potřeby dalšího rozvoje TDKIV. *Národní knihovna*. 2003, **14**(4), s. 229–233.

[4] A large part of these "misunderstandings" can be ascribed to "crossing" of ontological conception of information (information as organization of an existing entity) with epistemological conception (information as a carrier of meaning, as the content of a message, as the subject of cognition and communication).

[5] See CAPURRO, Rafael, Peter FLEISSNER, and HOFKIRCHNER, Wolfgang. Is a Unified Theory of Information Feasible? A Trialogue. In *The quest for a unified theory of information: proceedings of the Second International Conference on the Foundations of Information Science*. Amsterdam: Gordon and Breach Publishers, 1999. s. 9 –30.

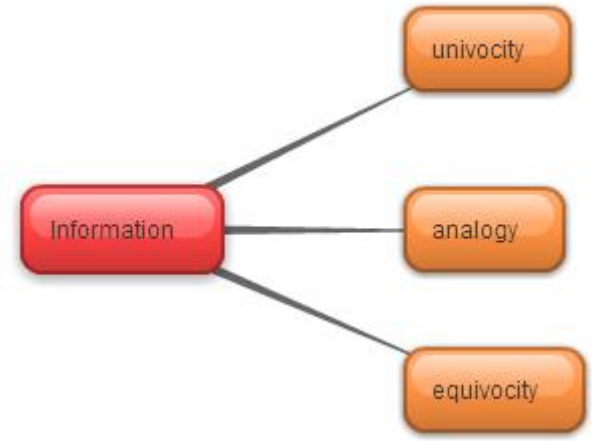

Fig. 1: Capurro's information trilemma

In order to create a *uniform theory of information*, the first option, i.e. the possibility that information is for all levels of reality *univocal,* would be probably the most convenient. At the same time, we are faced with the problem of how to explain the ontic difference of information, or variance of information in the physical, biological, sociocultural or technological world. What should this "same" be? And if there is a common "ground", why does information have so diverse manifestations? Can it be used to explain the diversity of forms of organization of reality? Furthermore, if information were the same phenomenon for all levels of reality, how can we explain the certain degree of incompatibility (or non-transferability) e.g. of biotic information (contained in animate nature) and technical information (contained in information technologies)? Thus far, neither the traditional nor the contemporary approaches of information science, or of philosophy of information, have provided a clear answer.

The second possibility, that is, that information is for different levels of reality in the position of "some" *analogy* seems to be a certain compromise. The problem of this possibility rests in finding "similar" attributes in various (different) types of information. Even the once so promising analogy between genes and memes has, over time, proved to be illusory [6] and the majority of information scientists currently embrace the view that it is only an etymological analogy, not an ontic one; thus we once again remain at the level of linguistic signs.

The third possibility, the possibility that information is *equivocal*, that is, that it is a different phenomenon for all levels of reality, in fact completely negates the possibility of formation of a logically coherent *unified theory of information*. The problem is that if such possibility were to correspond with reality, we would not be able to explain interactions between individual levels of reality.

Hence, we see that each of these thee possibilities represents a different probability of creation of a concept of *unified theory of information* and that each of them brings its own, specific problems. How to get out of this trilemma? And is there a "solution" at all? We are convinced that a solution to *Capurro's information trilemma* exists and that it is offered and represented by evolutionary-ontological conception of information. Let us examine it more closely.

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[6] R. Dawkins openly admits that he created the term "meme" as a linguistic analogy to the term "gene". Cf. DAWKINS, Richard. *Sobecký gen*. Dotisk 1. vyd. Praha: Mladá fronta, 2003. 320 s.

However, even Dawkins himself gradually arrives at the conclusion that in case of such information units there is no real analogy either in their creation, or in the manner of their transmission, dissemination or interpretation, or their function. On the contrary, he realizes that there are more differences than common features.

Evolutionary-Ontological Conception of Information

Evolutionary ontology[7] (hereinafter EO) conceives information as a basic ontological category enabling us to describe ontological reality in a comprehensive manner and in its procedural (developmental) character. The fundamental thesis of EO is the existence of two types of evolution that arise and proceed differently – *evolution of nature* (cosmic and terrestrial; inanimate and animate), which is the result of residual activity of the big bang and *cultural* (artificial) *evolution,* which is determined by the existence and conscious/purposeful activity of humans. Information is then both the very prerequisite of evolution (of nature as well as of culture)[8] and its resulting product. Within this ontic "division" of reality into two distinct types of organization, we may distinguish between *natural* (non-artificial) *information* and *socio-cultural* (artificial) *information*. Using this ontic distinction, we can describe – both within nature and within culture – inanimate (abiotic) systems [9] and animate (biotic) systems.[10].

In addition, each type of information has its *structural* and *semantic aspects* that are interrelated.[11] *Structural aspect* means the internal organization of the elements of the system described; *semantic aspect*, on the other hand, means the external qualities or functions/meanings of the system described.

[7] This part of the paper is the author's interpretation and paraphrase of the essential texts of Josef Šmajs, in which the evolutionary ontology model is formulated, but at the same time is subject to continuous change: ŠMAJS, Josef. *Drama evoluce: fragment evoluční ontologie.* Praha: Hynek, 2000, 188 s., ŠMAJS, Josef a Josef KROB. *Evoluční ontologie*. Brno: Masarykova univerzita, 2003. 399 s., ŠMAJS, Josef. *Filosofie – obrat k Zemi: evolučně ontologická reflexe přírody, kultury, techniky a lidského poznání.* Praha: Academia, 2008. 432 s. ŠMAJS, Josef. *Ohrožená kultura: od evoluční ontologie k ekologické politice*. 3. (upravené a rozšířené) vyd. Brno: Host, 2011. 272 s., ŠMAJS, Josef. *Ohrožená kultura: od evoluční ontologie k ekologické politice*. 3. (upravené a rozšířené) vyd. Brno: Host, 2011. 272 s.

[8] Since the amount of energy in our universe is constant and matter is only a kind of "condensed packet of energy", the only thing "subject to" evolutionary change, i.e. evolving, is the organization of reality, in other words, what we describe with the category of information. It should be noted that we do not understand evolution in its narrow (and often also ideological) sense, that is, only as an increase in the degree of organization, but as any change of organization (i.e. also as entropic processes).

[9] Inanimate (abiotic) systems are in nature represented by physical or chemical systems (e.g. subatomic particles, radiation, chemical elements and their compounds, etc.); in culture they are constituted by artificial products of human activity (so-called *material culture*).

[10] Animate (biotic) systems are in nature represented by biological systems (living organisms, e.g. bacteria, plants, animals); in culture they are constituted by the contents and meanings of human activity (so-called *spiritual culture*) that are stored in human central nervous system and can be viewed as psycho-physiological information processed and phenomena.

[11] A more detailed argumentation and substantiation of the interrelatedness of structural and semantic aspect of information has been provided (and defended) by the author of this paper in his doctoral dissertation: TIMKO, Marek. *Evolúcia – informácia – skutočnosť. (Evolučno-ontologická perspektíva)* Brno, 2009. Dostupné z: http://is.muni.cz/th/162688/ff_d/Timko_Dizertacna_praca.pdf. Dizertační práce. Filozofická fakulta Masarykovy univerzity. Vedoucí práce prof. PhDr. Ing. Josef Šmajs, CSc.

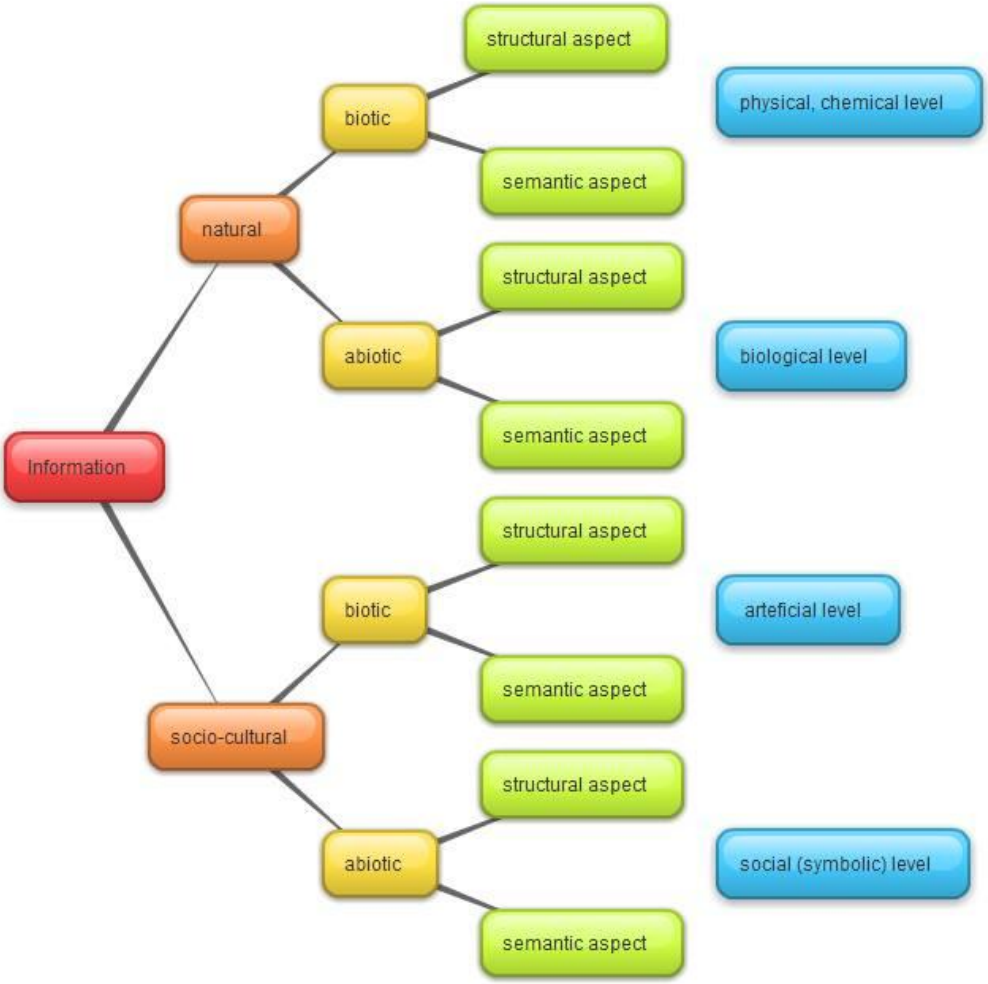

Fig. 2: A diagram of evolutionary-ontological conception of information

For clarity purposes, mutual links and relations between the structural and the semantic aspect of information will be demonstrated on several examples: The lead (in a pencil) is in terms of its chemical composition carbon. If we had a look at its internal structure, we would see a cubic crystalline matrix of individual carbon molecules. This specific internal organization is externally manifested by specific physical-chemical properties of the lead – it is soft and leaves a mark on paper. If we examined a diamond (which is, chemically speaking, the same carbon), we would encounter a more complex internal organization than it was the case in lead. Higher complexity of carbon molecules in diamond manifests itself through different physical-chemical properties (it is the hardest mineral existing in nature). A change of the structural aspect of information of an abiotic system thus also changes the semantic aspect (other properties are determined by different type of internal organization).

If we looked at natural biotic systems, we would discover that their structural aspect is the internal organization of organisms, that is, differentiation and complexity of their individual parts (of bodies, organs, tissues, on lower level cells; and if we continued to the lowest and most fundamental level, we would get to DNA/RNA organization). In simpler terms, we might identify the structural aspect of an animate system with its genotype. The semantic aspect is represented by external manifestations and properties of these subsystems that we might (again as a simplification) identify with phenotype. A change in the structural aspect (e.g. by mutation of DNA) results also in a change of the semantic aspect – it may even lead to occurrence of a new biological species (with new, more adaptable phenotype), or, which is

a more common occurrence, as a result of an impaired adaptation to external environment, an organism does not further reproduce or becomes extinct.[12]

A more common example of the dependence of the semantic aspect of information on the structural aspect can be illustrated by the smallest communication units of socio-cultural information – by words. Each word in the system of ethnic languages has both its structure (expressed through sound or graphic form), and its meaning (or meanings). The structural aspect of the word *ples* (in English*: a ball*) is the syntactic ordering of the graphemes (in case of a written word). A small change of such organization, e.g. replacing letter *s* with letter *š*, results also in a change of the semantic aspect of such information (the word *pleš* (in English: *a bald patch*) has a different meaning than the word *ples).*

Having presented the basic division of information within EO and having characterized the interrelatedness of the structural and semantic aspect of information, we will attempt a comprehensive definition of the category of information. It is surprising that the author of the conception of EO – J. Šmajs – does not provide a definition of information in his texts – a definition that would be in line with the evolutionary-ontological framework; what he provides are rather specific and particular characteristics of information in different contexts (e.g. information as "organization", "order", "degree of memory", "message content" or "communication content").[13] With regard to the theoretical positions of the EO conception, we thus propose the following definition: *Information is the structural-semantic aspect of a matter-energy evolving process*.[14]

A Proposal of an Evolutionary-Ontological Solution of Capurro's Information Trilemma

If we view *Capurro's information trilemma* from the perspective of evolutionary ontology and if we interpret information in accordance with the aforementioned definition, we will find that the three options stated by R. Capurro are in fact just three different aspects of an evolving reality, i.e. that they represent just three different angles of looking at the same thing.[15]

Evolutionary-ontological conception conceives information as *univocal* in the sense that at any level of reality (physical, biological, social or technical) the unifying element is formed by the structural-semantic aspect of information. Needless to say, forms and manners of organization on different levels (in particular configurations) differ; however, that does not negate the fact that the structural aspect of information is fundamental for all types of information. The semantic aspect depends on the structural aspect (it is the "external manifestation of the internal", i.e. an explication of the implicate), as well as on the broader context or the interpreting "subject" (system).[16]

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[12] It is important to bear in mind that the semantic aspect of information is not determined only by encoding of information in matter-energy (physical-chemical) carrier, but that it is co-created by the context, and thus by the environment in which the information process takes place. In different contexts, the same structural aspect of a piece of information can have different semantics. It seems that the semantic aspect of biotic information is determined also by the manner of expression or decoding, i.e. by the interpretation that the "reader" (in this case a living cell or a body) performs.

[13] Cf. e.g. ŠMAJS, Josef. *Základy systematické filosofie.* Brno: Masarykova univerzita, 2005, s. 23-24. ŠMAJS, Josef. *Evoluční ontologie kultury a problém podnikání.* Brno: Doplněk, 2012, s. 32–34.

[14] Given that reality – both the system of nature and the system of culture – is constantly evolving, we conceive it through the lens of a procedural paradigm. Systems and subsystems – that is, all entities existing in reality are interpreted as processes of change of individual manners (forms) of organization.

[15] A different conclusion is reached by Jiří Stodola who, however, dealt with resolution of *Capurro's trilemma* from the position of Aristotelian philosophy.

[16] Let us add that the "interpreter" need not be only a human subject. Interpretation of information occurs in all living organisms and to some degree also in some artificial systems (even though in that case we cannot speak about "understanding the meaning" in human sense, but about interpretation of the structural aspect of information, which will be "semantically" manifested as correct operation or expected interaction).

Information may be perceived as *analogous* from a procedural, i.e. evolutionary, perspective. All levels of reality evolve in the sense of change of organization, even though the character of these changes differs for individual levels (or for ontically opposite systems of nature and culture). Differences in evolution can be seen e.g. in speed – the speed will vary for changes in the quantum world, changes in the macrocosm of living organisms and changes in the organization of the universe as a whole. Also altering of the processes of increasing or decreasing of the degree of organization varies for different systems – isolated systems evolve only towards higher entropy, whereas open non-linear systems (e.g. living organisms) are capable of increasing and maintaining their own organization for a certain period of time. In this sense, we can think about evolution of information on different levels of reality on the basis of *similarity*, but not *identicalness*.

Information is *equivocal* in the sense of dissimilarity of its matter-energy carriers since every information system may be within its "assignment" to a particular level of reality characterized by its own and specific matter-energy carrier.[17] Information as a product of evolution arises differently on different levels of reality (as we have already seen in the case of *analogous* understanding of information) and the manner of its storing, processing and disseminating also differs.[18] Interaction – i.e. information processes – between individual levels arises through the unifying principle, constituted by the structural-semantic aspect of information mentioned above. It is "read" depending on the character of the system (animate or inanimate) that interprets the information. The proposal of an evolutionary-ontological solution of *Capurro's information trilemma* is outlined in the following figure:

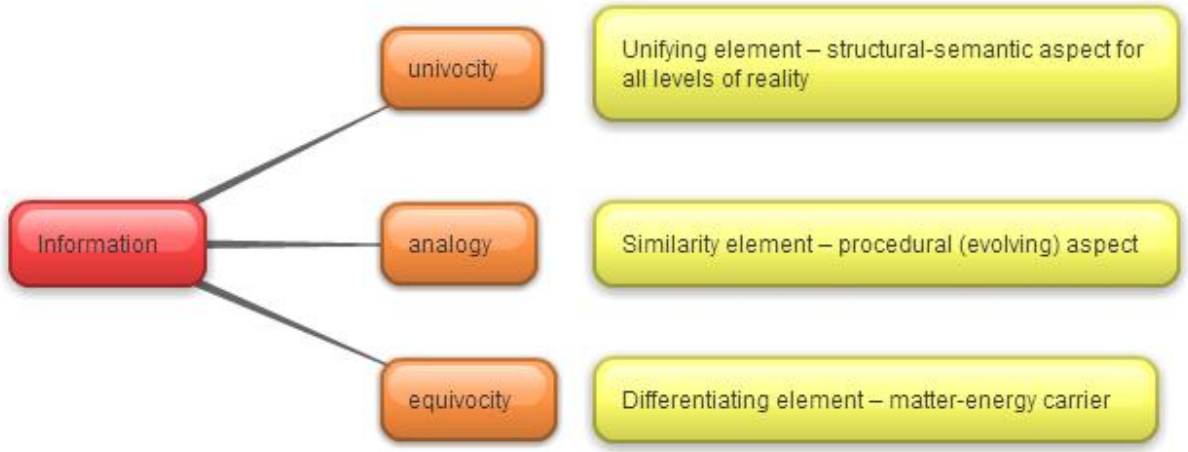

Fig. 3: A Diagram of a proposal of an evolutionary-ontological solution of Capurro's information trilemma

[17] In this connection, it is useful to recall the famous statement of the founder of cybernetics Norbert Wiener: "*Information is information, not matter or energy*." WIENER, Norbert. *Cybernetics: Or Control and Communication in the Animal and the Machine.* 2nd revised ed. New York: M. I. T. Press, 1961. S. 132.

The question of how an information carrier differs from information as such is answered by J. Šmajs as follows: "*... the carrier* (of information – note M. T.) *must be construed in such a manner that the system can store the information in it and that the information can be in case of need also retrieved, interpreted, applied – simply that it can be used pragmatically, ontically.* " ŠMAJS, Josef and Josef KROB. *Evoluční ontologie*..., s. 219.

[18] Even though information always "presupposes" a matter-energy carrier of some kind, it is to a certain degree independent of it. Probably the greatest "independence" from its carrier can be found in socio-cultural information (biotic or abiotic), e.g. the lyrics of a song can be stored on different types of media – paper, electronic document; it can be recorded on an LP/CD/DVD carrier, but we can also "just" remember it; our endocept (or more specifically the memory cells of our brain) thus becomes the carrier. The semantic aspect of such information will be identical despite the fact that it is "carried" by organization of different carriers.

To conclude, we would like to add that if the successfulness or appropriateness of a model (theory) may be indirectly confirmed also by the fact that it is capable of solving the problems of other models (theories), then it would in the case of the evolutionary-ontological solution of *Capurro's information trilemma* prove not only the relevance and "explanatory force" of EO, but it would also open up new possibilities for creation of a *uniform theory of information*.

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