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THE IRREDUCIBILITY OF CHANCE AND THE OPENNESS OF THE FUTURE

The Logical Function of Idealism in Peirce's Philosophy of Nature

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Abstract:

"...there is in the being of things something which corresponds to the process of reasoning, that the world lives, and moves, and has its being, in the logic of events." (C.S.Peirce, NEM, Vol. 4: 345)

How is Peirce able to turn chance and time into the logical foundation of his metaphysics? We have to assume that the structure of physical reality and the structure of mind are the same: both are continuous, temporally conditioned and interspersed with chance events. But chance events do not exist, but are only real in a wider sense.

This is Peirce's idealism: The spontaneity of mental processes is the epistemological basis for chance-events whereas probability theory (in the frequency interval interpretation) provides the formal model for them. Mind and reality agree in being continuous structures broken by chance events.

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THE IRREDUCIBILITY OF CHANCE AND THE OPENNESS OF THE FUTURE

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I. INTRODUCTION: CHANCE, EVOLUTION AND LOGIC

The 19th century saw quite a number of evolutionary philosophies. Despite this proliferation of evolutionary thinking, no other evolutionary account of the world and of the mind is as thoroughgoing as Peirce' evolutionary cosmology. This is so for the simple reason that Peirce did not as, for example Herbert Spencer in his many-volume evolutionary philosophy[2], simply assume the laws of nature as being fixed constraints for evolution in the biological and cultural domain.

For Peirce, the laws and uniformities of nature themselves stand in need of an explanation. Such an explanation, by the very logic of the situation, can only be an evolutionary one, for two reasons. The first reason is that an evolutionary explanation is much weaker, more general and therefore needs less substantial assumption. So every account that shows something of the form e.g. that *p* is possible in a state *S1* and that the state *S2* is later then *S1* but may follow from it by bringing about *p* will do as some weak sort of evolutionary explanation. Second, only an evolutionary account that describes the

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[1] This paper overlaps in part and continues a paper titled "Charles S. Peirce über Zufall und Zeit" read at the Symposium "Zeichen und Zeit" of the Académie du Midi, in Lagrasse France, June 1990 and was published in "C.S. Peirce über Zufall und Zeit" in: Zeichen und Zeit, hrsg. von T. Borsche, J. Kreuzer, H. Pape, G. Wohlfart, München 1993, S. 47-67, and. is in parts coextinsive with another paper on "Chance, Time and Methodology in Peirce's Philosophy of Nature" read in May 1992 at the 2. Pittsburgh Center for Philosophy of Science International Fellows Conference, Athen, Greece, which is to appear in the Proceedings of this Conference. - I want to thank Harald Pilot, Heidelberg and Glen Pate, Hamburg for corrections and criticism.

[2] For Peirce this undermines the claim of Spencer's philosophy as an evolutionary almost completely: "Spencer is, in short no evolutionist; but only a semi-evolutionist and a semi-Spencerian. Thorough-going evolutionism is called for in philosophy." (MS 956, around 1890)

lawfulness of the universe in general as the result of a development out of a state in which no lawfulness obtained, escapes a regress of explanation of laws of nature in terms of more general laws of nature, which in turn have to explained in terms of still more general laws ... etc. *ad infinitum.*

In switching the type of explanation - from the model of subsumption under a general law to evolutionary conditions of becoming - we escape the regress. So evolution gives us an autonomous pinciple of explanation which is an alternative to the covering law model. In any case, Peirce insisted correctly that an evolutionary explanation is logically superior to the thesis that no explanation is possible for any of the regularities and features exhibited by the universe. For example, the three-dimensionality of space is a regularity that should be explained because it is a determinate[3] feature of the universe:

> "A philosopher who confesses his inability to explain why space has three dimensions, no more and no less, or anything else of like difficulty may be pardoned, so long as he offers no other excuse than his ignorance. But if he sets up a theory of space which represents its three-dimensional character to be something absolutely inexplicable, now and forever, that theory is to be condemned as involving the hypothesis that no hypothesis is possible. ... The principle of evolution requires no extraneous cause, but the tendency to growth can be supposed itself to have grown from an indefinitely slight germ." (MS 956, c. 1890)

But is it not a form of begging the question to explain lawfulness by starting with indefinitely small degree of it and then "explain" regularities and laws by saying that they might have developed from this infinitesimal state? This reading of evolutionary explanation and the corresponding objection is misguided - though Peirce's wording is to a large degree responsible for such a misunderstanding. The "indefinitely slight germ" is not a sort of tiny, tiny law of nature, but a pobabilistic state in which the development is one among an indefinite number of other options for development. It is, if you read the passage more careful, not an infinitesimal law of nature but a tendency to growth that has grown out of this probabilistic state of the universe. And in this state such a development was one of *an indefinite number of possible options.* Therefore, the first and most radical invention that gives Peirce's evolutionary metaphysics an advantage over its rivals is his

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[3] In MS 956, c. 1890 Peirce introduces this passage by the remark: "To ask what determines anything to indeterminacy is a senseless and meaningless question. But when a fact or principle is determinate and peculiar, to silence inquiry as to its derivation by the theory that no theory can explain it, this is an affront to reason, and a plain inconsistency."

probabilistic realism. That is to say, Peirce defended his "tychism" as a metaphysical theory of chance - which he also termed "spontaneity" - which opens up a logical space in which the evolutionary development of the regularities of nature and of mind can be described. For example, he claimed that:

> Chance, whether it be absolute or not, is not a mere creature of our ignorance. It is that diversity and variety of things and events which law does not prevent. ... Chance itself pours in at every avenue of sense: it is of all things the most obstrusive. That it is absolute is the most manifest of all intellectual perceptions. That it is a being, living and conscious, is what all the dullness that belongs to ratiocinations's self can scarce muster hardihood to deny. (CP 6.612, 1893, "Reply to the Necessitarians"[4])

So tychism claims that chance is a real causal factor in the universe and that laws of nature are products of an "evolution" out of a state of unrestricted indeterminacy or chance. To have a state of unrestricted chance at the beginning of the universe and "then" an evolution therefrom are conceptions which require, to avoid a vicious circle, a careful analysis of the logic of temporal relations used here. But, surprisingly enough, Peirce never developed a temporal logic or even an explicit and separate theory of time but rather assumed that an implicit treatment of time as being instantiated or realized in experience and reasoning will do.

But this implicit approach to time is closely connected with the logical,

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[4] I quote the following editions of Peirce's writings in an abbreviated form:

- The decimal notation, e.g. CP 1.289, stands for the first volume and the 289. section of the "Collected Papers of Charles Sanders Peirce" Vol. I-VI, ed. by Charles Hartshorne and Paul Weiss, Harvard UP, 1931-35; Bd. VII and VIII, ed. by Arthur W. Burks, Harvard UP, 2. edit.: The Belknap Press of Harvard UP, 1958

- All numbers prefixed by "MS" refer to the microfilm edition of the manuscripts of C.S. Peirce as listed in Richard S. Robins "Annotated Catalogue of the Papers of Charles S. Peirce", Univ. of Massachusetts Press, 1967 and in "The Peirce Papers: A Supplementary Catalogue", Transactions of the Charles S. Peirce Society, 1971. In cases where I had, thanks to the generosity of Christian J.W. Kloesel, the fotocopies of the manuscript that are used in the Peirce Edition project at hand, I give the 000XXX numbering of their version. However in other cases, e.g. MS 875, I have used my own transcriptions from the microfilm and Peirce's own numbering and have inserted an arbitrary index, e.g. p. XX, B-version, if I refer to page of which more then one version exists.

- "Peirce 1991" refers to "Charles S. Peirce - Naturordnung und Zeichenprozeß Schriften zur Semiotik und Naturphilosophie", preface by I. Prigogine, edited with an introduction, p. 13-109 by H. Pape, translated by B. Kienzle, first edition: Aachen 1988, paperback edition: Frankfurt 1991, which contains most of Peirce's published and unpublished writings on the philosophy of nature.

- "NEM I-IV" refers to "The New Elements of Mathematics by Charles S. Peirce", ed. by Caroly Eisele, four volumes in five, The Hague-Paris, 1976.

methodological and substantial reasons that induced Peirce to describe chance by a number of idealistic features about the structural identity of real time and the time of experience. In what follows I will try to show that many of the contentions of this metaphysics, e.g. his idea that there is an evolution of the laws of nature, depend on the special role of chance in a continuous structure of real and experiential time. It will also become clear that Peirce's evolutionary metaphysics is at the same time guided by some powerful empirical phenomena and insights and is not in the sense idealistic as it seems at first glance.[5] By interpreting temporal continuity and chance as two structural elements which mind and matter share, Peirce gives an interesting account of how human beings are related to a chance-world.

II. PEIRCE'S IDEALISM AND THE METHODOLOGICAL FUNCTION OF ABSOLUTE CHANCE

Most contemporary philosophers don't take Peirce's idealism seriously. At best it is seen as an irritating but superfluous addition to his philosophy, especially in his evolutionary cosmology. But very often philosophers talk about rather different theses when they refer to Peirce's idealism. It is not always clear that this is

i) a metaphysical thesis about the nature of reality *in toto*, that is, the thesis that the ultimate reality is mental, or,

ii) an epistemological (Kantian) thesis grounded in a theory of mind about the way in which the structure of mind and mental activity relates to its objects, that is, the thesis that the categorical structure of our minds determines the order and the structure of our knowledge about the world, or,

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[5] Granted, Peirce sometimes sounds like Hegel or Schelling translated into English. For example, these are the first two sentences of "The Topological Basis of Philosophy": We thus see that the bare Nothing of Possiblity logically leads to continuity. For the first step a unidimensional continuum is formed." (MS 542, c. 1898, NEM iv, p. 127) The fascinating thing is that there actually is a "logic that leads" namely an interesting conception of the topology of concepts - which is implicit Peirce's difficult categorical schema of firstness, secondness and thirdness. For a proof of the formal adequacy of Peirce's claims about his universal categories see Hans G. Herzberger, Peirce's Remarkable Theorem. In: "Pragmatism and Purpose: Essays Presented to Thomas A. Goudge", L.W. Sumner, J. G. Slater, F. Wilson (Eds.), Toronto 1981, 41-58 and Robert W. Burch: "A Peircean Reduction Thesis and the Foundations of Topological Logic", Texas Tech University Press, 1990.

iii) a logico-semiotical thesis claiming that logical and semiotical laws are not only true independent of factual or material truth but are providing structure for all sorts of material truth; that is, the thesis that all important distinctions are distinctions of semiotical or logical form.

If you ask, whether Peirce is a metaphysical, epistemological or logical idealist, you will probably find evidence for all three varieties of idealism. But, as I see it, none of these stances fit completely the position developed by Peirce over the years. In fact, Peirce has changed the characterization of his idealism a number of times. However, his different characterizations of idealism point, it seems to me, to a common position that is implied in most of what Peirce had in mind. Let us take a short look at the three most important descriptions of idealism:

1.) 1891: "Objective idealism"

"The one intelligible theory of the universe is that of objective idealism, that matter is effete mind, inveterate habits becoming physical laws." (6.25)

2.) 1904: "Pragmatistic idealism"
"... the true idealism, the pragmatistic idealism, is that reality consists in the future. By mellonization ... I mean that operation of logic by which what is conceived as having been ... is conceived as repeated or extended indefinitely into what always will be (or what will some day be, that is, its absence will not always be, which equally involves mellonization, which does not assert anything but is merely a mode of conceiving)." (CP 8.284, Letter to W. James)

3.) 1907: "Conditional idealism"
"...what is meant is that the objectivity of truth really consists in the fact that, in the end, every sincere inquirer will be led to embrace it -- and if he be not sincere, the irresistible effect of inquiry in the light of experience will be to make him so. This doctrine appears to me, after one subtraction, to be a corollary of pragmatism. ... I call my form of it "conditional idealism." That is to say, I hold that truth's independence of individual opinions is due (so far as there is any "truth") to its being the predestined result to which sufficient inquiry would ultimately lead." (5.494)

All three passages explain what is metaphysically real - laws of nature, reality in general, the objectivity of truth - by a stable feature of relation to the future. For example, most physical systems we see as matter are real for us because they have habits which will not change in the future to any perceptible degree. In his concluding words of the paper "The Law of Mind" of 1892, 6.123, Peirce clearly sees that in the setting of his metaphysical theory of continuity, his synechism, logical realism, objective idealism and his tychism complement each other: "I have thus developed as well as I could in a little space the

synechistic philosophy, as applied to mind. I think that I have succeeded in making it clear that this doctrine gives room for explanations of many facts which without it are absolutely and hopelessly inexplicable; and further that it carries along with it the following doctrines: first, a logical realism of the most pronounced type; second, objective idealism; third, tychism, with its consequent thorough-going evolutionism." But Peirce formulates his synechism also as the methodological view that every topic should be described in a continuous way. When in the "Law of Mind" synechism is developed as a metaphysical theory about the ontological structure and functioning of mental processes he, stresses the logical element which conditions this ontological interpretation. Summing up these two aspects, we might say, as I will argue in what follows, that Peirce was a logical idealist because he believed *that logical processes are not only real for us, but that they are the only way we may come to understand the rest of reality.* That is to say, the logical idealist wants to account for the metaphysical reality of continuity in terms of a realistic model of the mind developing in an evolution of logical processes.

My proposal is that one of Peirce's most important contributions to modern philosophy is this unique fusion of these three kinds of idealism into a new type of "logical idealism". This, I take it, is what Peirce was driving at when in 1898 he asked:

> What is reality? Perhaps there isn't any such thing at all. ... But if there is any reality, then, so far as there is any reality, what that reality consists in is this: that there is in the being of things something which corresponds to the process of reasoning, that the world *lives*, and *moves*, and *has its being*, in a logic of events. (NEM 4: 343-5)

This passage clearly voices a version of idealism for which the time instantiated by the temporal structure of mental processes is the only viable link between mind and reality. The temporal structure of processes in reasoning and in reality is supposed to be not only isomorphic, but it is that which connects reasoning with reality. This defines the task for metaphysics to show that valid reasoning and physical processes have a temporal structure. which is, to some extent identical. Now, what kind of idealism could possibly claim to establish this temporaly based mental agreement with reality? Peirce's claim is, that in some way it is the same temporal structure expressed in the "logic" of both types of processes that connects reasoning and reality.

The second step of the argument adds another aspect. What does it mean to say that the being of the world consists in a "logic of events"? Either this is just a rhetorical phrase that emphasizes the first step - agreement between nature and mind can only be

grasped in terms of a temporal structure instantiated by reasoning - or it implies a stronger, controversial claim: That there is an idealistic account of the ontological structure of the world, which can be developed in terms of an agreement between processes of reasoning and reality, is correct only if it can be described in terms of a logic of events. I think that there is no way around admitting that we have to conclude that only an idealistic process-ontology of a very special type, namely an extreme logical realism, can do the job of what Peirce had in mind in this and other related passage where he talks about idealism. Namely:

> The most general characterization of reality is in terms of a logic of events that applies both to mental and physical processes. *Those processes are the sort of entites which are both indeterminate and spontaneous. They become real, if they are structured by logical processes that establish a relation to an open future.* (Cf. esp. 8.284, 1904)

This sort of logical idealism seems unavoidable, if we accept Peirce's thesis that "mind" can be defined as a process of reasoning, where "reasoning" stands for a process of representation of a special type. So it is safe to say that in the first step Peirce's argument in NEM 4: 343-5 proclaims a sort of logical idealism: If there are real things, their existence corresponds to the process of reasoning.

Let us turn to this stronger thesis because there is a tendency in Peirce's thought towards this type of claim.

Note, that this thesis need not imply any naive metaphysical reading of logic - say, any proposal that tries to convert to, say, quantification theory with identity into some sort of ontology. Peirce rather claims that idealism achieves a consistent account of reality only insofar as it describes correctly the logical properties which thoughts and things as events in space-time possess have in common. That is to say, processes of reasoning and, say, movements of my body, have a common logic of events which can be characterized only on idealistic grounds. Reality, viewed in this way, is a deeply conditional, temporal relation between the logical structure of thought and events, and this is the reason why Peirce describes his pragmatism as a sort of conditional idealism. But are there any interesting logical properties which thoughts and movements have in common which idealism captures? If there is, than there should be an account of Peirce's idealism as a theory that allows us to connect mind and matter via a logic of events. If this hypothesis about the structural isomorphism of logical and material processes is the core of Peirce's

logical idealism, we have to know more about how the epistemological and methodological setting in which this idealism is situated. Let us take a look at the methods and the themes from which Peirce's arguments for idealism evolved.

As we saw, in 1891 and later Peirces explicitly stated in some of his writings on metaphysics that he was an objective idealist (e.g. 6.25, 1891). Although he insisted that metaphysics must have a logical basis, and used the expression "objective logic" to suggest that his idealism is an application of his logic in a rather extensive sense, many of his interpreters have ignored his claim or refused to take his words seriously. "Logic" for Peirce does not mean formal or mathematical logic in our contemporary sense, although formal, even mathetmatical theories may be use in logic. "Logic" comprises semiotics (speculative grammar), the theory of valid arguments (critic), a theory of methods (methodeutic), and presupposes phenomenology and mathematics. When Peirce talks about "objective logic" he claims that his idealism is the thesis that logical and mathematical theories can be given a metaphysical reading, because they are phenomenologically justified in a way that provides a basis for philosophy independent of the sciences. That is to say, they structure and develop the content of our everyday-experience. This claim adds something very natural to Peirce's idealistic interpretation of logic: metaphysics itself rests on logic and on a phenomenological analysis of experience. Peirce's phenomenology, therefore, naturally complements his idealistic reading of logic. This combination makes sense because an objective reading of logic does not itself require or determine a phenomenological justification of each metaphysical thesis although the phenomenological meaning may secure the basis for it. We may use logical and mathematical principles in building theories about the most pervasive structures of experience. In this way, a phenomenological basis will complement a metaphysical interpretation of logic and mathematics by giving it a neutral evidential basis which is independent of any specific science. I believe that this is the reason why Peirce sometimes describes experience as a scientifically neutral and independent realm from which his idealism follows - if we only apply logic to it:

> Indeed, Idealism, in the sense in which Objective Logic, as I understand it, is Idealism, may be defined as the doctrine that nothing exists but phenomena and what phenomena bring along with them and force upon us, that is Experience, including the reactions that experience feels and all that logically follows from experience by Deduction, Induction, and Hypothesis.

Immediately after this passage Peirce discusses an objection to one of his idealistic

theories in metaphysics, his tychism, in a way that shows how logic and phenomenology may complement each other. Tychism as the thesis that chance is real and plays a crucial role in cosmological evolution, if taken by itself, cannot be inferred from phenomenological evidence, because we cannot experience that an event has happened by chance. In answering this objection Peirce specifies the conditions under which a metaphysical thesis can be introduced without a phenomenlogical existence of the objects postulated. His example are chance events required by his cosmological thesis that the universe has its origin in a state of chance events:

> ... the single sporadic event in point of fact does not exist ... but it *begins* to exist; ... The points of discontinuity at its [the universe's] origin and extinction are not full existence; and therefore are according to my form of Idealism not obliged to be phenomenal.

This strategy is characteristic for Peirce's idealistic methodology: In a case where a phenomenological justification is not available, we have to use logical and mathematical principles directly in building a theory, *provided these formal principles have an independent phenomenological basis.*

Chance is not a phenomenological property of single events, but a general property that exists only if distributed over events belonging to some interval. If we would have restricted, in an empiristic spirit, our methodology to the phenomenologically grounded arguments, chance would be an unjustifiable fiction. Instead Peirce proposes to use a logical or mathematical account of chance, e.g. one adapted from probability theory. For as Peirce says, "although the fact that a given event is casual cannot be inferred, yet the operation of chance itself is part of the regularity of nature and can be inferred." This is a typical Peircean move in doing philosophy: always try to introduce a formal type of law, if you go beyond phenomenological evidence but keep the contact to your phenomenological basis.

In order to be able to see how this methodology works in case of time and chance I have to tell you the background story by which time and chance are systematically situated in Peirce's philosophy of nature. We will first take a short glance at the evidence that motivated the metaphysical thesis that chance is real and some of the claims that Peirce developed from his thesis. The next step will be to discuss some of the problems the explanatory role of chance in Peirce's cosmology leads to.

Let us start with some of the phenomenological evidence for chance. The world of our experience is characterized by diversity, even by a steady growth of complexity. These

observations alone, Peirce claims, cannot be accounted for in a strictly deterministic framework that excludes chance.[6] The factor in reality which increases the complexity and diversity of things is chance. For Peirce the change and development of complex systems cannot be adequately described as a sequence of unique states. The development of an organism takes a sequentially structured course, because it is a succession ordered by growth and increasing complexity which leads to a finite, irreversible state of adaption.[7]

So the phenomenological starting point of Peirce's philosophy of nature, his tychism is this: We can not explain the multiformity and irregularity of the universe by any deterministic laws of the classical Newtonian type. Peirce urges us to acknowledge that the universe is multifarious because chance itself is an objective causal factor. The first of the three theories of his philosophy of nature, his *tychism* therefore amounts to the thesis that chance is an objective causal factor in the universe capable of causing all types of multiplicity - form the incertainty of microphysical systems to the indeterminacy and gemerality of the thought processes that govern our minds and our culture. But first let us complete the sketch of the comological model so that it becomes clear why chance and

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[6] For example, he says: "Question any science which deals with the course of time. Consider the life of an individual animal or plant, or of a mind. Glance at the history of states, of institutions, of language, of ideas. Examine the successions of forms shown by paleontology, the history of the globe as set forth in geology, of what the astronomer is able to make out concerning the changes of stellar systems. Everywhere the main fact is growth and increasing complexity. Death and corruption are mere accidents or secondary phenomena. ... From these broad and ubiquitous facts we may fairly infer, by the most unexceptionable logic, that there is probably in nature some agency by which the complexity and diversity of things can be increased; and that consequently the rule of mechanical necessity meets in some way with interference." (CP 6.58, p. 40-41; also in Peirce 1991, S. 173)

[7] Cf. Thomas Short, "Peirce's concept of final causation", in: Transactions of the Charles S. Peirce Society 17, 1981, 369-382. Peirce's semiotical concept of final causation is one of the most important as well as neglected aspects of his philosophy that links his logic and metaphysics with his pragmatism. His concept of a final cause is based on a very general model of change of a system or object towards a finite state. In this sense, e.g. an object changing its location under the effect of gravity behaves, in a restricted sense, according to a finite cause. I have discussed the concept of final causality in two papers which are about to appear: "Object and Final Cause in Peirce's Semeiotic", in: Proceedings of the C.S. Peirce Sesquicentennial International Congress, 1992 and "Final Causality in Peirce's Semiotics and his Classification of the Sciences", erscheint in: Theoria et Historia Scientiarum (Torun, Polen), 1992. Some consequences of his view of final causation for a cognitive theory of proper names are discussed in "Not Every Object of a Sign has Being", Transactions of the Charles Peirce Society, Vol. XXVII, 1991, S. 141-178.

time play a decisive role here.

Peirce may call his philosophy of nature an evolutionary cosmology because he can explain everything as the product of an irreversible process of evolution: Matter, time, space and the laws of nature themselves - they all have to be explained as emergent regularities of interaction arising from a state of indeterminateness. This is an account of the development of the cosmos as a progression from the homogenous, primordial chaos to the heterogeneous crystallized stable end state in three phases. All the past and future phases of development of the universe are the result of evolution from such a primordial state of chaos: "in the beginning - infinitely remote - there was a chaos of unpersonalized feeling, which being without connection or regularity would properly be without existence." (In: 6.33, "The Architecture of Theories", 1891; also in: Peirce 1991, S. 158). Time, space, the laws of nature and the existence of matter are to be explained as the products of the gradual reduction of this primordial chaos. For example, time emerges by means of the fact that the events which actually occur at some point may be come close enough to each other to establish dimensions of linear orderings. This closeness of dimensions of events introduces a new ontological aspect into the chaos - a moment of existence. The forming of things as continuua of event-occurrences and of some first approximations towards stable regularities and law-like features is a step of cosmological development which follows next and goes well beyond the occurence of single events in the chaos. Laws are described as regularities of interaction between qualities, embodied in feelings, that constitute events:

> This feeling, sporting here and there in pure arbitrariness, would have started the germ of a generalizing tendency. Its other sportings would be evanescent, but this would have a growing virtue. Thus, the tendency to habit would be started; and from this, with the other principles of evolution, all the regularities of the universe would be evolved. At any time, however, an element of pure chance survives ... (ibid.)

Later on, in 1898, he reformulates this view of an cosmological evolution in the logic of events in somewhat less mentalistic terms:

> The real events conspire as it were against the unreal ones, because there is no room for all. But observe that ... existence has its root in *pairing*. ...
> Since, then an accidental reaction is a combination or bringing into special connection of two qualities, ... such an accidental reaction ought to be regarded as an adventitious singularity of the continuum of possible quality, just as two points of a sheet of paper might come into contact. Topically the mere bending is no change at all. But the instant that bending brings two points together there is a discontinuous singularity. But although the singularities are discontinuities, they

> may be continuous. ... Thus the sheet instead of touching itself in the union of two points may cut itself all along a line. Here there is a continuous line of singularity. ... accidental reactions though they are breaches of generality may come to be generalized to a certain extent. .... (NEM IV, MS 942, Abstracts for 8 Lectures, pp. 135, 137)

Right now we only have an explanation how generalized relations between pairs of continuous qualities come about. Neither time, nor space, nor the existence of individual pieces of matter has been accounted for. Before limited space-time dimensions and complexes of continous interaction regularities, which Peirce calls habits, can be explained, we to describe the creation of substantial matter in a more specific sense. So our situation where we only have continuous singularities is a thought experiment which puts us at the wake of time:

> We place ourselves, then at the beginning of time. Qualities are already possible. Actual existence has begun. Accidental reactions are taking place. Several continua are established. A tendency toward generalization is operative. But as yet no *thing* can be said to exist. (NEM IV, MS 942, Abstracts for 8 Lectures, p. 139)

But matter in a full-fleshed sense to exist in individual sustances, a special type of generalization has to take place:

> But ... this generalization happens to come about, namely a limited but still a general tendency toward the formation of habits, toward repeating reactions that had already taken place under like circumstances. Now the difference between this generalization, this tendency toward law, and the rest was that this was one *which by its own law was always tending to grow stronger.* (NEM IV, MS 942, Abstracts for 8 Lectures, p. 140; italics are mine, H.P.)

Only by exhibiting a reflexive *and* future oriented capability of organized development, matter acquires the ontological status of objective existence. It is not a feature of biological life but of physical material systems to exist by manifesting a tendency toward generalization. The material existence of something groups accidental reactions into fragmentary continua, called *substances.* Substances consist of two types of event continua, namely *substantial* and *adventitious* causal reactions. The second type of *adventitious* reaction lets the identity of the substance stay unchanged over time. It only occurs between pairs of already existing substances, does not create new substances and is completely phenomenal. However, the continuum of possible modes of substantial reaction is *space.* And this event type has to vary through time. Substantial reactions are causal processes between substances creating an anti-generality "which yields to habit in a measure, but rebels against a complete surrender" (NEM, IV, P. 146).

From Peirce's account of the discrete and variable causality of substantial reactions it follows that his other claim that matter is effete mind, can be true only to some extent. An element of chance is always alive and is operative in the differentiating between the temporally different events of substantial causal reactions the same substances. However, owing to the tendency towards habit-taking that operates even on different substantial reactions, there will also be a development into self-reproducing organic compounds.

With introducing time, space and individual existence we have entered the second stage or dimension of cosmological evolution. This is the middle phase we now live in: Right now, substantial reactions between qualities with a strong chance element and rather strict laws of nature are present together. But there is an ever increasing tendency to develop in the direction of an increasing lawfulness of all types of processes. An open, to some degree indeterminate relation to the future is an element of phyical systems because it is brought about by the tendency towards habit-taking. It is this property by which Peirce describes reality and which has an important consequence for the temporal factors relevant to all causal processes:

> Strictly speaking, *there exist no purely mechanical causal processes. All causation contains an element of chance and teleological element which relates this process to a future state of things.*

Increasingly strict deterministic laws of nature, regularities and habits, are formed. This evolution will finally lead to phase three, to "an absolutely perfect, rational, and symmetrical system, in which mind is at last crystallized in the infinitely distant future." (6.33) This final state of the universe will be governed by totally deterministic natural and behavioral laws and is static. At this Omega-point of the cosmological evolution every trace of chance has been superseded by some sort of law.

It is obvious that for this program of an evolutionary metaphysics tychism, the assumption of objective chance, is absolutely crucial. Now the tychist must be able to deal with the following objection:

> To say of a fact, an event or a natural law that it emerged as a matter of chance does not explain its coming into being; it says only that we can give no certain cause for it. For a cosmology to state about events and laws of nature that they have their origin in a state of absolute chance is consequently nothing more than a metaphorical way of saying that there is no explanation. That is to say, there is no necessary connection from which, in conjunction with a description of the

> particulars facts invoked, it can be derived that a particular event will take place or has a certain probability.

This objection argues that the introduction of absolute chance as an element of reality, e.g. as a primordial state before the validity of any specific law of nature, is an empty move, just a phrase which disguises the fact that no explanation was given. But is it correct to assume that every sort of explanation which uses an ontological concept of chance as a crucial explanatory factor must yield an empty verbal phrase? It was this conception of scientific explanation as subsumption of individual cases under necessary laws which Peirce took for granted when he discussed this objection in 1893 in his reply to Dr. Paul Carus, the founder of the *The Monist*. This is what he says:

> ... to suppose that an event is brought about by absolute chance is utterly illogical, since as a hypothesis it could only be admitted on the ground of its explaining observed facts; now from mere non-law nothing necessarily follows, and therefore nothing can be explained; for to explain a fact is to show that it is a necessary or, at least, a probable result from another fact, known or supposed. (CP 6.606, 1893)

Peirce readily admits that the thesis that chance should be an explanation for an event is not logically admissible. He argues that in cosmology a mode of explanation which is designed to explain single events, is not applicable. In cosmology we simply don't have to explain single events or states of affairs. We are dealing with the distribution of properties over large and only vaguely defined classes of events. Nevertheless, the uniformities of these distributions need not be accidental. In particular, "chance" is not a property of single events. From the fact that we can show that cosmological collections of chance events which have perfectly well-understood properties described in terms of statistical laws, we cannot infer that for every single event has a definite probabilitity of occuring or not. For Peirce "the *existence* of absolute chance as well as many of its characters, are not themselves absolute chances, or sporadic events, unsubject to general laws. Everybody is familiar with the fact that chance has laws, and that statistical results follow therefrom. Very well: I do not propose to explain anything as due to the action of chance, that is, as being lawless." (ibid.)

How strong is Peirce's concept of absolute chance? Jan van Brakel[8] has argued

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[8] In "Peirce's Limited Belief in Chance", in: *From Time and Chance to Consciousness - Studies in the Metaphysics of Charles Peirce*, Berg Publ., Oxford 1994, S. 75-86,

convincingly that Peirce's concept of chance makes sense only on a background of order. For this reason, when Peirce speaks about "real" or "absolute" chance this only contrasts real chance as a factor really operative in physical reality with relative chance - which is chance only because of our lack of information. Van Brakel contrast Peirce's absolute chance with Cicero's concept of chance, which van Brakel aptly calls "deep chance". Now Ciceronian deep chance is

(a) operative in nature

but

(b) absolutely lawless and, therefore, cannot be captured even by probabilistic accounts.

But Peirce thinks that chance has laws, though non-deterministic, probabilistic ones. Therefore, Peirce's concept of chance shows a rather limited belief in chance. I don't think that van Brakel conclusion is as unrestrictely valid as he thinks. His account holds true for the notion of chance in as much as it is used to explain the emergence of probabilistic laws of nature in phase two of the cosmological evolution. But it follows from the account of chance developed in this paper that chance-events are also *non-existing* - they do not exist in a limited sense because they do not enter into reactions between continua of substantial reactions. But the first topological state of cosmological evolution which contains *only* this type of non-existing events and is completely lawless. This first topological state before it was transformed into a state containing time, space and substantial existence, is a state of deep chance. This is acknowledge by Peirce when he points out that this primordial state of unrestricted indeterminacy is less determined then a state in which nothing is the case: Every use of "nothing" presupposes some other state for which this "nothing" gives us the opposite. So we can talk cosmology only by speaking in terms of modal or topological differences: The first state of the universe is an indeterminate possibility. But the absence of individual existence does not imply non reality. For example, a continuum does not contain parts which have individual existence, because it can contain only homogenous parts. Nevertheless, continuua are real. Taking these two points together, in MS 942 "Abstracts of 8 Lectures" (The Topological Basis of Philosophy of Continuity) Peirce starts his most general description of his evolutionary cosmology with a statement that describes continuity as a state linked to indeterminate : "We thus see that the bare Nothing of Possibility logically leads to continuity." (NEM IV., p. 127)

In our days adaptations of probability theory are an important tool in all experimental science from physics to psychology. Probabilistic explanation is recognized by all contemporary models of explanations. There will be hardly any philosopher disagreeing with Peirce that, at least for some classes of events, say, in population dynamics in biology, we use probabilistic explanations with perfect ease. However, this agreement ends as soon as Peirce's starts with his next bold generalization in his evolutionary cosmology. He introduces the hypothesis that there has been a state of absolute indeterminacy from which all events, all matter and all physical laws have developed:

> I ... propose to explain the regularities of nature as consequences of the only uniformity, or general fact, there was in the chaos, namely, the general absence of any determinate law. In fact, after the first step is taken, I only use *chance* to give room for the development of law by means of the law of habits. (CP 6.606, 1893)

This "first step" involves a good many steps taken all at once. So let us begin with sorting out some of them. The impression of strangeness which this text provokes arises to a great extent from the fact that the term "habit", which - especially in the philosophy of nature - is not customary, is used by Peirce. In fact, this term is intimately connected to his theory of knowledge and with his anthropomorphic methodology.

Peirce's theory of absolute chance entails the proposal that all natural laws are habits in the sense that each of them is a "tendency to act in a certain way" that has developed out of a state of the universe which was indeterminate *before* this tendency towards actions of a certain type was established: In this indeterminate state there were no actions, no "customary mode of being" resulting from them. However, this law was a possibility for future events and appearances. Here we have no unusual concept of habit, but rather a widely used one. Taken in this sense, habits can be acquired, and they are strengthened with every action performed according to this habit. Peirce transfers this concept and especially the acquisition of habits into his philosophy of nature: In his cosmology the "acquisition of habits" implies that in our universe the most specific laws and uniformities are still changeable regularities.

But what justifies the transference of this concept to inanimate entities which for Peirce seems so easy and for us is so difficult? A "habit" in the logical sense is some contingent property which is not essential for the subject, e.g. a physical system, which has it. Habits are contingent properties which an object may acquire or loose while

staying, in some sense, the same object. For this reason, a logical condition for the transference of the concept "habit" to the domain of physical processes and entities is that they can have contingent properties. Futhermore, habits are *temporally* contingent properties. They depend crucially on the fact that the order of the behavior has to take place in a temporal sequence.

One problem which prevents a sympathetic interpretation of Peirce's metaphysical thinking is that his approach is presented in an anthropomorphic language and method:[9] What is gained except confusion by saying that sticks and stones have habits - just like human beings or apes? Thus the primordial state of the physical universe is described alternatingly as a state of "pure spontaneity" or as the "chaos of unpersonalized feeling". This idealistic anthropomorphism is most obvious in one of Peirce's unpublished drafts were he states his cosmological hypothesis in ouright idealistic terms:

> "... at first only mind existed, a vast unpersonalized manifold of mind and before this mind had taken any habit it only existed in a germinal sense, for existence consists in regularity. In this chaos of mentality there was an immense seething of ideas, - ideas not yet reduced to individuality, general ideas each of which was a sort of person, - among these came up spontaneously a tendency to take habits, for this tendency is nothing but an idea. The other ideas were extenigusihed as they were produced, and so too was this tendency to take habits in countless occurrences, but this tendency to take habits had ipso facto a tendency to become habitual, and thus perpetuate itself, and so the universe would gradually begin to crystallize into regularities." (MS 954, c. 1890)

Therefore, the question is whether any idealistic monism formulated in an anthropomorphic terminology disqualifies itself, in all possible versions, as a tenable contemporary philosophical position? If your answer is YES, I would say that this is so because such an idealism claims an autonomy of experience and its philosophical understanding even from the sciences, their methodology and results. For Peirce's idealism and his type of realism the context of qualitatively definite contents is constitutive for the relation of all theories of the sciences to the world.[10]

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[9] The most radical attack on Peirce, along these lines, was launched by Rulon Wells whose verdict about Peirce's evolutionary metaphysics was a medical one: He wrote an essay in "diagnostic pathology", titled "The True Nature of Peirce's Evolutionism", in: "Studies in the Philosophy of C. S. Peirce", Second Series, ed., by E.C. Moore and R. S. Robin, Amherst 1964, 323-344.

[10] Wilfrid Sellars argued in the early sixties in his famous article "Philosophy and the Scientific Image of Man" in Frontiers in Science and Philosophy, ed. by R. Colodny, 35-78,

Peirce's idealism does not only admit the use of logico-mathematical methods, their use is essential for it. The propositions of this idealism, those of the reality of chance or the idealistic basic principle of these metaphysics, the "law of mind", can only be understood as being a methodologically well thought through metaphysical interpretations of logico-mathematical principles of probability theory. It is in this sense that we are to understand that, for instance, the emergence of time is explained in the cosmological structure of progression as a phase transition out of a primordial state of absolute and unrestricted chance. To see this, let us take a look at his most straight forward explanation of laws of nature in terms of chance in the earliest surviving MS "Design and Chance" from the year 1884. There he talks about the heat death of the universe that he describes as a result of the dissipation of energy, which is "tending by virtue of its necessary laws towards a death of the universe in which there shall be no force but heat and the temperature everywhere the same":

> But although no force can counteract this tendency, chance may and will have the opposite influence. Force is in the long run dissipative; chance in the long run concentrative. The dissipation by the regular laws of nature is by these very laws accompanied by circumstances more and more favorable to its reconcentration by chance. Now when we take into account that feature of chance ... we find that this agent ... has the property of being able to produce uniformities far more strict than those from which it works. ... Now I will suppose that all known laws are due to chance and repose upon others far less rigid themselves due to chance and so on in an infinite regress, the farther we go back the more indefinite being the nature of the laws, and in this way we see the possibility of an indefinite approximation toward a complete explanation of nature. (MS 875, p. 30 - 32; Peirce 1991, S. 122-

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Pittsburgh 1962, that all attempts at translating scientific concepts back into the language of the experience of qualitative contents are unfitting attempts to save the anthropomorphic manifest image of man in the world. Sellars, and most other realists, therefore could not accept Peirce's thesis of the autonomy of experience and its philosophical elucidation because an adequate image must be first and foremost based on science only. Science postulates theoretical entities for which there is a mathematical structure but no qualitative content. What Sellars and other realists did not take into account is the possibility of formal, philosophical characterization of the (topological, cf. footnote 4) structure of experience which is independent of all sciences - though not of mathematics.

123)[11]

The crucial question is: Does Peirce have a consistent concept of the way in which chance-events may cause at least weak, law-like uniformities that justifies his talk of laws of nature being habits? There are at least some important types of causation, namely of events in physical and chemical processes far from thermodynamic equilibrium, that allow for a causal role of chance-events.[12] As Prigogine pointed out in his preface to Peirce 1991, p. 8, tychism may be understood as a theory that assigns a constructive causal role to chance. That is to say, in the context of irreversible physical processes far from thermodynamic equilibrium the dissipation of energy is determined by chance-events. Therefore, an explanation for why Peirce thinks that chance acts "concentratively" and a law of nature "dissipatively" is this: the occurence of chance-events are in a strict sense singular facts about individual irreversible processes in which they play a causal role that

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[11] The argument of the text may be summed up by four main theses, the first two of describing the action of chance, the other two dealing with the temporal properties and explicability of laws of nature that connect them with the account of chance given in (T I. & II.). Note that in (T III.) Peirce assumes a changeablitiy and an irreducible temporal ordering of laws of nature which is due to their being seen as habits: (T I.) Chance acts physically in such a manner as to effect a concentration of energy which counteracts that of entropy. [Cf. also the general formulation in MS 875, p. 29, B-version: "The operation of chance ... does show a definite tendency to bring about unlikely events by varying means under varying circumstances."] - (T II.) Chance acts as an anti-dissipative factor, when it acts upon already established regularities on the basis of these uniformities. [Cf. MS 875, p. 32: "Chance is indeterminacy, is freedom. But the action of freedom issues in the strictest rule of law."] - (T III.) Every law of nature, every so fragile regularity can be traced back to another less defined regularity whose specification it is and from which it has emerged. - (T IV.) A complete explanation of all laws of nature is possible if and only if all laws of nature are described as phases of an evolutionary, unlimited sequence of progressively weakening past probabilistic laws or uniformities. [Cf. MS 875, p. 12-13: "Evolution is the postulate of logic itself, for what is an explanation but the adoption of a simpler supposition to account for a complex state of things?]

[12] Peirce, whose only complete academic education was in chemistry, in MS 875, 1884, explicitly states that for him the paradigm case of a causal role of chance-event are chemical processes: "Certain laws of nature, laws of Boyle and Charles, the Second Law of Thermodynamics, and some others are known to be results of chance - statistical fact so to say. Molecules are so inconceivably numerous, their encounters so inconceivably frequent, that chance with them is omnipotent. I cannot help believing that more of the molecular laws - the principles of chemistry for example - will be found to involve the same element - especially as almost all these laws present the peculiarity of not being rigidly exact." (p. 31) I believe and have argued in more detail in the introduction to Peirce 1991, that tychism anticipates to some degree some type of non-standard thermodynamics by showing that non-equilibrium situation might bring about new types of regularities.

brings about an alternative course of events. A chance-event in a context of processes governed by perfectly deterministic, reversible and hence symmetrical uniformities, e.g. all the surrounding other physical processes are governed by the laws of Newtonian mechanics, will be without any such lasting effect.

What, then, in contrast to this type of occurence gives chance-events their causal function? As a physical system far from thermodynamic equilibrium is approaching a bifurcation point it becomes indeterminate with respect to two (or more) possible courses of events. In this situation, a microscopic initial disturbances, e.g. microscopic quantuum events, which we may identify with a Peircean chance-event, might be decisive for the system's developing into one sequence rather than the other. Changing the phase-state of such a system, e.g. the solution of chemicals in a fluid, may produce what Prigogine[13] calls a "dissipative structure", e.g. a certain solid crystal. In the framework of Peirce's tychism such a "dissipative structure", is a concentrative structure brought about by the concentrative action of chance events. It is a "concentrative structure" because the physical system stops the further dissipation of energy by forming a *habitus* of a new typ, e.g. by crystallizing. In contrast, consider the monotonic dissipation of energy in a closed physical system: According to the second law of thermodynamics there is a monotonic growth in distribution of energy up to the thermodynamic equilibriium. In this state the dissipation of energy is completed.

You might object that this is just my fanciful interpretation: Reading Prigogine into Peirce. Is it really what Peirce had in mind? Of course, there is some element of reconstruction here because in this way we capture only the local, physical aspects of tychism and leave out the question of its cosmological consequences.[14] However, we

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[13] Cf. I. Prigogine in chapter V. of his "From Being to Becoming", San Francisco 1980.

[14] Peirce had his doubts about the domain, content and force of his "tychistic hypothesis". In his late writings, e.g. in MS 292, 1905, he considered the possibility of identifying the action of chance with mental action: "I still believe that the universe is constantly receiving execessively minute accessions of variety; but instead of supposing, as I formerly did, that these are causeless, I think there is now sufficient ground for supposing that they [are] due to psychical action upon matter." (p. 00054) However, thermodynamic phenomena may have an interpretation on the microscopic level of quantum systems and on the cosmological level. Prigogine has argued for both of these generalizations, cf. his "From Being to Becoming", esp. ch. IX and Prigogine/George "The Second Law as a Selection Principle: The Microscopic Theory of Dissipative Processes in Quantum Systems", probably: Proc. Nat. Acad. Sci, (USA), 1982. (I only own have a manuscript version of this paper.)

cannot have everything, at least not at once. And given the crucial texts, especially from MS 875 and from Peirce's 1892 paper "The doctrine of Necessity examined" quoted above, I think that my interpretation is indeed a decent approximation of the paradigmatic phenomena which inspired Peirce's tychism.

Let us now turn to the methodological question which concerns the evolutionary character of the explanation that tychism uses: Why is it an evolutionary explanation, when we assign a specific less probable regularity to a more probable or more "general" regularity as its predecessor? The logical force of this type of evolutionary explanation seems to be rather weak. So it is hardly surprising that Peirce himself saw it as being a limitation of the unlimited validity of a logical "axiom". What Peirce means by an axiom here is not the contemporary meaning of this term, as e.g. in the phrase "Zermelo-Fraenkel axioms of set-theory", but rather that of a general principle or assumption. Furthermore, logic for him includes the theory of valid reasoning[15] as well as philosophy of science and semiotics.[16] One of Peirce's statements of this "axiom" of logic that he wants to deny is:

> "Real things exist" or " Every event has a cause"
>
> (MS 875, 1884, p. 6-9)[17]

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[15] It is often overlooked that most what we nowadays call "symbolic logic" is for Peirce part of mathematics or mathematical treatment of logical topics.

[16] It might come as a surprise for many, but Semiotics, which Peirce also called "Speculative Grammar" (the mediaval discipline that studies the linguistic and mental forms for the representation of objects), is closer to formal ontology and to semantics and pragmatics than to contemporary theories bearing the name "semiotics" by Derrida, Barthes or even U. Eco and C.W. Morris. For Peirce, semiotics is a theory of the forms by which objects are represented in experience. Cf. my "Charles S. Peirce on Objects of Thought and Representation", Noûs 24, 374-396, 1990.

[17] The other statements of the axioms are:
2. "Every intelligible question whatever is susceptible in its own nature of receiving a definitive and satisfactory answer, it it be sufficiently investigated by observation and reasoning"
3. "Nature is uniform" (Peirce attributes this formulation to Mill.)
4. "Every event has a cause"
What is the relationship between the four statements of this axiom? We understand what Peirce was aiming at, if we consider that the falsehood of one of these statement, esp. 4., implies (or is equivalent to) the falsehood of any of the others. If it is for example true that (4-N) Not every event has a cause, then it is also true that, (3-N) Nature is not always uniform, and, (2-N) Not every question can be satisfactorily answered, and, (1-N) Not every thing is real.

If it is not true that only real things exist, this might be the case because chance is not an existent thing or event but rather an entity of a different ontological type that has no place in the realm of existents, although it is real - in some sense. What does it mean to assume the reality of non-existing chance-events for an explanation of the laws of nature? An answer to this question is already implicit in the thermodynamic case of such an explanation: We are dealing with an explantion of natural laws or regularities by means of chance only in as far as we can assume a form of a probabilistic regularity in relation to which this natural law is a more specific kind of regularity. In this sense the primordial chaos is no existing state of affairs in time but rather a limiting state described by an ontological interpretation of probability theory in which there are no initial conditions or probablities that restrict the distribution of properties. That is to say, this initial limiting state is a state of complete chance which does not belong to the domain of existing objects or processes.

Now the explanatory strategy that inspired the thesis that laws of nature are developments out of a state of absolute chance is clear: If in Peirce's "physical metaphysics" the laws of nature are explained by means of the probabilistic law of chance, it is because Peirce has defends a principle of explanation which treats explainability as a value which is more important then all other principles or axioms. This methodological principle[18] contends that there always has to be an explanation and that we should never assume that a fact or law of nature cannot be subsumed under some kind of a more general state of affairs:

> Among the things that demand explanation, then, are the laws of physics; and not this law or that law only but every single law ... And then the general fact that there are laws, how is that to be explained? (MS 875, 1884, p. 12; Peirce 1991, S. 117)

If explainability is the most general methodological principle, and if there are purely probabilistic facts, then one cannot at the same time accept the unlimited validity of the classical causation principle that every event has a cause. If we want to explain the laws of nature themselves we have to limit the validity range of the principle of causation. When Peirce in 1889 called the theory of probability the future logic of the exact sciences

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[18] An earlier version of this in his early epistemology, in the paper "Some Consequences of Four Incapacities" is the thesis that "We have no conception of the absolutely incognizable" is the thesis" (CP 5.265, 1868).

(Peirce 1991, p. 481), he does so, because he believes that the theory of probability also describes the laws of absolute chance. Between absolute chance and the chance relative to a state of knowledge there is no formal difference in the way and content of that which we know. The only difference is an ontological one: it consists in extending the concept of explanation to apply probabilistic generalization of chance events. Therefore, the only difference between relative and absolute chance is

> ... that the hypothesis of absolute chance is part and parcel of the hypothesis that everything is explicable, not absolutely, rigidly without the smallest inexactitude or sporadic exception, for that is a self-contradictory supposition, but yet explicable in a general way. Explicability has no determinate limit. Everything being explicable, everything has been brought about; and consequently everything that can happen by chance, sometime or other will happen by chance. Chance will bring about a change in every condition. (MS 875, 1884, p. 19; Peirce 1991, p. 119-120)

Peirce's theory of chance is thus supported by a metaphysical approach which gives preference to the principle of explicability before the principle of causation. We can best understand how momentous this concept of chance is, when we examine other parts of Peirce's metaphysics for which it has important consequences.

III. LOGICAL DEPENDENCE AND THE CONTINUOUS STRUCTURE OF MIND

Peirce's thesis that all law-like aspects of physical reality, physical time included, are products of a temporal process originating from a state of absolute chance, has to involve some account of time - if only to get rid of a vicious circle that it took some time for time to evolve. Circularity might be avoided by the following move: The relation of sequence, of "coming after", nowadays often called "ancestral relation", can be developed formally without any circular reference to time[19]. On the other hand, the thesis (see (B) below), that all our thoughts and other mental processes take place in time, seems to be semantico-pragmatical fact, that is an important datum for logical analysis of thought and for epistemology, but does not cause a vicious circle for an evolutionary treatment of physical time. Although this move will carry Peirce along the way, things are more

[19] As Peirce actually did in MS 942, cf. NEM IV, p. 127f.

problematic than that.[20] But let us stick to the fairly simple case. To avoid circularity, evolutionary metaphysics and its treatment of time has to make use of semiotics, formal logic and mathematics: The regulative principles of logic should be interpreted as constitutive principles of being. For this reason, this is the place to take a closer look at the ambigous way in which Peirce relies on temporal concepts implicitly but insists on an atemporal approach to formal logic. For he says: "Time has usually been considered by logicians to be what is called "extra-logical" matter. I have never shared this opinion. But I have thought that logic had not reached that state of development at which the introduction of temporal modifications of its forms would not result in great confusion; and I am much of that way of thinking yet. The idea of time really is involved in the very idea of an argument. But the gravest complications of logic would be involved, [if we took] account of time..." (4.523) To do justice to this implicit approach, we will have to spell out how

> (A) the concept of sequence (the ancestral relation) and relations of logical dependence

are connected with

> (B) the ontological fact that there is always one sequence already *given in time*, namely the sequence of my present thoughts with which I think e.g. the logical and conceptual relations that this sentence expresses

and with the

> (C) real time of physical and even cosmological events in our universe.

In his treatment of time, in assuming (B), Peirce develops the Kantian insight that time is the form of the inner sense, that is to say, all thoughts and experience is always located in time. But he wants to claim more than Kant did: in his objective idealism, time will have subjective and objective reality. To be more precise: In as much as our

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[20] The circle with which Peirce's physical metaphysics finally ends with is not a vicious one, but a fairly harmless, external type of circularity, very much the same as anthropic principle of cosmology in theoretical physics: The mind is only able to explain the physical universe by using concepts like "sequence", "chance" and "evolution", developed from experience and the logical analysis of thinking, because it is itself formed by the universe that shapes our experience and our thinking. Of course, this is idealistic metaphysics, but an idealism which is compatible with Peirce's Pragmaticism. It amounts to an cosmological hypothesis, which Ian Hacking nicely formulates as the thesis, that "the universe reaches its successive states by processes formally and materialy analogous to those by which sound method reaches its conclusions." ("The Taming of Chance", Cambridge UP, 1991, p. 213)

experience has a form which is manifest in time, there has to be in some sense a logical form, which is the common form of experience and of objective time, of mental and of physical processes. The order which exists between both modes of manifestation of this common logical form may then be determined by the historical order, that is to say, by the evolutionary sequence of its emergence. This means: Time is the form in which our experience takes place, but in logical analysis this is only the way in which a rule-governed sequence of premisses is presented in our experience. Time as the form of the execution of our thinking is objective for the reason that in time both all (presently) executed thoughts are all alike in their character of being events and appear as minimally ordered but likewise independent:

> What is time? Shall we say that it is the form under which the law of logical dependence presents itself to intuition? But what is logical dependence, objectively considered? It is nothing but a necessitation which, instead of being brute, is governed by law. Our hypothesis therefore amounts to this, that time is the form under which logic presents itself to objective intuition; and the signification of the discontinuity at the actual instant is that here new premisses, not logically derived ... are introduced. (CP 6.87, "Causation and Force" 1898; Peirce 1991, p. 290)

This description of time as "the form under which logic presents itself to objective intuition" raises many questions. In the present context, we can only discuss the most pressing one:

- What is meant by "the law of logical dependence"?

The other, even more difficult question, - What does it mean "that time has a point of discontinuity at the present"? (ibid., CP 6.86) -*we must set aside for another occasion.

Peirce's logical theory of argumentation is a theory of "reasoning", that is to say, although he stressed the independence of the validity of formal logic from thinking and from psychology, "thought-signs" are the paradigmatic, though not the only way in which logical relations are expressed. Another motive for why he tried to build all of logic on the general concept of logical dependence was his strong interest in a dynamical, operational view of logic. The logical backbone of the relation of logical dependence is the concept of sequence. For example, the relation of consequence is instantiated in conditional sentences. Let us assume we want to analyse logically what process of thought is performed when we think such a sentence. Obviously, this mental process cannot be analysed in terms of a negation of a conjunction, if we want to do justice to the operation

performed in thinking two propositions connected conditionally. This is so, Peirce argues, because thought takes place in time and involves a real change.[21] To see this, try to analyze the thought process corresponding to

(I.) "If A, then B"

by its formal equivalent

(II.) "It is false that: A is true while B is false".

As an analysis of thinking it is obviously inadequate. Consider the state of affairs in which (II.) is true: In it, A is never true without B being true. That is to say, no change occurs. The material conditional cannot be analyzed by two negations, because thinking a conditional performs a real change e.g. from the sequent A to the consequent B.[22]

Now, regardless of what we think about the value of Peirce's approach to the problem of representing the logical form of the mental process of reasoning, it follows from Peirce's view of mental processes implicit in it that the temporal ordering of the change from one mental state to another is a logically relevant feature in the performance of thinking conditionals, e.g. when we draw inferences. In short, thoughts take place in time. As pointed out above the temporal ordering is always instantiated in the experience of our very thinking itself - we cannot avoid thinking in some kind of linear ordering, if

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[21] In 1908, MS 300, Peirce argues that it is an error to suppose that "the concept of Consequence is a special composite of two negations, so that to say, 'If in the actual state of thing A is true, then B is true', is corretly analyzed as the assertion, 'It is false to say that A is true while B is false'." (p. 00049) But he also acknowledges that "for most purposes and in a preliminary explanation, the error of this analysis is altogether insignificant." (ibid.)

[22] Peirce in MS 300, 1908, p. 00049, insists that the elementary character of the concept of sequence was implicitly assumed in all his writings on formal logic. He then gives the following argument: "In reasoning, at least when we first affirm, or affirmatively judge, the conjugate of the premisses, the judgment of the conclusion has not yet been performed. There then follows a real movement of thought in the mind in which that judgment of the conclusion comes to pass. Now surely, speaking of the same A and B as above, [in "If A, then B"] it were absurd to say that a real change of A into a sequent B consists in a state of things that should consist in there not being an A without a B. For in such a state of things there would be no change at all. Unquestionably, subsequent criticism may discover - often, indeed early does so, both experimentally and otherwise - that it cannot but disbelieve that any falsity in B coexists with the truth of A. But at first, we simply judge the composite premiss A to be true, and only afterwards, perhaps in some ... repetition of that judgment, become irresistibly impelled to judge the conclusion, B, to be true."

we think at all. [As we will see later on, time also provides a strong type of continuity.[23]]

The law of logical dependence assumes, not only that every important logical relation could be represented in such a way that it becomes isomorphic with the relation of sequence (which is transitive, antisymmetrical and irreflexive). Moreover, there should be a hierachy of progressively more specific relations of sequence between all acts of representation and of thinking. The law of logical dependence states that either A is logically dependent on B, or B on A, or that A and B are equivalent, whether we substitute concepts, statements or non-linguistic representations for A and B. Turning logic into metaphysics and the law of logical dependence has a counterpart in the ancestral relation. That is to say, it is interpreted by something close to this constitutive temporal principle of physical metaphysics (CTPM):

> (CTPM) All laws of nature are explicable as probablitistic laws of some historical state of the universe if and only if there is a temporal relation between all physical states such that either A is earlier than B, or B is earlier than A, or that A and B are contemporaneous and belong to the same state.

I take it that the type of ontological interpretation of the law of logical dependence that (CTPM) suggests, which is the very core of the principle of explanation, is what Peirce means by the assertion that evolution is a postulate of logic, because with the concept of evolution he assumes an explanatory connection between physical processes and states. He writes: "for what is an *explanation* but the adoption of a simpler supposition to account for a complex state of affairs?" (MS 875, 1884, p. 13; Peirce 1991, p. 117). When Peirce (in MS 875) speaks of his methodological belief "that the hypothesis of absolute chance is part and parcel of the hypothesis that everything is explicable" this is his attempt to justify the concept of absolute chance. He thereby tacitly assumes what I would like to describe as a general bridging principle for logical laws and their ontological interpretation. In particular, he holds:

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[23] This is a thesis of MS 300, 1908, p. 00055-56: "Now reasoning takes place in Time; and so far as we can understand it, in a Time that embodies our common-sense notion of Time. But this common-sense notion of time implies that every state of things that does not endure through a lapse of time is absolutely definite, that is, that two states, one the negation of the other, cannot exist at the same instant; ... Accepting the common-sense notion, then, I say that it conflicts with that to suppose that there is ever any discontinuity in change. That is to say, between any two instantaneous states there must be a lapse of time during which the change is continuous, not merely the false continuity which the calculus recognizes but in a much stricter sense."

The principle of unlimited explanation is based on the assumption that a temporal ordering of physical structures and their laws can be construed which exhibits THE SAME ordering as our thinking of premisses by means of relations of logical dependence.

Admittedly, this principle and the argument leading up to it make a number of problematic assumptions. For instance, one may argue[24] that whereas the rather abstract relation of logical dependence refers to ordered sets of properties, the ancestral relation is well-defined for temporal individuals only and it is therefore far from obvious that the ancestral relation is subject to the same conditions as the relation of logical dependence. I do not want to deny the obvious differences between the two relations. However, in one sense they are the same:

> In any domain which is structured by these two relations they are order relations and therefore, at least in this sense, isomorphic.

Admittedly, this is a weak result which leaves out the difficulty of identifying the different constitution of temporal individuals with ordered sets of properties. However, assimilating property-orderings to orderings of individuals has a much deeper justification in Peirce's ontology: In his critique of all tendencies to treat individuals as ultimates Peirce makes it clear that he prefered a sort of bundle ontology. That is to say, for him individual terms are universal terms with a special pragmatic or indexical feature added to them that performs their individuation.[25]

This does not, by far, solve all problems with Peirce's treatment of time and chance in his physical metaphysics. However, I think it is enough to show that the problems raised are interesting ones and should not be set aside without a more careful discussion. But this is what I cannot do here in the space-time available. I conclude that, at least in Peircean framework as outlined above, the ontological concept of chance is thus fitted into a temporal methodology of cosmological explanations by means of the application of the

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[24] This is Harald Pilot's which he raised when commenting an earlier version of this paper.

[25] Cf. CP 3.93n1: "The absolute individual can not only not be realized in sense or thought, but cannot exist, properly speaking. For whatever last for anytime, however short, is capable of logical division, because in that time it will undergo some change in its relations." Accordingly, Peirce concludes that what we normally consider an individual is only "one in number from a particular point of view" (CP 3.93, 1870)

law of logical dependence to physical processes in time.

The next step of my agrument will show that the entire project of the metaphysics of objective idealism rests upon a probabilistic model of mind which Peirce understands as an emergent ontological structure in a physical space-time world. Accordingly the concept of time must also be understood as applying to such a structure. It will be sufficient if it can be shown that the idealistic principle, the "Law of Mind", by means of which Peirce wants to construct his version of objective idealism, requires a continuous and indeterminate temporal structure of the mind. The second question, that of what the talk about the discontinuity of the present instant means, can be answered in the framework of the law of mind.

In the paper "The Law of Mind" of 1892 Peirce gives this first ontological principle of his metaphysics the following preliminary formulation:

> Logical analysis applied to mental phenomena shows that there is but one law of mind, namely, that ideas tend to spread continuously and to affect certain others which stand to them in a peculiar relation affectibility. In spreading they lose intensity, and especially the power of affecting others, but gain generality and become welded with other ideas. (CP 6.104; Peirce 1991, p. 181-2)

In what way is this law of mind an indeterministic principle, and what structure of time does it presuppose? At first glance it seems to be a principle only for the proliferation and attenuating of ideas through their association with other ideas. However, in this ongoing process of proliferation connections with other ideas are formed which, by some sort of feedback mechanisms, are strengthened and become habits when the association between ideas occurs more frequently. In this sense the law of mind is a principle of connectionism: It predicts the increase of the probability of an associative connection of ideas (cf. Peirce 1988, p. 203-3). Thus, we can describe the occurence of repeated association of one idea with another as an increase of the probability of certain connections or as the formation of a mental habit: The development of ideas is the formation of preferred connections, habits, which can be activated on certain occasions. In the course of this proliferation two opposing tendencies act reciprocally. The increase in the number of connections and in generality of one idea is accompanied by a decrease in the intensity with which it influences other ideas. In other words: At the beginning, when an idea enters a mind, the probability that it will have a lasting influence upon another idea is very high, but there are only a very few ideas upon which it might act. When the

new idea has influenced a number of other ideas, it gradually loses the intensity of its first encounter because of the subsumption under the continuous connections to which these ideas belong, e.g. by their relation to an unlimited number of other perceptions by the same type and to a similar or the same object. However, its general meaning for all other mental events will be increased with each newly established connection. It now effects any other ideas, but the probability is small that it will attain a large measure of influence. This increase in the probability of certain reactions which the law of mind assumes can take place only, if we presuppose *that mental events can be ordered by the ancestral relation and therefore has the same (but not strictly identical)*[26] *structure that physical time does according to (CTPM)*:

> The proliferation of ideas with decreasing intensity and increasing generality of influence establishes a uni-directional ordering of mental states from the past into the future.

If A and B are mental events or "states of feeling" (Peirce) then, if A is earlier than B, A influences B but not vice versa and "every state of feeling is affectible by every earlier state (CP 6.131)" though with indefinitely decreased intensity.[27] We can therefore describe a dependence relation of one idea to another as a relation of (uni-directional) influence based upon the ancestral relation which exists between past and future ideas at the moment an idea is inserted (by perception or thought) into the continuity of experience. Therefore, it follows from the law of mind that

> ... it makes time to have a definite direction of flow... in reference to any individual state of feeling, all others are of two classes, those which affect this one ... and those which do not. The present is affectible by the past but not by the future. Moreover, if state A is affected by state B, and state B by state C, then A is affected by state C, though not so much so. It follows, that if A is affectible by B,

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[26] Cf. Peirce in CP 6.127: "The relation of past to future is, in reference to the law of mind, different from relation of future to past. This makes one of the great contrasts between the law of mind and the law of physical force ..."

[27] In 1898, in MS 942, NEM, Vol. IV, Peirce uses the temporal interpretation of an ordering relation to describe the relation between any two qualities with greater intensity. He then next applies this "logical law" of ordered structure for different dimensions of qualities and concludes: "Logic radiates like light. At one end of the sequence then all the qualities come together in a zero. But they are separate from one another as they separate from zero." (p. 128

B is not affectible by A. (CP 6. 127-29; Peirce 1991, p. 195)

The first of these conditions is the requirement that the temporally ordered relation of influence must be transitive. In addition it must antisymmetrical: The relation exists in one direction only and is not reversible.

This last step ends our discussion of the structural isomorphism between physical time and the internal time of experience which the ancestral relation and the relation of influence or logical dependence have in common. In particular, this argument does not show that (i) in experience, all ideas and mental processes form one (unified and accessible) continuum and (ii) that this continuum is (partially) the same or emerges from the continuum of time. For all this, Peirce has to prove a stronger equivalence of time and mind, namely

(D) Time is in a strong sense continuous and the strong continuity of mental processes (ideas, feelings) emerges from the continuum of time.

Peirce's theory of continuity is a notoriously difficult and badly understood topic which we cannot here. However, it will suffice, if we sum up, in a short sketch, the steps by which Peirce connects the continuity of time with that of the mind. In a last step (section IV.) we will than take a look at the problematic relation between the continuity of mind and the notion of the present as a point of discontinuity.

Peirce needs two bold moves to interrelate the continuity of time and mind. His theory of qualia is rather a by-product of this relation. His first thesis is

(D*1) The continuity of time logically implies some other kind of continuity.

(D*2) Continuous time as the form of change necessarily implies the existence of a continuum of changeable qualities. (Cf. 6.132)

If we now assume what Peirce obviously does that

(D*3) All types of continuous connections between thoughts, perceptions, memories, etc., insofar as they exist, are modifications of (that is, emerge from) a fundamental continuum of qualitative feeling,

we have taken the step that provides the crucial premiss for Peirce's account of the mental continuity. Peirce wants to explain how past ideas - by being connected continuously - can be present. Otherwise, without continuous connection between them, a past idea would have been gone forever. It cannot even be compared with another one: thinking that one past idea is similar with another past idea would presuppose that the two ideas are co-present. But if every idea and mental process is a member of a number of continua and at

least a member of the continuum of qualitative feelings, in my consciousness there is always present a continuum of (possibly) felt qualities. This is Peirce's summary of his argument:

> ... time logically supposes a continuous range of intensity in feeling. It follows, then, from the definition of continuity, that when any particular kind of feeling is present, an infinitesimal continuum of all feelings differing infinitesimally from that is present. (CP 6.132)

This argument assumes that there exist infinitely small, but real infinitesimal feelings as parts of the mental continuum. The same assumption is used when Peirce tries to prove that in such a mental continuum past ideas can be in a general way present because there is a series of overlapping intervals, because in such a continuum

> ... a finite interval of time generally contains innumerable series of feelings; and when these become welded together in association, the result is a general idea. (CP 6.137, 1892; Peirce 1991, p. 198)

For Peirce the true continuum is the limit of an infinite series of transfinite multitudes, that is sets. It may be possible - let us assume that much - that we generate new ideas by "welding together" infinitesimal feelings (although I am not sure what this means). But because of the strength of the solution offered a difficulty arises. In a true continuum everything individual, *hic et nunc* is a point of discontinuity. How is it possible for a general idea to be this idea, the one which is the content of my present consciousness? How is e.g. the idea of "cream-coloured computer" present in the very instant when I look at my computer and represent in my thinking what is expressed by "These cream-coloured computers are ugly"? And in general: What is the result of the numerous discontinuities inserted into the mental continua of feeling and thought at every step of our conscious life? In what does the presence of my present consciousness consist in?

But Peirce's situation is not completedly hopeless. He ask us to perform a thought experiment: Imagine a Möbius-strip. This is two-dimensional continuum that is twisted in such a way that it is one-sided because the two surfaces have been connected and have become one surface that runs back into itself. If you insert a discontinuity here, by cutting a Möbius-strip along a line that runs parallel to one of its sides, you get two (smaller) Möbius-strips, one chained to the other. This shows that under some circumstances, inserting a sequence of discontinuities into a continuum does produce again continua. Is

then my present consciousness something like the cutting edge of my mind?[28]

IV. THE PRESENT REGAINED

We have assembled most of what we need to answer the second question: Why is the present moment a point of discontinuity? In doing this we will also be able to see in what sense present consciousness and chance are related to each other.

Peirce claims that the law of mind "follows the forms of logic" (CP 6.144, 1892). But the most important form of logic is the law of logical dependence which corresponds, as we saw, to the relation of influence between ideas which is to some extent isomorphic with the ancestral relation. This partial isomorphism highlights the methodological, explanatory function of chance events and states: they are the first relata of all the physical, temporal and mental sequences. If the relation of logical dependence and the sequence of feelings in time have the same order, is there another methodological function which the present moment and chance share?

The property of "being a point of discontinuity" has a very special meaning for the metaphysical and cosmological treatment of mind. As we saw above, if mind is a continuum, namely a "continuum of feeling" (CP 6.152, 1892), a point of discontinuity in it violates the crucial unifying function of the continuum that for Peirce generates the mental representation of a general idea and is the basis for logical dependence, and for the continuity between different types of qualities of feeling. A point of discontinuity therefore cannot completey belong to the mental continuum it appears in.[29] It refers to something that lies beyond the realm of unification provided by the mental continuum or it starts an altogether new continuum - just like a sequence of overlapping cuts creates two Möbius-strips.

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[28] Again, I have to thank Harald Pilot for his penetrating criticism which induced to me to discuss the question of discontinuity.

[29] Peirce acknowledges this problem: "What can be less independent than the parts of the continuum par excellence [that is to say, the temporal continuum] through the spectacles of which we envisage every other continuum?" He could allow for an aspectual independence of the present instant only: "It is not an utter, complete independence, but it is absolute independence in certain respects." (CP 6.86, 1898)

What about chance? In an evolutionary cosmology chance has a function analogous to a point of discontinuty. It is a state beyond the realm of phenomena unified by strict laws. Even if we grant the validity of probabilistic laws, the reality of chance-events introduces an element that counteracts and therefore excludes the applicability of all necessary causal explanation to cases of chance-events.

It is a truism that we can only live in the present, but that the present is specious, unextended and somewhat beyond comprehension. But isn't there a logical representation in the tense logic in the style of A. N. Prior favoured of the present? Not quite, I think. Even in such a temporal logic the present is represented by a sort of propositional constant, say *Q*, defined as being true now, in the moment of its use. But all temporal relations that express a relation to *Q* use *Q* only as a point of reference which remains outside the temporal logical relations they express. Even in temporal logic - where, as Peirce would have said, the law of logical dependence can be specified with elaborate formal sophistication - logic will never contain a theorem from which it deductively follows that, e.g. I have to *this* premiss *now* into considerations.

In sum, the present, the *hereness* and *nowness* of something is similar to the introduction of a new premiss into a body of deductively arranged knowledge because it is wholly a pragmatic affair that relates events to performative acts their experience. Nevertheless, they occupy an important position and have a methodological function: The present presentation of something introduces an element of indeterminacy which connects mental processes to some environment in which they are located. Introducing an undeducible premiss, a new perception or thought, into a train of reasoning has a complementary logical function which counteracts the closedness of a set of sentences from which all deductive consequences have been developed. It may stimulate a search for a new consistency of the enlarged set. Noises, errors, disturbances and my surprising experiences now are alike in functioning as counteracting impulses that point to what lies beyond or beneath the level of deductive stratification achieved within a systematic and coherent representation. The discontinuities of experience force upon us the need to react with a creative response to an independent part of reality that is beyond our ken.

My consciousness in the present moment is evidence that something independent appears now. Hopefully, we will be able to understand what is presently only a disturbance as a premise for a coherent train of future thoughts. But what is experienced, thought and felt in every present moment will remain the cutting edge of consciousness

which points in the other direction, towards a fortuitous distribution of events in time and which leads us into error. "This tendency to error", Peirce says in 1898, "when you put it under the microscope of reflection, is seen to consist of fortuitious variations of our actions in time. But it is apt to escape our attention that on such fortuitious variation our intellect is nourished and grows." (CP 6.86, 1898)

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