Physics and the Philosophy of Science – Diagnosis and analysis of a misunderstanding, as well as conclusions concerning biology and epistemology

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„It is impossible to scrutinize too carefully
the character to be assigned to the datum
in the act of experience. The whole
philosophical system depends on it.“
Alfred North Whitehead[1]

Abstract:

For two reasons, physics occupies a preeminent position among the sciences. On the one hand, due to its recognized position as a fundamental science, and on the other hand, due to the characteristic of its obvious certainty of knowledge. For both reasons it is regarded as the paradigm of scientificity par excellence. With its focus on the issue of epistemic certainty, philosophy of science follows in the footsteps of classical epistemology, and this is also the basis of its 'judicial' pretension vis-à-vis physics. Whereas physics is in a strong competitive relationship to philosophy and epistemology with respect to its position as a fundamental science - even on the subject of cognition, as the pretension of 'reductionism' shows.

It is the thematic focus on epistemic certainty itself, however, that becomes the root of a profound epistemological misunderstanding of physics. The reason for this is twofold: first, the idea of epistemic certainty as a criterion of 'demarcation' between physics and metaphysics obscures the view of the much deeper heuristic differences between the two kinds of knowledge. The second, related, reason is that epistemology does not ask the question of the reason for the epistemic certainty of physics; instead, it sets itself the task of 'legitimating' physical knowledge, and this, crucially, with reference to the interpretation of the process of cognition. Thus, as a matter of course, all epistemological assumptions about this process – including the common descriptive understanding of knowledge and its ontological premises – flow into the interpretation of physics as a science.

Consequently, this undertaking is not only doubtful from the ground up, because it presupposes for its meaningfulness nothing less than certainty of knowledge concerning (the interpretation of) the process of knowledge, thereby relying on mere convictions; moreover, by projecting the descriptive, 'metaphysical' concept of knowledge onto physics, it leads to unsolvable epistemological problems and corresponding resignative conclusions concerning the claim of knowledge of physics.

The cross-object, deconstructive approach to knowledge implies a completely different, non-descriptive understanding of physical concepts, and thus also affects the understanding of physics as a basic science, with consequences also for the setting of problems in biology and epistemology.

Content:

1 Whitehead, 1960, p. 238

1. Introduction and diagnosis

The standpoint that philosophy of science takes vis-à-vis physics is the epistemological one.[2] Its central issue is the question of the epistemic status of our empirical knowledge, expressed in the claim of its critical examination and/or legitimation from an epistemological point of view. The yardstick for judging the epistemic status – and thus the basis of the critical legitimation claim – is the epistemic norm of certainty as a criterion of true knowledge. Or, more generally, the question of epistemic safety. A logically indispensable prerequisite for the critical application of this epistemic norm is, of course, certainty concerning our knowledge, or at least our basic assumptions, about the cognitive process as such, i.e., our epistemological knowledge.

The same conclusion also follows from a slightly different perspective from the epistemological claim to legitimation regarding empirical science. For purely logical reasons, this claim excludes that the knowledge of epistemology about cognition and the process of cognition is empirical, because otherwise it would result in an infinite regress. Epistemology would then be only an empirical science among others, and its own epistemic status would therefore be no less questionable than that of the others. This regress can only be avoided by assuming self-evidence with respect to the conception of cognition in general, and the interpretation of the process of cognition in particular.[3]

On the other hand, Bertrand Russell, for example, writes in contrast to this: „It has been common among philosophers to begin with how we know and proceed afterwards to what we know. I think this a mistake, because knowing how we know is one small department of knowing what we know.“[4] Consequently, the question of the epistemological status of epistemology itself cannot be dismissed out of hand, if one really wants to take its critical claim seriously and justify it. This question concerns the assumptions underlying the understanding of cognition itself as well as the interpretation of the process of cognition based on it, which I would like to analyze in the following.

Thereby, unsurprisingly, it will turn out that the ontological premise of the independent (autonomous) determinatness of things (in themselves), which is expressed in the concept of substance, at the same time forms the indispensable basis of our (naïve) understanding of cognition, as well as of the interpretation of the process of cognition. It finds its direct expression in the epistemological terms, and is the indirect ground of their self-evidence.[5] This premise builds, as it were, the cornerstone of our entire conception of reality and cognition. The differences of epistemological positions (whether rationalism or empiricism) and conclusions (whether skeptical or apologetic) are secondary to this; they do not concern this basic premise but presuppose it in their turn. And it is this antecedent setting of basic ontological assumptions and epistemological convictions that builds the precondition for the epistemic norm of certainty in the sense of epistemology, namely in the sense of its definition with reference to the 'act (or process) of cognition', or rather the 'notion' of this. It is precisely this somewhat obscure association with certainty that also resonates in the notion of 'experience' or 'empirical science'.

'Obscure' primarily because the epistemological norm of certainty owes its epistemological function

2 I hereby refer exclusively to the philosophical theory of science, in contrast to that, e.g., of Norman Robert Campbell, which is predominantly oriented to the practice of the physicist, rather than to epistemological questions. Although, of course, it is also not free of epistemological assumptions.

3 The logical alternative to this would be the recognition of the holism of the real epistemic situation, i.e. of the fact that the interpretation of the 'world' (as the totality of objects, which also includes the cognizer himself) by means of distinction also forms the horizon or frame of the self-interpretation of the cognizer (as well as of the interpretation of the cognitive process). Which definitely excludes epistemic certainty in the strict sense.

4 Russell, 2007, p. 16

5 Bertrand Russell writes in this regard: „I found, when I began to think about theory of knowledge, that none of the philosophers who emphasize 'experience' tells us what they mean by the word. They seem willing to accept it as an indefinable of which the significance should be obvious.“ (Russell, 2007, p. 131)

and meaning (as a justification for the 'critical' standpoint of epistemology) to its ostensibly uncompromising presuppositionlessness, but in doing so, at least in the form in which it is conceived by epistemology, it refers to the interpretation of the cognitive process, and this in turn depends on fundamental ontological assumptions and epistemological convictions derived from them.

The situation resulting from this is peculiarly paradoxical, because by this conception of certainty the interpretation of the process of cognition moves into the center, but at the same time, as mentioned, a scientific (empirical) consideration of cognition as a process, respectively as a phenomenon is logically excluded. For this would be tantamount to admitting that in truth we do not (yet) know what the process of cognition actually is, that our present 'knowledge' about it has something provisional about it, which would lead the criterion ad absurdum, and undermine the 'critical' standpoint of epistemology respectively philosophy of science vis-à-vis empirical science.[6]

Not least in view of the fundamentally apologetic attitude of philosophy of science towards empirical science, this situation proves to be a serious dilemma, and its own position ambivalent. This ambivalence of philosophy of science manifests itself in a special way in the relation to physics. Namely, because the claim to knowledge of physics as a foundational science in principle does not stop at the assumptions and convictions of epistemology. This concerns in particular the competence field of ontology, but thus directly also the fundament of the understanding of cognition.

By epistemology, however, the genuine competence of physics in respect of the field of ontology is immediately restricted, namely with reference to exactly that peculiarity which characterizes it especially from the epistemological point of view, its epistemic certainty.[7] This manifests itself according to general opinion above all in its prognostic ability and in the continuity of its progress of knowledge. Both clearly distinguish it from classical metaphysics, which leads the philosophy of science to the postulation of epistemic certainty, understood as a norm, as 'the' criterion of demarcation between 'physics' and 'metaphysics'.[8] Namely, this is the decisive point, 'epistemic certainty' in the sense of epistemology, i.e. referring to the process of cognition, resp. the notion of it.[9] The logical consequence of this is a projection of the notions, norms, convictions and assumptions of epistemology onto the interpretation of physics as a science. After all, the requirement of epistemic certainty seems perfectly innocuous in its application to science, and so does the projection of epistemology's notions of the cognitive process (including its associated assumptions and convictions) onto physics.[10] Nevertheless, according to my thesis, this very projection is the source of a momentous 'metaphysical' misunderstanding of physics, namely because its epistemic certainty is of a quite different nature and provenance than assumed by epistemology, and because, in connection with this, its concept of knowledge is fundamentally different from that of metaphysics.

According to epistemology, it is the sense impressions that form the foundation or at least the source material of the cognitive process. Now physics, however, does not at all set out from sense impressions, but from the familiar objects (which, in contrast to sense impressions, can be

6 The same conclusion, by the way, follows from the scientific theoretical thesis of the hypothetical character of scientific theories when applied to epistemology. It follows that epistemology cannot itself be a science.

7 The debate about 'scientific realism' bears witness to this deprivation.

8 Which implies that there is no other essential point of distinction between the two 'types of cognition', and thus leads to the transmission of the descriptive concept of knowledge of metaphysics to physics.

9 Be it even, as in the case of the criterion of 'falsifiability', under quasi 'negative prefix'. (See Popper, 2002, p. 18f.)

10 Erhard Scheibe writes in this respect of „the embarrassment of the physicist, who feels himself unable to subject his discipline to one of the epistemological positions known from the history of philosophy but rather finds himself somewhere *in between* the philosophical extremes. Einstein has gone so far as to call the physicist an 'unscrupulous opportunist' who, depending on the circumstances, appears as a realist or an idealist or a positivist or even a Platonist.“ (Scheibe, 2001, p. [1])

'measured').[11] In this, by the way, it does not differ from metaphysics. However, there is a fundamental difference in the conceptual, heuristic approach to the objects. In contrast to everyday knowledge and metaphysics, physics does not proceed in a differentiating and categorizing 'object-related' way (based on immediate sensual perception), but in a leveling and measuring way 'across objects'.

The recognized epistemic certainty of physics rests on a completely different foundation than epistemology assumes, namely on the unambiguity of the measurement results, not on immediate 'sensual certainty' or 'empirical observation'. For measurement results are of marginal epistemic value in themselves, but they are unambiguous and verifiable. And unlike sense impressions, they also have a clear point of reference.

Sense impressions, on the other hand, are not only subjective and fleeting, they are also influenced by countless factors. And above all, they are never unambiguous as such (neither in themselves nor for themselves),[12] they always demand interpretation. The availability of interpreting schemes is, in other words, the precondition to be able to gain information (knowledge) from the 'raw sense data' at all. For neither the sense impressions nor the objects of observation have a definite meaning all by themselves. Thus, from the perspective of sense impressions, observations are always interpretations, whereby categories like 'substance' or 'causality' function as basal ontological interpreting schemes.[13] 'Certainty' in the sense of epistemology is logically but not conceivable without unambiguity. Hence the always futile search for unquestionable (pure) 'givenness' or the equally unsuccessful striving for 'objectivity'.[14]

The 'unambiguity' of the measurement results is, as said, of marginal epistemic value in the context of the object-related, descriptive concept of knowledge of metaphysics (it would in sum exhaust itself in mere listing). Not so in connection with the physical concept of knowledge. The measurement results get their significance only in the context of the epistemic concept, respectively the heuristics of (classical) physics. For the latter is not concerned with the description of the objects, but with the epistemic establishment of exact correlations between the objects in general (irrespective of their differences, be they apples or planets or liquids, etc.) and their specific behavior. The specific feature of the concept of knowledge of physics (compared to both metaphysics and epistemology) is its orientation on the dynamic phenomena. For the purpose of an inquiry into these phenomena (their 'deconstruction') it reduces the objects to bare instances of physical basic quantities.[15]

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11 Basically, this also applies to epistemology, because its approach to sensory impressions is in turn the product of a deconstruction of representational perception from an analytical point of view. Physics and epistemology are – in this respect both in clear contrast to metaphysics – two contrary ways of deconstruction of the familiar objects. Whereas epistemology declares the cognizing subject as a fixed point and takes it out of the realm of objects, physics due to its orientation on phenomena (not on 'entities'), in principle does not stop at a deconstruction of the subject either. In the one case this leads to the conception of the epistemic situation as a linear subject-object relation, in the other case we are dealing with its implicit understanding as a holistic situation. Epistemology and physics are basically incommensurable.

12 Their interpretation does not only concern the contents, but not least also their understanding 'as sense impressions'. In this alone there is already material for a row of metaphysical treatises.

13 Thus Descartes writes for example: „... yet substance cannot be first discovered merely from its being a thing which exists independently … We easily, however, discover substance itself from any attribute of it, … for, from perceiving that some attribute is present, we infer that some existing thing or substance to which it may be attributed is also of necessity present.“ (Descartes, 1965, § LII)

14 As Carnap writes: „Man pflegt in der Erkenntnistheorie zu sagen, daß die ersten Sätze sich auf 'das Gegebene' beziehen; es besteht aber keine Übereinstimmung, was als das Gegebene anzusprechen ist.“ (Carnap, 2004, p. 85). ([Translation:] „In epistemology, it is customary to say that the first sentences refer to 'the given'; but there is no agreement as to what is to be addressed as the given.“). It is the lasting merit of neopositivism to have put an end to this subliminal 'universal realism'. Every interpretation of something 'as something' already exceeds the horizon of mere 'givenness', even if this 'givenness' should prove to be 'unambiguous' within the framework of existing interpreting schemes.

15 While, conversely, metaphysics explains dynamic phenomena causally by ascribing it to a 'striving' (as a natural

The core of the metaphysical misunderstanding of physics consists simply in the descriptive view of physical concepts in the sense of object-related terms.[16] The concepts of classical physics do not denote the 'properties' or qualities of objects, but they are, metaphorically speaking, the comb over which physics generally shears all objects.[17] They simply stand for the physical basic quantities. The reference of physics to the objects is a mediate one (so to speak through the glasses of the physical concepts).[18] They are substituted – noticeably in the heuristic context (i.e. presumptive, on reasonable 'technical grounds') – by the physical concepts, i.e. the physical basic quantities.[19] The claim of physical theories to generality is established by this 'presumptive substitution', not by an ominous 'inductive inference'.[20]

The way to the heuristic goal of the epistemic establishment of exact correlations between the objects in general and their specific behavior leads therefore not via induction, but simply via measurement, more accurately quantification. Because 'quantification' differs from the simple (singularly object-related) 'measurement' through the aspect of the (leveling, 'normalizing') generalization across objects. Fundament of the quantification are the physical basic quantities, which appear in the heuristic context as 'physical concepts'.[21]

The epistemic status of physical concepts cannot therefore be separated from their heuristic function, from their connection with the inquiry into phenomena, and in this sense it is per se and irrevocably a presumptive one, however well it may be experimentally confirmed.[22] For it is the concepts themselves that are indirectly put to the test in the experiment (via confirmation of the theory).[23]

Authoritative for the 'legitimacy' of the presumptive substitution of the objects by the physical concepts is the strict alignment with the dynamical phenomena, i.e. the proof of exact correlations. This commitment by no means excludes the revision or supplementation of concepts in conjunction

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'property' of things) without further differentiation, except for the basal differentiation of causes, related to the 'nature' of various categories of things.

16 Corresponding to this view is the view of physical theories as propositions. See Popper: „Scientific theories are universal statements.“ (Popper, 2002, p. 37). Similarly, Quine: „It is occasion sentences that report the observations on which science rests. The scientific output is likewise sentential: true sentences, we hope, truths about nature.“ (Quine, 19914, p. 20). Therein lies the root of the 'problem of induction'.

17 See Descartes' general concept of 'res extensa'. Their extendedness does not distinguish objects from (empty) space, insofar the concept is not bound to the notion of substance.

18 For example, Kuhn also insists, „Paradigm changes do cause scientists to see the world of their research-engagement differently.“ (Kuhn, 2012, p. 111). This kind of generalization is fundamentally different from the 'subsumption' under categories obtained by differentiation, which is characteristic of descriptive ('metaphysical') terms.

19 The common interpretation of this process in the sense of 'abstraction' betrays the adherence to the object-related concept of knowledge of metaphysics. Physics, on the contrary, basically does not consider the concrete, transient objects as the 'actual reality', but its own fundamental concepts. In this sense, her approach corresponds to a 'deconstruction' of the objects, not an 'abstraction' from them.

20 Thus writes Norman Robert Campbell: „The substitution of numerical quantitative laws for merely qualitative laws is an excellent example of the increase in the value of a law due to increase in generality and definiteness.“ (Campbell, 1957, p. 70). And regarding 'qualitative laws': „It is of no service when we desire to establish a true law, characterised by the essential element of necessity. … There is no such thing as formal induction.“ (Ibid., p. 354). Campbell also speaks of „a very important fact, on which it is impossible to insist too strongly or too often, that magnitues, derived as well as fundamental, are concepts.“ (Ibid., p. 404)

21 Generalization by substituting concepts for objects is functionally equivalent to what is understood by 'normalization' in computer science. Such concepts can also be combinations of basic physical quantities (see 'specific weight'). All this is true for classical physics. I will talk about modern physics, whose basic concept is the 'electric charge', later.

22 It is also in this context that the problem of 'underdetermination of theory by observation' is to be considered.

23 This is probably also the reason for the resilience of theories against 'falsifications', which Kuhn brings into the field against Popper with good reasons. Thus when he writes: „But falsification, though it surely occurs, does not happen with, or simply because of, the emergence of an anomaly or falsifying instance. Instead, it is a subsequent and separate process that might equally well be called verification since it consists in the triumph of a new paradigm over the old one.“ (Kuhn, 2012, p. 146)

with the incorporation of others, or the discovery of new phenomena.[24] In this sense it is actually the revisability of its concepts which is the specific trademark of the safety of knowledge of physics and the continuity of its historical development. For this is not based on the concepts (as secure foundations), but on the heuristics, which can also provide for 'revolutions' and 'paradigm changes' again and again.

The choice of the relevant physical basic quantities as a basis for the epistemic establishment of exact correlations, however, is not a trivial process. Because correlations are in principle, as one can see just at the assertion of possible causal connections, arbitrarily producible.[25] And that is because the number of imaginable (as well as actual) factors, which may causally influence the behavior of an object, or the physical event, is theoretically almost unlimited. Therefore they are not simply 'ascertainable' by observation. It requires – under the precondition of the criterion of exactness –[26] besides an initial assumption, the isolation of the presumably determining factors in the way of experimental arrangements.[27] Therefore, the experiment itself plays a decisive role in the process of concept development and theory building. And it is therefore also the concepts themselves that are indirectly put to the test in the experiment. All these aspects go hand in hand, respectively flow into each other. The experiment serves in the first instance to build the theory, and only in the second instance to confirm the theory. It is the integral interplay of all these elements that characterizes the specifically 'physical' kind of rationality in dealing with the holistic epistemic situation.

The theories of physics are not 'statements' or 'propositions', but simply mathematical equations of quantities. The mathematical representation is not an auxiliary, but it builds the essence of physics. For this reason, confirmation by experiment is of the nature of mathematical evidence, not of the type of immediate sensory certainty. The experimental observation delivers only the numerical values.[28] The objects 'exist' in the context of the theories of classical physics only as values of variables (of physical basic quantities).

Philosophy of science fails in its task because it imposes the descriptive concept of knowledge of metaphysics (and epistemology) on physics. The fascinating thing about Neopositivism is still the spectacular failure of its project of an empirical 'verification' of physical theories on the conceptual level of sense impressions, or 'protocol sentences'.[29]

Significantly, as a consequence of this failure, Karl Popper completely abandons the approach of

24 For an enumeration of physical concepts, see again Campbell, 1957, p. 105f.

25 'Causality' is essentially a descriptive term. It does not belong to the inventory of physical concepts. It is fundamentally open to interpretation, and moreover, as a descriptive term, it cannot refer to anything else than coincidence. Its prominent role with regard to the common understanding of physics as a science can only be understood through the focus of physics on the dynamic phenomena and the simultaneous adherence to the descriptive ('metaphysical', object-related) concept of knowledge.

26 The exactness of the correlations is of fundamental importance insofar as it is essential for the elimination of the contingencies connected with the measurement process. These concern the arbitrary instantaneousness of the concrete measurement as well as the categorial differences of the objects and phenomena related to each other and the different units of magnitude involved, and last but not least the 'arbitrariness' of the applied scales. This elimination finds its direct expression in the status of natural constants as 'dimensionless quantities'.

27 Campbell writes in this regard: „Measurement is so distinctive of physics because it is almost always the aim of the physicist to find a method of experiment which will enable him to establish a mathematical relation between two measurable concepts.“ (Campbell, 1957, p. 106). See also Erhard Scheibe, who writes: „In a certain sense, the evolution of physics has tended towards the elimination of every causal conceptuality in the ordinary sense of the word.“ (Scheibe, 2001, p. 10)

28 For this reason, in case of 'inappropriate' results, not only the theoretical assumptions and the theoretical concepts (parameters), but also the setting of the experiment can be questioned.

29 One literally suffers while reading Carnap's small writing with the title „Physikalische Begriffsbildung“ („Physical Concept Formation“), when he tries to bring his understanding of the quite different heuristics of physics, which flashes through at many points, into congruence with the metaphysical concept of knowledge of epistemology.

analysis on the 'conceptual level', and starts from the 'sentence level' (theory level) instead.[30] The core problem, according to this view, is the question of the possibility of rational justification of the claim of physical 'statements' ('laws of nature') to universal validity on the basis of 'observations' alone, and he solves this problem by negating this very possibility, but at the same time offering the criterion of 'falsifiability' as a rational alternative. The idea behind this is the decoupling of the so-called 'questions of justification or validity' (as a topic of 'the logic of knowledge') from the so-called 'questions of fact', i.e. the questions in connection with theory formation (which are assigned as a topic to mere 'psychology of knowledge').[31] The formation of physical theories is thus rationally left to arbitrariness (in the sense of merely stating 'general assertions'), and the rational purpose of experiment is restricted to the attempt to falsify statements which can be deductively derived from the general assertions. The price for the separation of the 'questions of validity' from the 'questions of fact' is the explicit resignation with respect to the question of truth, which in turn is now declared a virtue in the garb of intellectual modesty.

In the following Thomas Kuhn's science-historically founded paradigm theory , as well as W.v.O. Quine's theory-holism, question the possibility of falsification in Popper's sense, and thus also his criterion of falsifiability, for principal reasons. Reasons which in both cases, albeit in different ways, concern the assumption of the independence of observation from theory (as a logical condition for the possibility of unambiguous falsification).

The philosophy of science seems to end up in an epistemological defeatism concerning physics, from which no reasonable way leads out, and thus at the exact opposite of the original expectation of neopositivism. A failure, the ground of which is not to be found in physics, but rather in the epistemological assumptions themselves.[32]

So to say, the counter-reaction to this defeatism is the so-called 'naturalism', i.e. the rationally (in the sense of epistemology) not justifiable confidence in natural science, even regarding a future solution of the riddle of cognition. The weakness of this position is that on the one hand it 'abandons' the 'goal of a first philosophy',[33] i.e. the epistemological claim of legitimation vis-à-vis empirical science, but on the other hand it adheres to the epistemological ('metaphysical') concept of knowledge (also with respect to physics) without reflection (so that the aforementioned 'confidence' ultimately amounts to the unspoken assumption of a 'scientific universal realism').

The consequences of this adherence, however, are not limited to mere epistemological misunderstandings and problems concerning the interpretation of physics as a science; in their implicit ontological dimension they reach far beyond physics. For the adherence to the descriptive concept of knowledge has the consequence that the originary ontological dimension of the physical concepts remains completely unnoticed.

What is to be understood by this? The core point is the epistemological view of physical concepts. If one understands physical laws as 'propositions' and physical concepts as 'terms' in the predicative sense according to the descriptive concept of knowledge, then one automatically bases the interpretation of observations (of whatever content) on the classical substance-property-scheme, on which in turn the causal scheme also relies. If, on the other hand, one assumes that the concepts of (classical) physics are not 'terms' in the sense of predicates, but stand for the physical basic

30 However, the 'terms' or concepts soon recapture their role on the level of theory in the form of Thomas Kuhn's 'paradigms'. His thesis of 'incommensurability', though, again betrays the descriptive concept of knowledge.

31 See Popper, 2002, p. 8. Today one usually speaks of 'context of justification' and 'context of discovery'.

32 Kuhn himself expresses a strong reserve about epistemology: „Are theories simply man-made interpretations of given data? The epistemological viewpoint that has most often guided Western philosophy for three centuries dictates an immediate and unequivocal, Yes! In the absence of a developed alternative, I find it impossible to relinquish entirely that viewpoint. Yet it no longer functions effectively, and the attempts to make it do so through the introduction of a neutral language of observations now seem to me hopless.“ (Kuhn, 2012, p. 125).

33 See Quine, 1994, p. 72

quantities, then their reference to the objects is not of a direct, predicative kind, but rather of the kind of substitution of the concrete objects by the respective measurement results, for heuristic purposes.

If one looks at the heuristic approach of classical physics, respectively its 'method' from an ontological point of view, it cannot be understood other than as a creeping deprivation of the autonomy of the objects.[34] This is evident both in the methodical procedure as such, namely in the leveling form of generalization – i.e. the substitution of the objects by cross-object concepts (by way of 'quantification') –, and in the result, the formulation of laws of nature in the form of quantity equations. By the way, this explains (epistemologically unconstrained) also the 'normative claim' of the 'laws of nature'. Namely, on the one hand, the claim to universal validity (borne by the substitution of the objects by the concepts), and on the other hand, the associated deprivation of the autonomy of the objects. Both together form the ground of the predictive ability of physics.

However, this deprivation of the autonomy of the objects is, as already said, a creeping process (and therefore corresponds in its ontological aspect in a certain way to a 'hidden agenda'). And this is because physic's proceeding is a stepwise one, due to its strict orientation to dynamical phenomena, and the corresponding laborious, experimental process of concept formation, that results in the concept of gravitation.[35] For physics does not simply declare (in philosophical manner) the objects to be mere 'appearances', or the categories of substance and causality to be mere 'habits of thought' or the like.[36] Rather, it works its way through the various phenomena, and in this way successively fathoms certain aspects of the behavior of the objects, leaving their other 'properties' untouched (for the time being). The 'autonomous' ontological status of the objects is somehow called into question in this way, but not fundamentally.

Therein lies a major reason for the difficulties that stand in the way of an adequate epistemological understanding of the physical concept of knowledge. Another reason also lies in the affinity of the concepts of classical physics to 'properties' of the objects.[37]

However, this changes fundamentally with the discovery of the electrical phenomena. Because the dynamic phenomena alone now take over the heuristic leading role, the objects cease to be the reference points of the physical concepts, and thus the reference points of measurement. In other words, the phenomena themselves now form the authoritative reference point of concept finding. We are talking here especially about the concept of 'electric charge', which in the course of the further development successively rises to a basic concept of all physics.

It derives, as said, directly from the heterogeneous phenomena. It serves equally their 'subsumption', as also their theoretical 'substitution'. In contrast to all other concepts of physics (starting with space

34 Carnap speaks in the small paper already mentioned in note 29 of the fact that „a thing-property is a way of reacting“, and that „all physical assertions are conditional assertions.“ (Carnap, 2019, p. 351 and 353). And there he also strictly opposes the atavistic conception of 'conditional relations' in the sense of 'causal relations'. (Ibid., p. 355 and 357)

35 This concept also includes a constant, more precisely a 'proportionality constant', an exact correlation of exact correlations (and is insofar to a certain degree selfreferential). Simultaneously, the assumption of an absolute (Euclidean) space and an absolute time reflects the ontological thought of the mutual independence of objects from each other and of space and time from them, and of all together from the cognizing subject.
By the way, to determine something like a 'proportionality constant' through induction on the basis of mere observation (that is by 'watching what happens' without 'substitution' of the objects by physical concepts) is hardly conceivable.

36 The declaration, so to speak, was made by Descartes, in the form of his general concept, the 'res extensa'. In a similar way as physics substitutes the objects by its concepts, Descartes' 'analytic geometry' incidentally substitutes the approach of Euclidean geometry to the figures by a coordinate system.

37 Mind the subtle difference between measurement and quantification. Another difficulty consists in the fact that this approach basically applies exclusively to physics, and with restrictions to chemistry, while other sciences operate largely at the 'object level' from the outset, i.e. proceed directly object-related, and are therefore much closer to the descriptive, metaphysical concept of knowledge, or even correspond to it entirely (also with regard to the role of 'observation').

and time), which – apart from mental associations or pictorial notions – are exclusively defined 'in terms of scale' (as quantities), with reference to concrete objects or phenomena, the 'electric charge' is a contentwise completely autonomously defined concept on its own, and only in second instance also a (indirectly measurable) quantity as well as in the further also a definite unit of measurement and the basis of further physical concepts (like that of the 'electric field' etc.).

The substitution of 'objects' by physical concepts subsequently takes a new, 'concrete' form by successively incorporating also their qualitative 'properties' as objects. While the substitution of objects by ('quantitatively defined') concepts in classical physics served the deconstruction of the dynamic behavior of objects, the notional substitution of electrical phenomena by the ('theoretical') concept 'electric charge' leads in consequence to the deconstruction of the objects themselves.

However, notwithstanding this gradual deconstruction of the 'properties' of the objects, the influence of the descriptive concept of cognition, as abruptly as inconspicuously, reasserts itself, in terms of the understanding of the 'electric charge' as a predicate, thus a designation for a 'property' of a 'charge carrier', conforming to the basal interpretative scheme of 'substance'.[38] In this way, this ontological interpretative scheme again takes command of our thinking and leads, as if by itself, to the notion of elementary particles as the elementary 'building blocks' of the universe.[39] Only the quantum phenomena cause irritation, but the weight of the elementary understanding of cognition, based on the concept of substance, obviously weighs heavier.

But if one does not leave it with the almost reflex association of the physical concepts with 'properties' of objects, but goes logically to the bottom of the concept 'electric charge', it turns out that, regardless of its 'discrete occurrence', it elementarily contradicts the idea of the autonomy of the charge carriers (the core of the concept of substance), that it rather categorically excludes such an autonomy. Because the concept 'electric charge' is per se defined as 'positive' or 'negative' charge, and therefore logically (apart from its manifestations) exclusively with reference to itself. Its two distinguishing 'features' cannot logically be imagined independently of each other (as autonomous 'properties' of something). What therefore characterizes these 'features' is the (logically prior) inherent unity in difference, their binary-logical character.[40] A conception of 'electric charge' in the sense of an 'intrinsic property' is therefore a contradictio in adiecto, a matter of logical impossibility.[41]

If one therefore, as a logical consequence, dismisses the idea of substantial autonomy concerning the elementary particles (and consequently also the 'building block model' of the universe), this allows for only one conclusion with respect to the ontological composition of the whole, namely the conclusion on the primacy of the constellation over the particles.[42] Autonomy in the strict sense is

38 The notion of 'description' always insinuates a reference to immediate perception. However, this is definitely excluded in case of a positive or negative charge, as well as a measurement independent of the effect context.

39 Bertrand Russell speaks of 'an inferred world'. „These entities, … since they owe their credibility to inference, are only defined to the degree that is necessary to make them fulfil their inferential purpose. It is not necessary to suppose that electrons … have that sort of simple reality that belongs to immediate objects of experience.“ (Russell, 2007, p. 22). The current debate about 'scientific realism' ignites precisely on this problem.

40 Analogous to the elementary unit of information, the 'bit', whose two 'units', '0/1', are also defined exclusively with reference to each other. They form a logical unity in difference.

41 And this is true independently of what other 'properties' (or features or parameters) may apply (or be in the play). By the way, already classical metaphysics knew that the idea of the autonomy of objects (their autonomous determinateness), which forms the basis of its descriptive concept of knowledge, contains a logical flaw, because the determindeness of the existing objects, insofar as it is based on distinctions, always points beyond itself to other existing objects. This is the origin of the idea of 'absolute substance' as well as of the thought figure of dialectics.

42 Whitehead writes: „The simple notion of an enduring substance sustaning persistent qualities, either essentially or accidentally, expresses a useful abstract for many purposes of life. But whenever we try to use it as a fundamental statement of the nature of things, it proves itself mistaken. It arose from a mistake and has never succeeded in any of its applications. But it has had one success: it has entrenched itself in language, in Aristotelian logic, and in metaphysics. For its employment in language an in logic, there is … a sound pragmatic defence. But in metaphysics

thus exclusively attributable to the constellation as a whole. From this results 'in causal view' necessarily the conclusion on the strict and exceptionless determination of the occurrences.[43] However, a basically non-linear way of determination, which only takes on linear features in the course of the formation of structures and formations in connection with the constitution of relatively autonomous atomic 'units' and the factor 'accumulation' (think of the 'three-body problem').

The essential question in this respect is that of the principle of structure formation, and this is logically, according to the 'binary-logical' principle of the basic structure, autarky. However, 'reallogically' in the gestalt of the (not purely formal, but contingent and virulent) 'synthetic unity in difference'. It is, I argue, this principle that underlies the formation of structures (atomic and beyond). Its peculiarity consists in the fact that it is (in a virulent way) 'locally' structures forming, while at the same time, by virtue of the primacy of the total constellation, it has a transversal or 'global' dynamic effect. The structures, considered as constellations, are, as it were, mere facets of the overall constellation. The latter is therefore to be understood vice versa as a dynamic constellation of (more or less) autarkic constellations.[44]

From the primacy of the constellation it logically follows on the one hand that all physical 'properties' are of emergent origin, thus are to be traced back to the constitution of autarkic units (constellations) within the framework of the total constellation. On the other hand it is also true that the contingent autarky of the structural units is transferred or represented 'outwardly' (in the form of actio/reactio) as relative autonomy. A 'lawfully' constituted autonomy, because it obeys superordinate principles, and in sum expresses itself as conformity.[45] The 'properties' are the 'qualitative side' of the instantaneous, and yet incessant interaction. They are instantaneously evoked by the interaction, and thus at the same time determine the events on hand.[46] Their 'determinateness' is a determination in steady flux.

Without going into possible further conclusions regarding the physical view of things here,[47] I will try in the following to give an outlook on the consequences that arise from this change of the ontological view with respect to the (heuristics of) biology and the understanding of biological phenomena. Starting from the question of the specific kind of autarky peculiar to biological entities,

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the concept is sheer error.“ (Whitehead, 1960, p. 122).
The position of the so-called 'Ontic Structural Realism', as it is represented by James Ladyman (see Ladyman & Ross, 2010), suffers from the fact that it assumes a 'primacy of relations', and therefore limits the autonomy of the relata, but without being able to do without them as an idea. In contrast to the 'relation' (which is a purely descriptive term) the 'constellation' has nothing outside of itself. Everything 'outside' (and be it the point of view of the observer) is ultimately also part of the specific constellation and is only conditionally negligible.

43 The thesis of indeterminism on quantum level is a logical consequence of the assumption of autonomy of particles.

44 The influence which constellations exert on each other in such a non-linear way on all levels can probably best be described in the sense of 'milieu building'. If the mental reproach of 'abstraction' (see note 19) applies anywhere, then to the idea of linear causality.

45 It is these superordinate principles that physics is tracing, and in which, of course, concepts or parameters other than charge also play a fundamental role. The mathematical counterpart of the principle of the 'synthetic unity in difference' is the equation by the way, and to the principle of autarky, as the principle of the dynamic, simultaneous organization of constellations on all levels, mathematically corresponds the symmetry. The discovery of 'constants' in the context of the fundamental dynamics of the events is of course of special, principled importance.

46 In this sense also writes Robert B. Laughlin: „I am increasingly persuaded that *all* physical law we know about has collective origins, not just some of it.“ (Laughlin, 2005, p. XV). And elsewhere: „The laws of electron motion beget the laws of thermodynamics and chemistry, which beget the laws of crystallization, which beget the laws of rigitiy and plasticity, which beget the laws of engineering. The natural world is thus an interdependent hierarchy of descent ...“ (Ibid., p. 7). I refer here also again to Rudolf Carnap's statement: „A thing-property is a way of reacting.“ (Carnap, 2019, p. 351)

47 An essential implication of the thesis of the primacy of the constellation, which should still be briefly noted here, is that space and time (prior to the 'perspectivization' or 'localization' through the formation of coordinates) are not something independent of the constellation, but rather integral to it. The constellation entirely immanently determines the 'trajectories'. The application of coordinate systems is essentially just an outsourcing of perspective. But the essential thing about the constellation is precisely its total immanence.

which in turn is responsible for the 'constellation' being transformed into a 'situation' (in each case). This question, as will be shown, also forms the logical approach to a scientific understanding of consciousness and cognition, which I will briefly sketch at the end of this paper. For the hitherto sketched conception of physics as a science, and the ontological conclusions deriving from it, deprive the common conception of cognition of its foundation.

In order to be able to adequately analyze and critically examine the common conception of knowledge (in the manner already indicated) – always with an eye on the heuristics of physics – it is first necessary, however, to dissect it, that is, to break it down into its various components. And this in the following order:

a) The understanding of cognition

b) The concept of knowledge

c) The process of cognition

d) The model of the epistemic situation

2. Analysis of the paradigms of epistemology

As noted at the beginning, the focus of philosophy of science concerning physics is on the question of its certainty of knowledge (see the 'induction problem'), which is a paradox insofar as the certainty of our knowledge about cognition itself is more than questionable, for it consists essentially of mere convictions. To get to the bottom of these, not least in their interrelations with conceptions based on them, is the purpose of the following analysis.

2a) The understanding of cognition

It is a fact that every act of cognition and every knowledge (of whatever kind) always involves a rough idea of what cognition or what knowledge is. And this simply in the sense of the notion of representation, i.e. of the (whatever kind it may be) content-related reference to something that is different from and independent of the act of cognition or of the knowledge itself, namely the 'real things' or 'the reality'.

The representation is on the one hand image-like, and on the other hand conceptual, and is usually related to singular objects, in the way of identification by means of predication. For this reason, the presupposed independence of reality is equivalent to the assumption of the autonomous, independent determinateness of things ('in themselves'). This naïve ontological assumption forms the basis and precondition for the common ('naïve') conception of cognition in both versions, namely as 'activity' (in the sense of passive reception) and as a goal and result of activity (in the sense of representation, of knowledge about ...). This in turn results in the conception of truth as (whatever kind of) correspondence.

Epistemology and ontology reflect and mutually condition each other. The 'naïve' assumption of the autonomous determinateness of objects, which forms the core of the idea of substance, is the logical precondition of the 'naïve' passive understanding of cognition, as well as its 'natural' logical consequence. One can speak of an ominous 'ontic-epistemic'-indifference which is mirrored in the German term 'Bestimmtheit' itself, which does not allow for a corresponding differentiation.[48]

48 In English it is (contrary to German) principally possible to distinguish terminologically between the ontic and epistemic aspects of the German term 'Bestimmtheit' by using the terms 'determinateness' and 'determinedness' – yet tellingly (in an epistemological context) only in a very awkward way. I will therefore stick with the term 'determinateness' except in cases where the distinction plays a role in my argument (especially in chapter 3). Incidentally, the term 'cognition' in German can be used in a similarly indifferent way for both the activity of cognition and its product, 'knowledge'.

The substance ontology is, in other words, both, the basis of the naïve understanding of cognition and at the same time its mirror. This mutual pervasion of epistemology and ontology transforms the ontological assumption into an epistemologically deeply anchored conviction. Namely, anchored in the epistemological notions and concepts themselves, in particular in notions such as 'perception',[49] but moreover more generally in the passive definition of perception and thought as 'cognitive faculties'. The ontological assumptions, as basal epistemic interpreting schemes (first and foremost substance and causality), thus form simultaneously the basic framework of the concept of reality, as well as the very foundation of the understanding of cognition.[50] The notion of cognition is in other words not a metaphysically blank sheet.

Just as the passive, receptive understanding of cognition is a logical consequence of the ontological assumption of the autonomous determinateness of objects, so from this understanding, in combination with the 'conceptual nature' of our cognition, the conclusion to the ontological assumption of 'universal realism' is logically compelling.[51]

As is well known, nominalism questions this ontological assumption, and with it at the same time the passive understanding of cognition. Epistemology does not seriously consider this option, it rather restricts itself to the mere question of the certainty of knowledge, and thus leaves the passive conception of cognition and its ontological premise as such essentially untouched. The epistemological doubt (in the form of the norm of certainty) is of the kind that it itself presupposes this premise. It is true that in the context of the interpretation of the process of cognition the activity of the mind now moves to the center, but this does not change anything about the definition of perception and mind as 'cognitive faculties'. Fundamental also remains the belief in the immediate (passive) 'givenness' of the basic epistemic contents through the senses. This ominous belief is further manifested in the association of certainty as an epistemic norm with sensory givenness, which builds the essential reason for doubting the ontological interpreting schemes. And it is this doubt (for lack of immediate givenness) that is the core topic of epistemology, whereas the other empirical (conceptual) contents of knowledge are hardly addressed anymore. The nominalistic critique of universal realism is thus sidelined.[52]

2b) The concept of knowledge

The object-related specifying, i.e. descriptive concept of knowledge of classical metaphysics, which is shared by epistemology, is a logical consequence of the ontological assumption of the autonomous determinateness of objects. The corresponding epistemological scheme is that of direct (concrete) reference, and of description ('identification') by means of predication. The logical core of cognition thus basically consists in the subsumption of the concrete entity under general terms (or in its categorization according to general linguistic schemata), and in logical conclusions based on them. The terms themselves thus represent, according to the logic of subsumption, the essence of

49 The autonomous determinateness of the objects, as each individual, is not least also the logical condition for the confidence in the immediacy of perception as a source of safe knowledge.

50 See the Descartes quote in note 13. It is only the aspect of autonomy that distinguishes the description of qualia of perception as phenomena from their description as properties.

51 As already briefly mentioned in note 41, classical metaphysics already knows (in this respect ontologically not at all naïve) about the logical flaw of the conviction of the autonomous determinateness of the existing objects, in that its conceptual determinedness (in a holistic way) points beyond itself to other existing objects. This becomes the point of reference of (speculative) reason (as a 'cognitive faculty' of its own), and the starting point of dialectics. Metaphysics thus distinguishes from the categorizing cognition by the faculty of understanding still a second level of cognition, namely that of the ontological reflection by the faculty of reason.

52 That epistemology does not really take nominalism seriously is also shown by the fact that it is not plagued by any nominalist scruples with respect to its own terminology. Basically, it is only through analytic philosophy of language that the nominalist critique of universal realism is taken up again and addressed in a serious way. In a certain way, however, already prepared by American pragmatism and existential philosophy (Nietzsche and Heidegger).

knowledge.

However, the relation between singularity and generality can basically be accentuated in two different ways. On the one hand, in the way of the direct, 'concrete' reference to the individual being, which in its specific suchness exemplifies a kind of conceptual generality, which (in an 'overarching' way) spatially and temporally points beyond this specific individual being. On the other hand, however, also in the way of the 'reflected' reference to the individual as something transient, which is subject to a constant change, a becoming and passing away. In this case one has to do with an 'indirect (reasoning) reference', which profoundly differs in its heuristics from the 'direct (concrete) reference' of classical metaphysics. The reasoning claim to explanation takes the place of predication; the General in this case is that which underlies the objects in all their suchness and change, and this in the sense of the idea of a set of fundamental elements which – obeying general principles or laws – form the basis for the constitution of the individual objects.[53] One can demarcate these two fundamentally different approaches to knowledge as 'description' versus 'deconstruction' of the objects.

Incidentally, it is the deconstructive, foundational approach to knowledge that stands at the beginning of philosophy, namely with the pre-Socratic philosophers with their various, concrete ideas, from Thales to Leucipp and Democritus.[54]

Galilean physics takes up this kind of reflective, exploratory approach to knowledge, but its own approach differs in several respects from the pre-Socratic one. Mainly by the fact that its deconstructive approach is primarily directed to the dynamic phenomena, and only secondarily to the objects, and that its approach is therefore an analytical one. This analytic purpose is served by the substitution of the objects by the physical concepts by way of quantification throughout,[55] and subsequently by the mathematical rigor of its reasoning. However, we have already seen in the previous chapter that this concept of knowledge is obscured by epistemology through the projection of the metaphysical, descriptive concept of knowledge onto physics, and thus rendered indiscernible. One of the far-reaching consequences of this projection is the neglect concerning the originary ontological dimension of the physical concepts.

This neglect proves to be peculiarly paradoxical on closer examination. For if there is a lasting insight of epistemology, it is that the ontological categories or schemes of interpretation (like 'substance' and 'causality') are not to be taken from perception, but are indisputably an originary contribution of thinking. Only for this reason they are finally also contestable by physics. In this way, epistemology does take a 'critical' stance on ontological questions, but this is a purely formal, not a conceptual one. In contrast, it is classical metaphysics that conceptually reflects (through the faculty of reason, as opposed to the faculty of understanding) on the logical pitfall of the idea of substance, the core of which is the assumption of the autonomous determinateness of things, and concludes that this autonomy is a logically constrained one. Thus, it questions this naïve ontological assumption (on which nevertheless its object-related concept of knowledge is based) conceptually by itself on grounds of reason.[56]

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53 In the Aristotelian metaphysics this Underlying is conceived as 'hyle' (as an indeterminate original substance, as mere formable 'material'). The foundational status, which is logically belonging to the elements of the pre-Socratics, is gone.

54 See Carlo Rovelli's work „The first scientist : Anaximander and his legacy“ (Rovelli, 2011)

55 This kind of indirect, reflected reference is not comprehensible if one starts from mere sense impressions as the 'material' of physical cognition. Epistemology deals with the 'constitution' of objects in the process of cognition, physics, on the other hand, starts from the objects thus constituted beforehand and investigates them in a completely different way. Both are different approaches to the deconstruction of objects (see note 11), with epistemology (mis-)understanding its own approach to the subject basically as a 'descriptive' one (otherwise certainty would be ruled out). This is a consequence of its notion of 'true knowledge', which is basically the notion of a 'divine perspective'. In this sense it describes the human cognitive faculty under the deficient aspect of its 'limitedness'.

56 In this way, it distinguishes between understanding and reason. See also notes 41 and 51. The question of the logical compatibility of 'autonomy and determinateness' from the point of view of the 'finite substance' (independent of

The peculiar paradox of the 'critical' position of epistemology concerning the ontological schemes of interpretation consists in the fact that with respect to its understanding of cognition and all the ideas connected with it (such as subject-object relation, sense impressions or certainty, etc.) it already presupposes precisely that (namely substance and causality) which it formally doubts.[57]

The assumption of certainty as an epistemic norm, to which epistemology owes its prominent, inquisitorial position, leads naturally on to the question of the interpretation of the process of cognition.

2c) The process of cognition

Epistemology directly follows classical metaphysics also in the interpretation of the process of cognition, with the distinction between sensuality and understanding as basic cognitive faculties (reason as a third faculty, however, is less highly esteemed).

It is striking, however, that epistemology does not pay special attention to the question of the epistemic status of universals, i.e. general concepts, as it should have been expected in the wake of the nominalist critique of the assumption of universal realism. On the contrary, this question is treated rather casually and assigned in an unclear way to 'sense impressions' or 'givenness by sense impressions' (in combination with 'association' as the logical basis of generalization). Exemplary for this can be seen Kant's dictum: „Thoughts without content are void; intuitions without conceptions, blind.“[58] Apart from the categories of the understanding, the connection between the intuitions and the thoughts, and thus the answer to the essential question of the origin and the epistemological status of empirical concepts, remains peculiarly obscure.

The reason for this obscurity is to be found in the fact that the sense impressions ('intuitions') form the basis, the 'blind' raw material of cognition, but not its source. It is rather the differentiation, or distinction, which is the actual source of information (concept formation) and cognition. But their criteria are not to be taken from the sense impressions themselves. To the crucial question of the origin of these criteria epistemology (apart from their assignment to the 'mind') offers no answer, and therefore implicitly (in an unclear way) short-circuits the concepts with the sense impressions.[59] In this way, it bypasses the crucial question raised by nominalism, namely that of the relation between perception and thinking.

It is in any case clear that the assessment of the epistemological status of sense impressions (i.e., their role in the process of cognition) must reflect on their interpretation as real ('causal') processes. And it is also clear that the immediate presence of sense impressions (as pure 'qualia') precedes their differentiation and interpretation. On an elementary, physical, respectively physiological level, the immediate sense impressions are primarily a process of absorption, which causes a certain reaction or effect, without (clear) reference to anything else. In this respect, there is no fundamental difference between the heat effect when sun rays hit the skin, and the effect of light sensation when they hit the retina of the eye. Whereby these rays are known to represent only a small section of the entire spectrum of radiation to which (usually without connection to conscious perception) the body is incessantly exposed.

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cognitive reflection) is a central topic of the whole further development of metaphysics, from Spinoza and Leibniz to Hegel. And also Descartes on this ground transcends his two 'summa genera' ('res cogitans' and 'res extensa') onto a common underlying reality, the 'absolute substance'.

57 Kant's thought of the 'thing in itself' is indispensable for this very reason, because without it the very understanding of cognition itself, and with it also the norm of certainty, would lose its hold. Under these circumstances the question of cognition would have to be posed radically anew. And the construct of sense impressions is contentless without the assumption of a reliable causal relation between subject and object.

58 Kant, 1991, p. 34

59 Believing that information or knowledge can be gained from pure impressions is comparable to believing that a computer can work without a software program.

From this process or its effect is to be distinguished in any case the differentiation of the immediate sense impressions according to criteria which do not directly correspond to the process or its effect.[60] Conscious differentiation, or distinction, cannot be attributed to immediacy for the simple reason that it always presupposes a 'spectral frame' which must include at least two 'objects'. In this respect one can also speak here of 'contextualization', or a spectral ('dialectical') logic of differentiation that manifests itself in a larger framework as conceptual holism. Differentiation is the missing link between 'intuitions' and 'concepts'. Another (more immediate) form of differentiation would consist in the ('natural') disposal of a simple grid, which makes an automatic distinction in the sense of a separation into groups or classes. Conscious differentiation, in turn, can lead to a kind of fixed (or 'customary') encoding, that is, to a (pre-)conditioned differentiation, which thus (decoupled from its 'frame') takes on the character of immediacy.

There are two points in particular that should be noted with respect to the question of the epistemological status of empirical concepts:

The one point concerns the aspect of self-referentiality of concepts, when considered on a larger scale (e.g. in the form of classification), as a consequence of the fact that differentiation is the real source of cognition. This self-referentiality corresponds 'objectively' (at the scale of the 'world') to the holism of the real epistemic situation. It is also reflected in the classical rule of definition 'genus proximum et differentia specifica', and leads in classical metaphysics – on account of the ontological assumption of 'universal realism' – to the logical inference on the 'limited autonomy' of the objects (of 'finite substances'), as the departure point of a dialectic, which leads to the idea of an 'absolute substance', which 'comprehends' all differences in itself, and therefore has (or needs) nothing 'beyond itself' concerning its self-definition.

The other point concerns the aspect of identification. Every identification of something 'as something' exceeds the horizon of sensual givenness for the reason just mentioned. And insofar as the options of differentiation and class formation are manifold, logically a certain arbitrariness and vagueness goes along with it.[61] This means that the immediate 'sensual certainty' in the strict sense is an illusion, because sense impressions in the context of cognition can never have more than indicative character (related to the criteria of their differentiation).[62] Unambiguity can be attributed to them only on the basis of a fixed encoding. This conclusion can only be avoided if one starts from a (mostly unspoken) low-threshold (sensual) universal realism.[63] In so far as the 'meaning' of sense impressions is determined by their embedding in a 'frame', a context, therein lies the 'logical' root of the background holism (as 'motor') of thinking. 'Truth' in the sense of correspondence has insofar not 'image'-character, but necessarily the character of the coherence of the overall picture. Whether and in which sense it possibly also has a 'likeness'- or 'correctness'-character nevertheless, can not be answered independent of the interpretation or the model of the epistemic situation.

2d) The model of the epistemic situation

It is the lasting merit of neopositivism, contrary to its original intention, namely „a rational

60 One aspect that we pass over here for the time being is the fact that both the presence of sensory impressions as well as differentiation presuppose reference.

61 There are exceptions, however: The encoding of something as 'food' (or, in contrast, as 'poison') is not arbitrary, it 'proves' itself – in the case of assurance – immediately. This points to a biological origin of cognition.

62 Compare Quine's dictum: „Truth is immanent, and there is no higher.“ (Quine, 1994, p. 21f.). Independent of their differentiation, sense impressions are mere events or effects (with which depiction for its part, of course, certain assumptions and interpretations are already linked in advance, just as with any possible other).

63 The fact that epistemology usually commences undifferentiated from physics as 'the' paradigm of cognition in general has probably to do with the fact that the question of the derivation of 'empirical concepts' in this case seems negligible due to the deceptive proximity of 'physical concepts' to immediately 'sensuously given' qualities of objects.

reconstruction of the world from sense data“,[64] to have proved the false association of immediacy with certainty in the meaning of cognition to be untenable. This 'failure' of the initial intention, however, is followed and accompanied by a second failure, namely the failure to draw the necessary consequence.[65] This concerns the model of the epistemic situation.

Epistemology not only poses the question of the certainty of cognition, but it declares certainty as a norm of cognition, and, mind you, with reference to the interpretation of the process of cognition. This norm is not only doubtful from the outset, because it presupposes certainty with respect to the interpretation of the process of cognition, which in reality does not exist at all, it also has serious consequences for the interpretation of the epistemic situation. What we are talking about is the epistemological model of the linear subject-object relation. Epistemology makes a clear separation between the cognizing subject and the objects of cognition. It takes the subject out of the total class of the objects of cognition and juxtaposes it solitarily and autonomously vis-à-vis the objects. The price of this strange 'operation' is the obscure 'transcendence of objects'.[66] But this 'transcendence' does not correspond in any way to our ordinary self-perception and experience as part of the 'world' or 'nature', neither subjectively, nor from a scientific point of view, and therefore demands a strong and correct argumentation. Now, however, the only justification or motivation for this radical cut consists in the categorical desire for certainty, or in the declaration of certainty as an epistemic norm.

In view of this, the decided failure of the initial intention of neopositivism to ground physics epistemologically on a secure foundation called 'sensory evidence' means nothing less than the omission of the only justification for the reinterpretation of the real epistemic situation into a linear subject-object relation and thus, in its consequence, necessarily implies the acknowledgement of the real, holistic epistemological situation as the natural departure point of epistemological reflection.

It is this consequence, however, that neopositivism, as mentioned, does not draw. Rather, it (as well as the entire subsequent philosophy of science) steadfastly adheres to the epistemic norm of certainty and thus also to the interpretation of the epistemic situation in the sense of a linear subject-object-relationship.[67] The logical consequence of the aforementioned failure is therefore a resolved resignation with respect to the scientific claim to knowledge. However, depending on the details of the assumptions regarding the interpretation of the process of cognition, this can be pronounced to different degrees: from a resigned undertone to cautious resignation to complete resignation. In sum, the span reaches from an opaque conventionalism (in different variants) over falsificationism,

64 Quine, 1994, p. 22. He comments on this 'project' there by saying, „My only reservation is that I am convinced, regretfully, that it cannot be done.“ (Ibid., p. 23)

65 As we have already seen in chapter 2b, coming to the right insight does not automatically mean drawing the right consequence.

66 But not only that, because by paying this price, epistemology simultaneously leads the reason for it, namely the epistemological norm of certainty ad absurdum, because just the 'transcendence of objects' completely excludes certainty of knowledge 'realiter'.
The declaration of certainty as a norm of cognition is usually attributed to Descartes. But I consider this attribution to be misleading. Because the criterion of certainty serves him only to be able to brush aside the whole classical and medieval metaphysics (with its concept of knowledge) with one stroke, in order to establish philosophically the physical concept of knowledge in its place, building up on the general concept of 'res extensa'. And this without making himself personally assailable (think of the fate of Galileo). From the very beginning Descartes does not assume a linear epistemic relation. This is shown by the fact that he not only determines the two 'summa genera' ('highest kinds of things') equally 'categorially', in demarcation from each other, (Descartes, 1965, § XLVIII) but transcends them once again as such 'limited' categories, in good metaphysical tradition, with regard to an underlying 'absolute' substance, God. (Ibid, § LI). By conceiving the principles of understanding as God-given (and therefore 'trustworthy') 'lumen naturale', the epistemic situation actually presents itself 'as a situation'.

67 This adherence to the epistemic norm of certainty and to the dogma of the linear epistemic relation (including all associated beliefs and interpretations) fulfills all the criteria of a paradigm in an almost exemplary way. Not least in its longevity and resilience. This can also be seen in the almost unbroken continuing belief in immediacy in connection with the idea of 'falsification'. The association of immediacy, certainty and truth, by the way, only makes sense in connection with the belief in the possibility of something like a fictitious 'divine perspective'.

paradigm theory, science-theoretical holism up to anarchism ('anything goes').

What changes by the acknowledgement of the real, holistic epistemic situation, what consequences result from it for the epistemological reflection? First of all, in general, the impossibility of sweeping judgments concerning the certainty of cognition. The central point of holism consists in the (self-)perception of the cognizing subject as an object of cognition among others, for which, as for all others, it is true that (self-)cognition – as naturally as inconspicuously – must take the 'detour' via differentiation, i.e. always involves a 'frame'. Thus, the epistemic situation per se does not offer a secure point of reference, an 'Archimedean point', which would guarantee certainty of cognition in a strict, punctual sense, related to single beings (at least as far as it is not only about pure 'presence', but about 'identification' and description). This 'uncertainty', however, does not only concern the objects (and the self-understanding of the subject), but also the understanding of cognition and the interpretation of the process of cognition itself. The acknowledgement of the real, holistic epistemic situation therefore means nothing less than the admission that our (naïve) understanding of cognition and our 'knowledge' about the process of cognition can at most claim provisional status.[68] The epistemic norm of certainty, as far as it refers to the interpretation of the cognitive process, thus proves to be completely 'insubstantial', because it is completely inadequate to the human epistemic situation, and, moreover, as we have seen, it contradicts per se the logic of differentiation, and thus of thinking (of gaining knowledge).

However, the consequences of acknowledging this situation are by no means predominantly of a negative (skeptical) nature, as they might appear to be; on the contrary. They are first of all of a corrective nature, and they concern all the points mentioned so far (2a-2c). But they are, moreover, building blocks for a scientific understanding of cognition. The most important consequences are, in converse order and very briefly:

Ad c) The perception of the role of the body in the process of cognition, which cannot be reduced to the sense organs alone. The linear subject-object model of cognition leads to an ignoring or disregard of a fundamental component of the epistemic process, namely 'embodied knowledge'. Because the subject is from the first breath itself part of that reality which it tries to fathom exploratively and inferentially in the way of interpretation (whether in the form of animism, metaphysics, religion or indeed physics). The entire physique (every single bone and every single muscle) is the result of being embedded in this very reality, and of being reliant on it. Without this biological factor neither the thought of causality (and certainly not the assumption of a universal causal connection), nor the origin of the criteria of differentiation can be understood.[69] Cognition as an elementary process in all its variants is not a pure 'glass bead game' (as epistemological reflection may be).

Ad b) The first step towards an adequate understanding of cognition is the differentiation of distinct types of cognition: the pragmatic everyday cognition, the object-related differentiating (descriptive) approach to cognition of metaphysics (which is also that of classical biology and other empirical sciences, each with its own object areas), and the completely different object-spanning, deconstructive approach of physics. These distinct types of cognition are distinguished by their respective frames of reference: For everyday cognition, practical use (or common 'practice') provides the framework,[70] for the approach of metaphysics or the descriptive sciences it is the frame

68 Classical metaphysics, whose conception of the epistemological situation is basically holistic, hides this 'not-knowing' behind the term 'cognitive faculty' and at the same time defuses the brisance of holism for the question of knowledge by the ontological assumption of universal realism.

69 The 'worldlessness' of the subject is also the basis of a large part of the (basically unsolvable) problems of epistemology. A toddler just beginning to crawl basically 'knows' (though without being able to formulate or even physically argue for it) more about causality and gravity than the subject would ever be able to recognize (or imagine) on the basis of mere sense impressions.

70 With respect to the concepts of everyday life, the practical 'use' of things (or the activity in question, or the cooperation connected with it) forms the frame of reference. The cognizer forms the point of reference, but appears in the frame itself only marginally (or as a 'legal person'). The same is true for the 'subject' itself, which can also,

of the 'world' or of detailed sections, whereas the frame of reference of physics is provided (in a presumptive way) by its own concepts.

Such a differentiation presupposes the acknowledgement of the real, holistic epistemic situation (including the variable positions of the cognizing subject in it), and it is instrumental in making cognition as a phenomenon scientifically accessible. The linear subject-object model of cognition, on the other hand, includes an undifferentiated, wholesale view of cognition, and is notably unable to make the deconstructive epistemic approach comprehensible at all (which leads it to ultimately misunderstand even its own deconstructive approach in descriptive terms).

Ad a) A serious reflection on cognition can ultimately not exclude a reflection on the ontological assumptions underlying the understanding of cognition. Concretely, this refers to the substance ontology. It is at the same time both consequence and condition of the fundamentally passive understanding of cognition, which in turn is reflected in the descriptive concept of knowledge, and it is also, as it were, immanent in the subject-object model of cognition. The core of the idea of substance consists in the assumption of the independent (autonomous) determinateness of objects ('in themselves'). This idea is also the precondition for the epistemic norm of certainty.

Thereby, from the logical point of view, concerning the question of 'determinateness' in ontological respect, a similar picture shows up as already before in epistemological respect. That is, the idea of an autonomous ontic determinateness, i.e. a determinateness in an absolute sense, without any reference to difference (neither inwardly, nor outwardly) is logically not conceivable, is a logical non-thing. For every single being (thing) owes its ontic determinateness to its internal constitution and its external embedding in an environment. The thought of the autonomous 'property' is nothing else than expression and consequence of an 'attribution', detached from the context.

A meaningful discussion of the questions of truth and certainty is ultimately possible only by taking into account the differentiating logic of thinking with reference to the different types of cognition and their respective frames of reference. The conditions for an answer to the question of truth in an absolute sense (as intended by the norm of certainty as understood by epistemology) are thus not yet clarified. In any case, such an answer is not possible without a scientific answer to the question of the 'constitution' of the cognizing subject (in the double sense of the word), and thus the clarification of the question of reference.

2e) Résumé

The made distinctions provide, I think, a suitable starting point to briefly and succinctly grasp the essential differences between metaphysics, epistemology and physics.

Metaphysics and epistemology essentially agree on the first three points (a-c), which means that the only originary contribution of epistemology to the analysis of cognition is the interpretation of the holistic epistemic situation as a linear relation of cognition (and this 'by virtue' of the declaration of certainty as 'the' epistemic norm). With the consequence that point c) 'the process of cognition' now becomes the central topic of epistemology, its pivot, however also its central weak point. For the process of cognition becomes a topic only from the 'critical' point of view of certainty as an epistemic norm, while for the rest it simply refers to the classification and description of the 'cognitive faculties' by metaphysics.

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depending on the frame of reference, be defined in different ways, as a 'teacher', a 'carpenter', a 'husband', a 'citizen of a state', etc.

In everyday language use, the copula usually does not represent the claim of 'objective' knowledge, but is a tool of communication in the service of cooperation (the 'common errand'), i.e. it is an expression of common, concordant reference. The claim to 'objectivity' in the meaning of cognition comes into play only through the comprehensive ('independent') frame of reference of the 'world'. The 'cognizing subject' can occur determined in this frame e.g. as 'image of God' or as specimen of a zoological species etc., or else just as subject of cognition.

Thus, both metaphysics and epistemology build on the 'conviction' of the ontological assumptions underlying the naïve understanding of cognition.[71] Physics, on the other hand, is quite different. It does not agree with epistemology in any of the four points,[72] while its only common ground with metaphysics is the agreement concerning point d), i.e. the acknowledgement of the real, holistic epistemic situation as the common starting point. Thus, both do not start from sense impressions, but (epistemologically more or less unreflected) from the manifold objects of everyday experience, among which the cognizer himself (as a human being, respectively as a 'physical subject') finds himself.[73] Physics, however, deals with this 'situation' epistemologically in a completely different way than metaphysics. In short, metaphysics explores it in a descriptive way, whereas physics inquires it in a deconstructive way.[74]

Without going into these differences again, I would like to point out another important aspect of the difference between metaphysics and physics, namely the position of the subject in view of the corresponding frame of reference. This frame is, as mentioned, in physics – unlike in metaphysics – not formed by the horizon of the 'world' (as the totality of objects, including the subject), but rather (in a presumptive and investigative way) by the physical concepts themselves.

This change of the frame of reference is in a certain way comparable to the outsourcing of the perspective by a coordinate system. Whereby the substitution of the objects by the physical concepts gives the frame of reference for the analysis and inquiry of the dynamic phenomena. In this sense, the physical concepts are 'subjective in origin', but at the same time 'subject-unbound'. Their only binding is the one to the explanation (resp. the inquiry) of the phenomena via the epistemic establishment of exact correlations.[75]

What is the position of the cognizing subject within this different frames now? In metaphysical cognition, with its frame of reference of the 'world', the position of the cognizer is relatively unclear. Because on the one hand he is himself (as 'human being') among the objects of cognition, and on the other hand he claims (as cognizer) a kind of 'bird's eye view' (untied to his limited perspective as part of the world). Both positions are ultimately brought into congruence by the assumption of universal realism. Moreover, according to its passive understanding of cognition and its corresponding descriptive cognitive approach metaphysics is compelled to ascribe the phenomenon of cognition as an activity to a property of a substance. The 'active-passive'-dilemma, which is amplified by the fact that this 'property' is involved in its own description, is being 'solved' by its interpretation as an ominous 'faculty'.

In the coordinate system of physics, on the other hand, the cognizing subject is included in a clear, separate way on the one hand itself by this system (namely as physical subject, as 'res extensa'), and

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71 And this although metaphysics questions the basic assumption of the naïve understanding of cognition, namely the ontological assumption of the autonomous determinateness of the objects through the faculty of reason. But (due to its assumption of universal realism) just not in the way that it questions the understanding of cognition, but in the way of ontological speculation. Which in turn leads to the declaration of certainty as an epistemic norm by epistemology.

72 As already stated in note 11, the two approaches of epistemology and physics are both deconstructive in nature from an object-related point of view and therefore basically incommensurable. Epistemology, however (mis)understands its own approach as descriptive because it assumes immediate certainty and autonomy with respect to the subject's self-knowledge.

73 As emphasized, also the question what 'sense impressions' are presupposes for its answer a comprehensive framework of assumptions about the world (or a 'knowledge of the world', including the notion of causality), which by far exceeds the sensual content of qualia 'a priori'.

74 As mentioned, also 'causality' is a descriptive term, open to all kinds of interpretation. Its important role within the philosophical theory of science (see the 'problem of induction') only betrays the (misleading) descriptive interpretation of the physical concept of knowledge. The concept of 'causality'

75 This outsourcing of the frame of reference is mirrored in the fact that the category of 'substance' (as an autonomous point of reference), plays no role at all in physics. The concept which comes closest to the category of substance in physics, the 'mass', with the parameter 'weight', is not autonomous at all, i.e. definable or ascertainable in an isolated way.

it stands on the other hand completely outside (as originator of the coordinate system, as thinking subject, as 'res cogitans'). However, not without perspective on a possible merging of the two positions, as far as it does not seem impossible from the outset to include also 'thinking' and 'cognition' as 'dynamic phenomena' into the coordinate system of physical concepts.

Essential for the success of the concept of knowledge of physics is the uncompromising orientation to the phenomena as a guideline, their analysis in the 'dialogue' with the fundamental concepts. The deconstruction of the phenomena serves only the aim of their successful reconstruction, exactly and in full. In as much as there is no other claim of deconstruction, there is no other standard. Deconstruction and reconstruction are like two sides of the same coin.

With respect to the possible goal of a scientific deconstruction of cognition as a phenomenon on a physical basis, there is therefore no way around an uncompromising orientation towards this phenomenon in all its facets and in the full extent of its complexity (from simple categorization to physical concepts and, in general, to the role of assumptions and arguments in the process of cognition and the comprehensibility of their respective claims to validity). And this not least for the reason that every scientific reconstruction of cognition would otherwise deprive itself (namely the knowledge on which it builds its own argumentation and the argument itself) of the rational basis.

2f) Intermediate reflection: Deconstruction vs. reduction

The problem with the attempt of scientific deconstruction of the phenomenon of cognition lies in the fact that its already existing interpretation, i.e. the common understanding of cognition, seems to represent the indispensable basis of the understanding of science itself. Its scientific deconstruction thus seems de facto excluded. This view corresponds to a fundamentally descriptive concept of knowledge. Under these preconditions, what offers itself as a point of reference for a scientific investigation (and eventual explanation) of the phenomenon of cognition itself is solely the common understanding and description of the phenomenon, in terms of 'perception', 'consciousness', 'object', 'intentionality', 'sense impressions' ('qualia'), etc. On the other side there stands, as a basis and instrument of its analysis or investigation, a scientific knowledge, which is also interpreted in a descriptive sense. Common to both, the explanandum as well as the explanans, in this respect, is the claim, inherent in the nature of 'description', of referring to something (directly or indirectly) 'given' (regardless of whether this 'givenness', as in the case of 'causality', is connected with doubts, or not). Yet insofar as 'givenness' as such is the enigma par excellence regarding the phenomenon of cognition, it is not quite clear, what any explanation that builds on it is supposed to accomplish at all. But even apart from this riddle, it thus becomes apparent that behind all descriptions, analyses and explanations the notion of 'passive reception' as ultima ratio of the common understanding of cognition always emerges again. A comprehensible, factual connection to physics, to which such a notion is completely foreign, does not come about in this way.[76]

The true problem of the attempt to explain the phenomenon of cognition on a descriptive basis is

76 It is the trademark of 'reductionism' that it does not 'deconstruct' the understanding of cognition, respectively flatly the 'mental phenomena' before physical background, but simply takes them in the 'described' form as given. He does not differ from 'dualism' in this point, but he only insists that these phenomena (resp. 'properties') stood in a relation of dependence on physical processes (resp. 'properties'). In as far as the declared 'dependence' is not a comprehensible relation 'in the matter', but a case of coincidence (or 'supervenience'), nothing can be said about to which physical 'units', processes or constellations the 'property' in question refers at all (whether to single, isolated processes or, for instance, to the totality of simultaneous corporeal processes at the respective time). In this respect the term 'supervenience' contributes about as much to an adequate understanding of the phenomenon of cognition as the metaphysical term 'cognitive faculty'. But such an understanding is not least the precondition for an adequate understanding of physics as a science, and thus indirectly also for the understanding of the position of reductionism itself.

not so much that the explanans necessarily and uncapturably presupposes the explanandum,[77] but primarily that with the descriptive notion of cognition, and the logically linked notion of reference to 'givenness' of whatever kind, the actual origin and source of cognition, namely differentiation, or distinction, is largely withdrawn from view and reflection as an originary phenomenon. It is absorbed, as it were, by the notion of 'passive reception'.[78] But it is just this point, the process of differentiation or distinction, which represents the real conundrum from the physical point of view. Nowhere else than here the key to the solution of the riddle of cognition can be found. Because the differentiation is ultimately also the condition for being able to distinguish something 'from oneself', and thus, in the end, also to consider it as 'independent from oneself', as 'object'. Especially if one takes into account that from the epistemological point of view the 'description' is in truth always an 'ascription' (by the 'sensually unfounded' mental interpolation of the category of substance, see the Descartes quotation in note 13).

Not the common analysis of the phenomenon cognition (in the aforementioned descriptive terms), but the physical event character of the immediate sense impressions (qualia) as 'substrate of cognition' in connection with the process of differentiation thus form the 'natural' points of reference of a possible deconstruction and subsequent reconstruction of the phenomenon of cognition on a physical basis. The necessity of such a reconstruction arose for two reasons. First, because the deconstructive concept of knowledge of physics, as has been shown, cannot be reconciled with the common (naïve, passive) understanding of cognition (and the corresponding descriptive concept of knowledge), which implies that the interpretation of the phenomenon of cognition in terms of this concept must be taken as a mere provisional one from the physical point of view. And secondly, because between the physical concept of absorption and the epistemological notion of 'passive reception' a double gap in the form of 'differentiation' and 'attribution' opens up, which demands to be filled up in the form of an explanation.

The concept of 'sense impressions', whose description includes both phenomenological and physiological components, and which embodies the link between objects and their 'mental representation', thus forms the natural point of reference for the analysis of the phenomenon of cognition on a physical basis. Specifically, it is a matter of analyzing the notion of 'passive reception', which is fundamental for the common understanding of cognition, against the background of the physical concept of 'absorption' for its (onto)logical implications in contrast to the physical level. Only on this basis it is then at all expedient to pose the question of its possible realization under physical conditions.

The prerequisite for this approach is, of course, the acknowledgement of the originary ontological significance and dimension of the physical concepts, i.e. the revision of the common projection of the descriptive, object-related concept of knowledge (with its implicit presumption of a fundamental ontological decision) onto physics as a basic science, i.e. in sum no less than the distancing from both the naïve understanding of cognition and its ontological basic assumptions resp. implications.

77 With this in mind, Russell states: „I maintain an opinion which all other philosophers find shocking: namely, that people's thoughts are in their heads.“ (Russell, 2007, p. 25). Theoretical entities like 'elementary particles' or 'neurons' are no exception. An obscure physical or neurological universal realism distorts the phenomenon, whose analysis and explanation it is actually about, to the point of unrecognizability. But it is of elementary importance to avoid any form of categorical fuzziness, especially where the question of the explanation of consciousness and cognition is concerned. This problem solves itself, by the way, if one takes into account the deconstructive approach to knowledge of physics.

78 From the point of view of differentiation as a source of knowledge, the concept of knowledge of physics shows a special conspicuousness, namely the distinction of objects on the basis of its own general concepts, not descriptively, but purely quantitatively. And among the physical concepts, again the concept of 'electric charge' occupies a special position. For it entails no connection to any kind of empirical differentiation at all, none that refers to a contingent spectrum, but is purely logical. It refers to nothing 'apart from itself', not even to a scale.

3. Conclusions with regard to biology and epistemology

The following exposition (within the framework of this paper) can, of course, be no more than an attempt at a cursory sketch of a path to the envisaged goal of a reconstruction of the phenomenon of cognition on a physical basis. The epistemic basis of this reconstruction will be the thesis of the 'primacy of constellation', as the ontological quintessence of the physical research enterprise (see chapter 1). From this follows as a logical consequence the total immanence of the physical level (which has nothing 'outside of itself'), on which there is and can be no definite determinateness ('determinateness as ...'), but only emergent 'determinateness in flux'. This total immanence forms the logical (as well as natural) starting point of the question.

The question that arises in this way is first of all that of the logical (and subsequently also the natural) conditions that lead out of this total immanence, and as a clue to its answer serves the question of the logical conditions of definite determinedness. The question about the natural conditions thus turns into the question, in which way from a physical point of view such a determinedness can come into play at all. The key to the answer to this question will be provided once again by the principle of autarky, and this in empirical connection with the question of the constitution of biological units. Only on the basis of the clarification of these questions it will then be possible to get a clearer picture of the development up to the questions of cognition.

3a) The pure immanence of the physical level

To illustrate the thesis of the pure immanence of the physical plane, I would like to start with a quote from Erwin Schrödinger, who writes: „But a world existing for many millions of years without any mind being aware of it, contemplating it, is it anything at all? Has it existed? For do not let us forget: to say, as we did, that the becoming of the world is reflected in a conscious mind is but a cliché, a phrase, a metaphor that has become familiar to us. The world is given but once. Nothing is reflected. The original and the mirror-image are identical. The world extended in space and time is but our representation *(Vorstellung).* “[79]

The pure immanence of the physical level is as a logical as well as natural starting point the precondition for an adequate analysis of the phenomenon 'consciousness', because in contrast to the conception of the 'building blocks' of the universe, it both marks and analytically represents something like an 'absolute zero point' of consciousness, as a result of the logical analysis of the physical concepts from an ontological point of view. As long as, on the other hand, one proceeds, as usual, unreflectively from an object-related understanding of the physical concepts, there is no reasonable starting point at all for the analysis of the phenomenon 'cognition' apart from its common categorizing description. For every theoretical 'entity', which should eventually be taken as a point of reference of a possible explanation, always already involves cognition, and can therefore in itself contribute nothing to its analysis. The explanation therefore ties in with the mere categorizing description of the phenomenon (in the frame of reference of the 'world'), on the basis of distinctions that likewise already involve consciousness and cognition. Cognition is thus in this respect both the precondition of its own 'description', as well as of its own potential 'explanation' as a phenomenon, whereby it itself becomes basically incomprehensible as phenomenon and must remain inscrutable in its preconditions.[80]

79 Schrödinger, 2018, p. 135f.

80 The missing connection between analysis and explanation allows only an explanation in the sense of a kind of spontaneous genesis, thus by a certain process which one hopes to discover without knowing quite what one should look for at all. By the way, such a process would have to produce consciousness and self-consciousness simultaneously, because only in this case it could distinguish something 'from itself' at all, and register it as independent or distinguished from itself.

In order to be able to grasp the phenomena 'consciousness' and 'cognition' conceptually at all, no other starting point is offered than the pure immanence of the physical level, as 'zero point of consciousness'. However, it can serve as such a starting point only because it has itself emerged as the result of ontological conclusions based on the analysis of physical concepts, which have led to the thesis of the primacy of constellation, and in logical connection with it to the assumption of the principle of autarky, as the principle of the constitution of 'relatively autonomous' contingent entities. The metaphorical image of pure immanence implies the complete indifference of the relations and interactions of all 'entities' within the framework of the total constellation, the only one which is autonomous in the strict sense, and which has nothing 'beyond itself'. This means that there is no determinateness in the definitive sense, and logically also no coordinates, but only trajectories). What exists are structures and formations on the basis of the principle of contingent autarky, and accordingly exclusively emergent 'determinateness in flux'.

3b) Unilateral reference; dependency

What logically cannot occur in the picture of pure immanence of the physical level is one-sided, unilateral, linear reference, and thus definite determinedness. Because from a purely logical point of view it is clear from the beginning that the precondition for the existence of definite determinedness is (in logical respect) differentiation, and thus (in ontological respect) unilateral reference.[81]

So as the unilateral reference is in logical view the 'precondition' for distinction and definite determination, so it is in ontological view the 'source' of distinction and definite determination. For real distinction, however, besides the reference, something further is needed, namely criteria of distinction, i.e. as a minimum requirement some kind of grid.

Unilateral reference (keyword: intentionality) and distinction (keyword: distinctive qualia) are the basic characteristics which also are largely associated with consciousness, the difference in terminology being, however, that in our case it is not about the description of properties or qualities of something (namely 'consciousness'), but about structural logical characterizations whose realization is still open. This openness of the realization, however, offers at the same time the possibility to transform them, via reference to the physical level, into concrete questions.

Since a direct (spontaneous, autonomous) reference would not be in accordance with our thesis of the primacy of the constellation, only dependency offers itself as ontological structure (and at the same time natural, ontic origin) of the phenomenon of reference. Dependency is at the same time the ontological characteristic of the biological units, whose qualitative side is 'need'. It is dependence, through which unilateral 'reference' as well as 'significance', and thus definite determinendness (Whitehead's 'datum') and (criteria of) distinction come into play, i.e. mingle into the physical level and lead out of its pure immanence.

Dependence as ontological structure and as ontic origin of the logical structure of 'reference' of course does not include the disposition of self-consciousness. This in turn is the precondition for 'representational' consciousness, i.e. for clearly distinguishing the 'object' of reference 'from oneself', and for perceiving it as 'independent'. This trait appears only in a much later stage of evolutionary development and requires a separate reconstruction on the basis laid by dependence.

81 What has always been clear from a purely logical point of view, however, as we have seen, was not so from an epistemological point of view. This was countered by the conception of the autonomous determinateness of the objects (the idea of substance). Metaphysics, as already mentioned several times, by means of the 'speculative reason', has drawn the consequences from this, in the sense of the dialectical transgression of the 'finite substances' in the direction of the idea of an 'absolute substance', which comprises all distinctions in itself (thus has nothing 'beyond itself'), but remarkably without giving up the idea of substance itself.

3c) Precarious Autarky as 'principium individuationis' of the biological entities; consciousness

Assuming that biological units, i.e. organisms, are based on physico-chemical processes, and therefore as concrete structures in their core do not differ from contingent physical structures and formations, the only real difference to the latter is their dependence on the availability of energy to maintain their unity or structure. Referring to our thesis of the primacy of the constellation and the principle of 'contingent autarky' as principle of the constitution of physical structures or formations within the framework of the total constellation, i.e. as physical 'principium individuationis', so, in view of the dependence on the availability of energy, the 'precarious autarky' can be formulated as 'principium individuationis' of the biological units.[82]

This means that the dependence is not a 'property' of the organism, as if it had an existence independent of it, but its fundamental mode of being, its 'conditio vitae', the expression of the primacy of the processes over its visible structure. This dynamic, self(re)producing form of unity, by the way, meets in principle with what is called in Kant the transcendental unity of pure apperception. In that need (as the qualitative side of the organism's dependent mode of being) is directed toward itself (its satisfaction), it is (namely, in the form of dependance) at once transitive and directly directed toward something else, and selectively, discriminatively so – thus not only functionally fulfilling the criteria of what Kant calls the transcendental unity of pure apperception, but at the same time involving the basis for distinction in the sense of a grid (an at least simple binary encoding). This ontological characteristic forms the basis of the immediacy of perception, of the being of consciousness 'with the things', and remains unchanged at all stages of the evolutionary development of consciousness.

Consciousness is on this elementary level the interface – founded in dependence, aka need – between the organism and its surrounding. So, in its elementary form it is not part of a relation, it is not itself 'something' and also not a 'property' or a 'state' of something, in fact it is nothing but the actual interface, without relationship to transcendence, because the reason of transitivity does not lie in consciousness itself.

The constellation as such is transformed, generally speaking, by the structure of dependency in a limited way (locally and temporarily) into a situation, information comes into play (significance, distinction, etc.) and coordinates are mingled, as it were, among the trajectories.

3d) The question of genesis

The basic processes of the physical-chemical level, on which the organism itself is built, remain the same as always, nevertheless, in the context of the overall constellation, so the thesis, a different form of autarky comes into play. The crucial question this raises is, of course, that of a conceivable explanation for the genesis of such a physically anomalous form of autarky on a physical basis. A possible answer to this question must of course be based on empirical research concerning physico-chemical structure formations as well as on biological findings concerning primitive life forms and the spreading of life, but it must, I think, due to its unusualness also be accompanied by principal considerations.

82 Thus Hans Jonas writes: „In purely physical description, no more than continuous presence in the containing continuum ist assumed … for the 'sameness' of an entity; and thus, on physical terms alone, there is only this external identity conferred on discrete units (particles or fields) by the *principia individuationis* (space and time), or, equivalently, by the totality of the physical universe defining their place: in either case a matter of external reference. Of an internal principle of identity in physical particles we do not know, even if there be one. … Organic identity, however, must be of a different nature altogether. In the precarious metabolic continuity of organic form, with its perpetual turnover of constituents, no inert substratum, no single 'path' and no 'bundle' of parallel paths of cotemporaneous members, is available as referent for external identity.“ (Jonas, 2001, p. 81f.)

Such a principal consideration, as a conceivable answer to the question of the possible physical realization of a dependent structure, or the possible constitution of a precariously autarkic unit on the basis of physical-chemical processes, and insofar a possible approach for the explanation of the connection between the physical-chemical and the biological level, I would like to sketch here very briefly. And this referring to the researches of Hermann Haken (his theory of 'synergetics'),[83] and of Ilya Prigogine (his investigations on topics of 'non-equilibrium thermodynamics', 'dissipative structures' and self-organization).[84]

The quintessence of this research consists in the insight into stable, reproducible structure formation effects under the conditions of available energy within the framework of certain (specific, limited) constellations, according to the on/off principle, i.e. in a way that has the character of spontaneous genesis. If one combines this insight with the statement that an organism is nothing else than a structure built on physical-chemical processes and at the same time dependent on the availability of energy for its maintenance, then the thought is obvious that it is the self-solidification of these processes (respectively processual structure formations) by a process of the accumulation or storing of energy, which leads to the constitution of precariously autarkic units. The storage of energy in the context of energy-induced structure-building processes is an elementary form of self-reference.

If one starts from this line of thought, then the genesis of life was thus a process of energetic 'cutting of the cord' of physical-chemical processes, namely of energy-induced processual structure formations, by a process of storage of energy (which is itself a part of these processes). From this follows the central function of metabolism both for the maintenance of the precariously autarkic units, and for the evolutionary development of life forms. From the point of view of energy-induced aka energy-dependent processes, the storage of energy is at the same time the most elementary form of self-reference. The combination of these two components, the dependence and the elementary self-reference, leads to the fact that intelligence comes into play, and becomes a determining factor of development of its own.

The question of the genesis of biological unities can be answered concretely of course only empirically, and – provided that there is something to the mentioned deliberations – the research in this connection will have to investigate in particular the (in a periodic way) unsteady availability of solar energy as a drive of the structure formation under the specific conditions, i.e. the contingent physical-chemical constellations, which are given on earth.[85] Whereby intermediate stages or mixed forms between 'off-on' mode and continuous energy supply are obviously also possible.

By the way, for the principle of 'precarious autarky' as a concept for the 'investigation' of biological phenomena the same applies as for the concepts of physics. They have to prove themselves by orientation to the empirical phenomena themselves. These are the only available measure of their suitability. It should be noted, however, that it is usually the fundamental concepts themselves that make correlations and relationships visible. In biology, no less than in physics, 'one sees only what one knows' applies, and the further development of concepts is always built on the 'dialogue' between the (already available) concepts and observation, referring to the riddles that observation (or the measurement) poses on the basis of the available concepts. Observation as such is never

83 Haken & Haken-Krell, 1995

84 Prigogine & Stengers, 1984

85 One aspect, which is particularly noticeable in connection with the phenomenon 'life', is of course the reproduction. If one starts from the mentioned line of thought, then this appears in a certain way as the continuation of the 'original' dynamic process of the 'spontaneous' energy-induced structure formation, now under the self-limiting conditions of the storage of energy (and the associated 'cutting of the cord'). For this storage, too, is as an 'accidental result' at the same time an integral part of those structure-forming processes, which is why this does not change anything about the 'original' dynamics and virality of these processes, which form the basis of the genesis (respectively constitution) of precariously autarkic individuals. The virality of the processes takes in this constellation, namely their self-solidification by the storage of energy, the form of the reproduction of the 'circuits' spontaneously generated in the way of the processual structure formation, now not in spontaneous, but in structural form (in the form of 'units').

more than an interpretation, i.e. what is supposedly observed can in principle always be interpreted in different ways, and per se can therefore never provide a secure foundation. This openness to interpretation concerns not least also the 'causal principle'. For this reason, 'coherence' is a decisive criterion for truth and credibility.

Two salient phenomena in the field of biology are the emergent development of biological entities, called 'evolution', and the development of their interface with the environment, called 'consciousness' (associated with the theme of cognition).

3e) The principle of evolution

The Darwinian theory of evolution is based on the concept (or principle) of 'adaptation' of biological individuals to their 'environment', without taking the environment as such into the concept. This fixation on the individuals in their struggle for survival corresponds to the object-related concept of knowledge and leads to a picture of evolution in the sense of a linear development, which corresponds to a blindly running optimization process, based on random mutations and selection according to the principle of 'survival of the fittest'. But the principle of 'adaptation' is in itself questionable for the reason that that there are no better adapted, and also more adaptable life forms, than just the most primitive life forms.

If, on the other hand, one does not start from individuals but from the concept of precarious autarky and the central role of metabolism, then a completely different, more dynamic picture emerges, in which the concept of 'adaptation' is only one facet. For the crucial point in the process of evolution is not the survival of the individual, but that each (evolutionarily 'optimized') individual becomes at the same time again a potential source of food to other individuals and other life forms. Each biological individual is itself part of the total constellation, thus directly part of the environment of all other individuals, and insofar itself a potential source of energy to others (parasites equally as predators). Through this diversification of energy sources, evolution takes on fractal features, so to speak. The image of evolution as a linear development, an optimization process, does not do justice to the real constellation and its holistic nature of change. The one-sided focus on the individuals distorts the real picture.

If we look at evolutionary development as a process from the viewpoint of dependency and the principle of precarious autarky, this itself turns out to be the motor of evolution, and 'parasitism' to be its pervasive principle. This principle develops dynamics simultaneously in all directions. Every 'successful adaptation' means at the same time a change of the whole constellation, respectively situation. Moreover, it is by far not about mere 'adaptation', but also about processes like stock regulation, or even complex phenomena like 'colonization' (see Lynn Margulis' theory of endosymbiosis). Evolution is therefore a process which, in its dynamics, its dialectics and its richness of facets, cannot be understood linearly (from the viewpoint of the individual), but only as a whole. The individual does not play the main role in it. It is a protagonist, but the script does not come from him.

A trend that accompanies the diversification of potential sources of energy, that is, of the potential 'food supply', as an accompanying factor of evolution, is the enrichment of the interface of the precariously autarkic organisms with their environment, which we have called consciousness.

3f) The evolution of consciousness and cognition

The genesis of consciousness is based on the dependence of the organism, its precarious autarky, and the development takes place in certain stages which essentially correlate with the biological systematics. I refer to the apt analyses of Hans Jonas.

I would like to point out here very briefly only two developmental steps that contribute significantly to the enrichment of the interface in the sense of spatial plasticity. One step is connected with orientation and movement in connection with the tapping of food sources. Whereby it again makes a difference whether fixed or moving targets are involved. For locating fixed targets, the sense of smell provides the necessary coordinates; for tracking moving targets, it requires the building of a coordinate system. The function of the brain as the central organ of the organism essentially consists solely in internal coordination, identification and coordinate building, in the sense of 'embodied cognition'.

The second crucial step, leading to the plasticity of the interface in terms of human consciousness, is the genesis of self-consciousness. I do not want to go further into this genesis here, which is connected with the appearance of a new form of dependence, and leads to an indirect form of reference, and the genesis of language (I have already written about it in my dissertation). Only thus the respective organism perceives itself within its own environment (at first simply by taking over or being assigned a 'role, as ...'), it thus enters its own field of vision, so to speak. The crucial point about this is that the genesis of self-consciousness is the logical condition for the organism to be able to clearly distinguish something 'from itself', and thus to perceive it as an independent ('autonomous') 'object'. Therein lies the origin of that shift of coordinates which marks the step from the horizon of the environment to the horizon of the 'world', and thus that particular form of plasticity of interface which characterizes human consciousness. Therein lies also the origin of the idea of substance. Differentiation as the origin and source of cognition thus acquires an entirely new quality and dynamic. Identification and categorization take on the character of 'predication' and 'causal' or conditional connections come into view, which together with the comprehensive 'horizon of the world' employ thought. Accompanied by all the onto- and epistemological riddles that have been driving philosophical reflection for quite some time.

Finally, a quote from Lynn Margulis and Dorion Sagan:

> „Life on Earth is a complex, photosynthetically based, chemical system fractally arranged into individuals at different levels of organization. We cannot rise above nature, for nature itself transcends.“[86]

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