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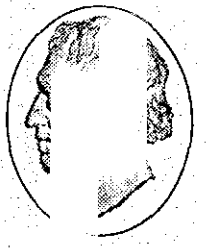

Hegel's Metaphysics of Nature

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Nature and the Dialectic of Nature in Hegel's Objective Idealism

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When the *Ideal* is understood as ontologically fundamental within the framework of an idealistic system, and the *Real*, on the other hand, as derived, then the first and foremost task of a philosophy of this kind is to prove the claimed fundamentality of the Ideal. This is immediately followed by the further demand to also substantiate on this basis the existence of the Real and particularly of natural being. These tasks have been understood and attempts made to solve them in very different ways in German Idealism - about which I cannot go into more detail here. Let me say this much: that Fichte and Schelling, it appears to me, already fail at the first task, ie. neither Fichte nor Schelling really succeeds in substantiating their pretended ideal as an absolute principle of philosophy. Fichte believes he has such a principle in the direct evidence of the self. However, as this is of little use for the foundation of a generally binding philosophy because of its ultimately private character, Fichte already replaces it with the principle of the absolute self[1] already in his first Wissenschaftlehre of 1794. As a construction detached from the concrete self, this of course lacks that original direct certainty from which Fichte started in the first place, in other words: because the construction of an absolute self can no longer refer to direct evidence, it must be substantiated separately, something which Fichte, I believe, nonetheless fails to do. The same criticism can, in my view, be made of Schelling, who ingeniously substitutes constructions for arguments. His early intuition of an absolute identity which simultaneously underlies spirit and nature, remains just as thetic and unproven as that eternal subject on which he based the representation of his system in, for example, the Munich lectures of 1827.

By contrast, Hegel sees clearly that only the Logical-Ideal (Logisch-Ideelle) can come into consideration as an absolute principle if its absolute character is to be truly graspable and provable. At the same time it is clear that the absolute claimed by Fichte or Schelling always already presupposes argumentation and therefore logic. The logical also proves itself to be more fundamental in this respect. When Hegel therefore attributes absolute character to it, this also means that it is to be more than simply a subjective thought principle, but beyond this that it is to have ontological relevance, and this in such a way as to be objective in a quasi-Platonic sense. Hegel's philosophical approach can therefore be characterized as objective idealism. It is my intention to approach the problem of idealistically conceived nature within this framework. It will become clear that the dialectical character above all of the logical, which can then be transposed onto the categorial structure of natural being, is of fundamental importance in this connection.

I have divided this study into five sections: firstly (§1) the question of the absolute character of the Logical-Ideal has to be taken up and the problem of its externalization into nature discussed. Consequences for the idealistic concept of nature will be expounded in the

second section. The process of development of categories through a dialectic of nature will then (§3) be clarified with a concrete example and the question debated as to what extent statements can be made on this basis in relation to the telos of a categorial dialectic of nature. The subject of the fourth section is the relationship between a dialectic of nature and natural law: could empirical knowledge of nature perhaps be substituted by an a priori dialectic of nature? Finally (§5), the idea of a real dialectic of nature argued by Engels will be discussed and confronted with the current interpretation of nature based on the theory of evolution.

It is hoped that these reflections will explore the possibilities and limits of an objective idealism of the Hegelian kind with reference to the concept of nature. This is why they repeatedly move away from the historical Hegelian text to follow up systematic questions and to contemplate possible present-day application. I am aware that such deliberations are far removed from the philosophical flavour of the period -whether analytic or "post-modern" - but that does not, of course, mean that they can be considered as finished. In the following, I simply want to attempt to gather arguments and to focus on the resulting conclusions.

1 The self-transcendence of the logical idea as the externalization into nature

Anyone wanting to understand Hegel's objective-ideal concept of nature has to keep in mind its dependence on Hegel's Dialectical Logic. For this reason, I wish to refer to this first. It is generally known that Hegel's logic is not a formal, but a material one, which is designed to perform the derivation of basic semantic categories ("definiteness", "relation", "quality", "identity", "reason", "concept", among others). Not of course in order to first explain their meaning in this way - that would be nonsensical, because these categories must already be known for the argumentation of the Logic itself. The undertaking is to be understood much more as their explication and with that basically as a self-explication of the Logic. The process taken into account by Hegel for this is the dialectic.

The Logic only gives an account of the dialectical method underlying the development of categories in its conclusion. That is no surprise in so far as the logical as a whole and its process can only be thematized at the end of the whole development. However, what Hegel says about the dialectic falls far short of a detailed theory of dialectic. Such a theory has not become available to date, even if there have been promising approaches in the meantime, which, of course, need to be further developed.

For the transition from the Logic to Hegel's Naturphilosophie, which is what concerns us here, it is of fundamental importance that logic determines itself as an absolute in its final self-thematization. The highest category in the sequence of logical fundamental categories is therefore correspondingly characterized by Hegel as the "absolute idea". There are two aspects to this: on the one hand, logic sees itself altogether as the universal, ordering relation of categories, and that means as the Ideal, whereby "ideality" can be paraphrased as

something like the "totality of the logical categories in their systematic relation".[2] On the other hand, this totality is supposed to be *absolute*. How are we to understand this?

Hegel's own comments on this point do not unfortunately reveal very much. He does indeed speak of the logical as the "absolutely true"[3] or of the "concept" as the "absolute basis"[4] or even of the "absolute character of the concept"[5] or also of the "absolute idea", which is the "only...being" and "all truth".[6] But beyond such formulations Hegel did little to prove the absolute character of the logical by way of argument.

However, of interest here is Hegel's remark, as yet little noted in this respect, to the effect that the development of the concept in the Logic "returned to the simple unity which was its beginning" in its conclusion. By "sublating (Aufhebung) the mediation",[7] it is in the end "the re-establishment of the first indefiniteness in which it began"[8] and thus again "the pure immediacy of being",[9] so that "the beginning" is itself really to be grasped as "something derived". This would, however, mean that the logical process "turns in a circle",[10] thus has a cyclical structure and, as a cyclical chain of arguments, is essentially self-substantiating and thus in fact an unconditional, an absolute.

It is of no little importance that this conjecture can be supported by an independent argument, which is, incidently, familiar from the current discussion on the "ultimate substantiation" of moral norms.[11] I will merely outline this briefly: certain fundamental structures of logic are obviously beyond dispute, because anyone challenging them must employ them for his contestation. Of course logic always also contains conventional elements which cannot as such be described as absolute. But there is obviously a core stock of logical fundamental structures which are indisputable in principle because they themselves have to be used if they are to be disputed. I am thinking, for example, of the principle that contradictions should be avoided or also of basic semantic relations (such as, for example, the opposition of "identity" and "difference") and possibly also dialectical relationships of principiation, as it were. For the same reason, it is impossible to substantiate this *fundamental logic* (as I wish to put it briefly), because substantiation is itself a logical relation which already presupposes fundamental logic. No extra-logical position can exist from which fundamental logic for its part could be substantiated again independently of logic. That would obviously be a nonsensical demand because it would be unfulfillable in principle. Fundamental logic is only conceivable as self-substantiating.

In this line of argumentation too the logical - in the sense of fundamental logic - thus appears as a self-supporting, self-contained cyclical structure, as a circle, as it were, which is of course to be understood as a necessary circle and should not therefore be confused with the circular reasoning of a petitio principii.[12] It is not unimportant, I think, that we have in this way an argument which proves the absolute character of the logical independently of the historical Hegel text.

It furthermore becomes clear from such reflections why Hegel can attribute ontological relevance beyond this to the logical: if the logical (in the sense of fundamental logic) is in fact something which definitely cannot be negated, it then represents necessary being: an ideal certainly, which nonetheless is not just subjective but which also has objective existence in a Platonic sense as it is binding for thought. Within the framework of an objective idealism such as that advocated by Hegel, the ideal, simply necessary being of the logical forms the ontological foundation which is also to be understood as the basis for the possibility and essence of real being and particularly for nature, as will be shown.

First, however, the fundamental question arises as to why there has to be conditional being beyond the unconditional being of the logical at all. Why does the absolute not simply remain "self-centred", why does it externalize itself into a non-absolute? That is undoubtedly a central question of every idealistic position.

Hegel's own comments on this point are the shortest imaginable and of an obscurity which is constantly deplored. He speaks, for example, of a "decision of the pure idea to determine itself as an external idea". "As the totality in this form" this is "nature". As the idea "voluntarily frees" itself in such a way, the "form of its definiteness is "similarly simply free".[13] The ideal, previously characterized as the "totality of the logical categories in their systematic relation" is to be isolated by way of the idea's voluntarily freeing itself into "released" determinations, as it were, and thus to constitute the spatial and temporal separateness of nature. But such formulations provide little clarification, because they do not explain anything. That is, by the way, also to be said of interpretations based on Hegel's topos of the idea freeing itself voluntarily.[14] On the other hand, the extent to which an idealist model of the Hegelian kind is of use or not in principle is decided on this very point.

It seems to me that an argument for the necessity of the externalization of logic into the non-absolute results from the very fact that it has absolute status. I have expounded this in more detail elsewhere[15] and wish therefore to limit myself to a brief reference here: of importance here is an essential feature of Dialectical Logic put forward by Hegel - with reference to Spinoza[16] - according to which determination is always a delimitation and therefore a negation. For the self-understanding of the logical at the end of Hegel's Logic, however, this then means that, by viewing itself as absolute in the concluding category of the "absolute idea", it determines itself simultaneously as independent of everything which does not belong to the totality of relations of the "absolute idea", ie. to the Ideal. The absolute character of the Ideal therefore also means the independence of same from a Non-ideal - whatever that may be. The category of a Non-ideal is thus also dialectically set out through the Ideal's understanding of itself as of the absolute. The "absolute idea" which determines itself as self-substantiating is at the same time its own self-transcendence. The dialectical movement does not come to a standstill even in the highest logical category. But as the whole dialectical-logical development is once again encompassed in its totality in the concluding

category of the "absolute idea", the dialectical opposition cannot now take place within the logical sphere, but must lead out of it.[17] According to the law of dialectic the concluding category of the "absolute idea" must now also be negated, and that simply means: the whole of the logical development, the Ideal, understood as a totality of the logical categories in their systematic relation. A Non-ideal is dialectically implied in this way. Hegel's cryptic formulations on the externalization problem of the "absolute idea" thus receive a - thoroughly Hegelian - interpretation.

But how is this externalization of the "absolute idea" to be understood in more detail? Does it externalize itself into a true non-ideal or is this not rather the *category* of a non-ideal? Well, obviously both: the result of a dialectical development of categories is in fact again a category, but as the category of the non-ideal has shown itself to be *necessarily* implied by the "absolute idea", what is categorized by it must also be necessary fact. The reason why the concept of the Kantian "Hundert Taler" does not likewise imply their existence, on the other hand, is because such a concept cannot simply be necessarily derived, but originates in free imagination. The idea that a dialectical development might lead only to a category of the non-ideal, not to an existing non-ideal, and is therefore ontologically irrelevant, is in this respect without foundation.

It must of course still be admitted that this touches on a central problem of objective idealism, which would demand detailed and thorough clarification beyond the scope of this paper. Yet it seems to me that the arguments missing in Hegel for the existence of an extra-logical, non-ideal being, can be supplied subsequently. For this reason it is important to differentiate constantly between the objective-idealistic *programme* and its undoubtedly unsatisfying *exposition* in the historical Hegel text.

2 Hegel's objective-idealistic concept of nature

What can now be said about the dialectically-implied Non-ideal? In any case that it itself is not ideal in nature and yet is determined by something ideal - ie. by the category "Non-ideal". It is, in other words, dominated and conditioned by the Ideal as something extraneous to it and thus, in contrast to the Ideal, it is a non-unconditional, non-absolute. That is a first structural feature. Secondly, the fact that the Non-ideal is determined by the Ideal means that it can be categorized and therefore that a dialectical derivation of its category is possible, which will be discussed below. The fact that the Non-ideal can be categorized thirdly means - from the epistemological viewpoint - that it can be recognized; according to this there can therefore in principle be no such thing as the "thing-in-itself".

The concept "non-ideal" is firstly, as stated, a category, because it shows itself to be a negation of the category "absolute idea". What is negated here is not the categorial character, but - as is contained in the sense of "negation" - the significance connected to it. "Non-ideal"

is, in other words, a meaning and in so far is itself an ideal entity. But what it describes, what is categorized by it, is completely different to it - it is a non-ideal. This is new with respect to the Logic: the logical categories represent lexical contents such as "definiteness", "difference", "concept" etc., which, within the framework of the Logic, are simultaneously characterizations of the ideal itself. The logical categories themselves are obviously "definite", "different", "conceptual" and so forth. By contrast, a category appears with the category "non-ideal" which, as a category, *is* in fact likewise of conceptual-ideal nature, but which *means* something different to this, ie. non-ideal. Here we have, it should be kept in mind, two types of the ideal: the ideal which in turn characterizes an ideal (thus in the Logic) and the ideal which characterizes a non-ideal exclusively. Elsewhere, I have called these categories the "homologous ideal" and the "heterologous ideal".[18] In the heterologous ideal, therefore, the categorial and the categorized draw apart: as something categorial it belongs to the ideal; what is characterized by it, by contrast, belongs to the non-ideal.

Up to now, the Non-ideal has been determined as non-absolute and capable of categorization and recognition. But more can be said, and indeed solely on the basis of its opposition to the Ideal: if this, as shown, is characterized by dialectical connection, then the Non-ideal, by contrast, must be characterized by isolation, in the way it appears empirically in the spatial, temporal and material separateness of natural being. Within the framework of objective idealism we thus have the plain "proof... that nature must necessarily exist", as Hegel formulates it in one of the addenda to *Naturphilosphie*.[19] The objective-idealistic interpretation of nature as a Non-ideal simultaneously understands it as a necessary "accompanying phenomena" of the Ideal. A notorious problem of Fichte's and Schelling's idealism is then resolved - at least in principle - in the Hegelian version.

The fact that nature as a Non-ideal is nonetheless determined by categories, that is by something ideal, further means from an ontological viewpoint that the being and essence of nature are not coincidental: nature appears as non-ideal being, but what it actually is, its essence, can still be grasped categorically and that means in an ideal manner. Nature remains bound back to the Ideal in its essence, as is indeed already expressed directly through its characterization as "non-ideal". That is why Hegel can say in a truly objective-idealistic sense that "the innerness of nature is nothing other than the universal", that is something ideal.[20] Of course nature is, in Hegel's words, "only itself the idea", so that "the unity of the concept" rather "conceals" itself in it.[21] Or in Hegel's well-known formulation: nature is "the idea in the form of other being".[22]

The situation whereby the being and essence of natural being exhibit this discrepancy is its inherent fundamental paradox, the "congenital defect" of nature, as it were, as a Non-ideal is then also a non-absolute and in so far something imperfect. "It is such that its being does not correspond to its concept."[23] For this reason, according to Hegel, the idea underlying it has to "gain breathing space for itself by shattering this inappropriateness."[24]

This graphic characterization suggests a tendency towards development. And in fact, according to Hegel, nature is a "hierarchy of many moments, which the philosophy of nature describes".[25]

The question arises as to how the "hierarchy" of which Hegel speaks should be envisaged. Does he mean by this a real evolution of natural forms in a temporal sense? This view must be unequivocally rejected: for Hegel, nature is indeed "a system of levels", whereby each of these "necessarily results from the other". But he immediately specifies that "one is not naturally generated" from the other. The hierarchical structure of nature lies from the outset rather in its concept, "in the inner idea which constitutes the basis of nature". "Metamorphosis" only befits "the concept as such".[26] The assumption of real natural evolution is, according to Hegel "an awkward notion"[27] and basically "completely empty" because "the difference in time is of absolutely no interest for thought."[28] "Man did not develop from animals, nor animals from plants; each is at once entirely what it is."[29]

Hegel's view of the impossibility of real natural evolution is expressed here as clearly as one could wish for. Development therefore only exists for him in the concept of natural being, and indeed because of the intrinsic dialectic of the conceptual: it is "the dialectical concept, which furthers the levels".[30]

The impetus for this development is obviously the already mentioned constitutive discrepancy between the natural form characterized by isolation and the conceptual-ideal which underlies it: "The concept wants to shatter the bark of external appearance and come into its own"; in this way "its progress is a regaining of its centre", ie. the internal relation of the conceptual-ideal, so that "existence as such is in itself, or is appropriate to the concept".[31] The tendency towards development thus tends to sublate (aufzuheben) the isolation of natural being.[32]

It should above all be kept in mind that the dialectic of nature is for Hegel quite definitely a *category dialectic* of natural categories, - neither a real dialectic such as that, for example, envisaged by Engels - more on that later - nor real natural evolution as is established for us today as an empirical fact.

How are we then to judge the argument presented by Hegel in this connection, according to which it is the Ideal underlying natural being which has to "shatter the bark of external appearance" and thus set the dialectical development of natural categories in motion?[33] As a general principle is formulated here, it must be possible to confirm this at any given point of the dialectic of nature. In the following I would like to carry out a model study in this sense and to focus more closely on the initial steps of argumentation in the *category development of the philosophy of nature* for this purpose.

3 An example of category development through the dialectic of nature

The discussion on the transition from the Logical-Ideal to the Non-ideal showed that the first category of natural being is that of separateness. I will render Hegel's argumentation at this stage briefly here, whereby I will limit myself to the essential points. Pure separateness as such does not yet, according to Hegel, possess "any definite difference in itself".[34] From this very lack of difference, however, the negation of space, the point[35] simultaneously emerges as a first difference in space. That is probably to be understood as meaning that completely non-differentiated separateness simply does not contain anything which is separate, therefore "collapses", as it were, and thus necessitates the introduction of negation, "non-separateness". The argument is obviously modelled on that at the beginning of the Logic, according to which the initial category of pure being transmutes into the category of nothingness because of its complete indefiniteness.

The point now is the negation of *space* and therefore, Hegel continues, is "itself spatial", ie. it sublates (aufhebend) itself as a point, thus is a "line, the first otherness, ie. spatial being of the point."[36] The further development of concepts, to which Hegel only alludes, leads via the category of the surface finally to the definition of a spatial element surrounded by an interconnected surface and with that to the "re-creation of spatial totality" on a higher level.[37]

As Hegel's comments are extremely brief, I have tried to reconstruct this argumentation. I will limit myself to the transition from separateness to point. I will base my remarks on reflections on a theory of dialectic which I have presented in a different work[38] and have, in the meantime, developed further.

"Separateness as such" involves the question: separateness *of what*? This means - in a modification of the Hegelian argument - that the category contains the demand for spatial difference, because only what is different can be separate. In the strict sense, however, this can only be something which does not permit any "overlapping" and thus has the character of *non-separateness or pointedness* (Punktualität), so to speak. In this respect, the categories "separateness" and, for want of a better word, "pointness" (Punktsein) belong together as counter-concepts. The following is therefore valid for the semantic relationship of both (with the abbreviations S and P for "separateness" and "pointness"):[39]

(1) ‹S› = ‹not-P›

It can firstly be said on the basis of this semantic definition that the separateness S is at any rate not pointlike; hereby it should be noted that it is no longer a question of the *category* ‹S›, but of separateness as an entity, ie. S,

(2) S is not ‹P›-like.

This means that S is not ‹P›-natured or, if one speaks instead more simply of the pointness P characterized by ‹P›:[40] separateness is not pointness, S is not P. This "is not" is likewise to be

interpreted spatially here, approximately in the sense of the statement that separateness is *outside* pointness. This also means that separateness is the outsideness of pointness. Now pointness is, however, nothing other than "outsideness", for it, as non-separateness, has no "inside", as it were, and therefore by definition excludes everything from itself. The outsideness or separateness[41] is in so far nothing at all other than pointness itself: S is P, or

(3) S is ‹P›-like.

Here too the separateness "collapses" to some extent into the point, but not, as in Hegel, because of the lack of difference in separateness, but because what is separate without limitation actually has the character of a point.

As separateness is now determined as pointness, it is "outside" in every conceivable respect. However, as such outsideness, it is in turn determined as separateness and, according to (1), again as non-pointness; S is not P or

(4) S is not not ‹P›-like.

With this, the argumentation has returned to the starting point (2) of these considerations, and repeats itself anew etc. ad infinitum. In other words, there is an *antinomic structure* here. How does it come to this?

Obviously because separateness is first understood as the outsideness of the point and so as the way of being of the point itself. This is possible because the point is nothing at all other than outsideness; if this were only one characteristic among others, it would of course be inadmissable to infer pointness itself from the outsideness of the point in this way. As outsideness, however, it is then immediately determined again as separateness etc. In other words, the *relatum* "pointness" is first inferred from the *relation* "outsideness" of the point, and then the *relation* "outsideness" or "separateness" is inferred again from the *relatum* "pointness" etc. But why? Obviously because the relation is "absorbed", as it were, by the relatum. Outsideness is, so to speak, the relational way of being of the point itself as a result of the determination of the point as something non-extensive. With the determination as pointness, however, the original oppostion (1) of separateness and pointness immediately becomes relevant, whereby the relation "separateness" is again set apart and pointness again becomes a relatum differentiated from the relation. At the same time, however, this is a relatum which absorbs the relation into itself anew by negating it according to its (the relatum's) definition (1), is therefore nothing other than outsideness, and this will thus be identical again with pointness - a typical *antinomic* relation, which appears here in the alternation of the contradictory predications (2), (3) and (4).

As the analysis of antinomic structures shows,[42] a fundamental antinomic concept in the form

(5) ‹P› = ‹not-‹P›-like›

can be inferred from this. As is also shown there, the right-hand side means the same as ‹not-P› or, because of (1), the same as ‹S›, so that (5) finally changes into

(6) ‹S› = ‹P›.

This result is now *contradictory* to the opposing relation (1) and would in so far be understood as a reductio ad absurdum of it. However, as the semantic definition that ‹separateness› and ‹pointness› are counterconcepts cannot, on the other hand, be dropped, the only possibility which remains is to also accept the resulting identity relationship (6), and thus we have altogether the *semantic contradiction*

(7) (‹S› ≠ ‹P›) ⊕ (‹A› = ‹P›).

The symbol ⊕ is intended to show that it is not a question here of a normal contradiction, but of an *antinomic* one, a point which is of extreme importance for reasons of argumentational logic. This means namely, as can be shown,[43] that its components refer to different levels of reflection and thus relate to different, as yet concealed aspects. They only appear to contradict each other in this respect due to a lack of categorial possibilities of differentiation, so to speak. Both components are, rather, legitimate and the antinomic contradiction could thus virtually be characterized as a "true contradiction". Hegel calls it the speculative,[44] the mirroring unity of opposites, as it were (speculum = mirror), without, however, explaining it further. In the case of a normal contradiction A∧¬A, by contrast, it follows with the excluded-third principle that one of the two components is true, the other necessarily false and hence their conjunction is logically false. For this reason, as shown, any given sentence follows from the normal contradiction - a characteristic which spells death for the logic of argumentation. There is no such danger in the case of the antinomic contradiction, if properly understood, ie. its occurrence is not detrimental to argumentation, a fact of central importance for the dialectic to be possible.[45]

The *necessity of synthesis formation* can also be understood from the antinomic contradiction because it demands that the categories of "separateness" and "pointness" no longer be thought of not only as opposed to each other, but also as signifying the same. This necessitates the introduction of a new category which meets this - at first apparently impossible - demand and is thus the synthesis of opposition and identity of both definitions. This demand for synthesis is obviously fulfilled by the category "line". In fact the line as separateness is, on the one hand, opposed to pointness, but as a "thin-as-a-point" separateness, as it were, it is just as much pointness. The newly-introduced category "line" is therefore the fulfilment of the derived postulate to bring "separateness" and "pointness" to a synthesis. The antinomic contradiction forces, so to speak, the introduction of a category which involves different aspects and is thus in a position to fulfill the demand of the synthesis in this way.

I shall break off this development of concepts here. This rather detailed depiction of some steps of development was intended to indicate how, in my opinion, dialectics can be

elaborated into a stringent procedure. I have already done this for that part of the Logic which approximately covers Quality Logic, whereby, however, far-reaching revisions of the Hegelian original are necessary. A more detailed treatment of the procedure is not possible in the present context. I refer therefore to the above-mentioned study which is soon to be published as well as to Wandschneider 1991. A question relevant to the matter which would have its rightful place here would be that regarding a possible difference between dialectical logic and the dialectic of the philosophy of nature. But here too, any answer must be deferred, because a closer discussion of the dialectic of the Logic would also be necessary for this, and both forms of the dialectic would have to be analysed more precisely and compared to each other, neither of which can be done here.[46]

I would now like to return to the fundamental point mentioned at the beginning of these reflections, ie. Hegel's thesis that the being of nature is inappropriate to the Ideal underlying it and is therefore determined by the tendency to again approach the way of being of the Ideal. If this is true, then this trend must be reflected in the dialectical development of concepts of natural categories. Can this be confirmed by means of the examination of the dialectic carried out here?

I think so. It was shown that "separateness", as the first category of the Non-ideal, demands the category of "point" as its negation. This, ie. "non-separateness", is, however, according to its semantic intention already the sublation (Aufhebung) of the separateness which characterizes the Non-ideal, and therefore in a certain sense a return to the Ideal. But it cannot come to this, so to speak, because pointness is already understood in respect of spatiality; it is in fact the negation of spatial separateness and remains in this respect bound back to this. But this negation, as was shown, then forces the separateness into a synthesis which necessitates the introduction of a new category "line". In this way, the line, unlike pure separateness, contains an excess of structure and relation. In other words, the dialectical development moves away from unrelated isolation towards greater structure and more relation. This is inevitable because dialectical progression necessarily leads to increasingly complex categories, to which more complex natural forms also correspond.

Hegel's concept of nature can thus be characterized as teleological. Decisive for natural being is, according to this, the immanent and, as stated, in Hegel's view purely categorial tendency to sublate natural isolation and to realize more complex structures, to become "more ideal", as it were. From this the question arises as to what should be understood as the ultimate *telos* of such teleologially-conceived nature. The return to the ideal? This seems to be likely here. In this connection we should, however, remind ourselves of the essentially dialectical character of the natural categories as well. In a global perspective this means: a non-ideal is opposed to the ideal and, according to the law of dialectics, one would now expect a synthesis of the two such that the ideal and non-ideal are not only opposed to each other but are also identical. The telos of the dialectical development of

natural categories would accordingly be the concept of an object uniting naturalness and ideality in itself. According to Hegel, this synthesis of nature and idea is *spirit*. "Spirit" is therewith, it should be noted, not the straightforward return to the ideality of the logical, but, as it were, the mediating of nature and logical idea or, it could also be said, idealized nature or naturalized idea. Here I merely wish to convey this consequence of the Hegelian concept of nature and not to discuss it further. Plausible examples of what has been said would be: thinking which depends on physiological substrata; language linked to sensory signs; but also, for example, culture realized in a physical world.[47]

This is not the place to trace and expound in detail the dialectical development of categories in Hegel's *Naturphilosophie*. I have done this to some extent elsewhere.[48] Instead, I would like to turn my attention to the now pressing question: if it is true that the dialectical development of natural categories virtually makes visible the "logic" underlying nature, how then are we to interpret those logical structures which determine natural events, what we call "natural laws"? Natural laws are, of course, also ideal relations as can, for example, be seen from the fact that, while they determine natural objects, they themselves are not natural objects. The law of falling bodies is itself not something which can fall, but only exists in the mind of the scientist as a lawlike relation. But how should we understand the relationship between a dialectic of nature and natural laws?

4 On the relations between a dialectic of nature and natural laws

So much is clear from the above considerations: If the category dialectic of nature is to be understood as fundamental for explanation, then it must also be possible to explain the following from it: firstly, why natural being is structured "according to laws", secondly, what these laws consist of and thirdly how the relationship between a dialectic of natural philosophy and natural law is to be understood.

This problem is basically only touched upon by Hegel: he declares in the introduction to *Naturphilosphie* that the philosophy of nature is a "grasping understanding" of what has previously been worked out by empirical natural science; "grasping" in the sense that the philosophy of nature, unlike natural science "does not need to appeal to experience", but grasps the empirical results rather in their "own, immanent necessity according to the self-determination of the notion".[49] By contrast, "the insufficiency" of "physical thought-concepts" can be recognized from the fact that these are "abstract or only formal", ie. they do not produce the "specificity" of the concrete, "definite content", so that this concrete, determined content conversely remains outside the physical thought-concepts, ie. is taken up empirically and so can only appear "in a fragmented, dismembered, isolated, separate way without the necessary relation within itself."[50]

What Hegel characterizes here is of course above all the methodological difference between the philosophy of nature and physics. But the substantiation relationship in question between a dialectic of nature and natural law still remains unexplained. If a relation can be established here, then it too must be obtained from the idealistic concept of nature developed. Hegel does not do this.[51] I will therefore indicate some considerations which could be developed further within this framework.

If isolation, separateness has shown itself to be the basic character of natural being, then the possibility of realizing this structure in the composition of nature must be contained in it from the outset. In other words: the determinants of natural isolation belong constitutively to natural being itself and define its characteristic property as *matter*. Matter is, according to this, determined by the possibility of keeping itself isolated - as something which holds itself together and at the same time keeps itself apart from other forms of matter. Physics has the concept of *force* for this. This very isolation of matter thereby simultaneously demands the possibility of dynamic action of matter upon matter, and this means: the concept of natural material being includes *causality* from the outset.

The concept of an action according to laws is not at first contained explicitly in this very general category of causality. Brief reflection shows, however, that the lawful character of nature is also linked to the character of natural isolation: if the effects on force of matter originate in matter itself, then its causality must essentially depend on the distance between the centre of the force and the place of its effect. The effect of force thus appears as a "force field" as it were. However, "distance" also means that it is not a question of a particular section of space being marked absolutely by it, for there can be distances everywhere in space; they are, mathematically speaking, invariant in the face of shifts in space. And in fact, if a material body is shifted, it takes its force field with it to a certain extent. Correspondingly, the distance dependence of causal action is similar both here and there, and that also means that it represents a universal structure, a *lawful* character.[52] The binding of forces to matter itself, which for its part again, as indicated, is to be understood as a result of the characteristic separateness of natural objects, is thus decisive for the lawful character of natural material being.

This offers fundamental access to an interpretation, according to which natural laws are principiated by the categories of separateness. Natural laws would be understood to some extent as a reflex of the dialectic of nature. The "logic" of real natural being would be founded on the dialectic. And I cannot do this here either. Let us nevertheless assume that the "logic" of real natural being is founded on the dialectic of the ideal categories of nature. In fact any other answer to the question regarding the relationship between natural law and a dialectic of nature within the framework of an objective-idealistic concept of nature can hardly be regarded as reasonable.

The question then arises, however, as to whether this means that an idealistic philosophy of nature could finally make empirical physics superfluous. Would knowledge of nature be possible in principle on a purely a priori basis, without recourse to experience? That is undoubtedly an extreme and unusual proposition, but I must confess that I do not see at least the hope of obtaining material laws of nature from the category dialectic of the philosophy of nature as too far-fetched - even though it is now a topos to view this as the most nonsensical thing to which overwrought idealism can rise.

I think, however, that there are examples which make the idea of an *a priori* physics thoroughly plausible. Hegel himself presents, for example, the beginnings of interpretations for the phenomena of inertia,[53] gravity[54] and light's lack of mass.[55] I have reconstructed Hegel's argumentation of this kind elsewhere,[56] and do not wish to go into this question in more detail here.

Nevertheless, this idea of being able to derive natural laws *a priori* in principle seems to me not only not implausible but, within the objective-idealistic framework, even irrefutable. If idealism has philosophical legitimacy - for which I think, there are good reasons - then the real structures of natural being must basically be principiated through a dialectic of natural categories. The question becomes all the more pressing: will empirical knowledge of nature be superfluous in the long run within the philosophical perspective? It may be surprising after what I have just said that I would still answer this question unequivocally in the negative.

Of crucial significance here is the insight that not only the recording of *universal natural laws*, but also the individual initial and marginal conditions of natural processes are generally known to form a part of the knowledge of nature. These - in brief - *antecedent conditions* are not captured by natural laws, because these only formulate universal relations, while the individual character of a factual natural process is only characterized by the additional account of the antecedent conditions. These thus represent an element of the knowledge of nature which is not part of natural law and is in this respect contingent; and for exactly this reason knowledge of nature cannot ultimately do without empirical knowledge.

It is evident that this contingent element of individual antecedent conditions rests in turn on the isolation of natural being. Let us consider an example: a body in the gravitational field of the earth can fall vertically or move along a parabola-shaped path as a missile. The cause of this is the powder charge with which the missile is propelled before it is left to the sole influence of the gravitational field and executes its movement then determined by laws. "Before" this law of motion, there is another law, so to speak, which acts on the missile and co-determines its movement. For not only does the earth exist, to which the missile stands in a lawful relation, but also the powder charge which influences its behaviour. There are, generally speaking, a variety of determinants for the very reason that natural being is determined by separateness. These determinants "extend" as it were, into the law for motion

in a gravitational field and are given expression in the law's formulation in the form of individual antecedent conditions.

It is notable from a philosophical viewpoint that both natural law and antecedent conditions originate in the same root, ie. in the isolation of natural being: the law originates in the causality linked to the isolated object itself, the antecedent conditions in the factual surrounding constellation of other isolated objects and their laws. Basically, the difference between natural law and antecedent conditions lies in the duality of the causality of the isolated object and that of the isolated objects surrounding it.

This then means, however, that the antecedent conditions also go back to natural laws. They are only "contingent" in the way charaterized above in the sense that they enter into the formulation of a certain natural law as initial and marginal conditions. These are, however, also in fact to be understood as the result of natural process governed by law.

As a kind of mental experiment, let us now make the extreme, fictive assumption of a complete a priori knowledge of natural laws. As, as stated, the antecedent conditions are also founded on natural laws, the question arises as to whether it would then also be possible to determine these a priori. Of course, complete knowledge of laws is pure fiction. But if one starts from this point by way of experiment, then it can be seen that the initial state of the universe would ultimately have to be known for such a calculation of the factual antecedent conditions. This would therefore in turn remain as a contingent factum brutum. However, if it were in fact also possible to determine this in some way, possibly even on the basis of philosophical a priori reflections, then the determination of later antecedent conditions would still require the calculation of the development of the whole universe from that point onwards.

At this point at the latest, the hopelessness of such an undertaking becomes clear and thus also the pragmatic impossibility of doing without empirical knowledge of nature, even with the fictive assumption of complete knowledge of laws.[57] Even if the possiblility of an *a priori* physics within an objective-idealistic perspective cannot thus be ruled out fundamentally, the indispensability of empirical knowledge still remains evident, because factual knowledge of nature, the knowledge of factual natural processes, is of course not only knowledge of laws, but also requires the determination of factual empirical antecedent conditions which thus constitute an essential contingent element for a knowledge of nature.

Hegel can therefore rightly say that it is "the most unheard of thing to demand of the concept that it should grasp such contingencies."[58] The demand made of Hegel to deduce "Herrn Krug's pen"[59] must indeed be rejected by philosophy as unfulfillable in principle. Hegel also speaks of "nature's fainting"[60] in this respect, in the sense of the isolation of natural being, which lacks the relation of the conceptual. The relations of factual constellations, which are necessary in natural law, are always also pervaded by contingent antecedent conditions. Natural being and correspondingly the knowledge of nature is

characterized in this way by the crossing of necessity and chance. It remains worthy of note that both originate in the same root, ie. the isolation of natural being. It could be said in this respect that a necessary consequence of the idealistic concept of nature is that there must also be chance, a point emphatically made by D. Henrich.[61]

5 Dialectic of nature and natural evolution

It has already been pointed out that Hegel concedes the notion of development with respect to nature only for the semantic level in the sense of a dialectical development of categories. He rejects, as just demonstrated, the view of real natural evolution and with this, incidently, also the possibility of a real dialectic of nature, as advocated by Engels. Yet it seems to me that this does not mean that the question can simply be considered as dealt with. Could dialectical relationships not also be realized via causal relations? This might be considered.

It was, however, revealed that the phenomenon of dialectical development is characterized by *antinomic structures*.[62] The level of development reached in each case is, according to this, simultaneously the condition of its negation, and thus produces its opposite. That such relations can indeed be realized through causal processes is well-known today.[63] It is further clear that structures of this kind are only possible within the framework of complex systems. I wish to look more closely at the example of an ecological system[64] in particular here (which I shall simplify considerably).[65] Let us assume there are two variants in a population, "aggressors" and "tolerators". These designations are intended to characterize corresponding behavioral strategies,[66] whereby the following dependences are of fundamental importance: if the population consists mainly of aggressors, their number is reduced through mutual destruction and, as a result, the tolerator variant increases in number. If the population consists mainly of tolerators, however, this is a chance for the aggressors to spread at the expense of the tolerators. But the larger the aggressor population becomes in this way, the greater is in turn its mutual self-destruction, which again leads to a reduction in the number of aggressors, and so forth. Each state generates its opposite, and in this sense we can speak here of a quasi-dialectical process; "quasi-dialectical", because the negation character does not appear as a transmutation into its opposite, but as a contrary developmental tendency which only has an effect in terms of numbers, ie. quantitatively.

This also holds for the result of those oscillation processes which settle down into a numerically more or less stable ecological balance of aggressors and tolerators.[67] This determines to some extent the "synthesis" of the characterized, quasi-dialectical process, because the opposition relation of aggressors and tolerators is in this way simultaneously one of co-existence. The "synthesis" of this quasi-dialectical process is therefore likewise not of categorial, but of quantitative nature. The genes of both variants are indeed carriers of information and in so far one could even speak of the co-existence of both in a certain sense

as a "categorial" enrichment of the "gene pool". But this only has additive character here. It does not lead, like the category dialectic, to a new categorial level. Correspondingly, such quasi-dialectical real processes are not determined by categorial but by causal determinants.

There are however also cases where, in a way, a new categorial level is generated through real-dialectical processes. An example of this is the evolution of herbivorous organisms on the basis of the already-existing plant world. As can easily be seen, the relationship between the herbivores and the plant population also has a quasi-dialectical structure. (A rise in the herbivore population results in a drop in the plant population and therefore a reduction in herbivores; a reduction in herbivores results again in an increase in the plant population and therefore also in an increase in herbivores.) At the same time it is clear that the transition from plants to herbivores represents a higher development, for the herbivores must be organized in a much more specialized way than the plants eradicated by them: they require special eating instruments and digestive organs. They have to find the stationary plants and need possibilities of movement to do so as well as sense organs for orientation. This further implies an efficient information system, ie. a nerve system which controls and co-ordinates these special systems. In this case, the real-dialectical process thus induces a higher level of organization and therefore results to a certain extent in the transition to a higher categorial level.

Both cases thus exhibit analogous real-dialectical structures, but only in the latter case is there categorial progress. This cannot therefore be based specifically on the structure of the real-dialectic of the process. On what then? The actual reason for the progress in development is obviously to be found in the cumulative character of natural evolution, because each level of development reached simultaneously offers new living space for new and, as indicated, necessarily more highly developed species. A "pressure of selection" in Darwin's sense therefore exists, which aims at the colonization of the living spaces produced by natural evolution itself and hence tends towards higher development. This argument in favour of cumulative progress, which takes its orientation from Darwin, is completely sufficient for a fundamental understanding of evolutionary higher development. Dialectical development is indeed also cumulative, but not every cumulative development is dialectical.

About forty years before Darwin's *On the Origin of Species* (1859), Hegel had as yet no access to an understanding of real natural evolution. For him, actual development is, as shown, only a dialectical development of categories, which as such has logical, not temporal character. On the other hand, he does not consider dialectically structured causal processes to be possible. Yet, as shown, such quasi-dialectical process structures can indeed be realized even if they are, as also became clear, not in fact to be understood as the actual basis of evolutionary higher development. Hegel essentially fails to recognize that there is real natural development, that it can be explained causally and furthermore, that it is non-dialectical.[68]

However, Engels' interpretation of dialectical relations in the sense of "true developmental laws of nature"[69] is also incorrect: the first of the principal laws named by him, "the law of transmutation from quantity to quality and vice versa",[70] proves on closer inspection to be a typical "system law" in the sense that specific "threshold values" exist for real systems, the transgression of which results in a quantitative change leading to a transmutation into a new quality (and conversely a change in quality calls for a change in quantity), as, for example, in the transition from ice to water at 0°C or from water to steam at 100°C (under normal conditions). In more general terms we are dealing here with the phenomenon known as "emergence". Completely new qualities arise here, which are essentially based on "system laws" and therefore only "come to light" in a system relation. This has nothing to do with a real dialectic, however.

The two other principal laws named by Engels on the other hand, "the law of the interpenetration of opposites" and "the law of the negation of negation"[71] play a role in the dialectic, but it is difficult to classify them as basic laws of natural evolution. The evolutionary mechanism is, as already stated, (neo-)Darwinian, and that basically means that it can be explained satisfactorily by causal theory. Engels, who already knew Darwin's "epoch-making work"[72], does not apparently recognize this or does not differentiate it clearly enough from quasi-dialectical process structures.

A point worth pondering, and I close with this, is the fact that natural evolution, which is basically non-dialectical, finally produces a being capable of thought and thus realizes dialectical structures on the mental (geistige) level again. It is exactly Hegel's concept of nature which takes account of this, even if not in the sense of a temporal, but a conceptual development. According to it, nature sublates itself into the mind according to the dialectical law as a synthesis in which naturalness and ideality are now linked. At the same time, nature overcomes in this way its essentially non-dialectical character and enters the dialectical development of human mental history.[73] The hierarchy of nature ends in a way in the conceptual and philosophical penetration of nature itself, which in this way also catches up on its own logical prerequisities. In my opinion, Hegel's dialectical concept of nature is therefore, even with its lack of detail, the most thoroughly reasoned concept of nature produced by philosophical tradition from a systematic point of view.

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1 Cf J G Fichte, *Werke*, Gesamtausgabe der Bayrischen Akademie der Wissenschaften, ed R Lauth and H Jacob, Stuttgart 1965. Vol I, 2; eg. p 388 f, 395 f, 399, 404 f, 409 f (or: *Fichtes Werke*, ed I H Fichte, 1834-1846, Vol 1, eg. p 251, 260, 264, 271, 277).

2 Hegel, *Werke*, ed Hermann Glockner, Stuttgart 1955 ff (or *SW* = Hegel, *Suhrkamp-Werkausgabe*, ed Eva Moldenhauer und Karl Markus Michel, Frankfurt a.M. 1969 ff), cf eg. Vo. 5, p 351 f (*SW* 6.572), Vol 8, § 237 and add (*SW* 8 § 237 and

add), vol 8, § 242 f (*SW* 8 § 242 f); "add" indicates the "addenda". All Hegel citations without the original italics.

3 Hegel, *Werke*, Vol 4, p 58 (*SW* 5.56).

4 Hegel, *Werke*, Vol 5, p. 5 (*SW* 6.245).

5 Hegel, *Werke*, Vol 5, p 25 (*SW* 6.264).

6 Hegel, *Werke*, Vol 5, p 328 (*SW* 6.549).

7 Hegel, *Werke*, Vol 5, p 352 (*SW* 6.572).

8 Hegel, *Werke*, Vol 5, p 348 (*SW* 6.569).

9 Hegel, *Werke*, Vol 5, p 351 f (*SW* 6.572).

10 Hegel, *Werke*, all Vol 5, p 350 (*SW* 6.570); cf also p 351 (*SW* 6.571).

11 Cf eg. K-O Apel, *Transformation der Philosphie*, Vol 2, Frankfurt a.M. 1973; W Kuhlmann, *Reflexive Letztbegründung*, Freiburg, Munich 1985; D Wandschneider, "Die Absolutheit des Logischen und das Sein der Natur", in *Zeitschrift für philosophische Forschung*, Vol 39 (1985), p 331-351; V Hösle, *Die Krise der Gegenwart und die Verantwortung der Philosophie*, Munich 1990.

12 Cf D Wandschneider, "Die Absolutheit des Logischen ...", *loc cit* p 333 f.

13 Hegel, *Werke*, Vol 5, p 352 (*SW* 6.573).

14 Thus H Braun, "Zur Interpretation der Hegelschen Wendung: frei entlassen" in: Hegel, *L'esprit objectif, l'unité de l'histoire*, Lille 1970; taken up again in B Falkenburg, *Die Form der Materie*. Frankfurt a.M. 1987, p 132, 141 ff.

15 D Wandschneider, "Die Absolutheit des Logischen...", *loc cit*; furthermore D Wandschneider, "Das Problem der Entäußerung der Idee zur Natur bei Hegel", in Hegel-Jahrbuch 1990, p 25-33.

16 Eg. Hegel, *Werke*, Vol 4, p 127 f (*SW* 5.121), Vol 4, p 634 (*SW* 6.159), Vol 19, p 374 f (*SW* 20.164); Spinoza reference in V Hösle, *Hegels System*. Hamburg 1987, Vol 1, p 195.

17 Cf on this point also Hegel's formulation: "Because it is in itself totality, the individual circle therefore also breaks through the limit of its element and establishes a further sphere; the whole therefore appears as a circle of circles, each of which is a necessary moment, so that that system of their characteristic elements makes up the whole idea, which equally appears in each individual one" (Hegel, *Werke*, Vol 8, p 61 (*SW* 8.60)).

18 D Wandschneider, "Das Problem der Entäußerung...", *loc cit*, p 29.

19 Hegel, *Werke*, Vol 9, p 31 add (*SW* 9.10 add).

20 Hegel, *Werke*, Vol 9, p 48 add. (*SW* 9.23 add).

21 Hegel, *Werke*, Vol 9, p 50 add (*SW* 9.25 add).

22 Hegel, *Werke*, Vol 9, p 49 (*SW* 9.24).

23 Hegel, *Werke*, Vol 9, p 54 (*SW* 9.28).

24 Hegel, *Werke*, Vol 9, p 720 add (*SW* 9.538 add.); cf also Vol 9, p 65 add (*SW* 9.37 add), Vol 10, p 54 f add (*SW* 10.45 add).

25 Hegel, *Werke*, Vol 10, p 29 add (*SW* 10.24 add).

26 Hegel, *Werke*, all Vol 9, p 58 (*SW* 9.31).

27 Hegel, *Werke*, Vol 9, p 58 (*SW* 9.31).

28 Hegel, *Werke*, Vol 9, p 59 add (*SW* 9.32 add); cf p 67 add (*SW* 9.38 add).

29 Hegel, *Werke*, Vol 9, p 466, add (*SW* 9.349 add); cf p 59 f add (*SW* 9.32 add).

30 Hegel, *Werke*, Vol 9, p 59 (*SW* 9.31); cf also Hegel, *Werke*, Vol 9, p 69 add (*SW* 9.40 add).

31 Hegel, *Werke*, Vol 9, p 65 (*SW* 9.37 add).

32 Hegel, *Werke*, Vol 10, p 28 f add (*SW* 10.24 add), p 36 f add (*SW* 10.30 add).

33 Hegel, *Werke*, Vol 9, p 66 add (*SW* 9.37 add), p 59 (*SW* 9.31).

34 Hegel, *Werke*, Vol 9, p 71 (*SW* 9.41).

35 Hegel, *Werke*, Vol 9, p 74 (*SW* 9.44).

36 Hegel, *Werke*, Vol 9, p 74 (*SW* 9.44).

37 Hegel, *Werke*, Vol 9, p 74 (*SW* 9.45).

38 D Wandschneider, "Dialektik als antinomische Logik", in: *Hegel-Jahrbuch* 1991, p 227-242.

39 Concepts enclosed in the angles ‹...› are intended to indicate in the following that it is a question of the categories themselves, ie. their lexical content, not what is categorized by them. ‹Space›, eg. stands for the meaning "space", not for space as an entity.

40 It should be noted that "separateness" ("das Außereinandersein") - and by analogy "pointness" - is not a separate being among other separate beings here, but the abstract noun "separateness" which as such has singular character; it is hence like "redness" or "red colour" in comparison to the plurality of red things.

41 "Separateness" and "outsideness" are always used synonymously here. The expression "separateness" is thus actually already sufficient, but linguistically possibly misleading with reference to the point: as if the point were separate "in itself".

42 Cf D Wandschneider, "Das Antinomienproblem und seine pragmatische Dimension", in *PRAGMATIK*, ed H Stachowiak, Hamburg 1986 ff, Vol 4.

43 Cf DWandschneider, "Das Antinomienproblem...", *loc cit*.

44 Eg. Hegel, *Werke*, Vol 5, p 99 f (*SW* 5.94).

45 For a more detailed discussion on this point D Wandschneider, "Dialektik als antinomische Logik...", *loc cit*.

46 Cf on this point V.Hösle, *Hegels System*, *loc cit* p 72 ff, 100 f.

47 On this point D Wandschneider and V Hösle, "Die Entäußerung der Idee zur Natur und ihre zeitliche Entfaltung als Geist", in *Hegel-Studien*, Vol 18 (1983), p 173-199.

48 Eg. D Wandschneider, *Raum, Zeit, Relativität. Grundbestimmungen der Physik in der Perspektive der Hegelschen Naturphilosophie*, Frankfurt a.M. 1982; D Wandschneider, "Anfänge des Seelischen in der Natur in der Deutung der hegelschen Naturphilosophie und in systemtheoretischer Rekonstruktion", in M J Petry (ed), *Hegel und die Naturwissenschaften*, Stuttgart 1987, p 443-467.

49 Hegel, *Werke*, Vol 9, p 37 (*SW* 9.15); cf also p 43 ff add (*SW* 9.20 f add).

50 Hegel, *Werke*, Vol 9, p 45 add (*SW* 9.21 add).

51 Nevertheless, something similar is mentioned by Hegel in the *Logic*; he speaks of physical laws as a "mathematics of nature" (Hegel, *Werke*, Vol 4, p 425 f (*SW* 5.406)), which, for its part, still has to be caught up on by philosophy: "an even higher proving of these laws must, however, be demanded, namely nothing other than that their quantitative aspects can be recognized from the qualities or from certain concepts...(such as time and space)" (Hegel, *Werke*, Vol 4, p 426 f (*SW* 5.407)).

52 Furthermore correspondingly, according to what is known as the "Noether theorem", certain conserved quantities correspond to such invariancies ("symmetries"). Coordinated, for example, to the translation invariancies in time and space is the conservation of the total impact and the total energy. Cf, eg. E Schmutzer, *Symmetrien und Erhaltungssätze der Physik*, Berlin and Oxford and Braunschweig 1972.

53 Hegel, *Werke*, Vol 9, § 264 and add (*SW* 9. § 264 and add).

54 Hegel, *Werke*, Vol 9, § 262 and add (*SW* 9. § 262 and add).

55 Hegel, *Werke*, Vol 9, § 275 and add (*SW* 9. § 275 and. add), § 276 and add (*SW* 9. § 276 and add).

56 D Wandschneider, *Raum, Zeit, Relativität...*, *loc cit*, Chaps. 4-6; cf. also D Wandschneider, "Relative und absolute Bewegung in der Relativitätstheorie und in der Deutung Hegels", in: R-P Horstmann und M J Petry (eds), *Hegels Philosophie der Natur*, Stuttgart 1987; D Wandschneider, "Die Kategorien 'Materie' und 'Licht' in der Naturphilosophie Hegels", in: M J Petry (ed), *Hegel und die Naturwissenschaften*, Stuttgart 1987.

57 Even more disastrous consequences follow if one takes into account the indeterminacies linked to the many body problem, or also aspects of chaos theory (if one were to consider a - naturally likewise fictive - measurement of all the antecedent conditions of the universe at a certain point in time).

58 Hegel, *Werke*, Vol 9, p 63 (*SW* 9.35).

59 See Hegel, *Werke*, Vol 9, p 63n (*SW* 9.35n).

60 Hegel, *Werke*, Vol 9, S 63 (*SW* 9.34).

61 D Henrich, *Hegel im Kontext*, Frankfurt a.M., 2. ed 1975, p 157 ff.

62 Cf on this point also D Wandschneider, "Das Antinomienproblem...", *loc cit*.

63 An example is what is known as an "auto-interrupter" circuit, as used, for example, in an electric bell.

64 The relations envisaged here are of "sociobiological" nature in the narrower sense, whereby sociobiology is, however, to be ascribed to ecology as the science of the interaction of natural forms within the framework of self-regulating systems.

65 R Dawkins, *Das egoistische Gen*, Berlin and Heidelberg and New York 1978, p 83 ff.

66 Dawkins speaks metaphorically of "falcons" and "doves", which could, however, be misleading here. (R Dawkins, *loc cit*, p 83 ff.)

67 Dawkins calls this an "evolutionary stable strategy" (R Dawkins, *loc cit*, p 83).

68 "A critical continuation of Hegel's Realphilosophie will therefore have to accord far greater space to the idea of evolution than did Hegel himself" (V Hösle, *Hegels System*, *loc cit*, p 96).

69 F Engels, *Dialektik der Natur*, in: Marx-Engels-Werke (MEW), Vol 20, Berlin 1971, p 349.

70 F Engels, *Dialektik der Natur*, *loc cit*, p 348.

71 F Engels, *Dialektik der Natur*, *loc cit*, p 348.

72 F Engels, *Dialektik der Natur*, *loc cit*, p, 489.

73 Cf on this point, the deliberations in V Hösle, "Sein und Subjektivität. Zur Metaphysik der ökologischen Krise", in *prima philosophia*, Vol 4 (1991), p 519-541.