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Hegel's Philosophy of Nature and the Contemporary Philosophy of Science

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by Aziz Yardımlı

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Introduction

It is still quite often maintained that Hegel's *Philosophy of Nature* is not based on experience, that it is irrelevant to the real world, the world of experience. Indeed, Hegel's *Philosophy of Nature* does not have an "empirical" content, if the latter term is understood as the supply of the individual sense-experiences to fill the "empty" concepts. Nor is it based on the inductions from the sense-data. Still in Hegel's philosophical system the petrified Intelligence is liberated from its petrified form in Nature, to use a Schellingean locution, conceptualized in its pure forms, and for that matter, conceptualized from the *same* empirical material. In empirical consciousness *Vorstellung*/representation precedes the concept, and since *Vorstellung* is only the deformed form of the *Begriff*, it stimulates the reason to ask what the particular concept really is, to find the logos implicit in its empirical representations. The premiss of the *Philosophy of Nature* is the empirical Sciences of Nature. In Hegel's own words, "in its formation and in its development, philosophical science [of nature] presupposes and is conditioned by empirical physics" (*Phil. of Nature*, § 246).

Empirical physics itself, too, has as its subject-matter not the singular or sensible entities of space, time and matter, but their concepts. However in the empirical science of physics these concepts are not yet organized in their systematical structure. They are still so-called *a posteriori* entities,

not manifested in their *a priori* or proven character. Empirical physics too deals with the concepts, not with the sense-perceptions. "It has in the first instance to be pointed out however, that empirical physics contains much more thought than it will either realize or admit; that it is in fact better than it supposes, or if thought is considered to be a bad thing for it, that it is worse than it supposes. Physics and the philosophy of nature are therefore to be distinguished, not as perception and thought, but merely by the nature and manner of their thought. Both are a thinking cognition of nature" (*Phil. of Nature*, Introduction).

But the distinction is there only to be negated. The very existence of the current Philosophies of the several Sciences is the recognition of the fact that these sciences are insufficient to themselves and in need of philosophy, and not any and every philosophy but philosophy in its true form. They have too many conceptual problems of which the solution is impossible by their experiential methods. Several existing Philosophies of Sciences have, at least as an intention, the attainment of a higher form by their respective empirical sciences, a form which would be in accord with the concept of science as such. But these Philosophies restrict themselves to the use the methods of the empirical sciences themselves only in order, ironically, to defeat themselves. For they show that the methods and means used by the empirical sciences such as analogies, inductions, reductions, axioms, postulates, models, techniques etc. can lead not to certainty but only to uncertainty, not to the knowledge but to the statistics and probability. Logical positivism, in order to show itself as scientific, has to acknowledge the impossibility of knowing anything to be the criterion of being scientific. In its long history, it managed only to show how to avoid philosophy and science, that is, how to produce what is in fact not science but only pseudo-science. This is indeed a service to humanity, even though it is only a negative one.

Hegel's *Philosophy of Nature* took the empirical sciences as its raw material at their relatively early stage of development and therefore participated into their deficiencies. To this extent, the current opposition to Hegel's work in the *Philosophy of Nature* is *not* directed against its imperfection in content. Rather, it is precisely the same old and new objection against his *conceptual* method. Like Schelling before him, Hegel thinks that Nature is essentially rational in character. And he thinks this as the very possibility of Nature as well as of its knowledge. Logical positivism denies precisely this possibility, and with a formal logic totally irrelevant to reality and knowledge, it survives only as a reaction to the philosophy proper.

Hegel's philosophical method is unique in its demonstration of the possibility of knowledge. It shows what is needed for the Sciences of Nature and of Spirit to be real Sciences. For him to affirm *the being of*

the concept is to affirm the possibility of the Sciences in general. This unity Hegel has recognised as the possibility of his entire system of philosophical knowledge. The failure to understand *the being of the concept* is possible only through the bad habit of the ordinary human thinking which permits *being* only to what is sensible, material, or physical, or to what is phenomenological, factual, or empirical which is thought to exist as pure *a posteriori* without the *a priori*.

Hegel's *Philosophy of Nature* has a lot to tell to the modern scientific activity about Einstein's mechanical theories of relativity, the several Quantum theories of the particles and the light, and the contemporary philosophy of biology, and that not only regarding their method but also content. Only rational mind can know what is essentially rational. And scientists, even those who imagine themselves as strictly keeping to the positivistic standpoint, approach to Nature at least implicitly rationally. Why not should they do that consciously?

Hegel's System and Methaphysics

If regarding Hegel's encyclopedic system the word 'metaphysics' is taken in its true sense, meaning as 'what is beyond nature,' then what is properly *meta*-physical in the context of Logos-Nature-Spirit is not *Science of Logic* but *Philosophy of Spirit*. But generally, and obviously confusingly, what is meant by 'metaphysics' is not what is *after* physics but what is *before* it. In Hegel's system, the *Science of Logic* is not *after* but *before* the *Philosophy of Nature*. And Hegel too accepts this invalid use, and applies the misnomer 'metaphysics' to his *Science of Logic* and calls it as the *real* Metaphysics (*die eigentliche Metaphysik*). Here "meta" should certainly be replaced with "pre" or "before," as it is in Aristotle's *First Philosophy*. But what is at stake here is not to find the correct preposition. The problem of metaphysics, that is, the *destruction of metaphysics*, is the basic problem for the empirical consciousness. And what is to be destroyed by this empirical consciousness is the *Science of Logic* as the *real* Metaphysics.

Empirical consciousness (which Hegel calls also as *common sense*, or *understanding*, or *reflection*), due to its *sceptical* nature, *can not understand or know* what it calls 'metaphysics.' Since it equates *being* with what is *empirical*, and derives its *faint ideas* from experience, it has no concepts whatsoever applicable to what is beyond empirical, to what is *purely logical*. So it really does not know what it intends to destroy; hence it does not destroy anything at all. It continues itself to be metaphysical, yet fancies that it deals with something physical. For Newton, Geometry was a branch of mechanics; the contemporary logical positivism affirmed an *a posteriori* 'Geometry'; Albert Einstein reduced, at least imagined that he reduced, the Geometry to a pencil and compass Geometry.

To the extent that it is *physicalist*, this empirical consciousness tends to reduce even what is *intellectual* (*geistig*) to the sense-data, and in its materialistic version, it denies being to what is immaterial. As consistent empiricism, materialism is a monism affirming *only* the existence of the matter, and we have no right to corrupt it by revising it. Since empirical consciousness is sceptical by definition, that is, it has no *knowledge* but only *opinions*, its criticisms and refutations directed to the conceptual thinking comes only from the *ignorance*.

Empirical consciousness wishes to avoid metaphysics through the fictitious reality of the sense-data. But the *subjective* sensation is itself metaphysical, that is, *mental*. Senses only sense, not know. Sensation is subjective; but knowledge must be objective. The misjudgement that only senses establish the *being* is itself an act of thought. Perception is more than mere sensation and involves the activity of the concepts. A point, line, triangle, bodies in general are not sensed but perceived. The road from protocol sentences to the sciences is paved by *Unding*.

In Hegel's system it is clearly seen that *philosophy* as such is metaphysical in the conventional sense of the term. All forms of Philosophy, together with Art and Religion, fall under the title of "Absolute Spirit" in Hegel's *Philosophy of Spirit*. Empiricism and its newer versions, such as logical positivism, scientific empiricism, philosophy of science, and *sciences* themselves in general, simply by being intellectual, also belong to the same category. *Physics is metaphysics*. To quote Hegel, "Newton gave physics an express warning to beware of metaphysics, it is true, but to his honour be it said, he did not by any means obey his own warning" (§ 98 *Zusatz* 1). Even those who reject Reason in Nature approach to Nature by means of their Reason and expect to know Nature by their *thoughts*. That is, they want to find the Reason in Nature.

Philosophy of Nature and Experience

"The natural sciences, and in particular, the most fundamental of them, physics, deal with such sense perceptions" (Einstein, *The Meaning of Relativity* 1951).

"Philosophy of Nature" is not the "Nature" itself and belongs to the realm of Spirit and is therefore metaphysical. Nature is obviously material; it is also *objective* in the sense of being independent of subjective human consciousness, and if the word 'reality' is to express what is sensible, Nature is certainly what is sensible throughout. But Nature which is the object of the sense-experience is at the same time *conceptual*. The *conceptual* nature of Nature is the possibility of its reality as well as of its knowledge, and it is what makes Nature the subject-matter of the natural sciences. Those who think that Philosophy of Nature must not be

conducted *a priori*, but must be based on empirical foundations, miss the fact that nature is *ipso facto* what is empirical itself.

Hegel says that "It is not only that philosophy must accord with the experience nature gives rise to; in its *formation* and in its *development*, philosophic science presupposes and is conditioned by empirical physics" (§ 246 *Anm.*). Yet, especially against his philosophy, it is often claimed that science must begin with the *experience* – just as eating must begun with the food. This is a pleonasm. Experience is not knowledge but what is to be known. As to the intuition, on which empirical consciousness clings, Hegel is clear about its role in the process of cognition: "[O]ne cannot philosophize on the basis of intuition" (§ 246, *Zusatz*). To the extent that Science has its goal as the establishment of the systematic connection of *concepts*, this structure can not be determined by loose and often arbitrary connections fixed by the so-called intitutional consciousness.

Current empiricism asserts that the concepts of science must be derived from experience. This assertion, like every and any assertion, is a matter of *association*, not a logical deduction. Previously, David Hume had done better than that and, taking experience as the source of 'knowledge,' showed that only *psychological* representations, so-called *faint ideas* could be derived from it. While the *connection* between the concepts is *logical*, the *connection* between the *representations* has no more significance than a kind of *association*, even *recitation*. In the main, contemporary 'Philosophy of Science' is a sort of empiricism using this material to *interpret* the empirical findings of the sciences.

Empiricism is what Hegel calls the "subjective idealism," a philosophy which permits human mind to know in its object only its own *subjective faint ideas*, that is its *representations*. On the other hand, in Hegel's philosophy, for the experience to be possible (or for the perception, fact, appearance to be possible), it must be determined *conceptually*, so that experience becomes the unity of objective and subjective elements. What the mind does in 'experience' as one of its forms is that it invests its categories to its object (to the so called *Ding-an-sich*). It *determines* its object conceptually, so that in its object what is present to the mind is nothing but itself. "Understanding experiences only itself" (*PhS*, § 165). What it imagines it receives into itself from outside physical and cultural world is in fact only its own categories. This ordinary, that is unconscious consciousness or common-sense imagines that in its object it is confronted by the *external reality*; it imagines that what it knows is its object, not itself. Mind, as understanding, is an unconscious subjective idealist.

Mind is the "movement of becoming an *other to itself*, i.e. becoming an *object to itself*, and of suspending this otherness. And experience is the name we give to just this movement" (*PhS*, § 36). "Consciousness knows and comprehends only what falls within its experience; for what

is contained in this is nothing but spiritual substance, and this, too, as *object of the self*" (*PhS*, § 36).

Philosophy of Science

The fact that *Philosophy of Science* exists is an indication that *empirical science* is not sufficient to itself, that it is not science in the true sense of the term but only *empirical science*. Logical Positivism was designed to complement the sciences by cleaning them from the *concept*. It asserted that Nature was a mere *fact* without any conceptual structure. It was devoid of any form or determination, so that thinking had absolutely nothing to do with it. It regarded the thought just irrelevant to what is material Nature. For Hegel, Nature is *determinate*, and its determinations is expressed by objective thoughts, that is by concepts. A Nature without any determination is a *Gedankending*, an abstraction. Logical Positivism had nothing to do with knowledge but only with statistics. Consequently, it corrupted the knowledge and rejected the very concept of science.

From Logos to Nature

In Hegel's encyclopedic system Nature *logically* follows the Logos or Reason (absolute Idea). Nature is the dialectical development or negation of Logos, and in the structure of Hegel's *absolute method* it corresponds to the *dialectical* moment and has its determination *relative* to Logos. In Hegel's words, "Nature ... is determinate only through its being relative to a first" (*Enc.* § 247, *Zusatz*). This determination of Nature is equally its *reality*. It is *determinate* or *real* Logos. Nature, if taken in total isolation from everything else, is an abstraction, a *Gedankending* — the principle of so-called Naturalism. Nature has its *quality*, that is, its *being as Nature*, only in relation to its other which is the absolute Idea. *All determination is relation*. And all determination is equally *negation* — as Spinoza rightly said. Nature is Logos in its negativity, otherness, externality.

In Hegel's system, Logos is the Idea in its *universality*. Bu universality itself has its determination only in its opposition to *particularity*. It is always connected to particularity, is determined by it, and in the case logical Idea, the particularity of Nature is the reality of the Idea. It was Schelling who called Nature as "petrified intelligence." But Nature is equally not petrified, since it is "the unresolved contradiction" (§ 248, Anm.) of the universality and particularity; so it sublates itself, and raises itself to the point of contact with the Spirit, to *the Idea of Life*. "Life is the highest to which nature drives in its determinate being" (§ 248, Anm.). Life is the beginning of *Geist*, its first and therefore simplest moment. *Geist* is the unity of Logos and Nature, the resolution of contradiction, the concrete unity comprising both preceding moments.

In Hegel's system, there is *no transition* from Logos to Nature in the

temporo-spatial sense of the term. Nature “has not issued from a process of becoming, nor is it a transition.” It is not “*ein Gewordensein und Übergang*” (*Science of Logic*, last paragraph). Nature is not created; on the contrary, in its spurious infinity, the material Nature is Space and Time from eternity to eternity. Empirical, that is, ordinary consciousness imagines a transition between Logos and Nature and, as *theism*, affirms a divine creation, and, as *atheism*, denies validity to the same representation which is, in fact, its own fiction. What is called as *creation* of Nature is in fact an endless process which takes place in eternity. Nature is a perennial origination or birth, that is, a process, a ceaseless flux, a never ending *becoming*. As the moment of “*unresolved contradiction*” of existence, it is finite in its infinity. “The Idea of Nature, like the Idea as such, is eternal” (§ 247 *Zusatz*). The Idea of Nature is its *concept* plus its *reality*, but its reality does not correspond to its concept. It is because of this disparity that Nature strives towards its perfect form.

The determination of Nature is “the externality of space and time existing absolutely on its own account without the moment of subjectivity” (*Science of Logic*, last paragraph). When the theory of relativity proposes that everything was created from *nothing* with a big bang, it practically does the same mistake that Kant objects against when he criticise what he thinks as the deduction of 100 Thalers from their concept, of the *determinate* something from pure, abstract being. What can be created determinately is only what already exists in *potentia*. Although it is true that *being* comes from *nothing*, yet *determinate-being*, for instance Space is not abstract being.

Space

While Space is positive, Time is negative.

While Absolute Idea is the totality of the conceptual system, material Nature is the same conceptual system in its *material externality*, that is, it is basically a logical structure determined in accordance with its laws, a cosmos determined by the systematic connections of the concepts of Nature. In order to follow Hegel’s analysis of the concepts of *Space, Time, and Matter* — of *infinitely small and infinitely great* —, it is absolutely necessary to be familiar with his analysis of the concept of *Quantity* and other concepts related to it. The concepts of Space and Time by their very nature mathematical; and “the name of mathematics also might be used for the philosophical consideration of Space and Time” (§ 259 *Zusatz*). But the *quantitative* language of mathematics is obviously so insufficient to express the determination of the concept that, “mathematical determinations such as the infinite and its relationships, the infinitely small, factors, powers etc. have their true notions in philosophy itself” (§ 259 *Anm.*).

Hegel's *first* concept in the *Philosophy of Nature* is Space. "The primary or immediate determination of nature is the abstract universality of its self-externality, its unmediated indifference, i.e. Space" (§ 254). Self-externality is *being-for-itself* in its spatial quality. Being-for-self is the crucial concept to understand the logical structure of Space (as well as of Time and Matter). Space is the *first* concept of Nature because in its *immediacy*, *abstractness*, or absolute *simplicity*, Space is pure affirmation or positivity. To the extent that *Time* includes *negation*, it can not be the first, since by including a *negation* or *mediation* it is more than itself.

To take Space and Time as only *subjective* forms of 'intuition' without any reality, as in Kant's subjective idealist account of them, is to make the existence of both Nature and Mind in their totality purely *phenomenal*. This means that 'science' of anything and everything has reference only to the *consciousness* which is disconnected to the *Ding-an-sich*, to the *objective reality*. In Hegel's system, Space and Time are self-externality of the Idea, and *our subjective logical thinking*, if it thinks *objectively*, that is *freely*, in pursuit of them, if it immerses itself in the movement of the concept, in this *a priori* process it becomes itself true, scientific, and *objective*. The reason why human Reason cannot accept that subjective idealism is the fact that Reason is the *unity of the concept with its objectivity*. In this sense, Kant's 'pure reason,' for instance, in its utter phenomenalism, in its absolute subjectivity, is *not* Reason at all. It is only consciousness cut off from what is objective. If such a fiction can not be understood or thought, then we must remember that only what is rational is capable of being understood or thought.

A priori thinking is not to be confused with the theory building as it is done in modern physics today without any experimental basis whatsoever, as, for instance, it is the case in the theory of super symmetry, or the string theory, or standard model theory, theories of Einsteinian relativity, etc. Quite the contrary, the concept of a *prioi* thinking implies the thinking performed by the *objective* concepts, or by what Hegel calls *Gedankenbestimmungen*. The task of the transformation of the pictorial representations/*Vorstellungen* to the *concepts* is, for Hegel, the *raison d'être* of philosophy. The question whether the concept is subjective or objective, whether it is physical or metaphysical, real or ideal – all this is invalid in his philosophical system, since the concrete concept is the unity of both, and what is important is the fact that our subjective thinking, in order to be scientific, should correspond to the objective reality. Hegel builds his system over the element of the *unity of being and concept* which were only separated in Kant's philosophy of *Ding-an-sich*.

In Hegel's analysis, Space is *indeterminate*, *so infinite*, but only quantitatively, since it does not contain any qualitative negation. "Space is in general pure *quantity*, no longer in its merely logical determination,

but as an immediate and external being" (§ 254 *Anm.*). Of course it has *limit*, or rather it is at its every point limited. But this limit is at the same time no limit since its beyond is itself Space – at every dimension. The concept of Quantity is nothing but the *progress in infinitum*, that is spurious infinity. Space is *self-externality*; it is not external to something else but to itself. It is *Außersichsein* or self-relatedness, being-for-itself. Being-for-itself expresses immediately the relation to *itself*. It is equally *determinate*-being since it is not immediate or abstract being, but related to an *other*, but this other is only itself, in its other it finds only itself. If at this point we may talk about the *structure* of Space, about its alleged curvature, expansion, contraction, motion etc., this would be to append external determinations to Space which do not belong to it. The dimensions of Space has their deduction in the conceptual character of Time: Universality, particularity, and singularity. (The Determinations of Space: Line, Surface, Volume; the three dimensions).

Space as *determinate* concept has its *negation* in itself (§ 257, *Zusatz*). The negation of Space by itself is the spatial Point which, while it is only a *definition* in Euclides, is deduced or proven in Hegel and no longer an axiom. This contradiction, which is Space, sublates itself. Or the Point, since it is negation of Space which gives it its determination as Point, by removing its opposite removes itself as well. The negative Space is Time.

Space is *determinate*, that is, it is burdened with *negation*. Its negativity, that is its *Nichtdasein* or its determinate non-being is Point. This negativity is obviously also the aspect which posits its determinations as line, surface, volume. In point Space is no longer; as Point, it is not; or rather, Point is not the abstract nothingness, but the non-being of Space, that is its unity with its absence. This contradiction is what makes the Space negate its *positive* being. Space as pure positivity is being-in-itself, a being totally turned into itself from all negation in the form of relation; but as negated Space, it is relation with itself, that is, it is being-for-itself. But this can not be Space.

Time

As self-externality Time also is being-for-self. And Time is the *dialectics* of Space.

Hegel calls the *scientific method* as *absolute* method or *speculative* method. He *never* uses the rhetorical expression of "*dialectical method*" to designate his method. Dialectic is the moment of the *first negation*, of finitude or mediation in the totality of the method, not yet the *negation of negation*, the restoration of the positive unity of the sublated opposite terms. The opposites are not only different or diverse terms; they are their own others, so that they sublata each other and by sublating each other they sublata their unity as well. Time is the negation

of Space, positing explicitly what Space implicitly is. In the dialectical moment of the movement of the concept, we still do not have their unity, which is Matter.

The *dialectical connection* of Space and Time does not mean an external togetherness of them as, for instance, the theory of relativity makes them to be. In their opposition, they are *one and the same*, since something can be derived only from that which, besides being itself, includes another as well in itself. Anything is itself as well as its other. Dialectical inference is not the taking something out of something else in which it has no presence. It is the making explicit what a concept implicitly is, or, to use more familiar but external terms, to show that what seems to be analytical is in its dialectics synthetical in itself.

In Hegel's words, Space "is the pure negativity of itself," (§ 260), that is it is both itself and its own other, and as such it is "the transition into Time" (§ 260). While Space is pure *positive* element in self-externality of the Idea, Time is equally the pure *negativity*. While the former is only in itself, the latter is both in itself and for itself. Space is timeless contradiction, that is, timeless *Aufhebung* —, not only logical, but *real* as well.

Time has equally the same nature. The *Now* as a moment of Time *is*; but its being is simply to vanish while it is. Its nature is such that while it is it is not. It is the permanent, or rather, *eternal* becoming. "[T]he being of the Now has the determination of not-being, and the not-being of its being is the Future; the Present is this negative unity. The not-being replaced by Now, is the Past; the being of not-being contained in the Present, is the Future. If one considers Time *positively* one can therefore say that only the Present is, Before and After is not, but the concrete Present is the result of the Past, and is pregnant with the Future. The true Present is therefore Eternity" (§ 259 *Zusatz*).

Hegel's deduction of the concept of Time corresponds to the *dialectical* moment of his absolute method. Method, that is, the movement of the concept, *does not stop* at this point because the opposition itself is already a *new* term. We only need to see only the two opposite terms as constituting a *third* term. Dialectics is not the end or completion of the movement of the concept. It is quite obvious that at the level of dialectical moment we have two terms which immediately show themselves as a totality, as a unity which is at the same time not an external juxtaposition. This new moment is what Hegel calls *positive speculative* moment at which the method turns again to a new starting point.

Einstein's rejection of *simultaneity* as implying the 'absolute' Time leads also to the rejection of the *continuity and infinity* of Space, and to the one-sided affirmation of the *discreteness and finitude* of Space. In spite of this, and it is expected in every act of forgetful analytical thinking, his world is at the same time "a four-dimensional continuum" (*Theories*

of the *Special and General Relativity*, § 25). Also, for him “Space is a three-dimensional continuum” and “time is an independent continuum,” and yet without *infinitesimals*. But important thing is not to show several blatant inconsistencies in Einstein’s thinking. The important fact is that his approach to the *rational* universe, to the cosmos with irrational theories based on Hume’s empiricism and Mach’s extreme positivism was only the bad science. It is very well known that Albert Einstein did not accept indeterministic interpretations of Copenhagen school of Quantum Mechanics to the end. He believed that he *defended* Reason. But even in one of his later works (in the *Meaning of Special Theory of Relativity*), he still believed that “the natural sciences, and in particular, the most fundamental of them, physics, deal with sense-perceptions.” He never understood the fact that a *rational* universe can be known only by *rational* thinking which deals with the concepts.

Both Space and Time are self-externality, that is, in their externality they are in relation with themselves and not with something else; they both have the character of being *continuous* and *discrete* since in its being-for-itself each is both *one* and *many*; both are quantities; both have, in accordance with their concept, *three* dimensions. (Physics, even Geometry, does not inquire as to why both Space and Time have such *three* dimensional structures, and takes them simply as something *given*.) There is nothing which can logically be told which would make it possible to distinguish Space and Time. Their unity means that Space is Time. The unity of these terms is at first only the Place — that is, *Here and Now* in one.

Place and Motion

The Place in a moment of Time is the *absolute* Space. The Point in Space is also a Point in Time. In their opposition, they are one and the same. It is impossible to put Now here and Here there. *Place* is spatial; it seems as if Place has nothing to do with Time and might just as well be without Time. Yet the Place is *temporal*. Why does Place necessarily include Time? Why Place is determined as “spatial Now”? The answer: Place is not simply Space as such but the *sublated* or *negative* Space which is Time. That the Place includes the Time is possible only through the fact that Place itself is *spatial*.

“The Place which is thus the *posited* identity of Space and Time is also [their] *posited contradiction*” (§ 261). This would lead to the sublation of the Place. — We think that Space and Time are components of the *motion* — as we all learn it in the textbooks of physics. But the deduction of Motion is quite a different matter. The sublated Place is *another* Place and this is the concept of Motion: *the sublation of Place is nothing but Motion*, so that it is logically impossible to separate the Place from Motion.

What can be extracted from the combination or unity of Space and Time is necessarily Motion. In other words, when the moments of Space and Time is considered in any relation, what we obtain is the concept of Motion.

Matter and Force

From Place and Motion, Hegel passes to *Matter*.

It is also the unity of Space and Time, that is, it is also Place and Motion. Matter includes Space and Time as *moments*; this implies that it too is *quantitative*. It can not *be* without Space and Time. They are not three different physical entities, sitting in different places. They are not externally juxtaposed to one another. They are one single 'compact' reality.

"The unit of *mass* will be taken as one of the three fundamental units." The other units are those of Time and Space. When writing about a universal system of units in 1873, Maxwell describes the relations between what he sees as the three fundamental concepts of nature, and says that "we may deduce the unit of mass in this way from those of length and time already defined." (*A Treatise of Electricity and Magnetism*, I, p. 4, 5.) Here we have an exact replication of Hegel's deduction of Matter from the concepts of Space and Time. The mass is not *matter* as such but *measured* or *quantified matter*, just as what Maxwell calls 'length' and 'time' are also determinate space and time. But mere quantity does not effect the fact that Maxwell, probably unaware of Hegel's *Philosophy of Nature*, confirms empirically what Hegel deduced some time ago conceptually: *Matter is Space and Time*.

Matter is *continuous* or One, because as being-for-self, in its other it is related only to itself. It is *Plenum* – *pure fullness*. without an abstract one-sided distinction. Plenum is the force of *attraction*, and the attraction, taken by itself without its opposite, would result in the point of singularity or nothingness of the big-bang theory. It is an absurdity. But attraction is, dialectically, *repulsion*. And mere repulsion would have made the universe disintegrated into mere *Vacuum*. Matter is the unity of the force of attraction and force of repulsion, or of the continuity and discreteness, or of Plenum and Vacuum. So Matter is *Gravity* since Gravity is not mere attraction but both attraction and repulsion.

WORK IN PROGRESS