WHITEHEAD'S FIRST COMING TO TERMS WITH THE LEGACY OF MODERN SCIENCE AND PHILOSOPHY

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Abstract:

This article summarises the underlying points of Whitehead's first systematic critique of the „materialistic" theory, which dominated modern scientific reasoning, as well as the philosophical motivation of his criticism of modern epistemology that originated as a result of a specific link towards science. Together with an outline of Whitehead's critique, this study offers a number of illustrative quotes from the works of thinkers against whom Whitehead delineated his own philosophy since his own texts do not systematically come to terms with primary literature. In conclusion, this study sketches out the key traits of Whitehead's own position representative of the particular phase of his thinking under scrutiny.

Keywords: Whitehead, Bifurcation, Modern Philosophy

1. Critique of the „Materialistic Theory"

During his long career as a thinker and publicist A.N. Whitehead passed through several developmental stages. These were invariably marked by a specific intellectual theme or rather an expanding gamut of subjects that came into the focus of his analysis. Furthermore, these phases can be dated, with a relatively high degree of accuracy, according to the major landmarks in his career since they coincided almost precisely with his places of work. Thanks to these links his works may be divided into the following stages of development:

a) works on mathematics and mathematical logic („Cambridge period") (1898–1913);
b) „pan-physical"[1] works, i.e. works on theoretical physics, „philosophy of nature" and the „philosophy of natural sciences" („London period") (1914–1924);
a) „metaphysical" works („Harvard period") (1925–1938).

The individual stages of his philosophical career display both a significant continuity, given by the author's personal idiosyncrasies, as well as a number of very substantial discontinuities since Whitehead also modifies or redesignates most of his terminology he built in his previous texts, along with the changes (or rather an extension) of his themes. A modest objective of this study is to outline the key features of the first version of Whitehead's critique of the tradition of modern science and philosophy

1 For the designation of all the texts written during the „London period" we use in our study the term „pan-physics" (for stylistic reasons we will also use quite synonymously the term „London period"). We are well aware that the use of this term, which is not very common in the secondary literature on Whitehead, poses certain risks. Apart from a possible reproach concerning lack of authenticity of this term (Whitehead himself uses it just in one place in *The Principle of Relativity* [4–5]), the greatest danger may be seen in jumping to conclusions in case of objections raised against Whitehead's later philosophy, „metaphysics", accusing it (rather superficially and undeservedly) of „panpsychism" or „pantheism" [Hubbs 1944: 267, Meljuchin (ed.) 1980: 235–243, Rorty 1980: 113, 117]. Owing to these possible contexts, the prefix *pan* acquires a pejorative touch. However, the frequency of this particular term in the works of commentators is not quite negligible either. It was systematically used in his monograph, for instance, by M. Hampe [Hampe 1998].

on the basis of which he subsequently embarks on his own philosophical analysis. (Full presentation of that synthesis is beyond the scope and possibilities of this paper). This particular critique is contained in the texts belonging to the „London" or the „pan-physical"period of Whitehead's career. As mentioned above, the pan-physical phase is only one of the stages of his philosophical development, and its natural contexts thus encompass those phases of his thinking that precede and follow it. In hindsight, we possibly hardly need to add that they interfere to a certain extent with it as well. As a result, the actual breadth of Whitehead's theoretical project that culminates with an attempt at shaping a universal metaphysics (or „speculative philosophy") is far from exhausted by his „pan-physics". Indeed, it forms a kind of „intermediate point" in his thought and its examination and comprehension prove to be important, *inter alia*, for the understanding of Whitehead's lifelong philosophical project as a whole.

Still, eventual overlaps of Whitehead's „philosophy of nature" are not exhausted solely by contextualization in his own philosophical works. A no less significant aspect is the fact that they originated within a specific intellectual milieu. First and foremost, in that period Whitehead was known to be making a sizeable contribution to the solution of issues posed to philosophers by progress in natural sciences. The actual sources of motivation of his pan-physical project could summarised in the following points:

1. Elaboration of a general terminological background for natural sciences by means of which it would be possible to deal with nature in a uniform and consequential manner. The following goals were singled out as the substantial aspects of this unification in particular:

a) unification of the epistemological and physical aspects of the natural science theory;
b) elaboration of a conceptual system adequate to the prevailing situation in contemporary science and designed primarily to cope with the

revolutionary theories in physics (the special and general theory of relativity, the emerging quantum theory);

c) possible incorporation of not only physics but also of other natural sciences (Whitehead concentrated primarily on questions of biology) into such a conceptual pattern.

2. Proceeding from this universal philosophy of nature, another task was to design solutions of the specific problems grappled with by contemporary justification in physics. This item concerns primarily the drafting of an alternative to Einstein's (general)[2] theory of relativity in an effort to correct those of its features which – seen from a contemporary perspective – could be regarded as its weak points (the relation between permanence and change, congruence of the units of measurement). It is apt to add that Whitehead was one of the first (definitely the very first systematic) theoreticians who pointed out this particular field of problems.

Viewed in this context, the first step within such an ambitiously conceived project was, quite inevitably, a critique of the traditions. Whitehead's texts written in the „London period" contain a number of allusions to the „materialistic theory of nature", to „scientific materialism". Indeed, in his view, the materialistic theory dominated the entire modern system of reasoning in physics, thus creating a systematic background to partial scientific theories.[3] As time went by, this theory was eroded by partial physical hypotheses (the theory of heat, the theory of electromagnetic field), being concurrently „patched up" – in counter-reaction – by *ad hoc* theories (the theory of material ether). In hindsight, Einstein's special theory of relati-

2 By placing the word „general" into brackets, we want to indicate that Whitehead's philosophy of nature differs from Einstein's also in case of the special theory, even though it endorses a number of its starting points. Transformations of the physico-mathematical part of the theory are, however, much more distinct in the field of the theory of gravitation, i.e. in that part of physics covered by Einstein's general theory of relativity.

3 But in Whitehead's view, the materialistic theory was espoused not only by natural scientists but also by philosophers whose thinking was more or less directly affected by science [Whitehead 1920: 70].

vity could be seen as a kind of „coup de grace" dealt to (certain aspects) of modern „materialism".

When referring to the „materialistic theory", Whitehead, therefore, had in mind that type of reduction performed by the thinkers who had stood at the cradle of modern science (Bacon, Boyle, Descartes, Euler, Hobbes, Huygens, Newton, etc.)[4] and who thus delineated the confines of the intellectual potential of modern science and, at the same time, the field of problems that could be satisfactorily solved within its framework. But Whitehead did not criticise the traditional concept of science solely on the grounds of being inadequate to the latest natural science discoveries of the early 20th century. The edge of his critique was aimed at the very heart of the theory – he tried to show that in itself this theory was incoherent, inadequate for a non-contradictory definition of elementary physical concepts (speed, acceleration, motion, kinetic energy) [Whitehead 1919: 2] as well as for a non-contradictory and terminologically uniform formulation of facts coming from different areas of natural scientific studies (e.g. the possibility of capturing the dynamic of development, i.e. of the continuity

4 An exception among modern philosophers is formed by the work of Leibniz. A link connecting Leibniz's thoughts and modern scientific relativity has been highlighted in literature for a long time now. Whitehead himself openly upholds the relational concept of space whose most consistent representative among philosophers was primarily Leibniz [Whitehead 1906: 467, 505–525].
In spite of numerous analogies (ensuing particularly from the accent on relatedness and „mirroring", see Whitehead 1925b: 81; eventually 1989: 125) Whitehead – in the further development stages of his thinking – displayed a tendency to single out more frequently incongruences than congruences of his own (metaphysical) concept with that of Leibniz. He most often criticises the idea of „isolated monads" and subsequently their integration by means of „pre-established harmony" [Whitehead 1925b: 193–194; 1929a: 190; 1933: 133–134]. For several reasons whose nature I cannot discuss here this criticism seems to be significant for the shift of Whitehead's views concerning the character of the continuum of events in his „metaphysical" period. Nevertheless, G. Deleuze sees in Whitehead Leibniz's follower, diadoch [Deleuze 1993: 76–82]. For a critical and systematic comparison of the concepts of both thinkers see Johnson 1959.

and transformations of living organisms).[5] Moreover, the theory does not live up to natural experience wherein continuity, change and becoming are included in an unreduced fashion.

Since Whitehead's intention was to summarise the general traits of the modern scientific concept, he did not address specific authors, enumerating instead some kind of the „lowest common denominator", shared by the works of modern scientists.[6] Therefore, it is questionable in detail whether such a theory was actually upheld by any author in the form Whitehead turns his attention to.[7] Indeed, his endeavours to identify that „common denominator" may, therefore, be perceived as a weak point as well as an asset of his approach. A precondition for holding it up as a positive aspect is to endorse Whitehead's „long-distance view" that makes it possible to see what – viewed at close quarters – tends to disintegrate into a number of individual cases that are not very compatible in their details either.

In Whitehead's view, the basic „ontological" pattern of modern science is established by the triad of elementary terms, all of which are marked by

5 Whitehead's „pan-physics" treats the issue of life and the living in connection with the theory of „rhythms" contained in: Whitehead 1919: 3; 195–200; *Time, Space and Material* in: Whitehead 1961: 57. We cannot discuss that in our study for reasons of its brevity. See also Kaplický 2005: 16–17.

6 A historically more adequate description of the genesis of the ideas of modern mathematical natural science is given by Whitehead in the following period, primarily in the first chapters of the book *Science and the Modern World* [Whitehead 1925b: 1–141]. An overview of the original Lowell Lectures on which the book *Science and the Modern World* is based may be found in the journal *Science* (New Series), vol. 60, pp. 310–311. This original schedule differed quite substantially from the later version of the book, while the key difference may be seen in a marked predominance of lectures dealing with the issues of „historic analysis" in the original outline.

7 Nevertheless, Whitehead's description of the „materialistic theory" is, to a larger part, a description of the general features of Newton's theory (whose foundations had been laid by Galileo). It might be claimed that it applies to modern science to the same extent to which its individual authors may be branded as „Newtoninans".

the quality of „absoluteness", i.e. independence of specific particulars or processes facilitated by them:[8]

1. „time" or rather „succession of instants" – modern science is known to perceive time as an „evenly flowing" scale or yardstick pre-existing before individual events universally and independently (absolute time). Time flow, as conceived by science, is a constant ordering of „durationless instants", displaying certain *mathematical properties of serial continuity* [*Time, Space and Material,* in: Whitehead 1961: 56].[9] These can be geometrically represented as serially arranged Euclidean planes perpendicular to a single common axis. Whitehead calls such an arrangement of instants a „time-ordering relation" which can, concurrently, define the direction of a (hypothetical) universally valid time arrow. Whitehead introduces

8 We have already mentioned that Whitehead's goal was not to outline a historically adequate description of the genesis of the term absolute time and space, and to trace a history of their universal reception. He only tried to emphasize traits of those concepts that are associated with the modern theories of knowledge and which were, at the same time, questioned by the new physical theories in the early 20th century. A more detailed overview of arguments in support of the absolute or relational concept of space is presented, for instance, by Burtt 1924: 243–263, Koyré 2004: 182–209, Khamara 1993, Newman 1989, Northrop 1941: 170–176, Patočka 1964: 208–254. Of particular importance for the establishment of the theory of absolute time and space in Newton's works are especially the scholium in *Principia*: scholium on definitions at the very beginning of the book [Newton 1999: 408–415] and the final *Scholium Generalis* [939–944] and *Querie 28* from his *Optics* [Newton 1952: 362–370].

9 Seen from a historical perspective, Whitehead's link of „absolute time" as an „uniform succession" and „ordering of dimensionless instants" in his thoughts probably results from a fusion of Newton's concepts with Hume's analyses. In *Science and Modern World* he speaks directly of a „Newtonian-Humesque" interpretation of nature. What Newton's and Hume's concepts have in common is the conception of time in an abstract fashion, i.e. independently of specific events in nature. In the book *Symbolism, its Meaning and Effect* Whitehead presents the substance of this abstraction as follows: *The notion of pure succession is analogous to the notion of colours. There is no mere colour, but always some particular colour such as red or blue: analogously there is not pure succession, but always some particular relational ground in respect to which the terms succeed each other* [Whitehead 1927: 35]. Seen from this angle, reduction of time to „instanteity" or „constant presence" may be viewed as two sides of the same coin.

two possible arguments in support of this particular concept [Whitehead 1920: 34–35]:

- Time transcends nature – our thoughts are in time just as the rest of nature, it is, therefore, meaningless to derive time purely from relations observed in nature.
- The serial continuity of time (the direction of the arrow, i.e. the irreversibility of individual time instants) results precisely from the „time-ordering relation" that sets the mode for each individual relatum to relate to the whole. Should we endorse the opposite stance (relational), the direction of time arrow would not be apodictically certain but only highly probable.

2. „space" – was conceived in modern science (originally in mechanics), just as time, as a pre-existing entity independent of particulars (absolute space). As such, it is a set of directionless (geometric) points representing relata in „space-ordering relations". Possible relationships between those points (modes of their organisation) are described by Euclidean geometry which, thus, constitutes a description of the basic properties of space. Just as in case of time, of great importance for absolute space is universal homogeneity – absolute space cannot change its properties in different places. Unlike time, space is, furthermore, isotropic – none of the directions in it is privileged. However – in Whitehead's opinion – out of the arguments mentioned in support of the idea of absolute time the first of these does not apply quite certainly since thoughts are not in space in the same manner as in time [Whitehead 1920: 36–37].

3. Seen from an „ontological" point of view, „material", „matter", „stuff" is a universally uniform substance of nature. It is divided into mutually diverse and separated corpuscles that display, first and foremost, the property of spatial extension. Individual material bodies exist throughout time – therefore, they are – in a sense – the source of nature's potential continuity. The relationship of the individual components (corpuscles) of the matter to time and space was called by Whitehead „occupation". Seen

in this light, it is vital for description of the material world through the concepts of space, time and matter to distinguish two groups of essential relations: the „relation of occupation" and the „time- and space-ordering relation". The possibility of geometrization of space in modern physical science was conditioned by the acceptance of this duality of the essential types of relations.[10] In Whitehead's view, a weakness of Einstein's physics lies in its assumption, inherited precisely from that line of physical reasoning and left unconsidered: an assumption of the identity of material as a basic substance of the world and identification of geometric description with the description of its distribution.[11]

Whitehead's reference to the „absolute" character of the traditional physical terms is motivated primarily by his insight that the fundamental issue of the modern mode of reasoning about nature is the method used to grasp the relation of continuity, change and immutability. In modern natural science, the constant continuity of changes in nature that has to be inevitably described by each natural science discipline is captured essentially as the epiphenomenon of immutability. Let us support this thesis by a series of arguments.

The triad of materialism constitutes a general explicatory framework of the physical theory known as „classical mechanics". Therefore, it is no accident that the theory of nature, built on those basic principles, proves to be mechanistic, i.e. a theory that lays down mechanism as an „exemplary existence" according to which it construes its further ideas. The equations describing motion and change actually describe motion in its „timeless

10 The study *On Mathematical Concept of Material World,* which may be taken in Whitehead's bibliography as the first text with a distinctly philosophical intent (in connection with a scrutiny of the fundamentals of geometry), uses for the description of the position of a material particle the term „triadic relation", a relation between material particle, a point of space and the moment of time [Whitehead 1906: 467].

11 Whitehead tries to correct this particular drawback in his own theory of nature by re-establishing the relationship between physics and geometry, based on a distinction between „uniformity" and „contingency" by differentiating „events" and „objects".

form" which is – thanks to the pre-existing absolute terms of reference – valid ever and everywhere, being valid in a determinist fashion.[12] Reduction of time to „timelessness" lies at the very foundation of the possibility of modern science to position itself „outside the world" and seem to be „looking into the cards" held by the creator of the world's mechanism, „the Great Watchmaker".[13] Whitehead believes that reduction to „timelessness" and, at the same time, to „instaneity", „momentarinesss", which boils down to one and the same thing with the momentary configuration of the distribution of material objects in space, lies in the basis of the pos-

12 M. Čapek [Čapek 1961: 139–140, 1981: 191–193] points to the confusion stemming from the substitution of two different meanings of the phrase „it follows". In one sense, this phrase denotes logical resulting, in the other temporal succession. The confused substitution of both meanings has led to falsifying non-reducibly temporal experience by atemporal concepts and thus to identifying temporality with inevitable causal dependence.

13 In his *Scholium Generalis* from *Principia* I. Newton describes the relation between God and the world by means of the notion of „Pantocrator". The aim of this description is to create a notion of God who is a guarantor (creator as well as preserver) of the world order: *This most elegant system of the sun, planets, and comets could have not arisen without design and dominion of an intelligent and powerful being.* [Newton 1999: 940]. Newton describes the relation between God and the world in these words: *And from the true lordship it follows that the true God is living, intelligent and powerful; from the other perfections, that he is supreme, or supremely perfect. He is eternal and infinite, omnipotent and omniscient, that is, he endures from eternity to eternity, and he is present from infinity to infinity; he rules all things, and he knows all things that happen or can happen. He is not eternity and infinity, but eternal and infinite; he is not duration and space but he endures and is present. He endures always and is present everywhere and by existing always and everywhere he constitutes duration and space. Since each and every particle is always, and each and every indivisible moment of duration is everywhere, certainly the maker and lord of all things will not be never or nowhere* [941]. The notion of God as an „infinite omnipresence" is a typical figure of speech used in European metaphysics, reducing „becoming" to „presence" with its roots dating back to Xenophanes (B 23–25) and Parmenides (B 2,3,6,7,8). On the relationship between Newton's deism and theism see Burtt 1924: 280–299.

In *Process and Reality* Whitehead expresses himself on Newton directly: (...) *Newtonian cosmology emphasized the „receptacle" theory of space-time, and minimized the factor of potentiality* [Whitehead 1929a: 70]

Whitehead comments on the notion whereby God constructs the world according to mathematical laws in *Adventures of Ideas* [1933: 113–115] where he views this concept as one of the four possibilites, nevertheless the one incompatible with his own concept.

sibility of this concept of „timelessness". Individual instants are only subsequently unified by means of an ad hoc prerequisite of the „time-ordering relation". In this sense, time is „spatialized" in modern science.[14]

Time „spatialized" into proportionless instants not only fails to meet direct experience but also excludes the possibility of positive appropriation of „continuity" and „change" without which there can be no meaningful definition of such basic physical terms as speed, motion etc. It is precisely the continuity of that makes it possible positively to treat the connection between the past, present and the future and which, therefore, is not only a co-ordinate appearing in equations with any sign that is necessary for their definition. Whitehead goes on to create such a (philosophical, and not only mathematical) concept of time in connection with the term „duration", based on a universal „becoming" of nature.[15]

14 Even though Whitehead does not use Bergson's term „spationalization" directly, it is highly probable that he was driven by an idea which had its origin in Bergson's work. On the possibilities of Whitehead's influences by Bergson see Kemp-Smith 1923, Lowe 1949, 1941, Lucas 1985, Northrop 1941. F.S.C. Northrop writes that Bergson affected Whitehead in a mediated fashion, through his friend Wildon H. Carr who was working on a Bergsonian study during the war years [Northrop 1941: 169]. Northrop regards Bergson's influence as one of the three key formative moment in Whitehead's philosophy [168]. V. Lowe [Lowe 1941: 66] reports on Whitehead's personal statement, saying that he did read Bergson but more than this reading he was at that time concerned with the relation between geometry and the real world. In another study, Lowe strongly warns against overestimating Bergson's influence [Lowe 1949]. Reports on frequent discussions on Bergsonian themes in the intellectual climate around Whitehead (The Aristotelian Society) are contained, for instance, in Broad [1920b: 232–233].
In his „metaphysical texts" Whitehead mentions Bergson relatively often, either in connection with his „anti-intellectualism" or „intuitivism" [Whitehead 1929a: xii, 33, 41; 1933: 223] or the problem of „spatialization" [Whitehead 1929a: 82, 114, 209, 220, 321; 1929b: 23]. Still, the concepts of both thinkers display – in addition to a number of correspondences – one basic difference of opinion: Whitehead does not share Bergson's view that the entire „spatializing" scientific heuristics has to be discarded, thus granting to philosophy a position based solely on intuition [Whitehead 1925b: 64, 183; 1929a: 209, 321].

15 Whitehead uses the term „becoming" throughout the texts of his „London" as well as „Harvard" periods. The general meaning of that term is similar (advance towards a „novelty"), however in the conceptual structure of the texts of both periods it holds a different position. In the texts of the „London period" it is used essentially synonymously with „cre-

The voice of the natural experience of temporal nature's continuity can be heard in the modern concept of nature solely through its transfer to two different types of continuity: that of the self-identity of substance (matter) and the continuity of causal effect. Since the continuity of matter may be transferred to *causa sui,* continuity is treated in the materialistic theory primarily through the term of causality. In the realm of modern science, causality is nothing but a continuity of the mechanical effect of mutually discontinual particles of matter. Furthermore, such a concept of continuity is known to give this particular notion of nature the character of a deterministic system (Laplace's demon) since future events (or „states") can be fully derived – thanks to the basic triad of the ontological terms of the materialistic theory – from the present state.[16] The notion of time in this triad refers to nothing else but to „the human incapacity to know everything at once" [Čapek 1981: 193; 1986: 304].

Any novelty in modern intuition is possible solely as a new combination of the basic elements. As a result, change is invariably apparent – nature itself in its substance does not change. What does change are „phenomena". Whitehead embarks on a path whose course is marked by efforts for positively mastering those areas that modern science perceives as epiphenomena. This is, first and foremost, continuity and change („becoming", „creative advance of nature"), concepts thanks to whose inclusion Whitehead's system evidently managed to anchor the irreversibility of time, and the novelty of the new, therefore, assumes a radical and unde-

ative advance of nature". In the texts written during the „Harvard period" it refers directly to the becoming of an individual „actual entity", an elementary unit of the cosmogonic process.

16 Čapek [Čapek 1961: 122] speaks of three conditions necessary for the causalistic dualism of traditional modern science:

a) spatiotemporal continuity

b) absolute simultaneity of even the most distant events

c) corpuscles with their positions and velocities sharply definable

Responding to the changes in physical justification, Whitehead will question all those three prerequisites.

rived character.[17] In a similar vein, positive evaluation is accorded to the apparent aspect of nature that will prove to be for Whitehead, in his pan-physical period, a permanent regulative to which all speculative reasoning must always be related. By integrating those two aspects, he will try to build a theory of nature that could function as a universal background to any area of the theory of natural science that is open to criticism and that, at the same, does not falsify experience.

2. Critique of Bifurcation Theories

In the previous chapter we have touched upon the theme whose negative role within the system of traditional knowledge is used by Whitehead to delineate his own position and subsequently to build his own system of thoughts. His critique is focused on the epistemological positions that emerged as a result of the birth of modern science. He does not criticise nature itself, as is sometimes erroneously inferred, but rather the modern noetic philosophy originating on the basis of its specific link to science. This famous analysis is known as the critique of „bifurcation theories".[18] However, as „bifurcation theories" are closely related to the „materialistic theory of nature", the „ontological" foundation of modern natural science, which – in Whitehead's view – had been led astray by substituting the immediate given fact for excessively derived abstractions, will also be cri-

17 Viewed in a greater detail, the existence of time arrow is more or less postulated rather than explicitly proved in Whitehead's pan-physical system. It is present in Whitehead's metaphysics quite explicitly and in a form well-elaborated terminologically. Together with problems of natural science these works assess also ethical issues where the presence of time arrow cannot be anticipated. Cf. also Čapek 1961: 121–143, 289–332; 1981; 1986. On the issues of time arrow in Whitehead's metaphysics see Hurley 1986, Miller 1986.

18 It is necessary to add that in the texts from the periods under scrutiny Whitehead analyses the genesis of the bifurcation theories from the perspective of the history of philosophy, doing so – once again – very inconsistently. In actual fact, the structure of the texts written in this period is subjected to other criteria than that of full espousal in the academic philosophical circles (we should not forget that at time he held the post of the professor of applied mathematics). However, this in no way detracts from the interesting and novel character of the analysis of the texts of the „pan-physical" period.

ticised. The key topic: critique of the reification of abstractions of acquired entities figures prominently in Whitehead's work (not only philosophical) as its central theme. Seen in this light, it is related to the preceding (modern) philosophical tradition to a similar extent to which the first modern theoreticians referred to the previous scholastic philosophy, criticising its dogmatic trust in abstract concepts with which it operated.

By bifurcation Whitehead understands an epistemological position which sharply distinguishes the world as it is perceived by the senses, and the realm of „genuine reality" grasped by the „mind", while the former is proclaimed as having been derived from the latter. This effort to express apparent nature by referring to its imperceptible cause then leads to dividing nature into two areas whose reality is – in either case – a reality of different kind. The first of these is nature, the cause of our knowledge – „causal nature", and it is expressed by means of abstract scientific concepts (e.g. time, space, matter, field, atom, electron). The other one is „apparent nature", viewed as a by-product of causal nature's direct effect on our sensory apparatus. To capture that relation, Whitehead also uses in this place the terms „influent" and „effluent" nature. The sum-total of „influent" impact on the mind is causal nature, while the mind produces, on the basis of influent nature, an apparent, effluent nature [Whitehead 1920: 31–32]. As a result, thinking basically relinquishes the possibility of systematically studying interlinks of the „world", as a perceived phenomenon, and the „world", as conceived by scientific theories (in this sense the mind has – to a considerable extent – the character of a „black box").[19]

19 Let us illustrate this theory of Whitehead by the following descriptive quote: *The molecular theory, the wave of light, and finally the electromagnetic theory of things in general have, as it seems, set up for scientific investigations a society of entities, such as ether, molecules, and electrons, which are intrinsically incapable of direct observation. When Sir Rutherford at Cambridge knocks a molecule to pieces, he does not see a molecule or electron. What he observes is a flash of light. (...) If we are to avoid this unfortunate bifurcation, we must construe our knowledge of apparent world as being an individual experience of something which is more than personal. Nature is thus totality including individual experiences, so that we must reject the distinction between nature as it really is and experiences of it which are purely*

Mechanistically conceived causality is a link between the epistemological position of modern science and the „materialistic theory". Modern epistemology embarked on a quest for what it called the „causal substance" of our knowledge, instead of merely seeking modes of expressing relations among objects which form the subject of knowledge.

Whitehead diagnosticates the actual causes of the genesis of the bifurcation theories in the modern era in two particular areas:

a) Demise of the scholastic theory of knowledge as a direct adequacy of object and intellect as a result of the emergence of the „transmission theory" of perception in the 17th century (notably the theory of light and sound – whether in its wave or corpuscular form) [Whitehead 1920: 26–27].

b) Even though the ontological foundation of the scholastic theory collapsed, its logical basis has survived: subject – predicate („two-termed") model which still suggested a specific mode of separating the substantial part from the accidental one. To retain the assumption of nature as an intelligible system, the modern model had to define a substantial aspect of nature and separate it from contingency. Contingency of appearance was classified as the content of the mind, („material") substance as the content of nature. The price that had to paid for that was the necessity of putting trust in substance (localised material objects) as an ontological foundation of nature [Whitehead 1922: 26–27].[20]

psychological. Our experiences of apparent world are nature itself. [Whitehead 1922: 61–62, underlined by M.A.].

20 Criticism of the „two-termed" model, whether set into any theoretical (i.e. „pan-physical" or „metaphysical") background, stands out as one of the constant motifs of Whitehead's work. Whitehead considers it a misleading abstraction that hampers a subtler analysis of the relations both within nature itself (pan-physics) and in the overall metaphysical contexts encompassing even human mentality and God (metaphysics). The following passages discussing this particular subject should be seen as relevant in the entirety of Whitehead's work: Whitehead 1920: 18, 108; 134–135; 1922: 27; 1925a: 201; 1929a: xiii, 7–8, 30, 48–56,

Whitehead then goes on to summarise the possibility of assuming positions in drafting bifurcation theories, dividing them basically into three groups. These will be presented here in the order which, we believe, best captures the sequence of their origin (Whitehead himself introduced the first two in the opposite order):

a) The theory of perception, which admits of the existence of „psychic additions". This theory assumes the world as it is (without the necessity of any a priori structuring „grid"), even though it recognises the need of introducing into epistemological analysis additive characteristics which are the products of the mind. Whitehead achieves this characteristic without direct reference to authors who endorsed it. He characterises it as *the outcome of common-sense in retreat* and ascribes it to the 18th and 19th century materialism. Judging by the context, one can inhere that this position has its source primarily in J. Locke [Whitehead 1920: 42–43].

b) The epistemological theory, which seeks the cause of knowledge about things instead of searching for properties of the things we know. Part and parcel of this position is the prerequisite of the knowledge about time and space independently of developments in nature. Even though Whitehead again explicitly does not refer to anyone, it can be surmised that he has in mind the philosophy of Kant or rather such forms of philosophy which more or less covertly envisage some form of apriorism [Whitehead 1920: 39].

c) The mildest form of the bifurcation theory is the position that recognises solely the existence of apparent nature and, as a result, regards entities through which science reaches its justifications (molecules, ether) as purely conceptual. This particular position would correspond to the conventionalist position in the theory of knowledge [Whitehead 1920: 45–47].

138, 158–159; 1938: 55, 84, 90–91; *The Philosophical Aspects of the Principle of Relativity,* in: Whitehead 1961: 136–144.

3. The Bifurcation Theory in a Historic Review

The early days of this theory could be traced as far back as to the beginnings of European philosophical thought, associated with an analysis of the origin of „metaphysics" as an ontological depreciation of the apparent (and corporeal) world in general. The Ancient authors to whom usually greatest attention in this context is devoted are the Pythagoreans, Eleans, Democrit and the subsequent Ancient atomistic tradition down to Plato and the Platonic tradition (including the „Pythagorean" motives in his work).[21] The impact of those authors on the process of shaping modern cosmology may be attributed to the rediscovery of their works in the Latin West during the „Great Renaissance" as well as to the abandonment of „Aristotelianism" of the medieval universities on the part of the founding figures of modern science. In the modern era, the atomist theory of matter was espoused by Galileo and Newton, and their authority quite definitely contributed to the establishment of this position in the theoretical background of modern philosophy and science.

The centrepiece of Whitehead's reflections lies precisely in modern positions bound up – due to their content – with modern science. As is evident from the overview above, Whitehead's objections to „the theories of bifurcation" go beyond the framework of traditional analyses of the genesis of depreciation of sensory experience in early modern authors (the theory of „ideas" and subsequently of „primary" and „secondary" qualities). That is why the key criterion for the detection of „bifurcation" in a given philosophical system is the existence of any type of intervention of the

21 For instance, Jan Patočka speaks in this context about Plato and Democrit as the founders of European metaphysics [Patočka 1992: 7 – 13]. For the sake of being absolutely correct it should be added, however, that the actual context of Patočka's analysis is his project of transferring the „intelectual foundations of Europe" (in this sense he follows the elementary ground plan of Husserl's *Crisis*). Therefore, his analysis, as Patočka himself admits, is not a historical overview [7]. It would be quite interesting to imagine Démokritos as a successor to the Eleat school of thought. (For instance H. Bartoš 2006: 159 expresses a similar opinion.). The idea of bifurcation would thus have been clearly extended as far as to the founding figure of European metaphysics.

mind into the formulation of relations observable in nature, which, subsequently, gives experience solely a derived status. This criterion renders Whitehead's analysis an enterprise of an unusually vivid interest as well as a source of many problems associated with the possibility of retaining the radical empiricist position Whitehead tries to elaborate in opposition to such systems.

Let us now attempt to sum up in short the genesis of the ideas of bifurcation in modern epistemology by references to the relevant places in the writings of the major authors (as mentioned above, Whitehead himself does not devote himself to this particular problem with a great deal of accuracy and meticulousness) and thus to illustrate the meaning of his afore-mentioned classification. Quite voluntarily we hereby succumb to the risk of accusations that our selection of illustrative passages of the pertinent authors is functional and sketchy. Indeed, the following text is not intended as a thorough analysis of the history of modern philosophy but just as a series of illustrations to highlight three possible groups of bifurcation positions missing in Whitehead's own text.

The first modern author whose works contain a clearly formulated „bifurcation position" is Galileo Galilei.[22] His writing *Il Saggiatore* (Assayer) offers a number of opportunities for selecting illustration quotations:

1. *Nevertheless I say, that indeed I feel myself impelled by the necessity, as soon as I conceive a piece of matter or corporeal substance, of conceiving that in its own nature it is bounded and figured and such a figure, that in relation to others is large or small, that it is in this or that place, in this or that time, that it is in motion or remains at rest, that it touches or does not touch another body, that it is single, few or many, in short by*

22 Burtt [1925: 56–57] points out that the precursor of this position in the modern era may be see in the works of Johannes Kepler. In Kepler's view, the difference between the „real" and „apparent" aspect of the universe is the ratio between the „mathematical" aspect of the world, as represented by its covert harmony and disharmonic phenomena perceivable by our senses. Seen against this backdrop, Kepler does not situate „bifurcation" in the field of problems pertaining to „substance" and due to that reason he is omitted in this overview.

no imagination can a body be separated from such conditions: but that it must be white or red, bitter or sweet, sounding or mute, of pleasant or unpleasant odour, I do not perceive my mind forced to acknowledge it necessarily accompanied by such conditions. [23] (underlined by M.A.)

2. *But first I want to propose some examinations of that which we call heat, whose generally accepted notion comes very far from the truth if my serious doubts be correct. (...) I say that I am inclined sufficiently to believe that heat is of that kind , and that the thing that produces heat in us and makes us to perceive it, which we call by general name fire, is multitude of minute corpuscles thus and thus figure, moved with such and such velocity (...) If the animate and sensitive body was removed, heat would remain nothing more than a simple word.*[24] (underlined by M.A.)

The first quote illustrates quite clearly the idea of separating qualities inherent in the substance itself (in this case form, size, motion and mutual contact) that emerge in nature itself from the qualities which originate by supply, being products of activities of the perceiver (qualities distinguished by the relevant senses – colour, taste, sound, aroma). The other quotation highlights yet another trait of the bifurcation concept – namely the prerequisite of intervention of the mind into perception by means of reference to the minimal material corpuscles that cannot be immediately perceived. Viewed against this background, Galileo evidently situates the origin of „secondary" qualities into the perceiving „subject".

Another step on the path of reinforcing the bifurcation principle was the philosophy of René Descartes. His metaphysics establishes mere extensionality as the basic ontological characteristic, thus perpetuating the distrust of sensory experience:

23 Quoted according to Burtt 1925: 78.

24 Quoted according to Burtt 1925: 75. Whitehead himself also quotes those passages [*The First Physical Synthesis*, in: Whitehead 1947: 173–174].

Because we perceive, or rather, stimulated by sense, clearly and distinctly apprehend, certain matter extended in length, breadth, and thickness, the various parts of which have different figures and motions, and give rise to the sensation we have of colours, smells, pain, etc. (...) It will be sufficient to remark that the perceptions of the senses are merely to be referred to this intimate union of the human body and mind, and that they usually make us aware of what, in external objects, may be useful or adverse to this union, but do not present to us these objects as they are in themselves, unless occasionally and by accident. For, after this observation, we will without difficulty lay aside the prejudices of the senses, and will have recourse to our understanding alone on this question by reflecting carefully on the ideas implanted in it by nature. In this way we will discern that the nature of matter or body, considered in general, does not consist in its being hard, or ponderous, or coloured, or that which affects our senses in any other way, but simply in its being a substance extended in length, breadth, and depth. [Descartes 1998: 83, 85, 87] (underlined by M.A.)

As implied by the selected quote, Descartes's position leads to several consequences:

a) reduction of the external world to extensionality and then, in turn, to purely mechanistic interactions between substances localised in space;
b) separation of spatial characteristics of objects from temporal ones;
c) separation of body and soul as two different types of entities.

Due to these aspects, the specific line of modern mechanistic materialism has been traditionally traced and derived from Descartes's philosophy. Seen from Whitehead's own positions, this had several unfortunate consequences, while the following should be generally summarised from the perspective of the theme under our scrutiny:

In the first place, Descartes's distrust of sensory experience eventually called for the known need to shield the possibility of adequate knowledge

by theological arguments, which can hardly be regarded as a satisfactory solution from Whitehead's point of view.

Secondly, another consequence may be seen in the radically formulated version of the psycho-somatic difference (psycho-physical parallelism) of the body (explained by means of purely mechanistically construed metaphors) and the soul (which, being immaterial, is not subject to mechanistic principles). This eventually resulted in the notion that an „immaterial" principle capable of driving the body has to be sought. This particular illusion has thus led many later European epistemologists astray.

The last problem associated with Cartesianism is the consistent separation of spatial and temporal characteristics, a practice that tends to result in the notion of „simple location" of an object in space (and simultaneously in time), which admits of very reduced possibilities of conceiving causality in nature.[25]

The author whose name can hardly be ignored in a list of authorities having contributed to the bifurcation theory is Isaac Newton. Newton's epistemological position was influenced by his conviction of the corpuscular nature of light and matter in general.[26] In this sense, he may be regar-

25 Whitehead elaborates on the problem of „simple location" under this name beginning with the book *Science and the Modern World* [Whitehead 1925b: 61–64, 72–75, 113; 1929a: 137] In the texts written during the „pan-physical" period, refutation of the teaching of „simple location" is connected with accentuation of the general „relatedness" and „signifaction". Whitehead expresses himself explicitly on aspects of Descartes's theory of nature relating to this issue in *The Principle of Relativity* [38–39]. On the problem of „simple location" see also Alston 1951, Bodnár 1989: 37–38; 2005: 194–196; Lowe 1941: 76–79, 94–95; Needham 1941: 251–262. For a critique of the use of that term see Lovejoy 1930: 156–189.

26 Newton applied himself to that issue primarily in *Querie* 29 in his *Optics* [Newton 1952: 370–374]. It ensues from the fact that this particular subject was not discussed in either of the books of *Optics* but rather in the problematising and speculatively charged *Queries* that Newton was restrained in this respect. In another place Newton writes: *This, it seems, Mr. Hook takes for my hypothesis. It is true, that from my theory I argue the corporeity of light, but I do it without any absolute positiveness, as the word perhaps intimates, and make at most but very plausible consequence of the doctrine, and not fundamental supposition*. [Opera IV.: 324, quoted according to Burtt 1924: 212–213] However, when evaluating Newton's philosophical theses, it is important to bear in mind Burtt's claim that: *In scientific discovery*

ded as one of the authors of the modern transmission theory of perception. This theory deprives colours and other qualities of object perceived by sight of their independent ontological status, turning them into qualities originating only in interaction of the properties of light and the perceiver's nerve system. In his *Optics* Newton writes:

For the rays to speak properly are not coloured. In them there is nothing else than a certain power and disposition to stir up a sensation of this or that colour. For as sound in a bell or musical string or other sounding body, is nothing but a trembling motion, and in the air nothing but a motion, propagated from the object, and the sensorium ´tis a sense of that motion under the form of sound. [Newton 1952: 108]

We have already mentioned that Newton also figures as a leading author involved in the genesis of modern materialist ontology, which uses the abstract terms of (absolute) time, (absolute) space and material for the purpose of providing a general ontological framework.

Having offered us – at the very beginning of his *Principia* – a definition of eight terms that do not use ordinary language and that play a pivotal role in his physical system (quantity of matter, quantity of motion, inherent force of matter, impressed force, centripetal force etc.), Newton adds what he calls scholium. In it he explains the meanings of the terms which are, however, so universally shared that the need of a definition seems to be minimal (and yet he submits quite paradigmatic and basic definitions):

Thus far it has seemed best to explain the senses in which less familiar words are to be taken in this treatise. Although time, space, place, and motion are very familiar to everyone, it must be noted that these quantities are popularly conceived solely with reference to objects of sense perception. And this is the source of certain preconceptions; to eliminate them it is useful to

and formulation Newton was marvellous genius; as a philosopher he was uncritical, sketchy, inconsistent, even second-rate. [Burtt 1924: 203]

distinguish these quantities into absolute and relative, true and apparent, mathematical and common. [Newton 1999: 408] (underlined by M.A.)

Let us notice the division into absolute, truthful and mathematical as compared with the relative, apparent and common. Due to its relativity the apparent aspect of objects is excluded from taking a share in absoluteness – phenomena are not conducive to truth. What leads to the truth is reason, which is capable of „transcending" phenomena, namely by means of mathematization. Truth cannot be expressed in the categories of phenomena.

Another author whose works are quoted in our short overview is John Locke, Newton's long-standing corresponding friend. In Locke's work, we encounter a formulation to which Whitehead refers most often in his own analysis of the bifurcation theories [e.g. Whitehead 1920: 27], namely the division into primary and secondary qualities:

Qualities thus considered in bodies are, first, such as are utterly inseparable from body, in what state soever it be; and such as in all the alterations and changes it suffers, all the force can be used upon it, it constantly keeps; and such as sense constantly finds in every particle of matter which finds in every particle of matter which has bulk enough to be perceived; and the mind finds inseparable from every particle of matter, thought less than to make itself singly to be perceived by our senses. (...) For division (...) can never take away either solidity, extension, figure, or mobility from any body, but only makes two or more distinct separate masses of matter, of that which was but one before. (...) These I call original or primary qualities of body, which I think we may observe to produce simple ideas in us, viz. solidity, extension, figure, motion or rest, and number. [Locke 1965: 83] (underlined by M.A.)

Such qualities which in truth are nothing in the objects themselves but powers to produce various sensations in us by their primary qualities, i.e. by the bulk, figure, texture, and motion of their insensible parts, as colours,

sounds, tastes etc. These I call secondary qualities. [Locke 1965: 83] (underlined by M.A.)

And since the extension, figure, number, and motion of bodies can of an observable bigness, may be perceived at distance by sight, it is evident that some singly imperceptible bodies must come from them to eyes, and thereby convey to the brain some motion; which produces these ideas which we have of them. [Locke 1965: 84]

In the case of Locke, we see the bifurcation theory completed. It definitively separates properties that inevitably belong to the substantial traits of nature („primary qualities") and qualities that arise only thanks to the presence of the perceiver („secondary qualities"), i.e. through a „psychic addition". In Locke, the transmission theory of perception, connected with the constantly refining knowledge of the nature of optical phenomena, is expounded by a reference to „imperceptible bodies" whose nature is essentially analogous to the composition of matter in general. Therefore, attributes are no longer part of the ontological structure of nature itself (as it was for the Aristotelians) from which it is possible further to enter the area of thinking by means of logical procedure; they are transferred to the realm of consciousness. It is evident that in the issue of evaluating the apparent aspect of nature Locke proves to be a faithful follower of Galileo and Newton.[27]

27 During his career Whitehead's relation to Locke will have further developed, progressing from a rather negative view, represented in the writings of his „London period", towards an appreciation of some traits of Locke's philosophy in later periods of Whitehead's metaphysics. Whitehead praised primarily Locke's term „power", which the latter includes among the simple ideas co-constituting the term substance [Locke 1965: 147; Whitehead 1929a: 58]. Whitehead views this principle as exemplifying Locke's transcendence of the „theory of representative perception". In a sense, Whitehead will later regard Locke's philosophy outlined in the last two books of his *Essays* as a precursor of his own philosophical position, the „philosophy of organism". (The term „philosophy of organism" is a terminus technicus Whitehead uses to describe his later philosophy.) See *Process and Reality* [xi; 18; 51–60; 123; 128; 147; 210–213]. In spite of this appreciation, Whitehead raises two key objections against Locke's position – which in Whitehead's view – prevent him from entering the genuine process of thinking: the „Cartesian" dualism of the mind and other natural

Newton's devoted follower was also Immanuel Kant whose interpretation of the bifurcation theory assumes a more sophisticated garb. At this point, it is impossible not to mention, however briefly, the key traits of Kant's philosophy, even though Whitehead himself in his texts written in that period does not expressly refer to Kant.[28] Kant's (theoretical) philosophy is great in that it provided (considering the current state of knowledge) the most comprehensive solution to the problem of harmonising the „empiristic" and „rationalistic" positions. Kant delineates the issues connected with the place of empirical experience within the system of knowledge as follows:

But experience teaches us what exists and how it exists, but never that it must necessarily exist so and not otherwise. Experience therefore can never teach us the nature of things in themselves. [Kant 1902: 294]

Kant's dissatisfaction with the insufficiency of direct experience finds its opposite in the necessity of the existence and philosophical justification of the universality of (Newtonian) laws of nature:

(...) every event is determined by a cause according to constant laws. These are actually universal laws of nature, which subsist completely a priori. [Kant 1902: 295]

But where to look for that *a priori* realm? Let us illustrate Kant's well-known solution by another quote:

(...) main proposition (...) that universal laws of nature can be distinctly known a priori – leads naturally to the proposition: that the highest legisla-

entities, and the subject-predicate dogma in describing the structure of reality [Whitehead 1929a: 54]. See also Sherburne 1966: 143–150.

28 Once again Whitehead rectifies this later on, especially in *Process and Reality* [primarily 112–113; 151–156]. The following quotation is to serve as an illustration of the line of Whitehead's reasoning which – in our opinion – dates back to the analyses of the bifurcation theories and which culminates with the analyses contained in *Process and Reality: Thus for Kant the process whereby there is experience is a process from subjectivity to apparent objectivity. The philosophy of organism inverts this analysis, and explains the process as proceeding from objectivity to subjectivity, namely, from objectivity, whereby the external world is a datum, to the subjectivity, whereby there is one individual experience.* [Whitehead 1929a: 156].

tion of nature must lie in ourselves, i.e., in our understanding, and that we must not seek the universal laws of nature in nature by means of experience, but conversely must seek nature, as to its universal conformity to law, in the conditions of the possibility of experience, which lie in our sensibility and in our understanding [Kant 1902: 319] (underlined by M.A.)

Hence, Kant succeeded in synthesising „empiricism" and „rationalism" solely at the cost of a „Copernican turnaround", i.e. by elaborating a system of transcendental philosophy which turns man (or rather a „transcendental subject") into a law-maker of nature (hence its apparent, „phenomenal") area. This particular position enables Kant to place Newtonian natural science on apodictic foundations, thus building a strictly deterministic model for an analysis of natural processes.

The series of quotes given above makes it clear why Kant, seen from Whitehead's positions, could not be perceived as an author who had found a satisfactory solution to the problem of bifurcation. True to say, he does not depreciate the apparent world,[29] as done – in his opinion – by ancient philosophers. But he evidently violates the principle declared by Whitehead that prohibits seeking causes of knowledge about objects instead of searching for the structure of things about which knowledge is acquired. Within the context of physical reasoning of the early 20th century, Kant's position on epistemology proves to be highly unsuitable. In the first place, it will be impossible to synthesise – from its perspective – space and time into a unified formal space-time construct (Minkowski, Einstein and others). At the same time, it will be inapplicable – in its rigid form – to the philosophy of general relativity, which requires – for the purpose of describing the structure of the temporal-spatial continuum – the possibility

29 *My doctrine of the ideality of space and of time, therefore, far from reducing the whole sensible world to mere illusion, is the only means of securing the application of one of the most important cognitions (that which mathematics propounds a priori) to actual objects, and of preventing its being regarded as mere illusion.* [Kant 1902: 292] (underlined by M.A.)

of using other geometric systems than Euclidean geometry, which was, in turn, a necessary component of the Kantian a priori structure.[30]

Having referred to Kant's philosophy, we have exhausted the second of the characteristics of possible bifurcation positions. The last one, also regarded by Whitehead as a good candidate for refutation, is probably the conventionalist one [Whitehead 1920: 45–47]. We have used the adverb „probably" because in this place Whitehead does not refer to it directly. Let us suppose that Whitehead, indeed, alludes here to the works of H. Poincaré or possibly to Poincaré's devoted adherents who were prepared to expound his theory of scientific knowledge in a looser form. What is, then, the substance of Poincaré's conventionalism? Let us approximate his position once again by quoting several passages:

The first condition of objectivity: What is objective must be common to many minds and consequently transmissible from one to other, and as this transmission can only come about by that „discourse". [Poincaré 1929: 349] (underlined by M.A.)

When we ask what is the objective value of science, that does not mean: Does science teach us the true nature of things? but it means: Does it teach us the true relations of things? (...) To understand the meaning of this question, it is needful to refer to what was said above on the conditions of objectivity. Have these relations an objective value? That means: Are these relations the same for all? Will they still be the same for those, who shall come after us? [Poincaré 1929: 351]

It will be said that science is only a classification and that classification can not be true, but convenient. (...) In sum, the sole objective reality consists in relations of things whence results the universal harmony. Doubtless these relations, this harmony, could not be conceived outside of a mind which conceives them. But they are nevertheless objective because they are, will

30 A brilliant summary of the arguments used against Kant's transcendental position in the period context is given by B. Russell in *The Principles of Mathematics* [Russell 1903: 456–461].

become, or will remain, common to all thinking being. [Poincaré 1929: 353] (underlined by M.A.)

In Poincaré's opinion, the importance of objectivity is given by a concurrence of views on a certain convention within the framework of discourse – objectivity can be searched for neither in nature, as given to us by sense impressions, nor in various a priori structures of the „subject".[31] Nevertheless, Poincaré's conventionalism may – as seen by Whitehead – be regarded as the outermost outpost of the bifurcation theory precisely because it leaves the constitution of meanings of physical terms fully in the powers of the perceiver's mind, which – in turn – produces the „discourse". This style of reasoning is untenable for Whitehead as well. In the first place, this kind of solution of the epistemological problems leaves us in a principally aporetic situation – through the statements on something that does not exist, we explain the nature of things that exist [Whitehead 1920: 45]. Furthermore, science does not function by devising a theory by means of conventionally defined terms and by subsequently applying it. Each term contains a link to empirical experience and the meaning of any scientific term is always somehow connected with it. Seen in this light, experience of nature, therefore, inevitably precedes any theory. As a result, terms inherited from the traditional modern natural science theory are not „sole" conventions but invariably point to something „in nature" [Whitehead 1920: 75]. If this really were true, practical efficiency of science would have to be the outcome of a highly improbable coincidence. The traditional theories suffered from the problem that they operated with too abstract terms that delineated an area of their possible applications. The task of a philosopher (of nature) is, therefore, always first to criticise the previous abstractions and subsequently to draft a conceptual system

31 For instance, Euclidean geometry cannot be viewed as describing the structure of spatial relations of the external world or as a priori in Kant's sense – it is not, as Poincaré claims directly, *form of our senses but a form of our understanding* [Poincaré 1929: 79]. According to Reichenbach, this statement is, nevertheless, a „back door" through which Kantian philosophy is getting back to the contemporary philosophy of science [Reichenbach 1951: 299].

that would descend as deep as possible towards immediate experience. The formal means of harmonising (logic) are then to serve the creation of a coherent explication that will connect the level of experience with a model endowed with a predicative capacity. Unlike Poincaré, Whitehead will defend a position to a certain degree closer to traditional objectivism or realism for which it is important to have at its disposal a possibility to display a link of the real world about which we learn through our senses, a world that is captured in the physical theory.

4. Whitehead's Delineation of Epistemological Problems within the Framework of „Pan-physics"

Let us attempt now to highlight those general traits of Whitehead's „pan-physics" that are of relevance for its epistemological foundation. The underlying restrictive requirement placed on the philosophy of nature is to exclude „metaphysics".

What exactly Whitehead means by „metaphysics"? For him metaphysical problems are invariably somehow associated with an analysis of the mind (and of the perceiver in general) by pursuing a self-reflective activity and by subsequently giving account of that activity in the shape of determination of its metaphysical status vis-a-vis the nature being studied. This self-reflective activity is further connected with a broad philosophical area which Whitehead excludes from the realm of his pan-physical scrutiny: namely an explicit reflection of the pre-scientific context of human life. This is associated primarily with axiological issues which are covered, for instance, by aesthetics, ethics or theology [Whitehead 1919: vii; 1920: 2–3, 5, 28; 1922: 4]. Whitehead does not regard these issues as irrelevant for philosophy but merely for the philosophy of nature. The genuine meaning of those problems will be appreciated in his metaphysical writings whose aim will be to create as comprehensible and adequate an explanatory pattern that cuts across all areas of human experience.

Generally speaking, the supreme feature of the metaphysical issues in Whitehead's view, therefore, lies in a synthesis of the knower and the known [Whitehead 1919: vii; 1920: 28, 32]. In a bid to bypass the whole spectrum of the problems associated with most versions of the „bifurcation theories" Whitehead does not incorporate into his „pan-physics" an explicit analysis of life of the subject. Epistemological problems, which constitute the backbone of „pan-physics", are defined by rejecting the questions „how" and „why" that merely pertain to possible content of knowledge. The „ontological status" of the knower („mind", „consciousness") and that which it concerns is – in Whitehead's view held in that period – irrelevant for epistemological analysis. It is of no substance „how" or „why" we know something (how does knowledge originate in us and what is its cause) but „what we know". The task facing the philosophy of nature is to elaborate a system of terms and their interrelations that could be applied to all the natural scientific disciplines, and also to arrange the existing corpus of knowledge about nature into a comprehensive conceptual-logical whole to make us adequately disposed towards formulating a general theory of nature and the status of partial conclusions of the systematic scientific scrutiny of nature (e.g. of the „natural laws").

The subject of (pan)physical knowledge is nature. In an effort to distinguish knowledge about nature from an eventual confusing practice of linking nature with thinking (and thus a potential recourse to any type of the bifurcation theory), Whitehead uses the formulation that „nature is closed to mind":

Accordingly nature as disclosed in sense-perception is self-contained as against sense awareness, in addition to being self-contained as against thought. I will also express this self-containedness of nature by saying that nature is closed to mind. [Whitehead 1920: 4–5, underlined by M.A.]

Whitehead also spells out this fact by distinguishing „homogenous thinking" about nature from „heterogeneous thinking". By homogenous thinking he understands such reasoning that in itself does not reflect that

thinking, i.e. „puts into brackets" the above-mentioned questions of „why" or „how" we know something. A general precondition which plays the role of a regulating principle within Whitehead's pan-physical system is the thesis that nature itself is an ordered system. In *The Concept of Nature* [146] Whitehead defines his point of departure as follows:

In these lectures we are keeping off the profound and vexed question as to what we mean by 'reality.' I am maintaining the humbler thesis that nature is a system. [Whitehead 1920: 146]

In this type of ordering, nature is self-sufficient and independent of the cognizing subject. However, this thesis of Whitehead, at the same time, does not say he would be attributing to nature any specific „ontological" („metaphysical") status. His methodological limitation has a purely epistemological relevance. That is why he merely notes that the content of knowledge about nature may and should be analysed independently of the relationship to the mind.[32]

Whitehead reserves the term „heterogeneous thinking" for each opposite situation, hence a situation whereby the arrangement of apparent nature results from any type of intervention of the cognizing (subject). His entire „pan-physical" reasoning will turn out to be an effort for a consistent application of the principle of homogenous thinking. Seen in this light, it may be stated that in this particular period, a radicalised empiri-

32 This particular postulate by Whitehead comes complete with the above-mentioned assumption that nature is a „uniform system". K.R. Popper describes this prerequisite as a „principle of the uniformity of nature", based on the „metaphysical belief in the existence of regularity in our world" [Popper 1994: 271]. Popper, the critical realist, refuses to argue in favour of or against such a „metaphysical" thesis in any other way than by transferring the issue of the metaphysical theme to the problem of a methodological postulate on the immutability of natural laws. Formulation of natural laws may subsequently be subjected to tests and may resist attempts at their refutation. Refutation (falsification) of a theory is a starting point for endeavours for the elaboration of a more comprehensive theory that will integrate explanation of facts, expounded by the older theory, with the explication of the fact, which caused the falsification of the old theory. Whitehead's position in this respect is closer to the traditional realism that postulates („uncritically") order as a property of the system (nature) under scrutiny.

cism proves to be for Whitehead a starting point for the study of nature. His essential motivation lies in a quest for the possibilities of deriving genuine natural laws and not only a priori logical truths. Indeed, the prerequisite of homogeneous thinking simultaneously sets specific boundaries to his entire pan-physical concept.[33] But an analysis of these issues goes beyond the scope of our study.

33 In the further stages of Whitehead's development, this particular position will undergo a major modification, thus creating one of the most significant results of the transformation of his ideas and conceptual system in his later period. This change will have been fully formulated in terminological terms only in the chapter „Appearance and Reality" in *Adventures of Ideas* [Whitehead 1933: 209–219]. „Phenomenon" is conceived here as an outcome of the interplay of the mental and physical pole of becoming of actual entity and is placed in opposition to a richer „reality" on the basis of which it is constituted. In *Process and Reality* Whitehead spells out the same fact by using the relation between positive and negative prehensions [Whitehead 1929a: 23–24, 41, 52, 72, 220–221, 235] and the term „decision" [Whitehead 1929a: 42–48] that refers to elimination of specific components of „reality" and thus constitutes the „apparent" aspect of the emerging universe. Since a full-fledged comparison of Whitehead's standpoints on this issue would lead us too far away, beyond the framework of our study, we limit ourselves here to references to the relevant terms and passages. Cf. also Johnson 1969: 353.

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