

The Processual Form of Thinking.

A New Perspective from Developmental Philosophy

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Abstract— Many contemporary theories of human cognition focus on the biochemical mechanisms that lie beneath the mind's operations, while neglecting the historical and developmental aspects of the human mind. This article argues (1) that a *processual form of thinking* has been developing since the Modern Era. Furthermore, it maintains (2) that this particular form of thinking is intrinsically connected with the historical phenomenon of the scientific revolution. The paper studies Günter Dux's innovative *historico-genetic approach* to the development of thought in historical process. It also analyses the processual form of thinking under specific conceptual aspects of Alfred North Whitehead's *philosophy of organism*. The present study also reveals (3) the connection between the developmental and the historical aspects of the evolution of thought. Overall, the study found (4) that there is an anthropological cognitive mechanism behind the historical forms of thought usually related to the elaborated figure of explanation.

Index Terms— *enarrativity, evolution of thought, history of science, process philosophy, theory of culture*

I. INTRODUCTION

IN the cognitive-theoretical line of philosophical epistemology, knowledge is embedded in the broader concept of cognition. Cognition is treated at least as the capability of information-processing, of discrimination, of organization, and finally of behaving and acting in accordance with the first three competencies mentioned. The cognitive epistemological approach may be the least attractive for philosophers because of its decided *naturalistic* orientation. This *naturalistic* orientation has however little —I would say, *nothing*— to do with the “strong” naturalistic approach, better known as the *naturalized*¹ program among epistemologists. The “weak” naturalistic orientation of the philosophical theory of cognition, to which I subscribe here, is quite one of interdisciplinary character. It just says that the theorist of cognition aligns himself to the interpretational system of the natural sciences in order to explain the physical, chemical and biotic conditions needed as basis for human cognition as part of the real world. Nevertheless, this does not mean, for

example, that the philosophical theorist of cognition reduce mind to synaptic activity. However, the synaptic activity must be taken in account as the mind's biological stratum and, as such, as one of the indispensable conditions for a sound explanation of it. In addition to and related to the biotic stratum of human cognition, it is necessary to develop a formal structure of thinking that makes a direct connection between the natural stratum and mind possible. In order to achieve this connection, I propose promoting a non-linear structure of thinking that avoids all dualistic and metaphysic regressions and prevents the incursion of *naturalistic fallacies* [2] in the opposite direction. This structure or form of thinking allows us to think inner mechanisms as complex processes in complex systems. This structure of thinking is the *processual form of thinking* (further on abbreviated as PFT). It is the main goal of the present paper to introduce this form of thinking. PFT is a clear achievement of Modernity, albeit it took whole centuries of development. Unfortunately it is still not the usual form in the philosophical reflections today. I will return to this topic below.

For now, I concentrate my efforts on framing the present study under a peculiar pragmatic perspective, which allows us to practice our research as a theoretical life science. We need to add the naturalistic orientation in the sense sketched above to the general aspects of traditional pragmatism, which are predominantly social. I am speaking about a *cognitive pragmatism*, which takes into consideration the whole organism-world-interaction in all its biological, social and mental spheres. In accordance to our focus on the three major spheres (biological or biotic, social and mental) of the organism-world-interaction, our theoretical considerations are to be understood as empirical. The developed theory is empirical not just in the physico-chemical sense of natural sciences, but also in the factual sense of historical sciences. That the human being has been organizing itself in specific ways throughout history must be taken into account as much as its biological constitution. The historical societal formations of human kind, for example, are real facts that have their crucial impact in the human cognitive development throughout history.

In order to avoid naturalistic reductionisms and derivational philosophemes, I am taking a decentered critical position as an observer in the frame of considerations for a critique of human cognition, which posit nature as found in the actual interpretative system of the natural sciences, just as polemical

Manuscript received January 10, 2014.

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¹ Quine coined the psychologist-naturalistic approach through his ambitious essay “Epistemology naturalized”. See [1].

DOI: 10.5176/0000-0001_1.1.6

as it may be (cf. [3]). This *epistemological decentered position* enables me not to presuppose thought, but rather to trace its emergence out of its multivariate conditions in the middle of nature's dynamic processes. Setting nature in advance does not necessary imply the reduction of mind to biology, but rather just the conditional relation between mind and biology.

The concatenation of dynamic processes and the resulting organizations out of such concatenation describe one of the distinctive aspects investigated by the sciences of complexity ([4], pp. 57f.; [5], pp. 20-44; [6], pp. 273-288). Regarding this, in order to reach an adequate approach to PFT, it seems to me consequent to consider this specific form of thinking as a reflected phenomenon acquired through interactions and experiences within a dynamic universe. At this point, I would like to narrow down our subject matter to the form of thinking necessary to grasp human thought as a complex phenomenon, namely to PFT.

With regard to PFT, I propose here that there are two major forms of thinking that we can identify throughout the history of humankind. I call the first one *linear form of thinking* (further on abbreviated as LFT), which has developed and prevailed from the very beginning of our history until the Modern Era. The second one, namely PFT, emerges out of the mature development of the first. I hold that thinking as such is developmentally, as well as historically, contingent. The present analysis shows that PFT originally developed in the context of natural scientific reflections and that it does not have effective consequences for philosophical theorizing like nowadays. The common thread throughout the discussion is the scrutiny of the anthropological basis of elucidative thinking, namely *enarrativity*.

I briefly expose the concept of *enarrativity* in the first part of Section III. This section is dedicated in its entirety to the detailed account of the development of LFT. In Part A of Section IV, I depict a historical argument outlining some of the historical antecedents and a constellation of historical factors for the gradual development of the later form of thinking, here referred to as PFT. Part B of Section IV expounds major conceptual aspects of PFT that are well apprehended in a preliminary form in Alfred North Whitehead's philosophy of organism. This section conceptually rounds the account of what PFT actually is. After framing and defining the approach of the study presented here, the present exposition begins, however, with a concrete example drawn from modern sciences at the beginning of Section II.

II. THE TWO FORMS OF THINKING

Until the first half of the past century novelty in nature and living organisms were unconceivable without incurring *metaphysical costs*.² Peter McLaughlin coined the term *metaphysical costs* in the philosophy of biology to designate functional explanations, which bind their argumentations, or interpretative systems, to some metaphysical propositions (e.g.

teleology). These imply again subjective presuppositions (purposefulness) that make them, to some extent, unsound ([7], p. 137, *passim*). Scientists, however, restated the problem: How can physico-chemical systems and indeed living systems produce something really new under observance of the same laws, which reign over the same matter out of which the entirety of nature is made up? They sought the answer to this question in "the principles of *organization*, which would account for their complexity and for their regulatory and adaptive properties" ([4], p. 57).

Although the answer to this problem may be found in the complex organizations themselves, the precondition to grasp that answer rests on the form of thinking employed to account for it. As I argue below, the understanding of complex emergences of new organizations was precluded in the past by the traditional LFT, which has been predominating the vast history of philosophical reflections until now. Therefore I suggest seeking the new capable form of thinking for the apprehension of a systemic and dynamic universe in the reflections of natural scientists, who have already achieved a highly plausible recognition of the universe's dynamics. To give an accessible example of this, I would like to mention two cases of modern physics and chemistry.

In the *reflections* of natural scientists, one can find different research objects and subject matters, which are embedded in a scientific frame of laws and methods conducted by one and the same basic form of thinking. A distinct example for PFT is the mode Albert Einstein [8] and Ilya Prigogine [9] reflect on their own way of thinking in order to develop their theories and to draw some implications for other disciplines. PFT is the means whereby Einstein and Prigogine, as well as modern scientists in general, apprehend the phenomena of their investigations. This form of thinking differs from the LFT by showing a dynamic relationality among related processes and systemic relations with respect to the complexity of the phenomenon in question. In contrast to the two-sided relationality of LFT, PFT exhibits a multiple level structure (non-linear), i.e. a systemic relationality, which allows the simultaneity of processes that mutually influence each other, as well as the emergence of novelty. Once again, there are two implications the present paper is arguing for. First, that PFT originally takes place in the natural sciences, and, second, that it is having a revolutionary influence in contemporary theoretical philosophy, for example in the theory of cognition and philosophical explanation.

PFT, as found in the natural sciences, proposes at the explanative level that every phenomenon to be explained can only find a sound explanation if it is relationally subsumed into the concatenated processes and factors in which it occurs or rather from which it emerges. This is the basic idea explained in Einstein's reflections [8]. Einstein belongs, however, to the branch of scientists, who associate the goal of science —and therefore its ideal— with prediction, operational conversion, reversibility and the supremacy of laws. These associations need not to be opposite to a broader view of science. In the meantime, the mode of thought implicit in them has experienced an important theoretical enhancement, especially as a result of the work of Prigogine [10]. He shows the emergence of new phenomena out of non-equilibrium situations. The new organizations beyond the

² The forthcoming discussion is based on [3], pp. 115-148 and pp. 167-176.

bifurcation points are the so-called dissipative structures. Prigogine also suggests bifurcations as a source of diversity and novelty. Because of the broad implications of his observations of irreversible processes, his elucidations on the concept of the arrow of time and on novelty are both topics — irreversibility and organizational novelty— object of vivid discussion also on the philosophical debate.

Relevant for a theory of philosophical explication is to sketch some aspects of the development the processual form of thinking has gone through in the last century. I emphasize these aspects in order to illustrate the research on nature as a vivid and interactive dialog with the universe, as Prigogine's work intends. For a theory of philosophical explication, the knowledge that there are complex systems open to some flow of matter and energy is less valuable and useful than the form of thinking involved in it. However, before we turn our attention to this form of thinking, we have to address some considerations about the primary one, namely LFT, to which PFT holds as the counterpart.

III. THE LINEAR FORM OF THINKING (LFT)

Contemporary ontogenetic insights are a strategic understanding requirement in order to avoid metaphysical speculations, by which the subjectivist and absolutist mode of thinking is fettered since the enculturation process began. These insights are distinct consequences of Jean Piaget's legacy. Piaget's revolutionary contribution consists in the discovery of ontogenesis for the contemporary naturalistic understanding of human cognition. His work launched a revolution in the field of theory of knowledge, known today as the *ontogenetic turn*. He formulated an epistemological question, which connects the organism-environment-interaction and the ontogenetic development of cognition with the contemporary understanding of the world. Since the formulation of this problem in his research and especially in his studies on the genetic theory, the theoretical question of human cognition is no longer attended in the same way as before the ontogenetic turn. For our purpose, Piaget's model of developmental psychological stages for cognitive development is not relevant. What we are keeping in mind is his questioning on the theory of knowledge in connection with the cognitive constructiveness in ontogenesis (see [3], p. 254). The metaphysical costs that arise by ignoring the ontogenetic insights, are only comprehensible as a long unproductive phase of the extravagant theoretical constructions in Modernity, since we do not gain any (new) real knowledge through them. This asseveration is of course only possible from the present perspective of consideration, for the development of the *enarrative thinking* is in major aspects historical as well as developmentally conditioned, as I suggest in the next sections. I emphasize that the metaphysical theories —as well as the consciousness of them— are both aspects of the historical development process of this specific faculty, which is symbolically mediated.

A. The elucidative structure of premodern thought

The adjective “enarrative” comes from the Latin verb *enarrare*, which means “to recount” or “to account of”. An *enarratio* signifies therefore “a detailed or expositional reconstruction” of an event or a happening, which may be also understood as an account of the actual state of affairs. I employ this adjective in an anthropological sense to connote the most basic form of the faculty of thinking that intends to reconstruct in detail the phenomenon in question. The enarrative schemata of thinking are what Günter Dux denotes *material logic*. These schemata determine how the phenomenal field of the world is perceived. They are organizational patterns, which the individual builds in the process of world realization by means of interaction experiences under concrete empirical conditions. Furthermore, these schemata consolidate in the process as structures ([3], p. 115ff., *passim*). The idea involved in the concept of enarrative thinking is to accentuate the reconstructive application and usage of the structures, rather than the genesis of their primary formations. The development of the structures used in enarrative thinking provides nonetheless a determinant condition for the dominance of these primary formations until their radical reshuffle in the Modern Era (p. 119).

It is in the primary structural formations of understanding where the subject-schema translates itself into a fundamental pattern of enarrative thinking. The care giving member of the species is for the offspring organism the dominant and therefore determining object in the early organism-environment-interaction. The most relevant and, correspondingly, the most imprinting happenings in the environment of the offspring organism come from the effective nucleus of this object. Inasmuch as the primary categories for the world realization are built in the early ontogenetic bout, this formation of structures takes place under the imprinting character of the caregiver's action. Objects and happenings are hence subjectivist realized under the structure of action ([3], p. 117). I use the term *realization* (and its variations) referring to the constructive process of inner as well as of outer world's building. This occurs under the consideration of the material substantiality of the pragmatic real, whether it be the encountered physical nature or the human specific existential form at hand. This factual condition of human ontogenesis looms hereby not only on the categorial, but also on the symbolic-mediated organization patterns in the process of world acquisition. These constructs are used in an enarrative fashion in later moments of reflection upon the world order and world perception.

The subject-schema is the specific formation of the elucidative structures of thinking. The field of objects and happenings of the world are perceived and organized by means of the subject-schema, as if every experience phenomenon were caused or driven by an acting agent. Because of its origin, Dux calls this schema subjective logic. I want to emphasize two aspects for our purpose. The first is the subjectivity of action and the second the action structure in the organization of the inner world, i.e. subjectivity itself. Despite the execution of a significant upheaval in the understanding of nature since Modernity, the subject-schema is still prominent

in the humanities and social sciences in new and more abstract forms today.

B. The subject-schema formation in early mythical thought

In early mythical thought happenings (and actions) find their explanation in the beginning, just as in the structure of action. While the subject has the function of the agent of happenings —as such it is the symbolic-mediated cause (reason) of the events in question—, it is regarded as their beginning. This structure resurfaces when it comes to make clear a happening or the existence of an object. If its beginning holds to be thought as unconditioned, it is consequently regarded as origin ([3], p. 121). The origin is therefore the absolute beginning by means of which the enarrative thinking has explained the world and its content in the past. This was possible because the happening or event to be explained was already thought in the origin, respectively in the absolute, and together with it. The absolute mode of thinking is hence one of the earlier variations of the subject-schema.

The step into the identity structure variation is so to speak easily done. Identifying a phenomenon with its origin follows the same structure, which stipulates that the phenomenon to be explained has to be implicit in its own origin ([3], p. 123). For this reason, it is inconceivable for this subjective structure of thinking to make clear how mind can emerge out of its natural conditions, without presupposing any kind of mediated intellection (*Geistigkeit*) in nature.

Another structural variation out of the subject-schema is to be found in the concept of *substance* in historical early thought. The historical early forms of reflection think the world embedded in a kind of cosmic intelligence. The world is determined by an organizing intellectuality, which is thought of as ontologically effectuating magnitude. I want to explicate this closer to its genetic constructiveness. Due to the fact that the primary forms of cognition are built in the organism's interaction with the environment, the symbolic means of thinking and language are also developed under the empirical conditions of the nature's materiality. Consequently the world's materiality is to be found translated into the basal structures of thinking. There is no doubt that the enarrative forms of early thought could already differentiate between the thought and the real (to be thought). Ancient philosophy also thematized this difference in a reflexive way. The early elucidative thought, however, did not (ontologically) separate the thought from the real (to be thought), even less organize them symbolical-mediated unconnected. Every single thought (*Gedachtes*) is conceived as a real (*Reales*), as an existing magnitude, to which one ascribes a place and a modus. In this sense, the symbolic-offered forms of the means of thinking and the materiality of nature at hand (*vorgefunden*) participate from one and the same substantiality. In the concept of the origin the thought and the real are therefore ontologically conceived as existence instantiations, connected by the substantiality ([3], p. 122).

In order to stress its importance, I would like to iterate that the world is built based on the action schema in the process of world acquisition (*Weltgewinnung*). The world is comprehended as coherent (*sinnhaft*) because the anchored action structure returns in the elucidatory arrangement of the

field of objects and happenings. In this context coherence (*Sinnhaftigkeit*) implies mediated intellection (*Geistigkeit*). It is precisely an intellectual (*geistig*) course by which the agent imagines the projection of a goal directly before the beginning of his action. Although the mental representations (*Vorstellungen*) may not be discursive, they are considered as thoughts, whereby the agent makes his intention mentally present (*vergegenwärtigen*) and coherently comprehensible. The structure of this mechanism is precisely what one finds transferred in the understanding of the world's organization, i.e. in the construction of the world as well as in the elucidatory thought about it. The coherence of action is connected to the mediated intellection, which constitutes again a condition for action. Under these factual premises the objects of the world, their actual constitution, and all mundane happenings are to be teleological construed in their immanent alignment. From our systemic-genetic vantage point, we can understand, then, the viability to posit an unconditioned but all-determining mind in the argumentative place of the origin. The world is therefore "structurally necessary to be conceived from the primacy of the absolute mind" ([3], pp. 123f.).

C. Abstractive development of the absolutist structure in philosophical reflections

During the social development of archaic civilizations (since ca. 6000 BCE) till Antiquity, the symbolical organized world went through a stabilizing process, which makes possible an abstractive rise in reflections. This abstraction heightening sets argumentative limitations to the arbitrariness in the understanding of the world's inner relations. Another consequence of the abstractive rise of enarrative thinking consists in the depersonalization of the absolutist structure. In connection with the limitations of arbitrariness in the world's understanding the personified figures are eliminated from the elucidative structure by means of the developed abstraction. Nevertheless the absolutist structure remains in the enarrative thinking. The phenomenon to be clarified is consequently to be attributed to the absolute cause, which implies this absolute operates as the "formative power for the world's being as it exists" ([3], p. 132). While the enarrative thinking constitutively redeploys the world into the absolute elucidative structure, it fixates the absolute instance on the world's organized immanence. As a structural consequence of this, the metaphysical concepts and categories, such as eternity or the demarcation between being and not being, replace the divinities and other personified figures (p. 133).

The teleological thought in Greek reflections becomes also lucid under the historic-genetic approach. The elucidative structure of Greek thought shows decidedly the subjectivist structure. Its formation is to be traced back to the action schema. The explanation of the natural objects and happenings in terms of purposefulness (*Zweckmäßigkeit*) reveals the basic structure of action in its formal execution as well as in its theoretical thematization.³ The structural abstractive form of Greek teleology consists *inter alia* of the depersonalized

³ For example, Aristotle expresses the teleological aspect with the conjunction *ἐνεκα* that means "because of" or "by reason of": „ἔστιν ἄρα τὸ ἐνεκά του ἐν τοῖς φύσει γυρομένοισι καὶ οὐδὲν“ ([12], B 199^a 7-8).

formulation and explicit thematization of this enarrative thinking due to the distancing in the reflection process. The progressive *reflective abstractions* enable gradually this abstraction heightening [11]. This Mechanism has a close relation to the one, which allows the thematization of the subject *per se* as an actor in a reflexive way. This cognitive capability of the organism ‘human being’ is what Helmuth Plessner conceptually developed as eccentric positionality (*exzentrische Positionalität*), namely, to virtually perceive himself as subject in front of himself and at the same time in the middle of his own field of experiences and actions ([13], pp. 360-365). For example, we can reconstruct the genesis of the teleology in Aristotle’s *Physics* by referring it to the state of facts, that the advanced argumentation structure there is to be traced back to the basal ontogenetic structure formation ([3], pp. 136f.). Dux’s thesis states that this argumentation structure is retained in the modern philosophical discourse, although in the field of the physical understanding of nature a progressive substitution of it has been done by means of the processual thinking since Modernity, and independently from the reflective abstraction heightening in modern philosophical reflections (p. 137).

The modern, elucidatory construction of transcendental consciousness, i.e. transcendental subjectivity, ensues through the raising consciousness about the convergence⁴ and constructiveness of the world in respect to the acting subject. While convergence means that the world in its formations, organization, and the understanding of it gets closer to the human being, constructiveness signifies that the subject itself construes the world and the forms of action in it.⁵

The world can only be known to the extent the subject is cognitively capable of recognizing it. In that case, how can we explain the common and universal agreement between the human being and the knowledge about the world of objects and happenings? Besides the known –and even today latent– alternative of innate ideas⁶, the proposition of a subjectivity that encompasses all empirical subjects develops as an alternative answer to this question, namely the transcendental subjectivity. The fundament of knowledge will be since then relocated in the transcendental subjectivity. “In the original apperceptions“, says Dux, “the transcendental subject assumes the actual constitutive performance in the constructive realization of the world“ ([3], p. 139). The insight on the convergence and constructiveness theoretically destabilized the pragmatic reality. The world of objects and happenings

⁴ Dux sees already in Montaigne the first indications of the consciousness of convergence: „Das Bewußtsein der Konvergenz ist seit *Montaigne* gut dokumentiert, seit 1781 liegt dieses Bewußtsein auch in systematisch ausgearbeiteter Form vor. Worum es heute zu tun ist, ist, die Konstruktivität mit der Handlungskompetenz des Menschen und damit der Pragmatik soziokultureller Gestaltungskompetenz zu vereinen. Das gilt für die Pragmatik im Umgang mit der Natur wie für die Pragmatik im Bildungsprozeß gesellschaftlicher Organisationsformen. *Piagets* Theorie ist darin leistungsfähig, daß sie zu erklären weiß, was der Radikale Konstruktivismus gerade nicht zu erklären vermag: weshalb die Konstrukte des Wissens so ausgebildet werden, daß es möglich ist, zwischen zwei Bäumen hindurchzukommen oder sich vor einem aufziehenden Unwetter in Sicherheit zu bringen“ ([3], pp. 209-210).

⁵ With these two historical insights develops the modern understanding of historicity of the world, or more accurately worlds.

⁶ For a historical introduction from 1690 to the problem of innate ideas, see John Locke’s deliberations, [14], pp. 48-65.

became unattainable.⁷ In any case, this is implied in the concept of *das Ding an sich*. The transcendental Philosophy in its multiple variations (e.g. Kant, Fichte, Husserl etc.) is a clear expression of this historical consciousness. It is also a systematic attempt to reach the world of objects and happenings in the immanence of the realizing subjectivity. The transcendental subjectivity intends to “catch” the phenomenal world (*Gegenstandswelt*) by means of its own presupposition, namely setting itself as *a priori*. In this structure of argumentation, the transcendental subjectivity takes the role of the fundament of knowledge –whether in the form of the original apperception, in the formation of the absolute I, or in the variation of the pure consciousness–. In its *a priori* disposition, the transcendental subjectivity of knowledge precedes the world. Consequently the recognizable world arises from the transcendental subjectivity. We recognize that the two-sided relationality of the subjectivist structure expounded above accomplishes its validity also in the transcendental explanation (cf. p. 139). It is indeed a modern achievement to understand constructiveness set in the subjectivity. The theoretical complication for our purpose consists moreover of thinking the subjectivity in an absolutist way. Every absolute argumentatively corresponds to the first position of the two-sided elucidative structure.

Not to ask for the contingent constitutive conditions of language and communication as real constructs amounts to positing them as absolutes. Language and communication are therefore considered in Modernity as uncircumventable, as well as every absolute. Every uncircumventable phenomenon in the sense of its unquestionability is forced to remain irreducible to the conditions of its emergence. However, the real conditions are only to be reached, if the processes for the phenomenon’s formation are taken into consideration in order to give a sound explanation of it. Constructs can only be explained by processually reconstructing it on the basis of its real conditions. Thus every absolute statement is valid as an absolute assumption. It occupies the obligatory first position required by the relationality of the subjectivist structure since the historical beginning of thought. As an example case, Dux elucidates Lyotard’s philosophy of language as a continuation of the absolutist structure in the *linguistic turn* (pp. 144f.).

A modern mindset developed gradually since the 1940s and the beginning of the 1950s first in biology (L. von Bertalanffy⁸), and then in cybernetics (N. Wiener) and in systems engineering (A. D. Hall and R. E. Fagen), as well as in psychology (in the tradition of G. Bateson) and finally in sociology (N. Luhmann). It consists of understanding the phenomenon in question as a partial complex of a more comprehensive complexity in which all elements are directly or indirectly concatenated between them.⁹ The different system theories express this achievement of Modernity, while its development is to be traced back to the scientific revolution

⁷ According to Edmund Husserl (1923/24), this problem remained unsolved by Hume. In respect of the transition into the consciousness, he gave up his enterprise. Cf. [15], pp. 102ff., 157ff., *passim*).

⁸ Ludwig von Bertalanffy tracks his system theoretical work back to 1937. Cf. [16], p. 90).

⁹ For an overview of the system theoretical influence in psychotherapy see [17] and [18]. For an anthological overview of important works for the system theory see [19].

of the 16th and 17th centuries. The systemic or processual thinking represents therefore a progress in the development of the argumentative thought to the extent that it is an attempt to overcome the two-sided subjectivist structure of thinking.¹⁰

In the specific case of Luhmann's sociological system theory, the system takes the position of the unquestionable cause-reason, whereby the absolutist constellation of the elucidative structure explained above takes shape. Within the system all elements are conceived as related to each other. A phenomenal description of the relations may produce a holistic and explanative impression. However, from the cognitive-theoretical point of view, it cannot explain how the system and its elements or subsystems constructively arose, nor can give a developmental account about the specific historical circumstances of the system process. The sociological system theory sees its origin of foundation in a first action, namely a choice or arbitration, which is ascribed to the system itself ([3], pp. 145ff.). Consequently, the system as such remains unfathomable in its constructive nature. This results in a quasi-logical dynamic of clarification that shows the absolutist structure of argumentation.¹¹ Dux here makes it plausible that this specific system theory clings to the metaphysical structure of explanation in a similar way as some idealistic systems did in their time.¹²

IV. THE PROCESSUAL FORM OF THINKING (PFT)

A. Historical argument

In the European history of thought, the mythological genre of elucidatory reflections was overcome through the philosophical reflections in the Ionian Islands and old Greece. The philosophical argumentation became the new genre by which LFT found its means of development. It is until Modernity that this form of thinking predominates in the interpretative paradigms of the world. One observes the decisive upheaval in the 16th and 17th centuries with the scientific revolution and its further developments with the industrial and political revolutions of the 18th and 19th centuries.¹³ The central achievement of these revolutions is to have eliminated LFT, first, from the understanding of the natural world and, second, from the civil world consequently in the form of *secularization*.¹⁴ Although we can trace the long

process of this development back to the Middle Age, it is the scientific revolution in Modernity that is our undisputable and clear historical reference.

In order to understand this upheaval in the structures of human thinking we must track some historical antecedents in the explanatory models of natural philosophy.¹⁵ In the natural philosophical reflections of the late 13th and early 14th centuries, Johannes Buridanus (1300-1358) uses the functionality of the mill as a model to explain the motion of the celestial bodies. He also successfully refines and develops the ancient theory of impetus, which would later be taken in account by Copernicus in his *De revolutionibus*.¹⁶ Likewise Nicole Oresme (1328-1382) employs the model of the clock mechanism, namely the functional relationality of the wheelwork, to put a systemic explanation of the motion of celestial bodies across. Though we find already the metaphorical use of the *machina mundi* in the ancient world – for example by Lucretius in the first century B.C.¹⁷ —, it is not until the end of 13th and the beginning of 14th centuries that we can historically corroborate its appliance as a trial to give account of natural phenomena without making reference to subjective, i.e. intelligent powers or incursions in the natural cosmos. Of course there are earlier attempts to avoid subjectivist interventions in the scientific accounts of the natural world. Adelardus Bathensis has already demanded functional-relational reasons in the first half of the 12th century for natural causes and repudiated any subjective explanative recourse —including God's interventions— for scientific accounts about the natural order ([21], p. 83ff.). Only then the recourse to subjectivist powers as explanative elements was permissible, if the sole naturalistic account of the state of affairs was not successfully plausible ([3], p. 31). However, I am explicitly confining the discussion to the paradigmatic use of the machine because it is through its employment that we can better observe the gradual substitution of LFT by means of PFT in matters of the dominant understanding of the world. Indeed, the paradigmatic use of the machine is one of the medieval antecedents of the scientific revolution of the 16th and 17th centuries in the particular sense that it made viable the

conditionality is ascribed to everything what in the world takes place ([3], pp. 33, 388, passim).

¹⁵ I am limiting the discussion to the paradigmatic use of the machine as an explanative model. For a broader insight on the development of the western natural sciences in the 12th, 13th and 14th centuries see [21], Chapters 11 and 12. Also cf. [22], pp. 195-204.

¹⁶ The complete title of the work is *De revolutionibus orbium coelestium Libri VI* (Six Books on the Revolutions of the celestial Spheres). Particularly the theory of impetus will be operationalized (mathematized) and put in terms of laws as the *lex prima*, the law of inertia, bei Newton in his *Principia mathematica*. For a brief account of the importance of Copernicus' work for Modernity see [22], pp. 219-232; [23], Chapter 1; and [24], Chapters 4 and 5.

Historically related with the theory of impetus and the law of inertia, we follow this developmental line up to the later formulation of the principle of conservation of energy, first formulated by Julius Robert Mayer (1814-1878) in 1842 and James Prescott Joule (1818-1889) in 1843. Sánchez Ron refers to the discovery of this physical law as a case of "simultaneous discoveries" because in the years between 1842 and 1847 at least four scientist independently formulated the same law, among them figure August Colding (1815-1888) and Hermann von Helmholtz (1821-1894). See [22], pp. 404-409. For a brief account of the inertia law in respect to energy, see [24], Chapter 6).

¹⁷ After all, a transcript of the forgotten *De rerum natura* was rediscovered in 1417 by Giovanni Francesco Poggio Bracciolini (1380-1459) and printed as early as 1473.

¹⁰ In the field of psychotherapy, it has proven itself as extremely advantageous in the practical application of the so-called systemic therapy to the point that in 2008 the German Scientific Advisory Council for Psychotherapy scientifically recognized it as a proven effective method [20]. Its heuristic success in finding solutions confirms that the systemic approach somehow works in psychotherapy, but it does not explain how the system behaves, nor how it emerged.

¹¹ „Was aus dem System herausgesetzt wurde, wird im Wege eines aus der Axiomatik der Mathematik entlehnten *re-entry* wieder in das System eingeführt“ ([3], p. 146).

¹² Dux refers here to the case of Hegel's system as an example.

¹³ For the following discussion on the change in the understanding of the world in Modernity, see [3], pp. 29ff.

¹⁴ With secularization we mean a specific process of structural changes in the interpretative systems of the worldview, of society, of science. It denotes the process in which every transcendental or interventional causality, like divine interventions or the postulation of subjective powers, is removed from the interpretative system in question and an interrelated-systemic

obsolescence of the recourse to subjectivist intelligences by means of the functional organization of the machine. An emblematic date for these historical developments can be fixed together with the year 1348, the date Giovanni de Dondi starts to work on the construction of his *planetarium*, a huge clock wheelwork with the motions of the celestial bodies in accordance with the Ptolemaic system.

Our historical consideration of these developments between the Middle Ages and Modernity illustrates in some extent what we are experiencing in the humanities and social sciences today. The emblematic date for the definite execution of the scientific revolution can be fixed with the publication of Newton's *Philosophiæ naturalis principia mathematica* in 1687, although it is well known its beginnings are to be tracked back to the transition from the High Middle Ages into the Renaissance. John Gribbin mentions the year 1453, the Fall of Constantinople by the Ottoman Empire, as an useful fixation date—and therefore also artificial—to grasp this transition because of its geographical and cultural implications for the history of western Europe ([23], p. 12, *passim*). Although it is with the scientific revolution that LFT is finally eliminated from the scientific understanding of the natural world and substituted by PFT, the works of thinkers and scientists like Copernicus, Vesalius, Galileo, Kepler, Descartes and Newton does not take place in a vacuum. It is the abundance of historical events of the Renaissance like new geographical discoveries, the rise of collections and museums, and many technical improvements (e.g. in cartography and sea navigation) that serve as an anteroom for the radical changes that resulted from the scientific revolution. From the plethora of important happenings in the Renaissance, I want to discuss just one, which seems to me worthy of mention because of its repercussions for the deletion process of the subjective, symbolic-mediated dimensions from nature. That event is the formation of a *consciousness about the fallibility of the authority criterion* as a fundament for the rational and scientific chore.¹⁸ The comparative philological work in the frame of humanism has greatly challenged the criterion of biblical and scholastic authority. In the revision of translations with their originals, for example, humanists and scientists were able to assess the reliability of the sources for their knowledge. They were confronted with contradictions, errors and insurmountable gaps. Out of the revisionary pursuit, the content of canon texts was compared with observations on reality and new empirical evidences. The geographical discoveries were another factor that challenged the traditional speculative knowledge. These discoveries were only possible through experience. Their protagonists proudly and constantly emphasized the experience, which consequently and in an extrapolated way took influence in the rational and scientific chore. Humanists and scientists started to associate the deficits in knowledge with the specific situations of the times, so that they gained a deeper awareness of history and, above all, of historicity. The resulting crisis of the scholastic authority as a rational criterion, the commotion of the medieval traditional scientific endeavor out of these and other historical factors, and, specially, the conscious reflection on these matters, decidedly led to two further historical insights, namely the

¹⁸ For the following discussion cf. [22], pp. 210-219, *passim*.

consciousness about the world's convergence and the constructiveness of human knowledge, already mentioned above.

Without leaving our historical mindset, this diachronic account of the development of PFT serves us now as a basis to focus our attention to the synchronic considerations of its conceptual aspects. The conceptual aspects of PFT have also their historical background.

B. Conceptual aspects of PFT

In this section I introduce some major conceptual aspects of PFT by referring to Whitehead's late philosophical developments, and afterward, I conclude with a summarizing sketch of the essential characteristics of PFT in the actual sense I develop for the present study. The motivation of exposing some major aspects of PFT on the basis of some notions of Whitehead's late thought is not only a synchronic-historical, but also a strategic one. School philosophy and humanities in general do not think processually. Therefore any introduction to PFT in terms of processuality will be experienced as counterintuitive, illogical or just irrational. We saw already why this happens. As outlined above, the structures of LFT has determined a whole history what ratio means. Accordingly to the tradition, rationality means 'to track back to the causes' and consequently to a final cause (an absolute). In this sense it is compositionally useful to introduce some important aspects of PFT in the metaphysical context of Whitehead's mature philosophy. However, it should be clear that what we find in his work for our purpose are mere apprehensions he perceived from natural sciences. Whitehead's attempt to integrate these insights in a metaphysic system deserves, nevertheless, a more extensive critical appraisal than the one I can undertake here.

In respect to the conceptual aspects of PFT, we can see in Alfred North Whitehead a precursor of it for the contemporary philosophy in general and for the philosophy of science in particular. Although he is strongly committed to a metaphysical program, it is Whitehead who introduces some important notions of PFT in the philosophical reflections of our near past century. From the following perspective, I want to underline the three major conceptual aspects of PFT that are already apprehended, at least in a germinal form, in Whitehead's late thought. These are the concept of process, of novelty and a particular notion of explanation.

1) On process

Like in PFT, the concept of process according to Whitehead is also to be understood in a holistic, as well as in an explanative, sense. The reality *per se* is thought as process and it is only apprehensible in terms of processes. Including the obvious nuance of organization, another term that entails the concept of process by Whitehead is the concept of organism. He called his philosophical endeavor philosophy of organism, even though it is better known nowadays as process philosophy. In this context, he brings it into contrast with Kant's philosophy:

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 the objectivity, whereby the external world is a datum, to the subjectivity, whereby there is one individual experience. Thus, according to the philosophy of organism, in every act of experience there are objects for knowledge; but, apart from the inclusion of intellectual functioning in that act of experience, there is no knowledge. ([25], p. 236)

Conceptually, we can observe here a strong naturalistic approach concerning subjectivity and knowledge, although we know it remained just an unfulfilled project. In fact it is quite counterproductive to intend a naturalistic account of subjectivity and knowledge without giving up the metaphysical praxis of ontologizing concepts and intelligible forms.¹⁹ However, for the purpose of our discussion, it is more important to notice that the concept of process by Whitehead permeates reality as a whole. The external world consists of procedures of *being* and *becoming* of actual entities, which are the final realities in it. The being of an actual occasion “is constituted by its ‘becoming’. This is the ‘principle of process’” ([25], pp. 34f.). In this sense, we notice that any analysis of the reality is a segmental cut in the flow of networking processes and systems.

2) *On the possibility of thinking novelty*

As recorded for the chemico-physical world through the work of Prigogine and the theory of dissipative structures, we saw already that novelty can occur far away from the equilibrium situation. Novelty constantly occurs in biology too as well as in many other fields, although it is less spectacular. Nevertheless, in everyday genetics, the new organism is not reducible to a mere mix of genetic information and characteristics. It is important to keep in mind, that each field of phenomena has its corresponding processuality, even though they must coincide in some aspects if they are to be considered as part of the same universe. For the present discussion, we are concerned just with the form of thinking required to grasp complex phenomena in their own dynamics. Trying to overlook the metaphysical connotations, I propose to focus our attention on Whitehead’s deep insight on novelty, keeping in mind his concept of process. His understanding of novelty still has some reminiscences of additiveness, but there is a genuine effort to overcome such a difficulty:

The ultimate metaphysical principle is the advance from disjunction to conjunction, creating a novel entity other than the entities given in disjunction. The novel entity is at once the togetherness of the ‘many’ which it finds, and also it is one among the disjunctive ‘many’ which it leaves; it is a novel entity, disjunctively among the many entities which it synthesizes. The many become one, and are increased by one. In their natures, entities are disjunctive unity. ([25], p. 32)

¹⁹ Whitehead critically appraises Descartes’ ontological pursuit as the “ontological principle”, see [25], pp. 64f. We discussed this phenomenon under the concept of *substance* above.

Surely, for the present purpose, some elements of the quoted text must remain unclear. However, it is important to stress two key facets along these lines. The first one is the possibility to think novelty at all. The second one is the formulation of it in the dynamic terms of a flow. Regarding the second aspect, we can notice that Whitehead formulates the motion of a dimension, which *finds* and *leaves* multiple entities. In one direction it combines many dimensions into a whole, in the other it dissects a whole into a variety of entities, leaving the diverse distinctiveness back in its motion. This formulation of a motion completely corresponds to the context of *Process and Reality* (1929), since there the terms *nexus* and *flux* play an important role. This dynamic aspect refers at the same time to a central factor for novelty, namely *creativity*. It is through creativity that Whitehead overcomes the conceptual blockade of mere additiveness for his processual understanding of reality. For the reason that novelty in the world is determined by creativity, it is precisely creativity that “introduces novelty into the content of the many, which are the universe disjunctively” ([25], pp. 31f.). Coming back to the first aspect, we see that the possibility to think novelty is a direct consequence of the conceptualization of the reality as multi-relational processes. With the old structure of LFT, we are able to think just derivatively or, in the best case, circularly, whereby the two-sided schema is repeated as much as needed. In LFT, novelty cannot be apprehended in its real determinations. Under the precepts of PFT, in contrast, novelty is essential to the dynamic of the universe as such. Since creativity, according to Whitehead, “is the universal of universals characterizing ultimate matter of fact” and since it “lies in the nature of things that the many enter into complex unity” ([25], p. 31), novelty is, therefore, necessary to the processuality of the world. Despite Whitehead’s beautiful formulations on novelty, they are structurally contradictory. They are exposed in metaphysical terms, i.e. derivative. A critical appraisal of this issue is, however, far from our present purpose. Important for the actual discussion is to notice that, on the one hand, the possibility of novelty and, on the other hand, its corresponding dynamic of creativity are already documented in Whitehead’s late metaphysical thought.

3) *An organic notion of explanation*

In order to introduce an initial notion of explanation, we need to keep in mind our concept of process. According to it, the reality of objects and happenings cannot be explained in terms of causal chains, but rather in terms of a networking causality. The linear (i.e. two-sided causal) structure becomes insufficient for any adequate account of complexity. Therefore it is indispensable to adopt the multi-relational structure that processes as well as systemic relations between processes exhibit, if we want to account for a complex phenomenon. In this sense, when we talk about explanation we mean a specific form of it, namely a processual explanation. On this view Whitehead makes an accurate remark in his enumeration of the *Categories of Explanation*. He writes that “[t]hat *how* an actual entity *becomes* constitutes *what* that actual entity *is*” ([25], p. 34). This short quote is very insightful for our understanding of processual explanation.

This quote reveals two important aspects of processual explanation. For the purpose of the exposition of these aspects,

I suggest breaking down the citation into the keywords *how*, *becoming*, *what* and *is*. Whitehead speaks here about actual entities in general, but in the immediate context more specific about the two ways an actual entity is required to be described: in one hand, in terms of its potentiality, in the other, in terms of its process of becoming. For our discussion, just the second aspect is relevant. In order to make a productive use of Whitehead's insights, I propose to extrapolate the quote's applicability to a real complex phenomenon in general, for example, the symbolic-mediated organization of thinking or a evolutionary period right after the *transition from animal to human* (hereafter just as *animal-human transition*). Indeed, from a processual point of view, to ask for *what* a complex phenomenon *is* holds not just for the mere description or analysis of its actuality. Furthermore, it means, in accordance with Whitehead, to ascertain its *becoming*. Consequently, the pursuit of the processes involved —and in what way— in its *becoming* must be methodologically done in terms of a *reconstruction*. The fact that the explanation as such finds its concretization in the form of reconstruction has a deeper root in the anthropological constitution of human being. I am not concerned with it now, but I will come back to this point in a later discussion. For the present, we have already the two important aspects of processual explanation at hand. I summarize. From the processual point of view, to ask for *what* a phenomenon *is* means to ask *how* it *becomes*. This is the first aspect. The second is also quite obvious. Since the mere description of its actuality has just a springboard role, the account of the *how* (e.g. relations, procedures, formations) of its *becoming* (e.g. dynamics of process) can only be reached in terms of a reconstruction. Connecting these two insights with the purpose of the present paper, a processual explanation of a complex phenomenon requires a reconstruction of its development in terms of its respective processuality, taking in consideration its real conditions.

V. CONCLUSION

Any contemporary explanative reflection that shows the subjectivist or absolutist structure of the past manifests itself as cognitive-theoretically insufficient for factual and complex explanation in respect of the modern advanced development of PFT. In accordance with the insight of the actual considerations, the subjectivist way of thinking holds not as an explanative, but rather as an interpretative symbolic-mediated intelligible activity. The dynamic is repeatedly the same: the existing knowledge is elaborated in the current available structure of thought in the respective historical mindset ([3], p. 147). The metaphysical costs may be at the end translated into overelaborated handlings of already known knowledge, which are insufficient to provide adequate explanations. Another negative consequence of LFT has been the nativist-empiricist impasse of the past thirty years, which I consider to be finally overcome [26]. In order to understand this assertion in its crucial point, it is necessary to take in account the historical antecedents and the specific conceptual aspects of PFT, discussed in the last section above.

For an accurate understanding of the present study, it is necessary to be clear at this point about what we mean by PFT. The following highlights will help to summarize its essential characteristics.²⁰

- PFT is a reflexive construct. Like all mental structures it has to be construed. In contrast to LFT, the organism human being cannot build it through basic experiences like the ones that take place in the early ontogenesis. Therefore it holds as counterintuitive because it derives neither from everyday life, nor from reflections based on everyday life, but from a broader reflexive-scientific interaction with the real world. It is a pragmatic construct.
- PFT has a structure, by which the enarrative mental activities are organized. Its structure is the multi-relational processuality as it occurs in the factual natural and social world.
- Due to its non-linear structure, PFT enables to think novelty. It is far beyond mere derivative schemata, such as the unfolding concept of development. The possibility of novelty leads to the plausible considerations of singularities as singular real happenings and, consequently, to unpredictable developments. In this regard, the possibility of closed metaphysical constructs is completely removed.
- Its concept of process is a contingent, i.e. a causal one. It entails the aspect of dynamics. Any phenomenon in question is to be explained in terms of process or processes out of its real conditions. Consequently, every processual account of a phenomenon holds in this sense as an empirical one, so far it takes in consideration the relevant facts of the physical nature and social world.
- PFT makes viable the connection of the processuality of the universe (nature) with the processuality of mind. While the first is reachable in terms of energetic systems, the latter is accessible in terms of symbolic-mediated organizations. On doing this it does not lose the differences between both types of processualities, avoiding reductionisms and fictions. This achievement is precisely the missing link in many naturalistic and constructivist approaches.

Assimilating Dux's pioneering structural-logical analysis of PFT and connecting it with the history of the emergence of PFT, as well as with early formulations of some conceptual aspects of it by Whitehead, is just one important first step to understand PFT in its cognitive extent. This was precisely the goal of the present paper. Since PFT is a reflexively achieved construct, we can gain a deeper comprehension of it by investigating the anthropological constitution of humankind in connection with the constructive-realist mechanism of human cognition. This may be a desirable research project for all disciplines concerned with *human cognitive development*.

²⁰ For the following summary cf. [3], pp. 167-186, passim.

ACKNOWLEDGMENT

My heartfelt thanks go to Prof. Peter McLaughlin and his research group at the Department of Philosophy in Heidelberg University for commenting extensively upon earlier drafts of this article. I am also grateful to Dr. Carl O'Brien for proofreading several times and editing the final version.

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