The problem of integrity in the context of quantitativistic and qualitativistic research programs competition in biology

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Abstract. The article considers the role of biological knowledge in the formation of modern holistic worldview, developed in the framework of global evolutionism, which has been established within the post-nonclassical scientific rationality. The studies of material in the history of science and the history of philosophy, as well as the works of modern authors, revealed the existence of contradictory quantitative (quantitativistic) and qualitative (qualitativistic) research programs in the development of knowledge and its worldview interpretations, which alternately claimed to dominate in science. On the basis of retrospective analysis of the science of living it is shown how the development of a qualitatively-holistic approach in biology helped to overcome the principles of reductionism and to what extent it can contribute to the introduction of significant adjustments to its methodology. The authors made an attempt to identify and justify a special role in this process of evolutionary and environmental studies, which serve as the basis for the formation of new promising theoretical and methodological programs based on the principle of integrity. The scientific novelty and relevance of the article consists in explicating on the biology material the heuristic and methodological significance of qualitativism as a cognitive-methodological approach in comprehending biological processes.

1. Introduction

One of the priority tasks of modern philosophy and science is the development of a holistic vision of the world. Theoretical, cognitive and practical crisis of contemporary civilization can be overcome only with a help of a fundamentally new approach to the analysis of natural and social processes. The relevance of developing qualitative-holistic techniques in scientific knowledge is determined by typical for nowadays loss of perception of the world as a whole. At the same time the formation and development of post-non-classical rationality stimulated the development of conceptual and methodological tools aimed at overcoming it. One of the mentioned tools is a qualitativistic research program as an essential feature of knowledge about qualitative characteristics that are not fundamentally reducible to mechano-structural and quantitatively expressed factors. And in this sense, it is close to the methodology of holism, which focuses on the integrity of the object. The formation of qualitativism is a process in which many sciences have been involved. Among them, a special place belongs to biology, as well as to philosophical generalizations that have made a significant contribution to the development of its categorical apparatus. The important directions in the development of a qualitativistic approach in post-non-classical biology were the construction of models of prebiological evolution as part of the study of the life origin problem, the question of historical transformations of the factors of evolution itself, the creation of a theory of self-organization
that describes the universal mechanism and conditions for the emergence of a complex from simple, the development of the concept of co-evolution of society and nature. A special role in the formation and development of a qualitativistic approach as a strategy for a holistic vision of the world belongs to evolutionary and environmental studies, which led first to the approval of systemic-structural, and then of global-evolutionary ontological-methodological attitudes in the science of the second half of twentieth and the beginning of current centuries.

2. Methods and Materials
Aim of the study. The purpose of this work is to analyze the philosophical, methodological and theoretical foundations of quantitativism and qualitativism and their manifestations in the science of living things.

Research methods and Materials. The object of research is the theory and methodology of the science of living in the context of a philosophical analysis of the radical transformations of general scientific cognitive strategies. The study used traditional methods (analytical and synthetic, dialectic and hermeneutic, phenomenological and hypothetical-deductive).

3. Results and Discussion
The early Greek philosophers of nature rooted in the mythological thinking considered the sensually perceived world of many distinctive peculiar qualities as a living harmonic integrity - Cosmos - using such semi-metaphorical thought constructs as, for example, Empedocles's Love and Hate to describe the forces that drive its emergence.

However, a fundamentally different approach to the vision and explanation of the world was soon formed, which later became known as the quantitative. It was most clearly expressed in the atomistic concept of Democritus, representing the World as a huge conglomerate of various atoms. All things are only a temporary association of the smallest particles, so their integrity is summative, it does not express their own nature, but the nature of the atoms that make them up (but the latter are recognized as inseparable integrity) [1]. It is not surprising that in this case, the main orientation of knowledge becomes the reduction of the complex to the simple, and its main method is measurement. Actually, one of the main intentions of the creation of the atomistic concept, which assumed universal calculus, was the salvation of Greek mathematics from the problems and paradoxes of infinity identified by the schools of the Pythagoreans and Eleatics. The works of Democritus, devoted directly to biology or medicine, are unknown. But the mention of his separate statements, for example, that it is depending on the properties of the atoms of which they are composed that various living beings are flying, floating or land, that their birth is the result of the union of such atoms, and death is the decay, confirm the above in relation to biology. The quantitativistic research program had great heuristic capabilities and later on at the classical and non-classical stages of the development of science played a very positive role in its development.

At the same time, the practice of initial biological observations and, in particular, the development of medicine already made adjustments to the above-described vision of the world. For example, the well-known idea of a contemporary of Democritus - Hippocrates that it is necessary to treat not a disease, but a patient [2] - expresses not only a strictly individual approach, but also an idea of the quality originality and integrity of each organism. However, Aristotle was, of course, the true founder of a Qualitativistic research program, inherently an alternative to Quantitativistic both in the general philosophical plane and in the interpretation of the living [3, 4]. It is the statement of the latter about the irreducibility of the essential, qualitative properties of the whole to the sum of the properties of its individual parts that is the basic principle of qualitativism, that consolidated the primary status of the quality category over the quantity category in the knowledge system [3, 5]. The whole is not a mechanism, but a living organism (according to Aristotle it concerns the whole world as well), integrity cannot be fully described only with the help of an arbitrarily rich and complex system of quantitative characteristics. Therefore, it is necessary to consciously and consistently refuse from reducing it to a mechanical type structure. The interconnection of the integrity quality of living
organisms with the target type of causality plays one of the most important roles in the understanding of the living by Stagirite, however, teleologism is characteristic of his entire philosophical system.

We cannot speak about biology as a science in the middle Ages - the times of the reign of theocentrism: in the works of this era it is almost impossible to single out the biological content itself. It comes down to either an extremely vulgarized repetition of the Aristotle classifications of organisms, or is generally based on the identification of their natural properties with their symbolic function in the culture of that time. Only in Arabic-language works on medicine (Ibn Sina and others) can one find interesting ideas and information. At the same time, the qualitativistic (including teleological) ideas about the world that arose in ancient culture are not just preserved, but strengthened, taking on a new, finalist and supranaturalistic form: the world is in the process of an irreversible directed transformation that realizes the unified will of its only Creator [6]. This circumstance to a large extent contributed to the fact that subsequently, after the emergence of the classical experimental-mathematical natural science with its primacy of mechanism, the qualitative ideas were forced out to the margins of science.

The anthropocentric attitude of the Renaissance makes completely new demands on medicine, which leads to an active study of the human body. Great geographical discoveries allow scientists to begin the study of many previously unknown living organisms, and the invention of the microscope in general gives them the opportunity to penetrate a completely new world of life for them - the world of microorganisms. In the future (XVII-XVIII centuries), the struggle of quantitativism and qualitativism in biology is clearly manifested in a long and acute polemic of two concepts of ontogenesis of living organisms - preformism and epigenesis within the framework of the emerging embryology [6]. It does not just reproduce ancient and medieval ideas, but creatively transforms and synthesizes them. All preformists (J Aromatari, J Swammerdam, A Levenguk, hereinafter G V Leibniz, N Malbranche, S Bonnet and others) believed that the germ cell as a whole (the differences between them concerned only details) already contains in itself a ready, albeit in a microscopic form, all the organs of the adult body, so the process of individual development is only their quantitative growth. But it is curious at the same time that a similar position is found just in the writings of Hippocrates [2], who believed that all parts of the body arise and stand out in it simultaneously, not earlier and not later than each other and then simply grow. Preformism, obviously, was based on creationist and teleological ideas. On the contrary, the epigenetic point of view (W Harvey, R Descartes, then J Buffon and others) generally denied the predetermination of individual development, considered it as occurring under the influence of external factors, the process of successive neoplasms of the germ cell as a whole, while focusing on their qualitative nature [6].

In general, the scientific revolution of the 17th century and the classical science that arose on its basis, for a long time confirmed the dominance of the mechanical and mathematical approach to the study of the world, including living nature. Confrontation between quantitativistic and qualitativistic research programs resulted in replacement of the first and the prevailing in the Renaissance vision of the world as an organic whole by a concentration of scientists on the search for rigid causal relationships of a mechanical type, studied mainly by quantitative methods [7, 8]. The concept of purpose is expelled from natural science. But it was biology that became the field of science where the victory of the quantitative approach is soon called into question. First of all, this was due to the gradual maturation of evolutionary ideas in the natural sciences of the 18th—19th centuries. This finds expression in cosmology (the Kant – Laplace theory of the origin of the solar system), in geology (J Getton, C Lyell) and in the science of living (the development of transformative ideas about speciation that arose earlier in their various interpretations of J Buffon, J B Lamarck and others, as well as the polemic of representatives of uniformism and catastrophism in paleontology - J Cuvier, A Broniard, etc.).

The formation of evolutionary theory was also seriously affected by the constructions of representatives of German philosophy of nature – L Ocken, F Schelling, and especially G Hegel, who formulated universal laws of development. Hegel's dialectical approach to the problem of the relationship of quantity and quality changes was a fundamental breakthrough in the development of
the integrity problem. The abrupt transformations of quality as a whole, on the one hand, sharply differ from changes in quantity that occur gradually, but, on the other hand, are inextricably linked and based on them. Since Hegelian natural philosophy is also generally characterized by teleologism (taking into account the differences between the mechanism and the organism that he analyzed), we can talk about the most important contribution of the creator of absolute idealism and dialectics to the further development of a qualitativistic research program [4]. Subsequently, a number of Hegelian ideas were transformed on a materialistic basis and used by K Marx in social science, for example, in the doctrine of socio-economic formations, in which each stage of social development appears as a system characterized by the quality of integrity [4, 9].

Thus, the idea of evolutionism in biology, which found its fullest expression in the Darwinian “Origin of Species”, was prepared by the whole process of development of previous scientific and philosophical thought [10]. In fact, asserting the probabilistic nature of the transformation of random changes in organisms into regular trends in the appearance and development of species, Darwin simultaneously paved the way for a similar approach to the analysis of the relationship between the quantitative and qualitative characteristics of the whole, including its completely new type. Further development of biology was associated with the transition from the study of individual organisms to research at the population-species level.

As a result, in order to study the increasingly complex hierarchy of natural supraorganism complexes, a number of concepts were gradually formed and introduced into biology, such as the “biocenosis” of K Moebius, the “biosphere” of A Suess, which was subsequently developed in the “Theory of biosphere-noosphere” by V I Vernadsky, “ecosystem” of A Tenseley and “biogeocenosis” V N Sukachev. L von Bertalanffy directly relied on the results of their researches in creating a general theory of systems, which became a new stage in the development of qualitativistic studies [11].

Meanwhile, the concept of vitalism became one of the important areas of the confrontation between the dominant quantitativistic reductionism and the attempts to implement a qualitativistic approach to the development of the integrity problem. Aristotle also believed that in living beings there is a special ability, the “life force”, which directs their existence to certain aims. This teleological thesis, quite consistent with the general spirit of the views of Stagirite, was taken in the second half of the 18th century to the arsenal of K F Wolf, who, developing the doctrine of epigenesis, corrected it in such a way that he asserted the presence in the germ of some transcendental force unobservable in the experiment that propels its qualitative development towards predetermined aims. Similar views on living things were generally held, for example, by a contemporary of Wolf K Linney, and later C Baer. The teleologism of their conception naturally led to its marginalization in the framework of the quantitative science of the whole of the nineteenth century.

However, in the late XIX - early XX centuries, vitalism is undergoing a rebirth and the controversy surrounding it flares up with renewed vigour. It was caused not only by the activities and views on the nature of the integrity of the living of the founder and main theorist of this idea G Driesch [12], but also by the rapid development of the new science of living – genetics (K Correns, G de Frieze, W Betson, V Johansen, H Morgan). Questions about its correct interpretation, fundamental and sometimes uncompromising discussions about the driving forces of evolution between proponents of classical Darwinism and geneticists in the 20-30s of the twentieth century eventually led to the formation of a synthetic theory of evolution (STE), based on the latest advances in ecology, population genetics, paleontology, etc. Within the framework of the STE the question of the possibility of transforming the driving forces of evolution itself (“evolution of evolution”), as well as its direction became the subject of discussions [13]. At the same time, the first versions of attempts to scientifically explain the origin of life were created (A I Oparin, J Haldane, later S Miller), subsequently continued by building models of prebiological evolution [14]. Along with the development of the concept of the biogesosphere as a multilevel ecosystem of biogeocenoses, this line of development of biology leads through the general theory of systems to the formation of synergetics as a theory of self-organization (G Haken, I R Prigogine, etc.) [15] and the theory of global evolution [16] describing the mechanisms and universal laws of the emergence of order from chaos, higher levels of organization from less high.
Philosophy of the 20th century interpreted the development of integral evolutionary representations in science in general and in biology, in particular, in its own way. Neopositivism and structuralism proceeded rather from quantitative models; on the contrary, phenomenology and hermeneutics emphasized the qualitative aspects of being and cognition and, thus, were inclined to the principles of qualitativism [8]. J Smats, back in the first half of the century, directly referring to Aristotle, began to actively promote the philosophy of holism (integrity) [17]. Arising at the end of the twentieth century deep ecology (A Neiss, B Devall, J Sessions, F Kapra, B Kommoner, A Leopold) and other variants of ecosophy, as well as global ecology (M I Budyko and others), actualized the problem of the laws of modern transforming of the biosphere as a qualitative whole and the role of man in this process.

Synergetics as a theory of self-organization rehabilitates to a certain extent the principle of teleonimicity of the evolutionary process, relieving it of rigid predetermination. The concept of global evolutionism asserts that the general trend of the Universe development as a supersystem is the emergence of increasingly complex structures, new levels of its organization, each of which produces a qualitative change in transformations of this entire system as a whole and of each of its previous levels. Moreover, the higher this new level of organization is, the more likely the future options have an impact on its development in the present. With regards to the Universe, the emergence of a person capable of self-knowledge leads it to the acquisition of a new quality - the ability to reasonably direct its own development as a whole [16]. The concept of aim in a new form and understanding of its relationship with the quality of integrity freed from supranaturalism and finalism is returning to natural science. This is quite compatible with the soft formulation of the well-known anthropic principle of B. Carter in cosmology. However, questions remain: what kind of changes can the subsequent level of evolution produce in the previous ones, and what exactly gives the emergence of man to the rationality of the Universe self-development? The understanding of the need to form a new quality of the relationship between man and the biosphere, society and nature led to the appearance of two seemingly alternative, but in fact complementary concepts in biology and ecosophy that respond differently to the two above-mentioned questions [18]. The first is the concept of the noosphere of V I Vernadskiy, which provides for the complete transformation of the lower level of global evolution generated by higher in his interests: the biosphere is completely absorbed by society and becomes a reasonably controlled subsystem of the social super-system. Here integrity is understood in the spirit of Hegelian totality. The second is the concept of co-evolution of society and nature [19], in which a higher level (man, society) ensures its development, coexisting with a lower level (living nature), not absorbing it, but only using its own laws of biological evolution, without transforming them essentially non-biological ways. Such an understanding of the quality of integrity goes back to the concept of unity.

Preventing the destruction of our world, preserving it as a whole, requires a completely new quality of foresight from a person – foresight all the more distant. Based on the statement of I R Prigogine: “We begin to go beyond the boundaries of the world that Koyre calls “world of quantity” and enter the “world of quality”[7], V P Vizgin comes to the following conclusion: “Discovered in science of the twentieth century trends ... in biology itself, as well as in a number of general scientific and interdisciplinary trends: ecology, evolutionism, system studies, synergetics, etc. lead to an understanding of the relevance of Qualitativistic thinking ... ”[7].

Modern Russian philosopher Yu N Solonin remarked: "... there is an erosion of radical quantitativism under the influence of the concepts and representations familiar to him that are close to qualitativism" [20]. This process has been going on for quite some time. The problem of insufficiency of mechanistic quantitative and measuring procedures for understanding of the world as a whole and of the living in particular, the ratio of quality and integrity has repeatedly attracted attention and was covered in various studies in our country in the second half of the last century [21, 22] and continues actively today [23, 24].
4. Conclusion
The study of the role of various sciences, including biological knowledge, in the formation of a modern holistic worldview, corresponds to the main trends of post-nonclassical scientific rationality. The formation and development of a qualitativistic research program, helping to overcome the principles of reductionism, provides the opportunity to make significant adjustments to the research methodology, to identify based on the principle of integrity general theoretical and methodological foundations of the integration of scientific knowledge, as well as their concretization for individual sciences.

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