Breaking the Barriers: Ontological Aspects of Relation and Mutuality in Contemporary Theories of Atomic Structure and in Philosophy of Personalism

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Abstract

The paper focuses on the interdisciplinary field between the sciences and the humanities. It explores the subject matter of breaking barriers and 'individuality' in terms of the subatomic particles as building blocks of the matter and the human beings according to existentialism and personalism as philosophical traditions. The 'overcoming the barrier' theme is considered in a twofold perspective in this paper: on the one hand, as an ontological, structural and organisational principle, and, on the other hand as a condition for interaction, relation and mutuality. Theoretical and conceptual references to some of the fundamental ideas and concepts of the Quantum Mechanical Model of the atom and the Standard Model of particles are made, emphasising the primary importance of the entanglement as the variation of relationality and mutuality in the field of natural sciences. Moreover, references are made as well as to Martin Buber's and Emmanuel Lévinas's philosophy. This paper will serve as a basis for the development of an interdisciplinary series of seminars in the Secondary school curriculum aiming to deepen the relation between the natural sciences (chemistry and physics) and the humanities.

Key words: ontology, personalism, subatomic particles, relation, mutuality.

In face of the directness of the relation
everything indirect becomes irrelevant.
(Buber, 2008, p.12)

Both in philosophy and in natural sciences, *curiosity* and *wonder* have always been appointed to be unlocking mechanisms of crucial importance. Great scientific discoveries are the results of questioning the surrounding reality taken previously for granted. In today's digitally revolutionised society, information and images, especially the visual ones, are overflowing and thus are challenging the human psychic rhythm and cognitive capacity of dealing with them. Taking the latter into consideration,

the specialists in the educational field face the responsibility to preserve and foster their students' curiosity and wonder, providing them with effective instruments and methodologies for orientation in the overabundant data.

Two mainstream tendencies could be profiled on the last decades' scientific geography map. On the one hand, this is the profound specialisation of some researchers, digging deeper and deeper in their relatively narrow niche. On the other hand, there is the constantly increasing interest in interdisciplinary fields, urged by the need of integrity corresponding to the diversity of complex world phenomena. Overwhelmed by the potential of the second tendency mentioned, we have decided to expand the requirements for interdisciplinary connections included in the Bulgarian educational standards and curricula. Therefore, in order to 'break barriers' and to open up wider epistemological horizons for our students from 11th and 12th grades of 32 Secondary language school "St. Kliment Ohridski" in Sofia, we have tried to build up *a series of seminars lying at the intersection between natural sciences (chemistry and physics) and philosophy*. As experienced teachers, reflecting upon and trying to meet the cognitive needs and interests of our students, we assess these seminars as adequate and useful *curiosity and thought-provoking stimuli*.

This paper presents our reflections and deals with our arguments vis à vis the first series of these interdisciplinary seminars, dedicated to *the common concept of relation (relationality)* in both fields – natural sciences and philosophy. (Here it is appropriate to recall, for example, the primal 'melting' of the origins and concerns of today's philosophy and physics.) Approaching the field of *ontology of relations* (sometimes articulated as *relational ontology*) as well as that of *philosophy of science*, our paper explores the conditions for, and possibilities of, 'breaking barriers' and overcoming 'individuality' or the state of separate 'entity' in terms of the *subatomic particles as building blocks of the matter* and the human beings according to the *philosophy of existentialism and personalism*. The mediation between natural sciences and philosophy could be made on the basis of a rich spectrum of phenomena explored by these sciences through applying different theories, concepts and instruments, for instance *matter*, *space*, *time*, *energy*, *light*, *interaction* and *relationality*. Therefore, we have decided to choose the latter as the bridge-maker for our interdisciplinary extra curricula seminars.

Bearing in mind the theoretical accumulations and the conceptual intricacies characterising the phenomenon of interconnectedness and relationality in both disciplines, an extracautious selection of approaches and instruments should be made. Nevertheless, we argue that the extremely complex nature of the subject matter 'relief' should not refrain the secondary school teachers, like us, from involving our students in research horizons usually opened up in the academic context of university education. Thus, observing these methodological assumptions, we apply the approach of *phenomenology*, largely used in both scientific fields and perfectly fitting the complex nature of the problem of 'breaking barriers' and relationality. Referring to some of the recent theories of the structure of matter in

chemistry and physics as well as to Martin Buber's and Emmanuel Lévinas's person-based philosophical reflections, we claim that, in both fields, the phenomena of *relationality* and *mutuality* create important *ontological implications* which emphasise further their scientific priority and importance.

Due to the word limit assigned, the order that our paper will follow includes a brief observation of: first, the semantic depth and the theoretical complexity of the key concepts (relation, mutuality, atom), as well as the assets of phenomenology as a leading approach; second, the conceptual framework of Buber and Lévinas concerning the transformation of ontology into ethics and thus the ontological/ethical implications of human relations; third, the foundations of the Standard Model of the subatomic particles, revealing the 'endless' multiplication of elementary particles (reductionism) with an emphasis on the postulated necessary relationality and interconnectedness of the quarks; fourth, presentation of the content of the interdisciplinary seminars, whose educational goals and assumptions have already been stated.

Some etymological and semantic sketches

The concepts of *relationality* and *mutuality* have already been declared as central for the subject matter of the paper. It is worth observing that these notions, residing extensively in the everyday language practices, serve to describe a wide range of situations and contexts, and their common-sense usage does not problematise their semantic sediments to a high extent. On a deeper level, however, reconsidering them from a scientific point of view, the concepts seem to reveal their rich semantic and philosophical storages. It would be impossible here to make a reconstruction of the 'cultural history' of the basic concept of relation/relationality and of every theoretical model dealing with it, and indeed, this is not done here. Our intention, tailored to the needs of the subject, rather includes the elucidation of the Greek or Latin origin of the key concepts and their potential for generating ontological implications. The Latin word '*relatio'* opens up a fan of meanings including 'connection, correspondence', 'act of telling, a report', *'a bringing back, restoring'*. Similarly, the corresponding verb *'referre'* means 'to refer, to report', *'bring back, bear back, carry back home, return'*.

What really counts in terms of our research interest is the idea of 'hidden direction or drive-back'. Referring to hermeneutics and its potential, we could build up the hypothesis of a deeply anchored dialectics underlying the meaning of the concept of relationality. On the one hand, it conveys the idea of an entity breaking its own 'barrier' or individual existence, and directing towards another 'foreign' entity; a hint of losing one's 'proper' place is detected. On the other, this movement forth is, in itself, a backwards movement (*'a bringing back, restoring'*). Then, we could summarise, on the basis of these semantic oscillations, that through

relationality the separate 'entities' involved in it are *brought back* and *restored* in a higher and richer reality as if this *restoration* is the natural, teleological 'state' of the 'entities'. The 'breaking' of one's own barrier seems to be the necessary condition for discovering oneself in a more complex 'reality' or 'state', which might be one's true 'ordination', one's very 'home'.

The obviously crucial idea of breaking or overcoming a 'barrier', of taking 'an initiative, direction', or making a beginning, lies at the heart of *ontology – the study of what there is and its general features (relations included)*. The Latin verb *ex-sistere* is the equivalent of the Greek verbs for 'to be' – *ειναι (einai)* and *υπαρχειν (hyparkein)*. 'E*x-sistere'* means 'arise, come to light, emerge, appear, project, *become, come into being, be produced*' (Edwards, 1967, p.141; Williams, 1981, p.3; Salmon, 1987; Fine, 2009). It is reasonable then to accept the phenomena of relationality and interconnectedness as imbued with ontological and metaphysical implications. Without going into too much detail, we should say that a distinction between *substantivist and relational ontology* is made, the former giving the priority to substances or entities, the latter to relations between them as more fundamental for being (Wildman, 2006; Imaguire, 2012; Brower, 2015; MacBride, 2016).

The same semantic layer of 'breaking barriers' and possessing a direction could be discovered in the Aristotle's reflections on *relation* in his treatise *Categories*. Relations comprise 'one of the accidental categories and must be understood as items inhering in particular substances' (Brower, 2015). Moreover, Aristotle names the relations 'things *toward* something (ta *pros* ti)[1]' (Brower, 2015). Referring again to the previously mentioned dialectics hidden in the nature of relations, we could agree with Jeffrey Brower that Aristotle speaks of relations „as inhering in one thing and somehow pointing toward (pros) another" (Brower, 2015). And that is the semantic zenith our subject needs – relation/relationality is an ontological category par excellence, enabling the variety of interactions between substances/entities[2].

Furthermore, the complex nature of relationality and mutuality, both in natural sciences and in philosophy, requires an approach able to encompass it, and the late 19th-century-born *phenomenology* seems to be the right choice. Phenomenology could be described as the method of 'focality', thus paying attention to each possible perspective on nature and human interpersonal world. Considered to give 'an idea of world's depth and density' (Internet Encyclopedia of Philosophy, n.d), this theoretical and methodological perspective reconstructs the world as having a multifaceted and multiprofiled character, due to the unique perspective of the observer. Ready to grasp an ever-changing phenomenon, this approach could deal with the 'surprises' and the new discoveries in the scientific field. This fact makes it a perfect match for the subatomic particle theories challenging humankind fundamental intuitions

1 The Latin equivalent to be 'ad aliquid'.

2 The possible classifications of the relations on the basis of different criteria (dyadic/triadic; symmetric/non-symmetric/asymmetric; internal/external, etc.) would not be explored further in this paper (Macbride, 2016).

about the world we live in. However, phenomenology's epistemological capacity is not exhausted with its sensitivity toward the phenomena and observers' diversity. It usually recombines the scattered reality it explores, relating the pieces and addressing the hermeneutics potential to make it full of meaning.

'Breaking barriers' and relationality: ontological/ethical principle in Buber's and Levinas's philosophy

… to reverse the relation is to abolish the reality…
(Buber, 2008, p.9)

Not only full of meaning, but predominantly full of relations seems to be the world for the Austrian philosopher and theologian Martin Buber and the French philosopher Emmanuel Lévinas. Both major representatives of the late 19th and 20th century *philosophy of personalism* (Mounier, 1952; Macmurray, 1961), a movement tightly intertwined with *existentialism* (Cooper, 1999; Judaken & Bernascony, 2012), Buber and Lévinas focus their work on the phenomena of *relationality* and *mutuality*. As the name of the movement is self-revealing, the concept of 'person' is considered as a fundamental ontological and epistemological principle: 'Personalism posits ultimate reality and value in personhood – human… as well as divine… Personhood… gives meaning to all of reality' (Williams & Bengtsson, 2018). So far in this paper, relations' ontological content and implications have been stated, but these two thinkers make a step further, emphasising the priority of *the ethical over the ontological aspect of relations*. An important epistemological shift is made in Buber's and Lévinas's reflective approach toward reality considering philosophy less as ontology and more as ethics.

Without any exaggeration, Martin Buber could be appointed an apologist for the relationality phenomenon. His best known work is the philosophical essay *I-Thou* (1923) which treats *relationality and mutuality as structural, organisational and ethical principles of existence*. Buber creates *two primal combinations/relations* as key concepts of his philosophy – *I-It relation* and *I-Thou relation*, the former describing the interconnectedness between the human beings and the world of nature, while the latter refers to the way human beings (persons) interact. These relations exist in the field of *the word* and *dialogue*, breaking the barrier of the sound and the vocalisation: 'There is only the one primal being unconfronted by another. We should plunge into the silent unity.' (Buber, 2002, p.28).

The two elements of the combination, especially as far as the *I-Thou* one is concerned, go inevitably together: 'If *Thou* is said, the *I* of the combination *I-Thou* is said along with it… The primary word *I-Thou* can only be spoken with the whole being' (Buber, 2008, p.3). Buber does not assume the solitary, 'individual' existence of either of the two elements of the combination: 'There is no *I* taken in itself, but only the *I* of the primary word *I-Thou* and the *I* of the primary word *I-It*' (Buber, 2008,

p.4). Furthermore, in the lap of the relation *I-Thou*, the real presence and the word that denotes it coincide, so we could talk about the ontological plenitude of this interaction: 'The existence of *I* and the speaking of *I* are one and the same thing' (Buber, 2008, p.4).

Being a philosopher, a Jewish theologian, and a fervent religious at the same time, Buber sees the world primarily as 'the world of relation' (Buber, 2008, p.6) and traces three spheres to perform this relationality: 'our life with nature', 'our life with men', and 'our life with intelligible forms' (Buber, 2008, p.6). Moreover, primary combinations/words/relations reflect the existence of the ontological higher figure of the One God: 'in each *Thou* we address the eternal *Thou'* (Buber, 2008, p.6). Here it is worth remarking that the inauguration of Jewish monotheism is realised precisely through the set of the interpersonal relation between the self-revealing One God and the patriarch Abraham following the Biblical evidence. It is not surprising that Buber's religious sensitivity brightly tinges his ontological/ethical reflections and feeds his philosophical conceptual framework.

According to Buber, the semantically close concept of *mutuality* constitutes 'the peculiar nature of the relation' (Buber, 2002, p.p.116-117). An emphasis on mutuality should be made here, revealing further *the dynamic depths of relationality*. The Latin roots of the word convey the idea of 'motion, action, change', as 'something reciprocal', which means that the relation is not static, but vital and enriching.

Submerged in a quite similar religious and philosophical atmosphere, Emmanuel Lévinas's major writing *Totality and Infinity. An essay on exteriority* (1961) sharpens further the conditions of relationality. The elements of Buber's primary relation *I-Thou* are transformed here into *the same* and *the other* or *I* and *the Stranger*. Again, the ontological/ethical horizon is widely open. The conceptual figures of *the other* or *the Stranger* refer to the fellow human being, the fellow person and behind them always is hidden *the Other*, without being explicitly revealed as God himself. The concept of *exteriority* corresponds to the idea of breaking the barriers of one's individual and solitary existence – of one's *totality*. Lévinas thinks of it as an openness of *the same* to encounter *the otherness* in *the face of the other*. The face is the only guarantee for a true relation and ontological/ethical horizon: „A relation whose terms do not form a totality can hence be produced within the general economy of being only as proceeding from the I to the other, as a face to face" (Lévinas, 1969, p.39). The experience of relation is one of *transcendence* as well. It includes the readiness to welcome the higher ontological orders.

Similarly to *the dialogic principle* in Buber's relational ontology/ethics, Lévinas describes *the language* and *the conversation* as conditions for the *revelation*/*epiphany* of the otherness. Again overcoming the sound parameters, the conversation is responsible for the preserving of the otherness of the other in relation. The relation does not delete the otherness: on the contrary, it feeds it as a condition for its own reality: „Conversation… maintains the distance between me

and the Other, the radical separation asserted in transcendence which prevents the reconstitution of totality“ (Lévinas, 1969, p.40).

Both Buber's and Lévinas's philosophical paradigms on relationality and mutuality are a prominent illustration of the previously mentioned 'hidden' initiative and direction of the separate 'substances'/'entities'. Lévinas's *Totality and Infinity* opens up with the striking statement: 'The true life is absent.' But we are in the world. Metaphysics arises and is maintained in this alibi. It is turned toward the "elsewhere" and the "otherwise" and the "other" (Lévinas, 1969, p.33). In the field of relation these 'entities' ensure their existence and are brought back 'home', maybe to 'the true life'.

Together-in-separation

Indeed, the foundational laws governing nature blur the distinction between individual things and their surroundings.
(Mann, 2014)

Even though lacking the full dignity and ontological/ethical depth of the interpersonal relation *I-Thou*, the relation *I-It* also bears important ontological implications. We said that this primal combination reflects *the interconnectedness between the human beings and the nature* in Buber's philosophy. The scientific picture of the world we live in has been dramatically changing with the last decades' discoveries in natural sciences, in chemistry and physics in particular. The modern *theories of the atomic structure as an entity made of different subatomic particles and the structure of the subatomic particles itself*, developed by scientists as Niels Bohr, Max Planck, Albert Einstein, Boris Podolsky, Nathan Rosen, Werner Heisenberg, Alain Aspect, Georg Zweig, Murray Gell-Mann, Sheldon Glashow and many others seem to turn the common-sense epistemology upside down. We shall reconstruct here some of the fundamental ideas and concepts of the Q*uantum Mechanical Model of the atom and the Standard Model of particles*, emphasising the primary importance of the *entanglement* as the variation of relationality and mutuality in the field of natural sciences and its ontological implications.

In the beginning of the 20th century, natural sciences proved that the atom is a complex particle. For a long time considered a fundamental particle, the atom turns out to be composed of nucleus and electron shell. The nucleus itself encompasses positively charged protons and neutral neutrons called nucleons, while the electron shell consists of negatively charged electrons. Whereas the electron turns out to be a fundamental particle, the same statement could not be said about to the nucleons – it turns out that they are divisible into even smaller particles, called *quarks*. Furthermore, there are carrier particles – *gluons* – which "glue" together

the quarks into the nucleons, thus implementing a so-called "strong interaction". This interaction holds protons in the nucleus together, thus preventing nucleus of decomposition. As colour-charged particles, *the quarks cannot exist individually*, because the color-force increases as they are pulled apart so they are confined in groups with other quarks, thus building hadrons. Hadrons are colour-neutral composite particles. Nucleons, for example, are hadrons.

The Standard Model as quantum theory finally breaks the barriers of imagination and reorders the image of the world, explaining what really holds it together. The subject matter of this paper requires that the emphasis is less on the variety of elementary particles (6 quarks, 6 leptons, and force carrier particles[3]) and in favour of their modes of complex interactions. The universe, which we constantly explore, exists because of the fundamental particles' interactions. These interactions include attractive and repulsive forces, decay, and annihilation. Basically, there are four fundamental interactions between particles – strong, weak, electromagnetic and gravitational interactions. All aforementioned bonds and mutual interactions present the idea of *togetherness-in-separation*.

However, in terms of the potential for relationality of the particles, the phenomenon of *entanglement* deserves special attention. Robert Mann (2014) defines it as „blurring the distinction between individual things and their surroundings… between the subsystems of a system". This quantum phenomenon generates significant philosophical consequences,

> 'implying that interconnectedness is a central feature of existence. It is so central that the relationships between the bits and pieces of nature can produce effects that each bit or piece on its own cannot produce. *Nature is intrinsically relational*…'
>
> (Mann, 2014).

The entanglement of particles has to do with the so called *EPR effect*[4], making evidence of the „counterintuitive *togetherness-in-separation*" (Polkinghorne, 2002, p.79; Polkinghorne, 2010) between particle 1 and particle 2:

> 'Quantum entities that have interacted with each other remain mutually entangled however far they may eventually separate spatially… The EPR effect's implication of deep-seated relationality present in the fundamental structure of the physical world is a discovery that physical thinking and metaphysical reflection have still to come to terms… the EPR effect is ontological and not simply epistemological'
>
> (Polkinghorne, 2002, p.79).

3 It is possible that, in some future development of the quantum theory, new even smaller particles are discovered.

4 The effect brings the first letters of the last names of Albert Einstein, Boris Podolsky and Nathan Rosen, its discoverers.

Reminding Aristotle's concept of *potentia*, Werner Heisenberg concludes that the elementary particles 'form a world of potentialities or possibilities rather than of things or facts.' (Polkinghorne, 2002, p.85). In the end, we should recall the idea of 'going back home' conveyed by the semantic field of the word *relation* and again Aristotle's idea of the relations as 'directing toward'. Could we suggest that the world of the nature and that of the personhood are both affected by the same ontological urge for relationality and mutuality providing a higher (or the only true!) access to existence?

Interdisciplinary seminars programme *Stay-in-relation: philosophy and/of natural sciences*

Seminar 1	Introduction. The interconnectedness of the curricula disciplines according to the national educational standards. Philosophy and natural sciences, philosophy of science. The spectrum of complex phenomena, explored in both fields – *matter*, *atom*, *space*, *time*, *energy*, *light*, *interaction*, *relationality*. Bibliography of major writings
Seminar 2	Ontological and epistemological concerns. Basic conceptual instruments. The methodological potential of phenomenology
Seminar3	Relationality according to personalism and existentialism
Seminar 4	Structure of matter theories. Relationality according to the Standard Model. Philosophical implications
Seminar 5	Practical assignment: *Capture-the-relations* (in a painting, photos, 3D model, poem, essay, song, etc.)

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Bio-notes

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