

THE PHILOSOPHICAL FOUNDATIONS OF THE KINEMATIC ATOMISM OF RUDER JOSIP BOSCOVICH

JANUSZ SYTNIK-CZETWERTYŃSKI

Akademia Świętokrzyska, Poland

Abstract. Ruder Josip Boscovich (1711 – 1787), a philosopher, mathematician, physicist and astronomer. The greatest of the forgotten – as Barrow says. The author of the Theory of Everything, based on the presumption that the whole substance of this world is reducible to simple, homogeneous, discontinuous and invariable physical points. These points being the centers of forces of repulsion and attraction. His system of kinematic atomism constitutes a crucial stage in the development of physics and philosophy. The physical points combine both material and psychological features, therefore among commentators the prevailing view is that they possess rather a quasi-material nature. The following presentation, however, emphasizes their psychological aspect, especially in the light of Boscovich's fairly original attempt to reduce mental states and physical facts to one, common definition. This reduction is based on the presumption that the rules which govern both kinds of substance (bodies and minds) can be reduced to the one (and only one) Rule of All Forces. Hence, this rule concerns everything in the Universe.

The dispute over the existence of the world brings two fundamental answers at the turn of the XVII century: Leibniz' conception of monads and of man as a computing machine, and Newton's radically different mechanistic theory. Leibniz – the Prince of Philosophy and Newton – the Prince of Physics, with their theories on man as a computing machine and man as a living mechanism. Ruder Josip Boscovich undertook an attempt to reconcile the two approaches. His kinematic conception presents the final reduction of the possible kinds of substances. Material points are the substance of the world, the link between the world of matter and spiritual reality. Using combinatorics and the notion of substantial qualities Boscovich gives not only an extremely interesting answer but demonstrates far-reaching

consequences for the theory of nature. He contrasts the world as it appears to be with the world as it really is.

I. The world as it appears to be

The solution of the Cartesian dualism of mind and body proposed by Boscovich is based on the reduction of substance to physical points which are the primitive elements from which the world is made. An explanation of the differences between points, minds and bodies is in order, as one may easily raise the objection that the physical points are identical with minds devoided of *vis viva*, or that minds supported by physical forces participate in physical phenomena. The distinction between matter and mind is based on the impenetrability and the faculty of thinking. Matter is perceptible to the senses but it is incapable of thinking, while mind is imperceptible to the senses but is subject to the processes of thought. Meanwhile Boscovich's physical points are something in between minds and bodies, uniting the properties of impenetrable matter with mental inextension and indestructibility.

MINDS

thinking
penetrability
inextension
indestructibility

POINTS

non-thinking
impenetrability
inextension
indestructibility

BODIES

non-thinking
impenetrability
extension
destructibility

The basis of the relationship between body and mind is the notion of force which knits both mind and body into a complementary Unity. Is it really possible to ascribe the categories of physical movement to mental categories, in particular since mental categories – thoughts and intentions which originate from internal impulses – and powers are totally different than impressions which are the result of external stimuli?

But what kind of physical representation can mental powers have? Well, our brain is undoubtedly doing physical work when we move a stone in our thought. Therefore, impressions and ideas originating directly from external impulses are different in nature from the stream of consciousness, cogitations, decisions and effects of the will which have been formed directly by the operations of the mind. Thoughts also need to be carefully distinguished because of their voluntary character. The ideas constituting the range of sen-

sory possibilities (tastes, colours, smells, sounds) have an intra-structural (local) and inextensive character. They do not manifest an independent nature. This also goes for uncontrolled states of mind (sadness, joy, etc.) and the movements attributed to our animal nature (physiology).

„The followers of Leibniz attribute a mind even to the brutes, although one that does not act directly on the body. But of those who attribute to the brutes the power of thinking and willing, all those that have any understanding admit that in the brutes it is far inferior to our own; and so dependent on matter, that without it they cannot live or act; while they believe that our minds, even if separated from the body, are capable of exercising the same acts of thought and will just as well. Again, of those who attribute to brutes the power of thought and will, some apply to both classes the term „spirit”, but distinguish between two different kinds of spirits; others attribute the name of spiritual substance to those only that can think and will without any connection with the body, and without any organic disposition of matter, and the motion that is necessary to the brutes in order that they may live.”¹

The relationship between the mind and the body is realized in three ways. Two of these defy the rules of classical mechanics and refer rather to endogenous movements. The third, in spite of its agreement with mechanics, is distant from the principles of physics on account of its nature. All of them are based on the conception of mind-body interaction. Mental impulses, which are internal in character, affect only the brain, as the seat of the mind. These movements are partly subject to the brain's location and dependence with respect to the body as whole. If the brain did not act as an intermediary in relaying the dictates of the mind to the body, the mutual harmony of the two would be possible even if the body were dismembered or the brain were at a distance from the body. But this is not the case. Hence, the necessity of differentiating between the nature of mental movements as follows:

¹ „Philosophi nam & Leibnitiani brutis ipsis animam tribuunt, quanquam non immediate agentem in corpus : sed ex iis, qui ipsam cogitandi, & volendi vim brutis attribuunt, in iis agnoscunt passim omnes, qui sapiunt, nostra inferiorem longe, & ita a materia pendentem, ut sine illa nec vivere possint, nec agere ; dum nostras animas etiam a corpore separatas credimus posse eisdem seque cogitationis, & volitionis actus exercere. Porro ex his, qui cogitationem, & voluntatem brutis attribuunt, alii utrique generi applicant nomen spiritus, sed distinguunt diversa spirituum genera, alii vocem spiritualis substantiae tribuunt illis solis, quae cogitare, & velle possint etiam sine ullo nexu cum corpore & sine ulla materiae organica dispositione, & motu, qui necessarius est brutis, ut vivant.” (Boscovich 1922, p. 205).

- those originating as a result of inspection of inherent and inextensive ideas (e.g. the motives)
- uncontrolled necessary movements (physiology).

Perhaps due to some indefinite law, minds have been equipped with inclinations that render some things

„easier than others because there always remains in the mind, and in that faculty of it which we call the will, a perfectly free power of choosing even that thing against which it is naturally inclined. There will even be a power of bringing it about that, due merely to its own determination, the thing, which independently of this determination would have the less force, will preponderate”.²

Yet the number of laws governing the mind remains unfixed. As in the case of physical events, the reduction to a single law is crucial. The third type of law, which accords with the rule of interaction of the physical points, pertains to the internal movements of the mind. It defines both the position of the mind in relation to the body and the positioning of the other organs. At every moment the mind supports the optimal configuration of the body. This configuration is subject to permanent control and constitutes the position considered as being of most benefit to life. The mind must necessarily move along with the body and keep its position in relation to the body as a whole. In this perspective the relationship between the soul and body is better described as mutual interpenetration. This interpenetration however does not have the character of direct interaction (it requires the mediation of the brain). The impulses of the external world are received by the senses and relayed to the brain, stimulating vibrations. In this way visions are excited within us by the intermediary of the cerebro-spinal fluid. However, the mind does not produce objective images of reality. It is stimulated to the inspection of its internal ideas only. The mind associates the vibrations with definite ideas, attributing ideal categories to the sensible categories of the vibrations received. It produces ideal interpretations of the impulses received from the outside world (Marković 1950, pp. 106-123).

Do mental phenomena have the ability to interpenetrate points of matter? The demonstration would require making the rules of geometry ap-

² „... licet fieri possit, ut certa lege ad id inclinent, & actus alios aliis faciliores reddant, manente tamen semper in animo, in ipsa illa ejus facultate, quam dicimus voluntatem, potestate liberrima eligendi illud etiam, contra quod inclinatur, & efficiendi, ut ex mera sua determinatione praeponderet etiam illud, quod independenter ab ea minorem habet vim.” (Boscovich 1922, p. 211).

plicable to the definition of all possible movements. One has yet to consider the situation in which the mind would be present in the body in a virtual manner, or fill the entire space containing all the physical points forming the body. This mind would still differ from matter as the physical points could not exist in any other way than at a single point in space and at a single point in time. Yet the mind would remain a composite unity, existing at a single moment in time but in an infinite quantity of points in space. Being united simultaneously with a single point in time and a series of points of space, it would be present at a single time, yet possess a real, spatial sphere of activity. Hence the conclusion may be drawn that in the relations of body and mind, movement cannot be produced by the mind in a material point without taking into consideration other movements in other material points balancing it in the opposite direction.

This is required by the principle of the equilibrium of forces. This principle does not manifest itself in local (endogenic) movements because they do not have the stability and durability of movements governed by the Law of Forces and are therefore subject to destruction at the moment of the decomposition of a given body (Petrović 1888, pp. 129-194).

Finally, human knowledge consists of mental images which interpret the impulses originating from the external world. This knowledge has the character of a perception of the brain's own states. It is the result of something we may call the *hydraulic processes of the brain*. Its properties are the following:

- a) all things are compounds of atoms of matter,
- b) atoms of matter are nothing more than fields of action of the forces originating from physical points; (therefore by the notion of the atom of nature we should understand physical points which constitute the substance of the world; these points are the centres of gravity, the simple elements of substance, or things in themselves, or the real things, or the real subjects, while by the notion of the atom of matter we should understand the simple elements of matter, or fields of action of the internal forces of physical points, or fields of impenetrability),
- c) the field of the action of forces (the atom of matter) is impenetrable, also for the senses,
- d) sensorial perception never reaches physical points, because impulses are deflected from the field of the action of forces,
- e) physical points remain in continuous movement; therefore the phenomenon of movement also refers to the fields of the action of their forces (i.e. the atom of matter),

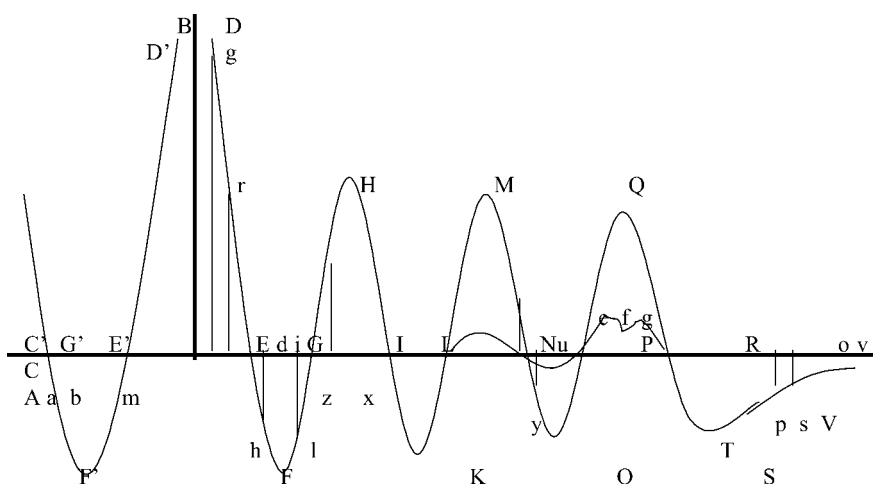
- f) it can be said that the movement of this field reflects the real activity of the physical points,
- g) the impulses deflected from this field (i.e. from the atom of matter) reach our senses,
- h) by the mediation of nerves and blood, the impulses reach our brain, stimulating its physical motions,
- i) the physical movements of the brain set the cerebro-spinal liquid in motion, and it in turn stimulates every separate part of the brain, also the part in which the mind is contained,
- j) as a result of stimulation by the cerebro-spinal liquid, the receptors of the part of the brain in which the mind is contained are forced into activity,
- k) the function of these receptors consists in the formation of images in our mind,
- l) the image in the mind is therefore the result of the physical movement of the brain receptors,
- m) the work of our mind consists in the identification of the palpable movements and in the assignment of the appropriate innate ideas to them,
- n) after the assignment of the appropriate ideas, our mind produces the image which is the interpretation of the felt movements.

The mental image is the interpretation of external stimuli. Therefore the term scientific knowledge refers to phenomenological images of the world. Phenomena are composite wholes and the role of knowledge consists in revealing their hidden simplicity. All the diversity in our world arises from the combination of the distances between physical points.

Physical points are connected with one another within the structures that manifest themselves as apparently hard and impenetrable material solids. It is thus impossible to attain objective knowledge. The basis of cognition consists in the action of forces issuing from physical points (i.e. from the atoms of nature). This activity is something different from the relations between local masses. Thus, detailed knowledge is an act of the will, while cognition is limited to the category of perception and to phenomena. Hence knowledge of the rules of nature and of the objective state of a given particle is impossible.

II. The world as it is in itself

As already mentioned, the substance of the world consists of centres of gravitation (i.e. of physical points) separated by varying spatial intervals. Changeability is the result of the action of their inner *vis viva*, where the reduction of the distance between them augments their mutual repulsive force, and the increase of distance, their attractive force (proportionally to the repulsive force). This law suffices to explain all phenomena and all properties of bodies. It is the elementary, primordial law of nature.



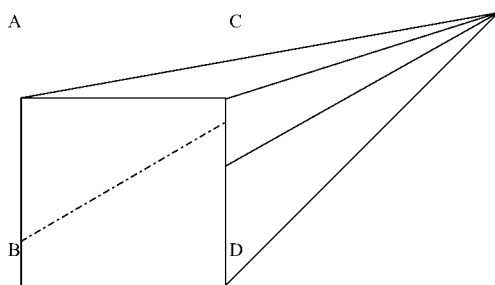
Diag. 1

The curve reflects the relation of the forces to the distance between two points. The axis AB defines the limit of the action, while the axis AC defines the range of the distances. In the case of relations between objects of imperceptible dimensions (i.e. endogenic or local relations), the position of the sine curve above the axis AB refers to the action of the repulsive force. In the case of external relations (i.e. between objects of perceptible dimensions), the force is attractive and is inversely proportional to the square of the distance. This law expresses the rule governing all things that exist in the Universe.

There is no multiplicity of forces. All of the known forces differ from each other only in name – they are but different manifestations of a single force that pervades everything in the Universe. The law expresses a universal principle, from which all other principles may be derived. Consequently,

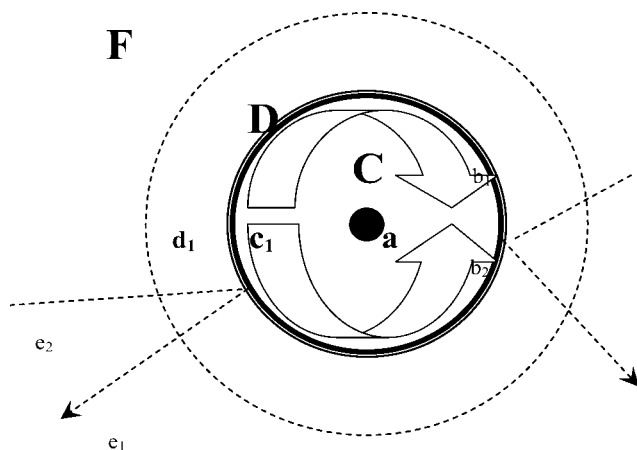
a compound body, as an apparently hard and impenetrable material solid, is in reality an open network of physical points separated by vacuum.

Therefore real space is a set of simple, finite and discontinuous points. At the same time, real time is a set of infinite and continuous distances between these points. This is what causes the impression of relative movement (e.g. in the diagram below, the movement along the line AB or AC is relative with respect to infinity).³



Diag. 2

The spatial location of the points, which are the primitive elements of the substance of the Universe, manifests itself solely within their sphere of activity, since the points do not have a strictly material status (although they do have a number of physical properties). The physical points are contained in bodies in a rather virtual, quasi-material way.



Diag. 3

³ The example is taken from T. Young's introduction to Boscovich 1992, p. 11.

where:

- a the physical point, the simple element, the primitive component of substance,
- b_1 and b_2 the repulsive and attractive forces, coming from the centre situated at the point a ,
- C the sphere of activity of the forces, coming from the point a , i.e. the impenetrable field of vacuum,
- c_1 the sequence of the points, which form the untraversable and critical border,
- D the field of the action of the repulsive force,
- d_1 the place of the conversion of the attractive force into the repulsive force,
- e_1 and e_2 external forces, for which the field C is untraversable,
- F the infinite space of the activity of the attractive force.

Since the field C is impenetrable in character, it is equivalent to an atom of matter. The point a represents an atom of nature, on the distinct understanding, with respect to alternative theories (e.g. the theory of Leibniz), that it does not have a mental nature (the centres of gravitation do not think). Since these centres are contiguous in their field of activity (i.e. the field C), there exists empty space in the Universe (i. e. space devoid of matter), but there is no such thing as space devoid of the activity of forces. Thus:

- a – the atom of nature, the simple substance,
- C – the physical atom, i.e. the sphere of activity of the internal forces of the atom of nature,
- $d_1 - c_1$ – the range of the action of the repulsive force
- $F - d_1$ – the range of the action of the attractive force

Physical points interact with one another without the possibility of penetrating the structure of any other point (a). These interactions activate one of the inner forces. The power of the force increases proportionally to the distance between the points. Bodies strive for contact, although it is impossible (because of the repulsive force). The impenetrability of the field C (i.e. of the atom of matter), is the result of the activity of the attractive force. Therefore impenetrability should be excluded from the set of properties of the atoms of matter (i.e. of the fields C) and acknowledged as the result of the critical value of the inner forces. The simple element does not possess the possibility of coming into contact with other elements, because of the activity of the field C .

Since physical atoms (i.e. the fields C) do not have the character of composite matter, nor shape, nor size, punctual atomism does not fully explain their participation in the laws of nature. Hence we should state, that all philosophical conceptions, which show the primitive elements of substance as extensive (or non-extensive), homogenous and co-reacting (the result of which are all processes occurring between compound bodies), do not present a complete image of reality.

It is therefore necessary to endow these primitive elements of substance with *vis viva*, in accordance with the system of kinematic atomism. This kind of atomism rejects the deterministic vision of the Universe, because our mind is unable to fathom the real circumstances that accompany phenomena. Such knowledge is totally out of the reach of human understanding. Objective determinism is an illusion. (White 1961, pp. 54-62). Only relative determinism can be considered here. Since Nature itself is based on a system of centres of activity (i.e. of physical points), to conceive of the Universe means to undertake the task of interpreting all phenomena, whose foundation is the activity of the forces. This leads to the aforementioned reduction of all physical laws to a single law, the Law of Forces.

III. The philosophical consequences

From the viewpoint of the geometry of systems, there is only one centre of gravity in every body. The definition of this centre is the elaboration of the notion of gravity. The centre of gravity of a given structure, situated in whichever position on a plane, is the point where the sum of the distances of all the points placed on its one side, equals the sum of the distances of the points on the other side. For mass is proportional to the countable quantity of physical points, these points constituting both the material and the form of a given body.

Finally, if:

- simple particles constitute the elements of reality, and, simultaneously, the material of everything that is,
 - the form is something observable by our mind,
 - and the activity of the simple particles gives rise to the impulses responsible for the phenomenological images present to the mind, and these images are certain manifestations of forms,
- then, the simple particles

- as the components of reality, are the material of the mass of bodies
- and as impulses, are the material of the forms.

Therefore, the stability of forms is made possible by their inner forces of gravitation. Since the form is the object of perception, the impressions require the engagement of an unimaginable quantity of notions.

Meanwhile, because the function of mind consists in the simplification of knowledge, the mind unites the relations between objects. In this way the division into relations between perceptible bodies, and endogenic relations (i.e. into the physical and mental relations) is lost. This leads to the recognition of many mental occurrences as physical occurrences and vice versa. This has important ontological consequences because we establish the character of Being by becoming aware of existence as such, but not by the acknowledgement of the real existence of a given object. We recognize the potentiality which causes a thing to be where it is and cease to be where it was, as a kind of existence.

Meanwhile the only property of a thing's mode of existence is that

„a thing is where it is, and exists then, when it does exist. Whether this mode is called the thing, or the mode of the thing, or something or nothing, it is bound to be beyond our imagination; and the thing may change this kind of mode, having one mode at one time and another at another time. [...] These several real modes are produced and perish, and are in my opinion quite indivisible, non-extended, immovable and unvarying in their order. They, as well as the positions and times of them, and of the points to which they belong, are real. They afford the foundation of a real relation of distance, which is either a local relation between two points, or a temporal relation between two events.”⁴

In this way we obtain the definition of the atoms of nature, which have an indivisible though quasi-material character. Consequently, if:

- each physical point emits a field corresponding to the level of the value of its inner forces,

⁴ „Necessario igitur admittendus est realis aliquis existendi modus, per quem res est ibi, ubi est, & tum, cum est. Sive is modus dicatur res, sive modus rei, sive aliquid, sive nonnihil; is extra nostram imaginationem esse debet, & res ipsum mutare potest, habens jam alium ejusmodi existendi modum, jam alium. [...] Modi illi reales singuli & oriuntur, ac pereunt, & indivisibiles prorsus mihi sunt, ac inextensi, & immobiles, ac in suo ordine immutabiles. Ii & sua ipsorum loca sunt realia, ac tempora, & punctorum, ad quae pertinent. Fundamentum praebent realis relationis distantiae, sive localis inter duo puncta, sive temporariae inter duos eventus.” (Boscovich 1922, p. 226).

- and this field acquires the property of impenetrability as a result of the action of these forces (because the forces set the space of the field into rotary motion up till such velocity, that this space becomes impenetrable for other physical points)

then:

- between any two physical points there is a rotating, empty space, which constitutes a definite distance,
- and, therefore, infinite divisibility is applicable only to the distance between points.

However, to define real space (and real time) and also (as will soon be shown) the ontological bases of Being in itself, we must also take into consideration the differing positions of points in their relation to other parts of the Universe. These differences cause changes to the modes of existence of these points. If two points had the same mode of existence, they would be the same point, in fact. The difference between these modes of existence is based on the infinite quantity of possible points of matter, which correspond to the infinite quantity of possible modes of existence. (Macan 1987, pp. 56-82).

Therefore all possible modes of existence of a given point assign to it all possibilities of its position and all possibilities of its duration. The relations between two such points are defined by the position of these points with respect to all the remaining points. Introducing any new element will modify the relations of the distances and positions. At the same time, in both cases the relations are recognized as identical by the mind. Hence, the realness of existence concerns only one kind of relation, as far as we are concerned. Although there is an infinite number of them, we obstinately stick to one and only one perspective with respect to all possible modes of existence (Gill 1941, pp. 42-44).

Therefore it is impossible to know the objective character of existence, because real existence should be defined by reference to all of its possible relations.

This is of crucial consequence for the ontological foundations of reality. What it means is that the foundation of simple beings consists in their mutual relations, originating from their position and duration. A being is the unity of the order of positions and the order of moments of duration. Every being can exist there, where it is, and exists when it is. Therefore the real modes of existence of all things create real time and real space. Meanwhile

perception assigns them an imaginary space and time. What then is real existence? Real existence refers to the acquisition of spatial and temporal relations by a physical point. There are eight possible combinations for the co-existence of a given point in space with any point in time:

- A. A physical point unites one point in space with several points in time, separated from each other by intervals.
 - this case illustrates the situation of the repeated returns of a physical point to its primordial place; this case is rather impossible in nature, although at the same time there is no convincing evidence excluding such a possibility,
 - this case corresponds to case *C*.
- B. A physical point unites one point in space with several points in time which constitute a continuous series.
 - this case illustrates the movement corresponding to the points of positions following each other,
 - this case corresponds to case *D*.
- C. A physical point unites several points in space that are separated from each other, with one point in time.
 - this is the example of a replica or of the bilocation of a being; this case is rather impossible in nature, because the perception of the portion of matter, which occupies two different positions at the same time, seems to be impossible to us;
 - this case corresponds to case *A*.
- D. A physical point unites one point in time with the sequence of gaps (which are between points in space) without violating the structure of points in space.
 - this is the example of the occupation of a divisible space by an indivisible particle of matter, and the example which illustrates the ontological foundations of the rational soul (i.e. „something which several of the Peripatetics admitted, calling it virtual extension; by virtue of which an indivisible particle of matter, quite without parts, could occupy divisible space”);⁵
 - this case corresponds to case *B*.

⁵ „Si quarto id conjungat cum serie continua punctorum loci aliquo intervallo continuo contentorum, habebitur quaedam quam plures Peripatetici admiserunt, virtualement extensionem, qua indivisibilis, & partibus omnino destituta materiae particula spatium divisibile occuparet.” (Boscovitch 1922, p. 238).

- E. Several physical points unite some points in space with one point in time.
 - this case corresponds to case *F*.
- F. Several physical points unite some points in space with some points in time.
 - this case illustrates the situation in which some physical points are in turn forced to occupy the same position;
 - this case corresponds to case *E*.
- G. Several physical points unite the same points of space with the same points of time.
 - this case corresponds to the case *H*.
- H. Several physical points have no common point in space and no common point in time.
 - this case illustrates a situation in which physical points neither coexist nor occupy a position occupied by any other point at any time;
 - this case corresponds to case *G*.

The quantity of physical points is finite. Therefore, the emergence of any new point in space should be excluded due to the impossibility of defining its position, and since this new point could not occupy the place which had been occupied earlier by another point, at whatever moment. This reasoning abolishes the cases *A, B, C, D* as well as case *F* which is dependent on the possibility of the return of physical points to their primordial place; the case *G*, which is dependent on the same possibility but with respect to a pair of physical points; and the case *H*, which does not illustrate the matter

„for all things created together as a whole will continually last as a whole, and so will always have a common instant of time. Only the fifth case, in which several points of matter connect the same instant of time with different points of position remains.”⁶

Therefore in all cases, except *E*, there should be assumed the intervention of God's Power, because there is no natural possibility to explain these

⁶ „Octavus autem pro materia excluditur, cum tota simul creata perpetuo duret tota, adeoque semper idem momentum habeat commune. Solus quintus casus, quo plura materiae puncta idem momentum temporis cum diversis punctis loci conjungant, non modo possibilis est, sed etiam necessarius pro omnibus materiae punctis, coexistentibus nimirum : fieri enim non potest, ut septimus, & octavus excludantur; nisi continuo ob id ipsum includatur quintus ille, ut consideranti patebit facile.” (Boscovich 1922, p. 239).

phenomena. Finally the nature of a being is hidden in the nature of the co-existence of physical points. The statement of the identity of any two points would require the recognition that:

- the geometrical distances in these cases are identical,
- the modes of existence of these points are identical,
- the changes of the modes of existence of these points are identical, and the processes of these changes are identical,
- the relation of these modes of existence with regard to all other points is identical.

This problem resolves itself into the question: does the arrangement of things in space depend only on these things themselves (the conception of Leibniz), or does this arrangement depend partially on the state of the space (the conception of Newton)? Recognizing the reality of space is done on the basis of our experience. The reason for this is that we experience participation in space although space seems to be something separate from us (from other real things too). But at this juncture we should recognize space to be something similar to an impulse which has the possibility to touch minds and to evoke in them the images of the external world. Since it has been proved that space is not something separate from bodies, our mind must create by itself the ideas of time and space. Therefore, these ideas must be inherent. They are a special mode of perceiving objects. The idea of space and the idea of time are

„a prejudice acquired from infancy and born with ideas obtained through the senses, which have not been considered, with proper care. And these ideas picture masses to us as always being composed of parts at a distance from one another”⁷.

„The consequence of all this is that we are quite unable to obtain a direct knowledge of absolute distances; and we cannot compare them with one another by a common standard”⁸. Therefore, though the announcement of

⁷ „Praejudicium est quoddam ab infantia, & ideis ortum per sensus acquisitis, a debita reflexione destitutis, qui nimirum nobis massas semper ex partibus a se invicem distantibus compositas exhibuerunt, cum videmur nobis puncta etiam invisibilia, & inextensa posse punctis adungere ita, ut se contingant, & oblongam quandam seriem constituent.” (Boscovich 1922, p. 313).

⁸ „Ex his omnibus consequitur, nos absolutas distantias nec immediate cognoscere omnino posse, nec per terminum communem inter se comparare, sed aestimare magnitudines ab ideis, per quas eas cognoscimus, & mensuras habere pro communibus terminis, in quibus nullam mutationem factam esse vulgus censet.” (Boscovich 1922, p. 354).

the universal Law of Forces is absolutely possible, we do not have the possibility to verify it in practice. We can only formulate conclusions about phenomena between perceptible bodies. Hence, the possibility of transferring the sphere of mental phenomena to the sphere of physics (or vice versa) remains an open question.

References

- Adamski, A., 2002, *Galileusza filozofia i teologia nauki*, Poznań: UAM.
- Ayer, A.J., 1987, *A Priori Knowledge*, Oxford: Oxford University Press.
- Bacon, F., 1905, *Philosophical Works*, London: J.M. Robertson.
- Boscovich, R.J., 1992, *Theoria philosophiae naturalis*, trans. by R. Steward, New York: Open Court Publication Company.
- Conway, A., 2002, *Zasady filozofii najstarszej i najnowszej*, trans. J. Usakiewicz, Kraków: Aureus.
- Eliade, M., 1963, *Myth and Reality*, New York: Harper and Row.
- Fraioni, L., 2000, *Materia*, trans. J. Fekecz, Warszawa: Dom Wydawniczy Bellona.
- Freising, W., 1986, *Metaphysik und Vernunft: das Weltbild von Leibniz und Wolff*, Lüneburg: J. Schmidt-Neubauer.
- Gill, H.V., 1941, *Roger Boscovich S.J. (1711-1787) forerunner of modern physical theories*, Dublin: M.H. Gill and Son Ltd.
- Huygens, C., 1926, *Correspondence of Descartes and C. Huygens*, Oxford: The Clarendon Press.
- Macan, I. (ed.), 1987, *The Philosophy of science of Ruder Bošković: proceedings of the symposium of the Institute of Philosophy and Theology S.J.*, Zagreb: Institute of Philosophy and Theology, Croatian Province of the Society of Jesus, distributed by Fordham University Press.
- Malebranche, N., 2002, *Dialogi o metafizyce i religii. Dialogi o śmierci*, trans. P. Rak, Kęty: Antyk.
- Marković, Z., 1950, *Grada za život i rad Rudžera Boskovića*, Zagreb: Jugoslavenska Akademije Znanosti i Umjetnosti.
- Pereboom, D., 1999, *The rationalists: critical essays on Descartes, Spinoza, and Leibniz*, New York: Rowman & Littlefield.
- Petrović, D., 1888, *Život i ocjena djela Rugjera Josipa Boškovića*, Zagreb: Jugoslavenska Akademije Znanosti i Umjetnosti.
- Rodis – Lewis, G., 2000, *Kartezjusz i racjonalizm*, trans. S. Cichowicz, Warszawa: Prószyński i S-ka.
- Smith, B., 1988, *Practical knowledge: outlines of a theory of traditions and skills*, New York: Croom Helm.
- Stróżewski, W., 2004, *Ontologia*, Kraków: Aureus and Znak.

- White, L.L., 1961, *Roger Josip Boscovich S.J. (1711-1787): studies of his life and work on the 250th anniversary of his birth*, London: G.Allen & Unwin.
- Widomski, J., 1996, *Ontologia liczby: wybrane zagadnienia z ontologii liczby w starożytności i średniowieczu*, Kraków: Wydawnictwo Uniwersytetu Jagiellońskiego.
- Zabierowski, M., 1998, *Wszechświat i metafizyka*, Warszawa: PWN.
- Ziółkowski, A.M., 1989, *Filozofia René Descartes'a*, Warszawa: Wiedza Powszechna.

Copyright of Forum Philosophicum is the property of Forum Philosophicum and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.

Copyright of Forum Philosophicum: International Journal for Philosophy is the property of Forum Philosophicum and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.