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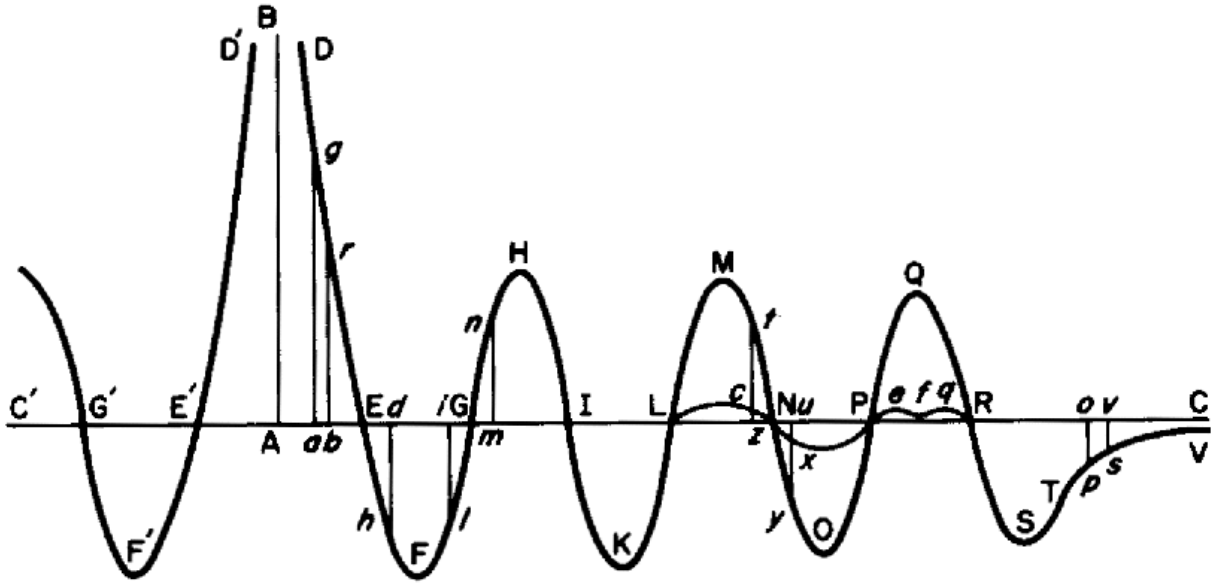
Boscovich distinction between the potential and the actual space from the standpoint of modern search for the union of mind and nature, especially in cosmology

(slides of the ppt-presentation)

Ruđer Bošković
(1711–1787)



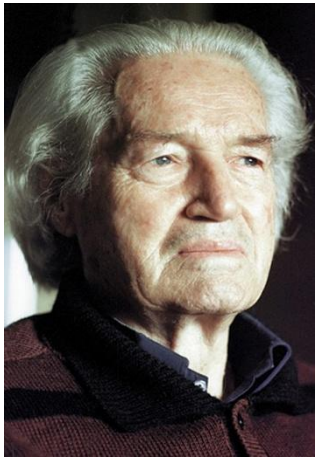
24th International Congress of History of Science, Technology and Medicine
Manchester, July 22, 2013

Abstract

Boscovich, in his treatise *De continuitate lege* (1754) applied the Aristotelian distinction between *potentia* and *actus* to his conception of space: the "potential" geometrical space is continuous and infinite, while the "actual" physical space is discrete, i.e., it is constituted of "points-atoms" which are bearers of a single force in nature that should be described by the universal natural law(s). In this way Boscovich tried to overcome the traditional opposites between empty space and physical objects, and also the principal philosophical controversy between idealistic and materialistic theories of nature. This distinction between potentiality and actuality was further developed in Boscovich's main work *Theoria Philosophiae Naturalis* (1758) where it served him to upgrade Newton's conception of forces into a unified "dynamic" theory of nature. In my contribution, the main point is that Boscovich's distinction between potential and actual space might be relevant and inspiring in modern search for unification of nature – i.e., not just for the unification of four basic physical forces in the so-called "Final Theory", but for *the union of nature and mind*, especially from the standpoint of modern cosmology.

Next to the treatise *De continuitate lege*, my starting point is Boscovich's Appendix to *Theoria Philosophiae Naturalis*, titled "*Ad metaphysicam pertinens: De Anima & De Deo*") – however, my contribution is not principally historical. My plan is the following: (1) first I shift and generalize Boscovich's distinction between *potentia* and *actus* from the classical geometrical space to the "phase space" of possibilities (we may call it also Hilbert space); (2) theoretical possibilities in the contemporary quantum physics and/or in cosmology can be conceived as different universes in a multiverse, in some "phase space"; (3) now, the principal question is the following: how the *actualization* (the "choice") in a huge space of possibilities happens (in cosmology, this is called the problem of "fine tuning"), especially whether *mind* has some role in this actualization; and finally (4): how Boscovich's conception of the "potential space", which he considers also as the "space of soul" (and/or of mind/spirit) vs. the "actual space" of physical point-particles, could be helpful for solving the modern "mind–body problem", not only in cognitive science, but also in cosmology, i.e., for solving the enigma of the putative "fine tuning" of our universe, which is *actually* – among and in spite of the huge number of theoretical *possibilities* for the values of the free physical parameters – "just fit for life". I think that Boscovich's ideas about soul and God in relation to nature might indeed be helpful in this great, perennial philosophical search, as well as in the contemporary scientific research.

Boscovich, unity of science and religion



Ivan Supek
(1915 – 2007)

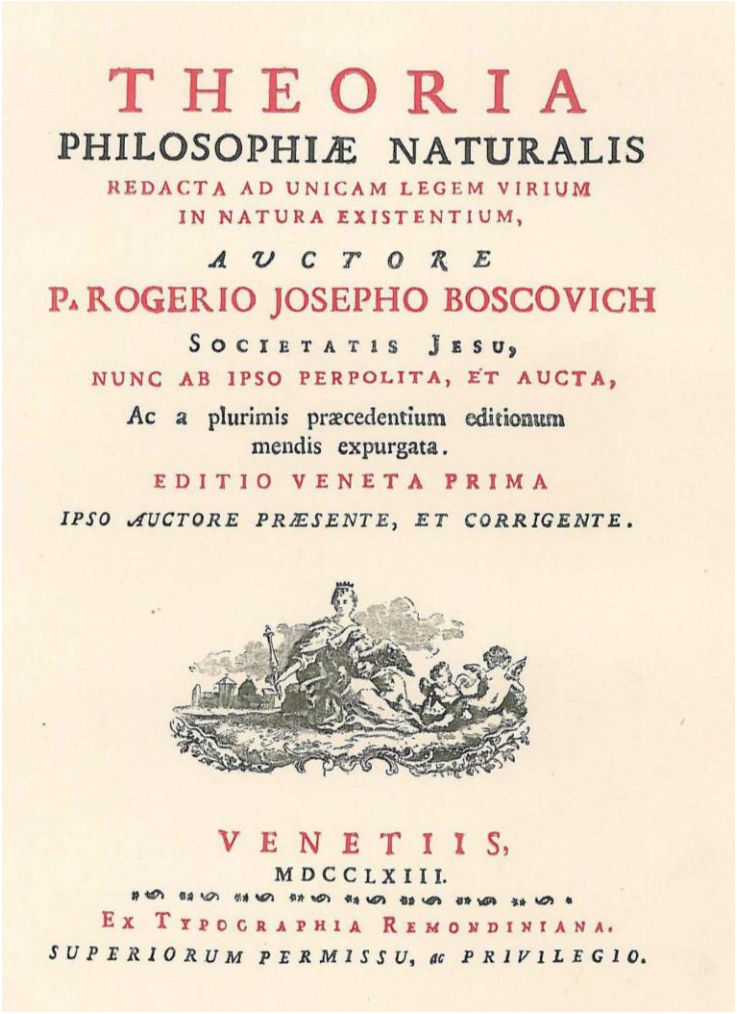
Let us begin with a fragment from the book:
Ivan Supek, *Ruđer Bošković*, *vizionar u prijelomima filozofije, znanosti i društva* <*a visionary in breaches of philosophy, science and society*>, Zagreb, 2005:

- "Roger Boscovich was one of the late humanists […] since in all his life he endeavored for the primeval unity of knowledge, arts and ethics […] He fervently tried to harmonize his research with his religious beliefs. […] Physics, from its beginnings, has been involving transcendental trends, while mystics has eventually helped the human phantasy to set free from rigidity." (p. 19, transl. by M. U.)

… and then Supek compares Boscovich's attitute with Einstein's views concerning religion:

- "To Einstein, Jehovah does not speak any more, but he comes closer to pantheism which, by deification of nature, throws light upon the marvelous existence of natural laws. Ruđer's last meditations also flowed in this direction, however, he strived to keep accordance with the dogma of the personal God." (p. 20)

Theoria philosophiae naturalis (1758, 1763)



THEORIA
PHILOSOPHIÆ NATURALIS
REDACTA AD UNICAM LEGEM VIRIUM
IN NATURA EXISTENTIUM,
AUCTORE
P. ROGERIO JOSEPHO BOSCOVICH
SOCIETATIS JESU,
NUNC AB IPSO PERPOLITA, ET AUCTA,
Ac a plurimis præcedentium editionum
mendis expurgata.
EDITIO VENETA PRIMA
IPSO AUCTORE PRÆSENTE, ET CORRIGENTE.

VENETIIS,
MDCCLXIII.
EX TYPOGRAPHIA REMONDINIANA.
SUPERIORUM PERMISSU, ac PRIVILEGIO.

THE THEORY OF NATURAL PHILOSOPHY,
put forward and explained by
ROGER JOSEPH BOSCOVICH …
Latin–English edition, from the text of
the first Venetian edition [1763],
edited & introduced by
J. M. Child [from Manchester University],
with the short biography by
Branislav Petronijević,
Open Court Publishing Company,
Chicago, London, 1922
(available also online, http://archive.org)

“The Law of Continuity”

- “The Law of Continuity <*continuitatis lex*>, as we here deal with it, consists in the idea that […] any quantity, in passing from one magnitude to another, must pass all intermediate magnitudes of the same class. The same notion is also commonly expressed by saying that the passage is made by intermediate stages or steps […] single states correspond to single instants <*singulis momentis*> of time, but increments or decrements only to small intervals of continuous time <*continuis tempusculis*>.” (TNP, § 32).

Cf. also Boscovich’s earlier treatise: *De continuitatis lege* (1754), § 131 ff.

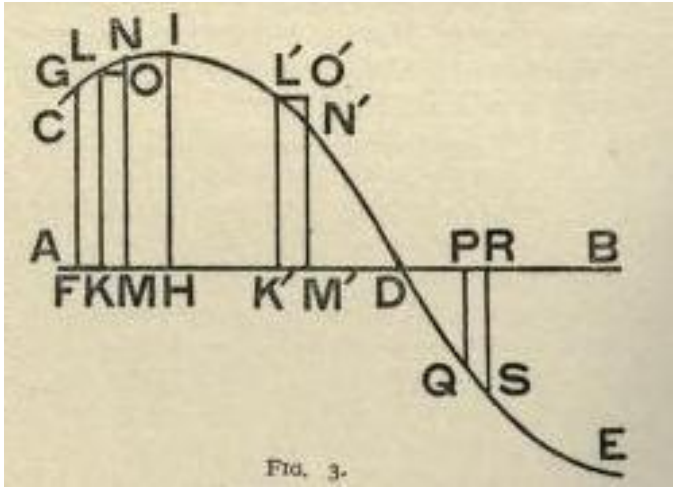
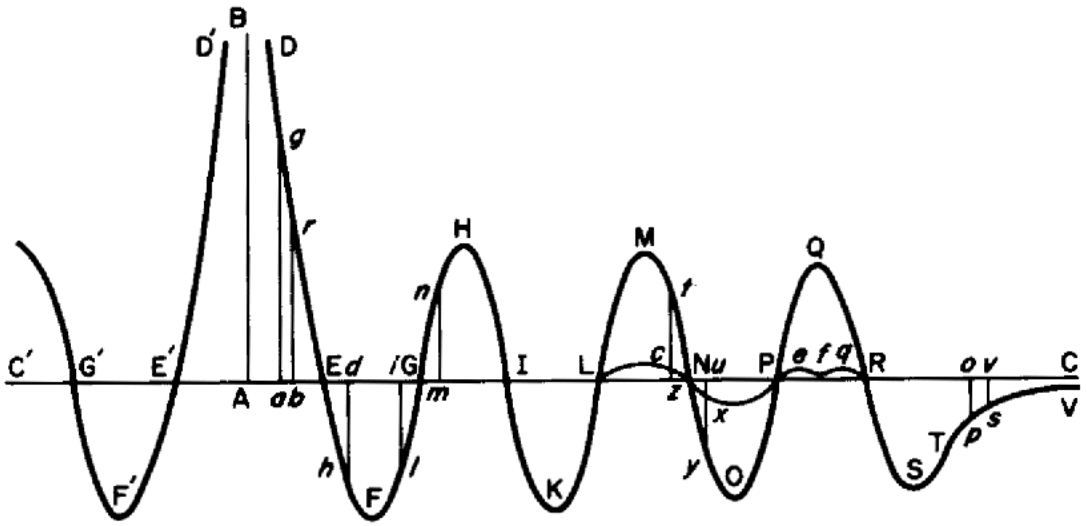


Fig. 3.

Boscovich's famous curve of the single force in nature



See: *TNP*, § 77

On the abscissa there are <u>distances</u> between point-particles (value *A* signifies zero distance), on the ordinate there are values of <u>forces</u> between point-particles, which could be either *repulsive* (positive values) or *attractive* (negative values), or "in balance" (zero values). The extreme right part of the curve (*TVC*) follows ~ Newton's inverse square law of gravity.

- "We have arrived therefore at repulsive forces that increase as the distances diminish, & increase indefinitely; that is to say, to the asymptotic arc, *ED*, of the curve of forces exhibited in Fig. 1" (above, § 77).

Nota bene: In the points where the curve intersects the abscise, there is no force, i.e., these points constitute a *static* "grid" (or "net") of point-particles.

“Grid” (or “net”) of discrete point-particles in the continuous space, which changes its configuration in time

- “Now, because the repulsive force is indefinitely increased when the distances are indefinitely diminished, it is quite easy to see clearly that no part of matter can be contiguous to any other part; for the repulsive force would at once separate one from the other. Therefore it neces-sarily follows that the primary elements of matter are perfectly simple, & that they are not composed of any parts contiguous to one another. This is an immediate & necessary deduction from the constitution of the forces, which are repulsive at very small distances & increase indefinitely.” (§ 81, underlined by M.U.)

These “primary elements of matter”, perfectly simple point-particles, can be considered as *metaphysically conceived physical atoms* of the actual *physical* (material) reality, which rise up from potentiality to actuality, and return back to mere potentiality – in the *continuous potential* (or “imaginary”) *space*.

Space-distance and motion are continuous, matter is discrete

- "Hence I acknowledge continuity in motion only, which is something successive and not co-existent […] Nature accurately observes the Law of Continuity, or at least tries to do so. Nature observes it in motions & in distance, & tries to in many other cases …" (§ 143, underlined, also below, by M.U.).

Then Boscovich mentions some examples of the apparent material "continuity", where discreteness of point-particles is hidden "in depth":

- "Thus, in the channels of rivers, the bends in foliage, the angles in salts, crystals and other bodies, in the tips of the claws that appear to the naked eye to be very sharp in the case of certain animals; if a microscope were used to examine them, in no case would the point appear to be quite abrupt, or the angle altogether sharp, but in every case somewhat rounded, & so possessing a definite curvature & apparently approximating to continuity. Nevertheless in all these cases there is nowhere true continuity according to my Theory; for all bodies of this kind are composed of points that are indivisible & separated from one another …" (§ 144).
- "To me, matter is nothing but indivisible points, that are non-extended, endowed with a force of inertia, & also mutual forces represented by a simple continuous curve having those definite properties which I [have already] stated …" (§ 516).

Boscovich's basic ontological (Aristotelian) distinction between *infinite potentiality* and *finite actuality* (i.e., material reality)

In the Supplement №1 to *TNP*, titled ***On Space and Time,*** Boscovich distinguishes between potentially *infinite* "real points of position" and numerically *finite* "real points of matter":

- "Hence beyond & between two real points of position of any sort there are other real points of position possible […] without any determinate limit. There will be a real divisibility to an infinite extent of the interval between two points, or, if I may call it so, an endless 'insertibility ' of real points. However often such real points of position are interpolated, by real points of matter being interposed, their number will always be finite […] & there will be no gap that cannot be diminished by adding fresh points in between; although it [i.e., gaps in the space continuum] cannot be completely removed either by division or by interposition of points." (§ 8)
- "In this way, so long as we conceive as possibles <*possibilia*> these points of position, we have infinity of space, & continuity, together with infinite divisibility. With existing things there is always a definite limit, a definite number of points, a definite number of intervals; with possibles, there is none that is finite." (§ 9)

Boscovich, a century before Cantor's infinities (a very short analysis)

Boscovich distinguishes several "orders" of infinities, for example, continuum of a 3D space is infinite of the "third order". This is, of course, *not* a proper Cantorian concept of the orders or "powers" of infinities, nevertheless, let us look how Boscovich's potential infinity of space "position points" might be interpreted from Cantor's conception of transfinite sets:

1) Suppose that "points of matter" were *infinite* by number (although Boscovich argues they are finite, nevertheless their number is enormous, some "googol number") – in this case, their cardinality would be at most $\aleph_0$ (Aleph-0), since they are *discrete* points, not a continuum with cardinal number $\aleph_1$ (Aleph-1), and following the famous Cantor's "continuum hypothesis", there is no other transfinite cardinal number between $\aleph_0$ and $\aleph_1$.
2) Following Cantor's formula that continuum is the "power set" of $\aleph_0$, of numerical infinity, i.e., $\aleph_1 = 2^{\aleph 0}$, there are as much ($\aleph_1$) *combinations* of actual (physically real) static "set-ups" (or "grids" or "nets") of "matter points" in the spatial continuum of "position points". However, in case that "matter points" are *not* (numerically) infinite, as Boscovich claims, and their number is some very large googol number N, there are still 2^N of their combinations, that is possible configurations of the physical "grid".

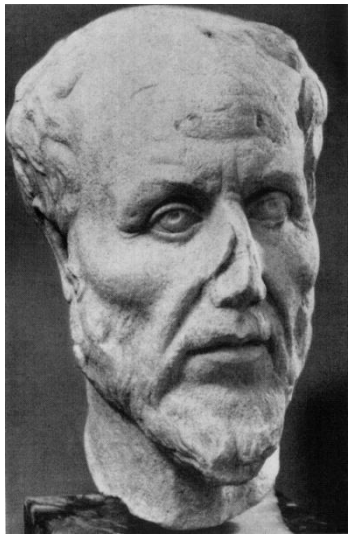
In any case, the set of *possible configurations* of "matter-points" (we may say, the power of their "phase space") is much larger that the set of themselves.

The infinite, possible space-continuum as the *topos* of the soul?

In the Appendix to *TNP*, titled ***De Anima, & Deo*** (in English translation: *On Mind and God*), Boscovich considers, *inter alia*, the question in which part of the human body the soul is situated (Descartes suggested in the pineal gland), or it <she!> is maybe present in the whole body – and after having stated that this issue cannot be reliably answered by science, Boscovich wrote the following impressive metaphysical speculation (it is worth to quote a larger passage):

- "But if it [she, *anima*, soul] should extend throughout a great part, or even the whole, of the body, that also would fit in excellently with my Theory. For, by means of such virtual extension as we discussed in Art. 83, the mind <*anima*> might exist in the whole of the space containing all the points which form that part of the body, or that form the whole body. With this idea, in my Theory, the mind <*anima*> will differ still more from matter; for the simple elements of matter cannot exist except in single points of space at single instants of time, each to each, while the mind <*anima*> can also be one-fold, & yet exist at one & the same time in an infinite number of points of space, conjoining with a single instant of time a continuous series of points of space; & to the whole of this series it will at one & the same time be present owing to the virtual extension it possesses; just as God also, by means of His own infinite Immensity, is present in an infinite number of points of space (& He indeed in His entirety in every single one), whether they are occupied by matter, or whether they are empty." (§ 537, underlined by M. U.).

Plotin's metaphor of a net in the sea (*Enneads*, IV. 3. 9. 40–45)



Plotin
(204–270)

- "The universe lies in soul which bears it up, and nothing is without a share of soul. It is as if a net immersed in the waters was alive, but unable to make its own that in which it is. The sea is already spread out and the net spreads with it, as far as it can; for no one of its parts can be anywhere else than where it lies. And soul's nature is so great, just because it has no size, as to contain the whole of body in one and the same grasp; wherever body extends, there soul is." (Translated by A. H. Armstrong, 1984, underlined by M. U.)

The space of possible combinations of physical "set-ups" as a model for the cosmological *multiverse*

Multiverse (a set of many universes) can be considered as a – possibly infinite – multidimensional "phase space" (in Hilbert's sense) of possible configurations, "set-ups" of physical and/or cosmological fundamental constants (or "free parameters").

In Boscovich's words: the "definite curve of forces […] can be varied in an infinity of ways" (*TNP*, § 542); so it is the source of infinite (or at least googol-large) number of different combinations of "matter-points" – it is the source of a multiverse.

Boscovich has already formulated the problem which is nowadays known as the enigma of the "fine-tuning" of our universe among many other possible universes:

- "… in this immense number of combinations, there will be, for any kind, infinitely more irregular combinations, such as represent indefinite chaos & a mass of points flying about haphazard, than there are of those that exhibit the regular combinations of the Universe, which follow definite & everlasting laws [… that is, laws of] such an Universe as we see & wonder at." (§ 543)

… and from here there is only one step to Boscovich' s theological solution:

- "Then, to overcome definitely this infinite improbability, there would be required the infinite power of a Supreme Founder selecting one from among those infinite combinations." (*Ibid*.) – However, this great question remains open …

Thank you for your attention!