Programme

Thursday, September the 8th

14,30 Registration of participants

15,00 Welcome address:

Angiolino Stella, Rector of the University of Pavia

Institutional representatives of the Edizione Nazionale delle Opere e della Corrispondenza di R. Boscovich

15,30 Introduction to the Conference:

Edoardo Proverbio – Commissione Scientifica Edizione Nazionale

16,00 Key note speakers

John L. Heilbron - Worcester College, Oxford

16,45-17,00 Coffee Break

Ugo Baldini - University of Padova

Edoardo Proverbio - INAF **-** Osservatorio Astronomico di Brera

18,30 Opening of the exhibition: "Boscovich and his time through the Pavia University Library Collections"

19,00 Welcome Cocktail

Friday, September the 9th

9,00 Invited speakers:

Ivica Martinović - University of Zagreb

Salvo D'Agostino - University of Roma "La Sapienza"

10,30 Coffee Break

10,45 Contributions:

Barbara V. Villone - Istituto di Fisica dello Spazio Interplanetario, INAF

Augustus Prince - Brookhaven National Laboratory

James McAllister - University of Leiden

Fabio Bevilacqua, Angelo Chierico - University of Pavia

12,45 Visit to the University sundials

13,00 Break

14,30 Invited Speakers:

Hans Ullmaier - Forschungszentrum Jülich Gmbh, Jülich

Enrico Giannetto - University of Bergamo

Arcangelo Rossi - University of Salento

16,15 Coffee Break

16,30 Contributions:

Lucio Fregonese - University of Pavia

Dragoslav Stoiljkovic - University of Novi Sad

Davor Krajnovic - European Southern Observatory, Garching Bei München

Roger Anderton - United Kingdom

18,30 Visit to the Museum for the History of the University

20,00 Conference Dinner

Saturday, September the 10th

9,00 Invited Speakers:

Stanislav Joze Juznic - University of Ljubljana

Pasquale Tucci - University of Milano

10,00 Contributions:

Luciano Agnes - Pavia

Efthymios Bokaris and **Vangelis Koutalis -** University of Ioannina

Eri Yagi - Eri Yagi Institute for History of Science, Tokyo

11,20 Coffee Break

11,35 Contributions:

Ivan Mirnik - The Zagreb Archaeological Museum

Marco Martin - Liceo Classico D'Oria, Genova

Daniele Macuglia - University of Chicago

13,00 Break

14,30 Invited Speakers:

Luigi Pepe - University of Ferrara

Cesare Tocci e **Danilo Capecchi -** University of Roma "La Sapienza"

Luca Guzzardi – INAF – Osservatorio Astronomico di Brera

16,15 Coffee Break

16,30 Contributions:

Elio Antonello - INAF **-** Osservatorio Astronomico di Brera

Ezio Vaccari - University of Insubria, Varese

Maria Giulia Lugaresi - University of Ferrara

Riccardo Balestrieri - SAIt, San Marino

18,30 Concluding remarks: A panel on the future of Boscovich's *Opera Omnia* Project and on the related historiographical problems:

U. Baldini, F. Bevilacqua, J. L. Heilbron,
I. Martinović, E. Proverbio, H. Ullmaier.

Abstracts

Thursday, September the 8th, 2011

John L. Heilbron, Worcester College, Oxford

A Jesuit Mathematician at Loose in the Republic of Letters

After some 35 years at the Roman College, Boscovich began to roam the wider Republic of Letters. He had several once-useful techniques for finding his way: a great facility in Latin and in geometry, practiced self-discipline, some experience as a courtier, and a command of Newtonian physics in the form in which Newton had left it. All this he acquired at and from the College. His efforts to develop Newton's ideas gave him additional tools. His geodetic survey of the Papal States, which concerned the earth's shape as well as the Pope's dominions, brought him expertise in practical astronomy and surveying, and contacts in the highest reaches of ecclesiastical authority. His theory of matter, a generalization for Jesuits of Newton's physical theories, established him as a philosopher, destabilized teaching at the College, and distanced him from it. At first the learning and character he brought from Rome recommended him to the learned and powerful he met on his journeys. Subsequently, and almost in step with the decline of the Society of Jesus, his authority and accomplishments lost their edge and appeal. That did not stop the growth of his self-esteem, however. By the time the Society was suppressed, he too had become insufferable. A few analogies to the case of Galileo suggest themselves.

Ugo Baldini, University of Padova

Physics and metaphysics in Boscovich

Comparisons of Boscovich's scientific work with those of such great physicists- mathematicians of his time as Euler, Clairaut or d'Alembert may employ – and have in fact employed – as frames of reference such different things as: internal technical parameters (for instance, the kind or level of the mathematics employed); contextual elements (as the epistemic conventions and the "style" of an individual's intellectual milieu); "neutral" scales of originality, generality or fecundity of methods and/or results; an assessment of a scientist's main research themes with respect to the mainstream of scientific progress in his time; the singularity of the "tone" of his most characteristic ideas or theses (in Boscovich's case, for instance, the link between an unique force in nature and a "pointed" conception of matter).

All of them may produce pertinent and interesting judgments; however, a fundamental element perhaps characterizes and explains the peculiarities of the Jesuit's scientific "way" much more specifically and internally. Certain parts of Boscovich's work – in fact, the most typical ones **-** exhibit, at a basic conceptual level, an intertwining between scientific terminology and procedures (as current in the mid-eighteenth century) and others that, at a first approximation, may be qualified as categorical - metaphysical. An evident example is the continuity principle, introduced by Boscovich as an a priori tool to establish conditions and properties obtaining for the whole of nature.

Most academic scientists of his time - d'Alembert being only the best known case – judged that intertwining partly as a relic of a pre-modern form of intellectual discourse, to be excluded from any evaluation of the Dalmatian's scientific contribution (which, when so "purified", they estimated to be of middle, or even low, level); partly as an attempt by a *charlatan orgueilleux* (as d'Alembert qualified him) to achieve undeserved prestige by means of ungrounded or fictional ideas and results. A close inspection, however, shows that elements coming from the metaphysics tradition are essential for the structure of some of Boscovich's most admired conceptions, specially of those that seem to foreshadow aspects of today's theoretical physics much more than does the purely "technical" Newtonianism of his contemporaries.

In extreme synthesis, those elements are to be attributed to his studies in the Society of Jesus. Around 1730, in the best schools of the Society the (declining) tradition of Aristotelian natural philosophy and metaphysics merged with a growing treatment of recent mathematical physics. On one side, this resulted in

Boscovich's technical equipment (mainly in advanced mathematics) being backward with respect to that of authors formed in more "modern" contexts than his, and this had a role in originating some reductive and supercilious judgments on his works. On the other side, it enabled him to insert into technical Newtonian discourse an essential aspect of the medieval tradition: namely, the view of the perceived world as just one of the many (infinite?) ones that God could produce.

It is important to observe that in Boscovich this is not just a pure logical-ontological principle, as is in Leibniz. He considered the basic, a priori conditions for some of the "alternative" universes, arguing that perhaps they coexist in fact, though being mutually unperceivable; and in considering this he did not limit himself to the logical generalities of the Scholastic cosmology, but introduced some of the physical parameters typical of post-Newtonian science. So he made some (generally unappreciated, and even despised) steps toward transforming a formerly speculative theme for mainly verbal disputes into a decisive enlargement of the phenomenical world of his time's science.

Most contemporaries did not perceive the importance of this, because their intellectual background made them unable (or unwilling) to look for the new contents under the surface of Boscovich's link with the scholastic metaphysical tradition. So his prefiguration of a dramatic amplification in the conceptions of physical reality was ignored or mistaken as something spurious and external to proper science.

This paper aims to substantiate the interpretation stated above, also using texts little considered so far. If correct, the perspective suggested has far-reaching implications, inasmuch as it may show that highly innovative conceptions in the natural sciences may derive from unforeseeable and "unlikely" combinations of elements, some of which may appear, if not intrinsically unscientific, at least external to the modern ideas of what natural science is and how it should be practiced.

Edoardo Proverbio, INAF – Osservatorio Astronomico di Brera

Ruggiero Giuseppe Boscovich's research into producing quasi-achromatic and aplanatic compound lenses and eyepieces made of one single material

Ruggiero Giuseppe Boscovich's interest in light phenomena and astronomical optics started with his early research at the *Collegio Romano*. His first trip to France and then England (1760), when he got to know the chief opticians and optical experts in these two countries, and then when John Dollond's work, published in London in 1768, presenting his first achromatic telescope, came out, occasioned his directing interest towards theoretical and practical problems connected with producing lenses and achromatic telescopes. At that time no theory on these achromatic systems had been made public but we can say that Boscovich was already clear, towards the end of 1760, why correction of chromatic aberration was possible using lenses of different refractive indices.

Unfortunately his long sea trip to Constantinople, then back by land to Vienna and Rome (1761 and 1762), took his mind off these problems, just when Clairaut and Klingenstierna published their first theoretical works, and John Dollond and his son Peter took out a patent for producing achromatic telescopes, and when, in Paris, Clairaut and his numerous collaborators produced the early compound lenses and achromatic telescopes.

After he returned to Italy, frenetic activity between August 1763 and 1765 helped Ruggiero Boscovich regain the ground lost to Clairaut and Klingenstierna. He could also deal, for the first time using quantitative methods, with measuring the refraction and dispersion of glass used in achromatic systems in lenses and eye-pieces. He designed and made measuring instruments for the purpose. He dealt with the equally important issue of measuring and checking sphericity in these lens systems, so he was, we can assert, the founder of modern refractometry and spherometry.

In the second half of the 18th century the main difficulties in producing good lenses and achromatic eye-pieces were connected with the difficulty of getting the extremely rare lead crystal (English flint glass), devoid of faults (veins, twists, bubbles, etc) that made glass unsuitable for optics. Aware it was difficult to get good lead crystal, like flint glass or strass (produced in Austrian territories), Boscovich brought out a lens made with two pieces of ordinary glass, in March 1780. This could correct refraction aberrations by 1/3 and also diminish spherical ones. The *Accademia delle Scienze di Padova* too was interested and set up a prize competition. For various reasons, Boscovich showed he was not satisfied with his discovery.

Several years before, about 1775, he had thoroughly dealt with the problem of correcting chromatic aberrations in eyeglass lenses. He had designed various achromatic eyeglasses with lenses of a single material, which he documented well in *Opera pertinentia ad Opticam et Astronomiam*, published in 1785. Here he detailed his experiments and results for producing lenses and eye-pieces corrected for spherical aberration using systems of lenses of a single material.

Account is given of all these researches and observations of considerable interest to astronomical optics, which have remained strangely in the shade, until now.

Friday, September the 9th, 2011

Ivica Martinović, University of Zagreb

Distinctive characteristics of Bošković's natural philosophy

Besides lecturing in mathematics and astronomy at the *Collegium Romanum*, that is, during his regular activities as a professor, Ruđer Bošković constructed an original theory of forces – the core of his natural philosophy. This he achieved through a series of treatises (dissertationes) from 1743 onwards, when he first questioned a problem from Euler's *Mechanica* (1736), to his last writing – annotations to the third volume of Benedikt Stay's epic *Philosophia recentior* on Newton's and Bošković's natural philosophy, published posthumously in 1792.

Bošković's philosophemes formulated and published during this long research may be classified into four groups. The results of Bošković's reasoning on force and matter between 1743 and 1755 fall into the first group:

1. the theory of forces, with three distinctive characteristics: definition of force as *determinatio*, introduction of the potentially infinite repulsive force at the infinitely small distances, and the genesis of the curve of forces (*curva Boscovichiana*), with which the philosopher from Dubrovnik aimed to explain all the known physical phenomena;

2. explanation of the structure of matter on the basis of his fundamental conclusion: extended body is composed of "the perfectly indivisible and unextended points, which are mutually separated by a certain interval and connected by certain forces that are at one time attractive and at another repulsive, depending on their mutual distances" (1755), with a clear distinction between "elementary" points of matter and particles of higher orders;

3. doctrine on space and time as "real modes of existence" (*reales modi existendi*), but without clear ontic status.

The second group of Bošković's philosophemes rests upon his views of Newton's natural philosophy:

4. views of inertia, with an intriguing philosophical evolution from 1747 to 1758;

5. disregard of Newton's second law of motion;

6. modification of Newton's law of universal gravitation.

The third group of Bošković's distinctive views includes the applications of his theory of forces "to physics", which he developed between 1745 and 1758:

7. the application of the theory of forces to the general properties of matter;

8. the application of the theory of forces to the »principles of chemical operations»

The fourth group is concerned with Bošković's views of the fundaments of special physics – from theory of heat and optics to electricity and magnetism, where he failed to submit or expound his own solutions:

9. thesis on the nature of fire;

10. theses on the nature of taste and smell;

11. thesis on the nature of light;

12. theses on the nature of electricity and magnetism.

With regard to the theses in group four, one can merely establish with whom Bošković shared his views or disagreed.

These twelve philosophemes clearly determine Bošković's role in the history of natural philosophy, and represent an excellent aid in recognizing and distinguishing Boscovichians, who, especially after the publication of *Theoria philosophiae naturalis* in 1758, emerged among the British scholars from London to Edinburgh, among university professors of Central Europe from Vienna to Tyrnau, and among the professors at philosophical schools in Croatia – from Zagreb and Čakovec to Ilok.

Salvo D'Agostino, University of Rome "La Sapienza"

Boscovich's Theoria Philosophiae Naturalis as a Synthesis between a Relativistic and a Structure - of - Matter Theories

In 1758, Roger Joseph Boscovich published his masterpiece *Theoria Philosophiae Naturalis*, where he presented in a united and systematic form theories that were inspired by his previous researches. One of his early sources of inspiration was his study of a theory of collisions, published in *De Viribus Vivis* (1745). The other source of inspiration was his 1748 work on optics, *De Lumine*, where he examined optical theories in connection with optical and astronomical observations. Modern scholars have expressed various views on the prevalence of either one or the other of the above mentioned works by Boscovich as sources of inspiration for his *Theoria*.

Although both theses illuminate relevant features of Boscovich's masterpiece and both thus deserve due consideration, it is my conviction that the problem of the sources of inspiration for Boscovich's masterpiece can be answered only after a careful evaluation of the nature and scope of this same work. Whether to consider *De Viribus Vivis* or *De Lumine* as the main source for *Theoria* depends on how we interpret the relative significance of the two theories within the context of *Theoria*. If this work is more than else a relativistic mechanical theory illustrated by the relativistic conceptions therein presented, then *De Lumine* is its main source of inspiration, but the opposite would be the case if we considered *Theoria* mainly as an early example of a structural theory of matter founded on Boscovich's celebrated force-law.

In my thesis, *Theoria* presents both aspects, i.e. at the same time it reconciles a relativistic theory with a structure-of-matter theory and, moreover, this is precisely the feature that characterizes Boscovich's main opus, and differentiates it from our modern theories. In fact modern Relativity and structural theories do not necessarily overlap in modern physics. Einstein's theory is relativistic without directly concerning any structural theory of matter and modern theories on the structure of matter are not necessarily relativistic (other non-relativistic structural theories as exemplified by the 19th century integrating-molecules theories).

Both the *De Viribus* and the *De Lumine* are thus to be considered on an equal footing as the sources of inspiration for *Theoria*, provided that the characterizing features of Boscovich's work are properly understood. As regards the structure-of-matter features of Boscovich's *Theoria* they can be grasped from Boscovich's reaction to Newton's mechanics. The understanding of the real nature and scope of Boscovich's theory does not diminish our appreciation for the greatness of his contributions. Rather, it allows us to evaluate more precisely his historical position in the development of 18th century science and gives us a more solid ground for this appreciation.

Barbara V. Villone, Istituto di Fisica dello Spazio Interplanetario, INAF

The Boscovichean concept of space and time in the Supplementa to Philosophiae Naturalis Theoria

In this paper I analyze the Boscovichean concept of both space and time from the starting point of the *Supplementa* in the *Philosophiae Naturalis Theoria*. An important point investigated in the paper is the analogy between space and time as it is discussed in the work of Boscovich. Also the connection between the concept of matter and both the idea of space and time and the idea of the real modes of existence, local and temporal, for the points of matter is studied, with an analysis of both the Boscovichean paradigms of "existence" and "capability of existence".

An examination of the difference of the concept of space and time in Boscovich's works with the same concepts in Newton's and Leibnitz's works is presented.

In this paper is also discussed the great contribution of Roger Boscovich to the idea of "field", as a tool to investigate the nature, which has been later developed by Faraday. Other original contributions of Boscovich connected with space and time will be thoroughly examined.

Augustus Prince, Brookhaven National Laboratory

An Analytical Form of the Boscovich Curve with Applications

Using an analysis from a physical and phenomenological viewpoint employing the renowned and recognized continuity of Boscovich's force curve, a new paradigm is formulated to explicate various physical phenomena in both the micro-world and the macro-world.

Within this paradigm, an algorithm is established which produced a functional representation of the atomic spectra of hydrogen and a temperature dependent black-body energy distribution of radiation which compares very favorably with the experimental data. Further representations afford suggestions for the predictions of the specific heat of solids, photoelectric effect, etc. The Boscovichian points are assumed to move under the action of a force (acceleration) that varies inversely proportional to the cube of the radius from the point center, which leads to an orbit described by an equiangular (logarithmic) spiral. This spiral is subsequently used to simulate the concepts used in phyllotaxis (a constituent of plant morphology) and the gnomonic growth of mollusk shells (e.g. nautilus).

The intercepts for the stable and unstable points on the Boscovich curve which are the roots of the equation used, are calculated via the application of Fibonacci-type sequence of integers.

In addition, utilizing the shape of Boscovich's "extended" curve of force (acceleration), the prospect of interpreting the mysterious attractive force beyond the visible Newtonian region of space (e.g. black holes, dark energy, etc.) is proposed.

It is hoped that this phenomenal approach will serve as a beginning for description of both the micro-universe and the micro-universe .

James McAllister, University of Leiden

Boscovich, the Paradoxes of Contact Action, and the Rise of Dynamism

Classical physical science envisages two ways in which causal influence may be transmitted between bodies: contact action and action at a distance. Traditionally, the notion of contact action has been regarded as the paradigm of intelligible phenomenon. What could be more familiar than the idea that two hard bodies, such as billiard balls, collide and thereby transmit an influence from one to the other? By contrast, the idea of action at a distance has been regarded as more opaque: how can causal influences propagate from one body to another without an intervening medium?

Roger Boscovich turned this view on its head. Assuming the principles of impenetrability of matter and of continuity, Boscovich argued that, before two solid bodies can collide, their velocities must be equalized by some repulsive force that extends beyond its surface. This force, rather than impact, is the true mechanism by which motions are transferred. Boscovich thus eliminated the notion of contact action from natural philosophy, arguing that it is mechanistically less intelligible than action at a distance. The Boscovichean theory can thereby be regarded as diametrically opposed to the Cartesian theory: René Descartes acknowledges only matter, denying the existence of force except in a trivial sense as a label for that which prevents particles from interpenetrating, while Boscovich acknowledges only force, denying the existence of matter except in a trivial sense as the source of a strong repulsive force.

This paper examines Boscovich's solution to the paradoxes of contact action and the implications of his view that the essence of matter was a resisting power rather than solidity, a view that has been given the name "dynamism".

Fabio Bevilacqua e **Angelo Chierico**, University of Pavia

Boscovich, the "vis viva" Debate and the Unitary Law of Force

The sixth volume of the *Edizione Nazionale delle Opere e della Corrispondenza di R. Boscovich* will be dedicated to a set of small books on natural philosophy which, while preceding the *Theoria* (Wien 1758, Venice 1763), have unfortunately received much less attention, namely: the *De Viribus Vivis* (1745), the *De Continuitatis Lege* (1754), the *De Lege Virium* (1755), and the *De Materiae Divisibilitate* (1757). Except for the *De Continuitatis* there are no existing translations: work is in progress towards an Italian translation of the four booklets and of the *Theoria*.

The unitary law of force appears for the first time in 1745 in the *De Viribus Vivis*. The well-known dimensional identification with living forces of the areas outlined by the geometrical representation of the law indicates the relevance of Boscovich' s work for the history of energy conservation.

In the *De Viribus Vivis* there is also the first formal solution of the long-lasting "vis viva debate": quantity of motion deals with effects in time while living force with effects in space. This was prior to d'Alembert's similar approach which only appeared in the 2nd edition of his *Traité de dynamique* (1758).

But what does Boscovich mean by "vis viva"? Why does he deny its "existence"? He demonstrates a deep knowledge of the contemporary literature and of the various meanings attributed to "vis viva conservation" by various authors, basically conservation during collisions, conservation at given positions and conservation during motions.

Among Boscovich's successors who dealt with various interpretations of the *vis viva* debate, Lagrange (1788), Helmholtz (1847) and Planck (1887) will be briefly discussed.

Hans Ullmaier, Forschungszentrum Jülich and Technische Hochschule Aachen, Jülich

Boscovich's Pioneering Ideas on the Elementary Structure of Matter

After a short introduction, definitions of some terms used in the lecture are given, in order to avoid confusion of their earlier and present-day meaning. Then the key assumptions of classical atomism and Boscovich's "atomism", respectively, and the resulting characteristic differences are discussed.

Boscovich's model of matter led to several new aspects which influenced the subsequent research in this field. Boscovich was the first who
- pointed out that our (common) senses fail in the world of microcosm
- anticipated the divisibility of atoms
- attempted a "theory of everything" (→ TOE) by postulating one kind of elementary particles (*puncta*) and one universal force law (*curva Boscovichiana*)
- emphasized the importance of the spatial arrangement (= structure) of the elements of matter

In my opinion the last aspect has somewhat been neglected in the literature on Boscovich. Therefore I will discuss in some detail the various ways of agglomeration of *puncta* to form *particulae* of manifold sizes, shapes and internal structures. Then some of the resulting consequences will be illustrated by means of a few examples (polymorphism of carbon, hardening of steel, etc.).

Finally I will summarize my contribution and stress the great influence of Boscovich's ideas on the development of condensed matter physics.

Enrico Giannetto, University of Bergamo

Boscovich's Theoria Philosophiae Naturalis

Principles and fundamental concepts of Boscovich's *Theoria* are discussed by a comparison with Newtonian and Leibnizian traditions of Natural Philosophy. In particular, the concepts of matter, force, space, time and motion are analyzed for their relevance in relativity problem.

Arcangelo Rossi, University of Salento

R. J. Boscovich's Philosophy of Space

In 1753 R. J. Boscovich raises a very important issue on the structure of physical space in contrast with Newton's conceptions. According to Boscovich, it is not possible to put in evidence an absolute motion when it is composed by, "*exempli gratia*", a rotation plus a common inertial motion. In fact, sometimes, the latter can even overcome the former and reduce it to a mere relative motion, while being itself undetectable. Thus, Boscovich made explicit, for the first time, the full dynamical meaning of Galilean Relativity as the impossibility of detecting an absolute motion by mere dynamical means.

Afterwards, Boscovich's conception of space is also linked to the unique force law by which he represents all the phenomena in the universe in his "*Philosophiae Naturalis Theoria*" of 1758. There, he reduces matter to unextended point atoms acting according to their reciprocal distances. Therefore, Boscovich identifies space with the universal force pervading the whole universe and differentiated according to the special relations between point atoms, in contrast with Newton's distinction between (absolute) space, matter and force.

Lucio Fregonese, University of Pavia

Heat and Electricity in Boscovich's Theoria philosophiae naturalis

In his famous treatise *Theoria philosophiae naturalis* the Jesuit Ruggiero Giuseppe Boscovich (1711-1787) devoted some sections to heat and electricity.

Thermal phenomena, he maintained, result from a subtle "fermenting substance" (*substantia fermentescens*) having "elasticity" (*elasticitas*) and "expansive force" (*vis expansiva*). Besides this, he required a force of attraction acting between the subtle thermal fluid and the matter of bodies and worked out a detailed molecular model in which thermal phenomena are interpreted in terms of both attractive and expansive forces.

In the sections devoted to electricity Boscovich assumed that the chief phenomena observed in this area conform to the same principles as heat, but assumed at the same time that the phenomena of the Leyden jar are ruled by "another principle".

In this presentation both the thermal and electrical elaborations of Boscovich will be analyzed in detail and put in relation with the ideas and physical models of central coeval figures working in the same areas, such as Joseph Black (1728-1799), Benjamin Franklin (1706-1790) and Giambatista Beccaria (1716-1781).

Dragoslav Stoiljkovic, University of Novi Sad

Contemporary Verifications and Applications of Boscovich's Theory of Natural Philosophy

The modern scientists usually no longer mention Boscovich, however, and perhaps they no longer find him a source of stimulation in their explanations of specific phenomena, but there is no doubt that their results can be remarkably related to Boscovich's theory. An outline of Boscovich's theory and its confirmation by contemporary science achievements are to be presented.

Numerous achievements of modern science show that Boscovich was right in many respects, especially where his curve of forces is concerned. We have found in modern literature the several dozens of two particles interaction curves that confirm the similarity with Boscovich curves in a wide range of the hierarchy of matter: nucleons, nucleons and lambda zero hyperons, atoms (the chemical and the physical interactions), molecules, charged colloidal particles, clay particles, macromolecules, and nano-particles.

The similarity of the current interaction curves with Boscovich's curves is evident. The only difference is that the energy (E) is presented on ordinates, instead of force (F) as it was done by Boscovich. Knowing that there is the relation $F = - dE/dr$, however, an energy curve can be easily transformed into a force curve: the minimum and maximum values of energy curves correspond to the limits of cohesion and non-cohesion on Boscovich' s force curve.

Furthermore, several times we have applied Boscovich' s theory to solve some current scientific problems: (1) physical meaning of cohesion and non-cohesion limits on Boscovich' s curve; (2) the calculation of specific volume of matter at some characteristic states; (3) explanation of supra-molecular organization and free radical polymerization of liquid methyl methacrylate and compressed ethylene gas; (4) prediction of effect of pressure on melting temperature of low density polyethylene. A short outline of these applications will be presented, too.

Davor Krajnovic, European Southern Observatory, Garching Bei München

Legacy of Bošković: Understanding assumptions and knowing uncertainties

Research in modern astronomy has moved a great deal from the topics of interests of Boškovićs's day, although striking similarities exit in the way ideas develop and propagate within the scientific community. Bošković addressed problems at the forefront of the research, some of which aroused a great deal of controversy, but ultimately contributed to the advancement of our understanding of the Universe.

In my contribution, I will compare two scientific achievements of Bošković, his approach to the motion of Earth in space and his method of deriving trajectories of comets, with two controversies of modern astronomy: the existence of dark matter and the shape of the light distribution in galaxies. While these topics seem unrelated, the link is ultimately in our (in-)ability to measure phenomena to a precision which can rule out one of the hypotheses. There, one can recognize perhaps the most lasting influence of Bošković on modern research: his insistence on understanding the uncertainties of the instruments and the assumptions of the methods used is the crucial aspect without which modern science would not be able to make progress.

Finally, I will compare the effort of Bosković in organizing a successful 18th century astronomical observatory with the European effort to build a telescope of 42m aperture, making it the largest telescope in the world.

Roger Anderton, United Kingdom

Boscovich's Influence on Einstein's Unified Field Theory Research

Unified field theory comes from Boscovich's idea of there being spheres of influence around point-particles; this became his theory of atomism. Faraday called this sphere of influence – field; an idea picked up on by Maxwell; and Maxwell's theory was worked on by Einstein. Hence Einstein and a select number of scientists were engaged in Unified Field Theory research based on Boscovich's theory. Boscovich was the forerunner of modern 20th Century physics and his theory held insights into what became the Relativity and Quantum revolutions. Einstein's method was to work from an approximation and then update; hence his Special Relativity was an approximation which needed update to General Relativity. Similarly Einstein's General Relativity was deemed an approximation that needed update to Unified Field Theory. Boscovich's theory was the Blueprint for this.

Saturday, September the 10th

Stanislav Joze Juznic, University of Ljubljana

Boscovich' s Mid-European Legacy

The physics lectures following the introduction of Boscovich' s aspects of Newtonian physics in Ljubljana and Graz are described. Boscovich personally visited Ljubljana at least three times on his way from Vienna to Venice and back.

Boscovich traveled through Ljubljana in early April 1757 on his way to Vienna where he took care of the first edition of his main work.

On his return trip from Vienna to Venice he was kindly welcomed in Ljubljana Jesuit house and slept there on March 9, 1758. That second Boscovich' s visit was recorded in Ljubljana Jesuit Diary, although under the misleading name Woscovich, who was supposedly already famous for his meridian measurements in the Papal State. The Ljubljana Jesuit scribe called Historian of the House did not mention other Boscovich's work certainly because of the ongoing controversy about them in Rome of those times early after Benvenuti's affair in 1754.

In early June 1763 Boscovich probably visited Ljubljana for the last time just after the Count Gian Rinaldo Carli from Koper-Capodistria successfully lead the commission for Boscovich's chair in Pavia in April 1763 and Rinaldini published the second edition of Boscovich's masterpiece in Venice.

Ljubljana professor Biwald welcomed Boscovich in Ljubljana during Boscovich's first visit in 1757 and played a very important role in the promotion of Boscovich's physics; after Biwald left Ljubljana for Graz where he was a longtime rector. In 1767 Biwald reprinted Benvenuti's controversial pamphlet on light, and promoted many other Boscovichian books. High Nobles were frequently extremely interested in Boscovich know-how because Boscovich was always welcomed in their meetings. The Counts Cobenzls (Kobencl) from Ljubljana were Boscovich's personal friends and helped him a lot, acting from their influent positions in Brussels where Johann Karl Philip Count Cobenzl was the Empress' omnipotent minister for Habsburg Belgium.

The only Jesuit professor of physics belonging to the strongest Carniolan noble family Auersperg, the Count Herbert, widely supported new ideas and later made an extraordinary success as the church official in Carniola. Auerspergs were among the most important high nobility in Habsburg monarchy. The development of Ljubljana Jesuit physics and astronomy did not suffer much after the suppression of the Jesuit order because just the Jesuit theology professors lost their positions, but the chairs connected with mathematical sciences were occupied by Jesuits for next three decades. There were just no other professors to replace them.

After the introduction of Boscovich's way of Newtonian physics in Ljubljana and Graz higher studies, the local professors there were among the greatest promoters of Boscovich's views in their physics and mathematics lectures. The Ljubljana professors welcomed the new ideas in now Slovenian lands and eventually connected them with Asclepi, Boscovich's successor at Roman College, although Boscovich personally disliked Asclepi. The future philosopher Karpe was among the best Pogrietschnig's Ljubljana students and he used Asclepi's book for his graduate work. Karpe republished Asclepi's book with Karpe's exam theses in Ljubljana. The philosopher Karpe was among the best Pogrietschnig's Ljubljana students. Karpe was trained in Boscovich physics as a young man and kept his sympathy for Boscovich's world view all his life. Karpe's connection with Boscovich and his followers was the base for his later criticism of Kant's philosophy when Karpe became an extremely influential Viennese professor. Boscovich was extremely popular among the Mid-European Jesuits, and his fame did not fade when the young Jesuit students Karpe or Georg (Jurij) Vega became the professors of their own because they still preferred Boscovich's ideas.

The Ljubljana Franciscans acquired Boscovich's main work comparatively early, eight years after its printing in Venice. The item was issued by Ljubljana Jesuits and bound with another Pogrietschnig's exam in 1768. Boscovich's popularity among Ljubljana Franciscans went hand in hand with Boscovich collaboration with French Franciscan teaching in Italian colleges, as were Thomas Le Seur in Parma or François Jacquier in Roman La Sapienza. Joseph Xavier Liesegang, Karl Scherffer, Paul Mako von Kerek-Gede, and other Boscovich's Mid-European Jesuit friends were also widely read among Ljubljana and other Franciscans and Capuchins.

The Ljubljana Rector and later Viennese Professor Anton Ambschell promoted Boscovich in his textbooks famous for Ambschell and his teacher Herbert's very first exact measurement of the water compressibility.

The suppression of the Jesuit order obstructed the development of Boscovich's ideas but in no way removed them from the scientific or students' scene. The Boscovich's followers and their students were able to develop strong high-schools supporting of Boscovich, who kept his great influence even in 19th century and paved the way for the modern use of Boscovich's ideas in Faraday-Maxwell's electromagnetism, Kelvin's atomism, and Bohr-Heisenberg's quantum mechanics.

Ugo Baldini recently proved the oblivion of Boscovich's physic in Italian frame, but Boscovichs's ideas were never forgotten somewhat northern in Mid-European textbooks. Boscovich legacy also became strong among the Beijing Jesuits headed by Jesuit-astronomer Augustin Hallerstein from Ljubljana for three decades until the suppression of the order and Hallerstein's death in 1774. The suppression of the Jesuit order prevented Boscovich's physics from becoming the standard textbook frame worldwide, but at least second generation of his students including Vega or Karpe still followed Boscovichs's ideas in the 19th century. That fact could be proved with the pictures of Boscovich's curve published in Vega's or other Mid-European textbooks. Therefore Boscovich's ideas did not need any reintroduction via John Robison's Scottish university students into the Mid-European milieu of 19th century because Boscovich's fame never faded among the Mid-European scientists.

Pasquale Tucci, University of Milano

Boscovich's Influence on Nineteenth-Century Electricity and Magnetism

Alessandro Volta, Ottaviano Fabrizio Mossotti, Humprhy Davy, Michael Faraday, William John Macquorn Rankine, William Thomson, James Clerk Maxwell quote explicitly Boscovich in some parts of their memoirs.

But historians express very different opinions on the effective influence that the Ragusian natural philosopher exercised on the nineteenth century scientists involved in the studies on electricity and magnetism.

On the one hand we know that Boscovich' memoirs and books, first of all the *Theoria*, belonged to the store of knowledge of cultured natural philosophers and scientists of the nineteenth century. It's reasonable to think that this knowledge exercised some influence.

But on the other hand it's too easy realize that natural philosophers and scientists had in mind very different ideas about some Boscovichian fundamental concepts like "matter" "force" "power" and so on, when they wrote about Boscovich's theory.

We can think that mention of Boscovich's theory be a rhetorical cross-reference in order to be considered part of an ideal "Republic of letters". But I think that the influence can be claimed and that a transcultural approach can be useful to throw light on this issue.

In the first part of my communication I'll outline Boscovich's interests in electricity and how they are a strictly integrated in his *Theoria* with the rest of his varied interests.

In the second part of my communication I'll list some nineteenth century scientists involved in the studies on electricity and magnetism whose reference to Boscovich is clear.

And I'll try to sketch the origin of the different and controversial historiographical approaches to the influence of Boscovich on the nineteenth century science.

Luciano Agnes, Pavia

Ruggiero Boscovich in Pavia

He was 53 and already a famous scientist well known in all European Courts when he reached the University of Pavia.

The Empress Mary Theresa of Austria strongly wanted him to occupy the vacant Chair of Mathematics. At that time, the University was poorly organized and promptly Boscovich. drew a report suggesting all of the actions needed to bring that University up to the European level. Unfortunately, the turning point occurred some years later.

During his stay in Pavia, Boscovich designed the astronomic Observatory inside the building of Brera, convent of the Society of Jesus in Milan. The construction was completed in an amazingly short time and the Observatory became one of the most advanced in Europe. Even the astronomic instruments were designed by Boscovich without penalizing his teaching responsibilities.

Boscovich continued researching in many fields of science, philosophy and theology with the best minds of Europe. He had a bad temper; did not want to be contradicted. As a young student in the C*ollegio Romano* he was classified as *temperamento ardente* or hot tempered. Because of this marked disposition Boscovich had several adventures in town, some serious, some funny, some courteous.

Efthymios Bokaris and **Vangelis Koutalis**, University of Ioannina

Teaching Boscovich's Puncta in S.E. Europe: Athanasios Psalidas' "Physics in General"

Athanasios Psalidas (1767-1829), one of the most eminent Greek-speaking representatives of enlightenment in SE Europe, in his book "*Kalokinemata*" ("Movements Ahead") of 1795, announced that a "philosophical survey course" of experimental physics composed by him was on the way to the printing house. This book was never published. Psalidas, however, for the next two decades, taught "experimental physics" at the Maroutsaia and later at the Kaplaneios school, in the city of Ioannina. His lectures there were probably based on his unpublished "philosophical survey course", but we also know, thanks to the testimony of one of his contemporaries, that Psalidas, planning his lessons on physics, followed the "system" of Johann Baptiste Horvath (1732-1799).

An anonymous manuscript held today by the library of the Archimandrite's Church in Ioannina, Greece, (Ms. 4) contains a relatively extended treatise (ff. 1r-82v) under the heading "*Peri Physikis en Geni*" ("On Physics in General"). A large part of this treatise is dedicated to the "chemical properties of bodies". It is apparently a textbook, which can be dated back either to the end of the 18th century or to the first years of the 19th. There is convincing evidence that its authorship should be attributed to Psalidas, and in this case it would be the only sample hitherto known of his educational work in regard with natural philosophy and chemistry, as well as the only preserved sign that he somehow kept the promise he had given in 1795.

A closer study of this textbook's content reveals some very interesting intellectual affiliations. Despite the fact that Psalidas is acquainted with the most recent developments in chemical theory, since he presents Lavoisier's oxygen theory as an already tested and corroborated hypothesis, he still endorses a general theoretical approach reminiscent of the various undertakings, flourishing before the emergence of Lavoisier's "new chemistry", to unify the knowledge of nature by treating natural attractions and chemical affinities under certain common principles. In this respect, Psalidas does not only reproduce Torbern Bergman's typology of elective attractions, but he also expounds, for the time in a Greek-speaking audience, as the present state of our knowledge permits us to say, Ruggiero Boscovich's theoretical scheme, in which extended matter is rendered reducible to non-extended entities such as forces and mathematical points.

Matching Psalidas' text against Horvath's *Physica Generalis* we can conclude that this latter book was actually the source from which he derived Boscovich's conceptualizations. Horvath's version of "*Physics in General*", borrowing a great part of its conceptual material from Boscovich's *Theoria Philosophiae Naturalis,* was not an isolated case during the second half of the 18th century. Leopold Gottlieb Biwald's *Institutiones Physicae* is another, and equally popular in Central-Eastern Europe, textbook demonstrating a strong influence of Boscovich's mathematical atomism. Both Biwald and Horvath served for many years as academic professors inside a territory under Habsburg rule (Biwald at the University of Graz and Horvath at the University of Trnava). Their textbooks reflected more the experience of a learned scholar or a philosophically inclined educator than that of an innovative experimenter.

Psalidas shared this common feature with them: the social space he inhabited was not that of the laboratory, but that of the educational institution. He never took part in controversies over the available options to explain a particular observed phenomenon within an experiential terrain already tending to be visibly demarcated. He frequently participated, though, in public debates covering a wide range of philosophical, cultural, or even political issues. Boscovich's theory, laying significant emphasis on the problem of the composition of matter, and aspiring to explain both physical and chemical phenomena by a single law of forces, provided a framework compatible with the needs of educators who tried, as was the case with Psalidas, to link their educational work with the task of promoting a far-reaching cultural change in a context where the political structures of the past were destabilized, by bringing forth internally consistent theoretical productions in which natural reality was depicted as a rationally structured wholeness and could thus be posited as an exemplary model for the reorganization of society by means of rational criticism.

Eri Yagi, Eri Yagi Institute for History of Science, Tokyo

The Important Role of Particles through the Development of the Mechanical Theory of Heat

Through the development of the mechanical theory of heat, the concept of particles, especially originated by Newton, and followed by Boscovich, played an important role in the 19th century. R. Clausius adopted the term “Disgregation” which meant the degree of dispersion of particles in his important papers in 1862 and 1865 when his famous term “Entropy” was proposed. I would like to emphasize the micro nature of thermodynamics although it is often characterized as the macro nature in modern text books. Detailed discussions were written in our paper: E. Yagi and Rika Tadokoro Okamato , “A History of Entropy through Various Methods: Specially Focused on Technical Term Analysis,” *Historia Scientiarum*, Vol.20-1(2010) 47-56.

Ivan Mirnik, The Zagreb Archaeological Museum

Roger Boscovich on Croatian Medals

Roger Boscovich does not seem to have been portrayed on medals of his time. In more recent times in Croatia his medals have become quite numerous. The earliest medal and badge bearing the portrait of Boscovich were modeled in 1960 by Ivan Jeger (b. 1911- d. 1973) on the occasion of the Yugoslav Congress of Theoretical and Applied Chemistry. Then in 1965 came another medal made by Ante Jakić (b. 1930) for the most distinguished Croatian award for achievements in sciences. He was followed by various other eminent sculptors and medalists, such as Želimir Janeš (b. 1916 – d. 1996), Kuzma Kovačić (b. 1952) and Stipe Sikirica (b. 1933). Sikirica made a medal, 71 cm in diameter, commemorating Boscovich's second centenary of death in 1987. The medal was struck in various metals and the dies are preserved in the Zagreb Archaeological Museum Numismatic Collection. In 1994 a 1 Ducat piece in gold was struck after a model by Kuzma Kovačić. In full sculpture Boscovich was portrayed for instance by Toma Rosandić (b. 1878 – d. 1958), Ivan Meštrović (b. 1883 – d. 1962) and Stjepan Divković (b. 1961).

Marco Martin, Liceo Classico D'Oria, Genova

"Il Giornale di viaggio da Costantinopoli in Polonia di Ruggiero Giuseppe Boscovich". A surprising Report through Eastern Europe

This original report describes the stop of an adventourous journey from the Turkish capital to Polish borders carried out by Boscovich with the English ambassador in Costantinople, William Porter. We can read this book as an interesting historical document with much information about not so much known countries for western travellers. So through Thracia, Bulgaria, Valacchia and Moldavia, Boscovich analyses a hidden part of the great Turkish Empire and his vilayets and becomes eye-witness of Slavic villages, Greek orthodox churches, the country of Moldavia until the coasts of the Black Sea and tries to understand words and realities very different from Western Europeans' customs. So Boscovich with his report can be fit into the rich Italian tradition of travel writers in the Eighteenth century, because his bright observations must be underlined for precision and sharpness.

In short, Boscovich wrote a little report about archeological ruins of the town of Alexandria in Troade 110 years before of Schliemann and this interesting description was added as appendix with a personal commentary to a Latin epigraph founded in Alexandria in Troade (see CIL III 1). The present work intends to give importance and consideration to this diary of the great scientist from Ragusa of Dalmazia.

Daniele Macuglia, University of Chicago

Boscovich and the Mechanism of Vital Phenomena: An 18th Century Jesuit at the Borders Between Physics and Biology.

During his full and active life, the priest and Jesuit Ruggiero Giuseppe Boscovich (Dubrovnik, 1711 – Milano, 1787) made significant contributions to a variety of different disciplines, in addition to his attempt to understand the structure of the universe in terms of a single idea. Boscovich was one of the leading minds of his period, and decidedly influenced modern scientific thought. [1]

Because he was such a curious and systematic scholar, he also crossed the boundaries of the more canonical traditions of scientific inquiry and did not ignore fundamental and controversial issues related to the intimate nature of living creatures.

Although a wealth of research has been conducted on Boscovich as a mathematician, physicist, poet, astronomer, archeologist, geodesist, engineer, diplomatist, and social figure, very little has been said on "Boscovich as a biologist." Nevertheless, we know that Boscovich commented on Lazzaro Spallanzani's (1729-1799) surprising experience with self-regenerating cochlea brain, gave his opinion about the way in which plague spread, and also speculated on the location of memory and the way in which ideas are "inscribed" into our brains.[2] Furthermore, a direct analysis of the primary sources reveals that Boscovich also dealt with the psycho-physiological conditions which allow acquisition of knowledge, the duality between matter and spirit, the nature and location of human and animal soul, the source of the finality of organisms, and the conflict between absolute determinism and the freedom of living beings[3].

The 1988 article by Grmek[4] on the explanation of vital phenomena in Boscovich's work represents one of the very few examples of detailed analysis of Boscovich's contributions to the biological sciences in understanding the nature of living creatures. Yet, especially due to more recent advances in the theory of complexity and synthetic biology, important points seem to be missing from Grmek's analysis, warranting further research.

In the following I will call attention to certain specific affinities between Boscovich's work and some basic concepts of our current understanding on the origin of life, such as the continuity principle (Oparin, 1924; Haldane 1929)[5]. In addition, I will show that Boscovich proposed interesting considerations in regard to what we now call weak emergentistic views of the origin of life (Atmanspacher and Bishop, 2002; Schröeder, 1998)[6] and contextual ontology (Primas, 1998)[7].

Furthermore, as MacDonnell pointed out in his analysis on Jesuit geometers, Russian scientists have always shown a certain interest in Boscovich's work[8] Therefore, it cannot be excluded that Boscovich might have had some kind of influence on the Russian biological tradition, especially on the school of Alexander I. Oparin (1894-1980). An analysis of all these complex facets can shed new light on the origin of the outstanding tradition of 19th century biological thought. All this, in turn, can have significant resonances for the understanding of the foundations of our current views about the complexity of living phenomena.

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2 Proverbio, E. (1996-1998). *Giovan Stefano Conti, Lettere a Ruggiero Giuseppe Boscovich*. Roma: Accademia nazionale delle scienze detta dei XL.
3 Grmek, M. D. (1988). *L'Explication des Phénomènes Vitaux Dans L'Oeuvre de Boscovich*. In R.J. Boscovich, Vita e Attività Scientifica - His Life and Scientific Work. Atti del Convegno Roma, 23-27 maggio 1988. Istituto della Enciclopedia Italiana, pp. 321-36.
4 Ibid., p. 323.
5 Oparin, A. I. (1924). *The Origin of Life*. Moscow Worker publisher. Haldane, J. B. S. (1929). The Origin of Life. Rationalist Annual. 148, pp. 3-10.
6 Atmanspacher, H. and Bishop, R. (2002). *Between Chance and Choice, Interdisciplinary Perspective on Determinism*. Imprint Academic. Schröeder, J. (1998). Emergence: Non-Deducibility or Downward Causation? Phil. Q., 48, pp. 434-52.
7 Primas, H. (1998). *Emergence in Exact Natural Sciences*. Acta Plitechnica Stand. 91, pp. 86-87.
8 MacDonnell, J. (1989). *Jesuit Geometers: a Study of Fifty-Six Prominent Jesuit Geometers During the First Two Centuries of Jesuit History*. Institute of Jesuit Sources (Saint Louis). Volume 11, 1st edition, p. 11.

Luigi Pepe, University of Ferrara

"Boscovich's Elementa universae matheseos": An incomplete project

In 1741-42 Ruggiero Giuseppe Boscovich began teaching mathematics in the *Collegio Romano* in place of his teacher Orazio Borgondio. He kept this lesson until 1760, but in 1751-52, during his mission to measure the meridian arc between Rome and Rimini, he was substituted by Carlo Benvenuti.

In the twenty-year period of his mathematical lessons, Boscovich wrote several essays about geometry, mechanics and optics. At the end of the early stage of his scientific and also teaching activity, he published a work in three volumes, that represents one of the best maths elementary books of the XVIII century: the "*Elementa universae matheseos*" (1754). This work was conceived in more volumes and should have included also cartesian geometry, differential and integral calculus, but only three volumes were published. The third one was about geometric theory of conical sections. During his journey in the Papal State to measure the arc meridian, Boscovich wrote many letters, especially to his brother Natale. These letters give important supplements to the editorial history of the "Elementa matheseos".

When Boscovich came back to Rome in 1753, he was consulted about several hydraulic questions which brought him to make scientific journeys to Vienna (1757-58), Paris (1760), and London, where he stayed until the end of the year. Here he met the mathematicians Thomas Simpson and Edward Waring, but also the American scientist Benjamin Franklin and the painter Joshua Reynolds. He visited Cambridge, Oxford and Greenwich, where he met the astronomer James Brandley. At the end of 1760 he left for Netherlands, then he went in Lorena and in Germany. In 1761-63 Boscovich made a journey to Costantinople and in East Europe with the aim of observing the Venus transit. In December 1762 he was at Krakow and between January and May 1763 he was in Vienna.

In 1764 Boscovich was called to teach mathematics at Pavia University, but he didn't dedicate himself to pure mathematical studies. Boscovich preferred to settle in Milan where he was involved in the foundation of the Brera Astronomical Observatory. In Milan he oriented his promising pupil, Francesco Luino, at mathematical studies and gave to the Jesuit Giovanni Antonio Lecchi (1702-1776) the opportunity to improve hydrodynamics by a theoretical point of view. Luino's "*Lezioni di matematica elementare*" (1772) and "*Delle progressioni e serie*" (1767) represent evidences of Boscovich incomplete mathematical program. Boscovich by that time couldn't compete in advanced mathematical techniques with new scientific talents like Lagrange, Condorcet, Laplace, Monge.

Cesare Tocci e **Danilo Capecchi**, University of Roma “La Sapienza”

Three Technical Reports of Boscovich on the Statics of Domes

This work presents a comparative reading of three reports written by Boscovich on the occasion of his intervention in the debates which developed, during the eighteenth century, on famous structural disputes: we are talking about the *Parere* for the dome of St. Peter (1742), the *Scrittura* for the Imperial Library of Vienna (1763), the *Sentimento* for the Cathedral of Milan (1765).

The importance of the three reports – even though characterized by significant differences related not only to the specific nature of the involved problems but also to the scientific growth of Boscovich – is that, for the first time in the history of architecture, we are in presence of a systematic treatment of mechanical problems aimed at a rational justification of architectural interventions.

Therefore, in addition to their scientific value, which can be summed up in the methodological cogency and the thorough discussion of mechanical issues, the three reports allow reflecting, even though marginally, on the complex relationship between science and architecture which, just in the eighteenth century, shows a growing involvement of static expertise in designing of buildings.

Luca Guzzardi, INAF – Osservatorio Astronomico di Brera

The End of a World? Ruggiero Boscovich and the Tradition of Didactic Poetry

In an unpublished letter (August 9th, 1786) to the Habsburg plenipotentiary in Milan, count Johann Joseph Maria von Wilczek, Ruggiero Boscovich stated that "the taste of the century is changed: too few people have an interest in Latin poetry, few people in geometry and very few in a work which applies poetry to the objects related to geometry". In this private communication he most probably referred to a new edition of his *De Solis ac Lunae Defectibus*, published in 1760 in London.

However, Boscovich's interest for the "science in verses" traces back to the beginning of his teaching and scientific career: he originally composed and recited in 1735 a first brief version of his poem about solar and lunar eclipses, now preserved in manuscript.

The aim of this paper is to discuss Boscovich's original contribution to the didactic poetry in the 18th century from the early years as a disciple of C. Noceti, the author of the didactic poem *De Iride*, until the French translation of *De Solis ac Lunae Defectibus* as *Les Eclipses* (1779) and Boscovich' last attempts to reprint his own verses. In particular I will stress as a novelty of his approach to didacticism in poetry his attitude to add his own footnotes and explications to poems composed by himself or others (Noceti and Stay).

Elio Antonello, INAF, Osservatorio Astronomico di Brera

Water-filled telescopes

A short review is given of the projects and experiments with water-filled telescopes, that is the projects intended to test the propagation of the light in different media in the 18th and 19th centuries. The topic was treated in depth by some scholars in the past years.

Those works included a discussion of a) Boscovich's ideas and projects in 1766 (and following years), b) the ideas of Wilson (1782) and Robison (1790) in England and the studies of Arago and Fresnel (1818) in France, and c) the laboratory experiments performed by Respighi in Bologna (1859).

Hoek and Klinkerfues in 1866 gave contrasting explanations for the different values of the stellar aberration constant derived from the observations, and as the light transmission in different refracting media was involved, Klinkerfues presented the result of a test with a water telescope. These results pushed Airy to perform his well known decisive experiment in 1871.

Ezio Vaccari, University of Insubria, Varese

Boscovich and the Earth Sciences

The aim of this paper is to evaluate the extent of Boscovich’s knowledge and involvement in the study of the Earth Sciences, with particular attention to geological phenomena such as mountain building, the origin of rock strata, the role of ancient volcanoes and the position of fossils, also in relation to impressive meteorological events such as windstorms. Besides the correspondence with Antonio Vallisneri jr. and with other scientists interested in the Earth sciences, also the reports of Boscovich’s travels, such as the “*Giornale di Viaggio da Costantinopoli in Polonia*”, and other primary sources mainly related to the 1770s, will be compared and analyzed. Boscovich’s ideas will be placed and evaluated within the context of the late 18th century Earth Sciences in Italy and Europe.

Maria Giulia Lugaresi, University of Ferrara

Hydraulics and Hydrodynamics in Boscovich papers

The lecture presents some results of a research about Ruggiero Giuseppe Boscovich' hydraulic works. The works about astronomy and optics were collected and published in Bassano by Ruggiero Giuseppe Boscovich in 1785. Boscovich wanted to gather also his papers about hydraulics, but he died before this project could be realized.

Boscovich papers about hydraulics were both theoretical and practical: he wrote two important theoretical works written in the form of letters. The first one was addressed to the French mathematician and astronomer Alexis Claude Clairaut (1713-1765), the second one was written to the Italian mathematician hydrographer Giovanni Antonio Lecchi (1702-1776).

In the letter to Lecchi Boscovich explains principles and rules for waters measure, both those coming out of vessels and those running in the rivers. Lecchi appreciates Boscovich' work and decides to put it into his treatise, *L'Idrostatica esaminata ne' suoi principj e stabilita nelle sue regole della misura delle acque correnti*, published in Milan in 1765.

But Boscovich displays all his talent especially in the practical field. He was consulted many times about practical hydraulic questions. He wrote reports about Tiber's damages at Fiumicino, the regulation of some rivers (Po, Adige) and streams (Caina, Nistore), some harbours (Magnavacca, Rimini, Savona), the reclamation of wide marshlands (Paludi Pontine, Bientina). His main contributions deal with the settlement of harbours placed at the mouth of a river.

In Boscovich' papers there are references to some technical work: the *Architecture hydraulique* (1737-1739) by Bernard Forest de Bélidor, the *Traite élémentaire d'hydrodynamique* (1771) by Charles Bossut and, most of all, the *Idrostatica* (Milano, 1765) by Giovanni Antonio Lecchi. Some Boscovich' papers are still unpublished and they are kept in the Bancroft Library of California University at Berkeley.

Riccardo Balestrieri, SALt, San Marino

The silting-up of the port of Savona (1771-1772)

The unpublished apograph manuscript here described is the most reliable version of a report of R. G. Boscovich concerning the port of Savona: the Republic of Genoa requested the analysis to solve the ancient question of its silting-up. Boscovich used a persuasive method to quantify the problem and weigh the possible solutions. The exactitude of the report is enforced by the collation of the manuscript with the printed source: in this one there are several errors and omissions and a cut by a censor for political reasons.

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