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Three Centuries from the Birth of Rudjer Boskovic (1711 – 1787)

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It has been three hundred years since the birth of one of the most versatile scientists of all times, a great renaissance mind, Rudjer Josip Boskovic. He has left an indelible imprint on mathematics, astronomy, physics, optics, geodesy, architecture, archaeology, pedagogy, philosophy, literature and diplomacy. To this Dubrovnik-born scientist of Serbian origin whose original research, discoveries and inventions significantly improved the world science we dedicate this text.

RUDJER BOSKOVIC one of the most illustrious minds of the world science, was born on 18th May 1711 in Dubrovnik, during the peak of the Republic of Ragusa (or the Republic of Saint Blaise as it was also called). The city of Dubrovnik/Ragusa got all the attributes of a republic owing to Louis I of Hungary on the basis of a peace treaty signed by him and the Republic of Venice in 1358, and lost them under the Napoleon occupation in 1808.

At the end of 17th century Rudjer's father Nikola, an Orthodox Serb from Orahov Do near Trebinje in Herzegovina, came to Dubrovnik as a merchant where he got married with Paola Bettera from a prominent Italian noble family. Rudjer was the seventh child out of eight (five sons and three daughters). Interestingly, none of all children got married except for one sister, who was also childless, and the lineage of Nikola Boskovic died out with this generation.

Dubrovnik, native city of Rudjer Boskovic

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At the age of 8, Rudjer was sent for schooling to the local Jesuit Collegium Regusinum where he acquired elementary knowledge and the knowledge of Latin. His father died when he was 10, and four years later, in 1725, his mother, following the recommendation of his teacher, sent him to Rome to continue his education in a Jesuit school, Collegium Romanum. His extraordinary gift for natural sciences started to flourish in his studies of mathematics, physics and philosophy. He was satisfied with his life among Jesuits in the beginning. However, when he criticised the Collegium Romanum for not giving enough attention to mathematics, he experienced many an unpleasant moment from the rather intolerant environment where theology was considered to be far above natural sciences.

Rudjer Boskovic after finishing Collegium Romanum

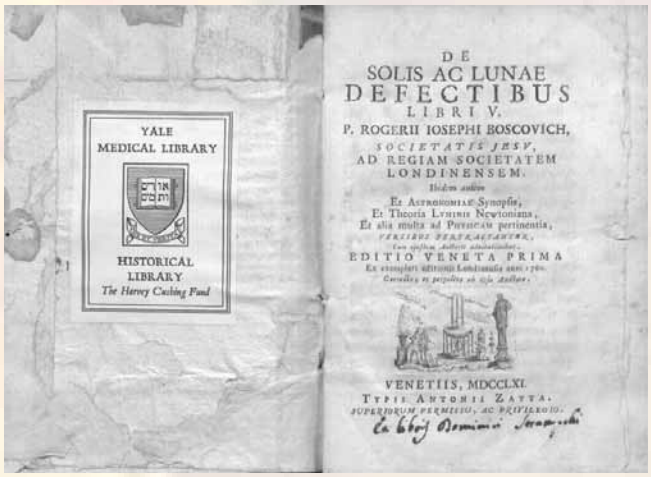
In Rome he studied Aristotle's physics and mathematics, Euclid's mathematics, astronomy, ethics and logic. His first scientific works come from the field of applied mathematics. Geometry preoccupied him at that time as well, differential geometry and the theory of continuity and infinity in particular. Many years devoted to mathematics would later give numerous scientific dissertations, books and manuals.

Rudjer Boskovic as a Jesuit clergyman

Having finished his studies of theology, Rudjer became a member of clergy. However, he did not devote his attention to theology and missionary work but he worked as a professor at the Collegium Romanum until 1760. At the age of 22 he started teaching mathematics at lower grades of the Collegium Romanum. Two years later, he left for Fermo to teach at a Jesuit Collegium and upon his return to Rome at the age of 29, in 1740, he took over the chair of mathematics from his favorite professor Borgondi.

Several important works in mathematics, mechanics, geophysics, optics, astronomy and geodesy had already been finished by then, including *"Application of telescope for the determination of celestial bodies"* and *"Movement of bodies thrown into space without resistance".*

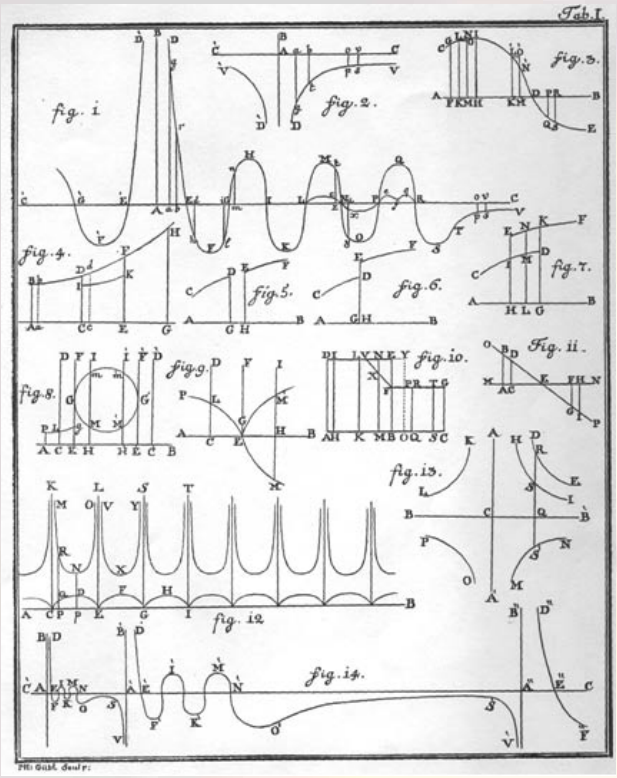
In 1735, literally gifted as his mother's father Bartolommeo, he expressed his ideas about the Solar and Lunar eclipses through a 300-verse poem *"De Solis ac Lunae defectibus, libri V, cum ejusdem auctoris adnotationibus",* the final version of which was enlarged and published in London in 1760 in six volumes. In an original way, Boskovic's verses show what happens during the eclipses. For example, stars are visible during a solar eclipse while during a lunar eclipse, the Moon either becomes so dark that it is invisible or it turns deep red. At a solar eclipse, the Moon prevents sun rays from reaching the Earth. At a lunar eclipse, the Earth prevents sun rays from reaching the Moon. Since both phenomena are connected with the Skies, Rudjer evokes the Sun as the ruler of everything in this system. Most of his scientific works and hypotheses were expressed in verses.



The title page of Boskovic's books about the soler and lunar eclipses

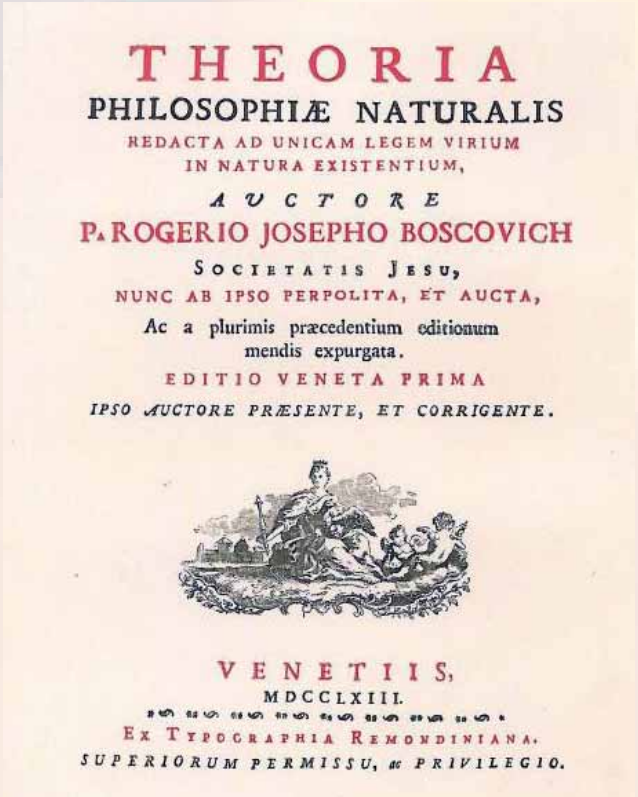
One of his first significant dissertations, published in Rome in 1737 under the title „*De Maculis solaribus" (Abour Sun Spots)* caused a lot of attention and controversy in the scientific circles of the time. Since he was the first to explain this phenomenon, he would refer later to his discovery: „As early as in 1737, in one dissertation about Sun spots printed in Rome, I gave two mehods for determining the elements of the Sun revolution based on the three positions of one of his spots, where one method was based on graphic construction and the other one on trigonometry".

In 1742 he was consulted, with other mathematicians, to offer the best means of securing the stability of the dome of St Peter's in Rome in which a crack had been discovered and a year later he dealt with the stability of the apsidal part of the same church. Maria Theresa asked him to help with the static problems of the Royal Library in Vienna. His knowledge of hydraulics also helped in the reconstruction of the ports of Rimini and Savona.



One of Rudjer's works dealing with continuity and infinity

In his two-volume work "*On light*" in 1748, he was a visionary claiming that light could not be proved to propagate in a straight line, especially in the intergalactic space where "some forces" as he said, could change the trajectory of light particles. It took 150 years to pass for this theory to be proved – shapes of light ray paths are influenced by the gravity of a celestial body light rays pass by.


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 title page of Rudjer's most important work "Theory of Natural Philosophy"

In his geodesic research, Rudjer studied the shape and the form of the Earth as well as the differences in the gravity in different parts of the world. He was to travel to Brazil with a Portuguese expedition to measure one degree of the arc of the meridian, but was persuaded by Pope Benedict XIV to stay in Italy to measure an arc of two degrees between Rome and Rimini and to make a new map of the Papal States. With an English Jesuit, Christopher Le Maire, he completed the operation in two and a half years. An account was published in 1755 under the name "*De Litteraria expeditione per pontificiam ditionem ad dimetiendos duos meridiani gradus et corrigendam mappam geograficam*".

His geodesy knowledge helped him to measure meridians in Austria, Hungary and Piedmont. When a dispute arose between the republics of Tuscany and Lucca over the frontier waters, Rudjer supported the claim of Lucca before the Austro-Hungarian monarch, Franz I, in Vienna. During his stay in Vienna (1757-1758) he finished and published his most important scientific work "*Theoria philosophiae naturalis redacta ad unicam legem virium in natura existentium*" (*Theory of Natural philosophy derived to the single Law of forces which exist in Nature*), which was going to have several editions up to the present day.

Having returned to Rome at the end of 1758, Rudjer faced many problems coming from Jesuits, many of whom he knew in person. His work "*Theory of Natural Philosophy*" encountered misunderstanding, disapproval and dispute. The scientific postulates from theoretical physics published in his most complex and most famous work provoked many arguments since they clashed with the Jesuit ideology. Although he explicitly stated the dual nature, both spiritual and material, of the Nature, Jesuit dogma could not accept this concept.

Rudjer Boskovic during his residence in Vienna

Boskovic used every opportunity to emphasize that all his research of life, spirit and liberty was confined to the field of natural philosophy without entering the domain of religion. Unfortunately, his explanations seemed to cause even more increasing criticism and he left Rome in 1759, never to return. On one occasion he wrote to his benefactor marquis Romagnoli that he thought he would never return to Rome and that he could hardly wait to go to Constantinople where the Turks would treat him much better than Christians.

During his stay in Paris, he frequently visited the French Academy of Sciences a correspondent member of which he had been since 1748. He was also a member of academies of sciences of Rome, Bologna and Holland. Lomonosov himself was present when he was elected a member of the

Academy of Science in Saint Petersburg. In England, he was made a fellow of the Royal Society to which he dedicated his poem „De solis ac Lunae defectibus“. Interestingly enough, most of the countries of his residence bore animosity towards Jesuits; nevertheless, Rudjer was everywhere respected as a scientist.

Computer animation of Troy

June 1761 was very important for astronomers of the time since the passing of Venus was expected in front of the Sun and, at the urging of the members of the Royal Society, Boskovic travelled to Constantinople to observe this phenomenon. He was too late to observe Venus, but he took the opportunity to examine the ruins of Troy. He applied mathematical and astronomic parameters into his observations and challenged the then-popular idea of Troy's location, stating that it was further inland – which was confirmed at the end of 19th century by a famous German archaeologist Heinrich Schliemann.

Monument of Rudjer Boskovic by Ivan Mestrovic

Not yet fully recovered after serious ilness, he travelled from Constantinople to Poland via Bulgaria, Romania and Moldavia, having to give up going to Saint Petreburg. He described this almost two-year journey in a diary „*Giornale di un viaggio da Constantinopoli*,“ published in 1762 in Italian and soon afterwards in French, German and Polish. Not only is this travel book an interesting adventure novel about the Balkan region in the middle of the 18th century, but also it offers abundance of data on the Balkan peoples of that period. A successful mixture of science and literature, it depicts the ethnology, etnography, history, geography, geomorphology, folklore and religion of the region in a terrible state under the Turkish tyrany.

Institute of Rudjer Boskovic in Zagreb

Having travelled all over Europe for four years, in 1763 he returned to Italy, but not Rome, to work as a professor at the University of Pavia. He was soon offered a post with the directorship of the construction of the astronomic observatory of Brera in Milan as well. He afterwards assumed the optics and astronomy chairs in Milan. Intrigues and a lack of understanding for his work led him to accept an invitation from a friend from Paris to come to the city which had always had appreciation for his research. He was made a French subject and appointed Director of Naval Optics of the French Navy where he devoted himself to perfecting the achromatic telescope. In this period he participated in heated scientific discussions, both in oral and in writting, with Dalambert and Laplasse.

In 1782 he returned to Italy and spent two years at Bassano where he published five books about his research during his stay in Paris. Due to ill health he never returned to France. In October 1785 he went to Milan where the first signs of his mental ilness appeared. Since the state of his ill health aggravated, he died of pneumonia on 13 February 1787 and was buried at the Santa Maria Padone in Milan

In his work Bošković investigated various fields of science, being ahead of his time in many of them thus encountering a lack of understanding. He left a significant trace in mathematics, physics, statics, astronomy, geodesy, optics, archaeology, phylosophy, and even poetry. He is considered to be the first scientist who clearly stated that the matter „is composed of the same particles“ and that only „different laws of force make it different“. He claimed that a dimensionless particle is the source of force and that time and space were relative, contrary to Newton, which rightfully makes him the predecessor of Albert Einstein and his theory of relativity. A physicist J.J.Thomson, Nobel laureate, took Boskovic's „atom model“ (1907), which was central for the Bohr Model of the Atom (1913).

Observatory of Rudjer Boskovic in the Belgrade fortress, Dizdar Tower

Another Nobel laureate, Leon Lederman, wrote in 1993: "Rudjer Boskovic had an idea, completely insane for the 18th century, and may be for any other century. He claimed, no more no less, that the matter consists of particles with no dimensions! Twenty years ago, we found a particle which fits the description. And we called it quark."

One crater on the Moon has been given Rudjer Boskovic's name for his extraordinary merits for science, especially astronomy.

One Moon crater named by Rudjer Boskovic

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Tri veka od rođenja Ruđera Boškovića (1711 – 1787)

Prošlo je tri stotine godina od rođenja jednog od najsvestranijih svetskih naučnika svih vremena, velikog renesansnog uma, Ruđera Josipa Boškovića, naučnika koji je ostavio neizbrisivi trag u matematici, astronomiji, fizici, optici, geodeziji, arhitekturi, arheologiji, pedagogiji, filozofiji, književnosti i diplomatiji. Ovom rođenom dubrovčaninu srpskog porekla, čija su originalna istraživanja i otkrića značajno unapredila svetsku nauku posvećen je ovaj tekst.

Три века с рождения Руджера Бошковича (1711 – 1787)

Прошло триста лет со дня рождения одного из самых универсальных в мире учёных всех времён, великого ума Возрождения, Йосифа Руджера Бошковича, учёного, который оставил неизгладимый след в математике, астрономии, физике, оптике, геодезии, архитектуре, археологии, педагогике, философии, литературе и в дипломатии. Эта статья посвящена этому учёному родившемуся в Дубровнике, но сербского происхождения, чьи оригинальные исследования и открытия значительно улучшили мировую науку .

Trois siècles depuis la naissance de Ruđer Bošković (1711-1787)

Trois cents ans se sont passés depuis la naissance de Ruđer Bošković, l'un des savants les plus universels de tous les temps. Ce grand homme d'origine serbe, né à Dubrovnik, possédait un esprit de Renaissance. Il a laissé une empreinte indélébile dans plusieurs domaines: mathématiques, astronomie, physique, optique, géodésie, architecture, archéologie, pédagogie, philosophie, littérature et diplomatie. A ce savant célèbre dont les recherches et les découvertes ont fait progresser la science mondiale on a dédié ce texte.