Djordje Nikolić' *Yugoslavs in Astronomy*

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Abstract: The serendipitous re-discovery of an old paper and appendix entitled *Les Yougoslaves en Astronomie (XV-XX siècles)*, by Djordje M. Nikolić (Warszawa 1938-1939), gives the opportunity for a concise review of the advances in Astronomy due to south-Slav scientists in the past centuries. The importance of the works by these scientists is apparent especially in the case of those belonging to the "school of Dubrovnik" - whose most famous, but not unique, representative is Rudjer Bošković. It is worth to point out their marked experimental-practical inclination as well as the international context in which they were used to work, with intense and lifelong collaborations all over Europe. The humanistic and cosmopolitan character of their inspiration is repeatedly underlined by Nikolić himself, and strengthens the conclusion that scientific research can only fully flourish under the conditions of free transfer of knowledge and multi-national cooperation.
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Introduction

It was by chance that an appendix to the *Bulletin of the polish group affiliated to the Committee of the International Academy of History of Science*, dated 1939 (Nikolitch 1939), showed up out of the stack of old scientific publications collected at Bologna University by prof. Ettore Bortolotti[3], which were being catalogued by one of us. We subsequently queried for the main paper (Nikolitch 1938c) until we had it sent to us by the National University Library in Strasbourg, where the only available copy is preserved.

The paper and appendix, entitled *Les Yougoslaves en Astronomie (XV-XX siècles)*, written by the Serbian science historian Djordje M. Nikolić, inspired us a few reflections which may be of general interest. Strasbourg librarians also sent to us a third paper in French language written by the same author, entitled *Roger Bochkovitch* (i.e. Rudjer Bošković: Nikolitch 1938a[4]), which helps to draw an

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3) Ettore Bortolotti (1866-1947) teached Geometry at the Faculty of Mathematics in Bologna, where he was a close associate to Salvatore Pincherle. After his death he left a significant collection of scientific publications, including antiquarian books, booklets, serials, which are now in the possession of the Historical Faculty Library.

4) The paper has an Annex which is the integral text of a Conference on Rudjer Bošković that the author had held in Belgrade on 16 May, 1937, on the occasion of the 150th anniversary of Bošković' death. Interestingly, Nikolić opened his talk by stressing that his due, to speak about Bošković as a Yugoslav, was '*a little bit difficult, given the present circumstances*' (Nikolitch 1938a: 185): it was in fact the eve of WWII with the subsequent disgregation of the Kingdom of Yugoslavia by German and Italian occupiers and their local collaborators. Nikolić clearly endorsed the same pro-yugoslav viewpoint of the biggest intellectuals of pre-WWII Yugoslavia, e.g. '*the writer Ivo Andrić and the sculptor Ivan Mestrović* [who] *eschewed both supranational Yugoslavism and separatist nationalism in order to create a "synthetic" Yugoslav culture that could "join the existing tribal cultures into a new and dynamic culture suitable for the new state"*' (Clark 2003, quoting Andrew Wachtel's contribution in Djokić 2003). About Djordje M. Nikolić (1908-1971) we also know that he got Degree and PhD in Astronomy in France, where he acted as a member of the Resistance during WWII. He was also detained in a

even larger, integrated although concise picture of south-Slav Astronomy, its main actors and motives. We think that these writings, although written to the aim of popularizing the issue, are very meaningful from the point of view of Astronomy in Culture and can prompt further investigations and discussions on the achievements and character of Astronomy, Physics and Mathematics in the south-Slavic context.

In the papers, Djordje Nikolić divides the history of Yugoslav Astronomy into three periods, which we may identify with the customary philosophic-historical concepts of *Humanism*, *Enlightenment* and *Positivism*. In the following we will highlight the personalities[5] and the themes which characterized each period. We will also add some more specific notes about the (many) scientists from Dubrovnik - whose main representative is Bošković - as well as some considerations on the characteristics of south-Slav Astronomy.

The first period (Humanism)

Interestingly, several astronomers of the post-Middle Age epoch and up to the end of the XVII century came from Dalmatia – i.e. the Adriatic coast and islands (several of them from the Republic of Dubrovnik/Ragusa: we will deal with these separately below). Scientists in this epoch used to communicate in Latin language, which was the international scientific and intellectuals' language at the time.

The first to be mentioned are the priests ***Martina*** (1450s) and ***Janus Pannonius*** (Ivan Česmički, alias Joannes Quinqueecclesiensis, 1434-1472). Both worked at the service of the Hungarian Kingdom and the Roman Church.

Andrej Perlah (German: Perlacher, Latin: Perlachius, 1490-1551) was born in a family of Slovene peasants but raised up to the position of professor, later rector at the University of Vienna and court astrologer to Archduke Ferdinand of Habsburg. Nikolić remembers him for his almanacs and ephemerides.

Franciscus Patricius (Frane Petrić, 1529-1597), a well-known philosopher, is mentioned by Nikolić in his accompanying paper (Nikolitch 1939: 125) although, being born in the Dalmatian island of Cres, after moving to Italy he actually maintained quite poor relationships with the south-Slav culture. Because of his advanced conception of an infinite Universe and profound reflections on light radiation and gravity, Patricius is highly estimated by Nikolić, who remembers him as one of the "natural philosophers" together with Bruno, Telesio and Campanella. Based on a section of the book *Nova de universis philosophia* (1553), entitled *Pancosmias*, where some fundamental ideas of the Universal Gravitation are sketched, Nikolić speaks of Patricius as as a forerunner of Newton and '*an ardent partizan of the ideas of Copernicus*' (Nikolitch 1939: 127).

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concentration camp in Germany from 1943 to 1945. Afterwards (1947-1966) he worked at the Geography Institute of the Yugoslav National Army.

Before the war, he had been the first president (1934-1936) of the Belgrade Amateurs Astronomers Club "Rudjer Bošković" and the founder of its magazine *Saturn*. He was not only the author of several popular papers on the work of Bošković (e.g. Nikolitch 1938b), Astrogeodesy, Mathematics etc., but also the translator of Einstein's *Relativity: the Special and General Theory* in 1935 (http://www.adrb.org/index.php?lang=en&page=presidency).

Let us make an important remark at this point. When using the term *Yugoslav* one may intend it in the "ethnic" and literal meaning of *south-Slav* - thus including all Serbs, Croats, Slovenes, Slav Muslims, Montenegrins and Macedonians; however, it can be also used in the even broader sense of "anybody who was born or lived in the nationally-mixed area of the late Yugoslav State", be it the Kingdom or the Socialist Federation - thus including also not-Slav individuals in the ethnic sense. The latter meaning actually prevailed in the XX century. When accepting this meaning, then people which were not *Yugoslavs* in the ethnic sense but lived in a south-Slav context – for example Hungarians from Vojvodina or Italians from Dalmatia - can be also considered.

5) Since the information on individuals given by Nikolić is sometimes incomplete or uncertain, we performed checks and additions. In particular, we use here the "true" names of the scientists, giving priority to the historically most recurrent or to the proper "ethnic" way of writing instead of Nikolić' French option (for example *De Dominis* instead of *Gospodnétitch*).

Marcus Antonius De Dominis, alias Marko Gospodnetić or Domnianić (1566-1624), born in the isle of Rab/Arbe and later archbishop of Split/Spalato, spent much of his life in Italy, too (esp. Padua, Venice), but also in England. He investigated the spectrum of the light and the appearance of rainbows. His works are mentioned in detail by Nikolić, who quotes two entire chapters from the rare book *De radiis visus et lucis*, respectively dealing with the refractor telescope and the formation of rainbows (Nikolitch 1938c: 118):

> *Gospodnetić wrote in 1591 a manuscript, which was published in Venice in 1611, entitled* De iride*, where there is the very first description of the astronomical lenses (refractor) telescope, which is identical to the lenses-refractor telescope discovered by Galileo 20 years later.*

De Dominis' achievements in this field were recognized and reported by Newton and Goethe themselves. Moreover, he correctly understood the tides as a moon-induced phenomenon. Galileo did not, and used sarchasm instead:

> *Lately, a certain prelate* [De Dominis] *has published a little tract wherein he says that the Moon, wandering through the sky, attracts and draws up toward itself a heap of water which goes along following it...*[6]

While Patricius and De Dominis originated from northern and central Dalmatia (Cres and Split, respectively), several scientists in this epoch were from the southern Dalmatian town of Dubrovnik: we will deal with them further below. Basic Astronomy must have been also cultivated in the Yugoslav hinterland, including Bosnia and Serbia, under the Ottoman Empire since the XV century at least, in connection with the religious rituals of Islam. Although written testimonies of these activities are rare, artefacts do exist, but have been neglected by Nikolić.[7]

The second period (Enlightenment)

South-Slav scientists in this period used mainly Latin or German as scientific languages, but some cases of Russian and French. The most famous astronomer of this epoch is of course Rudjer Bošković from Dubrovnik (see below). Others are:

Ivan Paskvić (1754-1829), born in Senj, moved first to Zagreb and then to Hungary, where he teached and worked mainly in the fields of Mathematics and Astrometry. He worked at the Observatory of Buda[8] like ***Daniel Kmet*** (1783-1825), a Slovene, whose astronomical publications in Latin language have survived to our epoch, and ***Jan Horvat*** alias János Horváth (1732-1799), actually a Hungarian from the border town of Koseg. One of Paskvić' discipules was ***Mirko Danijel Bogdanić*** (1760-1802) from Virovitica, a Croatian town at the border with Hungary. He spent most of his life in Vienna and Budapest, but was also in France, Germany, Italy and Vojvodina, above all working in the field of Cartography and Geodesy.

Jurij Vega (Georg von Vega, 1754-1802), of Slovenian origin, was in Ljubljana as a student, but then moved to Vienna; as an army officer he was sent to Belgrade to combat the Turks and to Paris to

6) Galileo's sarchastical words are cited in Pecker 2001. De Dominis died in Castel Sant'Angelo prison in Rome following a conviction by the Inquisition because of theological "errors" contained in his book *De Republica ecclesiastica*. Some sources attest that, acting as a sort of diplomat between the Roman and the Anglican churches, he was not trusted by the catholics any more. His corpse was burned at Rome's Campo dei Fiori, along with all his manuscripts (Newland 1859).

7) We know that the first Astronomical "employements" were assigned in Belgrade in 1741 to the *muvekit*s, religious officials who cared about the exact time for prayer and determined the direction of Mecca. In specially equipped rooms (*Sahatnica*), the time was determined by the *muvekits* using the height of the Sun measured with the astrolabe-quadrant (*rub'tahta*: Milisavljević et al. 2011). Mosque's clock towers (*Sahat Kula*) were set to show lunar time *à la turca*, which starts with the astronomical sunset: the clock must read 12 at the precise time of sunset each day; therefore, the clock must be adjusted constantly.

8) In Hungary, although Nikolić uses the German name of the town *Offen*.

combat the revolutionaries. Although his knowledge extended over several different fields, especially Mechanics and Mathematics, his contribution to Astronomy can be recognized in a book on Newtonian General Gravitation, edited in 1800 in German language.

For this epoch[9] Nikolić finally mentions a linguist – ***Žiga Popovič*** – and an extraordinary intellectual – ***Zaharije Stefanović Orfelin***. While the first is said to have created the German word for *observatory* (*Sternwarte*), the second popularized Astronomy through his *Perpetual* (Eternal) *Calendar*. Orfelin (1726 – 1785), a prominent Serb literary man born in Vukovar, deserves perhaps a few more words than Nikolić used:

> *Among his most important works is* Slavenoserbski magazine *printed in Venice in 1768. This is the first South Slavic magazine. Although it was printed just one volume, its importance is great. In the preface he presents the idea of civil enlightenment, and also speaks that science, literature and philosophy should leave the narrow circle of educated people and should become available to everyone. In 1768 Zechariah Orfelin introduced into the Serbian literary a language which was a mixture of Church and peoples language, having many Russian words. In this way he practically* ***founded Slavoserbian language***. (...) *Orfelin's* Perpetual Calendar *has been printed in Vienna in 1783. The book has 366 pages and 9 astronomical drawings at the end of the book. Its content is mainly on natural sciences and astronomical phenomena and contains as well description of historical events since the creation of the world chronologically presented. Chapters in astronomy bear the names: Space, The Moon and the planets, comets, solar eclipse and Moon eclipse. It includes information on weather cycles, tables with information about the Sun and the Moon (...), tables on the length of day and night, moon phase tables, and more. Therefore* **Perpetual Calendar** ***is the first book on astronomy written in Slavonic language****, how Orfelin says* 'to the benefit of the people slovenoserbskim'.[10]

The third period (Positivism)

Like Orfelin, also ***Toma Miklučić*** published an *Eternal Calendar* (Zagreb 1819). With this author we have entered the latter period in Nikolić' description, that is the period of scientists who worked in XIX century and up to the dawn of the XX century. Most of them were born under the Austro-Hungarian Empire and used German as the customary scientific communication vector.

A few names of scientists are listed by Nikolić who were mainly experts in nautical sciences: not by chance, all of them were from the Adriatic coast.[11] Afterwards, he mentions three scientists of Slovenian origin:

Jožef Stefan (1835-1893) is by sure the biggest Yugoslav scientist of the XIX century. He is best known for his achievements in Thermodynamics (the well-known *Stefan Law* of black body radiation), but the very same achievements paved the way to the whole Astrophysics as a new science. Born in the small village of Sveti Peter near Žrelec, Slovenia,

> *like Bošković and Getaldić, Stefan always remains connected to his homeland, through several collaborations with slovene magazines where he publishes his poems and stories* (Nikolitch 1938c: 148).

Matej Vodušek (1839-1931) wrote several Astronomy textbooks in German language, and, in particular, was

> *the first to edit a book*[12] *on theoretical Astronomy in Yugoslavia*,

9) In the same epoch, some Astronomy was taught at the first Serbian schools in Slavonia, for example in Sremski Karlovci where a Latin school was established in 1749 and a big Christian-orthodox gymnasium was also founded in 1791, with the first school program in "slavonic" language that included Astronomy: from 1798 to 1825, Astronomy lessons were given with a textbook in German (Milisavljević et al. 2011).

10) From Pejović & Mijajlović 2010.

11) ***Ivan Benko*** from Pula; ***Juraj Carić*** (*Tzaritch*); ***Eugen Gelčić***, from Kotor.

12) That is Vodušek 1890.

while ***Viljem Ogrinc*** (*Ogrinetz* in Nikolić' writings; 1845-1883) was a writer and popularizer of Astronomy into Slovenian language.

Spiridon "Spira" Gopčević, (alias ***Leo Brenner***, 1855-1928) was a Montenegrin from Trieste. Both an astronomer and a historian, he was also a patriot: he was imprisoned in 1893 due to some articles against the Austro-Hungarian government. Immediately after that he must have moved to Chile, where he '*worked in private astronomy*' (Nikolitch 1938c: 146). But in 1893 he was back in Dalmatia, to found the Manora Observatory on the island of Mali Lošinj.[13] He travelled again to South America at the beginning of the XX century, for instance to Arequipi (Peru) in 1903 where he carried on important observations of planets at the local observatory. In the same years he was the founder and editor of the popular scientific journal *Astronomische Rundschau*. His personality must be remembered as a typical world-open, polyglott, eager to travel and learn.

Oton Kučera (1857-1931), a Croat, *was in relation with Gopčević for the installation of an observatory in Zagreb*[14] - more precisely, he was co-founder of the town's observatory at Popov Toranj (Priest's Tower)[15] -, but his main activity was popularizing Astronomy in Serbocroatian language, writing for instance *Naše nebo* (*Our sky*) and a plenty of magazine articles.

Serbian astronomers are subsequently mentioned by Nikolić, most of them affiliated to the "Društvo srpske slovenosti" (Society of Serbian Letters) in Belgrade. They are: ***Gavrilo Popović*** (1821-1867); ***Konstantin Dragačević***; ***Milan Andonović***[16] (1849-1926); ***Radovan Miletić*** (born 1844); and, most importantly, ***Milan Nedeljković*** (1857-1950), founder of the first State Observatory in Serbia in 1891:

> *This first observatory was small and developed very hardly. It disposed of a* meridian*, an* altazimuth *and a* refractor *telescope.* (...) *The State did not want to invest bigger sums of money for "stars". This situation forced Nedeljković to deal more with metereology,*[17]

nevertheless he wrote some interesting astronomical books, including a *Project for a Calendar Reform* (1900, in French language[18]) which raised interest also at the Pontificia Accademia dei Lincei in Rome.

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13) The observatory was '*named for his wife, a wealthy Austrian noblewoman. At this observatory, Spiridon used the 17.5 cm refractor telescope to make observations of Mars, the rings of Saturn, and other planets. However he would eventually close the observatory in 1909 due to financial problems.* (...) *A new observatory was built on Mali Lošinj in 1993, and was named* Leo Brenner' (from: http://en.wikipedia.org/wiki/Spiridon_Gopčević). '*At Manora Observatory he had a 17.5 cm* Rasmussen *refractor telescope at disposal, furnished with objectives* Reimfelder *and* Hertel*, and also a* Negus *chronometer and an excellent micrometer, apart from a huge library. It is worth mentioning that the library and instruments owned by Gopčević are now* [1938] *in possession of Mr* ***Nika Miličević****, astronomer in Brać, an island where he holds a private observatory*' (Nikolitch 1938c: 147-148). Nikolić further mentions other cases of small observatories and instruments existing at the end of XIX in Slovenia (owned by ***Andrej Krajtz***) and Croatia (owned by ***Ivan Stozira***, an Astronomy writer himself. Nikolitch 1938c: 150).

14) Nikolitch 1938c: 150. Another scientist who worked in Zagreb was ***Josip Torbar*** (1824–1900), but not only as an astronomer. Evidence of cooperation between Serbian and Croatian astronomers of the time is contained in the early publications of the Astronomical Observatory of Belgrade *Godišnjak našeg neba* and *Nautical Almanac*, including several articles by Croatian scientists (Milisavljević et al. 2011).

15) '*This observatory disposed of a 16.5 cm* Reinfeld *refractor telescope, subsequently furnished with a position micrometer and small meridian made by the* Mailhat *firm*' (Nikolitch 1938c: 151).

16) The author of an important *Kosmografija* which was the first Astronomy textbook in Serbia, just like Kučera's *Naše Nebo* was the first in Croatia. Both were published in 1888 (Milisavljević et al. 2011).

17) Nikolitch 1938c: 151-152. Nedeljković was also appointed first Director of the Astronomy Department at the newly established Belgrade University in 1905. In the same University in 1936 Slobodanka Dimitrijević, a female student in a majority of male fellows, was the very first to graduate at the Faculty of Astronomy (Milogradov-Turin 1997, cit. in Milisavljević et al. 2011).

18) Nedeljković had been a student at the Sorbonne University in Paris.

In fact, it was precisely at the eve of the XX century that the question of a calendar reform was posed in Serbia like in the other christian-orthodox countries where the Julian calendar had remained in use for centuries after the Gregorian reform.[19] Other Yugoslav scientists which were involved in this discussion are[20] ***Mirković***, ***Mihailović***, ***Savić***, ***Maksim Tripković*** and ***Milutin Milanković*** (1879-1958). The latter two wrote important essays on this issue, respectively in 1900 and 1924 - but Milanković gaine world fame after linking Earth climate changes to the oscillations of the Polar axis.

Nikolić ends his main essay with a few remarks on the contemporary situation of Astronomy at the eve of WWII. The accompanying paper is instead closed with a longer and detailed section on meteorite findings in Yugoslavia and a complete list of the meteorite collection which was held by the Museum of Serbia, in Belgrade, until WWI.[21]

A "School of Dubrovnik"?

Several scientists mentioned by Nikolić were born and/or worked during the here presented first period in the then Republic of Dubrovnik.

Giovanni Gazoli or Gazzoli alias Ivan Gazolić[22] (1460s) is referred to as a mathematician and the builder of an armillar sphere ("*Ptolomeus sphere*") in a letter that was addressed to him in 1466 by Pannonius. This letter is fully reproduced in both the original Latin[23] and a French translation in Nikolić' accompanying paper (Nikolitch 1939: 123-124).

> *The bare fact that an instrument existed in Dubrovnik in the XV century is outstanding and enough as a proof that Astronomy was very developed there already in 1460* (Nikolitch 1939: 125).

The development and use of scientific instruments in the town is apparent also in the case of ***Marino Ghetaldi*** alias Marin Getaldić (1568-1626). This scientist, who originated from a noble family of ancient south-Italian origin and studied in Italy and Germany, was said to perform "magic" experiments with sunlight reflected by parabolic mirrors in a cave near Dubrovnik,[24] thus getting the fame of a sorcerer who was able to set fire to fishermen's boats at a distance. This is indeed the time

19) The Gregorian calendar will be adopted in Serbia in 1918 and Yugoslavia in 1919, only for civilian purposes (the Orthodox Church still uses the old calendar).

20) As mentioned in Nikolitch 1938c: 152.

21) It is worth stressing here that the first work on meteorites in the world was written in Russian language by another Yugoslav scientist, ***Atanasije Stojković*** (1773-1832), who worked in Kharkov, Russia, but was not mentioned by Nikolić. For more personalities of Yugoslav astronomers, which were not mentioned by Nikolić, cp. for instance the recent contributions by Pejović & Mijajlović (2010), Milisavljević et al. (2011).

22) Sparse information can be found on this scientist, whose works are all lost. This person is mentioned in Appendini 1802: 40-41, 207-208. Another paper by the same Dj. Nikolić (1938d) deals with Gazoli, but without adding much of information.

23) *Joannes Episcopus Quinque-Ecclesiensis ad Joannem Gazulo Raguzinum*, also in: Appendini 1802: 40.

24) The cave is located behind the Betina Špilja plage. As a matter of fact, a parabolic mirror (diameter 66 cm) attributed to Ghetaldi is currently kept at the National Maritime Museum in Greenwich, UK: http://collections.rmg.co.uk/collections/objects/10955.html .

when a famed "*Dubrovački durbin*" was said to exist, i.e. a mirror (reflector) telescope in Dubrovnik.[25] Nikolić (Nikolitch 1938c: 135) therefore concludes that

> *Getaldić* had built the first parabolic mirror, *a full century before Newton, and it is likely that he had used it as a mean to observe with the naked eye the real image of a boat by projection*.

It is known that Ghetaldi wrote several works dealing with Optics and was able to apply full algebraic methods to geometrical and optical problems for the first time. He had intense correspondence with all main scientists of his epoch, including Galileo, Clausius and Viète. Strictly speaking, he was rather a mathematician and physicist than an astronomer: his name is linked to Astronomy only for his activity as a telescope builder. From other sources[26] we know that he was also politically engaged for his homeland Dubrovnik/Ragusa - just like Bošković was (see below).

More *Dubrovnicians* are mentioned by Nikolić. ***Nicola Sagri*** alias Nikola Sagroević (died 1573) was above all involved in studies on sea currents and tides; ***Nicola Nale*** alias Nikola Nalješković (1510 ca. - 1587) was rather a poet and a cultivated person than an astronomer, nevertheless he participated in serious discussions on the calendar reform. ***Stefano Gradi*** alias Stjepan Gradić (1613-1683) dealt with Mathematics, Astronomy and Physics, but Navigation was at the top of his interests. After settling in Amsterdam, he wrote several works which are mentioned by Nikolić, who presents the full text[27] of two letters which cardinal Barbarigo addressed to Gradi in 1660-1661, asking for advice on the interpretation of the Copernican theory and the odd appearance of Saturn.[28]

We have seen so far how many important personalities had already emerged in Dubrovnik in a time span of barely two centuries: so many, that it could be appropriate to speak of a specific Astronomy "school". This would then be called the "school of Dubrovnik" - or "The Ragusan school", from the old Latin name of the Dalmatian town; and an even more relevant personality would be added to the count, that is Rudjer Bošković, although he actually lived in the following (XVIII) century. As a figurative representation of this "Ragusan school" we could use the beautiful image of the astronomical clock tower dating back to 1444, which, being located at the bottom of the *Stradun* (main avenue), still dominates the view of Dubrovnik's old town center.

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25) So the testimonies by contemporaries like T.L. Burattini and A. Gisgoni, mentioned in Nikolitch 1938c, p.135. In his *Doctorat*, Arnold Lebeuf (1990) explains that these testimonies were originally reported by M. Libri and critically analyzed by Martin 1871. The Italian physician Gisgoni had practiced his profession in Dubrovnik for almost ten years when he met Burattini in Warsaw in 1670, almost half a century after the death of Ghetaldi. Gisgoni told Burattini about an earthquake which had recently struck the Dalmatian town, perhaps destroying '*that admirable instrument, that the tradition ascribed to Archimedes, and which made it possible to see the boats at 25 or even 30 miles away, just as clearly as if they had been within the haven!'* (Lebeuf 1990). However, such an "admirable instrument" – which was installed '*on a tower*' and whose description corresponds to a sort of Cassegrain telescope - could not really date back to the time of Archimedes, since its existence had never been reported by scientists before, not even by '*Marino Ghettaldo*' who was among others the author of a *Promotus Archimedis* (Rome 1603). It may be that Ghetaldi, the likely builder of this "admirable" artifact, simply had not found the occasion to write about his outstanding achievement during his lifetime. This comes as no surprise if one considers the following significant quote from Ghetaldi reported by Nikolić: 'Is enim ego sum qui malim scire quam nosci, discere quam docere', that is: '*I belong to those who prefer to know, instead of being famous, and to learn, instead of teaching*' (from the Preface to *Promotus Archimedis*).

26) http://mis.element.hr/fajli/251/27-08.pdf ; http://fr.wikipedia.org/wiki/Marin_Ghetaldi .

27) Both in the original Italian version and in a French translation (Nikolitch 1939: 129-130).

28) Due to the ring, which could not be clearly recognized with the first refractor telescopes.
Nikolić also mentions a "Ragusan" ***Vinko Pučnić*** alias Pozzo, and "Ivan Odierne" that is Giovanni Battista Hodierna or Odierna (1597-1660). In the latter case, the birth place appears to have been mistaken after Appendini 1802 (pp.48-49): Odierna was clearly born in the Sicilian town of Ragusa, not in the Dalmatian Dubrovnik, given that he spent all of his life in Sicily.

Alternatively, we could also include individuals such as Patricius and De Dominis, who lived in different locations at the Dalmatian coast, and then speak of an even more extended "Dalmatian" tradition in Astronomy. At the core of this tradition are scientists (De Dominis and Ghetaldi) who were among the *very first* telescope builders! Dalmatian Astronomy showed a marked experimental-practical inclination, which has been interestingly underlined by Nikolić together with the international context in which those scientists were used to work. None of them was a "pure" astronomer, but instead they knew Optics and Geometry and used this knowledge to build astronomical instruments. In some cases they were also experts in Mathematics and Hydrodynamics: all interests and abilities which were closely related to Navigation, i.e. the main activity in the coastal context.

Dalmatian scientists were used to write their scientific essays in Latin, the customary international language for scientific correspondence at the time; in the same language they kept intense and life-lasting scientific collaborations all over Europe. Obviously, they normally had close relations with the Catholic Church, which was the most powerful scientific institution at the time, and some of them also belonged to the clergy, like the great majority of cultivated people and intellectuals at that times. This did not avoid, however, conflicts and problems with the religious authorities, even leading to the involvement of the Inquisition. The “Dalmatian” tradition is placed in the period of Humanism and Enlightenment, whose *esprit* had a clear influence on these intellectuals, including De Dominis and Bošković as the greatest examples.

Rudjer Bošković and the controversy on his nationality

With ***Rudjer Josip Bošković*** (Dubrovnik 18 May 1711 – Milan 13 February 1787) we have come to the second of Nikolić' periods. This scientist is not only the most famous Ragusan, but also the most famous south-Slav astronomer. His biography and achievements are well known especially after all celebrations which took place in 2011, 300th anniversary of his birth; therefore, we will not spend many words on him in general, but rather focus on a single significant issue, that is the controversy about his *nationality*.

At present, the Serbian Academy of Sciences and Arts ranks Rudjer Bošković among the 100 most prominent *Serbs* of all times. In fact, he was born seventh child of Nikola, an orthodox trader from Orahov Dol near Trebinje.[29] Nikolić romantically writes that grandfather Boško must have been used to wear the traditional Serb costume and shoes (*opanke*) and to listen, together with all the family, to *guslas* melodies and the epic poems of the Serbian oral tradition. Later on, Nikola would have travelled as a merchant through South Serbia, that is in the so-called *Raška* or *Old Serbia* region (Sandžak and Kosovo), and described its ancient orthodox monasteries in a detailed report to the jesuit Filippo Riceputi (1667-1742).[30] Therefore, together with his brothers and sisters, Rudjer must have received from their father

> *all the ideal force of the national* [traditional, epic Serbian] *songs* [… and] *the humanism of the Balkans* […] *How could it be surprising that, under such conditions, Bošković has become the biggest humanist of the XVIII century?* [31]

29) The ancient *Tribunia*, located in Dubrovnik's hinterland, in the Herzegovina region. The figure of Rudjer's father, Nikola Bošković, is depicted by Nikolić with greater accuracy, but the primary sources are not reported.

30) So Nikolitch 1938a: 186, apparently referring to the *Relazione dei monasterii della Provincia di Rassia datoci dal signore Nicolò Boscovich in Ragusa* transcripted in Pantić 1972: 258-260 (a serbocroatian translation in Truhelka 1930). But the author of that report must have been a *different* Nikola Bošković from Dubrovnik - somebody who was active in Bulgaria around 1737! After being '*an alumn of the* Collegio di Propaganda Fide *in Rome*', this Nicolò Boscovich, '*the nephew of archbishop Andriaši*', was beheaded in Odrin (the ancient Adrianopolis, now Edirne, Turkey) in 1738, at the age of 31, under the conviction of being an austrian spy (sources: http://www.testodigitale.com/francescani_balcani/stantchev.htm , http://cosebulgare.blogspot.it/2011/08/bulgaria-1738-mamma-li-turchi.html). Clearly a catholic, this Nikola Bošković may have been a younger relative of Rudjer's, not his father.

However, Rudjer's mother Paula was of *Italian* descent, the family of the famous poet Bara (Bartholomeus) Bettera, who moved to Dubrovnik from Northern Italy in 1610 already. Rudjer himself moved to Italy as early as at his 14, and in Italy he spent most of his life. It is also true that he used Italian language in private writings, e.g. for the correspondence with his brother Bartolomej.[32] But on this regard, it should be remembered that a first thorough codification of the Serbocroatian language came only with the linguistic reform carried out by Ljudevit Gaj and Vuk Stefanović Karadžić in the first half of XIX century – before that, written Serbocroatian had uncertain fundaments and cultivated people used to write in other languages. When d'Alembert in his *Opuscule mathématiques* (D'Alembert 1761: 246) called him *Italian*, Bošković said that

> *the author* (i.e. himself) *is Dalmatian from Ragusa, and not Italian* (...) *but for the long time passed in Italy since its first youth, he can in some way be called Italian*.[33]

Croatian sources prefer to stress that Bošković somehow referred to his *Croatian* identity. For instance, in writings to his sister Anna, he told her he had not forgotten the *Croatian* language;[34] when he was in Vienna in 1757, he spotted Croatian soldiers going to the battlefields of the Seven Years' War, wishing them '*Godspeed*' in Croatian (Harris 2003); in a letter to his brother in the same year, he described this encounter and remarked: '*Long live to Haddick and to our Croats!*';[35] and so on.

Nikolić preferred to demonstrate how Bošković was above all a proud *Ragusan*, truly fond of his small Dalmatian republic:

> *There is a glorious city, already known for a long time because of the uninterrupted maintenance of liberty in it, and because all geniuses which it delivered... My Dubrovnik, my beloved country... We cultivate tough sciences as well as beautiful literature in both Latin and Slavic, the language which we speak at home.*[36]

Bošković was even active as a diplomat for his small Republic, which he defended and tried to *save from ruins*[37] in several European courts as well as in front of Pope Benedict XIV himself.[38] In a letter to the King of Poland Stanislav August he wrote (Nikolitch 1938a: 177):

> *Dubrovnik, that is my Fatherland.*

In his diary of a journey from Costantinopoles to Poland, while passing through Bulgary he wrote:

> *The language in this country is a variant of the Slav language, and I could understand and let me be understood, 'cause this is a bit of my mother tongue.*[39]

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31) Nikolitch 1938a: 187. The author explains that there are many similarities between the Bošković and the Jugović families, the latter being the heroes of the Kosovo Field battle (1389) and subsequent epics in Serbian literature.

32) See Boscovich 2009.

33) Boscovich & Maire 1770: 449 (in footnote).

34) Dadić 1987. This is the main reference of most information on Bošković which can be easily found in internet.

35) But written... in Italian language:'*Eviva Haddick e i nostri Croati!*'. Similarly, as once in Paris he saw a Croatian unit from Ragusa at a military parade, his words were: '*there are, my brave Croats*'.

36) Dedication to Louis XVI, in the Preface of the French edition of his reknown book *The Eclipses.* Quoted in Nikolitch 1938a: 176.

37) As he repeatedly wrote: cp. Nikolitch 1938a: 177, 190.

38) Bošković was able, among others, to obtain a commercial agreement between Dubrovnik and France in 1760 (therefore acting as '*the pioneer of French-Yugoslav friendship*': Nikolitch 1938a: 190), and a peace treaty between Dubrovnik and Russia in 1775.

39) From Boskovich 1784, quoted in Nikolitch 1938a: 177.

Bošković's legacy is nowadays celebrated in Croatia, Italy and Serbia – but whose *nationality* was Bošković in fact? Djordje Nikolić had quite a different opinion on this matter (Nikolitch 1938c: 139):

> *His* [i.e. Bošković'] *life is well-known to us just like his yugoslavism.* (...) *He himself always refused both the Croatian and the Italian nationalities*

and (Nikolitch 1938a: 185)

> *felt to be a Balkans' Slav, which entirely corresponds to the nowadays idea of being Yugoslav.*

As a matter of fact, the Ragusan astronomer never declared himself explicitly to be a *Croat* or an *Italian* – he simply *could not* declare as such since neither Croatia nor Italy existed as political entities at the time, and "croatian" as well as "italian" cultural-national identities were uncertain and yet-to-come.[40] Looking at this matter from a scientific-historical point of view, one should simply recognize that the question about the "true" nationality of Rudjer Bošković is nonsense. Moreover, Bošković' life and work are a perfect example of cosmopolitanism. As a Jesuit priest, he used to move and communicate beyond borders. He was the member of scientific academies in London, Harlem, Rome, Florence, Bologna, Cortona, Livno, Metz, Nancy, Paris, and others, and the founder of the Brera Astronomical Observatory in Milan, the town where he died in 1787...

Conclusions

The modern concept of *nation*, based on language, culture, religion, custom, etc., was developed only in the 19th century. Not by chance, the idea of a common south-Slav (*Yugoslav*) identity was born at the same time. More generally, the attribution of a definite "nationality" to individuals who lived in the previous centuries is often arbitrary; it is indeterminable above all when they lived in ethnically mixed regions and frequented various cultures, peoples and languages, as it was the case of the Ragusan scientists. Since their scientific achievements were extraordinary, their example provides clear evidence of the fact that scientific research can only flourish in a context of free transfer of knowledge and multi-national cooperation.

The humanistic and cosmopolitan character of all the scientists we mentioned here is repeatedly and correctly underlined by Nikolić. As far as their "humanism" is concerned, Nikolić (Nikolitch 1938c: 116) stresses that

> *the Balkans possessed* (…) *great humanism seven centuries before the French Revolution,*

a humanism indeed

> *that was for Emperor Dušan* (…) *a sort of law which defended the poor as well as the noble*

(Nikolitch 1938a: 187), where the reference is to Emperor Dušan and his advanced *Code of Laws* (1349).

Western-Balkan scientists gave their own contribution to the study of phenomena such as: the nature of rainbows and the understanding of the Earth's atmosphere; theory and use of telescopes, either based on lenses ("*cannocchiale*") or on parabolic mirrors; light, irradiation and temperature - up to the formulation of Stefan's Law; Geography and Cartography; time computation and the calendar reform. Most of them used Astronomy as a test field for advanced physical theories in the domains of Optics, Geodesy, Mathematics and Geometry. Thermodynamics, Hydrodynamics, Oceanography,

40) Even the *Italian* identity had not yet been firmly established until the dawn of the XIX century: Italy was divided into several different States, with peoples speaking completely different languages without a proper linguistic (written) codification ad the time.

Earth Sciences (Milanković) and Planetology (Bošković, Gopčević) were developed by them to the highest level.

Many of these south-Slav scientists were not only astronomers but intellectuals in a broader sense. Starting with Enlightenment, they often contributed to the establishment of a defined south-Slav identity in the domains of language, literature, and politics by striving for independence and freedom. Finally, the activity of communicating and popularizing the astronomical knowledge was common for many of them.

Their attitude was progressive and world-open during Renaissance, Enlightenment and beyond, which is to be expected in a territory like the western Balkans, where many different cultures coexist and people of all origins pass through for trading, sometimes for waging wars, or simply traveling from one to the other side of Europe. All these scientists had an international stature. Speaking in modern terms, we can say that they were great *Yugoslavs* and best examples of *Europeans* at the same time.

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http://www.edizionenazionaleboscovich.it/
Hrvatski Biografski Leksikon
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Virtual library of the Mathematical Faculty of the University of Belgrade
http://elib.matf.bg.ac.rs:8080/virlib
(contains a collection of Yugoslav astronomical books printed in the XVIII and XIX century)