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MATHEMATICS IN BOSNIA – HERZEGOVINA

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Abstract: The situation of mathematics in Bosnia and Herzegovina between 1878 and 1918 is shortly described. At first, the general historical and political background is given. A few short biographies of mathematicians and non-mathematicians are discussed in order to give an impression of the cultural situation of the period. At the end, several items for future research are mentioned in order to better investigate the sciences in the bridge country of Bosnia and Herzegovina.

1 Bridges between East and West

Od svega što čovek u životnom nagonu podiže i gradi, ništa nije u mojim očima bolje i vrednije od mostova. (Ivo Andrić) [1]¹

Ivo Andrić was a Nobel Prize winner in literature of Bosnian origin, born when Bosnia belonged to the Habsburg Empire. In his literary work the history of Bosnia is well presented, in particular as a bridge country between East and West. A short biography is found below.

In the context of the symposium on *Mathematics in Austria-Hungary* the case of Bosnia and Herzegovina plays a special role. Whereas before 1867 the borders of the Habsburg monarchy were shifted very often, the territorial area in the time considered here (between 1867 and 1918) was changed only once in 1878 when Austria-Hungary occupied Bosnia and Herzegovina which had belonged to the Ottoman Empire for 400 years. In 1908 the new territory was officially annexed, in 1914 World War I broke out, also because of the murder of the crown prince in Sarajevo, and in 1918 the Habsburg Empire was dissolved. In this sense Bosnia and Herzegovina was for forty years a remote part of the empire but also an important one.

On the other hand it was a bridge country between East and West, between the Oriental Islamic culture and the Occidental Christian culture. Transfers of knowledge played an important role in the history of science, in particular between East and West. Here East and West may mean even Hungary and Austria, or the Orthodox and the Latin Christian Europe, or the Oriental Islamic region and the Occidental Christian region, or the Far East of Asia in comparison to the West including Europe and India, or on a lower scale Pest and Buda, connected by many bridges. In this sense this paper is just a small contribution to a much bigger project.

Because of several reasons this paper is shorter than earlier planned. Mainly some short biographies of mathematicians and non-mathematicians are presented. In the end several aspects of future research are described.

¹ *Of all the things created and built by humankind as a part of life's effort, nothing in my mind is better or worthier than bridges.*

2 The historical background

The general history of Bosnia and Herzegovina can be described here only very shortly. For further details the reader is referred to the many books available on this topic. For the purpose of this paper the reader is particularly referred to a book [2] and a recent thesis [3] which is probably not so well known.

During the fifteenth century Bosnia and Herzegovina became part of the Ottoman Empire. Maybe there were already Muslims in the country before the Ottoman period. Whereas the country was multireligious it was quite homogeneous from the point of view of language. A Slavonic language was spoken showing certain variations concerning the cultural and religious background. The population of Turkish language was quite small. In the middle of the nineteenth century when the Ottoman power had already decreased the strategic and ethnic question concerning Bosnia and Herzegovina became more important. The long border between the Habsburg and the Ottoman Empire and the Panslavonic question in the context of a general European political plan concerning the Balkan Peninsula lead to the situation of 1878.

The period after 1918 is shortly described here because it is related to the many different views in historiography concerning Bosnia and Herzegovina today. The point of view can be Austrian, Hungarian, Croatian, Serbian, Bosnian or Yugoslav in the sense of one of the two countries between 1918 and 1992, or even German, Russian or European. After World War I the first Yugoslav state was created as the Kingdom of Serbs, Croats and Slovenes including Bosnia and Herzegovina. After World War II the second Yugoslavia was founded as a federal state. In the 1990s the dissolution of Yugoslavia finally lead to an independent state of Bosnia and Herzegovina.

3 The occupation of Bosnia and Herzegovina in 1878

In 1878 the German *Kaiser* invited the big European powers (i.e. Austria-Hungary, France, Germany, Italy, the Ottoman Empire, Russia, and the United Kingdom) to meet in a conference in Berlin to decide on a variety of diplomatic issues. In the treaty of Berlin of July 13, 1878 it was agreed upon the occupation of Bosnia and Herzegovina by Austria-Hungary. However, the population of Bosnia and Herzegovina was not asked. In particular, the Muslim part was afraid of living under Christian rule and partially opposed against this occupation. The whole campaign started at the end of July 1878, and it took nearly three months to occupy the country of 51,000 square kilometres and around 1.1 million inhabitants. In the following table the distribution of the four religious groups (Orthodox Christians, Muslims, Catholic Christians, and Jews) is shown for the four *Volkzählungen* in the years 1879, 1885, 1895 and 1910.

Table (Religious groups in % of the population)

Year	Orthodox	Muslim	Catholic	Jewish	Others
1879	43	39	18	0.3	0
1885	43	37	20	0.4	0
1895	43	35	21	0.5	0.2
1910	43	32	23	0.6	0.8

In absolute numbers all the groups grew bigger since the overall population in 1910 was 1.9 million inhabitants. The changes in percentage are not due to conversions of individuals (there were only very few of these) but to emigration and immigration. Whereas the percentage of Orthodox was nearly constant, part of the Muslim population moved outside, mainly to the rest of the Ottoman Empire. On the other hand, among the immigrants from the rest of Austria-Hungary, the majority were Catholics from Austria, Hungary, and Croatia. Also Ashkenazi Jews from Austria-Hungary and Germany joined the Sephardic Jews and increased their number. Although the overall percentage of Jews was quite small, their role in the few towns where most of them lived was important.

4 Bosnia and Herzegovina under Austrian-Hungarian rule

The school system in Ottoman times had mainly been organised by the religious groups themselves. This led to extreme differences in the children's education. The best education was given to the Jewish children in the towns, the worst to Muslim girls in the countryside, also because of the lack of suitable traffic connections.

The Austrians came and surveyed the country, they built some main railway lines; they tried to build public schools which partially replaced the religious schools of different kinds. The political strategy was to create a Bosnian identity and loosen the bonds of the different communities to their centres in the Orthodox or Muslim world. Concerning the Catholic group a new archbishop was established in Sarajevo who tried to govern his church in close connection with Rome. For the Muslim population a head of scholars (reis-al-ulema) was introduced who should be independent from Istanbul. In the case of the Orthodox population it was tried to link them to the Orthodox groups within the Habsburg Empire. This only worked partially.

5 The "first" Bosnian mathematician

Throughout the whole Ottoman period there were scholars who were born in Bosnia and Herzegovina and became traditional scientists in the Ottoman Empire, among them were also mathematicians. Since this paper is dedicated to the Habsburg period, the focus will be on more modern mathematicians. As far as it is known, the first paper which was published in a mathematical journal by a Bosnian was written by a Bosnian woman.

5.1 Vera Šnajder

Vera Šnajder (born Popović) was born in Reljevo on February 2, 1904 and died in Sarajevo on February 14, 1976. She was the daughter of Simo Popović who was the director of the Orthodox Seminary in Reljevo. She attended the *Gymnasium* in Sarajevo, and in 1922 she studied mathematics and physics in Beograd where she graduated in 1928. After one year as a teacher in the *Gymnasium* in Sarajevo till 1929 she went to Paris and continued her studies till 1932. Thus it happened that the first Bosnian mathematical paper [5] was published in a French journal. Back in Sarajevo in 1932 she became a teacher again. After WWII she joined the new University of Sarajevo and in 1951 she became the first female dean in the whole of Yugoslavia. By the way, her daughter Milica left Sarajevo in 1992 for Ljubljana because of the war in Bosnia.²

² A more explicit biography can be found in [6].

6 Other Bosnians, mathematicians and non-mathematicians

There was a mathematician who was born in Bosnia two years earlier than Vera Šnajder. Stanisław Gołąb was born in Travnik in 1902. However, soon his parents moved to Austrian Poland, and he became a Polish mathematician and died in Kraków in 1980. Another Bosnian mathematician was Mahmut Bajraktarević, born in Sarajevo in 1909. He died in Bugojno in 1985.

There were two Yugoslav Nobel Prize winners, both were born in Bosnia. Vladimir Prelog was born in Sarajevo in 1906 and died in Zürich in 1938 and got the Nobel Prize in chemistry.

Ivo Andrić was born in Travnik in 1892 and died in Beograd in 1975. He attended the *Gymnasium* in Sarajevo. In 1912 he started his studies in Zagreb in the Department of Mathematics and Sciences. Hence he may play a role in this paper. But soon he changed to philosophy, Slavonic languages, and history, and later continued his studies in Wien and Kraków. He wrote his dissertation in Graz in 1922 *Die Entwicklung des geistigen Lebens in Bosnien unter der Einwirkung der türkischen Herrschaft*. He became a diplomat in Italy, in Spain, and in 1939 in Germany (Berlin). In 1941 he left diplomacy and became a writer. His most famous work is *Na Drini ćuprija* of 1945 where he describes the history of a Drina bridge during Bosnian history. In 1961 he obtained the Nobel Prize in literature.

There are two further Bosnians who were born in the 1870s and attended the school system of Austrian Bosnia.

Džemaludin Čaušević was born in Bosanska Krupa in 1870. He attended a traditional *medrese* in Bihać, and in 1887 he went to Istanbul to obtain further religious education. In 1901 he became a teacher of Arabic in the *Gymnasium* in Sarajevo, in 1903 in the *Šeriat* school. In 1914 he became the *reis-al-ulema* (the highest Muslim scholar in Sarajevo for Bosnia), a position which he obtained till 1930. He died in 1938.

Moritz Levy was born in Sarajevo in 1879. He attended the *Gymnasium* till 1901. Then he studied Semitic languages in Wien till 1906 (Ph.D.). In 1907 he became a rabbi. He went back to Sarajevo and worked as a teacher and rabbi till the German occupation of Yugoslavia in 1941. He died in a concentration camp. Levy wrote a book [4] on the Sephardic Jews in Bosnia.

7 Future research topics

The aim of describing the biographies of mathematicians and non-mathematicians who attended school during the Habsburg period of Bosnia and Herzegovina was to shed light on the cultural situation in this time. A closer investigation of the school education could tell more about members of the different religious groups and their way in the Bosnian society and later, after World War I, in Yugoslavia and other parts of Europe.

An interesting case study could be the comparison between Bosnia and Herzegovina on the one hand and the Bukovina (with capital Czernowitz) on the other hand. The Bukovina was occupied already in 1775, was even multilingual, and got a university in 1875. A direct relation to Bosnia and Herzegovina was the fact that the university in Czernowitz had the only Orthodox theological faculty in the West, i.e. in a country

dominated by Latin Christianity. Many Orthodox Bosnians studied there instead of studying outside of the Habsburg Empire.

A further topic of investigation could be the transition from Ottoman culture to Habsburg culture around 1878. This is not easy to investigate since many important sources are lost. In particular, the war of the 1990s destroyed a lot of valuable manuscripts, mainly in institutions in Sarajevo. A Bosnian Manuscript Ingathering Project tries to rescue the situation, at least partially.

The traditional Muslim schools (*medresa*) were founded already early in the Ottoman period. In Sarajevo the *Gazi Husrev Beg Madrasa* was founded on Rajab 26, 943 AH. This date reminds us of the fact that, of course, the Muslim calendar was used before 1878. It corresponds to January 8, 1573 AD. Those schools were closed in 1918 (Cazin) or 1941 (Travnik) and have now been reopened again in Cazin in 1993 and in Travnik in 1994.

Apart from astronomical manuscripts there were clock towers (*sahat-kula*) whose role could be further investigated as well as the use of calendars and astronomical instruments.

8 Last but not least: Mathematics in Austria-Hungary

The last part of this paper is not related to Bosnia and Herzegovina but to the topic of the whole session of the ICHST in Budapest to which this volume is dedicated. At the end two Hungarian mathematicians and their field of research (graph theory) will be shortly discussed.

One of the most important and influential mathematicians of the twentieth century was born in Budapest in 1913 (still in Austria-Hungary!) and died in Warszawa in 1996. His name is Pál Erdős. In the 1930s he belonged to a big group of students of Dénes König (1884–1944) who can be called one of the founders of modern graph theory.

9 Again bridges

Graph theory studies relations between certain elements called vertices. There is a famous problem related to the bridges of Königsberg which is described in a song called the *Graph Theory Hymn* composed by the Czech mathematician Ryjáček. The text was written by the Czech mathematician Zelinka and translated into many languages. It starts with *Přes Pregolu sedm mostů stálo*. There were seven bridges across the river Pregel in Königsberg. A few lines of the English translation are as follows:

*Königsberg's wise leaders were delighted
To have built such very splendid structures
War brought strife and ruin to the Pregel,
Bombs destroyed these seven splendid bridges,*

Euler's name and fame will, notwithstanding,

Be recalled with Königsberg's for ever.

These verses build a bridge to the first part of this paper which dealt with people born in Bosnia and Herzegovina, a bridge country between East and West. There were mathematicians who wrote poems and novels. Bridges were built and destroyed in Bosnia. They all can and must be reconstructed. Because bridges are the best and most valuable creations and buildings of mankind. And they lead to the transfer of scientific knowledge and to the progress of science in Bosnia and Königsberg-Kaliningrad and everywhere.

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