Academician and geodetic general Stevan P. Bošković, the head of Military Geographic Institute in Belgrade

Stevan RADOJČIĆ1*

1Military Geographical Institute, Belgrade, Serbia

Abstract. Stevan P. Bošković (1868-1957) was a Serbian geodesist, geographer and cartographer. As a head of Military Geographic Institute, he was the organizer of the first modern geodetic works in Serbia and Yugoslavia. He was the first our geodetic general and the first academician in Serbia and Yugoslavia in the area of geodesy. He innovated and improved geodetic instruments, equipment and methods. He gave a remarkable contribution to activities of the International Union of Geodesy and Geophysics. Stevan P. Bošković is one of the most educated officers of Serbian and Yugoslav Armed Forces, and our scientists of that time in general. This paper gives the basic fact about Stevan P. Bošković's work and life and his importance in history of geodesy in Serbia and Europe.

Keywords: Geodetic history, Control geodetic networks, Geoid, Invar wires, Serbia

* Stevan Radojčić> vgi@vs.rs
1 Introduction

Stevan P. Bošković (1868-1957) is the organizer of the first modern geodetic works in Serbia and Yugoslavia. He designed and established the first control (trigonometrical and levelling) networks in Serbia and undertook a precise topographical survey of the terrain on its basis. He incorporated state-of-the-art scientific and professional achievements in his projects, improving upon them with his own solutions, modifying measurement methods, surveying instruments and equipment. He also undertook the first astronomical measurements with the objective of ascertaining the shape of geoid throughout the territory of Serbia. Finally, he established links between his geodetic works in Serbia and Yugoslavia with similar undertakings in neighbouring countries establishing geodetic continuity among the Balkan countries and linking them with Europe in the process [1].

2 Education in Russia and work in Serbia

Stevan P. Bošković was born in Zaječar on May 10, 1868. After high school he entered the Military Academy in Belgrade, which he completed in 1889. After working for three years in Niš he spent seven years in Russia, from 1892 to 1899, pursuing geodesy studies. In St. Petersburg he graduated from the Military-Topographic School (three years) and the Geodesy Department of the General Staff Academy, followed by a supplementary course in astronomy with geodesy at the Observatory in Pulkovo. Geodesy department was an excellent geodetic college with prestige professors, like N. J. Cinger (1842-1918), V. V. Vitkovski (1856-1868), etc. In Pulkovo, Bošković accomplish a numerous works and projects in area of astronomy and geodesy. The director of the Observatory was O. A. Backlund (1846-1916), and teachers were astronomers and visiting scholars, like E. Jaderin (1852-1923). He was hard-working, and very soon his teachers noted his capabilities for science and research as well as for measurements and practice. Although student, he was even in charge of some Pulkovo's international projects, including an examination of the very first invar wires of Jaderin’s baseline instrument. He showed the ability for inovations, when he put the Talcott’s level on a transit instrument, and during the preparation two Kern's universal theodolites (which he purchased in 1899) for future measurements in Serbia, which he planned in Pulkovo. His professors nominated him for the member of Russian Astronomic and Russian Geographic Society, and those were the first two scientific societies which accept him as a full member [2].

In 1899 he returned to Serbia (in Belgrade) and was appointed professor of geodesy at the Higher School of Learning of the Military Academy. He held this post until retirement. From 1899 he was also in charge of the works of the military geodetic service, first as a head of the Trigonometric Division of the Geography Department of the General Staff of the Serbian Armed Forces (SAF), and then, from 1900, as a head of the whole Department.
By 1905 he had developed the first triangulation of the Kingdom of Serbia which he had personally designed, with due regard to all the highest professional and scientific standards of the time. That network was consisted of triangles which covered the territory of Serbia continuously, and it had the four baselines (with length of about 5 kilometres each, all measured in 1904) measured with three invar wires, two of them purchased (1904) from Bureau of Weight and Measures from Sevres, France, and the third one which Bošković has got in Pulkovo as a present (this wire, called wire O or wire O, was made by Swedish manufacturer Ahlberg & Ohlson in 1899). Previously, Bošković visited Bureau in Sevres where took distance measurements with deputy director of the Bureau, C. E. Guillaume (1861-1938) and done some different efforts in order to convince himself about accuracy of this technique distance measurements.

The accuracy of measured angles in Serbian control network, expressed by Ferrero's formula, is $m_F = \pm 0.66$. The accuracy of the measured baselines was better than 1:1,000,000 [4]. He linked this network in 1904 with Austro-Hungarian triangulation network integrating it thus into European geodetic works.

In parallel he also developed precise levelling of the Kingdom of Serbia which in 1905 he also linked with the Austro-Hungarian levelling network, making height systems related to the mean level of the Adriatic Sea possible for the first time in Serbia [3]. These geodetic works are the cornerstone of the basic geodetic networks which are still being used today for some purposes in Serbia.

In addition to his geodetic projects, he personally undertook astronomic measurements at 30 points thought Serbia, with the objective of establishing the form of geoid throughout of the state. Serbia is the first country in which this kind of examination was conducted throughout the whole territory.

Proceeding from this mathematical basis, in 1906 Bošković undertook a precise topographic survey on a scale of 1:25,000. With the breaking out of the two Balkan Wars and then also World War I, the works of the networks and systematic survey had to be discontinued in the period from 1912 to 1920. In that period, Bošković's Department worked tirelessly to satisfy war needs, both in connection with the retreat of the SAF as well as after was relocated to Corfu and later to the surrounding of Thessaloniki, where the Department also catered to the needs of Allies, not only of SAF.

3 Work in Kingdom of Yugoslavia

Upon the liberation of Serbia and creation of Kingdom of Serbs, Croatians and Slovenians (later Kingdom of Yugoslavia), general Bošković resumed his pre-war geodesy projects extending them to the territory of the Novi Pazar Sandžak, Kosovo, Metohija, Montenegro and Macedonia, according to the same principles and with the same accuracy of the measured angles, lengths and altitude differences. He connected his triangulation and levelling networks with all our neighbours, thereby creating an integrated geodetic system among the Balkan countries and linking them to
European geodetic works. Proceeding from this mathematical basis, he organized a topographic survey on a scale of 1:50,000 and the making of a map on a scale of 1:100,000. Revising the originals of 1:75,000 Austro-Hungarian maps (made in scale of 1:25,000) he made a 1:100,000 map for the other Yugoslav provinces as well, so that by 1933 the entire territory of Yugoslavia had been depicted on the leaves of this map. Few years after, the topographic survey originals 1:50,000 had been prepared and printed as 1:50,000 map. Those 1:50,000 and 1:100,000 maps were in use for several decades after that (with some updates from time to time, of course) and were the basis for all maps drawn on a smaller scale.

General Stevan P. Bošković was active in a number of international associations. He was a delegate of the Sebian Academy of Sciences and/or SAF at six assemblies of the IUGG (Rome 1922, Madrid 1924, Prague 1927, Stockholm 1930, Lisbonne 1933 and Edimbourg 1936), four assemblies of the IGU (Cambridge 1928, Paris 1921, Warsaw 1934 and Amsterdam 1938), and three assemblies of the Slav geographers and ethnographers (Prague 1924, Krakow 1927 and Belgrade 1930).

At these assemblies he presented papers describing the projects of the Military Geographical Institute, he was a member of many commissions (some of which were of standing nature), he delivered lectures and gave suggestions and proposals for the improvement of national works and the future activities of these associations. For example, at assembly of the IUGG in Rome (1922), he recommended the joint measurements along a meridian arc, from the Arctic Ocean to the Mediterranean Sea extended to Africa and later presided to the appropriate commission, established at assembly in Madrid 1924. Similarly, he recomended measurements along the "middle" parallel arc (i.e. 45°N) and preseded to the appropriate commission, etc. At five assemblies of the IUGG, from Madrid 1924 to Edimbourg 1936, he was the president of 14 commissions, secretary of one and the member of 12.

On the basis of his ideas and recommendations various instruments and equipment for geodetic and astronomical observations were improved. For the highest precision levelling he proposed the rods (staffs) equipped with a invar tape seated in a protection groove of staff profile and tensioned by dynamometer ("with constant force of 20 kg" [2], i.e. about 196.133 N).

He considerably modified the method of distance measurements by invar wires, as well as equipment for those measurements, because of which (and his distance measurement campaignes taken 1904. and later) he is assumed as a pioneer of this method. According to his suggestion, the precision of pointing in the measurement of horizontal angles is increased.

He designed a lightweight and stable alidade, and it was according to his idea that the theodolite-alidade for detailed measurements by the numeric and graphic methods was developed.
Stevan P. Bošković published numerous books and papers in the fields of geodesy, astronomy, geophysics and geography. He is the author of a number of geographical maps, too. He was a full-member of many foreign and domestic learned societies.

He retired in 1937 on his 70th birthday, but he continued with his work and activities. He was devoted to work in Serbian Academy of Sciences and Arts (SASA). He was active even during the WW2, working on some SASA’s projects. After the war, he was writing and publishing some books and papers, and he helped in reconstitution of some national science institution and societies. From 1947, he was very active in Geographical Institute "Jovan Cvijić" of SASA.

Stevan P. Bošković was married with Nadežda Stepanov from St. Petersburg. They had two daughters: Ana and Natalija, but they had not descendants.

He died in Belgrade on May 9, 1957.

References