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Special Issue

# Science Education and Bureaucratization of Fieldwork: Creating a Geological Collection in Nineteenth-Century Serbia

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The establishment of a network of collaborators in nineteenth-century Serbia, dedicated to scientific rock specimen collecting, required ongoing negotiation with the state administration over allocation of resources, including the mobilization of state clerks. In this period, Serbia's state-building involved, among other things, considerable investments in science education and mining. By appealing to the state's educational goals, Jovan Žujović managed to organize collecting through the network of schools, whose professors occasionally sent specimens to him. Various other state clerks, officers, and diplomats participated in this network as well, making field collecting practices situated by state administrative networks and contemporary nationalist ideologies. Through the collaborative and competitive intellectual efforts of scientific and non-scientific actors, fieldwork was co-produced as a politically contested space through the interplay of scientific, administrative, political, educational, and diplomatic initiatives that competed and collaborated within state-building projects.

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*Regarding mineralogy, we all liked those partitioned boxes with nicely ordered and enumerated rocks that the professor brought to class, from which one sample always disappeared during the lecture.*

Branislav Nušić, *Autobiografija* [Autobiography], 1924.<sup>1</sup>

When Serbian satirist Branislav Nušić reminisced in his autobiography about his time spent at school, he remembered fondly the "nicely ordered and enumerated rocks." The fact that his school, around the late 1870s and early 1880s, had a box of minerals as a didactic tool is a testament to the state's increasing investment in science education, which in spite of difficulties and many logistical problems, managed to secure such valuable teaching artifacts. While Nušić himself did not become a scientist, during one episode of his diplomatic service as a consul in Pristina, he sent several shipments of minerals and rocks from Kosovo to the geological collection of the Grand School, which included tertiary fossils of mollusks. Over the years, similar shipments from Kosovo were sent by two other Serbian consuls.<sup>2</sup> These fossils were later used by Jovan Žujović and Petar S. Pavlović to establish the presence of Tertiary layers in the Lab and Sitnica valleys of Kosovo. In honor of Nušić's contribution, Pavlović named one species of mollusks *Planorbis nušići*

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<sup>1</sup> Nušić, *Autobiografija*, 99.

<sup>2</sup> AS, Fond Jovan Žujović 40. Work Diary, 3 May 1895; *Zapisnici Srpskog geološkog društva*, vol. I, 1897–1900, 71. zbor 10.5.1899. vol. IX, no. 3/4; *Zapisnici Srpskog geološkog društva*, vol. II, 1901–1902, 86. zbor 10.4.1901. vol. XI, no. 4 and 90. zbor 10.12.1901. vol. XI, no. 8.

[today *Gyraulus nusici*, Pavlović, 1903].<sup>3</sup> Kosovo was at the time an Ottoman territory, and research based on these geological and paleontological collections served as a political means of establishing a dominating presence in scientific knowledge production about the region.

Nušić, who was educated in Serbia's secondary schools, and a politically engaged nationalist intellectual, a playwright, and a diplomat, became a collaborator in the projects of specimen collecting and geological mapping that combined scientific and nationalist goals. Investment in education, championed by nationalist intellectuals since the beginning of the nineteenth century, began to yield results. The knowledge he acquired from his mineralogy lessons, learned from the aforementioned sample box, provided him with enough knowledge to assemble several scientifically valuable shipments for the earth scientists in Belgrade to start charting a nationally coveted territory. In this way, Nušić became part of a network of collaborators attached to the Department of Geology at the Grand School, but at the same time he was one of the actors in a nationalist state-building project that invested in education.<sup>4</sup>

This article analyzes the role of fieldwork in the formation of a scientific network of collectors that established Serbia as a field of geological research. Following previous research on the social construction of scientific knowledge and its dependence on local power structures and exercises of power that produce situated knowledge, this article focuses on the situatedness of scholarly networks within the political and administrative context of the second half of the nineteenth century in Serbia, and examines the particularities of the socio-political system that affected fieldwork.<sup>5</sup> By following the attempts of Jovan Žujović (1856–1936), the founder of the Serbian school of geology and later a politician, to establish the Grand School as the center of a network of collaborators, where all the data and rock specimens from Serbia would be assembled, this article demonstrates how scientific practices of collecting were situated by the contemporary social and political structures, and ideologies. Knowledge and social life are in this way seen as being mutually co-produced through the daily interactions of Žujović and his students with various levels of state bureaucracy. Jasanoff proposed the idiom of co-production as a shorthand for denoting the mutual interdependence of social and epistemic factors within knowledge production, calling attention “to the social dimensions of cognitive commitments and understandings, while at the same time underscoring the epistemic and material correlates of social formations.”<sup>6</sup> This article argues that the field, as an object of scientific inquiry in nineteenth-century Serbia, was co-produced as a politically contested space by the interplay of scientific, administrative, political, educational, and diplomatic initiatives that competed and collaborated within state-building projects. Fieldwork, thus, became bureaucratized through the constraints of the state administration that allocated resources and mobilized networks, but at the same time influenced understandings of space, land, and national identity. Bureaucratization, in this sense, denotes the institutional framework within which the state administration brought diverse activities under its control, employed people, and created channels of communication and transportation for scientific and non-scientific actors to transfer ideas and materials.

## Education and State-Building

The field of collecting did not emerge as a neutral space, and the adaptation, appropriation, and emulation of various scientific practices happened in tandem with the state-building agenda.<sup>7</sup> From the perspective of the earth sciences, that meant that their disciplinary advancement was determined by perceived economic benefits, or perceived relevance for education. Collecting rocks, minerals, and fossils was practiced in Serbia from the 1850s, but in the early days the collections remained mostly disorganized and out of sight. There was no methodological collation and presentation of specimens, and investigations focused solely on the identification of the economically remunerative locations. A different and parallel development can be observed through the endorsement of collecting and collating in secondary and higher education. However, in the first decades of Serbia's independence, schools were still short of qualified personnel and the teaching of natural history was assigned to individuals with any kind of general education. Initially,

<sup>3</sup> Pavlović, “Građa za poznavanje tercijara,” 164.

<sup>4</sup> The Belgrade Lyceum was a predecessor of the university and existed between 1838 and 1863, when it transformed into the Grand School (1863–1905), and in 1905 it became the University of Belgrade.

<sup>5</sup> Haraway, “Situated Knowledges.” See also Coen, *Climate in Motion*; Feichtinger, “‘Staatsnation’, ‘Kulturnation’, ‘Nationalstaat’”; Fox, *The Savant and the State*; Hubbard, “In the Wake of Politics”; Oh, “The State, Science, and Planification.”

<sup>6</sup> Jasanoff, “The Idiom of Co-Production,” 3.

<sup>7</sup> Gavroglu, “The STEP Initiative,” 315–17. See also Kreuder-Sonnen, “Epidemiological State-Building in Interwar Poland”; Raina and Habib, *Domesticating Modern Science*; Shefer-Mossensohn, *Science among the Ottomans*.

teachers had only secondary school degrees, usually obtained in the Habsburg Monarchy, and over the years they were gradually replaced by former students of Belgrade's schools.<sup>8</sup>

The construction of the notions of place, natural site, field, region, state, and nation during the nineteenth century developed through the collaborative and competitive intellectual efforts of scientific and non-scientific actors, locals and foreigners, who were embedded in social hierarchies, and influenced by national identities, and political interests. In that setting, the construction of the notion of Serbia as a state and nation, could not be disentangled from the notion of Serbia as a natural site and a field of research, both entangled and connected with the rest of Europe, and at the same time separated from it through the political, administrative, and scientific construction of places. The distinction between Serbia, and (Western) Europe thus emerges as a self-identifying point of view from Serbia, produced through international intellectual interactions and on-site production of knowledge. Livingstone previously stressed that "Regions are not hermetically sealed 'givens.' They are better thought of as outcomes, the products of forces both within and beyond their contingent boundaries."<sup>9</sup> From the perspective of contemporary earth sciences Serbia did not constitute a clearly distinguishable category, as its physical traits were in all directions entrenched within neighboring regions. In order to study the geology of Serbia, one had to go beyond borders. Geologists followed the transition of crystalline and volcanic Carpathian formations through eastern Serbia into the Balkan formations in Bulgaria, and the distribution of the Dinarides that connected most formations in Serbia with the rest of the Peninsula. The majority of layers were Jurassic and Cretaceous, but there was nothing intrinsically different from the neighboring regions. The local and foreign scientific fieldwork thus co-produced Serbia both as a political entity and a natural site.

Several Austro-Hungarian travelers established close links with local scholars. At the same time, the Empire and Serbia were closely intertwined intellectually, as a considerable number of Serbian intellectuals were educated in Austrian-Hungarian schools, often belonging to their Serbian minority. The knowledge on ore prospecting and mining of the Ottomans was lost with the withdrawal of their personnel after Serbia gained autonomy, and Serbia's subsequent search for expert knowledge primarily relied on the educated Serbs from their northern neighbor. Austro-Hungarian citizens regularly found employment in Serbia and led some of the public institutions. Viennese scholar Ami Boué conducted surveys during the 1830s that would set the foundations for the geology of Southeastern Europe. In addition, the first mining engineers in Serbia usually came from Austria-Hungary, and sent specimens for laboratory analysis there. This placed Vienna as the key center of exploration of the Balkans, which caused a lot of frustration among Serbian scholars throughout the second half of the century, who argued that foreign geological research was compromising Serbian national interests.<sup>10</sup> This posited knowledge about the earth as one of the aspects of the identity politics of Serbia: it was used to defend the young nationalism against the foreign influence and build an equivalent scientific response. At the same time, this knowledge was co-produced by the overlapping initiatives in the countries through cooperation and competition, and through individuals who crossed between spaces in their surveys.<sup>11</sup>

In practice, the knowledge of nature was co-produced with the knowledge of the population, through the accumulation of knowledge, deemed necessary for state-building. Wakefield has previously demonstrated how in Germany, under the influence of the *Staatswissenschaften* and statistics, early intellectual engagement in geography initiated large-scale cataloging of the population and settlements, including mountains and rivers, and consequently – economic resources.<sup>12</sup> The nationalization of scientific knowledge followed the development of state sponsored scientific institutions and projects all over Europe, which focused on charting people and natural resources, embedding knowledge about the land within cultural, economic, and political structures.<sup>13</sup> Serbia gained its independence from the Ottoman Empire in 1878, but after a slow and gradual state-building transformation that started in 1830. Serbian historiography has previously described attempts to emulate various European state-building practices, and to overcome the obstacles of the post-Ottoman bureaucratic system. This gave the intellectual elites of the country a sense of inferiority when considering their European peers.<sup>14</sup> The complexities of social hierarchies, the absence of aristocracy,

<sup>8</sup> See Karanovich, *The Development of Education in Serbia*; Perović, "Politička elita i modernizacija"; Trgovčević, *Planirana elita*.

<sup>9</sup> Livingstone, *Putting Science in its Place*, 88.

<sup>10</sup> Lukić, *A Strong Class of Serious Scholars*, 270–303; See also Petrović, "Geološki anali Balkanskog poluostrva," 116–117.

<sup>11</sup> Lukić, *Ibid.*

<sup>12</sup> Wakefield, *The Disordered Police State*.

<sup>13</sup> See Crawford, *Nationalism and Internationalism in Science*; Duančić, *Geography and Nationalist Visions*; Duančić, "Nationalist Geographies in Interwar Yugoslavia"; Klemun, "National 'Consensus'"; Surman, *Universities in Imperial Austria*.

<sup>14</sup> See Perović, "Patrijarhalan odgovor na izazov modernizacije"; Perović, "Politička elita i modernizacija"; Stojanović, *Kaldrma i asfalt*.

and structural problems within Serbian state-building left individual initiatives dependent on the former peasant elites of the country, who were often led by intellectuals educated abroad, striving to introduce foreign ways to the post-Ottoman peasant population. From the outset, Serbian scholars wanted to be equal participants in scholarly exchange, desiring recognition from their colleagues abroad. Žujović believed his mission was to promote science and encourage his students towards surveying and collecting as a means of advancing Serbia to “a more respectable position among cultured countries.”<sup>15</sup> This influenced the strategies of Žujović and his students, as they first needed wider public attention within Serbia in order to mobilize resources and find supporters. At the same time, they had to establish connections with scholars abroad and build networks through which they could exchange books, journals, instruments, and specimens.

That bureaucracy could be considered a form of knowledge production that goes beyond simple administrative duties and that its labor actively produces knowledge has been previously examined, most notably in the first volume of the *Journal of the History of Knowledge*. The need to record, quantify, control, and regulate, influenced and even produced a number of intellectual and scholarly activities, determining the historical coming together of social and natural sciences.<sup>16</sup> In the case of the Serbian principality, it is possible to observe the emergence of a previously non-existent state administration that formed after the 1815 insurrection. The growth of the state apparatus enabled the first institutional support for the earth sciences. An initial phase of geological fieldwork took place in the 1830s and 1840s, while Prince Miloš Obrenović (1815–1839, 1858–1860) was still in power. He ordered for all natural objects to be stored at the military hospital. Not much is known about this collection, except that its first custodians were military physicians.<sup>17</sup>

The replacement of private and religious education with state controlled public education was one of the key aspects of state-building in most European countries. Green has previously stressed that this process strengthened the state’s grip on industrialization and enabled the growth of the state bureaucracy, while homogenizing the society through the imposition of national interests.<sup>18</sup> Through this process, it is possible to observe the co-production of knowledge and social structure. With the growth of the educational system and the employment of new professors at the highest schools in the country, new strategies and practices emerged, changing relations between institutions. The Ministry of Education decided to relocate the geological collection to the Lyceum in 1854, a year after Josif Pančić, an Austro-Hungarian physician of Croatian origin, began working there as a professor of natural history. Along with this collection, the Ministry of Education decided to relocate all of the natural history specimens stored on their premises. The existence of the second collection assembled by the ministry is a testimony to the attempts to assemble natural history specimens on a state level through bureaucratic intervention. But at the same time, the available evidence does not reveal how the materials of the collections were gathered, nor if there were systematic plans to maintain them.<sup>19</sup> It seems likely that randomly discovered items were donated to the various authorities, and then accumulated at the Ministry of Education. In the Lyceum, Pančić made only an incomplete inventory.<sup>20</sup>

During the first decades, the collections were not accompanied by written records of the locations and items were usually left unidentified. In order to establish cooperation, individuals had to negotiate with administrative authorities, by appealing to the already recognized goals of the bureaucracy, which invested in the exploitation of natural resources, and in education. The Department of Mining of the Ministry of Economy assembled what was to become the largest collection of specimens in the country. Pančić realized that he could acquire specimens from the mines and tried to obtain rock and mineral specimens by contacting engineers. He pleaded with the Ministry of Education to urge the mining department to regularly ship specimens to the Lyceum.<sup>21</sup> At the same time, Josif Pančić, being primarily interested in botany, regularly conducted field research, collecting plants, which he later examined and classified. As a consequence, he introduced his students to a broad understanding of general practices of fieldwork, collecting and collating. These students were then to become the main body of teaching staff in secondary schools in Serbia during the 1880s and 1890s.

<sup>15</sup> Žujović, *Pristupno predavanje*, 20.

<sup>16</sup> Felten and von Oertzen, “Bureaucracy as Knowledge”; Porter, “Revenge of the Humdrum.”

<sup>17</sup> Jovan Žujović, “Izveštaj za god[inu] 1880–1888,” 84.

<sup>18</sup> Green, *Education and State Formation*, 90–93.

<sup>19</sup> Žujović, “Izveštaj za god[inu] 1880–1888,” 85.

<sup>20</sup> *Ibid.*, 85–89. On the list of donors, one could find former Habsburg citizens, Mihailo Rašković, Ljubomir Klerić, Felix Hofmann, Emilijan Josimović, and Janko Šafarić, who migrated to Serbia, just like Pančić.

<sup>21</sup> *Ibid.*, 86.

## The Educational and Administrative Infrastructure

When Žujović began teaching mineralogy and geology at the Grand School in 1880, the school collection contained a total of 4,086 specimens that included 1,600 different kinds of minerals, rocks, and fossils. Žujović set aside a collection that was meant to be used for teaching that included 200 crystal models, 230 minerals, 130 rocks, and 200 fossils. Then he separated the specimens from Serbia and those from abroad. The foreign mineral collection consisted of more than 1500 items, but around one third of the minerals did not have their place of origin. The collection had fewer foreign rock specimens, only 480, mostly from Banat, Hungary, and Saxony. By comparison, the Serbian collection was even smaller and contained 180 unidentified minerals, 280 sedimentary rocks, 234 eruptive rocks, eighty-six petrifacts, and thirty mammal bones.<sup>22</sup> The original purpose of this collection was to assist learning, and Žujović's initial reorganization reflected this. His arrival prompted the foundation of the Department of Mineralogy and Geology at the Grand School, which was the first step in the further institutionalization of earth sciences. The goals set for the department were to facilitate the learning process, improve natural history knowledge about Serbia, and for it to act as a natural history museum until a larger institution was built.<sup>23</sup> This combination of aims appealed to a larger audience through emphasizing the usefulness of the earth sciences for educational goals that were already recognized by the nationalist and state agenda.

Behind the idea of improving natural history knowledge about Serbia was primarily the aim of creating a detailed geological map, based on a thorough survey of the country. During the 1880s Žujović was the sole authority in the earth sciences and he tried to recruit collaborators to help him. His students, Urošević and Radovanović, joined him in the 1890s, conducting mostly laboratory analyses of already assembled collections. They appealed to a wider audience and tried to attract non-scientific participants, who would be potential providers of rock samples. Many former Grand School students were employed in the state administration across the country, and potentially possessed the skills to gather specimens. They did not need expertise to identify the samples on the spot, as the samples were normally analyzed and identified in the laboratory later.<sup>24</sup> If we compare this with the case of the Italian geological survey, in the case investigated by Corsi, we see similar structural problems that stemmed from inefficient state administration and a lack of resources. In both cases, the state initiated land surveying in order to map geological features of the land, but at the same time the state acted as an inconsistent and irresolute actor.<sup>25</sup> Serbia's lack of resources and institutional support was particularly damaging, as the country lacked qualified experts for these surveys. For this reason, the search for participants in the surveying and collecting projects went beyond institutionalized boundaries of science, seeking contributors from educational and administrative circles.

Considering that the professors at the Grand School were working as state servants, their activities had to happen within the already existing structures and networks. Such conditions could be observed in other European countries, most notably in France and Germany, whose educational systems Serbia emulated. The embeddedness of academic circles within the state apparatus has been previously demonstrated in multiple studies, and similar relations between scholars and the state could be observed in Serbia.<sup>26</sup> The bureaucratization of scientific knowledge was most visible in matters of education, where the state administration allocated resources and functioned as an intermediary between the actors. One such bureaucratic intervention, a mobilization of schoolteachers on an educational project across the state, affected the emergence of systematic practices of collecting in Serbia. When the Ministry of Education decided in 1880 to improve the secondary school teaching of mineralogy and geology, their idea was to create rock and mineral collections for their schools. They contacted the Department of Mining and asked them if they could spare a part of their collection for teaching. The plan did not go well because the Ministry of Economy ignored their request until July 1882, when they finally declined it with an explanation that they could not assign any employees to the project. Instead, they suggested contacting the Grand School and asking their professor to complete the task.<sup>27</sup>

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<sup>22</sup> Ibid., 90–93.

<sup>23</sup> Ibid., 104.

<sup>24</sup> Ibid., 108–9.

<sup>25</sup> Corsi, "Much Ado About Nothing," 99–112.

<sup>26</sup> See Fox, *The Savant and the State*; Hansen, *Mapping the Germans*; McClelland, *The German Experience of Professionalization*; Oh, "The State, Science, and Planification"; Ringer, *The Decline of the German Mandarins*; Ringer, *Fields of Knowledge*; Sepkoski and Tamborini, "An Image of Science."

<sup>27</sup> AS, Velika škola 1882.108.1.

Because the original plan did not work, they contacted Žujović and asked for help, but as he did not have enough specimens at the Grand School, they made a different kind of arrangement. The Ministry of Education ordered all high schools that were under their jurisdiction to start collecting rock specimens.<sup>28</sup> All teachers of natural history were ordered to gather specimens and then send them to Žujović, who would examine them, assemble the collections for teaching, and then return them to the schools of origin.<sup>29</sup>

Things, again, did not go according to plan. Žujović complained to the ministry that only a small number of schools had joined the initiative, and that the specimens they sent were in most cases useless, often damaged, too small for identification, and without any notes about the location. This final gripe was the most damaging, as this was the key information he would have gotten from the field, that would have guided him in where to conduct field surveys in the future, and how to potentially color the region on the map once he ascertained the data about the region. He pleaded with the ministry to pressure schools to send more specimens, but received no response from them.<sup>30</sup> For unknown reasons, it appears that the ministry itself lost interest in its own project. These projects were supported and carried out by the state administration, but were at the same time hampered by lack of interest and incompetence. Individuals, however, once put in contact, continued to collaborate when the state administration stepped back. By 1888, ten schools had sent specimens, which were identified and sent back to be used for teaching.<sup>31</sup>

Even though Žujović considered the project unsuccessful, this new network assisted in establishing relationships with teachers of natural history, which proved useful for him in forthcoming years. Žujović's personal records of his acquisitions reveal that teachers and schools who initially sent specimens for this project continued to send specimens in the following decade.<sup>32</sup> Through these efforts, Žujović managed to establish a lasting communication with schools, their teachers and students, who explored their neighborhoods in search of rocks. A number of gymnasium teachers became part of Žujović's network of collaborators.<sup>33</sup> For example, Aleksa Stanojević from the Čačak Gymnasium was one of the key investigators during the acquisition of particles of the meteorite that fell on the Jelica mountain (1889). Žujović learned about the event from the state police that asked him to investigate the case. While the explosion was heard over a wide region, it was Stanojević who informed the police that this was a meteorite fall. Stanojević surveyed the region, gathered samples, and interviewed villagers after the Jelica meteorite fell, preparing the ground for Žujović before he was able to come in person to investigate.<sup>34</sup> One of the primary goals in the field was to interview the peasants who witnessed the fall of the meteorite, heard its explosion or knew where the debris could be found. The randomness of meteorite falls made eyewitness accounts essential, and the schoolteachers were well distributed around the country to search for observers. The reliance on such testimonies was part of regular practices in the earth sciences, particularly with the study of earthquakes.<sup>35</sup> Similarly, when another meteorite fell near Guča (1891), another professor of the Čačak Gymnasium, Sima Trojanović, explored the area and gathered all the pieces of the meteorite. This time, Žujović did not come to the site and the entire collecting work was conducted by Trojanović.<sup>36</sup> Even though most collaborators never became experts, this was a way for Belgrade scientists to access the field by using the school system. The nexus between education and state service formulated the administrative means through which the shipments were organized and sent, putting knowledge in the service of the bureaucratization of the state, where knowledge became part of state practices, which in return made state resources available to scholars involved in surveying and collecting.

## Collecting as a Collective Practice

As Strasser previously stressed, collecting was a spatial practice, conditioned by control over the field; a local practice, dependent on local collaborators, and a collective practice, dependent on the networks of diverse actors.<sup>37</sup> The number of individuals in Serbia who had sufficient training in natural history to recognize items

<sup>28</sup> Such large-scale educational projects that involved fieldwork were common at the time in Europe. See Gomes, "Observation versus Experimentation."

<sup>29</sup> AS, Velika škola 1882.108.3.

<sup>30</sup> Žujović, "Izveštaj za god[inu] 1880–1888," 111.

<sup>31</sup> Ibid.

<sup>32</sup> AS, Velika škola 1889.9. 1,3; 1889.96; 1890.131; AS, Fond Jovan Žujović 40. Work diary.

<sup>33</sup> AS, Fond Jovan Žujović 40. Žujović, "Izveštaj za god[inu] 1889," 117–21. Žujović, "Izveštaj za godinu 1890–91," 163–69.

<sup>34</sup> Žujović, "Jelički meteorit," 177–78.

<sup>35</sup> Coen, *Earthquake Observers*.

<sup>36</sup> Pavlović, "Gučki meteorit," 179–85.

<sup>37</sup> Strasser, "Collecting Nature," 315–16.

of geological interest grew over time. Considering that the majority of educated men found employment in various state institutions, their often random allocation around the country situated fieldwork within administrative networks. These individuals formed networks of diverse actors that established control over the field by mobilizing local collaborators.

During the nineteenth century, the earth sciences became closely connected with state administration through organized geological surveys that mapped countries. This process was slow and changed the nature of collecting, putting local collectors in a different role – as informants, rather than possessors. Rock specimens were not valued for their appearance, but became valuable for the information they revealed about the localities in which they were found. This required samples to be complete, with fossils clearly identifiable and possible to be allocated to stratigraphic layers.<sup>38</sup> The Austro-Hungarian surveys began in 1849, and produced the first geological survey map in 1867, employing many surveyors across the land. Klemun stressed the importance of negotiation between surveyors, who worked in teams, and whose work was reevaluated in the case of controversies.<sup>39</sup> In addition, Austrian scholars carried out extensive surveys in the region, mapping the Balkan Peninsula.<sup>40</sup> As previously mentioned, Austro-Hungarian surveyors were the first to map the geological features of Serbia. Building on previous mining research and filling in the gaps left behind by foreign surveyors, Žujović wanted to establish an organized survey of the country without any foreign participation. Even though they were fully aware of the necessity of collaboration with foreign scholars, Žujović and his students believed that allowing them to conduct field surveys endangered national interests, and urged the government not to allow foreign surveyors to conduct research in Serbia.<sup>41</sup>

The Geological Institute was founded in 1883, with Žujović as its only employee. Between 1880 and 1914, the most regular and reliable collaborators were Žujović's own students. By training his students to conduct field surveys, Žujović promoted methods of systematic collecting: teaching his students how to find identifiable specimens, distinguish between volcanic, metamorphic, and sedimentary rocks, recognize fossils, and to properly record where the items were found. Taught during joint field expeditions what to look for, they usually sent specimens to Žujović that they assembled during summer holidays from their own regions. During the 1890s and 1900s, the majority of schoolteachers in the provinces were former students of either Pančić or Žujović, and had experience in collecting. Other former Lyceum and Grand School students, who eventually became mining engineers, diplomats, municipal officers, or local managers of other kinds, also occasionally sent specimens. They all possessed diverse knowledge and were to varying degrees able to identify rocks, but the minimum requirement expected from them was to record the location from which they collected the specimen.<sup>42</sup>

When the Serbian Geological Society was founded in 1891, it occupied the same two rooms in which Žujović, Urošević, and Radovanović taught their students. Unlike similar geological societies across Europe, the Serbian society was not drawn from the most elite and richest members of the society. Nonetheless, like their contemporaries, they still functioned as a network that operated throughout the country and connected the society to local contributors in an attempt to connect with diverse elements in the field and establish control over the access to information about the land.<sup>43</sup> The Geological Society of Serbia intended to expand membership beyond the Grand School and included a diverse group of scholars interested in research, who were not necessarily located in Belgrade. In this way, Žujović managed to introduce a number of state clerks and schoolteachers into his circle of collaborators, who explored their own areas. Due to the small number of people working in these scientific institutions, access to the field relied on already existing state resources, relying on co-production of epistemic and state bureaucratic initiatives.

For the younger generation of scholars, collecting was a way to become connected to the scientific circle Žujović created during the 1880s and 1890s. After becoming schoolteachers in provincial towns, they sent their specimens and survey reports to the Geological Society. Those who were ambitious would either attempt to find employment in Belgrade and participate in person in the meetings of the Geological Society, or they would apply for a scholarship abroad.<sup>44</sup> This practice of using fieldwork as a means of joining a circle of scholars was not detached from wider European practices, where students of poorer

<sup>38</sup> Kohler, "Finders, Keepers," 434–36.

<sup>39</sup> Klemun, "National 'Consensus' as Culture and Practice," 90–97.

<sup>40</sup> Tollmann, "Das Geologische Wirken."

<sup>41</sup> Lukić, *A Strong Class of Serious Scholars*, 270–303.

<sup>42</sup> AS, *Fond Jovan Žujović 40. Work Diary*; Žujović, "Izveštaj za god[inu] 1889," 121. Žujović, "Izveštaj za godinu 1890–91," 163–64. Žujović, "Izveštaj za školsku godinu 1891–92," 204.

<sup>43</sup> Knell, "The Making of the Geological Society of London," 9.

<sup>44</sup> Lukić, *A Strong Class of Serious Scholars*, 122–78.

social backgrounds used field exploration as a means of social advancement.<sup>45</sup> What separates this case from others is its dependence on the network of schools, dispersed across the country, which situated the network of scholars within the educational system.

Žujović's documents reveal a number of acquisitions from the members of the upper and lower political and administrative establishment that included members of the royal family, provincial administrators and politicians, professors of the Grand School who taught other subjects, railway station managers and tax officers, military officers, and peasants.<sup>46</sup> Such donations did not always come with knowledge claims, and were often received in Belgrade with simple descriptions, such as "a box of sand from Loznica" or "a box of snails from Drina."<sup>47</sup> Vetter's distinction between experiential and cosmopolitan forms of knowledge is useful here to distinguish between the types of labor conducted by the participants. The field collecting conducted by trained surveyors belonged to Vetter's cosmopolitan knowledge – systematically ascertained at the center of knowledge production. It consisted of identification of rocks and strata, measurement of strike and dip, and mapping of the layers, along with the laboratory analyses and classification that followed. Diverse kinds of local information and materials coming from random collectors from the provinces encompassed heterogeneous forms of knowledge of the neighboring terrain and can be treated as experiential – unsystematic everyday local knowledge.<sup>48</sup> The experiential knowledge from the field provided materials in a size and shape by which their identification and analysis was possible, along with information about the location, while the cosmopolitan knowledge of Belgrade professors accounted for their examination and classification in the laboratory.

These donations were considered an act of patriotism and became part of the knowledge required for the mapping and surveying of one's own country for the sake of economic development, but also knowledge of the land was treated as an aspect of national identity. From that perspective, a peculiar group of donors were the diplomats serving in the neighboring regions, Kosovo and Macedonia, which at the time still belonged to the Ottoman Empire and were coveted by Serbian nationalists as "naturally" belonging to Serbia. Consul Mihailo G. Ristić sent a box of sand from the Skopje neighborhood while he was stationed there.<sup>49</sup> Branislav Nušić, the playwright mentioned earlier, also sent specimens to Belgrade when he was a consul in Pristina.<sup>50</sup> By establishing Belgrade as the center of knowledge production for Kosovo and Macedonia, Serbian intellectuals tried to set stronger claims over the region, even though the ethnic Serbian population was a minority. While their diplomatic mission did not necessarily envision fossil hunting, this was one of the outcomes of Serbia's foreign relations. Žujović and Radovanović were fully aware of the surveying the Austro-Hungarian earth scientists were conducting in the Balkans.<sup>51</sup> Tollmann's research on the scientific imperialism of the Austrian scholars in the Ottoman realm connected the imperial ambitions of the Serbian neighbor with geological surveys conducted in the Balkan Peninsula.<sup>52</sup> The way the Serbian earth scientists emulated the political aspects of the Austro-Hungarian geological surveys influenced the nationalist elements in Serbian science that wanted to incorporate parts of Ottoman territories into the Serbian sphere of influence.

While most of these donations were the product of individual collecting initiatives, in the case of mining facilities, the state became involved in the processes of collection and collation. The mining surveys began in 1835, with the first state commissioned survey conducted by Baron Herder.<sup>53</sup> Miners and scientists did not set priorities in the same way, and in the Serbian case, the lack of desire to publish and present results to the public slowed down efforts to collect rock specimens and publish geological maps. While the discordance occurring in the Italian geological survey of that era between the scientists and the mining engineers could not be observed in Serbia, the disunity of their initiatives was similar.<sup>54</sup> However, the collaboration improved with the establishment of the position of official state geologist in 1891, which was the informal title for the custodian of the geological collection at the Department of Mining. The

<sup>45</sup> Hodacs, "Linnaeans Outdoors."

<sup>46</sup> AS, Fond Jovan Žujović 40. Work Diary; Žujović, "Izveštaj za god[inu] 1880–1888," 102; Žujović, "Izveštaj za god[inu] 1889," 119–21; Žujović, "Izveštaj za školsku godinu 1891–92," 204.

<sup>47</sup> AS, Fond Jovan Žujović 40. Work Diary.

<sup>48</sup> Vetter, *Field Life*.

<sup>49</sup> AS, Fond Jovan Žujović 40. Work Diary.

<sup>50</sup> Ibid.

<sup>51</sup> Radovanović, "Odgovor g. prof. dr. Francu Tuli."

<sup>52</sup> Tollmann, "Das Geologische Wirken," 360–376.

<sup>53</sup> Herder, *Bergmännische Reise in Serbien*.

<sup>54</sup> Corsi, "Much Ado About Nothing," 99–112.



already existing collections of the Department of Mining were transformed into the Mining and Geological Museum under the supervision of the Ministry of Economy. In this way, a bureaucratic intervention enabled the students of Žujović, first Svetolik Radovanović, and then Dimitrije Antula, to take control of the mining museum and to organize it in a way that facilitated exchanges with the Grand School.<sup>55</sup>

The network that was emerging also depended on means of transportation, as all participants faced the problem of shipping specimens. The solution was to rely on various local state and municipal clerks and railway station managers for storage and shipping of crates with specimens. Also, state railways often gave free tickets to Žujović and his students when they went on expeditions.<sup>56</sup> While conducting surveys around the country, Žujović often left boxes with specimens at local schools, municipal offices, and railway stations, whose clerks shipped the boxes to Belgrade for him. Teachers and school principals, clerks and officers, and miners used the same methods of shipping.<sup>57</sup> Consequently, the field was additionally bureaucratized through the transportation network, with railway stations and municipal offices becoming additional nodes of communication, strengthening the official and informal communication of the school networks. These mechanisms of political communication emerged as a means of knowing, as vestiges of administrative ambition to gather all available information at the center. However, as Brendecke noted, recognition and practical application of all the available data was not always possible, leaving it to individuals to set priorities for the central administration on which information should be acted upon.<sup>58</sup>

## Conclusion

Žujović had to negotiate the already existing social and political structures that determined scholarly life in Serbia in order to find the means to recruit collaborators who could supply him with specimens and information. He was particularly dependent on already existing non-scientific networks, which he used to build his own networks of collaborators. Over time, his own students came to occupy various administrative positions around the country, which gave him access to specimens from different localities, and consequently allowed him to exploit the networks of the state administration and transportation communication for the transfer of materials and data to Belgrade.

From 1899, Žujović was for the most part absent from scientific work, mainly for political reasons. His students, Urošević and Radovanović, took control of the collection and its specimens. The networks of schools and mining institutions already possessed the administrative hierarchy capable of mobilizing skilled individuals for the purposes of surveying and collecting. This story of Serbian geological collecting reveals how knowledge of nature was produced through administrative labor, creating new social and professional hierarchies, and becoming a means of career advancement for the newly emerging elites that sought social recognition through education. Žujović and his students were also part of the state-building process that incorporated scientific work into its developmental schemes, while striving to gain independence from foreign expertise.

The co-production of science and social order in nineteenth-century Serbia was conditioned by the adaptation of scientific practices to local circumstances and depended on their embeddedness within locally determined socio-political goals, which in the case of Serbia were tied to the promotion of education and the mobilization of the educational, administrative, and political power structures. Nationalism, as an ideologically universal setting for that period, facilitated the collecting of rocks as a patriotic act that established the reputation of Serbia internationally.

This case demonstrates how the scientific community existed and functioned beyond institutionalized disciplinary boundaries. Historical context, the temporality of the historical processes and the place where science was produced, set the stage for the characters involved in this knowledge production, whether they were scientists, informed individuals with various types or degrees of knowledge, or disinterested participants, and conditioned the dynamics and outcomes of scientific endeavors. The development of scientific practices in nineteenth-century Serbia depended on their congruence with already established socio-political goals, and the administrative and economic system. The practices of collecting were thus situated by the administrative networks of schools and municipal offices, diplomatic representations,

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<sup>55</sup> Lukić, *A Strong Class of Serious Scholars*, 132–43.

<sup>56</sup> Žujović, "Izveštaj za god[inu] 1889," 118.

<sup>57</sup> AS, *Velika škola* 1882.111.1,3. Letters; AS, *Velika škola* 1885.84.1.; 1886.103.; 1890.168.; 1891.142. Accompanying shipping documents.

<sup>58</sup> Brendecke, *Empirical Empire*, 4–6.

railway stations, and other localities, producing the bureaucratization of the field. The field, through its actors' interaction, thus emerged as a co-created and politically contested space, contextually determined through the socio-political power-play in which non-scientific/non-academic actors performed scientific work, translating its meaning to the aims of administration, education, and diplomacy.

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The author has no competing interests to declare.

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