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Costa Sena: From Minas Gerais, in Minas Gerais, and through Minas Gerais (1852-1919)

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ABSTRACT . Joaquim Cândido da Costa Sena (1852-1919), a native of Conceição do Mato Dentro, Minas Gerais, followed a fairly common educational path for those who pursued higher education: having learned his first letters in his hometown, he went to the Caraça Seminary and from there to the Court, where he attended the Polytechnic School. In 1878, he enrolled in the newly inaugurated School of Mines of Ouro Preto - EMOP. After completing his studies, he remained at EMOP, achieving the position of professor and later director, until 1919, when he passed away. In this article, we discuss this trajectory from the perspective of the history of education, tracing links between the individual and the institution. Costa Sena can be understood as a mediating intellectual whose network of sociability extended beyond the limits of the national territory. We highlight the importance of his work and contributions to mineralogical studies, with international recognition. We have added Costa Sena's presence in the political arena and other social spaces, concurrent with his teaching position. Our purpose is to give visibility to figures like Costa Sena, still little known in academia, whose trajectory allows us to better understand the Brazilian educational landscape in the final decades of the 19th and early 20th centuries.

Keywords: Costa Sena; Ouro Preto School of Mines; history of education; secondary education; higher education; Ouro Preto.

Costa Sena: das Minas, nas Minas e pelas Minas (1852-1919)

RESUMO. Joaquim Cândido da Costa Sena (1852-1919), natural de Conceição do Mato Dentro-MG, fez um percurso escolar bastante comum àqueles que cursaram o ensino superior: tendo aprendido as primeiras letras na cidade natal, seguiu para o Seminário do Caraça e de lá para a Corte, onde frequentou a Escola Politécnica. Em 1878 matriculou-se na recém inaugurada Escola de Minas de Ouro Preto - EMOP. Terminado os estudos, permaneceu na EMOP, alcançando o cargo de professor e depois diretor, até 1919, quando faleceu. No presente artigo, discorremos sobre essa trajetória na perspectiva da história da educação, traçando vínculos entre o sujeito e a instituição. Costa Sena pode ser entendido como um intelectual mediador cuja rede de sociabilidade extrapolou os limites do território nacional. Destacamos a importância do seu trabalho e contribuições para os estudos mineralógicos, com reconhecimento internacional. Acrescentamos a presença de Costa Sena no cenário político e outros espaços sociais, concomitante à sua posição docente. Nosso propósito é dar visibilidade a personagens como Costa Sena, ainda pouco conhecido no meio acadêmico, cuja trajetória nos permite compreender melhor o cenário educacional brasileiro nas décadas finais do século XIX e início do século XX.

Palavras chave: Costa Sena; Escola de Minas de Ouro Preto; história da educação; ensino secundário; ensino superior; Ouro Preto.

Costa Sena: das Minas, en Minas y por Minas

RESUMEN. Joaquim Cândido da Costa Sena (1852-1919), nacido en Conceição do Mato Dentro, tuvo una reconocida trayectoria escolar: tras aprender las primeras letras en su ciudad natal, pasó al Seminario de Caraça y de allí a la Corte, donde asistió a la Escuela Politécnica. En 1878, se matriculó en la recién inaugurada Escuela de Minas de Ouro Preto - EMOP. Terminados los estudios, permaneció en la EMOP, donde fue profesor y director hasta 1919, año de su muerte. En este artículo, discutimos esta trayectoria desde la perspectiva de la historia de la educación, trazando vínculos entre el sujeto y la institución. Añadimos la presencia de Costa Sena en la escena política y en otros espacios sociales, concomitante con su posición docente. Nuestro objetivo es dar visibilidad a personajes como Costa Sena, cuya trayectoria nos permite comprender mejor la escena educativa brasileña de finales del siglo XIX y principios del XX.

Palavras clave: Costa Sena; Escola de Minas de Ouro Preto; historia de la educación; educación secundaria; educación superior; Ouro Preto.

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Introduction

Joaquim Cândido da Costa Sena was born on August 13, 1852, in the municipality of Conceição do Serro, now Conceição do Mato Dentro (Brazilian Institute of Geography and Statistics, 2022), a city that belonged to the Serro district[1]. The beginning of the settlement of the region was motivated by the discovery of the Serro Frio mines, which expanded further south, giving rise to the population centers that today constitute the municipalities of the microregion of Conceição do Mato Dentro. Currently, the *Anglo American compan*y mines iron ore in this region and, therefore, we can affirm that Costa Sena's life was surrounded by and sustained by the mines and minerals of Minas Gerais.

Probably having acquired some knowledge of Latin in his hometown, where the imperial government had established a chair of Latin grammar, created by decree of May 5, 1823 (Costa, 1975), his secondary studies began at the Caraça Seminary in October 1869 (Santuário do Caraça , 2022). The Caraça Seminary was the training ground for the intellectual elite of Minas Gerais during the 19th century, whether of ecclesiastical background or not. And not necessarily the economic elite, because many children were sponsored by this institution, given the common practice of families having at least one son linked to the Catholic Church. Sponsorship must have been the case for Costa Sena, son of a family of modest means, as Wagner Combarolli states. He also mentions the name of Father Júlio Clavelin as a special protector of Costa Sena.

Costa Sena arrived in Caraça at the age of 17, an advanced age for secondary school, which also indicates a limited socioeconomic condition. In June 1872, he enrolled in the Central School in the Court[2], where he studied Mathematics, physical and natural sciences, and content specific to Civil Engineering. This school gave rise to the Polytechnic School in 1874. Having turned twenty-six years old, he entered the School of Mines of Ouro Preto - EMOP in August 1878. It is important to highlight, then, this path through educational institutions that enjoyed a high reputation.

Costa Sena received a scholarship during his years of study in Ouro Preto. It is certain that this aid was not solely for economic reasons, but was also based on his demonstrated academic excellence throughout his education. The scholarship was granted by Law No. 2,483, of November 9, 1878, when the government was authorized "[...] to assist, from now on, the student of the School of Mines, Joaquim Cândido da Costa Senna, with the sum of 60,000 réis[3] per month to continue his studies" (Arquivo Público Mineiro, 2022).

He graduated in 1880 and remained at the School of Mines until 1919, when he passed away. Initially, he held the position of tutor and preparer of Mineralogy and Geology. He became a tenured professor in 1885 and in 1900 he took on the role of director of the School.

He combined his teaching career with political activity during the establishment of the Republic. It is known that the establishment of the School of Mines in Ouro Preto was only possible because it had the support of Emperor Pedro II, at a time when opposition to the empire was already quite fierce. Costa Sena's presence as a student, teacher, and director points to a complex scenario, where coexistence must have been very tense, given his republican stance. He was a senator for Minas Gerais, vice-president of the state, and even briefly held the position of President of the State of Minas Gerais.

Costa Sena died on June 20, 1919, in Belo Horizonte. He was buried in the Church of the Third Order of Saint Francis of Paola, to which he belonged, in Ouro Preto.

This article highlights the period during which Costa Sena attended the School of Mines – 1878-1919: first as a student, then as a professor, and finally as the institution's director. Thus, following the proposition of Gomes and Hansen (2016), we understand that he acted as a mediating intellectual given his background and the dissemination of the knowledge produced, both in his teaching role and as a researcher. As Sirinelli (2003) discusses, he frequented networks of sociability organized around mineralogical explorations and means of scientific dissemination, such as specialized journals and international exhibitions.

[1] https://pt.wikipedia.org/wiki/Serro Accessed on 17/09/2025, at 10:00 AM

[2] The Central School was established in 1858, initiating the process of separating military and civil engineering education in Brazil. Aiming to separate military and civil engineering education and, simultaneously, train technical personnel for the construction of the Brazilian Imperial State, Decree 2,156 of March 1, 1858, promoted another institutional reform, establishing the Central School. Regimentally, the Central School was "intended for the teaching of mathematics and physical and natural sciences, and also for the doctrines proper to civil engineering" (Brazil, 1858 apud Moreira, 2012, p. 21). Some time later it became known as the Polytechnic School of Rio de Janeiro.

[3] Approximately R$ 7,380.00. But it is important not to consider the value in an absolute sense, but rather a relative one, considering that monetary values also have subjective meanings. For example: at the Collegio Atheneo Fluminense, in January 1878, it received students for the secondary course at a cost of 150$000 per quarter, that is, R$ 18,450.00 per quarter, equal to R$ 6,150.00 per month.

The School of Mines of Ouro Preto

An expression of the most modern aspects of mining education, the Ouro Preto School of Mines was born old, considering that the first steps towards its creation began in 1803, with the Royal Decree of May 13th. At that time, an administrative board was established to oversee the creation of mineralogy schools similar to those already existing in Europe. Twenty years later, in an independent Brazil about to approve its first constitution, "[...] the amendment by Antonio Luiz Pereira da Cunha to a project presented in August 1823 to the Constituent Assembly, considered the creation of a college of natural sciences in Mariana". Following the initiatives surrounding the establishment of this school, on "[...] October 18 of the same year, the superintendent of diamonds, Manoel Ferreira da Câmara Bittencourt e Sá, proposed the founding, in Minas Gerais, of an academy of montanistics, docimastics and other doctrines of metallurgy" (Távora Filho, 1939).

The law that created the School of Mines of Ouro Preto dates from October 3, 1832, but it only became a reality with the arrival of Claude-Henri Gorceix in Brazil in the 1870s. Gorceix came to Brazil on the recommendation of Emperor Pedro II. He presented the project for the school's installation in Ouro Preto and, despite much resistance, it was approved with a budget allocation foreseen in the Imperial Revenue and Expenditure Law of October 20, 1875. The following month, the school already had its first regulations establishing its purpose – "[...] to train engineers for the exploration of mines and for the metallurgical industries [...]" and Article 2 established "[...] free education, with poor students, but with proven aptitude, also receiving a pension from the State" (Távora Filho, 1939).

Inaugurated on October 12, 1876, the school reflects, to some extent, the history of higher education in Brazil. This only began after 1808, when the presence of the Portuguese Court demanded a broader educational and political landscape. The teaching of Medicine and Law soon took place, while some courses such as Chemistry and other natural sciences were gradually established. Engineering, as it exists today, was still being formed: military engineering, whose main objective was the defense of the territory, was predominant. From the construction of bridges, roads, forts, lighthouses, lodgings, and barracks, a field of knowledge was formed that, by the end of the 19th century, was better defined, resulting in the separation between military engineering and civil engineering. This process accompanied, albeit belatedly, the formation of modern science, whose main characteristic is specialization and the consequent fragmentation into various fields of knowledge.

The establishment of the school in the 1870s also reflects a very promising scenario for the organization of education in Minas Gerais. The Normal School was reopened, as were other public schools, some established for the first time. Among these was the Liceu Mineiro, a leading secondary school in the capital region of the province, which attracted students from very distant locations. However, Henri Gorceix's proposal differed from what already existed, as he envisioned a school focused on the training of technicians, not a purely bookish culture as was then prevalent; a technical education built on empirical, practical, and laboratory studies, mirroring the model of the École Normale Supérieure in Paris, from which he graduated, and the École des Mines in Paris.

Gorceix proposed a school organization that went against the traditional, academic culture characteristic of 19th-century secondary education. It began with a two-year course with classes over ten months and practical activities, including excursions, during the remaining two months. This implied full-time work for teachers and students, often including Saturdays and Sundays. The selection of students through competitive examinations presented a Gordian knot for Gorceix, requiring the provision of preparatory courses to supplement the knowledge brought from secondary school by candidates, which did not meet the school's requirements.

To guarantee the quality of education, teachers should be well paid and classes small, with a maximum of 10 students. Despite being a public school, the costs of maintaining a student were high, and Gorceix advocated for the provision of scholarships by the government, as well as funding professional development trips to Europe and the United States for the best students.

Just as at the Paris School of Mines, the model used for the Ouro Preto school, where the best students from the Polytechnic School course were admitted[4], something similar occurred here. The School received students graduating from the Polytechnic School of Rio de Janeiro who brought with them the necessary knowledge to continue their studies concentrated in the field of mineralogy. Depending on their performance, they would have guaranteed employment with the State. (Carvalho, 2002, pp. 50-51).

[4] École Polytechnique, currently belongs to the Institut Polytechnique de Paris.

The reforms that have occurred over time in the education offered by EMOP illustrate well, on the one hand, the process of disseminating scientific knowledge and, on the other hand, the political game at play. The establishment of a school of mineralogy in Ouro Preto may seem very logical to us today, but the institution's history demonstrates that this was not the case. Resistance to educational decentralization in the 19th century was vigorous. After all, primary and secondary education was the responsibility of the provinces, and higher education was the responsibility of the imperial government. Preferably, this should be established in the Court or in politically significant locations. Ouro Preto was not only far from the Court, but the roads also did not facilitate travel. The metallurgical industry was still incipient (Carvalho, 2002).

Initially operating in a two-story building on Rua Padre Rolim, EMOP was transferred, in the early 1890s, to the Governors' Palace, a building constructed in the first half of the 18th century. For over a century, the building had housed not only the official residence of the governors and presidents of the Minas Gerais province, but also other public administration bodies. The transfer of the capital to Belo Horizonte left this immense space vacant, which is currently the property of the Federal University of Ouro Preto and houses the Museum and documentary collection of the School of Mines.

At EMOP, the school year ran from August 15th to June 15th, very similar to the European school calendar. According to Elysiario Tavora Filho, a teacher at the school in the 1930s, in a conference published in the *Jornal do Commercio* , from Rio de Janeiro, in the edition of November 5th, 1939, this calendar also took into account local climatic characteristics.

> This measure, which is still in effect today, dates back to the time when the Central do Brasil railway had not yet laid its tracks to Ouro Preto, which only happened in 1887. At that time, the most favorable period for horseback riding was during the dry season, between June and September. Outside of this period, the continuous rains, making the roads almost impassable, hindered access to the mountain city (Távora Filho, 1939).

The educational structure established by Gorceix, based on the French school system, encountered arduous ground in Brazil, mainly due to a secondary education system focused on the humanities. Initially, the problem did not arise, since its first students came from the Polytechnic School of Rio de Janeiro. However, the arrival of students recently graduated from secondary school, having passed the preparatory exams, highlighted the gap between this training and the requirements for admission to the EMOP (Polytechnic School of Rio de Janeiro), which, at Gorceix's insistence, administered a specific selection exam. This exam assessed knowledge of Mathematics, Physics, Chemistry, Botany, Zoology—in other words, knowledge of sciences not included in the curricula of secondary courses, whether at the Imperial College of Pedro II in the capital, or in the provinces, such as the Liceu Mineiro or the Caraça Seminary.

Solutions were sought, such as offering an ancillary course, also known as a preparatory course. To enroll in the preparatory course at the School of Mines itself, candidates had to be over 14 years old and have passed the selection process in Latin, French, Geography, and History. The course lasted two years, covering elementary content in Mathematics, Physics, Chemistry, Botany, and Zoology, as well as analytical and descriptive geometry.

It wasn't a boarding school, but rather a full-time school, to use a modern term. Lessons and practical classes took place during the day, and excursions to nearby locations occupied weekends and holidays. The school's location was, after all, privileged, facilitating students' contact with diverse mining areas.

Claude-Henri Gorceix left the school in 1891, not by chance, shortly after the Proclamation of the Republic. Until 1889, the political tension between monarchists and republicans did not overtly permeate the school's corridors. However, with the victory of the republicans, the political arrangements began to change, and the possibility of being removed from the school's administration due to his friendship with Dom Pedro II increased daily. Perhaps to avoid this situation, Gorceix "[...] resigned in 1891, after having already been on leave from April to October 1890" (Carvalho, 2002, p. 86). Professor Archias Eurípedes da Rocha Medrado, originally from the Polytechnic School of Rio de Janeiro, took over the direction of the school and remained there until August 1900.

When Costa Sena took over as director of the school in 1900, it was a difficult time for the institution, which had Dom Pedro II as its main supporter. The school's future depended on the political stance of its graduates. The winds of the republic were already impacting the school's daily life, and the transfer of the state capital to Belo Horizonte affected the city of Ouro Preto and all the institutions there. This resulted in years of struggle as director to maintain the quality of education and the school's reputation achieved up to that point. According to José Murilo de Carvalho, it was still possible to maintain the school's profile until

1930, but this became impossible after the 1930 Revolution, when Minas Gerais lost much of its political influence on the national stage.

Throughout the 20th century, we can identify fluctuations in the school's structure, both from a pedagogical and administrative point of view. However, its students and alumni have managed to maintain a tradition that is expressed in the bonds established between the residents of the student residences. Current and former students are supportive of each other in various ways, including job placement.

Another fact that demonstrates EMOP's tradition is the Festa do 12 (Festival of the 12th), when, in allusion to the school's founding date - October 12, 1876 - the student residences welcome their former residents and the city experiences a celebration as expansive as Carnival.

The school's (Figure 1) coat of arms features crossed hammers, the international symbol of mining schools. The inscription on the banner, **cum mente et malleo** , which translates to 'with mind and hammer', reflects the school's educational mission: scientific practice and research. For a time, it also featured the Vignole rail, representing civil engineering.

Figure 1. EMOP coat of arms.

From the very beginning of the school's operation, it was clear that mining engineers would not easily find employment, given the reality of local industries that used practical labor and did not demand formally trained professionals. The history of the steel industry in Minas Gerais demonstrates that the creation of a mining school was not a local need at that time. It was much more of a visionary than a rational aspect. However, over time it proved indispensable. So much so that it is common for EMOP graduates to occupy important positions at the state and federal levels.

Costa Sena at the School of Mines

On August 16, 1878, a Friday with a full moon, Joaquim Cândido da Costa Sena enrolled in the School of Mines of Ouro Preto. He was the third student to enroll in the school's third class, which opened in 1876. Along with him, three other classmates entered in the first year and two in the second year. With the students entering in 1876 and 1877, the school had a total of eighteen students. With a background in higher education from the Polytechnic School of Rio de Janeiro, Costa Sena was promoted to the second year in first place and in 1880 received his mining engineer diploma. He was 28 years old! Linked to the School of Mines, occupying various positions, he remained there for another forty years.

The reality of higher education in 19th-century Brazil is thankfully very different from what we have today. In August 1878, six students enrolled at EMOP. The current Mining Engineering course at the Federal University of Ouro Preto offers 36 places per semester. The history of education is also characterized by continuities and ruptures, and it would be beyond the scope of this article to outline these characteristics between 19th-century EMOP and what we have today. However, some aspects deserve highlighting, allowing the reader to identify the continuities and differences.

One piece of data that brings us closer to the reality of the school in its early years of operation is the number of students. In 1876, the school's first year of operation, four students enrolled, three from Rio de Janeiro and one young man from Cuiabá. Their ages ranged from 19 to 22 years old. The following year, four more students enrolled in the first year, two from Maranhão, one from Bahia, and one from Rio de Janeiro. All were over twenty years old. Along with Costa Sena, three more students enrolled, which, added to those in the second year, totaled six students. In 1879, there are eight students listed in the enrollment register, reaching 26 students enrolled by 1880.

From 1886 onwards, the number of students increased considerably when the general or fundamental course was added to the already existing higher education course. This change was established by the 1885 law: “[...] those who completed the 2nd year of general education would be given the title of surveyor. Those

who finished the six years would have the title of mining engineer with the privileges and rights of a civil engineer" (Carvalho, 2002, p. 72). In that year, the school had 51 students, with only 11 in the higher education course. In 1895, there were 20 students in the higher education course and 49 in the general/fundamental course. At the turn of the century, the total number of students decreased again, reaching 9 students in the higher education course and 14 in the general course.

Based on the number of students – an average of eight during the first five years and currently 72 – we can project other components of the school environment to understand the scale of this institution as it approaches its 150th anniversary: faculty and other staff; laboratories, equipment, and materials necessary for research and experiments; classrooms and school furniture. Add to this the exponential growth and corresponding complexity of scientific knowledge and its applicability over this period.

The first four students, as well as Costa Sena, transferred from the Polytechnic School of Rio de Janeiro. We can consider that these students came in search of a specialization not offered in the schools of the Court and São Paulo. Already in 1877, probably due to the arrival of students who had not undergone the technical studies offered by the aforementioned school, Gorceix instituted the preparatory course. This course, with some adaptations, functioned for many years. On the one hand, it highlighted the high demand for basic knowledge and, on the other, it attested to the deficiencies of the secondary education offered in the country, which was much more focused on humanities studies than on natural sciences.

Another significant aspect of the scientific and market-driven influence on the school was the awarding of diplomas. In 1885, already under its third regulation, the course lasted six years, and diplomas were issued according to the time spent at the school: completion of the second year entitled the student to a surveyor's diploma; the complete course, that is, six years, led to a diploma in mining and civil engineering.

Table 1, compiled by Costa Sena when he was the school's director, gives an idea of the difficulties faced by the school's administration in welcoming new students.

Table 1. Candidates registered and approved – 1897-1906.

Year	Registered	Approved
1897	33	13
1898	56	2
1899	22	6
1900	10	5
1901	9	6
1902	9	5
1903	7	7
1904	7	7
1905	6	2
Total	142	54

Source: Report of the Minister of Justice and Interior Affairs (1907 apud Carvalho, 2002, p. 65).

We can observe that at the end of the 19th and beginning of the 20th centuries, the number of registered candidates suffered a drastic reduction; the same did not occur with the number of those approved. This suggests two possibilities: either, with fewer applicants, the selection level was relaxed, or the preparatory courses began to fulfill their objective, which is to prepare those interested for admission to the School of Mines.

Costa Sena, professor and researcher

Joaquim Cândido completed his studies and graduated as a mining engineer in 1880. In September of that same year, he already held the position of instructor and preparator at the School of Mines, having passed the selection process that took place at the National Museum of Rio de Janeiro. He even held the chair of Physics and Chemistry, but in 1893, with Gorceix's return to Europe, he became a professor of Mineralogy and Geology, which was his specialty (Guimarães, 1952).

In this chair he rose to the position of a full professor.

His teaching career was always based on research activities and he did not shy away from the law of knowledge, which demands expansion and dissemination. Professor José Carlos Ferreira Gomes [5]recounts that at the age of

[5] Professor in the Department of Geology at EMOP, he is said to be the son of Gastão Gomes, also a professor at EMOP. In 1935 he reorganized the school's Geology Museum (Jotta, 2021).

nine he received his first collection of minerals from Costa Sena, who was the author of pamphlets on Mineralogy and Geology "[...] for the use of students at Colégio D. Bosco." He adds: in these pamphlets "[...] I gathered the first notions for my preparatory exams in these branches of Natural History" (Gomes, 1952, p. V).

As a researcher, Costa Sena published many articles, disseminating his knowledge and publicizing the discoveries and riches of Brazilian soil. The publication of articles in the Bulletin of the French Society of Mineralogy continued the network of scientific connections initiated by Henri Gorceix and consolidated by the presence of mineralogical samples selected by Costa Sena for universal expositions.

In addition to his participation in world expositions, between 1908 and 1909 Costa Sena represented Brazil at the Pan-American Scientific Congress (Guimarães, 1952) and in the early 1910s he organized mineralogy sections in museums in Brazil, Geneva and Paris (Guimarães, 1952).

We can consider the extension of scientific relations with mineralogical research societies based in France as a logical consequence of Gorceix's presence. Costa Sena, as a researcher in the field, established a network of sociability with French researchers, being one of the three Brazilian ordinary members of the French Society of Mineralogy[6] founded in 1878. Between 1884 and 1896, Costa Sena published 6 articles in the Bulletin of the aforementioned society, namely: in 1884, 'Note on scorodite in the vicinity of Ouro Preto' and 'Note on hydragarite in the surroundings of Ouro Preto'. In 1890, he published an article whose content dealt with a staurolite deposit, also in Ouro Preto. An actinolite deposit was the subject of study discussed in three articles published in 1893 (Volume 16, p. 206), 1894 (Volume 17, p. 267) and 1896 (Volume 19, p. 65). These research notes confirm the correctness of the choice of location for the school, situated in an area that facilitated *on-site study* .

Costa Sena was also mentioned in newspapers circulating in Paris. In 1897, the newspaper *Le Messager* de Paris cited Costa Sena as a Senator. The same newspaper, in its 1910 edition, informed readers of Costa Sena's position as Director of the School of Mines; information corroborated by *Le Figaro* in 1913, which added that the director acted as organizer of a mineral sample room. His death, which occurred on June 20, 1919, was reported in the Bulletin of the Mineralogy Society, volume 43, of 1920. Costa Sena's name appears on other pages of this periodical, due to his scientific collaboration with French researchers.

Within the context of scientific sociability, it is important to mention two researchers with whom Costa Sena came into contact: Charles Friedel, a geologist, and Pierre Weiss, a physicist. In an article published in 1892, also in the *Bulletin de la Société Française de Minéralogie* , entitled ' *Sur des cristaux de soufre contenus dans une pyrite épigène* ', Friedel cites Costa Sena. Similarly, in 1897, Weiss cites Friedel and Sena in the article ' *Sur l'aimantation plane de la pyrrhotine* ' (Pierre Weiss, 1899). The Brazilian researcher is indicated as a supplier of mineral samples, such as pyrrhotite, of excellent quality, to test the theories on magnetism developed by Friedel and Weiss[7].

In the Revista do Arquivo Mineiro, Costa Sena published the article 'Brief considerations on the geology and mineralogy in the surroundings of Ouro Preto', in 1911 (Senna, 1911).

His research was not limited to the Ouro Preto region, nor even to stones! He traveled through the Araxá plateaus, responding to a request from the city's mayor to study the characteristics of the abundant mineral waters in the region (Guimarães, 1952).

According to Colombarolli (2022), the researcher's recognition was demonstrated, among other things, in two very unique situations: in his honor, "[...] his name was given to a mineral, *senaite* , a satellite of diamond; and to the botanical species: *Senaea coerulea, Coccoloba senoei, Neosenoea schwacke, Lavoisiera senoei, and Endlichera senoei* "

The extent of his scientific sociability can be measured by his participation as a full member of the Paris Society of Mineralogy, the Imperial Society of Mineralogy of St. Petersburg, the Institute of Engineers of Chile, the Geological Society of Paris, the Geological Society of Berlin, the Geological Society of America; corresponding member of the National Museum, the Chilean Society of Mineralogy, the German and French scientific societies; full member of the *American Association for the Advancement of Science* , the Society for the Promotion of Agriculture of Brazil, the National Society of Agriculture and the Latin American Scientific Congress (Guimarães, 1952).

Costa Sena director

The last decade of the 19th century was particularly difficult for EMOP as an institution and, arguably, for the population of Ouro Preto as well. Firstly, because the establishment of the Republic led to the exile of

[6] Bulletin No. 16 contains the society's statutes and a list of honorary, life, and ordinary members (Liste des Membres de la Société (1893).

[7] The authors are grateful to Professor Leandro Hostalácio of CDTN/UFMG for pointing out the scientific relationship between Pierre Weiss and Costa Sena.

Dom Pedro II, the school's idealizer and enthusiastic supporter. Subsequently, due to political constraints stemming from the republican political movements, Gorceix returned to Europe. The absence of its creator left a void in the school, which only time and the presence of his disciples were able to fill. Secondly, the transfer of the state capital to Belo Horizonte impacted the city of Ouro Preto, suddenly emptied of a significant population contingent made up of state agency employees who had their headquarters there. The city experienced a cultural decline and only began to recover in the 1920s and 1930s, thanks to the modernist movement which, by valuing the national element, revived attention to the existing colonial architecture, so expressive in the local characteristics of the Baroque.

Costa Sena was in charge of the School of Mines for the first twenty years of the 20th century, between 1900 and 1919. Gorceix had stepped down in 1891 (Archias Medrado replaced Gorceix as director for nine years) and, despite the drastic change in the political landscape with the establishment of the Republic, and the exile of an important supporter - Dom Pedro II, the school had already achieved sufficient stability to remain in operation.

Taking on the role of director, Costa Sena brought with him all the experience gained during his time as a student and teacher at the school. The reports he presented during his tenure indicate a high degree of commitment to the school's future. According to Carvalho (2002), Costa Sena demonstrated concern about the failure rate, concluding that two alternatives should be pursued: either a preparatory course or the teaching of elementary mathematics in the first year of primary school. In the 1907 Report of the Minister of Justice and Interior Affairs, Costa Sena states: "To want to base the study of the subjects of the School of Mines on that of elementary mathematics, as is generally done in secondary schools, is to try to build granite walls on clay foundations." (Carvalho, 2002, p. 65).

The knowledge of elementary mathematics that incoming students brought from high school was insufficient to continue their studies at the School of Mines, resulting in a high failure rate, even in the first year.

An immediate consequence of the low level of knowledge with which students entered school was the restriction of research, since teaching demanded almost all of the teachers' energy. Costa Sena and Antônio Olinto were among the few who stood out in the area of research until 1931. The *Annals of the School* [8], which compile, among other topics, research reports and scientific articles on mineralogy and related subjects, whose publication was interrupted in the final years of the 19th century, were resumed in 1902 and again suspended between 1925 and 1931. The final years of the 19th century were marked by much politics and little research.

During Costa Sena's administration, 17 issues of the Annals of EMOP were published, with this issue being the most prominent, featuring works in the field of mineralogy. The suspension of the publication of this journal signals the existence of obstacles to research and, not coincidentally, coincides with the ostracism experienced by the school after Gorceix's departure. Therefore, Costa Sena's effort to resume publication needs to be highlighted as a movement that repositioned the school in the field of mineralogical research. Even though the other contributors to the journal were not professors at the school, this remained a center of reference (Carvalho, 2002).

The first issues of the Annals of the School in the 20th century featured publications by nationally and internationally renowned researchers, such as Arrojado Lisboa (Miguel Arrojado Ribeiro Lisboa), a graduate of EMOP, where he graduated in 1894. He was the General Inspector of Works Against Droughts, and his geological studies greatly contributed to the definitive design of the Northwest Railway of Brazil (Lisboa, 2023). Euzébio Paulo de Oliveira was also a frequent contributor and, like Arrojado Lisboa, was a graduate of EMOP, class of 1905. A scholar of geology, he worked at the Geological and Mineralogical Service of Brazil, which, in 1933, became the National Department of Mineral Production.

Eugen Hussak (1856-1911) (Atencio, n.d.), an Austrian petrologist hired by Emperor Pedro II as a mineralogy professor for his grandson Pedro Augusto, also had several articles published in the Annals of EMOP during Costa Sena's directorship. This researcher established strong ties with mineralogical research in Brazil and was involved in choosing the location for a future capital of the country in the Central Plateau, which decades later became the capital of Brasília.

Costa Sena at the Universal Expositions

World's Fairs are testaments to the advancement of scientific knowledge and its applicability achieved during the 19th century. These exhibitions showcased the great discoveries developed by Western countries:

[8] Lund and his works in Brazil (1884) are available in the Newspaper Archive of the National Library.

machines, a wide variety of inventions, cultural and artistic production, agricultural and animal production, literary works, and teaching materials, etc. London hosted the first exhibition in 1851. It was at the Philadelphia exhibition in 1876 that Emperor Pedro II tested Graham Bell's telephone.

The world's fairs held in the second half of the 19th century and the first decades of the 20th century undoubtedly had varied repercussions, but no participating country remained indifferent to the unfolding of this investment. Initially, they were limited to the participation of European countries and the USA, which was no less universal for that, since ideas, knowledge, values of progress, and civilizational standards were disseminated from there to countries within their sphere of influence.

Brazil's participation in the Paris Exposition of 1889 was sponsored by the Franco-Brazilian Syndicate. To this end, two printed materials were published. The book *Le Brésil en 1889*, by Santa-Anna Nery, with several collaborators, whose objective was "[...] to show old Europe that it is not unworthy, because of its progress, of entering more fully into the economic concert of the great States" (Nery 1889, apud Kuhlmann, 1999, p. 162). And a second edition of the entry *Le Brésil* from Émile Levasseur's encyclopedia. Also with the participation of collaborators, it included a photo album of Brazil[9].

In both publications, the chapter on mineral resources was written by Henri Gorceix, in addition to an informative text about the Ouro Preto School of Mines, titled *École des Mines d'Ouro Preto - son organisation, son enseignement.* (Santos, 2009).

An eloquent image of the importance of world's fairs was presented by Margarida de Souza Neves in a 1980 work: 'The Showcases of Progress'. In more recent research, Paulo Coelho Mesquita Santos investigated Brazil's participation in world's fairs between 1862 and 1911 within the context of mining, involving business and publications related to this field. Within this chronological framework, the author points to three distinct phases, considering Brazil's representatives and the characteristics of their participation in the corresponding exhibitions: the imperial period; the years of transition between the Empire and the Republic; and the first exhibitions of the 20th century. Initially, the commissioners of the mineral sections were individuals linked to the imperial regime. From the years of transition onwards, it was the mining engineers of EMOP who represented Brazil.

Santos (2009) states that Brazilian participation in the various exhibitions was part

> [...] of the efforts to recover mining activity in Brazil, which had an initial surge in exploration during the 18th century. During the 19th century, mining in Brazil went through a period of decline. This increase in the mineral sector at the end of the 19th century was marked by the continuation of gold and diamond mining (carried out since the colonial period) and by the development of mineral deposits that were not explored or were explored on a small scale until this period, such as iron, manganese, monazite sands, among others. (Santos, 2009, p. V).

During the imperial period, Brazil participated in the London exhibitions of 1862, Paris in 1867, Vienna in 1873, and Philadelphia in 1876. Santos (2009, p. 41) states that "[...] in the mineral sections, Brazil's participation in these early international events had as its main objective to understand the transformations that the metallurgical and iron and steel sector was undergoing." Costa Sena's participation in the universal exhibitions was constant while he was a professor and director of the School of Mines, whether as a commissioner, as occurred in the exhibitions of Chile (1894) and Turin (1911), or as a collaborator, as in the exhibitions of Berlin (1886) and Paris (1889). The prizes and medals obtained by the school in these events demonstrate the quality of its participation.

The collection and sending of samples were recurring contributions from Costa Sena. In a conference held at the University of Brazil and published in the *Jornal do Commercio* on November 5, 1939, Professor Elysiário Távora Filho outlines the following overview:

> The mineralogy museum boasts a brilliant tradition. Beyond the extraordinary variety of minerals on display, its great value has been honorably attested to in the international exhibitions to which the School has always participated with unusual brilliance. The distinguished Professor Dr. Joaquim Cândido da Costa Sena, who held the chair of Mineralogy for a long time, was, on most occasions, responsible for organizing the School's displays, a mission he fulfilled with unsurpassed care and competence (Távora Filho, 1939).

Regarding the international exhibitions in which the School of Mines participated, Távora Filho presents interesting information, pointing out the medals, awards, and other developments. In 1894, on the occasion

[9]Participants included Baron Rio Branco, Eduardo Prado, d'Ourém, Henri Gorceix, Paul Maury, E. Trouessart, and Saborowski, with an appendix by Levasseur and Glasson. This appendix can be found in Levasseur (1889).

of the inauguration of the Mining and Metallurgy Exhibition in Santiago, Chile, Costa Sena participated as a representative of the School and delegate for the state of Minas Gerais, giving several lectures. The Chilean government congratulated Brazil for "[...] the wisdom and competence of delegate Costa Sena" (Távora Filho, 1939) (Santos, 2009, p. 67).

At the Rio de Janeiro Exhibition in 1908, a national event, the School of Mines garnered four major prizes: gold, silver, and bronze medals. The school's presence at the Turin Exhibition in 1911 was also brilliant, with the "[...] contribution selected by Professor Costa Sena, who went to Italy as a Brazilian delegate." Távora Filho recorded the statement of Professor Jorge Spdezzia, director of the Turin Museum and professor of Geology and Mineralogy, upon seeing the samples from the State of Minas Gerais and the School of Mines: "[...] these collections alone would be enough to save the honor of Brazil" (Távora Filho, 1939).

According to Távora Filho's tally, the School of Mines received six grand prizes, gold medals, and a bronze medal. The Brazilians who participated in the organization received honorary diplomas.

> In this event, the role played by Dr. Costa Sena was so remarkable that he was already being called the Ideal Commissioner in Turin. During his visit to the Exhibition, Queen Letizia, who received all the necessary information from the Brazilian professor, in a gesture of great significance, demanded that he keep his hat on at all times (Távora Filho, 1939).

Before the start of the First World War, universal expositions were held in Belgium in 1913 and in the United States in 1915. Unfortunately, we still do not have information about whether or not the School of Mines participated in these events.

Costa Sena in other social spaces

There is no doubt that the establishment of the School of Mines in Ouro Preto was the result of a scientific inclination and political arrangements spearheaded by Dom Pedro II, with the technical support of Gorceix. For this reason, the changes resulting from the end of the Empire and the loss of prestige among republicans overshadowed the future of the school, considered a monarchist symbol. However, graduates of the School of Mines, also due to Gorceix's efforts in this regard, were generally promoted to executive positions in the Minas Gerais government, when they were not occupying posts in the private sector. And this practice continued, to some extent, during the Republic.

With Costa Sena, it was no different. He had barely taken office as a tenured professor when he combined his teaching career with the political position of senator, occupying a seat in the Constituent Congress of the State of Minas Gerais, from which the first republican state constitution emerged. He remained a senator in the following legislature, completing an eight-year term in that post – 1891-1898.

For the third legislature, which covered the period from 1898 to 1902, he was also elected. However, he did not serve as a senator, but rather as vice-president of the state, when Francisco Silviano de Almeida Brandão was president. Silviano Brandão stepped down from the presidency for health reasons in 1901 and died on September 25, 1902. Costa Sena held the presidency of Minas Gerais from February 21 to September 7, 1902.

It would not be difficult to describe Costa Sena as an intellectual who placed his knowledge at the service of society, both by occupying political and cultural spaces. At the Historical and Geographical Institute of Minas Gerais [IHG-MG] (1907a), Costa Sena is the patron of chair number 53, having been present at the meeting that created the institution, which took place on August 15, 1907, in the hall of the Chamber of Deputies, according to the minutes of the installation. It had been decided that the founders of the IHGMG would be the correspondents of the Minas Gerais Public Archive and, consequently, the patrons of the respective chairs (IHG-MG, 1907b). A hundred chairs were created, whose patrons represent a prominent fraction of the Minas Gerais and Brazilian intellectual community. Chair 53 is currently occupied by Professor Walter Combarolli, who produced a memorial text about Costa Sena, accessible on the institute's website.

Another important cultural institution that demonstrates Costa Sena's intellectual quality is the Minas Gerais Academy of Letters, where he founded chair number 14, whose patron is José Senna[10]. Currently, the chair is occupied by Antenor Pimenta Madeira, the third successor[11].

He is said to be the number 1 Patron of the Ouro Preto Academy of Letters, founded in 1952 and active until the 1960s. This institution has been operating regularly since 2009, at Rua Cláudio Manoel, 93, in the center of Ouro Preto.

[10] José Cândido da Costa Sena, physician, poet, brother of Joaquim Cândido da Costa Sena (Costa, 1975).

[11] Minas Gerais Academy of Letters (2023).

Some of the titles attributed to him and the societies of which he was a member speak of his presence in many cultural spaces: Knight of the Imperial Order of the Rose, Officer of the Legion of Honor, Commander of the Order of the Crown of Italy, Officer of the French Academy, Benefactor Member of the National Institute of Italy for Soldiers' Libraries, Honorary Member of the General League of Workers of Italy, member of the Center for Sciences and Letters of Campinas, of the Institute of Ceará, of the Royal Society of Arts of London, of the Geographical Society of Lisbon, of the Academic Society of International History, among others (Guimarães, 1952).

Final considerations

Having lived 67 years, Costa Sena spent 41 years, or almost two-thirds of his life, in the corridors, classrooms, and laboratories of the School of Mines. He is also buried in Ouro Preto. On August 13, 1952, on the occasion of the centenary of his birth, the School of Mines and other public entities paid homage to this scientist, and the speeches given were compiled into a separate issue of the School of Mines Magazine, year XVII, October 1952, no. 4 (Separate Issue 1st Centenary of the Birth of Prof. Costa Sena, 1952).

The ceremonies first took place in the cemetery adjacent to the São Francisco de Paula Church, as was fitting given its association with this third order. Speeches were given there by a student representative – Will Damaso de Oliveira, a faculty representative – Professor Alberto Barbosa da Silva, and Professor Brito Machado, from the Ouro Preto Academy of Letters, of which Costa Sena is patron number 1. In the afternoon, in the room where he taught, a commemorative bronze plaque was unveiled, and a speech was given by Professor José Carlos Ferreira Gomes, representing the Department of Geology.

A solemn session was held in the main hall of the School of Mines, presided over by the director, Professor Domingos Fleury da Rocha[12] who, along with Professor Alberto, were his last disciples present on the school's faculty. The then-director delivered his opening and closing remarks at the session, interspersed with a lecture by Professor Djalma Guimarães (Marciano, 2007), a graduate of 1919, the last class to receive diplomas from Costa Sena. Continuing these ceremonies, in the evening, at the headquarters of the Ouro Preto Academy of Letters, Professor Moacyr do Amaral Lisboa gave a speech.

Beyond the venues in Ouro Preto, Costa Sena was honored in the Federal Senate, with a speech by Senator Mello Viana, and in the Legislative Assembly of the State of Minas Gerais, with a speech by Deputy Jorge Safe.

A common thread in all the speeches is praise for Costa Sena, whether in the intellectual field, highlighting his intelligence and memory; or in the human field, extolling his kindness and exemplary conduct, especially towards his students. In many of these speeches we find references to Costa Sena's trajectory: from a humble family to director of the School of Mines, representing Brazil in several world expositions; his political activity and, always mentioned, his knowledge of several languages.

One aspect deserves to be highlighted, given its relevance today, as cited by Professor Djalma Guimarães in the closing conference of the tributes paid to Costa Sena on the centenary of his birth. Quoting the honoree, Guimarães (1952, p. IX) emphasizes a piece of advice given in 1881:

> It would be absurd to think that the African's sledgehammer and the panner's gold pan are sufficient for extracting our mineral wealth: the miner, setting aside routine, needs to focus on using easy-to-install equipment, which, by making the work less arduous, can yield more satisfactory results.

In other words, besides documenting a technique originating from enslaved workers, he envisioned the need to replace such tools with equipment that today we would call more technological. Professor Djalma Guimarães continues, still referring to Costa Sena:

> Despite the primitive and incipient charcoal-based iron and steel industry, Costa Sena was already drawing attention, at that time, to the destruction of the forests, given the miserable thermal efficiency of the furnaces used by our ancestors. What would he say today, faced with the voracity of the blast furnaces that devastate our scarce forests? (Guimarães, 1952, p. IX.)

What would they, Costa Sena (1852-1919) and Djalma Guimarães (1894-1973), say today, in the face of deforestation in the Amazon and other Brazilian regions?

This article has achieved a significant goal by disseminating information about Joaquim Cândido da Costa Sena, a Brazilian researcher and geologist who, through his work, took the name of the School of Mines and

[12] https://anebrasil.org.br/domingos-fleury-da-rocha/ Accessed on 09/17/2025 at 10:00 AM

Brazil far and wide. However, Costa Sena's work was not fully appreciated in this study, which leaves us with a promising opportunity for future research.

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