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Earth Sciences

Essay

The pioneering scientific endeavor and contributions of José María González Benito (1843-1903), the first Colombian modern astronomer

Los esfuerzos y aportes científicos de José María González Benito (1843-1903), el primer astrónomo moderno colombiano

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Abstract

Astronomical interest within the current Colombian territory has its roots in the Botanical Expedition of the New Kingdom of Granada (1783-1813), which stimulated the creation of an astronomical observatory in 1803, the first one established in the New World to pursue systematic observations and meteorological studies. After the death in 1816 of its first director, Francisco José de Caldas (1768-1816), during the convulsive independence period, no major astronomical observations were made for decades, with few exceptions. In this work, we delve into the contributions of the astronomer José María González Benito (1843-1903), the main reactivator of the *Observatorio Astronómico Nacional de Colombia* in the second half of the 19th century focusing on his pioneering efforts that draw worldwide attention to the national observatory and to his own private observatory. González Benito stands out as one of the figures most committed to the development of astronomy in the country and the most renowned Colombian in the international astronomical research scene of his time.

Keywords: José María González Benito*; Observatorio Astronómico Nacional de Colombia*; Flammarion Observatory; 19th century; Comets; Mars.

Resumen

El interés astronómico en el actual territorio colombiano tiene sus raíces en la Expedición Botánica del Nuevo Reino de Granada (1783-1813), en cuyo marco se impulsó la creación de un observatorio astronómico en 1803, el primero establecido en el Nuevo Mundo para realizar observaciones sistemáticas y estudios meteorológicos. Tras la muerte en 1816 de su primer director, Francisco José de Caldas (1768-1816), en medio del convulso período independentista, no hubo grandes observaciones astronómicas durante décadas, salvo contadas excepciones. En este ensayo profundizamos en los aportes del astrónomo colombiano José María González Benito (1843-1903), principal reactivador del Observatorio Astronómico Nacional de Colombia en la segunda mitad del siglo XIX, destacando sus esfuerzos pioneros, los cuales volcaron la atención mundial sobre esta instalación astronómica y sobre su observatorio privado. González Benito sobresale como una de las figuras más comprometidas con el desarrollo de la astronomía en el país por su impulso a un campo hasta entonces considerado localmente apenas como una herramienta práctica en tareas de ingeniería como la cartografía. Exponemos, así, las razones para considerar a González Benito como el colombiano más destacado en el panorama de la investigación astronómica internacional de su época.

Palabras clave: José María González Benito; Observatorio Astronómico Nacional de Colombia; Observatorio Flammarion; Siglo XIX; Cometas; Marte.

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Introduction

In the second half of the 19th century, the figure of the Colombian astronomer José María González Benito (1843-1903), hereafter JMGB, is inescapably connected with a large number of works of paramount relevance for the advancement of national science. His great capability to get involved in ideas and projects of various kinds is reflected in a long list of contributions that transcended purely scientific domains and transformed the social and cultural environment of his time. Besides the noteworthy scientific contributions of JMGB in astronomy, which are the main focus of this work, his pioneering contributions in other scientific areas should be considered. In 1871, he pioneered the teaching of stratigraphy in the geology and paleontology courses that he led at the *Escuela de Ciencias Naturales* (School of Natural Sciences) at *Universidad Nacional de Colombia*. His curiosity also led to his interest on bacteriology and microphotography. Since 1895, JMGB alternated his lectures on this subject and on solar physics at the *Instituto Politécnico*. This initiative arose during a meeting with several academics at JMGB's house in 1893 to establish a scientific center to support the study of new branches of human knowledge in the country; later, this private institution would become *Instituto Colombia*. His studies on the microcosm are currently lost. However, it has been established that he used state-of-the-art imported microscopes to undertake studies of great practical utility which he communicated to the local *Academia de Medicina* (Academy of Medicine), formerly known as *Sociedad de Medicina y Ciencias Naturales de Bogotá,* placing him as a national leader in this branch of knowledge.

Our essay is the first using the information from JMGB's autobiography, a manuscript lost for more than a century that was accidentally found in 2018 and transcribed by Armando Martínez Garnica and Ramón García Piment (**González,** 2018). This material is complemented by the biographical description written by **Sánchez** (1906) and **Arias de Greiff** (1993), among other multiple references and information from national and international historical manuscripts and other sources.

Focusing on JMGB's passion for the cosmos and after reviewing the material that reveals his motivations and contributions to solving decisive astronomy problems of his time, his expertise with instrumentation, and his countless efforts to get involved in fundamental astronomy research, we dare to assert that JMGB is the first Colombian modern astronomer (what we now call an astrophysicist with vast technical and theoretical knowledge), as also acknowledged by other present-day astronomers (**Portilla,** 2017). Besides his purely scientific interest, JMGB was well aware of the importance of popularizing science among the general public. In this sense, as a member of the *Sociedad de la Luz* (Society of Light) at the *Instituto de Artes y Oficios* (Institute of Arts and Crafts) created in 1872 in Bogotá, he displayed countless efforts to spread useful knowledge for the country through his articles about astronomical phenomena in newspapers (e.g., *La Ilustración*) and by motivating others to do so.

Historically, JMGB is mainly recognized for his role as the director of the *Observatorio Astronómico Nacional de Colombia* (OAN) for several periods between 1868 and 1891. During this time, the Observatory fully achieved the goal set at its creation: to carry out continuous astronomical observations with scientific rigor. JMGB did not hesitate to spend his own capital to adequate the premises of the OAN and to acquire sophisticated instrumentation, clear evidence of his commitment to the development of Colombian astronomy.

The OAN was founded in 1803 in Bogotá (**Figure 1S,** https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323), in the framework of the *Expedición Botánica del Nuevo Reino de Granada* (Botanical Expedition in New Granada) led by the Spanish physician José Celestino Mutis (1732-1808). In the first decades of the 19th century, the Observatory was mainly devoted to meteorological studies and astronomical observations related to cartography (**Bateman,** 1954; **Arias de Greiff,** 1993). Its first director was Francisco José de Caldas (1768-1816), who was shot by the royalists in 1816, during the fight for independence from the Spanish Crown (**Portilla,** 2020). Due to the many adverse

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political and social circumstances surrounding the observatory that limited its administration and use, no major astronomical observations were made in the following years, with a few exceptions (**Uricoechea,** 1860; **Torres-Sánchez & Salazar Hurtado,** 2002).

Here we rescue and compile some of the most remarkable and innovative activities pursued by JMGB, including those related to his role as director of the OAN, an institution he reactivated in the second half of the 19th century. We also highlight the personal astronomy projects that he carried out in his private observatory.

The scientific life of José María González Benito

The Colombian astronomer JMGB (**Figure 1**) was born on September 1st, 1843 in Zipaquirá, a town located 50 kilometers north of Bogotá in Colombia. From an early age, he was involved in drawing maps and surveying large salt mines around his birthplace under the supervision of Manuel Ponce de León (1829-1899), one of the founders of the *Sociedad Colombiana de Ingenieros* (Colombian Society of Engineers), who was his first prominent mentor and gave him private lessons (**Sánchez,** 1906; **Torres-Sánchez & Salazar-Hurtado,** 2002). From him, JMGB learned integral and differential calculus and physics, among other science subjects, at a time when formal education was not standardized in the country. Later, he became a young assistant of Indalecio Liévano (1834-1913), a distinguished Colombian engineer, and was able to contribute to the layout of the railway joining Zipaquirá to Nemocón via Sesquilé and Tausa (**Liévano,** 1875; **Tisnés-Jiménez,** 1956; **González**, 2018). JMGB's many trips to rural areas fostered his interest in geology and paleontology and took him to travel through the mountainous region from Sumapaz to Tunja (**Arias de Greiff,** 1993). His interest in astronomy arose in 1862 when he was appointed as Liévano's assistant when he became the director of the OAN.

In 1864, JMGB traveled to Europe, where he enrolled in the Central School of Paris and attended some courses at Sorbonne University. This allowed him to meet the famous French scientists Urbain Jean Joseph Le Verrier (1811-1877) and Jean-Baptiste Boussingault (1801-1887), among others, who further catalyzed the enthusiasm for astronomy of the young Colombian (**Sánchez,** 1906). When he returned to Colombia in 1866, JMGB was appointed by the government as an assistant at the *Oficina Central del Cuerpo de Ingenieros* (Central Bureau of the Corps of Engineers) and in charge of the diary of observations at the *Observatorio Astronómico de Santafé de Bogotá* (Astronomical Observatory of Santafé de Bogotá) since both places were united at the time. Two years later, JMGB became the first astronomy and meteorology teacher at the recently founded (1867) *Universidad Nacional de Colombia* (UNAL). At that same time, he was appointed by Manuel Ancízar

Figure 1. Portraits of José María González Benito. Left: Photograph of the Colombian astronomer in his 30s. Middle: Painting from 1948 hung at the OAN (photo taken by the authors). We argued that it was based on the photograph on the left. Right: Colorized photograph of the astronomer in his 50s (**Sánchez,** 1906)

(1812-1882), provost of the university, as the new director of the OAN. However, JMGB would not last long in this position since he decided to return to Zipaquirá, his hometown, to complete his previous and unfinished tasks: the meteorological records of the location and, most importantly, the *Carta Geológica de la Sabana de Bogotá* (Geological Chart of the Plateau of Bogotá) (**Figure 2S,** https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323), that represented eight years of intense work (**Arias de Greiff,** 1993). This work deserved him an honorable mention in an outstanding event, the 1871 Exhibition of the National Industry, which was the most important in the country (**Revista Científica e Industrial,** 1871). The study was published in scientific journals in Colombia and Germany and served to establish new carbon mines in the region. That same year, he returned to the UNAL, this time as a professor of geology and paleontology, disciplines taught for the first time in the country. During his classes, he used the collection of more than 5.000 pieces of crystallography, mineralogy, geology, and paleontology samples that he had acquired in Paris, as well as other materials collected in his exploration trips. Three months later, he was notified that he had been appointed for the third time as director of the OAN and professor in charge of the master's classes in astronomy and meteorology at the UNAL School of Engineering. His meteorological observations were published in the Annals of the Observatory (1882a, 1882b, 1882c, 1882d, 1882e). Again in 1871, the *Academia de Ciencias Naturales* (Academy of Naural Sciences) was integrated by a national decree into the UNAL's School of Natural Sciences and JMGB became one of its members together with other teachers of the university. During the same period, JMGB was invited to be a member of the *Amigos de la Luz* (Friends of the Light) society whose aim was to promote the popularization of science through courses and outreach activities addressed to the general public. There he was mainly in charge of the topics related to geography and astronomy (**Sánchez,** 1906).

As for his academic work at the OAN, he resigned in 1872 due to differences with the university authorities and colleagues regarding his duties, as well as his refusal to receive a salary and his insistence on paying from his own resources the public services, cleaning, and maintenance of the OAN building and garden. However, he would return for the fourth time to be the director of the OAN that same year in September, but this time as a professor of astronomy and geodesy in the School of Engineering. Then, JMGB decided to spend some time in Europe, mainly in France and England, and his position at the OAN was covered by Luis María Lleras Triana (1842-1885), a renowned mathematician and engineer (**Arias de Greiff,** 1993). During his trip, he visited the observatories of Saint Petersburg and Moscow (**Sánchez,** 1906), and in England, the Queen approved him as consul of the United States of Colombia at Southampton (**Bulletins and Other State Intelligence,** 1874).

In Paris, JMGB's interest in deepening his scientific knowledge took him to enroll in an astronomy course given by the French astronomer Pierre Puiseux (1855-1928) and in a geology course taught by the French geologist and mineralogist Gabriel-Auguste Daubrée (1814-1896), both leading scientists of their generation. During his stay there, he established relations with European scientific institutions such as the Paris Observatory. In 1875, soon after receiving membership to the Royal Astronomical Society in London, he returned to Colombia. In 1882, he became one of the founding members of the French Astronomical Society. His last days were devoted to the creation of the Institute Colombia, where he aspired to integrate the academies of mathematics, moral and ethical sciences, and social sciences. Unfortunately, JMGB died the day before the inauguration of the Institute that was to take place in Bogotá on July 28, 1903 (**Sánchez,** 1906; **Arias de Greiff,** 1993).

His role as director of the *Observatorio Astronómico Nacional de Colombia* (OAN)

One of the first actions of JMGB at the OAN was the reconstruction of the original meridian line damaged during the country's civil wars, which he had helped to build when

he was the assistant of Indalecio Liévano in 1862 (**Arias *et al.*,** 1987). He was further involved in various actions to strengthen the development of the observatory infrastructure and astronomical instruments during the following half-century. He also stood out for making the OAN known in Europe from the time of his first trips to London and Paris. He established a special connection with the French astronomer Camille Flammarion (1842-1925), a major source of inspiration and information on astronomical issues, but also a close friend for the rest of his life. Flammarion highlighted many times that the OAN was located in a privileged place since it was the closest observatory to the equator, a very important advantage for observing the stars of both the Northern and the Southern hemispheres. Another advantage was its altitude at over 2600 m.a.s.l., which meant it was one of the two highest observatories in the world, an ideal location for better imaging. These qualities were published in the journal of the French Astronomical Society, specifically in the list and description of the world's observatories published in volume VIII of the Études et lectures sur l›astronomie with the statement "the Observatory of Bogotá is the closest to Ecuador and the highest in the world" (**Flammarion,** 1882).

Once in charge of the OAN and after his trips to Europe, JMGB identified the main requirements for an observatory. During the presidency of Rafael Núñez (1825-1894), he managed to obtain a generous financial budget to acquire new instrumentation and to make refurbishments in the premises including the improvement of the surroundings of the observatory with a beautiful garden (**Ibáñez,** 1891). During his various periods at the head of the institution between 1868 and 1892, JMGB transformed the OAN from a place with no instrumentation that lacked even a telescope into an observatory with modern equipment, a new dome, and a library, which achieved international recognition from the scientific community (**Quintero,** 2002).

JMGB installed a memorial plaque (**Figure 3S,** https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323) at the OAN on July 20, 1881, the anniversary of the country's independence (July 20, 1810), to acknowledge president Núñez's support to the reinstatement of astronomical observations in September 1880 thanks to the new instrumentation.

JMGB summarized the main objectives he proposed for the OAN (**González,** 1882d) in one of his statements: "Colombia would render a great service to science if the following works, considered of great importance by the scientific world, were carried out in this Observatory:"

- A catalog of the stars, a catalog of double and multiple stars, and a catalog of the nebulae and stellar groups of the Southern Hemisphere
- A continuous study of asteroids
- A special study of solar physics
- Applications of spectral analysis to the study of celestial bodies
- A sustained study on the zodiacal light
- Special selenographic studies
- Assiduous observations on the physical constitution of the planets
- Application of photography to the study of the physical constitution of the Sun, the Moon, and the planets
- A sustained study on shooting stars
- Observation of the transit of Venus in front of the solar disk.

The following are the main improvements and tasks performed by JMGB at the OAN during his periods as director:

- Construction of a movable dome
- Ordinary meteorological observations
- Acquisition of imported meteorology and astronomy equipment including an anemometer, hypsometer, spectrometers, and telescope to properly fulfill the Observatory's different functions.

• Continuous communication with European observatories in England, France, Italy, and the Vatican, and also American and even African observatories, for example, the Chapultepec Observatory and the Algiers Observatory, despite the difficulties to communicate from Bogotá (**González,** 1882c). This allowed the OAN to receive numerous publications from these observatories and keep an updated local library (**González,** 1882b).

• The creation of an OAN publication, the *Anales del Observatorio Astronómico* (Annals of the Astronomical Observatory), with six volumes published between March and November 1882.

• Due to the advances in communications, by the end of the 19th century, the need to establish a zero meridian and create time zones became evident. In this context, the OAN was invited to participate in the 1881 meeting for the adoption of the prime meridian in Washington. JMGB was unable to attend but he delegated Colombia's participation to a North American astronomer (**González,** 1882a).

• JMGB served as an academic international peer reviewer for several studies including De Large's 1895 article.

The Flammarion Observatory

During his travels in Europe, JMGB acquired astronomical instrumentation, and back in Colombia, he decided to equip a private observatory. In 1880, he received the equipment and inaugurated the *Observatorio Flammarion* (Flammarion Observatory) in Zipaquirá, his birthplace, in honor of his friend, the renowned French academic Camille Flammarion. The Flammarion Observatory housed a 1.65 m focal length telescope, a five-prism spectroscope, and many more implements such as chronometers, thermometers, microscopes, and meridian circles (**Flammarion,** 1882). However, on September 3, 1881, JMGB was appointed director of the OAN in Bogotá and he decided to move his observatory to the Los Mártires neighborhood in the capital where he set up very impressive facilities for a private observatory with all the instrumentation, a library, a gallery, and even lodging for the assistant astronomers (**Figure 2**). In May 1882, the Flammarion Observatory was inaugurated with the attendance of prominent Colombian academic figures, the ambassador of France (given that it honored a French citizen), and the Chilean ambassador (**Figure 4S,** left, https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323) (**Flammarion,** 1882). Numerous French newspapers covered the event: *Le Petit Journal* (**Figure 4S,** right, https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323), *Le Spectator*,

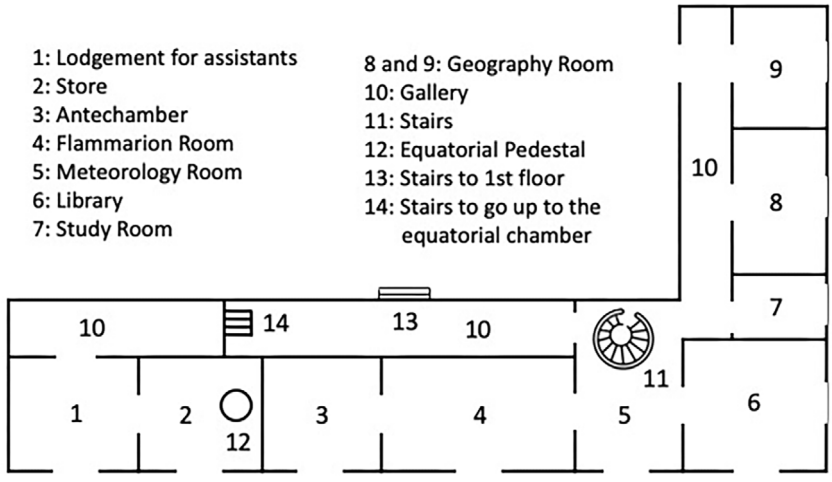

Figure 2. Sketch of the configuration of the Flammarion Observatory inaugurated in 1873 in Bogotá as designed by JMGB. The image was made by the authors based on JMGB's notes and drawings found in the repository of the *Biblioteca Nacional de Colombia*

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L'Avenir de Vichy, *Journal de L´Orne*, and *Progrès* highlighting "the inauguration of the Flammarion Observatory in the United States of Colombia, very close to the equator and at a great height of 2640 m.a.s.l."

The observatory building, however, was not the most suitable one, and JMGB began the construction of a whole new building in 1892, where the observatory would be located on the third and fourth floors. The design of this definitive location was characterized by a movable construction (rotating booth) which allowed JMGB to pursue diurnal and night observations and spectroscopy studies.

Figure 3 (top image) shows a visualization of the Flammarion Observatory as inferred from photographs that we found in photographic archives after a long search. Some were aerial photographs (lower left image) while the last image, from the late 1960s, shows the Observatory nearly a decade before the building was demolished (bottom right image). This is the first time that the view of the Flammarion Observatory is shown in an academic paper; we could not find any visual reference of the construction beside a short mention and photograph in **Revista Semana** (1951). The construction must have been a very remarkable view over the roofs of Bogotá, as shown in photographs from the 1940s and 1950s (**Figure 4**). While the works were being completed, the Flammarion Observatory operated temporarily not far from its final location. Three years later, a new

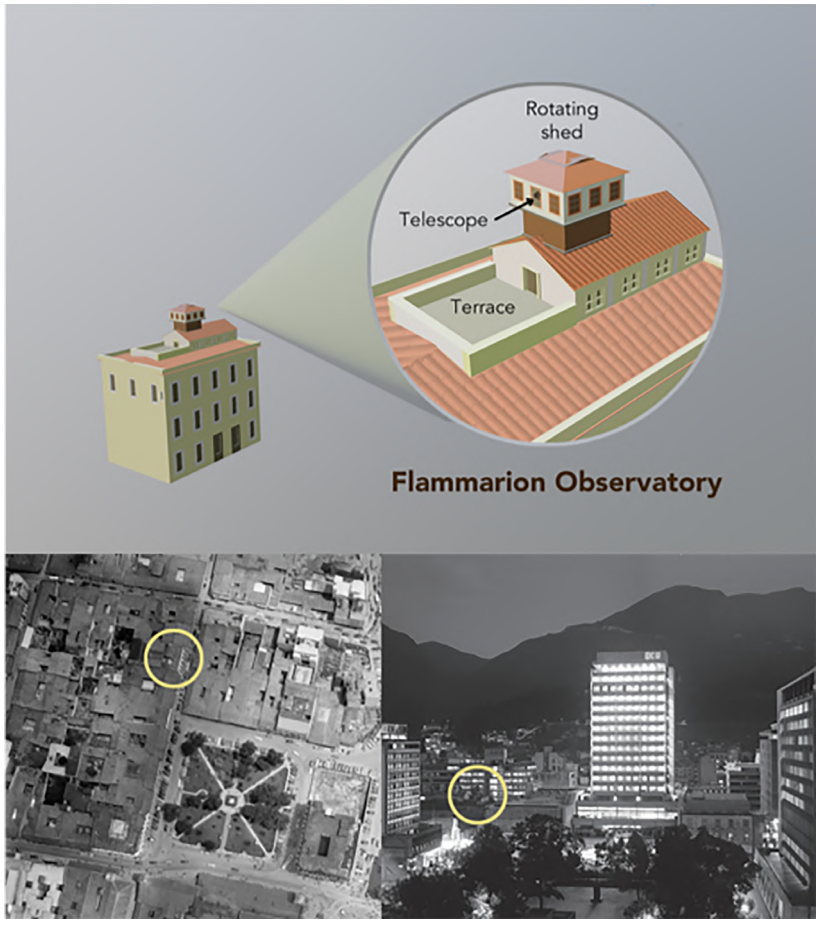

Figure 3. Flammarion Observatory. Top: A 3D sketch of the house that supported the Flammarion Observatory on its terrace made by the authors based on several historic photographs of Bogotá showing the construction from different angles including the aerial view from the 1940s (lower left image) and the last image where the observatory is recognizable from the late 1960s (lower right panel)

Figure 4. Colorized photographs of the surroundings of the Flammarion Observatory where the construction of the booth stands out raising about 20 meters above the ground. Left: Unpublished photograph of the funeral of Margarita Villaquirá, an iconic local figure known as "crazy Margarita"), which took place in January 1942. Middle: Photograph of 1951 from *Revista Semana*. Right: Photograph from the 1940s where the Flammarion Observatory is visible in the background

equatorial telescope with a larger diameter manufactured by the Secretan company in Paris was installed. From this date and during almost a decade until JMGB's death in 1903, numerous astronomical observations were made there (see comments in the next section), as well as meteorological measurements including temperature values from 1874 to 1895 (**Sánchez,** 1906), directly requested by Flammarion to compare them with European records as he reported in a private communication (**Flammarion,** 1895) (**Figure 5S,** https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323). His interest in the further development of observational astronomy in Colombia motivated JMGB to propose to the Royal Astronomical Society the construction of another observatory at 3300 m.a.s.l. near Bogotá (**Figure 6S,** https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323) as a joint endeavor of the British government and this private Colombian initiative (**MNRAS,** 1874).

The Flammarion Observatory was later operated by his son-in-law, Manuel Laverde Liévano (**Figure 5**), but there is very little information on the observations pursued at the facilities other than some eclipse observations, for example, the annular solar eclipse observed in Bogotá on March 7, 1951, made with a 16-cm equatorial telescope and 2 m focal length (**Revista Semana,** 1951). As a curiosity, the Observatory had one of the first lifts in a private building in the country. In the second half of the 20th century and beyond, no mention of the facilities was made; the building was demolished in the 1980s and no written evidence of its existence was known until our findings.

Astronomical research and main scientific contributions

As we mentioned before, JMGB had a strong interest in the physical sciences in general. During his stays at the OAN, he compiled continuous records of the climate in Bogotá including maximum, minimum, and average temperatures, wind direction, cloud cover, amount of rain, day and night irradiance, and the number of meteors per hour (**González,** 1871). He was also very interested in geomagnetic and seismological studies for which he installed in his house in Zipaquirá instruments for magnetic and seismographic measurements, i.e., a magnetic needle to register terrestrial magnetic field variations and a seismograph. During the first days of June 1870, he noticed variations in the position of the magnetic needle preceding the occurrence of an earthquake on June 4 and reported the detection (**González,** 1871). At the OAN, he set up the magnetic needle on building's roof for continuous registration of the magnetic field direction and he recorded the data in his diary of astronomical-physical observations. On August 30, 1871, he started perceiving abnormal changes in the position of the magnetic needle that pointed 0º6'10'' towards the East and increased in the following

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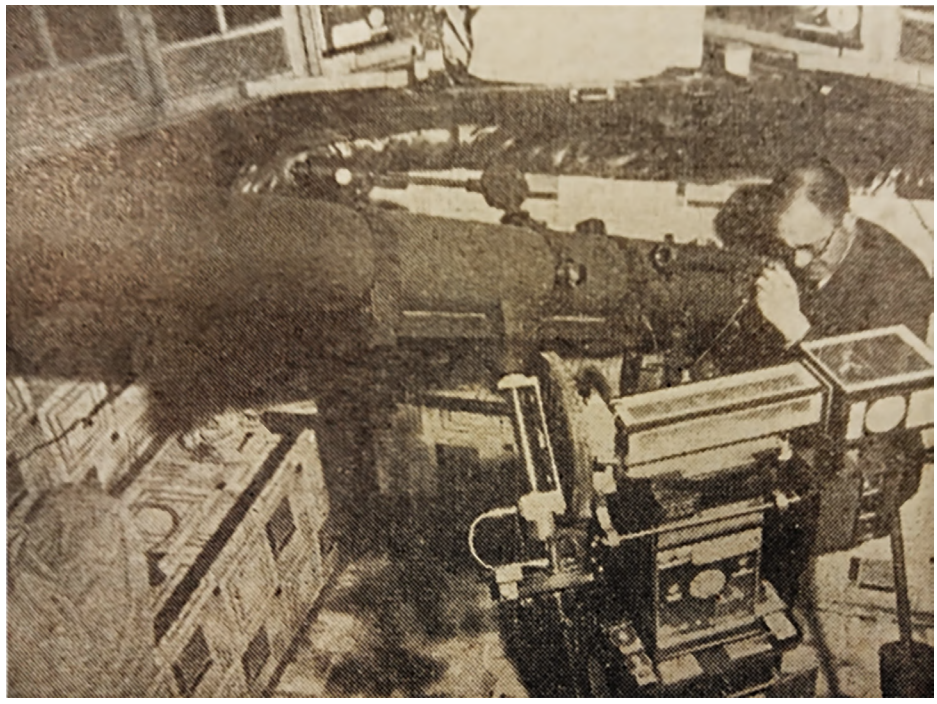

Figure 5. Photograph of the interior of the Flammarion Observatory from the 1950s. Manuel Laverde Liévano, JMGB's son-in-law, is seen observing with the main telescope and instrumentation (*Revista Semana*, 1951)

days. This reminded him of a similar detection the previous year in Zipaquirá, which made him suspect of a possible seismic movement that effectively occurred on September 7, 1871, with a duration of about 15 seconds while the magnetic needle was deviated 0º10'50'' towards the East, as JMGB reported (**González,** 1871).

Among JMGB's scientific interests, astronomy occupied the first place as confirmed in the following presentation of his main astronomical observations, calculations, and investigations referenced especially in international sources.

Solar observations

One of the most interesting phenomena attracting the attention of observers occurs when a planet transits in front of the solar disc. In 1881, Mercury's transit was described by **González** (1882b) as follows: "This phenomenon took place on November 7 last year, at 5 hours, 19 minutes p.m., Bogotá average time, and was observed in this Observatory under convenient conditions despite the proximity of the Sun to the horizon".

The transit of Venus had long been of interest to scientists despite being less common as it is easier to observe due to the larger size of Venus compared to Mercury. JMGB presented the ephemeris in the Annals of the Astronomical Observatory (**González,** 1882c) including the date and hours in which the transit of Venus would occur on December 6, 1882 (**Table 1S,** https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323). Given the eventual poor meteorological conditions at the OAN's location in Bogotá, he established an additional observing point at the Flammarion Observatory (**González,** 1882c). The transit of Venus was finally observed in Bogotá with careful attention both at the OAN and the Flammarion observatories. Venus presented the appearance of a large cherry standing out against a greenish background (**Sánchez,** 1906). Solar observations

were a recurrent source of interest for JMGB. In 1894, his drawings of a large sunspot observed by him in August 1893 as evidence of the maximum of the solar cycle number 13 (**Figure 7S,** https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323) were published in *L´Astronomie* (**Flammarion,** 1893). The caption of the corresponding image says: "Director of the Observatorio Flammarion Bogotá. Observed since its formation. Drawing of the great sunspot of August 1893". The description of the sunspot was also included in **Flammarion** (1894).

Mars

In 1894, Mars opposition occurred and Flammarion requested JMGB to send him the drawings of the event he had made from his observatory in Bogotá, which were later published in 1895. The quality of JMGB's work can be certified by these observations. At that time, he was already a well-known astronomer in Europe and kept continuous communication with his French friend and colleague. Indeed, JMGB made the observations from the Flammarion Observatory and sent 24 drawings, four of which were published in *La Planète Mars et ses Conditions d'Habitabilité* (**Flammarion,** 1909). Such drawings were completely unknown for the Colombian academic community until we have found them (**Figure 6**). The quality of the images drew the attention of the famous Italian astronomer Giovanni Schiaparelli (1835-1910) who used them for his research (**Flammarion,** 1909) (**Supplementary information, text, tables and figures,** https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323)

JMGB's report was followed by a letter signed by Schiaparelli (**Figure 8S,** https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323) commenting on the Colombian astronomer's drawings (**Flammarion,** 1909): "These observations are particularly interesting given the altitude of this observatory established on the equator (4°35'48'' N). At the height of 2640 m, the atmosphere is very clear. Mr. Gonzalez is a careful and sincere observer. Of the 24 drawings that the wise founder of this equatorial establishment sent, we

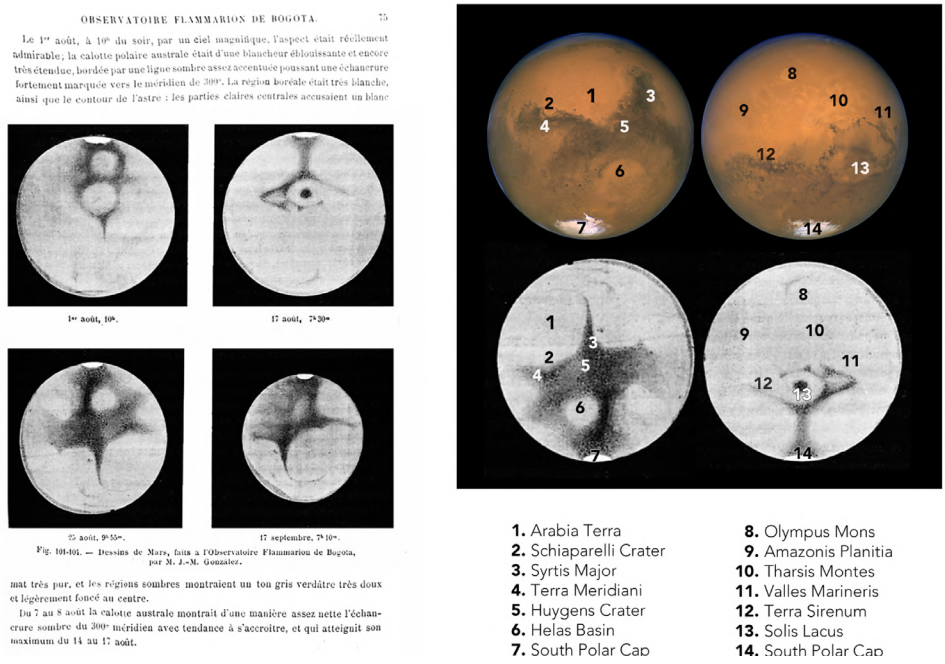

Figure 6. Mars observations. Left: Observations made by JMGB at the Flammarion Observatory and extracted from *La Planète Mars et ses Conditions d'Habitabilité* (**Flammarion**, 1895). Right: Comparison of Mars observations captured in 1999 by the Hubble Space Telescope with some of the drawings made by JMGB highlighting the main Martian features

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chose four to be annexed here in our general documentation. Remarkably, the polar notch and the Main Sea (Lake Mœris) could be observed with the aid of a 108 mm telescope. As for the decrease in the red coloration of the planet with its elevation in the sky, this may be due in part to an effect of our atmosphere that acts on the coloration of the Moon and the Sun, and in part to the objective of the lens, less achromatize, perhaps, by the blue and violet rays".

Meteor showers and meteorites

From his first contact with astronomy, JMGB had been interested in meteor showers. He observed the Leonids at dawn on November 14, 1867, and together with Liévano, OAN's director at the time, he organized the observation of the phenomenon. To get more precise data, they contacted the *serenos*, name given to the night guards of the city before the police existed, and explained to them what was going to happen, then they trained them to annotate the number and characteristics of the observed meteors. Unaware of what was happening, some inhabitants of Bogotá thought they were witnessing the end of the world due to the impressive scene. Countless meteors were seen, so many that according to JMGB, "nothing can compare with the grandeur of the spectacle: at one and thirty minutes in the morning, time of departure from the radiant point, some shooting stars were seen, and from two to five, the number was immense, it really looked like a gigantic artificial fire that, radiating from Regulus in the constellation of Leo, spread throughout the celestial vault" (**Sánchez,** 1906). These observations were made both at the Flammarion Observatory in Zipaquirá and in Bogotá.

A young JMGB reported a myriad of unknown shooting stars on the night of November 24, 1872, whose origin was the constellation of Leo. These observations were published in volume V of the *Studies and readings on astronomy* (**Figure 9S,** https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323) printed in Paris (**Flammarion,** 1874). His work on this topic served to verify Giovanni Schiaparelli's theory that established that the meteor showers were the result of cometary disaggregation (**Flammarion,** 1874). Many years later, in 1899, JMGB observed the Leonids and prepared a study explaining their origin and motivating the community to observe the phenomenon and share the data with him (**Sánchez,** 1906).

Concerning meteorites, JMGB wrote a detailed report of the most important event in the history of Colombia, the Meteorite of Santa Rosa de Viterbo (**Flammarion,** 1874), fallen in 1810 and studied by **Boussingault & Rivero** (1823), which was presented by Alexander von Humboldt (1769-1859) to the French scientific community the same year.

Comets

JMGB was also a virtuous and devoted comet observer; he had the advantage of being located close to the equator and, therefore, able to see comets in both hemispheres (**Sánchez,** 1906). During 1880, he observed a large number of comets, all visible to the naked eye, including the Great Southern Comet, also called 1880 I, Comet 1880 V (discovered by Cooper), which reached a magnitude close to 5, and Comet Hartwig (1880 III) with a magnitude of 5 to 6 (**Vsekhsvyatskii,** 1964). In 1881, he reported the observation of seven comets from Bogotá: Comet 1881 II, discovered by the astronomer Lewis Swift (1820-1913) from Rochester, New York; Comet 1881 III, discovered by Tebbutt from Australia, widely seen in Colombia and the most beautiful according to JMGB; the periodical Comet Encke; Comet 1881 V Barnard; Comet 1881 VI, discovered by Denning; Comet Schaeberle 1881 IV, and Comet 1881 VIII, also discovered by Swift (**González,** 1882b).

While directing the OAN, JMGB reported another visitor in a note addressed to the Colombian *Secretaría de Instrucción Pública* (Secretary of Public Instruction) on June 22, 1882 (**González,** 1882b), which reads as follows: "I have observed this afternoon at 6:30 p.m. a large comet located south of the planet Venus, not far from Procyon, where the constellations Cancer, Can Minor, and Gemini border. Its core is extremely bright, it has

the intensity of a second magnitude star, and its tail, a uniform matte white, extends more than 10º. A comet of such magnitude and beauty has not been observed for a long time. Its tail is directed to Sigma of the constellation of Hydra". This one is known as the Comet of Wells (1882 I) and was named after the observer who discovered it on March 18 that same year in Albany (USA) in the constellation of Hercules (**Vsekhsvyatskii,** 1964).

During its passage, Comet 1882 I traveled the constellations of the Lyre, Cepheus, Dragon, Giraffe, Perseus, Auriga, and the Bull, until reaching their perihelion on June 11 at a distance of 0.06 astronomical units (AU), then it went through Orion, Gemini, and Cancer. Several observatories reported it very close to the Sun during the day. By June 17, its tail was about 40º long. On the 22nd of that same month, Pakl reported that its core was well defined and had a brightness equivalent to that of a second magnitude star with a 2.5º-wide fan-shaped tail, i.e., characteristics similar to those observed by JMGB and hardly repeatable since its period is more than a million years. **Table 1** lists some of the parameters found by JMGB and another report from **Vsekhsvyatskii** (1964).

At the beginning of September 1882, one of the most striking comets of the 19th century was observed; it was called the Great Comet of September (1882 II) due to the brightness it reached in the middle of the month, equivalent to a star of 0 magnitude, and the length of its tail that reached between 15º and 20º in early October. The first reports of this comet originated in the Gulf of Guinea and the Cape of Good Hope on September 1st (**Kronk,** 1999), and others from New Zealand and an Italian ship on the 1st and 3rd of the same month (**Vsekhsvyatskii,** 1964). Very concerned about what was happening in the sky, JMGB carried out astronomical observations during the early hours of August 14 and reported having seen the comet at dawn that day (**Figure 10S,** https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323). However, in the following days, he could not observe the comet due to poor weather conditions (**González,** 1882e) but he received reports at the beginning of that same month from Boyacá, a region a few hundred kilometers from Bogotá. With this information, JMGB wrote to several European observatories about the observation of Comet 1882 II in mid-September, although in *L'Astronomie* only two very short reports from him appeared on October 5 and 20. Due to a bronchitis he developed as a result of the observation on August 14, JMGB could not continue with the study of the orbital elements of the comet and delegated this work to his colleagues Benjamin Ferreira (1857-1918) and Eloy B. de Castro, who took the coordinates from the Flammarion Observatory and made drawings of the comet with a particular star shape. It is unknown why Flammarion did not publish such observations of this very relevant comet, which apparently was seen in Colombia before other places in the world. From the data collected, JMGB established that the diameter of the comet's hair was 6' 55" and that of the nucleus, 2' 2" at the beginning of October 1882, much bigger than in June when the hair was only one minute in diameter. Furthermore, JMGB calculated that for October 3, the comet would travel an angular distance of 4° 9´ 30" in 24 hours and would reach a speed of 30 leagues per second, i.e., four times the speed of the Earth in its orbit around the Sun (**González,** 1882e).

Table 1. Orbital elements for Comet 1882 I assuming parabolic orbit as presented by **González** (1882e) and **Vsekhsvyatskii** (1964), respectively

Orbital elements	González 1882(e)	Vsekhsvyatskii (1964)
Perihelion date	10 June 1882	11 June 1882
Longitude distance perihelion	8,78367	No data
Longitude of ascending node	204º 54' 50''	206.94º
Inclination to the ecliptic plane	73º 47' 30''	73.81º
Perihelion distance (q)	2250000 leagues (10845000 km)	0.0608 AU (9120000 km)

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L'Astronomie (1893) reported the news of the discovery of a new comet by the French astronomer Ferdinand Quénisset (1872-1951) on July 9 (**Flammarion,** 1893). Quénisset, who was working at the Juvisy Observatory founded by Flammarion the same year, telegraphed Félix Tisserand (1845-1896), director of the Paris Observatory, and the Central Office in Kiel, Germany, to communicate his discovery. The same journal included reports from observers in various parts of the world. Eyewitnesses in Minnewasta, New York, claimed having observed the magnificent comet the day before, in the constellation Lynx, with a tail extending to the pole star. The amateur astronomer Alfred A. Rordame (1862-1931), from Utah, also observed and reported the comet to Lewis Swift in Rochester. The observation reported by Randolph Sperra from Massachusetts on June 19 seems to be the first report (**Vsekhsvyatskii,** 1964) of an observation with the naked eye. In Colombia, JMGB reported having seen it from Bogotá on July 1 and the following days (**Sánchez,** 1906); he sent the ephemeris for the second semester in 1893, drawings of the comet, and its orbital elements (**Table 2**).

It is not known why the earlier report sent by JMGB before that of the official discoverer Quénisset was not considered (**Arias de Greiff,** 1993). Perhaps, this would have meant changing the name from Comet 1893 II Rordame-Quénisset to Sperra-González and having the first comet in history discovered by a Colombian.

An example of the intense observing activity developed by JMGB at his private observatory is evidenced in the manuscript written on September 14, 1898, with the following statement: ‘’The comet that is currently visible is not the only one, there are no less than five in the following order: Comet Coddington, SE of Antares, or Alpha of the Scorpion, visible as of half-past six in the afternoon; very dim, the telescope is necessary to observe well. Second, a telescopic one in the constellation Capricorn is nearly visible at the same time. Third, Encke's Comet, whose period is three and a quarter years, is visible to the naked eye at the moment, starting at two in the morning, between Gemini and Canis Major. Fourth, another telescopic comet located between the Polar Star and the Alpha of Perseus, in the constellation of the Giraffe, was observed in Bogotá at eleven o'clock at night, and fifth, Comet Wolf, observed in 1891 and slightly visible in the constellation of Aries as of ten at night, passes through the meridian at three in the morning’’ (**Sánchez,** 1906).

Stargazing

The French Astronomical Society delegated to the OAN the task of methodical observation of the sky and, therefore, entrusted JMGB with the study of astronomical phenomena located in the declinations between 40°N and 55°N (**Sánchez,** 1906). According to an annotation found in **Sánchez** (1906), JMGB apparently worked continuously on this project, although no publications on the subject have been found yet. JMGB also received requests to solve doubts, such as the request sent from the Italian astronomers Annibale de Gasparis (1819-1892), director of the Naples Observatory, and Giussepe Franchini, in 1882. Franchini had the hypothesis that the sky rotates in mass around the North Pole with a convergent movement, so the phenomena observed in the Boreal Hemisphere should be very different from those observed in the Southern Hemisphere, while de Gasparis

Table 2. Parameters found by JMGB for Comet Rordame-Quénisset 1893 II assuming parabolic orbit

Orbital elements calculated by JMGB	Comet Rordame-Quénisset 1893 II
Perihelion date	1893 July 7,291
Argument of perihelion	47º 7’ 15.7’’
Longitude of ascending node	337º 23’ 25.9’’
Inclination to the ecliptic plane	159º 58’ 10.3’’
Perihelion distance (Log q)	9,828936

maintained that there was uniformity in both regions. Such a request certainly responded to the privileged observation of both hemispheres from the advantageous position near the equator at the OAN. After observing the stars in both hemispheres, JMGB's reply was "that a star located at 80° southern declination describes a parallel equal to that traversed by stars located at 80° northern declination. As for the apparent movement of the Milky Way, an observer in the Boreal Hemisphere would see the same as one observing it in the Austral region; but these are only appearances; given that the movement is uniform as a whole and for each individual star, the law is general" (**Sánchez,** 1906).

JMGB maintained continuous communication with Flammarion and was informed about the most important projects carried out by the French Astronomical Society, and he wanted to participate actively in one of them: the revision of the measurement of the meridian arc at the equator. This research was suggested by the renowned mathematician Henri Poincaré (1854-1912) and supported by the International Geodesic Association in 1889. Due to political issues, measurements could only start in 1899 right on the border between Colombia and Ecuador extending through the latter to the border with Perú (**Littlehales,** 1907). With this in mind, JMGB trained a group of Colombian engineers and established communication with the French embassy in Bogotá to bring the necessary equipment to the country and extend the measurement to Colombian territory. However, in 1899 the worst civil war that the Colombian nation has ever faced broke, and the project could not be carried out as initially planned (**González,** 1902; **Schiavon & Rollet,** 2017).

Analysis of González Benito's pioneering work in Colombia

In the second half of the 19th century in Colombia, the figure of JMGB was inescapably associated with a large number of studies of great relevance for the advancement of science. His great ability to get involved in initiatives and projects of various kinds from an early age is reflected in the long list of contributions that transcended purely scientific areas to include the social and cultural spheres of his time. As an example, his family business, *González Benito Hermanos*, which he ran with his brothers Eugenio and Fabián in the center of Bogotá (a few blocks from the OAN), had the first private telephone line installed in the city in December 1884 connecting to JMGB's home in the neighborhood of Chapinero, about seven kilometers away (**El Comercio,** 1884). This represented the very beginning of the public telephone network in the country.

As for JMGB's passion for the cosmos and his role in the modern astronomical scene of his time reflected in his interest in the investigations about Mars, the origin of meteor showers, the understanding of solar activity, and his comet observations, among others, there are enough elements to consider JMGB as the first Colombian modern astronomer.

As director of the OAN and of his private observatory, JMGB made numerous observations on different astronomical objects, especially comets, regardless of the difficulties implied in the mostly cloudy conditions of their location. He observed three comets during 1880, seven in 1881, and Comet 1882 II two weeks before its first report made from New Zealand on September 1, 1882. In 1893, he observed the Comet Rordame-Quénisset nine days before the observations from the United States and France (designated as the official discovery). In 1898, JMGB identified five more comets. He also observed meteor showers: the Leonids, on November 14, 1867, and November 13, 1899, as well as the unknown one he reported on November 24, 1872, in Andromeda.

Besides his scientific qualities, we must also highlight JMGB's virtues and commitment as an administrator. When he was appointed as OAN's director, the building was in a state of abandonment mainly due to the difficult social and political conditions that Colombia had throughout the 19th century after its independence. He recovered the premises and refurbished part of the infrastructure, renewed the instrumentation, and did not hesitate to spend his own capital to do so as clear evidence of his commitment to the development of Colombian astronomy. Like no other Colombian in the astronomy international scenario, JMGB had a great ability to establish and maintain relationships with relevant people

within the world of science, and his name continued to open doors even decades after his death. His education and his direct contact with the European astronomical environment allowed him to identify and define the functions a modern observatory should fulfill. In Europe, he had the opportunity to acquire telescopes and other state-of-the-art equipment for both his private Flammarion Observatory and the OAN.

JMGB's interest in further consolidating observing sites in Colombia motivated him to propose to scientific societies in the United Kingdom and France the construction of an observatory at an altitude of 3300 m.a.s.l. with the participation of these foreign governments and a private Colombian institution to be funded. Unfortunately, the project did not succeed after JMGB's death, but his effort to consolidate such an observational facility in the high Colombian mountains evidences his clear vision of the development of astronomy and the advantages that this would bring to scientific research in Colombia. Furthermore, his determining connections with some of the international inquiries on astronomy issues of his time demonstrate his robust scientific profile and worldwide significance.

The Flammarion Observatory was his life project. JMGB and Flammarion kept always close and continuous communication, and the French astronomer was the best man at JMGB's wedding. JMGB created the Flammarion Scientific Society, which was the first in the world among the many others formalized in the following years based on the Colombian experience in the cities of Jaen, Argentan, Marseille, and Bruxelles. In 1893, JMGB was presented by Flammarion and Anatole Bouquet de La Grey to the Astronomical Society of France as a founding member. His initiatives and dynamism allowed the first collaboration of Colombian astronomy within an international network for the exchange of information and knowledge.

Although the society of his time was still immersed in civil wars and showed little interest and understanding of science, JMGB fostered fundamental studies in astronomy and showed that it was possible to make important contributions from Colombia even without extensive support from the academic community. An illustration of this is the fact that his detractors finally managed to prevent him from entering the OAN claiming that the science the country needed had no room for JMGB's interest in fundamental astronomy, considered useless and alien to the scientific development that was supposed to be entirely aligned with the premise of astronomy as a tool for engineering towards the development of the country. After this, JMGB responded: "they do not realize that where there is an observer equipped with instruments, there is, in fact, an observatory" (**Sánchez,** 1906). While part of the national academic community closed its doors to him, internationally, JMGB continued to gain renown.

Flammarion, a prominent figure in the astronomy of his time, openly appreciated JMGB's contributions and included him in his novel *Fin du Monde* where he featured JMGB as the Chancellor of the Colombian Academy of Sciences, one of the world's notable scientists attending a meeting in Paris to assess the damage the Earth would suffer in the imminent event of the collision with a comet (**Flammarion,** 1894a). There he wrote: "Everyone knew that he was the founder of an observatory located on the same equinoctial line, three thousand meters high, from which the entire planet was dominated and both celestial poles were visible at the same time … His universal fame also contributed to his being heard with the utmost attention." The observations and drawings made by JMGB of the characteristics of the Martian surface helped Schiaparelli and other later astronomers to develop hypotheses about the possibility of the existence of life on the planet, which today is the object of trips including the use of probes to explore it and investigate astrobiology topics.

During his academic life, JMGB was a member of numerous local societies and groups and was distinguished with multiple honors by, among others, the *Academia de Ciencias Naturales* (1871), the *Instituto de Artes y Oficios* (1872), the *Sociedad Politécnica* (1876), and the *Ateneo de Bogotá* (1884); besides, he was a founder member of the *Sociedad Colombiana de Ingenieros* and the *Instituto Colombia*, created under the same principles of the French Academy. He was also a member of international societies and institutions

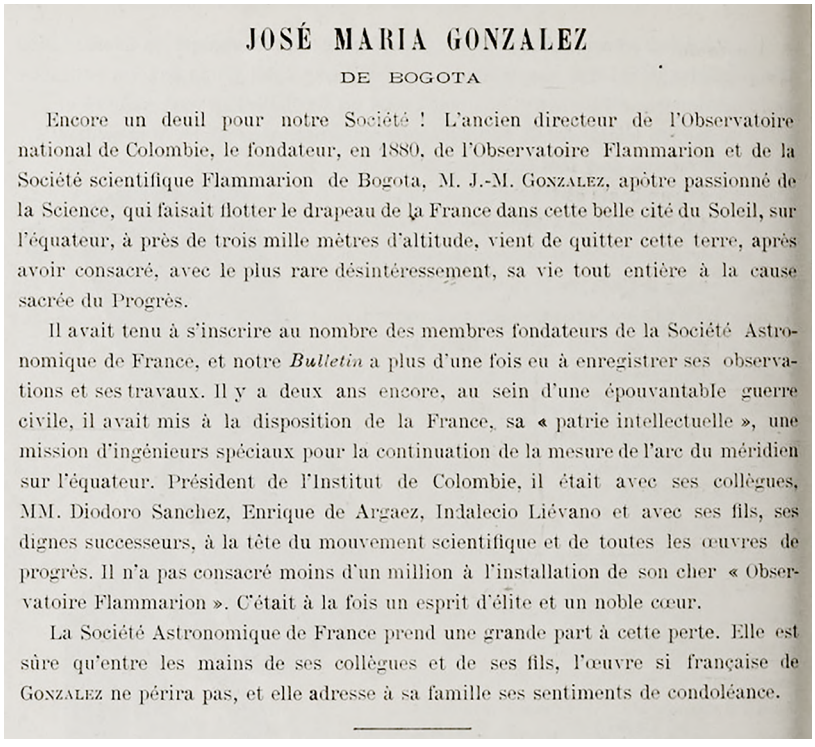
(**Revista Ilustrada,** 1898; **Arias de Greiff,** 1993), such as the Royal Astronomical Society (1875), the British Science Association (1875), the Society of Geographical and Historical Studies of Salvador (1892), the Universal Academy of Arts and Sciences of Brussels (1892), the French Astronomical Society (1898), the French Academy in the degree of Official (1898), the Belgian Astronomical Society (1898), the Astronomical Society of the Pacific (1890s), and the French Public Instruction as Officer (1903).

In the Bulletin of the French Astronomical Society in 1903, his obituary was published soon after he passed away (**Figure 7**); there he is recognized as having an "elite spirit and noble heart".

Conclusions

In this work, we collected evidence from well-known and undisclosed sources that support the assertion that JMGB was one of the most important figures in the history of Colombian astronomy, mainly due to the advances and discoveries he achieved as the result of innumerable investigations and projects although much of his history and studies were lost after his sudden death. Despite his intense scientific life, the legacy of JMGB has not been properly acknowledged in Colombia and his name has been diluted internationally, which were some of the reasons that led us to embark on this work. JMGB's contributions to astronomy were mostly published in international journals, but we believe that most of his works were lost. His overall contributions, international collaborations, and accomplishments in the field of fundamental astronomy cannot be undervalued if we consider the topics and questions that occupied the astronomy community worldwide at his time.

According to the evidence, JMGB's works were not very well appreciated by the academic community in Colombia at that time, as its members were more focused on the immediate application of astronomy to engineering tasks such as cartography, delimitation of the territory, and issues related to the standardization of the local time used for telegraphic



JOSÉ MARIA GONZALEZ

DE BOGOTA

Encore un deuil pour notre Société ! L'ancien directeur de l'Observatoire national de Colombie, le fondateur, en 1880, de l'Observatoire Flammarion et de la Société scientifique Flammarion de Bogota, M. J.-M. Gonzalez, apôtre passionné de la Science, qui faisait flotter le drapeau de la France dans cette belle cité du Soleil, sur l'équateur, à près de trois mille mètres d'altitude, vient de quitter cette terre, après avoir consacré, avec le plus rare désintéressement, sa vie tout entière à la cause sacrée du Progrès.

Il avait tenu à s'inscrire au nombre des membres fondateurs de la Société Astronomique de France, et notre *Bulletin* a plus d'une fois eu à enregistrer ses observations et ses travaux. Il y a deux ans encore, au sein d'une épouvantable guerre civile, il avait mis à la disposition de la France, sa « patrie intellectuelle », une mission d'ingénieurs spéciaux pour la continuation de la mesure de l'arc du méridien sur l'équateur. Président de l'Institut de Colombie, il était avec ses collègues, MM. Diodoro Sanchez, Enrique de Argaez, Indalecio Liévano et avec ses fils, ses dignes successeurs, à la tête du mouvement scientifique et de toutes les œuvres de progrès. Il n'a pas consacré moins d'un million à l'installation de son cher « Observatoire Flammarion ». C'était à la fois un esprit d'élite et un noble cœur.

La Société Astronomique de France prend une grande part à cette perte. Elle est sûre qu'entre les mains de ses collègues et de ses fils, l'œuvre si française de Gonzalez ne périra pas, et elle adresse à sa famille ses sentiments de condoléance.

Figure 7. JMGB's obituary published in the Bulletin of the French Astronomical Society (1903) shortly after his death in 1903

purposes and communications in general (**Quintero,** 2002; **Benavides,** 2020). JMGB was not very much into those practical aspects; his interests moved around fundamental astronomy issues, and this was not aligned with the idea of the development the country should have as expressed by Abelardo Ramos (1852-1900), president of the Colombian Society of Engineers, in the editorial of the Society's journal written a couple of years before JMGB's contract as director of the OAN ended and was not renewed (**Ramos,** 1890).

The historian Camilo Quintero Toro's article in **Purcell and Arias-Trujillo,** 2014, suggests that the figure of JMGB was intentionally enshrouded by that of Julio Garavito Armero (1865-1920). Garavito, JMGB's successor as director of the OAN, is perhaps the most renowned Colombian astronomer of all time, especially since 1970 when a crater on the Moon was named after him (**Arias *et al.*,** 1987). However, at his time, Garavito was less known by far in the astronomical worldwide community than JMGB and his works were never published in international journals. Garavito's duties as director of the OAN were mostly aligned with the engineering purposes defended by Ramos and other members of the academic community, which overshadowed much of the astronomical work led by JMGB in Colombia. During the first half of the twentieth century, astronomy in Colombia did not have significant changes that would resume JMGB's pioneering actions.

Here our objective was to spread his ideas, projects, and legacy to wider academic circles and the general audience. For such purpose, we were able to collect remarkable chronological documentation (**Table 2S,** https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323) and evidence that had remained unknown for more than a century. We hope that much more of JMGB's legacy may be recovered to appropriately recognize the figure of a man who can be considered the father of Colombian modern astronomy.

Supplementary information

View supplementary information in https://www.raccefyn.co/index.php/raccefyn/article/view/1795/3323

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Contribution of the authors

JCM: Bibliographic search and contextualization; FMC and SVD: research, bibliographic search, analysis, and writing of the manuscript.

Conflicts of interest

The authors declare no conflicts of interest.

References

Arias, J., Arboleda, L.C., Espinosa-Baquero, A. (1987). *Historia social de la ciencia en Colombi*a. Colciencias, pp 92-105.

Arias de Greiff, J. (1993). *La astronomía en Colombia*. Academia Colombiana de Ciencias Exactas, Físicas y Naturales. 1a Edición, pp. 95-105.

Bateman, A.D. (1954). *El Observatorio Astronómico de Bogotá*. Universidad Nacional de Colombia. pp. 34.

Benavides P. (2020) Pies en el cielo, ojos en la tierra. Modos de ordenar, tiempos y fronteras en la circulación de saberes astronómicos (1865-1902). Tesis doctoral. U. de los Andes.

Boussingault, J.B., Rivero M. (1823). Memoria sobre diferentes masas de hierro, encontradas en la Cordillera Oriental de los Andes. *Boletín de Historia y Antigüedades.* Volumen XXVIII, Número 31. Academia Colombiana de Historia, pp. 572-577.

Bulletins and Other State Intelligence. (1874). Part 1, p. 238.

El Comercio (1884). El teléfono. 3 de diciembre 1884.

Flammarion C. (1874). *Etudes et Lectures sur L´Astronomie*. Tomo 5. Gauthier-Villars Imprimeur Libraire, Paris. pp. 170.

Flammarion, C. (1882). *L´Astronomie*. Societé Astronomique de France. Paris, p. 31.

Flammarion, C. (1893). *L´Astronomie*. Societé Astronomique de France. Paris 1893, pp. 104, 228.

Flammarion, C. (1894a). *La fin du monde*, Gauthier-Villars et Fils, Paris, pp. 63, 64, 67.

Flammarion, C. (1909). *La Planète Mars et ses Conditons d'Habitabilité*. Tomo II. Gauthier-Villars Imprimeur Libraire, Paris, pp. 74-77

González, J. (1871). Física y Meteorología. Temblor del día 7 de septiembre de 1871. *Revista Científica e Industrial.* Bogotá, pp. 12,13.

González, J. (1874). Proposed observatory at Bogotá, South America. *Monthly Notices of the Royal Astronomical Society*, *35*(1), 12.

González, J. (1882a). La adopción de un primer meridiano, *Anales del Observatorio Astronómico Nacional de Bogotá*. Marzo de 1882, pp. 8-16.

González, J. (1882b). Nuevos estudios sobre estrellas, *Anales del Observatorio Nacional Astronómico de Bogotá*. Junio de 1882, pp. 50-54.

González, J. (1882c). Paso de Venus por el disco del Sol, *Anales del Observatorio Astronómico Nacional de Bogotá*, Noviembre de 1882, (6), 82.

González, J. (1882d). Observaciones que deben practicarse, *Anales del Observatorio Astronómico Nacional de Bogotá*, Mayo de 1882, (3), 45-46.

González, J. (1882e). El nuevo cometa, *Anales del Observatorio Astronómico Nacional de Bogotá*, Julio de 1882, (5), 66.

González, J. (1882e). Fin del Mundo. *La Ilustración*, Bogotá. p. 158.

González J. M. (1902). La mesure de l'arc de méridien a l'equateur. *Bulletin de la Société Astronomique de France*. Paris, p. 90-91.

González, J. (2018). Autobiografía de José María González, Transcrita por: Martínez-Garnica, A., García Piment, R., 2018. Archivo General de la Nación, *Revista Memoria, 19*, 62-104.

Ibáñez, P. M. (1891). Las Crónicas de Bogotá y sus inmediaciones. Imprenta de la luz. Bogotá, p. 193.

Kronk, G. W. (1999). Cometography a catalog of comets 1800-1899.Volume 2. Cambridge University Press, London, p. 154.

Liévano, I. (1875). Apéndice de las Investigaciones científicas publicadas en 1871 por Indalecio Liévano. Imprenta de Medardo Rivas, Bogotá, p. 2.

Littlehales, G.W. (1907). The Recent Scientific Missions for the Measurement of Arcs of the Meridian in Spitzbergen and Ecuador. *Bulletin of the American Geographical Society*, *39*(11), 641-653.

Portilla, J.G. (2017). Observatorio Astronómico Nacional: sobreviviente del primer intento de construcción de ciencia nacional. En E. Restrepo, C. H. Sánchez, G. Silva (eds.). Patrimonio de la nación. Tomo 1. Colección del sesquicentenario. Bogotá: Nomos Impresores, pp. 340-368.

Portilla, J.G. (2020). *Firmamento y atlas terrestre: la astronomía que practicó Francisco José de Caldas*. Facultad de Ciencias Sede Bogotá. Universidad Nacional de Colombia. p. 252.

Purcell, F., Arias Trujillo, R. (2014). Chile-Colombia: Diálogos sobre sus trayectorias históricas. *Ediciones Uniandes.* pp. 62-103.

Quintero, C. (2002). La astronomía en Colombia, 1867-1949. *Documentos CESO*, *17*, 1.

Revista Científica e Industrial. (1871). Exhibición de la Industria Nacional, *12*, 1.

Revista Ilustrada. (1899). Reseña histórica del Observatorio de Bogotá, *1*, 147-149.

Revista Semana. (1951). Astronomía. Retina gigante. pp. 26-27.

Sánchez, D. (1906). Biografía de José María González Benito. *Anales de Ingeniería*, *XIV,* 165-166.

Schiavon, M., Rollet L.T. (dir.) (2017). *Pour une histoire du Bureau des Longitudes* (1795- 1932), PUN-Edulor, Nancy.

Ramos, A. (1890). Editorial. *Anales de Ingeniería*, *37*, 7.

Tisnés-Jiménez, R. M. 1956. *Capítulos de Historia Zipaquireña* (1480-1830), Vol 1. p. 678.

Torres-Sánchez J., Salazar-Hurtado, L.A. (2002). *Introducción a la Historia de la Ingeniería y la Educación en Colombia*. Universidad Nacional de Colombia. Bogotá, pp. 41-45.

Uricoechea, E. (1860). Contribuciones de Colombia a las Ciencias i a las Artes, con la cooperación de la sociedad de naturalistas Neo-Granadinos. *Imprenta de El Mosaico,* Bogotá, pp. 106-108.

Vsekhsvyatskii, S.K. (1964). *Physical Characteristics of Comets*. NASA and National Science Foundation. Jerusalem. 1964.