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Review article

**Análisis histórico-dendrológico de la cubierta arbórea
del Bosque de Chapultepec (1ª sección): 2ª parte**
**Historical-dendrological analysis of the tree cover of
Bosque de Chapultepec (1st section): 2nd part**

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Abstract

This paper is a continuation of the essay on *Bosque de Chapultepec*, the first part of which was published in 2023, and, in this second one, continues with the analysis of the changes and events that took place in the tree cover of the Forest (the most important urban green area in Mexico), from the Second Mexican Empire to the beginning of the 20th century. This part highlights the project to improve and renovate the Forest, carried out within the context of the centennial celebrations of Mexico's Independence, which changed its physiognomy and whose constructions, fountains, infrastructure, and even remnant trees remain to this day. The modernization of the Forest and the means of transportation (electric streetcars) facilitated and induced the visit of the inhabitants of Mexico City in a more numerous way. It is also analyzed the environmental impact at the upper part of the basin on *Bosque de Chapultepec*, which caused the depletion of the forest springs and the lowering of the water table, with the consequent decline and death of many trees of the *Taxodium mucronatum* species (*ahuehuete* or Montezuma cypress) —a situation that induced a change in the tree species used. Finally, it comments on the lack of technical direction in the *Bosque de Chapultepec* until the improvement project was carried out, when a Superior Board was constituted to be in charge of the technical work.

Keywords: Urban green areas, Mexico City, urban tree species, History of arboriculture in Mexico, Miguel Ángel de Quevedo, *Taxodium mucronatum* Ten.

Resumen

La presente contribución es una continuación del ensayo sobre el Bosque de Chapultepec, cuya primera parte se publicó en el 2023 y que en esta continúa con el análisis de los cambios y acontecimientos que sucedieron en la cubierta arbolada del Bosque (el área verde urbana más importante de México), a partir del Segundo Imperio Mexicano para concluir a principios del siglo XX. Se resalta el proyecto de mejora y renovación del Bosque, realizado en el contexto de los festejos del centenario de la Independencia de México, el cual cambió su fisonomía y del que perduran, hasta ahora, construcciones, fuentes, infraestructura e incluso, árboles remanentes. La modernización del Bosque y de los medios de transporte (tranvías eléctricos), facilitó e indujo la visita de los habitantes de la Ciudad de México de manera más numerosa. Asimismo, se analiza el impacto que produjo en el Bosque de Chapultepec, la afectación ambiental en la parte alta de la cuenca, que ocasionó el

agotamiento de los manantiales del bosque y el abatimiento del manto freático, con la consecuente declinación y muerte de muchos árboles de la especie *Taxodium mucronatum* (ahuehuete o sabino), situación que indujo un cambio en las especies arbóreas utilizadas. Finalmente, se comenta la evidente carencia de una dirección técnica en el Bosque de Chapultepec, hasta que se llevó a cabo el proyecto de mejora, cuando se constituyó una Junta Superior que se encargó de los trabajos técnicos.

Palabras clave: Áreas verdes urbanas, Ciudad de México, especies arbóreas urbanas, Historia de la arboricultura en México, Miguel Ángel de Quevedo, *Taxodium mucronatum* Ten.

Introduction

In the first part of this essay (Benavides, 2023), the initial issues around *Bosque de Chapultepec* (*BCh* in Spanish) were exposed, including its strategic condition for Mexico City since pre-Hispanic times, given that its springs supplied potable water until the end of the 19th century (Armijo, 2005; León-Portilla, 1970); the ownership of the forest by the City since 1530 and the possibility for its inhabitants to use the site, since 1550, limiting only the access to the area of springs that supplied water to the City (Armijo, 2005; Campos, 1919; Moreno, 2005; Zapata, 2007). It was also highlighted the use of the site as a place of rest, recreation, and purification by the Mexica emperors (*tlatoani*) (Campos, 1919; Matos, 2003; Moreno, 2005); continued to be this practice of later hierarchs during the viceroyalty, the Second Empire, and Independent Mexico, as their resting houses or permanent residences were located there (Archivo Histórico de la Ciudad de México [AHCM], 1528; Armijo, 2005; Blasio, 1903; Moreno, 2006).

The direct intervention of the rulers in office is evidenced by the allocation of a budget for the Forest, for example, the one reported by the person in charge of British affairs in Mexico from 1825 to 1827, who analyzed the expenses of the Central Government and referred that *Chapultepec* had received 5 470.00 dollars (he expressed it in that currency) out of a total of 317 273.00 spent by the Ministry of the Interior (Ward, 1829).

It is important to highlight that, at that time, wooded sites in the cities or in their vicinity could not be used anywhere in the world by the common population for recreational activities, as they were generally owned by royalty or nobility; therefore, the possibility provided by viceroy Luis de Velasco to the inhabitants of Mexico City probably had no similar precedent. Since then, the recreational vocation of the *BCh* has been maintained, regardless of the great social and political changes that occurred in Mexico over the following centuries, vocation that continues to the present for the inhabitants of Mexico City and its metropolitan area—one of the largest in the world—, consisting of the 16 municipalities of the City, 50 municipalities of the State of Mexico, and one municipality of *Hidalgo*, which together cover an area of 7 866 km² and harbor a population of more than 22 million inhabitants (Instituto Nacional de Estadística y Geografía [Inegi], 2020; Secretaría de Desarrollo Agrario, Territorial y Urbano [Sedatu], 2018), as referred in the first part of this essay (Benavides, 2023).

Within this context of urban population expansion and increase, the strategic value of urban green areas (UGA) is magnified, as they are places that improve the urban environment and the quality of life of their inhabitants (Benavides, 1989). This situation acquires greater relevance in developing countries such as Mexico, since, according to Borelli et al. (2018) and Salbitano et al. (2017), the accelerated urbanization processes in these countries result in unplanned expansion that inhibits the sustainability of urban cores.

The objective of this second part of the essay was to continue analyzing the dendrological, water, and environmental issues of the tree cover in the now called 1st Section of the *BCh*, in view of the changes in the conditions that occurred in the forest and in the basin of the Valley of Mexico—the technical and administrative aspects included— from the second half of the 19th century up to the start of the 20th century, with the understanding that, given the length of the subject and the space limitations in this type of publication, the analysis will have to be completed in a third installment.

Characteristics of tree cover in the second half of the 19th century

The original forest stand of the *BCh* was of the a hygrophilous type, derived from the presence of springs in the area and its proximity to Lake *Texcoco* (Benavides, 2023). In this forested area stood out the individuals of *Taxodium mucronatum* Ten. (*ahuehuete*, Montezuma cypress), also known as *Taxodium distichum* (L.) Rich. var. *mucronatum* (Ten.) A. Henry, which amazed conquerors, chroniclers, and travelers who visited *Chapultepec*, among them von Humboldt, in 1803 (von Humboldt, 1827), and J. R. Poinsett (1825), the first American ambassador in Mexico, who described *Chapultepec* as a hill surrounded by exuberant vegetation and referred that its *ahuehuete* trees had a greater diameter and height than those of the swamps in the United States of America (*Taxodium distichum* (L.) Rich.), and, finally, the marquise Frances E. Calderón de la Barca, wife of the first plenipotentiary minister of Spain in Mexico (Ángel Calderón de la Barca), who gave an extensive laudatory and detailed description of the *ahuehuetes* and the Spanish moss that hung from them, when she visited the site at the end of 1839 (Calderón de la Barca, 1843).

It is pertinent to clarify that, since pre-Hispanic times, during the viceroyalty and until the end of the 19th century, the *BCh* was in a rather wild and rural condition, according to the scarce visual representations that we have, such as the lithograph made by the painter Casimiro Castro in the years 1855/1856 (Figure 1), which differs from the current image of the forest.



Source: <https://museoblaisten.com/Obra/6772/interior-del-bosque-de-chapultepec>.

Figure 1. Interior of the *Bosque de Chapultepec*. Engraving, lithograph by Casimiro Castro, ca. 1855-1856. The trees are in good condition, with a random distribution, irregular paths, and even cattle in the lower left corner.

The information available on the trees in the *BCh* towards the end of the 19th century is scarce. Prominent among the few documents that can be found at the Historical Archive of Mexico City (*AHCM*), are a document on the construction of an acclimatization garden (*AHCM*, 1886) and the proposal by a member of the Natural History Society for the establishment of a botanical garden at the *BCh*, alleging the appropriateness of such a garden (Alcocer, 1886). This proposal reiterates the interest in establishing a botanical garden in the *BCh* manifested since the viceroyalty of New Spain; according to the informative note that appears together with a plan in the General Archive of the Indies (Archivo General de Indias, 1792), which operated from 1793 to 1820 (Benavides, 2023), although everything indicates that it was never installed.

Bárcena (1891) makes a detailed review of the cause of the mortality of the *ahuehuete* trees at the request of the Ministry of Development. This author stated that the most serious problems were undoubtedly found in the areas located to the North and South of the forest, and related this mortality to the decrease in "groundwater" due mainly to the opening of artesian wells and the use of pumps. He also indicated the presence of eucalyptus trees (*Eucalyptus* sp.), ashes [*Fraxinus uhdei* (Wenz.) Lingelsh.] and white cedars [*Cupressus lusitanica* Mill., also referred to as *Hesperocyparis lusitanica* (Mill.) Bartel] in different parts of the forest (Bárcena, 1891).

Alteration of the hydrological regime

Over the centuries, environmental deterioration was recorded in the upper part of the basin and the Valley of Mexico, as commented already by von Humboldt (Benavides, 2023), eventually affecting the hydrological regime. A first situation arose in 1820, when the president of the City Council of Mexico City (*Cabildo de la Ciudad de México, CCM*) asked the person in charge of the forest to stop cutting down trees and extracting stone from the hill, as this was causing damage to the springs; therefore, an official letter was sent to the viceroy requesting "... that he remedy these evils in the manner indicated ..." (AHCM, 1820).

The effect on the springs was related not only to environmental damage at the local level but also to the damage done in the upper part of the basin, as Altamirano (1895) explained in detail; by the 70s decade of the XIX Century, its effect was already evident in the expenditure that supplied reduction of the springs. The minute of the *CCM* of October 7, 1870, exemplify the above, because in the town council requested the investigation of the flow reduction in the reservoir that

supplied the City due to the opening of an artesian well at *Rancho de la Hormiga* (neighboring the forest) —a situation that was repeated some years later at the neighboring *Hacienda de la Teja* (AHCM, 1870, 1876; Barcena, 1891).

The reduction of water in the springs of *Chapultepec* led to the use of a driving wheel to supply the castle, an action that affected the water supply for the City, so the City Council requested to stop using it (AHCM, 1877). However, pumps were later utilized “to increase the level of the pool to supply the City” (AHCM, 1878a) and, coincidentally, conflicts over water with the owners of the recreational pools located near *Chapultepec* began (AHCM, 1878b; Arciniega, 2005).

Related to the above, in 1885 the attendant of the *Chapultepec* Palace reported to the City Council the death of some trees due to the lack of water, arguing that this was a consequence of the pool opened out for baths in the vicinity of the forest; the problem was so extreme that he requested the City Council to irrigate the groves of the forest (AHCM, 1885). Several years later, in 1892, and most probably as a consequence of the lowering of the water table, an allocation of water from the reservoirs supplying the City was assigned for the irrigation of the *BCh* and ratified months later (AHCM, 1892, 1893).

As a corollary of the above, Cabrera et al. (2005) confirm that, at the end of the 19th century, the springs dried up and, consequently, the lowering of the water table worsened, increasing the damage to the *T. mucronatum* trees (Barcena, 1891) and causing a significant change in the characteristics of the tree stand with respect to its initial condition.

In addition to that mentioned by Barcena (1891), no other detailed records of the species established under the new conditions were found, but it is to be assumed that native tree species such as *tepozán* (*Buddleja cordata* Kunth) and Texas mulberry (*Morus celtidifolia* Kunth) also occurred there spontaneously.

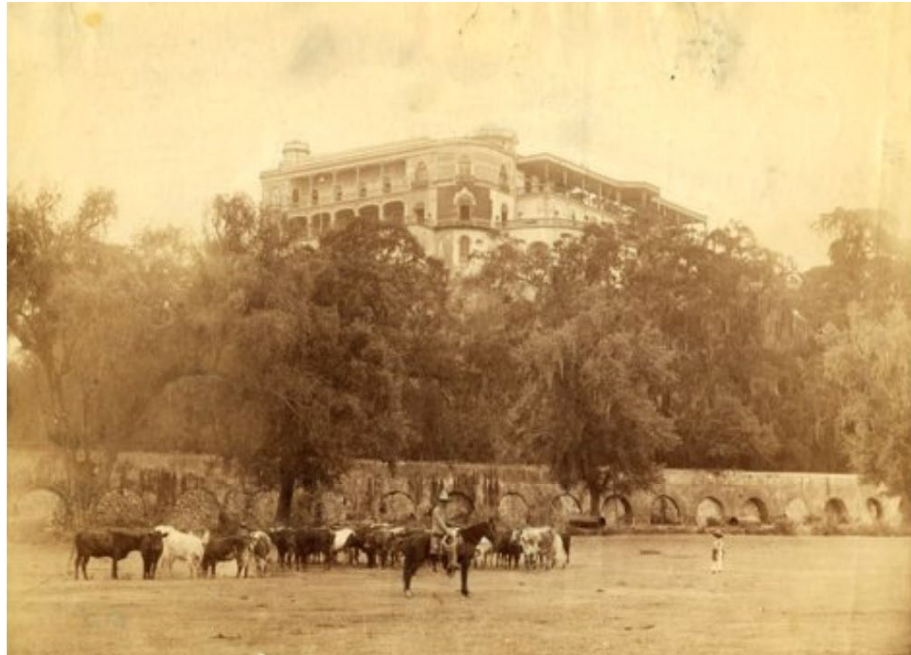
Modernization of the *Bosque de Chapultepec*

Through several centuries, the *BCh* evidently lacked a technical direction regarding its trees, while the landscaped areas in the houses of the *tlatoani*, viceroys, and presidents, were surely in charge of specialists and had adequate maintenance, as in the Second Empire (Knechtel, 2012). A proposal for intervention in the wooded area and the hill written by H. Grube and addressed to Emperor Maximilian was located in the General Archive of the Nation (Archivo General de la Nación [AGN], 1865). Most probably, it was not carried out due to the ephemeral nature of the empire, and the forest continued in a state of abandonment from an arboreal point of view.

This situation led José Yves Limantour, Secretary of Finance in the government of General Porfirio Díaz, to comment in his memoirs (first published in 1965), on the "... state of absolute savagery it found itself in, in which the incomparable *ahuehuetes* that populated it were dying by the hundreds ...", a paragraph that served as a preamble to mention that, thanks to the project that was implemented as from 1895, the *BCh* "... has become one of the most beautiful parks in existence, and its beauty will only be enhanced by the effect of the time it takes for the thousands of newly planted trees to develop, among them numerous foreign species that have been acclimatized in the park ..." (Limantour, 1965).

In order to carry out the project for the improvement of the *BCh* ordered by General Porfirio Díaz (very much in accordance with the ideas of modernity that prevailed during his government), a Board of Improvements of the *Bosque de Chapultepec* was formed under the coordination of the aforementioned José Limantour, for the purpose of enlarging and improving the infrastructure of the park for the recreation of the population, much of which still remains to this day, such as the lakes, the lake house, fountains, kiosks, and the layout of roads.

The modernization of the *BCh* was closely associated with the change of its surroundings, as it was no longer in a semi-rural context (Figure 2), but in an environment then in the process of urbanization.



Source: *Instituto Nacional de Antropología e Historia (INAH)* National Photo Library.

Figure 2. *Chapultepec Gardens, ca. 1880. A. Briquet.*

By the end of the 19th century, there were already electric streetcars (that went to *Tacubaya*) instead of the old mule trains, which made communication to *BCh* from Mexico City faster, radically facilitating the possibility of visiting it (Figure 3); besides, the city was expanding towards the West, coming closer to the forest, which rendered it an ideal site for an urban park.



Source: <https://www.mexicoenfotos.com/antiguas/distrito-federal/ciudad-de-mexico/tranvia-y-bosque-de-chapultepec-MX13229838190590/207>.

Figure 3. Electric streetcar service to *Bosque de Chapultepec*. 1900. Postcard.

Within the framework of the modernization project, the CCM ceded the land surrounding the pool that supplied water to the City, since the Improvement Board considered it pertinent to include that space in the rehabilitation (AHCM, 1895) —an action for which the President thanked the City Council—, under the agreement that the portion related to the pool would be respected as an area of competence of the City (AHCM, 1896).

Díaz Dufoo (1909) refers that the project allowed "... resurgence from the abandonment in which it had lain for many years... signaling wide avenues, lakes, flowerbeds and... care for those secular giants... the *ahuehuete* trees..." (Figure 4).



Source: *Instituto Nacional de Antropología e Historia (INAH)* National Photo Library

Figure 4. *Bosque de Chapultepec* after the improvement process at the beginning of the 20th century.

Based on newspaper reports of that time, Bolívar (2013) described the progress of the rehabilitation and improvement of *Chapultepec* over several years, including the draining of the old lake, the construction of a new one, a zoo, a natural history museum, a restaurant, and the creation of meadows or prairies (Figure 5).



Source: Mexico City Historical Archive.

Figure 5. 1906 plan of *Bosque de Chapultepec* after the rehabilitation project. Highlights include the land located North of *Paseo de la Reforma* and the views projected from *Lago Mayor*.

The activities or new achievements in the modernization of the Forest continued until 1906, and even the Improvement Board remained active until 1912, when the Porfirian regime ended and the Maderista regime began, as the budget of this agency is reported in the Federal Public Finance Account (Secretaría de Estado y del Despacho de Hacienda y Crédito Público, 1913).

Consultation of the paper by Wakild (2007) is recommended to gain an impression of the environmental and social significance of the rehabilitation project of the *BCh*, within the context of the last years of the Porfiriato, as well as of the work developed by Mr. Limantour and Engr. de Quevedo in the park, which was inaugurated in 1907, as part of the celebrations held for the centenary of the National Independence during the government of General Porfirio Díaz.

Technical and administrative aspects of the project

In addition to the aspects of infrastructure construction that were coordinated by the Improvement Board (*Junta de Mejoras*), the Governing Board of the *Bosque de Chapultepec* (*Junta Superior del Bosque de Chapultepec*) was created in 1901, also under the presidency of Mr. Limantour (AHCM, 1901), in order to carry out the technical work, and hiring for this purpose European specialists such as engineer Leon van de Hende (AHCM, 1905) and the horticulturist Alberto Kerzmann (AHCM, 1907a), whose contracts were renewed during these years; in addition, landscape gardener Julio Riousse (AHCM, 1907b) hired in such year. These professionals worked as technical directors or specialists in specific areas.

In accordance with the time, Engr. de Quevedo mentioned in a report he wrote at the end of 1932 that, in his capacity as Councilman of Public Works of the City Council of Mexico City (at the beginning of the 20th century), he conceived the *BCh* as a suburban park and acknowledged the outstanding work of Mr. Limantour and the French landscape architect Riousse in the project for its improvement (de Quevedo, 1933). In the same text he mentioned that, within the framework of the renovation project, the forest was expanded to the West, acquiring for this purpose the land of *Rancho de La Hormiga* and other adjacent lands so as "... to leave it well isolated from external properties ...", and he mentioned that, as a result of this expansion, the forest already had an extension of 400 ha at the beginning of the 20th century (de Quevedo, 1933). This comment on the acquisition of the ranch land casts doubt on the purchase ordered by Emperor Maximilian (referred to in the first part of the essay), which may not have been carried out at the time.

The Governing Board continued its work during the provisional government after the resignation of General Diaz to the presidency (May 1911) and, later, in the Maderista government, under the Ministry of the Interior (AHCM, 1911a, 1911b). During the coup government of Victoriano Huerta, the Board continued its activity

with new members appointed by the usurper government (although the foreign technicians had already resigned) until its dissolution in September 1914, when they resigned; from that date onwards it was left with a technical management rank under the coordination of the Ministry of the Interior (AHCM, 1914). With the arrival of the constitutionalist government, the *BCh* became dependent on the presidency (AGN, n. d.) and remained in that administrative location, without its technical level being clear, until the presidency of General Cárdenas (de Quevedo, 1935), which will be reviewed in detail in the third installment of this review.

The author was able to consult, at the AHCM, two very detailed reports on the work carried out by the Governing Board of the *Bosque de Chapultepec* in the period of July 1903 to June 1904 and 1905-1906 which include lists of specimens of over 50 tree and shrub species that were acquired from the company Balme y Cía. The vast majority of the species purchased from this supplier were allochthonous species from temperate climates. A report was also obtained on the number of trees, shrubs and herbaceous plants (more than 22 000) planted during the 1903-1904 period, among which the following tree species stand out: *Platanus occidentalis* L., *Gleditsia triacanthos* L., *Ulmus americana* L., *Ginkgo biloba* L., and *Eucalyptus globulus* Labill. However, also planted in large numbers were the native *T. mucronatum* and *Cupressus benthamii* Endl. [also referred to as *Hesperocypris benthamii* (Endl.) Bartel] (AHCM, 1903).

This manner of introducing allochthonous species has been a constant in the urban forests of many countries in the search for more attractive alternatives due to their foliage, flowering or bark, and, in the case of *Chapultepec*, it was surely strengthened by the European professionals who knew them. Notwithstanding the above, and based on the data derived from the diagnostic studies carried out by the author of this paper in the 1st Section of the *Bosque de Chapultepec* (unpublished data), it can be said that few of these species survived the environment of the *BCh* and Mexico City, there are individuals of *Gleditsia triacanthos* in good condition, and

Platanus occidentalis trees, which much of them exhibit trunks in poor sanitary conditions because bad pruning, evidenced by tears or rotting. Also, two individuals, respectively, of *Ginkgo biloba* and *Ulmus americana* L. remained (2020) in severely declining condition and may now be dead.

A factor to consider in the decline of these individuals, in addition to their age, is the fact that the lack of cold hours influenced a poor morphological development, worsened by the increase in temperature due to global warming and the urban heat island in Mexico City, coupled with the lack of irrigation that has occurred in a large part of the forest and the drought that has affected the city and exacerbates the evaporative demand of individuals.

New social context of the *Bosque de Chapultepec*

As a result of the *BCh* improvement project and thanks to the transportation facilities provided by the electric trains, it became possible for the inhabitants of Mexico City's less affluent socioeconomic classes to travel to the very gates of the forest (Figure 3), making it the preferred place for its inhabitants to spend holidays and weekends.

During the first years after the renovation project and due to the increase of visitors, the interest of merchants to establish themselves in the place began, although there were limited authorizations for food, refreshments and other stands for visitors (even chair rentals, very common at that time), as well as the concession of a *café-restaurant* for the economically more affluent visitors (AHCM, 1898). The number of merchant applications continued to grow and increased at the beginning of the 20th century (AHCM, 1910).

Concluding remarks

The lack of a technical guideline was a constant in the *BCh* throughout the 19th century, as well as. So was the lack of precise information on the characteristics and conditions of the trees. General, only the chronicles on the majestic *ahuehuetes* during the beginning of the 19th century were available.

In the reports prior to the renovation project, it was common that the characteristics and conditions of the trees were not mentioned, but there were recurrent descriptions of the deplorable condition of the site, which is even referred as wild, probably due to the unkempt appearance of the trees, lack of maintenance, and mortality due to lack of water, before the modernization project of the *BCh* was carried out.

Because of its historical, social, recreational, and environmental importance, the *Bosque de Chapultepec* holds an important place in the esteem of Mexicans, not only among those who live in Mexico City. Therefore, it deserves specialized attention for its protection, conservation, and improvement, particularly of its tree mass, which is facing new adverse environmental conditions derived from global warming and the increase of the urban heat island, as significant as those that occurred when the humidity levels in the soil and the flow of the springs decreased.

Conclusions

The depletion of soil moisture levels and exhaustion of springs at *Bosque de Chapultepec* and the subsequent lack of water for irrigation, led to the weakening

and death of a significant part of the tree cover of *T. mucronatum* and other related species towards the end of the 19th and the beginning of the 20th century.

The lack of a technical guideline on arboriculture influenced the conditions of the park until the formation of the Governing Board of the *Bosque de Chapultepec* within the framework of the project for its improvement.

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Conflict of interest

The author declares that he has no conflict of interest with any company or institution related to this work.

Contribution by author

The author is responsible for all the components of this work.

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