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History of the paleobotanical collections of the Museo de La Plata during the 19th and 20th centuries

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HISTORY OF THE PALEOBOTANICAL COLLECTIONS OF THE MUSEO DE LA PLATA DURING THE 19TH AND 20TH CENTURIES

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Abstract. Two collections are housed in the División Paleobotánica of the Museo de La Plata, one of megafossils and the other of microscopic preparations. Both are nationally and internationally recognized. The collections began modestly with the fossil plants collected by Santiago Roth in the late 19th and early 20th centuries. From 1933, it had a great development with the donation of the personal collection of Joaquín Frenguelli. During the 1930s, 1940s, and 1950s, the materials housed in the division acquired world renown thanks to the work of Frenguelli, fundamental in the knowledge of the flora of Gondwana. However, the División Paleobotánica did not exist at that time. In the 1960s when, with Sergio Archangelsky as chief, it became independent. As the Museo de La Plata is a university museum, since the middle of the 20th century, the collections have maintained a very close relationship with the educational field, both because of the objects that are used as teaching material and because of the people who have carried out theses, internships, and scholarships in the division. The objects of the collections served for the undergraduate training of the students who later, during their postgraduate studies, incorporated many specimens into the collection. In this way, the institution's relationship with university education functioned as a positive feedback process that made the collections grow significantly and continuously into the early 21st century.

Key words. Fossil plants. Facultad de Ciencias Naturales y Museo. Roth. Frenguelli. Archangelsky. Artabe.

Resumen. HISTORIA DE LAS COLECCIONES DE PALEOBOTÁNICAS DEL MUSEO DE LA PLATA DURANTE LOS SIGLOS XIX Y XX. En la División Paleobotánica del Museo de La Plata se resguardan dos colecciones, una de megafósiles y otra de preparados microscópicos. Ambas son reconocidas a nivel nacional e internacional. Las colecciones comenzaron de forma modesta con las plantas fósiles recolectadas por Santiago Roth a fines del siglo XIX y principios del siglo XX. A partir de 1933, tuvo un gran desarrollo con la donación de la colección personal de Joaquín Frenguelli. Durante las décadas de 1930, 1940 y 1950, los materiales alojados en la división adquirieron renombre mundial gracias a los trabajos de Frenguelli, fundamentales en el conocimiento de la flora de Gondwana. Sin embargo, para ese entonces, la División Paleobotánica no existía como tal. Fue en la década del 1960 cuando, con Sergio Archangelsky como jefe, se independizó. Al ser el Museo de La Plata una institución universitaria, las colecciones mantienen desde la mitad del siglo XX una vinculación muy estrecha con el ámbito educativo, tanto por los objetos que son empleados como material didáctico como por las personas que han realizado trabajos de tesis, pasantías y becas en la división. Los objetos de las colecciones servían para la formación de grado de los estudiantes que luego durante sus estudios de postgrado incorporaban una gran cantidad de ejemplares a la colección. De esta manera, la relación de la institución con la educación universitaria funcionó como un proceso de retroalimentación positiva que hizo crecer las colecciones de manera significativa y continua hasta principios del siglo XXI.

Palabras clave. Plantas fósiles. Facultad de Ciencias Naturales y Museo. Roth. Frenguelli. Archangelsky. Artabe.

THE DIVISIÓN Paleobotánica is a department of the Museo de La Plata (Buenos Aires Province, Argentina) focused on the study of fossils of plants, algae, and fungi (Fig. 1.1–1.2). First, this section was part of the Sección Paleontología, created a few years after the museum's foundation, between 1889 and 1895 (Teruggi, 1994; Lanteri, 2021). It was not until the 1960s that the División Paleobotánica functioned as an independent division from the rest of the museum's paleontological disciplines (Morel *et al.*, 2015).

Currently, the division houses two collections (Fig. 1.3–1.9), which preserve thousands of fossils of plants, algae, and fungi from localities worldwide. The oldest collections consists of macroscopic specimens, while the newest comprises microscope slide preparations of fossil woods, leaf cuticles, and pollen/spores, among others. The former holds *ca.* 16,000 pieces and the latter *ca.* 1,600 pieces (Fig. 1.4–1.9). On the whole, they include samples from 28 countries (Argentina, Austria, Bolivia, Brazil, Canada, Chile,

Figure 1. 1, Front view of the Museo de La Plata. **2,** Corridor of level 0 of the Museo de La Plata, where the collections of the División Paleobotánica are located. **3,** Door of the former "Parodi" classroom, where the largest part of the megafossil collection of the División Paleobotánica is currently housed. **4,** Furniture of the megafossil collection. **5–6,** Inside of the drawers where the megafossil collection specimens are housed. **7–8,** Furniture of the microscopic slide collection. **9,** Trays with microscopic slides.

China, Czech Republic, Egypt, England, France, Germany, Ireland, Italy, Japan, Norway, Peru, Poland, Russia, Scotland, Somalia, South Africa, Spain, Sweden, Tanzania, Uruguay, USA, and Venezuela) and 16 provinces of Argentina (Buenos Aires, Catamarca, Córdoba, Chubut, Entre Ríos, La Rioja, Mendoza, Neuquén, Río Negro, Salta, San Juan, San Luis, Santa Cruz, Santa Fe, Tierra del Fuego, Antártida e Islas del Atlántico Sur, and Tucumán). The materials correspond to stromatolites, fungi, calcareous algae, bryophytes, lycophytes, sphenophytes, ferns, seed ferns, cordaitaleans, ginkgoaleans, conifers, and flowering plants, ranging from Proterozoic to Holocene ages.

These collections are recognized at both national and international levels. However, their history is intricate to reconstruct due to certain divisions' instabilities and the incomplete records of material entry. In this work, we revisited the history of the paleobotanical collections at the Museo de La Plata and analyzed how they developed during the 19th and 20th centuries, as well as their relationship with the activities integrated into the museum, including undergraduate and graduate education.

ORIGINS OF THE COLLECTIONS

At the end of the 19th and the beginning of the 20th centuries, the paleobotanical collections of the Museo de La Plata began modestly with the fossil plants collected by Kaspar Jacob Roth (1850–1924), also known as Santiago Roth, who was chief of the Sección Paleontología between 1895 and 1906 (Fig. 2.1–2.2) (Bond, 1998a; Riccardi, 2011). This position allowed Roth to carry out numerous geological, paleontological, and hydrogeological works in different parts of the country, in addition to acting as an expert for Argentina in the border issue with Chile (Bond, 1998a; Riccardi, 2011). Roth (1899) mentioned the presence of silicified wood in levels corresponding to the Upper Cretaceous of Patagonia in its "strata with dinosaurs". Some of these woods are housed in the megafossil collection. Roth also collected Jurassic leaf impressions from Sierra Pintada, Neuquén Province, which were later studied by Kurtz (1902) (Fig. 2.3–2.5). In paleobotanical studies, Federico Kurtz (1854–1921), the founder of this discipline in Argentina, produced his first works at the Museo de La Plata (Bondesio, 1977).

When the museum was nationalized in 1906 and became part of the Universidad Nacional de La Plata, Roth also became professor of paleontology. In 1915, Eduardo Carette (1886–1946) joined as associate professor of the same discipline (del Ponte, 1947; García, 2004; Riccardi, 2011).

In 1921, the Sección Paleontología was divided into two independent sections, one dedicated to invertebrates and plants (in charge of Carette) and the other dedicated to vertebrates (in charge of Roth). However, Carette's relationship with the museum lasted only a short time and the two sections were reunited two years later (Riccardi, 2011).

When Roth died in 1924, the fossil plant collections were again part of the Departamento Paleontología, which was in charge of Ángel Cabrera y Latorre (1879–1960) (Bond, 1998b). Cabrera was the chief from 1925 until 1934, when the department was finally divided into the División Paleozoología Invertebrados-Paleobotánica and División Paleozoología Vertebrados. At that time, the collections comprised nearly 860 specimens from the country and abroad. Among them, it is worth mentioning the fern and gymnosperm fossil leaves from the Jurassic of Piedra Pintada collected by Roth (Neuquén Province, Argentina), the stromatolites from the Paleocene of General Roca (Río Negro Province, Argentina) whose collector is unknown, and the angiosperm fossil leaves from the Cretaceous of Cerro Guido (Chile) brought by Rodolfo Hauthal (1854–1928).

THE COLLECTION OF DIVISIÓN PALEOZOOLOGÍA DE INVERTEBRADOS-PALEOBOTÁNICA

In 1934, the Italian physician and naturalist Joaquín Frenguelli (1883–1958) joined the museum, first as secretary and then as director between 1935 and 1946. Until then, Frenguelli worked at the Universidad del Litoral (Santa Fe) and attributed 124 publications on geology, paleobotany (especially diatoms), and stratigraphy, among others. One of his first decisions was to divide the paleontology area into two divisions: Paleozoología Vertebrados, headed by Ángel Cabrera (1934–1947) (Bond, 1928b) and Paleozoología Invertebrados-Paleobotánica, supervised by him.

The work of Frenguelli was crucial to give a renewed

impetus to the collections of fossil invertebrates and plants. He donated his collection, which consisted of 1,908 boxes with 6,000 specimens of fossil invertebrates and plants and 2,000 microscopic slides of fossil and living diatoms (Teruggi, 1994; Riccardi, 2011). The microscopic slides were later transferred to the División Ficología of the Museo de La Plata, while *ca.* 1,440 pieces from Frenguelli's boxes were given to the División Paleobotánica (Fig. 3.1).

Figure 2. 1, Fossil wood found by Roth, Carette, and Schiller, incorporated in the beginnings of the División Paleobotánica collections (near 1921), with the label used in the 1930s and 1940s, **LPPB 7747**. Scale bar= 2 cm. **2,** Original label of the fossil wood from Figure 2.1., with information about its provenance and date of collection. **3,** A fossil leaf of "***Thinnfeldia***" (=***Scleropteris vincei***) collected by Roth, with its original label, **LPPB 4283**. Scale bar= 1 cm. **4,** A fossil leaf of ***Dictyophyllum*** (=***Clathropteris kurtzi***) collected by Roth, with its original label, **LPPB 4285**. Scale bar= 2 cm. **5,** Plate modified from Kurtz (1902), in which the specimens from Piedra Pintada collected by Roth were studied. The drawing with number 3 corresponds to the specimen from Figure 2.3, while the illustration with number 5 corresponds to the specimen from Figure 2.4. Scale bar= 2 cm.

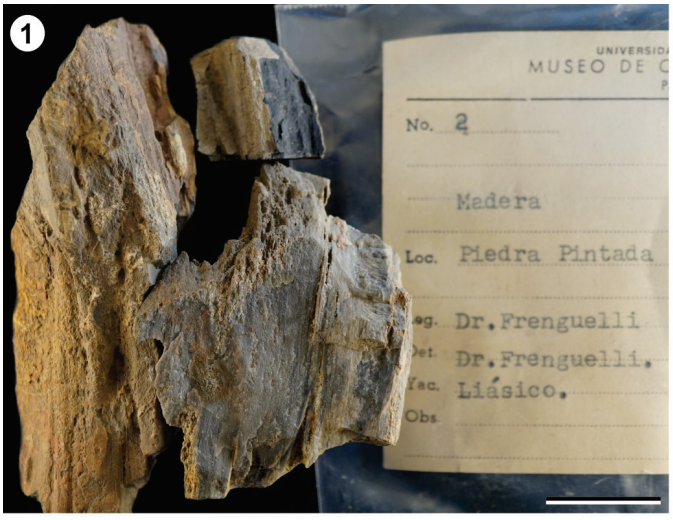
Frenguelli methodically identified and incorporated *ca.* 500 specimens that entered the museum before his arrival (Fig. 3.2–3.3). He began a new cataloging system with alphabetical, systematic, geographic, and stratigraphic files, which complemented the entry book (Morel *et al.*, 2015). This cataloging system did not include the year of collection, entry, and determination of the material (Fig. 3.4). This information was only available through the memoirs that Frenguelli published periodically in the journals of the Museo de La Plata (Frenguelli, 1935; Frenguelli & Tribiño, 1936, 1937, 1938, 1939, 1940, 1941, 1943, 1944, 1945). Compared to other divisions, the work of the División Paleozoología Invertebrados-Paleobotánica, during the period in which Frenguelli was its director, was limited by the scarcity of time, since he was also the director of the museum. Another inconvenience was that the division had scarce staff, which consisted of only one preparation technician and one volunteer, in addition to the division chief. The volunteer was the geologist Armando Leanza (1919–1975), who began to collaborate in the fossil invertebrates' section in 1941. Two years later, he was named a section manager, but in 1944, he retired from this position and the division.

Between 1934 and 1955, approximately 2,000 pieces were registered, collected during fieldwork made by Frenguelli and, on several occasions, accompanied by his disciple Héctor Orlando (*ca.* 1918–?) (Fig. 3.5, 3.7). Among these pieces the stromatolites from the Cretaceous of Salta Province, 12 boxes with materials from the Jurassic of Neuquén Province and the Eocene of Chubut Province, and numerous specimens from the Carboniferous of La Rioja Province and the Permian of Chubut Province stand out. Furthermore, Frenguelli described and determined more than 700 samples, which other people donated. They comprise, for example, fossils from the Paleogene–Neogene of Pichi Leufú (Río Negro Province) and Laguna del Hunco (Chubut Province) brought by Rodolfo Maldonado Bruzzone (*ca.* 1900–1975; Fig. 3.6); the Permian of various localities of Chubut Province provided by Alejandro Piatnitzky (1879–1959); the Jurassic of Puesto C. Meschio (Chubut Province) by Tomás Suero (1915–1963); the Paleogene of Río Turbio (Santa Cruz Province), donated by José Brandmayr (?–1953); the Jurassic of Cerro Madre e Hija (Santa Cruz Province) by Franz Mansfeld (?–?); the Carboniferous of Caballo del Anca (La Rioja Province) by Horacio Harrington (1910–1973); and the Triassic of Uspallata (Mendoza Province) by Félix Rodrigo (*ca.* 1928–?) (Frenguelli, 1953; Rolleri, 1964). Also during this time, materials were added through exchange with other institutions, among which it is worth mentioning 14 pieces of the Cretaceous of North America from the Royal Ontario Museum. By 1943, the collection of the division had reached 10,000 specimens, including fossil plants and invertebrates. In 1955, when Frenguelli left his position definitely, it is calculated that *ca.* 5,000 fossil plant specimens were part of the collection. Approximately 3,000 of these materials were identified by Frenguelli himself, but despite his enormous effort, *ca.* 1,400 pieces were just assigned to taxa by subsequent researchers, and at least 600 specimens remain undetermined to this day.

During the 1930s, 1940s, and 1950s, the materials housed in the division gained world renown through the work of Frenguelli, who pioneered the knowledge of the evolution of the Gondwanan flora. He published more than 270 scientific research and teaching papers.

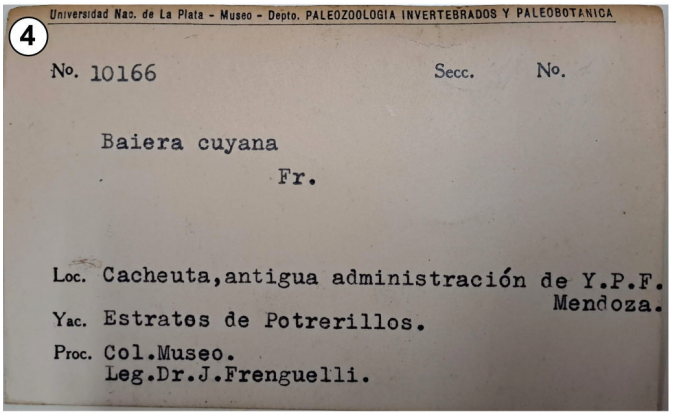
In parallel, Frenguelli began the modernization of the exhibition rooms dedicated to fossil plants and invertebrates. Regarding paleobotany, he was responsible for the restoration of the fossil trunk pedestals and the assembly of display cases dedicated to "problematic fossils" and algae,

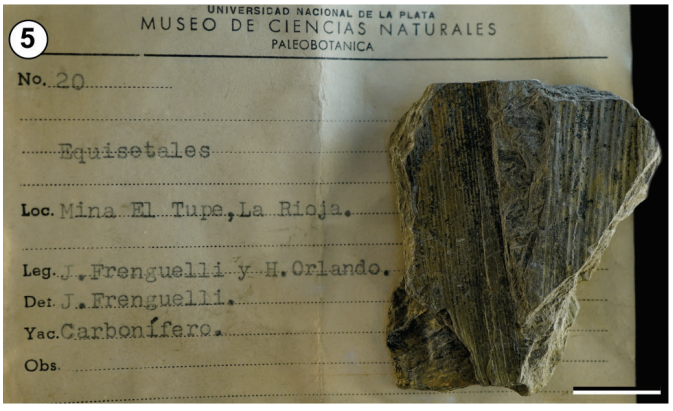
Figure 3. 1, Fossil wood which belonged to the personal collection of Frenguelli, **LPPB 2**. Scale bar= 2 cm. **2,** Fossil reproductive structure determined as ***Stachyopitys anthoides*** by Frenguelli, **LPPB 10260**. Scale bar= 0.5 cm. **3,** Label of specimen from Figure 3.2, the legend "*Col. Museo*" indicated that it was entered before Frenguelli arrived at the division. **4,** File from the Frenguelli's cataloging system. **5,** Sphenophyte stem found during fieldwork by Frenguelli and Orlando in the Carboniferous of La Rioja Province, **LPPB 20**. Scale bar= 1 cm. **6,** Angiosperm fossil leaf "***Lomatites occidentalis***" from the Eocene of Chubut Province, brought by Maldonado Bruzzone and determined by Frenguelli, **LPPB 2531**. Scale bar= 2 cm. **7,** ***Lithothamnium*** (calcareous alga) from the Holocene of Chubut Province, found during fieldwork by Frenguelli, **LPPB 5113**. Scale bar= 4 cm. **8,** Exhibition case with araucarian cones and trunks from Cerro Madre e Hija mounted in 1935. The photograph was taken from Frenguelli & Tribiño (1936), used under Creative Commons license CC BY-NC-SA 4.0 DEED.


1
MUSEO DE
No. 2
Madera
Loc. Piedra Pintada
Leg. Dr. Frenguelli
Det. Dr. Frenguelli.
Yac. Liásico.
Obs.


2

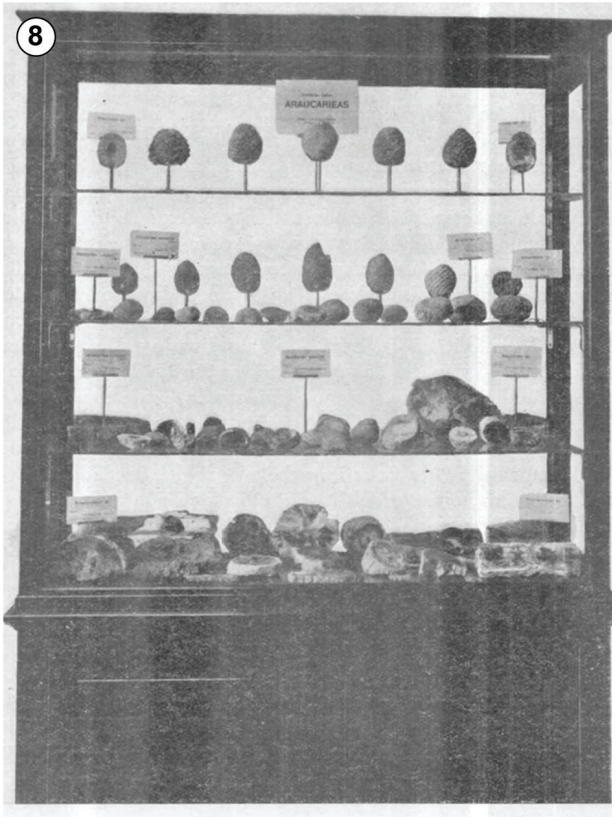

3
Universidad Nacional de La Plata
MUSEO
DEPTO. DE PALEOZOOLOGIA INVERTEBRADOS Y PALEOBOTANICA
Nº 10260
Stachyopitys anthoides
SINTIPO
Fr.
Cycadocarpidium minus
(Wiel.)
Yac. Estratos de Potrerillos.
Loc. Zanjón, Cacheuta, Mendoza.
Proc. Col. Museo.
Leg. Dr. J. Frenguelli. (4-III-1943)


4
Universidad Nac. de La Plata - Museo - Depto. PALEOZOOLOGIA INVERTEBRADOS Y PALEOBOTANICA
No. 10166 Secc. No.
Baiera cuyana
Fr.
Loc. Cacheuta, antigua administración de Y.P.F. Mendoza.
Yac. Estratos de Potrerillos.
Proc. Col. Museo.
Leg. Dr. J. Frenguelli.


5
UNIVERSIDAD NACIONAL DE LA PLATA
MUSEO DE CIENCIAS NATURALES
PALEOBOTANICA
No. 20
Equisetales
Loc. Mina El Tupe, La Rioja.
Leg. J. Frenguelli y H. Orlando.
Det. J. Frenguelli.
Yac. Carbonífero.
Obs.


6


7


8
ARAUCARIEAS

angiosperms from the Laguna del Hunco (Chubut Province), seed ferns, and araucarian cones and trunks from Cerro Madre e Hija (Santa Cruz Province) (Fig. 3.8).

At the end of the 1940s, the museum became a faculty of the Universidad Nacional de La Plata, which was named Facultad de Ciencias Naturales y Museo. Therefore, it attained a greater emphasis on education. In 1946, the faculty and the museum were intervened and Frenguelli presented his resignation from all his positions, which was accepted in February 1947 by the new director Emiliano Mac Donagh (1896–1961, director between 1946 and 1949) (Bondesio, 1977; Teruggi, 1981; Riccardi, 2013). From 1953 to 1955, Frenguelli returned to the museum and resumed his research in the División Paleozoología Invertebrados-Paleobotánica (Lanteri, 2021).

After Frenguelli, different people succeeded each other as division head; most were professors of paleontology courses, who marginally dealt with aspects related to the collections (Riccardi, 2011). In 1947, Armando Leanza assumed as the division leader, but he resigned in 1948, and subsequently the museum director Mac Donagh took over this position. It was not until 1950 that Orlando was appointed professor and designated as the new division chief. He specialized in paleobotany and kept the collections within the guidelines established by Frenguelli. Orlando remained in his position until 1955, when the museum was again intervened, and Fernando Márquez Miranda (1897–1961) took over as director (Lanteri, 2021). There is no record of who took charge of the division from 1955 to 1958.

Between 1958 and 1961, Pedro N. Stipanicic (1921–2008), a specialist in paleobotany and biostratigraphy of the Argentine Mesozoic and professor of paleobotany, was division head. Horacio H. Camacho (1922–2015), a specialist in Cenozoic invertebrates and professor of the course "*Paleontología de Invertebrados*" (Invertebrate Paleontology), succeeded Stipanicic between 1961 and 1966. Both Stipanicic and Camacho devoted most of their time at the institution to teaching (Riccardi, 2011). Therefore, the growth of the collections was somewhat halted compared to the time of the Frenguelli and Orlando directorships.

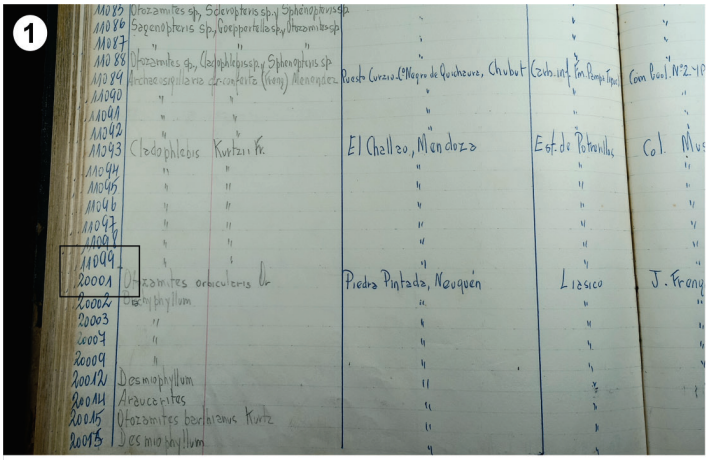
THE COLECTIONS OF THE DIVISIÓN PALEOBOTÁNICA

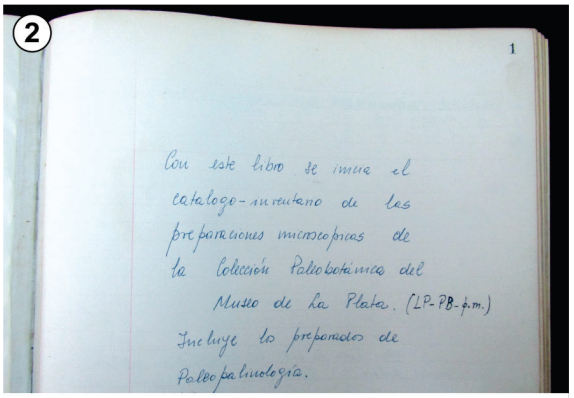
In 1957 it was decided to divide the División Paleozoología Invertebrados-Paleobotánica into two independent divisions. However, this separation did not take place until 1966, when Arturo J. Amos (1927–1999) was appointed chief of the División Paleozoología Invertebrados and Sergio Alchangelsky (1931–2022) as head of the División Paleobotánica (Riccardi, 2011; Morel *et al.*, 2015).

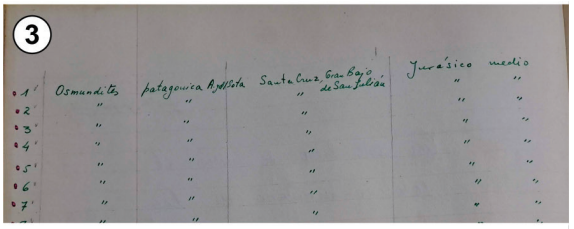
Archangelsky's management brought profound positive changes to the paleobotanical collections. The megascopic specimen collection was reorganized and given the acronym LPPB (*La Plata-Paleobotánica*). In this rearrangement, the specimens kept the original numbers given to them at the time of the División Paleozoología Invertebrados-Paleobotánica. For this reason, the collection numbers did not follow a chronological order and there were spaces in the numbering. For example, specimens between 276 and 278 were entered in the 1960s; while materials from 20,766 to 20,774 were entered in the 1940s. In addition, there were no specimens with numbers between 11,099 and 20,000 until 1996 (Fig. 4.1).

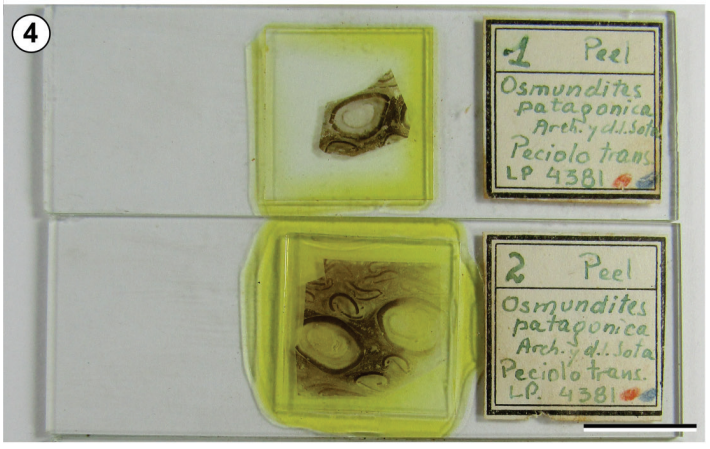
Archangelsky also started the microscopic collection with the acronym LPpm (*La Plata-preparado microscópico*) (Fig. 4.2–4.4). This collection houses microscopic slides of permineralized stems and woods, fossil leaf cuticles, and fossil palynomorphs. In the same year that Archangelsky took over the direction of the División Paleobotánica, the

Figure 4. 1, Page from the entry book of the collection of megafossils, in which it is indicated with a box that there was discontinuous numbering of the pieces prior to the arrival of Archangelsky as division chief. **2–3,** First pages from the entry book of the collection of microscopic slides. **4,** Peel of ***Osmundites patagonica*** stem, which were between the first slides being incorporated to the collection, **LPpm 1–2**. Scale bar= 1 cm. **5,** Several specimens of ***Pararaucaria patagonica*** cones and "***Araucarites sanctaecrucis***" branches and cones, from the Jurassic of Santa Cruz Province, collected and determined by Archangelsky. **LPPB 6106, 6097, 6119, 6110, 6112, 6115, 6113, 6111, 6105, 6019, 6117, 6121, 6126, 6118, 6122, 6116** (from left to right and from top to bottom). Scale bar= 2 cm. **6–7,** Collection label and sample with leaves of ***Ptilophyllum***, ***Ruflorinia***, and ***Apterocladus*** from the Early Cretaceous of Santa Cruz Province found and determined by Archangelsky, **LPPB 5730**. Scale bar= 2 cm. **8,** Part and counterpart of an impression of ***Neuropteris*** cf. ***clarksonii*** from the Carboniferous of Mazon Creek**, LPPB 7593.** Scale bar= 2 cm.


Clathophlebis Kurtzii Fr.
El Challao, Mendoza
Piedra Pintada, Neuquén
Liásico
J. Frenguelli


Con este libro se inicia el catalogo-inventario de las preparaciones microscopicas de la Colección Paleobotanica del Museo de La Plata. (LP-PB-p.m.)
Incluye lo preparados de Paleopalinologia.


Osmundites
patagonica Archangelsky
Santa Cruz
Jurásico medio


1 Peel
Osmundites patagonica
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Osmundites patagonica
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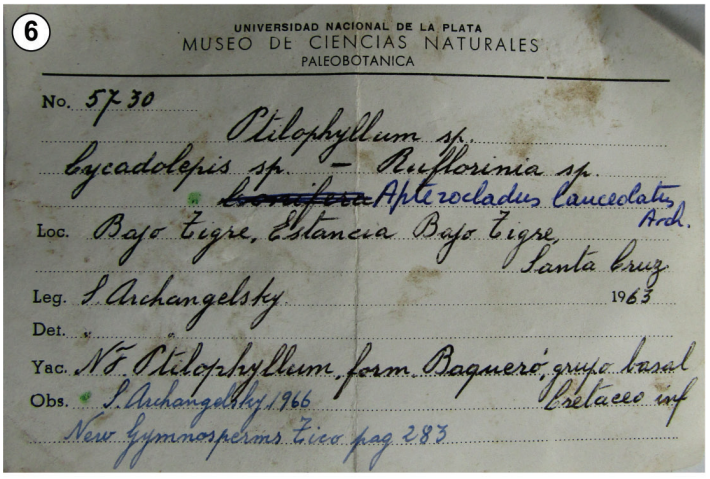
Peciolo trans.
LP 4381


UNIVERSIDAD NACIONAL DE LA PLATA
MUSEO DE CIENCIAS NATURALES
PALEOBOTANICA
No. 5730
Ptilophyllum sp.
Lycadolepis sp. – Ruflorinia sp.
Aptenocladus lanceolatus Arch.
Loc. Bajo Tigre, Estancia Bajo Tigre
Santa Cruz
Leg. S. Archangelsky 1963
Det.
Yac. N° Ptilophyllum, form. Baguero, grupo basal
Obs. S. Archangelsky 1966 Cretaceo inf
New Gymnosperms Tico pag 283

palynologist Juan C. Gamerro (1923–2013) joined the staff, and the palynology laboratory, focusing on both fossil and extant palynomorphs, began to function in the same division.

Like Frenguelli, Archangelsky substantially improved the megascopic collection by incorporating nearly 2,500 specimens collected by himself, in some cases together with other renowned paleobotanists such as Carlos Menéndez (1921–1976) and Rafael Herbst (1936–2017). Among these materials, it is worth highlighting the 2,200 samples from the Middle Jurassic and Early Cretaceous of Santa Cruz Province (Fig. 4.5–4.7) and 150 fossils from the Jurassic of Yorkshire (Great Britain). On the other hand, during his tenure he studied and identified approximately 3,000 fossils previously entered or donated. On occasions, he conducted this labor together with Elías De La Sota (1932–2013), Rafael Herbst, and Oscar Arrondo (1936–1992). Other outstanding pieces which were entered in that period came from the Upper Carboniferous of various basins in Spain (La Magdalena-León, Ciñera-Matallane, among others), the Permian of China, and the Triassic of South Africa through donations; and several pieces from the Carboniferous Mazon Creek fossil beds (Illinois, USA) were exchanged with the Field Museum of Natural History (Fig. 4.8).

Regarding university education, Archangelsky was the first professor of the course "*Paleobotánica*" (Paleobotany), where he incorporated many specimens from the division's collections as teaching material. Likewise, he published a textbook titled "*Fundamentos de Paleobotánica*" (Archangelsky, 1970), a reference for several undergraduate subjects of the Facultad de Ciencias Naturales y Museo and other faculties in the country. This book was illustrated with numerous photographs of specimens from the division's collections.

In 1976, Archangelsky and Gamerro left the Museo de La Plata and from that year on, Arrondo was the new chief of the division. With Gamerro's departure, the palynological studies were almost interrupted. Arrondo, together with Bruno Petriella (1943–1984), continued research and teaching in paleobotany, the enrichment of the collections, and the training of Ph.D. students (Morel *et al.*, 2015; see "Relationship of the collections with the educational field" section below). In particular, Petriella promoted a discipline known as xylology (*i.e.*, the study of stem and wood anatomy) which was not yet developed in the museum. With this purpose, he started a didactic xylotheque of extant woods, with macroscopic and microscopic samples. At the same time, he added numerous pieces to the division collections, which he analyzed in his doctoral thesis (from the Paleogene of Cerro Bororó, Chubut Province) and subsequent contributions. Unfortunately, after Petriella's untimely death in 1984, the xylotheque began to deteriorate and become disorganized and never acquired the character of a formal repository.

The income of specimens through donations and exchange decreased considerably at the end of 1970. From that moment, the materials arrived mainly from fieldwork carried out by the museum and faculty staff. Approximately 1,400 pieces were incorporated in the 1970s and 1980s, mainly from the Triassic of central-western Argentina and the Triassic, Jurassic, and Paleogene of Argentine Patagonia.

Regarding the exhibitions, during the 1970s and 1980s, a reorganization of the rooms dedicated to paleontology was carried out (Teruggi, 1994), which remained almost unchanged until the beginning of the 21st century. Several pieces of the collection were displayed at renewed display showcases, among which can be mentioned those dedicated to the Carboniferous–Permian Gondwanan flora in exhibition room III (Fig. 5.1), the Triassic flora of Ischigualasto (San Juan Province) with large *Rhexoxylon* trunks in exhibition room IV (Fig. 5.2), the Cretaceous fossil plants from Baqueró, Santa Cruz Province in exhibition room V, and the Paleogene fossil stems from Cerro Bororó (Chubut Province) in exhibition room VIII. While preparing the pieces for the exhibition, several of them underwent alterations to emphasize the fossils (Fig. 5.3).

In 1990, Arrondo took a leave of absence due to a painful illness that led to his death in 1992. Analía Artabe (1954) took over as head of the division and remained in charge until 2003. During this period, the division staff research mainly focused on the comprehensive study of the Triassic floras of Argentina, so that the collections by the end of the 20th century became the most important paleobotanical repository with the largest number of Triassic pieces in South America.

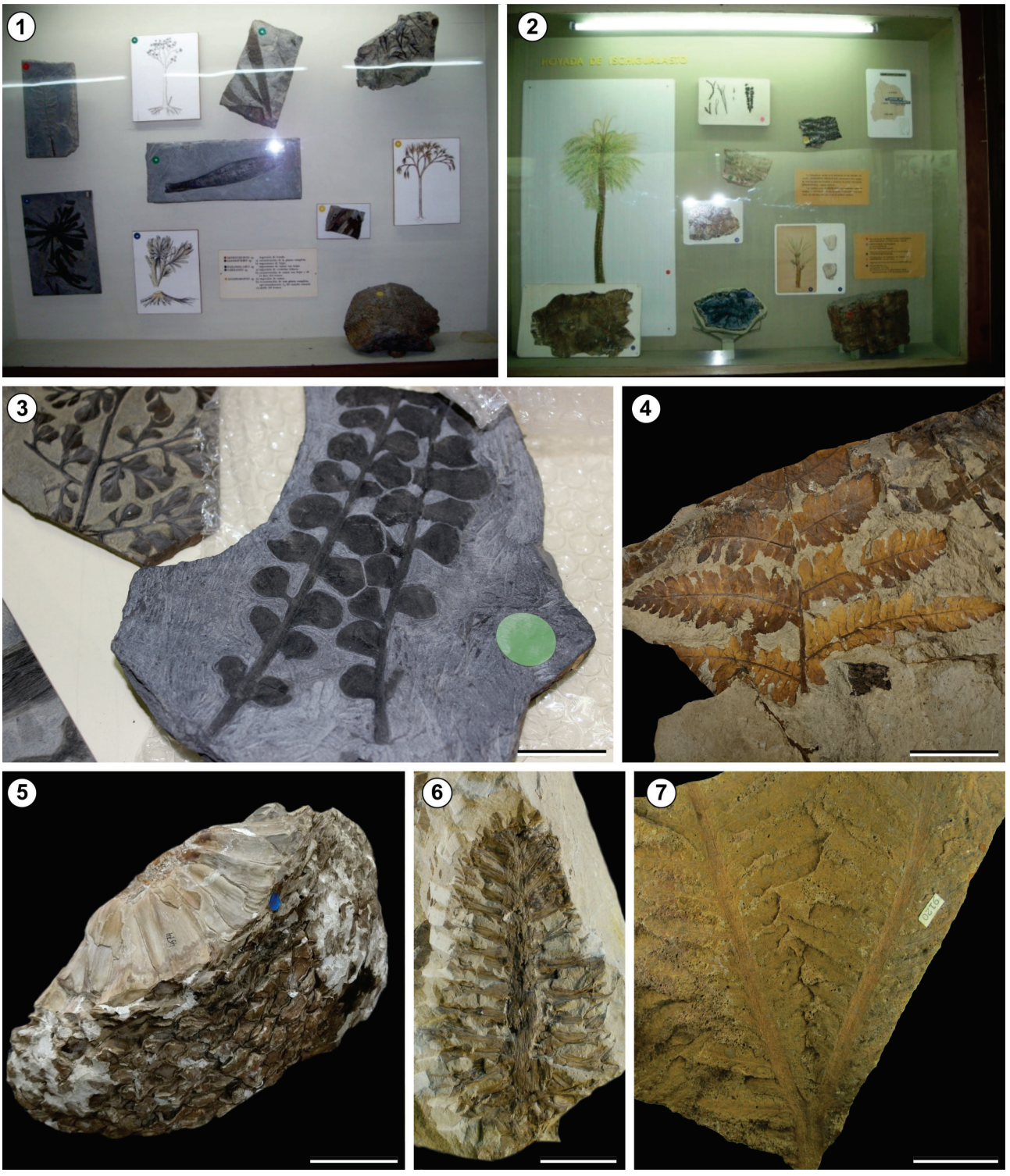


Figure 5. 1, Display case dedicated to the Carboniferous–Permian Gondwana flora in exhibition room III of the Museo de La Plata (from 1970s to 2003). **2,** Display case dedicated to the Triassic flora of Ischigualasto (San Juan Province) with large ***Rhexoxylon*** trunks in exhibition room IV (from 1970s to 2017). **3,** Pieces altered to highlight the fossil used in the exhibition. Scale bar= 2 cm. **4,** Fern leaf of ***Cladophlebis mendozaensis***, brought by Arrondo from the Triassic of La Juanita locality, Santa Cruz Province, **LPPB 14424**. Scale bar= 2 cm. **5,** Cycad stem of ***Bororoa andreisii*** studied by Petriella from the Paleogene of Cerro Bororó, Chubut Province, **LPPB 4574**. Scale bar= 4 cm. **6,** Conifer cone of ***Telemachus elongatus*** from the Triassic of Cerro Cacheuta, Mendoza Province, studied by Morel, **LPPB 11844**. Scale bar= 1 cm. **7,** Leaf of ***Zuberia zuberi*** from the Triassic of Los Menucos, Río Negro Province, studied by Artabe, **LPPB 9120**. Scale bar= 2 cm.

RELATIONSHIP OF THE COLLECTIONS WITH THE EDUCATIONAL FIELD

As the Museo de La Plata is a university museum, the collections have maintained a very close relationship with the educational field since the middle of the 20th century, both through the objects that are used as teaching material in classes and illustrations in textbooks, as well as through the people who have carried out theses, internships and scholarships in the division.

Regarding Ph.D. theses, Ernesto García (?–?), who studied the stratigraphy and tectonics of Southwestern Jáchal, San Juan Province, provided a collection with fossil plants of the Carboniferous period (García, 1945). Another geologist, Francisco R. Dara (?–?), developed his thesis under the supervision of Frenguelli and incorporated 30 pieces of fossil leaves and reproductive structures from the Carboniferous of San Juan Province (Dara, 1946; Frenguelli, 1946). Orlando and Norberto Traverso (?–?) completed their theses by studying fossil plants already housed in the division, although in the first case Orlando also provided dozens of new pieces (Orlando, 1946; Traverso, 1951).

Between 1969 and 1999, eight Ph.D. theses were developed in the División Paleobotánica. In all cases, the Ph.D. students reviewed existing material in the collection and incorporated new specimens resulting from their fieldwork. Arrondo focused on fossil plants from the Permian, Triassic, and Jurassic of the La Juanita locality, Santa Cruz Province, resulting in the addition of more than 300 new specimens to the collection (Arrondo, 1969; Fig. 5.4). Petriella contributed with approximately 200 macroscopic and microscopic samples of stems a wood from Cerro Bororó, Chubut Province (Petriella, 1971; Fig. 5.5). Edgardo Romero (1942–) focused on Eocene Río Turbio Formation palynology and provided several slides for the microscopic collection (Romero, 1973). Alicia Baldoni (1945–) mainly studied the fossil plants of the Lower Cretaceous of Patagonia, which Archangelsky had previously incorporated (Baldoni, 1977). During her thesis regarding the Los Menucos Triassic Flora, Artabe incorporated *ca.* 100 specimens of fossil stem, leaves, and reproductive structures (Artabe, 1984; Fig. 5.6). Eduardo Morel (1949–) provided more than 150 pieces of fossil bryophytes, sphenophytes, ferns, and gymnosperms from the Triassic of Cerro Cacheuta, Mendoza Province (Morel, 1991; Fig. 5.7). More than 40 macroscopic and microscopic samples of stems, leaves, and leaf cuticles were added by Alba Zamuner (1959–2012) from Ischigualasto, San Juan Province (Zamuner, 1992). The last thesis made during the 20th century in the division, whose materials were deposited in its collection, was that of Mariana Brea (1965–), who studied the Darwin Petrified Forest of Uspallata, Mendoza Province (Brea, 1995).

At the end of the 1960s, with the creation of the División Paleobotánica, the course of "*Paleobotánica*" (Paleobotany) was also established. To serve as study material for undergraduate students, a series of fossils were selected from the collections of the divisions. The didactic collection is currently housed in classrooms D3 and D4 of the Facultad de Ciencias Naturales y Museo and hosts megafossils and microscopic material. The megafossil collection has about 100 specimens, including pieces from the cherts, coal balls, leaf impressions and compressions, reproductive structures, and stems from Paleozoic and Mesozoic localities of Argentina, as well as from the Devonian, Carboniferous, and Eocene of North America and Europe. The Paleozoic specimens from abroad were acquired by the first professor of the course, Archangelsky, and later the didactic collection was nourished with samples representing the study topics of the division research group: Neopaleozoic of La Rioja and Chubut provinces, Triassic of San Juan and Mendoza provinces, Jurassic of Patagonia, and Eocene of Canada. The microscopic material comprises mostly sections of coal balls from the Carboniferous of the northern hemisphere, including anatomical sections of vegetative and reproductive organs of the most representative groups of that time. In addition, it is complemented by phytolith samples, wood sections, and palynological samples, mostly from Argentina. This collection is mainly used in paleobotany courses for botany and paleontology students, and other courses for geology and biology students.

In addition to the research work, the general and didactic collections have been enriched by the material deposited by students of geology and paleontology for their theses and doctoral dissertations. The objects of the collections were used for the undergraduate education of the students, who later, during their postgraduate studies, incorporated many specimens to the collection (Fig. 6).

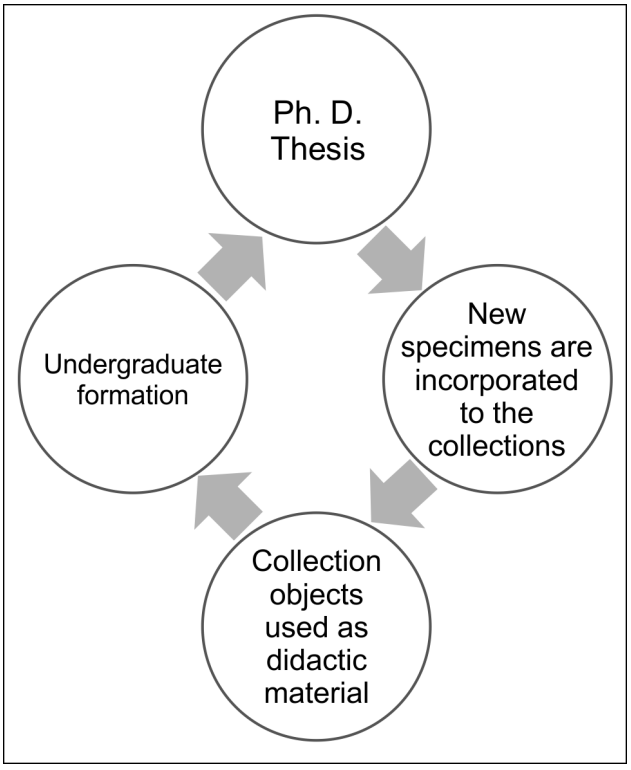


Figure 6. Scheme of the feedback process between the collections of the División Paleobotánica with the university education.

CONCLUSIONS

In the history of the paleobotanical collections of the Museo de La Plata during the 19th and 20th centuries, we can define five stages. The first stage spans from the end of the 19th century to 1934, when the materials were received without prior study, since the museum did not have a specialist in paleobotany. The second stage, from 1934 to 1955, when Frenguelli, as paleobotanist, enhanced the collections through his research and management. This period was characterized by a great diversity of ways of entering pieces: donations, fieldworks made by Frenguelli and other museum researchers, and Ph.D. theses. The third stage, between 1955 and 1966, was a time of standstill for the collections. From 1966, the fourth stage began with Archangelsky's management, when the plant fossil collections finally became segregated from the other fossil collections. From 1966 to 1976 was the period of modernization and strong reorganization. The fifth stage started with Archangelsky's departure in 1976, when the pieces incorporated by donation and exchange were gradually reduced. In this period (1976–2000), the new specimens were entered after their study and thus few lack a systematic classification.

It can be concluded that the institution's relationship with the university education functioned as a positive feedback process that made the collections grow significantly and continuously from the 1940s until the beginning of the 21st century.

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