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Development of the Paleobotany Section in the Museum at the Botanical Garden of Naples, Faculty of Sciences, University of Naples "Federico II", Italy

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Riassunto

La sezione di Paleobotanica è una parte del Museo di Paleobotanica ed Etnobotanica ospitato nell'Orto botanico di Napoli, Facoltà di Scienze, Università di Napoli "Federico II". La sezione di Paleobotanica mostra circa 150 fossili vegetali ed enfatizza il loro ruolo nella comprensione dell'evoluzione delle piante terrestri a partire dalle forme più primitive del Siluriano.

Con l'ausilio di ricostruzioni di fossili, di testi descrittivi e di un albero filogenetico tridimensionale, vengono illustrati la comparsa di forme differenziate avvenuta nel Devoniano, la scomparsa di rami evolutivi e l'origine di nuove forme fino alla descrizione dei gruppi vegetali attualmente viventi sulla Terra.

The Museum of Paleobotany and Etnobotany occupies a part of the building referred to as the "Castle" on the grounds of the Botanical Garden of Naples, Faculty of Sciences, University of Naples "Federico II". The two themes, developed in the display cases of the museum, integrate and expand upon concepts presented in the living collections of the Botanical Garden.

In the present paper the Paleobotany Section is illustrated and its arrangement, educative meaning as well as some taxonomic problems encountered in its organization are discuss.

In the Paleobotany section, displays of fossils, plant reconstructions, and descriptive texts demonstrate current concepts of terrestrial plant evolution from early forms, noting extinction in some evolutionary lineages, the development of new forms, and the evolution of living plant groups.

Key words: paleobotany, phylogeny, scientific museology, vascular plants.

A three dimensional phylogenetic tree illustrates the evolution of the plant kingdom from the origin of vascular plants in the Silurian to the present. The tree acts as a focal point, showing the correspondence of the fossils displayed in the museum cases and the living plants displayed in the garden collections. Fossils are chosen as representative examples and are arranged according to taxonomic group. Moreover, the fossil displays are augmented by various illustrations and descriptive texts.

Each fossil is labeled with the species name, author, age, locality, class, order, family, and donor. In each display case, a geological timetable permits the visitor to place each fossil within the context of earth history.

The Paleobotany section occupies the entryway and the next two rooms of the five that comprise the museum. Each room is here described in details. A layout of the rooms, showing the location of each display, is shown in Fig. 1.

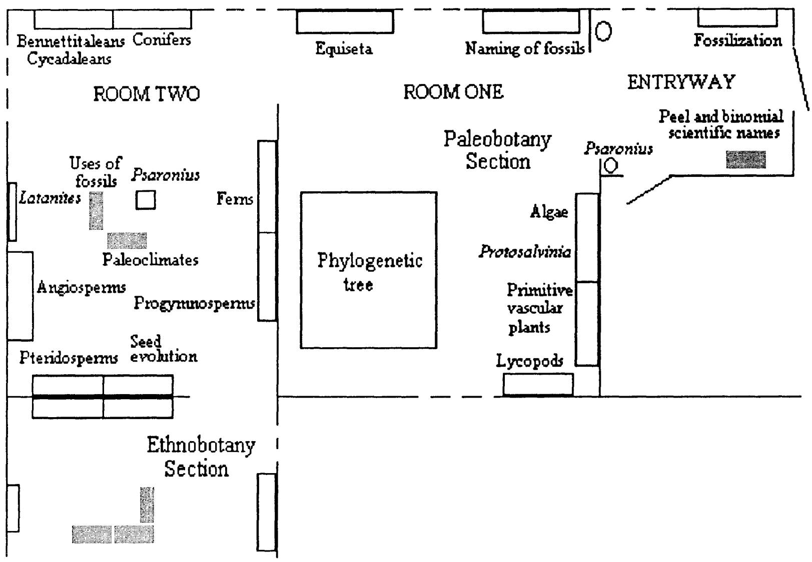

Fig. 1 - Layout of location of each display case of the Paleobotany section in the Museum.

ENTRYWAY

The first displays encountered by the visitor in the entryway present general principles related to fossils and the fossil record: processes of fossilization, means by which fossils are studied, and naming of fossils.

The first display case shows the fossilization process: plant fragments fall into an aquatic environment, are transported, become waterlogged and sink to the bottom, are covered with sediments, become fossilizzed, and are discovered for study. Various kinds of preservation, such as impressions, compressions, petrifications, molds and casts, and unaltered remains are demonstrated. In the next display case, the cellulose acetate peel technique, used in the study of coal balls (calcium carbonate permineralizations of peat) is demonstrated using specimens, photographs of the tecnique in progress, and a description of each phase of the process. This technique allows a thin section of plant material to be embedded in cellulose acetate for further study; fossils preserved in peels are used in several other display cases in the museum. An additional display case introduces the concept of binomial scientific names.

The following display case shows the reconstruction of whole fossil plant as well as the fossil nomenclature according to CHALONER (1986) and COLLISON (1986).

A list of display cases follows, fossils displayed in each case with their taxonomic collocation are likewise specified.

Binomial scientific names:
GINGKOOPSIDA
Ginkgoaceae
Ginkgo adiantoides Brown
Ginkgo huttonii (Sternb.) Heer
Peel:
coal ball
Fossilization:
LYCOPODIOPSIDA
Lepidodendraceae
Stigmaria sp. Brongniart
POLYPODIOPSIDA
Adiantaceae
Acrostichum hesperium Lesquereux
LYGINOPTERIDOPSIDA
Medullosaceae
Neuropteris sp. (Brongniart) Sternberg
PINOPSIDA
Araucariaceae

Araucarioxylon arizonicum Knowlton
Amber with leaves

Naming of fossils
(fossils and peels are displayed)
LYCOPODIOPSIDA
Lycopodiaceae
Lepidodendron sp. Sternberg
Lepidodendron modulatum Lesquereux
Lepidophylloides sp. Snigirevskaya
Lepidostrobus sp. Brongniart
Stigmaria ficoides Brongniart

ROOM ONE

This room depicts a major area of study within paleobotany: the origin and evolutionary relationships among major plant groups that live today and those that have lived in the past. In essence, this is a study of the history of the plant kingdom. The proposed phylogeny was based mainly on information deriving from STEWART & ROTHWELL (1993), TAYLOR & TAYLOR (1993), DOYLE & DONOGHUE (1987), THOMAS (1981), CRONQUIST (1981), and MEYEN (1987). A focal point of the museum, illustrated in the room, is the phylogenetic tree showing the evolution of terrestrial plants, emphasizing vascular plants but also including bryophytes. The tree is 3 m by 3 m at the base and is 2,5 m tall. The major lines of evolution are represented by branches constructed of metal pipes covered with fiberglass. The brances represent classes, subclasses or orders. Time is indicated by vertically from the Silurian upward to the Holocene (present day). Geological time scales are mounted on the corner posts that support the tree.

In order to clarify the various lines of evolution represented by the tree, the branches are coded with colored rings; each color corresponds to a class. Moreover, the name of each taxon is written on its corresponding branch. Solid white branch points indicate ancestor/descendant relationships reasonably well established by the fossil record. Equivocal phylogenetic relationships are shown by alternating black and white bands. In a few cases, such as the angiosperms, the segments are not attached to any other segment in the tree, indicating an unknown origin for these groups. Branches that extend to the top of the tree represent living plant group. Table 1 shows the colors scheme used to indicate the various classes represented in the tree.

In parallel to the phylogenetic tree, the display cases show important steps in the evolution of terrestrial plants. One display case, entitled algae, describes the appearance of the prokaryotes, of the eukaryotes, of the algae, and ideas concerning the derivation of land plants from the green algae, with reference to the Charales as a probable ancestral group. Devonian age fossils of *Protosalvinia bilobata* (Dawson) Clarke, of incertain affinities (perhaps a brown alga), are shown as an example of an early evolutionary "experiment" in the transition to land that was an apparent phylogenetic dead end.

Tab. I - Color coding used on the phylogenetic tree.

COLOR	DIVISION	CLASS
Light-pink	Bryophyta	Bryopsida
Pink	Bryophyta	Marchantiopsida
Dark-pink	Bryophyta	Anthocerotopsida
Dark-gray	Rhyniophyta	Rhyniopsida
Light-gray	Zosterophyllophyta	Zosterophyllopsida
Gray	Trimerophytophyta	Trimerophytopsida
Lilac	Lycophyta	Lycopsida
Purple	Psilotophyta	Psilotopsida
Red	Polypodiophyta (Pterophyta)	Polypodiopsida (Pteropsida)
Orange	Equisetophyta (Sphenophyta)	Equisetopsida (Sphenopsida)
Blue-green	Progymnospermophyta	Progymnospermopsida
Yellow-green	Pteridospermophyta	Pteridospermopsida (Lyginopteridopsida)
Light-green	Pinophyta	Gingkoopsida
Brown	Pinophyta	Cordaitopsida
Dark-brown	Pinophyta	Pinopsida
Dark-yellow	Cycadophyta	Cycadopsida
Olive-green	Bennettitophyta	Bennettitopsida
Brick	Gnetophyta	Gnetopsida
Blue	Magnoliophyta	Magnoliopsida
Green	Magnoliophyta	Liliopsida

Algae:
Indeterminate Family
Protosalvinia bilobata (Dawson) Clarke
PHAEOPHYCEAE
Phascolophyllophycus lohrensis Leary
CHLOROPHYCEAE
Coelospheridium cyclocrinophylum F. Roemer

A display case describes primitive vascular plants, fossil groups that constitute the base of the phylogenetic tree. From the Rhyniopsida (Middle Silurian to Middle Devonian) developed the Trimerophytopsida (Lower Devonian to Upper Devonian) and the Zosterophyllopsida (Upper Silurian to Upper Devonian). Fossils and descriptive texts give the morphological characteristics of groups derived from each class. The trimerophytes gave rise to all later classes with the exception of the Lycopsida, which were derived from the zosterophylls.

Primitive vascular plants:
RHYNIOPSIDA
Rhyniaceae
Renalia hueberi Gensel
TRIMEROPHYTOPSIDA
Trimerophytaceae
Pertica dalhousii Doran, Gensel et Andrews
Psilophytaceae
Psilophyton forbesii (Andrews et al.) Gensel
ZOSTEROPHYLLOPSIDA
Zosterophyllaceae
Sawdonia ornata (Dawson) Hueber
Sawdonia acanthotheca Gensel, Andrews et Forbes
Crenaticaulis verruculosus Banks et Davis

A display gives a description of the lycopods and places this group in direct relationship with the earlier zosterophylls, and considers the probable derivation of the lycopod microphyll (a leaf type characteristic of the class) from the spinose emergences found in zosterophylls.

The lycopods were a dominant group during the Carboniferous, but today are a minor group represented by only a few genera. Orders included in the display case are: Drepanophycales (Devonian), Protolepidodendrales (Devonian), Lepidodendrales (Devonian to Permian), Pleuromeiales (Triassic to Cretaceous), Isoetale (Cretaceous to present), Selaginellales (Carboniferous to present), and Lycopodiales (Carboniferous to present). These last three orders contain the living representatives of the lycopods, and are characterized by an herbaceous habit with limited geographic distribution.

Shown in the same display case are the Psilotopsida, represented by only two living genera, *Psilotum* Swartz and *Tmesipteris* Bernch. In the past, these plants were classified with the Rhyniopsida; actually, this group may be derived by reduction from the Lycopodiopsida.

Lycopods
(Fossils or peels are displayed):
LYCOPODIOPSIDA
Drepanophycaceae
Drepanophycus gaspianus (Dawson) Krausel and Weyland
Lepidodendraceae
Lepidodendron sp. Sternberg
Lepidodendron modulatum Lesquereux
Lepidodendron worthenii Lesquereux
Lepidodendron scleroticum Pannell
Lepidodendron cfr. *vasculare* Binney
Lepidocarpon lomaxii Scott
Lepidocarpon linearifolium (Lesquereux) Schopf
Lepidostrobus sp. Brongniart
Lepidostrobus oldhamus Williamson
Lepidodendropsis sp. Lutz
Lepidophloios hallii (Evers) DiMichele
Stigmaria ficoides Brongniart
Sigillariaceae
Sigillaria sp. Brongniart

The following case draws the geological history of the equiseta (Sphenopsida) that parallels that of the lycopods. The first fossils of this group are encountered in Devonian age sediments. They reached their maximum diversity in the Carboniferous and are today represented by a single genus, *Equisetum* L.

Various orders riunited in this class are presented as well. Is discussed the controversial phylogenetic position of the Hyeniales (Devonian). Reconstructions of the fossil suggest that this group represents a transitional form between the Trimerophytopsida and Sphenophytopsida. The Cladoxylales (Devonian to Lower Carboniferous) and the Hyeniales probably should be considered to be part of a complex of primitive plants that gave rise to the equisetophytes and some ferns.

The Pseudoborniales are represented by a single fossil species, *Pseudobornia ursina* Nath., of Devonian age. Sphenophyllales and Calamitales are known from the Devonian to the Permian.

Calamitalean plants grew to 20 m. tall, and evolved into a rich diversity of forms during the Carboniferous. These plants already showed many of the caracteristics found in Equisetales. Equisetales (Permian to present) are delimited from the Calamitales in that Equisetaleans lack bracts between sporangiophores in the cones, and do not form wood.

Equiseta
EQUISETOPSIDA
Cladoxylaceae
Calamophyton primaevum Krausel et Weyland
Pseudosporochnus nodosus Leclerqc et Banks
Sfenophyllaceae
Bowmanites dawsonii (Williamson) Weiss
Sphenophyllum cuneifolium Stenberg
Calamitaceae
Calamites sp. Schlotheim
Asterophyllites sp. Brongniart
Phyllotheca indica Bunbury
Annularia stellata (Schlotheim) Wood
Annularia sp. Sternberg
Equisetaceae
Equisetites arenaceus Jager
Indeterminate Family
Neocalamites virginiensis (Fontaine) Berry
Neocalamites knowltonii Berry

The display case dedicated to the ferns, or Polypodiopsida (Devonian to present) describes their principal characteristics and their derivation from the trimerophytes. In many cases classification of fossil plants as ferns has rested solely on a fernlike appearance, resulting in uncertainty in their phylogenetic affinities. Displays include the Rhacophytales (Devonian), a small group considered to be the ancestral group to the ferns, the Marattiales (Carboniferous to present), Ophyoglossales (Cretaceous to present), and the Coenopteridales (Devonian to Permian), an artificial group of Paleozoic ferns. Among carboniferous ferns may be found the ancestral to the largest group of modern ferns, the Filicales (Carboniferous to present). The vast majority of ferns in the living plant collections in the Orto are members of the Filicales.
Marsileales and Salviniales (Cretaceous to present) represent two orders of aquatic, heterosporous ferns.

Ferns
POLYPODIOPSIDA
Rhacophytaceae
Rhacophyton ceratangium Andrews et Phillips
Tedeleaceae
Ankyropteris brongniartii(Renault) Bertrand
Botryopteridaceae
Botryopteris sp. Renault
Psaroniaceae
Pecopteris sp. Brongniart
Asterotheca sp. Presl
Psaronius melanedrus Morgan
Dennstaedtiaceae

Dennstaedtia americana Knowlton
Schizeaceae
Lygodium kaulfussi Heer
Tempskyaceae
Tempskya sp. Cotta

Room Two

The first paleobotanical subject discussed in this room regards the progymnosperms or Progymnospermopsida (Middle Devonian to Lower Carboniferous) that were anatomically similar in many respects to the gymnosperms, principally in wood structure, but had fernlike reproductive syndromes that included homospory and heterospory. The progymnosperms are generally regarded as the group ancestral to the seed plants, however, there are varying interpretations about exact evolutionary lineages that led from progymnosperms to the various seed plant groups. Aneurophytales (Devonian) and Archaeopteridales (Devonian) are two progymnosperm orders shown in the museum displays. Because there is no consensus about the role of these orders in the evolution of conifers and seed ferns, the phylogenetic tree was constructed to show this incertaintly. As a matter of fact, BECK & WIGHT (1988) hypothesize that the order Aneurophytales is ancestral to pteridosperms. In contrast, ROTHWELL (1982) believes that this order is ancestral to all seed plants. Moreover, BECK & WIGHT (1988) assume that Archaeopteridales are ancestral to the conifers while MEYEN (1984) holds that the order is ancestral to all seed plants. The Protopityales (Lower Carboniferous), an incompletely understood group, probably consisted of small, homosporous woody plants that are included in the progymnosperms based on gymnosperm-like features of the wood and fernlike reproduction.

Progimnosperms
PROGYMNOSPERMOPSIDA
Archaeopteridaceae
Archaeopteris macilenta (Lesquereux) Carluccio Hueber et Banks
Moresnetia zalesskyi Stockmans
Aneurophytaceae
Rellimia thomsonii (Dawson) Leclercq et Bonamo

A display on the evolution of the seed uses fossil material, two-dimensional reconstrucions, and three-dimensional models to illustrate this critical step in the evolution of the land plants. The models attempt to reduce the actual appearance of early seeds; the models are based on reconstructions published in TAYLOR & TAYLOR (1993) and STEWART & ROTHWELL (1993), and are related to the problems of the hypothetical pattern of diversification of early seeds, as reported by DIMICHELE *et al.* (1989). The models are approximately 15 cm high, wich represents a great enlargement compared to actual size (e.g., about 2mm for *Moresnetia zalesskyi* Stockmans).

Seeds are integumented, indehiscent megasporangia, and occur among those plants that develop an embryo. Since the Late Devonian (ca. 363 million years ago) seeds have increased in importance as a reproductive syndrome.

Three of the models reconstruct hypotetical evolutionary stages leading to the seed. The remaining models are based on actual fossil forms and include: *Genomosperma kidstonii* Long, with unfused surrounding integumentary lobes; *G. latens* Long, with partially fused integumentary lobes; *Salpingostoma dasu* Gordon, with integumentary lobes fused approximately one-half the length of the seed; *Physostoma elegans* Williamson, with fusion of the integumentary lobes to about three-quarter of the length of the seed; *Eurystoma angulare* Long, with fusion of the integumentary lobes nearly to the apex; and *Stamnostoma huttonense* Long, with fusion of the integumentary lobes to the apex, forming a micropyle. A common feature among these early seeds is a reproductive syndrome referred to as "hydrasperman reproduction".

An addictional external protective structure, the cupule, is thought to have evolved from additional surronding axes. Models of cupulate seeds in the display case include *Moresnetia zalesskyi* Stockmans, *Elkinsia polymorpha* Rothwell et al. and *Archaeosperma arnoldii* Pettit and Beck.

Spermolithus devonicus Johnson is included as the first konwn platyspermic ovule. The exact phylogenetic position of this seed is controversial (CHALONER *et al.*, 1977), and inclusion of this form shows the museum visitor that not all of the evolutionary details of the earliest seed plants are fully understood.

Seed evolution
(Models displayed)
Hypothetical steps 1 - 2 - 3
Genomosperma kidstonii Long
Genomosperma latens Long

Eurystoma angulare Long
Stamnostoma huttonense Long
Salpingostoma dasu Gordon
Physostoma elegans Williamson
Moresnetia zalesskyi Stockmans
Elkinsia polymorpha Rothwell et al.
Archaeosperma arnoldii Pettitt e Beck
Spermolithus devonicus Johnson
(Fossils displayed)
LYGINOPTERIDOPSIDA
Elkinisiaceae
Moresnetia zalesskyi Stockmans
Indeterminate Family
Lagenospermum imparirameum Arnold

The next case describes the Lyginopteridopsida (Devonian to Cretaceous) also known as the pteridosperms or seed ferns. The Lyginopteridopsida represent a large, diverse group of seed plants and as a taxon this group is probably to a certain extent artificial. Cycads, bennettitopsids, angiosperms, and possibly the ginkgophytes and conifers probably evolved from pteridosperms. Groups of pteridosperms presented in the museum display case include the Calamopityales (Lower Carboniferous), known only from permineralized stems. Calamopityaleans shows early stages in the evolution of the eustele. Other included orders are: Lyginopteridales (Devonian to Carboniferous); wich had cupulate seeds and the hydrasperman reproductive syndrome; Medullosales (Carboniferous to Permian); Callistophytales (Upper Carboniferous), showing monosaccate pollen; Glossopteridales (Permian to Triassic), known only from the Southern Hemisphere; Caytoniales (Triassic to Cretaceous) and Pentoxylales (Jurassic to Cretaceous).

Pteridosperms
LYGINOPTERIDOPSIDA
Medullosaceae
Neuropteris sp. (Brongniart) Sternberg
Alethopteris sp. Sternberg
Alethopteris serlii (Brongniart) Goeppert
Alethopteris sullivantii (Lesquereux) Fontaine et White
Trigonocarpus sp. Brongniart
Pachytesta sp. Brongniart (peel)
Calamopityaceae
Genselia uberis (Skog et Gensel) Knaus
Lyginopteridaceae
Conostoma sp. Williamson (peel)
Gnetopsis hispida Gensel et Skog
Glossopteridaceae

Glossopteris browniana Brongniart
Caytoniaceae
Sagenopteris nillsonia Brongniart
Corystospermaceae
Dicroidium odontopteroides Morris
Umkomasiaceae
Xylopteris elongata (Dun.) Ret.
Indeterminate Family
Rhodeopteridium sp. Zimmerman
Mariopteris sp. Zeiller

In the same display case are drawn bennettitaleans and cycadaleans. The bennettitaleans or Bennettitopsida (Triassic to Cretaceous) were an important part of the Mesozoic flora. Superficially they resembled the cycadaleans in vegetative morphology, but differed greatly from the other group in their reproductive structures. The bennettitalean reproductive structure consisted of a central axis bearing ovules and bracts surrounded by fleshy pollen-producing organs. The reproductive structures were borne laterally on the stems. These plants were probably insect pollinated.

Bennettitaleans
BENNETTITOPSIDA
Williamsoniaceae
Otozamites hespera Wieland
Otozamites powellii (Fontaine) Berry
Ptilophyllum sp. Morris
Bennettitaceae
(peel displayed)
Cycadeoidea weilandii Ward.

The cycadaleans or Cycadopsida (Upper Carboniferous to present) probably originated from the medullosan pteridosperms. The earliest fossils of cycads are found in Permian strata, although equivocal cycad fossils are known from Upper Carboniferous strata. living collections of cycads in the Botanical Garden of Naples include the great majority of genera and species in this class.

Cycadaleans
CYCADOPSIDA
Cycadaceae
(photo displayed)
Leptocycas gracilis Delevoryas et Hope
Indeterminate Family
(fossil displayed)
Taeniopteris daintreei Mc Coy

The display case for conifers (Lower Caboniferous to present), includes the Cordaitopsida (Lower Carboniferous to Permian), whose phylogenetic position with respect to the conifers is still somewhat controversial. These plants were trees or shrubs with long, straplike leaves. Some forms may have grown in a habit similar to modern mangroves. The Voltziales (Permian to Jurassic) are considered to be the group ancestral to the living conifers, occupying a phylogenetic position intermediate between earlier Cordaitopsida and the conifers. The Pinales (Triassic to present) are well represented in the fossil displays and in the living collections at the Botanical Garden of Naples.
The Taxales (Upper Jurassic to present) have vegetative features similar to conifers, but differ markedly in the morphology of their reproductive structures.

The museum displays present a comparison of the characteristics of the cones of the cordaites, voltzialeans and conifers, and suggests that the compact cone of the conifers evolved as a mechanism to protect against the increasing dryness of Permian and Triassic climates.

Ginkgoopsida (Jurassic to present) are also displayed in the same case. This group was quite diverse during the Mesozoic, but is now represented by a single species, *Ginkgo biloba* L.

Conifers
CORDAITOPSIDA
Cordaitaceae
Cordaites sp. Unger
Rhabdocarpus multistriatus Stenberg
Indeterminate Family
Samaropsis newberryi Andrews
PINOPSIDA
Utrechtiaceae
Ortiseia leonardii Clement-Westerhof
Lebachia lockardii Mapes et Rothwell
Utrechtia piniformis (Schlotheim) Mapes et Rothwell
Taxodiaceae
Sequoia dakotensis Brown
Metasequoia sp. Miki
Araucariaceae
Araucaria mirabilis (Spegazzini) Windhausen
Brachyphyllum sp. Brogniart
Pagyophyllum sp. Heer
Pinaceae
Pinus laricio Poiret
Indeterminate Family
Walchia filiciformis (Scholtheim) Stenberg

Walchia sp. Stenberg
GINKGOOPSIDA
Ginkgoaceae
Ginkgo adiantoides Brown

Gnetopsida (Lower Cretaceous to present) are represented only very rarely in the fossil record and no fossils are in the museum displays. This group is of uncertain affinity; some researchers consider them to be phylogenetically close to the Bennettitopsida and Magnioliopsida.

The last display case of taxonomic groups describes Magnoliophyta (Lower Cretaceous to present), the angiosperms or flowering plants, that probably evolved during the Early Cretaceous (possibly Late Jurassic) and today are the dominant group of vascular plants. Examples of the two classes of angiosperms, Magnoliopsida and Liliopsida, are included in the displays.

Angiosperms
MAGNOLIOPSIDA
Cercidophyllaceae
Joffrea speirsii Crane et Stockey
Platanaceae
Platanus wyomingensis Knowlton et Cockerell
Ulmaceae
Ulmus brownellii Lesquereux
Zelkova sp. Spach.
Juglandaceae
Pterocarya hispida Brown
Fagaceae
Berryophyllum saffordii (Lesquereux) Jones et Dilcher
Quercus clarnensis Trealease
Betulaceae
Alnus carpinoides Lesquereux
Betula fairlii Knowlton
Corylus insignis Heer
Stercularíaceae ?
Florissantia speirii (Lesquereux) Manchester
Rosaceae
Prunus sp. L.
Mimosaceae
Eomimosoidea plumosa Crepet et Dilcher
Indeterminate Family
Lesqueria elocata Crane et Dilcher
Eorhachis lomarioides Arnold
LILIOPSIDA
Arecaceae
Latanites sp. Massalongo

Palynology is displayed in one case, with emphasis on basic concepts and importance of this field to the study of ancient plants. Another case discusses the use of the morphology of present and fossil leaves in the study of paleoclimates.

Paleoclimates
MAGNOLIOPSIDA
Betulaceae
Corylus insignis Heer
Simaroubaceae
Ailanthus lesquereuxii Cockerell

The final case displays ways in which fossils have been utilized, and the formation and use of coal.

Uses of Fossils
peat
lignite
bituminous coal
anthracite
amber
diatomaceous earth

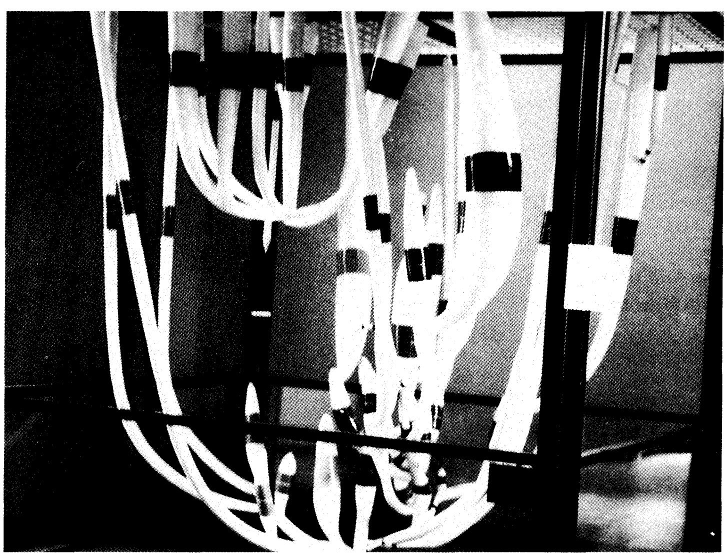

Fig. 2 - Phylogenetic tree of terrestrial plants.

Fig. 3 - *Moresnetia zaleskyi* Stockmans compared to the model of cupula showing three of four constituent elements.

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Abstract
Paleobotany section is a part of the Museum of Paleobotany and Ethnobotany housed in the Botanical Garden of Naples, Faculty of Sciences, University of Naples "Federico II". The Paleobotany Section displays over one hundred fifty plant fossils and emphasizes the role of the fossil record in our understanding of plant evolution. Displays in the entryway depict modes of fossilization, "living fossils" and methods of studying fossils. In the first room there are displays on fossil nomenclature, algae, evolutionary transition to land, early land plants, lycopods, and equisetophytes. The evolution of the plant kingdom is illustrated by a three-dimensional phylogenetic tree that is 3x3m at the base and 2,5 m tall. The phylogenetic tree serves as a centerpiece of the museum and reference point for all displays of taxonomic groups. Evolutionary lineages on the tree are color coded to mach the color of identification tags for taxa displayed in the cases. The second room has displays on ferns, gymnosperms, angiosperms, palynology, paleoclimatology, evolution of the seed, and uses of fossils. Displays are correlated with living collections in the garden in order to increase awareness of the continuity between plants known from fossils and those known from living communities.

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