Delpinoa, n.s. **46**: 107-116. 2004

The carboniferous paleobotanical collection of the "Centro Caprense Ignazio Cerio" (Capri, Italy): a taxonomic revision

J. E. Mickle[1], A. Bartiromo[2], M. R. Barone Lumaga[3]

[1]Department of Botany, North Carolina State University, Box 7612, Raleigh, N.C. 27695-7612 U.S.A. [2]Dipartimento di Scienze della Terra, Università di Napoli Federico II, Largo San Marcellino 10, 80138 Napoli, Italy. [3]Orto Botanico di Napoli, Università di Napoli Federico II, Via Foria 223, 80139, Napoli, Italy.
james_mickle@ncsu.edu a.bartiromo@unina.it mrbarone@unina.it

Abstract. Authors filed, revised and updated nomenclature of the specimens belonging to the Carboniferous fossil plants collection housed in the "Centro Caprense Ignazio Cerio" (Capri, Naples, Italy). The specimens, presumably acquired between the end of 19th and the beginnings of 20th century, originate from European and North American localities.

Riassunto. Gli Autori hanno catalogato, revisionato ed aggiornato i campioni della collezione di piante fossili del Carbonifero conservata presso il "Centro Caprense Ignazio Cerio" di Capri (Napoli). I campioni, acquisiti presumibilmente tra la fine dell'Ottocento e l'inizio del Novecento, sono risultati provenienti da siti carboniferi di Europa e Stati Uniti.

Key words: Capri, Carboniferous, Centro Caprense Ignazio Cerio, Europe, Fossils, North America, Paleobotanical collections

Introduction

The collection of carboniferous fossil plants analysed in this paper is housed at the "Centro Caprense Ignazio Cerio" (CCIC), in the Island of Capri (Naples, Italy). The CCIC was established as an "Ente Morale" by decree of the President of the Italian Republic on October 20th, 1949. The Centre was intended to encourage cultural initiative on the Island, including defence of its natural beauty. The Centre was founded by the engineer and writer Edwin Cerio (1875-1960) and by Mabel Norman Cerio (1876-1949). They gave the Centre its current location and initial funding. The Centre is comprised in part of a library containing a collection of materials related to Capri and a Museum that owes its origins to the untiring efforts of Doctor Ignazio Cerio, a physician. The majority of the collections date from the end of 19th century and consist of over 20,000 naturalistic and archeological finds gathered mainly on Capri by Ignazio Cerio.

The Island of Capri is constituted essentially of Mesozoic sedimentary rocks and is situated at the margin of the Carbonatic Campanian-Platform. Triassic sediments seem to be absent, whereas the presence of Dogger has been ascertained and attribution of *Ellipsactinia* limestones to Malm-Lower Cretaceous confirmed (Barattolo & Pugliese 1987). Pleistocene sediments are also found on the Island, although they are limited to a few areas, such as the "Quisisana" and "Grotta delle Felci." These Pleistocene sediments are the source of numerous vertebrate remains and lithic fragments that constitute an important part of the CCIC collections.

Some noteworthy collections of the Centre include the herbarium of the Island of Capri collected at the end of the 19th century by Ignazio Cerio, the zoological collections which consists primarily of marine invertebrates from the Bay of Naples, and the Mediterranean algological collection belonging to Oronzo Gabriele Costa (1787-1867). Geological collections are also present, among which stand out the Mt. Vesuvius volcanic

material.

The collections also include paleontological material, among which is the Carboniferous plant collection, the object of the present paper. This collection contains characteristic representatives of the Carboniferous flora, such as arborescent lycopods, ferns, seed ferns (Pteridosperms) and horsetails (Sphenopsids). These taxa dominated coal swamp forests in the Carboniferous (Stewart & Rothwell 1993).

The plant fossil collection consists of 64 specimens. During the revision of the collection it was found that several specimens lacked any indication of the provenance locality.

Table 1 lists the original nomenclature of species and provenance of samples that make up the collection, as found on the labels, and the nomenclature as proposed after revision. Fig. 1 shows some of specimens in the CCIC Paleobotanical Collection.

The following taxa resulted after the revision:

Class: **LYCOPODIOPSIDA**

Order: **Lepidodendrales**

Family: ***Lepidodendraceae***

Genus: *Lepidodendron* Sternberg 1820

Typus: *Lepidodendron aculeatum* Sternberg 1820 (Sternberg 1820).

The genus *Lepidodendron* was established by Sternberg (1820) based on bark fragments of arborescent lycopods showing spirally arranged rhomboidal leaf cushions with their vertical dimension greater than the transverse (Stewart & Rothwell 1993). Just above the middle of leaf cushion a rhomboidal leaf scar, extended transversely, is present. In the middle or just above the middle of the leaf scar is a vascular bundle scar flanked by lateral parichnos. Just above the leaf scar is a ligule pit. Below and to either side of the leaf scar are two additional parichnos scars. Transverse wrinkles may be present along a median ridge on the lower portion of the cushion (Stewart & Rothwell 1993). *Lepidodendron* is a name used as a "traditional" genus for stems of indeterminate generic affinity (Arnold 1940, 1960; Leisman 1970).

The time of decline of *Lepidodendron*, as well as several other arborescent lycopod genera, corresponds to the decrease in extent and duration of coal swamps during the transition to the late Pennsylvanian (Di Michele 1981).

Lepidodendron simile Kidston (Jongmans 1909) (= *Lepidodendron elegans* Brongniart; Brongniart 1822).

Samples of *L. simile* are usually of reduced size and are likely related to branches instead of trunks (Boureau 1967). Leaf cushions are in spiral arrangement, rhomboidal, and tapered at the base. Leaf scars are at the upper third of the cushion (Doubinger *et al.* 1995).

Lepidodendron aculeatum Sternberg, 1820 (Sternberg 1820).

L. aculeatum is similar to *L. obovatum* but has a more symmetrical, spindle-shaped leaf cushion that is distinctly longer than broad, and with apices that are distinctly deflected in opposite directions (Oleksyshyn 1982).

Genus: *Stigmaria* Brongniart, 1822 (Brongniart 1822).

Typus: *Stigmaria ficoides* Brongniart, 1822 (Brongniart 1822).

Rhizomorphs of *Lepidodendron* and/or *Sigillaria*, and their rootlets are placed in the form genus *Stigmaria*. The spirally arranged scars, which indicate the points where the rootlets were attached to the rhizomorph, are shallow dish-like pits 3 to 7 mm in diameter with a central punctiform scar (Stewart & Rothwell 1993).

Stigmaria ficoides Brongniart, 1822 (Brongniart 1822).

Thick rhizomes, diameter about 10–15 cm, branching dichotomously. Lateral appendages borne spirally. Scars of lateral appendages persisting, round with a raised periphery, a centrally placed raised protuberance, and an intervening punctiform depression (Frankenberg & Eggert 1969).

Family: ***Sigillariaceae***

Genus: *Sigillaria* Brongniart, 1822 (Brongniart 1822).

Typus: *Sigillaria scutellata* Brongniart, 1822 (Brongniart 1822). The genus *Sigillaria* was established on bark fragments of arborescent lycopods showing spiral leaf cushions arranged in vertical rows (Stewart &

ROTHWELL 1993). *Sigillaria* leaves abscised on the older parts of the stem leaving leaf cushions. The leaf scars were hexagonal, round or oval. Above the midpoint of the leaf scar a vascular bundle scar was flanked by two conspicuous parichhnos (STEWART & ROTHWELL 1993; TAYLOR & TAYLOR 1993).

Sigillaria reniformis Brongniart, 1832 (BRONGNIART 1832).

The scars are double, and of an oval form, somewhat resembling pairs of kidneys; a resemblance to which the species owes its name.

Sigillaria mammilaria Brongniart, 1824 (BRONGNIART 1824).

The leaf cushions of this species form defined longitudinal ribs; they can show furrows that are lightly winding between these ribs.

Genus: *Syringodendron* Sternberg, 1820 (STERNBERG 1820).

Typus: *Syringodendron organum* Sternberg, 1820 (STERNBERG 1820).

Decorticated stem of *Sigillaria* showing the sub-epidermal surface. Sub-cortical scars double, elliptic, and in vertical rows. Scars with rough, broken cross striations. Surface with straight to wavy longitudinal parallel striations formed into bands of ridges and furrows. (DILCHER *et al*. 2005).

Class: **EQUISETOPSIDA**
Order: **Calamitales**
Family: ***Calamitaceae***

Genus: *Annularia* Sternberg, 1821 (STERNBERG 1821).

The leaves occur in whorls at the nodes, in a plane that is oblique to the supporting branch. The leaves compressions show at nodes the apparence of stellate patterns; usually fused at their bases to form a little collar. The nodes bore 8 up to 20 leaves with variable shape and lenght (ABBOTT 1958; STEWART & ROTHWELL 1993).

Genus: *Calamites* (Suckow) Brongniart, 1828 (BRONGNIART 1828).

Typus: *Calamites radiatus* Brongniart, 1828 (BRONGNIART 1828).

This genus accommodates pith casts with internodes of longitudinal ribs and furrows. The internodes are wider than long and the longitudinal ribs are straight to undulate. The nodal areas possess or lack leaf/branch scars (DILCHER *et al*. 2005). The primary vascular system presents vascular strands that alternate longitudinally from internode to internode across a node (STEWART & ROTHWELL 1993).

Calamites gigas Brongniart, 1828 (BRONGNIART 1828) (= *Calamites cannaeformis* Schimper).

Calamites gigas is the biggest species in the genus; stem with diameter up to 1m. Internodes are wider than long. Longitudinal ribs up to 1.1 cm wide; usually vascular strands alternate at the nodes. The edges of the ribs ending with oval marks. Ribs with surfaces granular or with longitudinal wrinkles (BOUREAU 1967).

Class: **FILICOPSIDA**
Order: **Marattiales**
Family: ***Marattiaceae***

Genus: *Pecopteris* BRONGNIART, 1822

Typus: *Pecopteris pennaeformis* Brongniart, 1822 (BRONGNIART 1822).

Pinnatifid fronds with pinnules attached to the rachis by their entire base; lateral margins of the pinnules parallel or weakly convergent and rounded at the apex; inferior pinnule margins may be decurrent; pinnules may be entire or slightly lobed, with a median vein arising from the rachis ascending to near the apex. Lateral veins of the pinnules obliquely emerging from the median vein and diagonally ending at the margin of the lamina; the emergent lateral veins may remain simple or dichotomise (CORSIN 1951).

The form genus *Pecopteris* Brongniart includes over 290 Paleozoic and Mesozoic pteridophyll taxa (BOUREAU & DOUBINGER 1975). According to DARRAH (1969), there are approximately seventy-five species of *Pecopteris* reported in United States. The criteria utilized to distinguish species are: venation, pinnule shape, villosity, with the venation pattern being deemed as the most reliable feature (GASTALDO & MATTEN 1978). Based on morphology, the vegetative fronds of *Pecopteris* may also be referred to Pteridospermopsida or considered *incertae sedis*.

Fig. 1 - Examples of specimens in the CCIC Paleobotanical Collection. 1: *Calamites gigas*. 2: *Neuropteris gigantea*. 3: *Sigillaria reniformis*. 4: *Alethopteris lonchitidis*. 5: *Stigmaria ficoides*. 6: *Pecopteris miltoni*. (bar = 1 cm)

Pecopteris plumosa (Artis) Brongniart, 1832 (Brongniart 1832).

Pinnule triangular tilting on the rachis, basal pinnules catadrome are bilobate and shorter of anadrome pinnules, secondary ribbings widely spaced. This species is one of the most widespread in the European coal fields (Delcambre *et al.* 1998)

Pecopteris miltonii Brongniart, 1828 (Brongniart 1828).

Primary and secondary rachis wide and smooth; rachis tertiary often tight and striated, sometimes with hairs. Pinnules variable in shape, tilted on the supporting rachis, basal margins sometimes decurrent on the rachis, edge entire or repand and converging towards the apexes rounded. Basal pinnules sometimes larger than terminal (Boureau 1967).

Based on preservation type and locality indicated by the label affixed to the specimen (Grundy County, Ill.), the specimen in the CICC collection is almost certainly an ironstone nodule from the well-known Mazon Creek locality of northern Illinois, U. S. A. (Janssen 1965).

Incertae sedis

Genus: *Sphenopteris* (Brongniart) Sternberg, 1825 (Sternberg 1825).

Typus: *Sphenopteris elegans* (Brongniart, 1822) Sternberg, 1825 (Brongniart 1822; Sternberg 1825).

This genus accommodates pinnae which are alternate and narrowly attached to the rachis. The pinnae are lobed to pinnatifid. The pinnules are broad to narrowly attached to the rachis (Dilcher *et al*. 2005). *Sphenopteris* is a form-genus that may represent foliar remains of pteridophytes, pteridosperms or other groups.

Sphenopteris affinis Lindley et Hutton, 1832 (Lindley & Hutton 1831-1833).

The large compound fronds of this species are characterized by the regular dichotomy of the main branches, a feature frequently met with in Palaeozoic fern-like leaves: the cuneate or oval cuneiform pinnules vary considerably in dimension. Several spreading veins cross the lamina (Seward 1963).

Genus: *Noeggerathia* Sternberg, 1823 (Sternberg 1823).

Typus: *Noeggerathia foliosa* Sternberg.

This genus of uncertain position is characteristic of Lower Carboniferous rocks and is compared with Ophioglossaceae. Axis bearing ovate leaves with several spreading veins. The distal part of the axis forms a "spike" composed of fertile leaves forming oval bracts, 2 cm broad, with a serrate edge bearing on the upper face several sporangia. Probably, this genus is more nearly allied to the Cycads than to any other group (Seward 1963).

Class: **PTERIDOSPERMOPSIDA**

Order: **Medullosales**

Family: ***Medullosaceae***

Genus: *Alethopteris* Sternberg, 1825 (Sternberg 1825).

Typus: *Alethopteris lonchitidis* Sternberg, 1825 (Sternberg 1825).

Bipartite fronds, sometimes of large dimensions, up to 7 metres long. Primary branches usually tripinnate, with no intercalated pinnae or pinnules on the primary or secondary rachises. The rachises were usually striate. Pinnules strongly asymmetric, fused at the base, decurrent at the basiscopic side, straight or lightly constricted at the acroscopic side. Pinnule lamina generally rather thick, with a vaulted aspect. Venation characterized by a well marked and strongly decurrent midvein and numerous, non-anastomosed laterals that meet the pinnule margin at about right-angles or somewhat obliquely. The lateral veins fork at irregular intervals, mostly one time, sometimes by a tripartite division, and occasionally each fork divides again (Zodrow & Cleal 1998).

Alethopteris serlii (Brongniart) Göppert nov. emend., 1804 (Göppert 1836).

Pinnules fairly large, 8-37 mm long and 5-10 mm wide, with typically biconvex lateral margins and bluntly acuminate apex. Midvein moderately thin. Lateral veins generally perpendicular, once or twice (rarely three times) forking, and flexuous. Terminal pinnule stout and well individualized (Zodrow & Cleal 1998).

Genus: *Neuropteris* (Brongniart), Sternberg, 1825 (Sternberg 1825).

Typus: *Neuropteris heterophylla* (Brogniart) Sternberg, 1825 (Sternberg 1825).

Following the emendation by Cleal *et al.* (1990) and Cleal & Shute (1992, 1995), the main diagnostic features are: fronds bipartite, with tri- or occasionally quadripinnate primary rachis branches. Orbicular cyclopterids absent from the lower part of frond. Pinnules basally constricted. Lateral veins broadly arched or flexuous. Pinnules hypostomatic (Laveine 1998).

Neuropteris gigantea Sternberg, 1825 (Sternberg 1825).

Frond bipinnate, pinnules cordate-oblong, obtuse, flexed, entire. Frond strong, palmate-auricular, thick, pinnae alternate, pinnules opposite, 18 to 20 pairs, more generally striate (Janssen 1940).

Laveinopteris loshii (Brongniart) Cleal *et al*., 1990 (=*Neuropteris loshii* Brongniart) (Cleal *et al*. 1990).

Fronds with no pinnae attached to primary rachis. Apical pinnules on all pinnae deltoid, trilobate, squat. Penultimate pinnae parallel-sided for most length, but taper rapidly near apex. Ultimate pinnae elongate oval, with alternately and obliquely attached oval pinnules that have rounded or bluntly acuminate apex, and markedly cordate base. Midvein distinct for one–half to two-thirds of pinnule length. Lateral veins delicate, emerging from midvein at a narrow angle, forking two or three times, broadly arched, and meet the pinnule margin at variable angles (Cleal & Shute 2003).

Genus: *Odontopteris* Brongniart, 1831 (Brongniart 1831).

Typus: *Odontopteris brardii* (Brogniart) (Brogniart 1822).

Genus instituted for compound fronds from the Coal-Measures characterised by pinnules inserted by the whole breadth of the base and crossed by numerous forked veins. Pinnules often present on the primary rachis and in some species the petiole bears modified pinnules which are larger than the ultimate segments of the pinnae and in some cases cyclopteroid in shape. The pinnules are trasversed by numerous dichotomously branched veins, midrib absent or limited to the basal part of the lamina (Seward 1963). *Odontopteris* occurs from Upper Cretaceous to the Permian (Stewart & Rothwell 1993).

Family: ***Mariopteridaceae***

Genus: *Mariopteris* Zeiller, 1879 (Zeiller 1879).

This name is applied to Palaeozoic fronds characterised by a double bifurcation of the rachis of the pinnae. *Mariopteris muricata* (= *Pecopteris muricata* Schloth.; Schlotheim 1820) may be taken as the type of the genus. This species is common in the Lower and Middle Coal Measures of Britain. The main rachis gives off alternate naked branches, each of which bifurcates at its apex into two short naked axes, and these are again forked, the ultimate branches having a bipinnate form, which bear large Sphenopteroid pinnules

Class **CORDAITOPSIDA**

Order: **Cordaitales**

Family ***Cordaitaceae***

Genus: *Cordaites* Unger, 1850 (Unger 1850).

Typus: *Cordaites borassifolius* (Stenberg) Unger, 1850 (Unger 1850).

Linear fragment of leaf that display an entire margin. Length 50 cm, basal width 4 cm, apical width 6 cm. Numerous closely packed parallel longitudinal veins, about 30-40 per cm (Dilcher *et al*. 2005).

Cordaites are a large and diversified group of extinct gymnosperm trees and shrubs that were widespread in the Carboniferous, inhabiting a variety of ecological niches. Their taxonomy is based on morphological features, such as number of veins/linear cm, which is known to be unreliable for taxonomy (Zodrow *et al.* 2003).

Class: **PINOPSIDA**

Order: **Voltziales**

Family: ***Walchiaceae***

Genus: *Walchia* Sternberg, 1825 (Sternberg 1825).

Typus: *Walchia piniformis* Sternberg, 1825 (Sternberg 1825).

The name *Walchia* is applied to foliage-shoots, occasionally bearing terminal cones. Foliage-shoots are characterised by a pinnate

Table 1 - Studied specimens with original and revised nomenclature[1]

Access. No.	Original nomenclature	Revised Nomenclature	Formation	Provenance
BC 1	*Calamites cannaeformis*	*Calamites gigas*		Bohemia
BC 2	*Sphenopteris* sp.	Confirmed	Coal Measures	Staffordshire
BC 3	*Noeggerathia flabellata* (Lindt)	*Noeggerathia* sp.	Coal Measures	Newcastle
BC 4	*Sphenopteris affinis*	Confirmed	Coal Measures	Edinburgh
BC 5		*Pecopteris* sp		U.S.A.
BC 6	*Sigillaria reniformis*	Confirmed	Coal Measures	Newcastle
BC 7	*Lepidodendron obovatum*	*Lepidodendron aculeatum*		Bohemia
BC 8	*Lepidodendron*	Confirmed		
BC 9		*Alethopteris* cf. *serlii*		
BC 10	*Stigmaria ficoides*	Confirmed		England
BC 11	*Alethopteris serlii* Brong.	Confirmed	Coal Measures	Dudley, Staffordshire
BC 12		*Syringodendron*		Bohemia
BC 13		*Pecopteris* ?		
BC 14	*Neuropteris gigantea* Sternb.	Confirmed	Coal Measures	Staffordshire
BC 15	*Neuropteris gigantea*	Confirmed	Coal Shale	Dudley
BC 16	*Pecopteris* sp.	Confirmed	Coal Measures	Staffordshire
BC 17		n.d.		
BC 18		*Mariopteris* sp.		
BC 18		*Alethopteris* sp.		
BC 19		*Annularia* sp.		
BC 20	*Neuropteris gigantea* Sternb.	Confirmed	Coal Measures	Newcastle
BC 21	*Nephropterys genarium*	*Neuropteris* sp.	Coal Shale	Dudley
BC 22	*Pecopteris* sp.	*Pecopteris* cfr. *plumosa* ?	Coal Measures	Shropshire
BC 23	*Alethopteris lonchitidis* Sternb	Confirmed	Coal Shale	Dudley
BC 24	*Stigmaria ficoides*	Confirmed		England
BC 25	*Pecopteris miltoni*	Confirmed	Coal Measures	Bendley
BC 26		*Stigmaria* sp.		
BC 27	*Neuropteris loshii*	Confirmed	Coal Shale	Dudley
BC 28	*Sigillaria mammilaria* Brong.	Confirmed	Coal Beds, Steinkohlenlager	Mons, Belgium
BC 29		*Calamites* ?		
BC 30	*Sphenopteris* sp.	Confirmed	Coal Measures	Dudley
BC 31		n.d.		
BC 32		*Pecopteris* sp.		England
BC 33		*Syringodendron* sp.		
BC 34		*Pecopteris* sp.		
BC 35		n.d.		
BC 36		*Cordaites* sp.		
BC 37		*Neuropteris* sp.		
BC 38		*Odontopteris* sp.		
BC 39		*Neuropteris* sp.		
BC 40	*Alethopteris* (Serii) Brgt	*Alethopteris* cf. *serlii*		
BC 41		*Walchia* ?		
BC 41		*Sphenopteris* sp.		
BC 42		*Pecopteris* sp.		
BC 43	*Alethopteris lonchitidis* Sternb	Confirmed	Coal Measures	Newcastle
BC 44		*Pecopteris* sp.		
BC 45	*Lepidodendron elegans* (Brong.)	*Lepidodendron simile*	Coal Measures	Bishop Auckland Durham
BC 45		*Neuropteris* sp.	Coal Measures	Bishop Auckland Durham
BC 46		*Calamites* sp.		Bohemia

Table 1 - Continued

Access. No.	Original nomenclature	Revised Nomenclature	Formation	Provenance
BC 47		*Syringodendron*		Bohemia
BC 48		n.d.		England
BC 49		*Annularia* sp.		U.S.A.
BC 50	*Sigillaria*	*Syringodendron*		
BC 51		*Sigillaria* sp.		Bohemia
BC 52		*Pecopteris* sp.		
BC 53	*Pecopteris villosa*	*Pecopteris miltoni*	Coal Measures	Grundy County, Illinois, U.S.A. cf. Mazon Creek
BC 54		*Pecopteris miltoni*		U.S.A.
BC 55		n.d.		
BC 56	*Stigmaria ficoides*	Confirmed		
BC 57		n.d.		
BC 58	*Pecopteris plumosa*	*Pecopteris* sp.		
BC 59	*Neuropteris gigantea*	Confirmed	Coal Shale	Dudley
BC 60		*Calamites* ?		Bohemia
BC 61		*Calamites* sp.		
BC 62	*Neuropteris loshii*	Confirmed	Coal Measures	Newcastle
BC 62	*Noeggerathia flabellata*	Confirmed	Coal Measures	Newcastle
BC 63	*Sigillaria oculata*	n.d.	Coal Measures	Newcastle
BC 64		*Sphenopteris* sp.		

[1]Information on original nomenclature, formation and provenance derives from labels on specimens; blanks indicate absence of information; ? = uncertain; n.d. = not determined.

arrangement of the ultimate branches attached at right angles or obliquely to an axis of higher order. Leaves are spirally disposed, crowded and imbricate, short and ovate or linear and spreading, usually tetragonal and more or less falcate and decurrent (SEWARD 1963). Specimens that lack preserved cuticles are placed in the form genus *Walchia* (STEWART & ROTHWELL 1993).

CONCLUSIONS

The collection appears to have been assembled to demonstrate a diversity of Carboniferous age plants. The collection includes plant fossils related to the main orders living in the Carboniferous, including genera referred to Lepidodendrales, Calamitales, Marattiales, Medullosales, Cordaitales, and Voltziales, as well as genera of uncertain affinity probably related to Filicopsida or Pteridospermopsida. The presence of Carboniferous plant fossils from several European and North American localities allows an interesting comparison of Carboniferous paleofloras and specimens of the same genera from different geographic areas. In addition, this collection, due to the attention of the Cerio family to paleontological studies, may play a noteworthy role as a teaching collection. Thus, the significance of the plant fossil collection of the CCIC lies mainly in its historical and didactic value.

Acknowledgements. We wish to thank Professor Filippo Barattolo, Director of the "Centro Caprense Ignazio Cerio" Museum, Claudio Giordano, President of the "Centro Caprense Ignazio Cerio", who graciously allowed the study of the collection, and Drs. Gar W. Rothwell and Gene K. Mapes, Ohio University, for assistance in specimen identification.

Literature Cited

Abbott M.L. 1958. The American species of *Asterophyllites*, *Annularia*, and *Sphenophyllum*. Bull. of American Paleo. 38: 174.

Arnold C.A. 1940. *Lepidodendron johnsonii* sp. nov., from the Lower Pennsylvanian of central Colorado. Contrib. Mus. Paleo. Univ. Mich. 6: 21-52.

Arnold C.A. 1960. A *Lepidodendron* stem from Kansas and its bearing on the problem of cambium and phloem in Paleozoic lycopods. Contrib. Mus. Paleo. Univ. Mich. 10: 249-267.

Barattolo F., Pugliese A. 1987. Il Mesozoico dell'Isola di Capri. Accademia Pontaniana. Quad. N° 8, Napoli.

Boureau E., Doubinger J. 1975. Traité de Paléobotanique. IV (2): 1-178. Paris.

Boureau E. 1967. Traité de Paléobotanique. Masson et C^{le} Éditeurs. Paris.

Brongniart A. 1822. Sur la classification et la distribution des végétaux fossiles en général, et sur ceux des terrains de sédiment supérieur en particulier. Soc. Philom., Bull., pp. 25-28 et Mémoires Du Muséum d'Histoire Naturelle 8: 203–240.

Brongniart A. 1824. Observation sur quelques végétaux fossiles du terrain houiller et sur leurs rapports avec les végétaux vivants. Ann. Sci. Nat. IV: 23-33.

Brongniart A. 1828. Prodrome d'une histoire des végétaux fossiles. Grand dictionnaire Hist. Nat., 57: 170-212, Paris.

Brongniart A. 1828-1838. Histoire des végétaux fossiles ou recherches botaniques et géologiques sur les végétaux renfermés dans les diverses couches du globe, Dufour et D'Ocagne, Paris

Brongniart A. 1831. Histoire des végétaux fossiles 1 (5). Dufour & d'Ocagne, Paris.

Cleal C.J., Shute C.H. 1992. Epidermal features of some Carboniferous neuropteroid fronds. Review of Palaeobotany and Palynology 71: 191-206.

Cleal C.J., Shute C.H. 1995. A synopsis of neuropteroid foliage from the Carboniferous and Lower Permian of Europe. Bulletin of the British Museum (Natural History), Geology Series 51**:** 1–52.

Cleal C.J., Shute C.H. 2003. Systematics of the Late Carboniferous Medullosalen Pteridosperm *Lavaeinopteris* and its associated *Cyclopteris*. Palaeontology, V. 46, P. 2: 353-411.

Cleal C.J., Shute C.H., Zodrow E.L. 1990. A revised taxonomy for Palaeozoic neuropteroid foliage. Taxon 39**:** 486–492.

Corsin P. 1951. Flore fossile Bassin Houiller de la Sarre et de la Lorraine. Fasc. 4^{e}. Pécoptéridées. Etude des Gîtes Minéraux de la France.

Darrah W.C. 1969. Upper Pennsylvanian Floras of North America. Privately published, Gettysburg, PA.

Delcambre B., Mercier C.L., Coquel R. 1998. Révision de la flore carbonifère du Briançonnais. Implications stratigraphiques. Partie II: Le Nord de Briançon, de la vallée de la Guisane à celle de la Clarée. Palaeontographica 248 B: Lief. 4-6: 87-125.

Di Michele W. 1981. Arborescent lycopods of Pennsylvanian age coals: *Lepidodendron*, with description of a new species. Palaeontographica 175 B: 85-125.

Dilcher D.L., Lott T.A., Axsmith B.J. 2005. Fossil plants from the Union Chapel Mine, Alabama. Pennsylvanian Footprints in the Black Warrior Basin of Alabama. D. C., eds. Alabama Paleontological Society, Monograph no. 1.

Doubinger J., Vetter P, Langiaux J., Galtier J., Broutin J. 1995. La flore fossile du basin houiller de Saint-Etienne. Memoires du Museum National D'Istoire Naturelle. Editions du Museum National d'Histoire Naturelle, Paris.

Frankenberg J.M., Eggert D.A. 1969. Petrified *Stigmaria* from North America: Part 1. *Stigmaria ficoides*, the underground portions of Lepidodendraceae. Palaeontographica 128 B: 1-47.

Gastaldo R.A., Matten L.C. 1978. Studies on North American Pecopterids. I. *Pecopteris vera* n. sp. from the Middle Pennsylvanian of Southern Illinois. Palaeontographica 165 B: 43-52.

Göppert H. 1836. Systema filicum fossilium. Nova Acta Acad. Caes. Leop. Car. Nat.

Cur. 17 (Suppl.): pp. i-xxxii, 1-486, pls. 1-44, Halle.

JONGMANS W. 1909. The flora of the Dutch Carboniferous. Meded. Rijks Opsporing Delfstoffen 2.

JANSSEN R.E. 1940. Some fossil plant types of Illinois. Scientific Papers, Vol. I. Illinois State Museum. Springfield, Illinois, U. S. A.

JANSSEN R.E. 1965. Leaves and stems from fossil forests. Popular Science Series, Vol I. Illinois State Museum. Springfield, Illinois, U. S. A.

LAVEINE J.P. 1998. Proposal to conserve the name *Neuropteris* (fossil plants) with a conserved spelling and ultimate type. Taxon 47: 45–46.

LEISMAN G.A.. 1970. A petrified *Sporangio-strobus* and its spores from the Middle Pen-nsylvanian of Kansas. Palaeontographica 129 B: 166-177.

LINDLEY J, HUTTON W. 1831-1833. The fossil flora of Great Britain. Vol. I: James Ridgeway and Sons, London.

OLEKSYSHYM J. 1982. Fossil plants from the anthracite coal fields of eastern Pennsylvania. Pennsylvania Geological Survey. General Geological Report 72.

SCHLOTHEIM E.F. 1820. Die petrefactenkunde auf ihrem jetzigen Standpunkte durch die Beschreibung seiner Sammlung versteinerter und fossiler Ueberreste des Thierund Pflanzen reichs der Vorwelt erläutert. Gotha.

SEWARD A.C. 1963. Fossil plants. V. II. Hafner Pub. Comp. New York & London.

STERNBERG K.M. 1820-1838.Versuch einer geognostischbotanischen Darstellung der Flora der Vorwelt: v. I II, Prague.

STEWART W.N., ROTHWELL G.W. 1993. Paleobotany and the evolution of plants. Cambridge University Press.

TAYLOR N.T., TAYLOR E.L. 1993. The biology and evolution of fossil plants. Prentice Hall. Inc. New Jersey.

UNGER F. 1850. Genera et species plantarum fossilium. 627 pp. Vindobonae.

ZEILLER R. 1879. Note sur le genre *Mariopteris*. Bull. Soc. Géol. France (3), tome VII., p. 92.

ZODROW E.L., CLEAL C.J. 1998. Revision of the Pteridosperm foliage *Alethopteris* and *Lonchopteridium* (Upper Carboniferous), Sydney Coalfield, Nova Scotia, Canada. Palaeontographica 247 B: 65-122.

ZODROW E.L., MASTALERZ M., SIMUNEK Z. 2003. FTIR-derived characteristics of fossil gymnosperm leaf remains of *Cordaites principalis* and *Cordaites borassifolius* (Pennsylvanian, Maritimes Canada and Czech Republic). International Journal of Coal Geology 55: 95-102.