REVISTA ESPAÑOLA DE PALEONTOLOGÍA, 7 (2), 161-165. 1992. ISSN 0213-6937.

COMPARISONS BETWEEN THE CRETACEOUS AND TERTIARY FLORAS OF CENTRAL AND SOUTHWEST EUROPE: A COMMENTARY

Erwin KNOBLOCH

Czech Geological Survey, Malostranské nám. 19, CS-118 21 Praha 1, Checoslovakia

ABSTRACT

The well documented floras from the Lower Cretaceous of Spain are useful for a comparison with similar floras from Portugal, Germany, France and England. The Upper Cretaceous floras in Spain are characterized by only a few plant remains, in contrast to the rich floras from Bohemia. The genus *Frenelopsis* occurred worldwide in the Cretaceous.

A mangrove vegetation with *Nipa* and *Acrostichum* as known from Spain spread along the Eocene shoreline from England-Belgium-France-Spain-Italy-Hungary to Ukraine. The flora from Sarreal near Tarragona is similar to that from Häring in Austria. Arctotertiary elements, whose frequency increased during the Oligocene in Bohemia and Germany, were developed less abundantly in Spain. A warm (subtropical) climatic oscillation during the Early Miocene has not been noted in Spain, but is well known in Central Europe. Leaves identified as *Castanea atavia* or *Quercus kubinyi*, which are widespread in Central Europe in Middle-Upper Miocene strata are apparently not well represented in Spain. There are some similarties between the flora from Cerdanya (Rérolle, 1884) and Crespia (Roiron, 1983) in NE Spain and that of Willershausen in Germany. The names of modern plants should not be used for Pliocene leaves. It is not possible to regard the flora from Crespia to be of Pleistocene age for it contains a high percentage of typically Neogene species (e.g. *Zelkova zelkovaefolia, Acer integerrimun* and *Parrotia pristina*).

Keywords: Cretaceous, Tertiary, important plant assemblages, Spain, Central Europe.

RESUMEN

Las floras del Cretácico Inferior de España, bien documentadas, son de gran interés como término de comparación con las floras similares de Portugal, Alemania, Francia e Inglaterra. Las floras españolas del Cretácico Superior son relativamente pobres en restos contrariamente a las de Bohemia que presentan gran riqueza florística. El género *Frenelopsis* tuvo en el Cretácico una amplia distribución mundial.

Los manglares, con *Nipa* y *Acrostichium*, de España se extendieron a lo largo del Eoceno siguiendo las costas desde Inglaterra-Bélgica-Francia-España-Italia y Hungría hasta Ucrania. La flora de Sarreal (Tarragona) es comparable a la de Häring en Austria. Elementos arctoterciarios que se incrementaron mucho durante el Oligoceno en Bohemia y Alemania, fueron menos abundantes en España.

Las oscilaciones climáticas a clima subtropical del Mioceno Inferior no han sido notadas en España contrariamente a lo observado en Europa Central. Hojas de *Castanea atavia* o *Quercus kubinyi* se encuentran en Europa central durante el Mioceno Medio y Superior pero no están tan bien representadas en España.

Hay algunas similitudes entre la flora de la Cerdaña (Rerolle 1884) y Crespiá (Roiron 1983) situadas en el NE de España y la de Willershausen de Alemania. Los nombres de plantas actuales no debían ser empleados para hojas del Plioceno. No es posible considerar la flora de Crespiá como pleistocena por el alto porcentaje de especies típicamente neógenas (e.g. *Zelkova zelkovaefolia, Acer integerrimum* y *Parrotia pristina*).

Palabras clave: Cretácico, Terciario, principales asociaciones vegetales, España, Europa central.

INTRODUCTION

A brief stay at the Department of Palaeontology, Faculty of Geological Sciences, University of Madrid (Complutense), in 1991, allowed the present writer to put some thoughts down on the subject of Cretaceous and Tertiary floras in Spain.

It seems useful to point out some of the similarities and differences between the Cretaceous and Tertiary floras of Spain and those of Central Europe. Unfortunately, it has only been possible to observe the material deposited in Madrid at the Departamento de Paleontología, Facultad de Ciencias Geológicas, Universidad Complutense. The illustrations in some important papers were often not clear enough to serve for a precise comparison with Central Europe (e.g. Menéndez Amor, 1955).

CRETACEOUS

Rich fossil plant collections have been described since 1820 from the Cretaceous of Bohemia, mainly from the so-called Peruc Member of Cenomanian age.

https://doi.org/10.7203/sjp.25043

These collections were studied mostly by Velenovský, Viniklář, Bayer, and Maříк in the second half of the nineteenth century and in the early part of the twentieth century. After the Second World War the Cenomanian leaves were studied by Hluštík, Kvaček and Knobloch. These are the richest Cenomanian megafloras in Europe. The Cretaceous floras in other parts of Europe are mainly of early Cretaceous age (Portugal, Spain, France, Germany, England) or of the late Cretaceous (Germany, Portugal, Austria). Only a few Cretaceous plant fossils have been recorded from Italy, Poland and Rumania.

The finds of plant megafossils (leaves) being quite limited, it is good that additional information has been obtained from palynology. Encouraging results have been obtained in this way from the surroundings of Burgos (Floquet & Lachkar, 1979) and in the Dordogne (Colin, 1974). Especially the Cenomanian megaspores from these localities show interesting similarities with those from Bohemia.

Two questions are particularly important with regard to the Cretaceous floras, viz. the use of the generic name *Sphenopteris*, and the ecological characters of *Frenelopsis*, in relation to its distribution and species differentiation.

It is difficult to decide whether the formgenera *Sphenopteris* and *Pecopteris* should be used for Cretaceous floras. Their application has been mainly in the Carboniferous and Permian where these formgenera have been used for fernlike foliage without a known fructification. At least ten species of *Sphenopteris* have been recorded from Portugal (Teixeira, 1948). From Spain, Depape & Doubinger (1956, 1960) described *Sphenopteris (Ruffordia) goepperti* Dunker and *Sphenopteris hispanica* Depape & Doubinger. Some of the leaves described under *Sphenopteris* may be attributed to *Onychiopsis*. Likewise, some of the forms recorded as *Pecopteris* may be attributed to *Gleichenites* or *Cladophlebis* (e.g. *Pecopteris dunkeri* Schimper = *Cladophlebis dunkeri* (Schimper) Seward). From Bohemia several species have been referred to *Sphenopteris, Pecopteris, Gleichenia, Gleichenites* or *Cladophlebis*.

The genus *Frenelopsis* occurs worldwide in Cretaceous deposits of the northern hemisphere. In Czechoslovakia there are indications that this genus was connected with a brackish marine environment (e.g. *F. hoheneggeri* which occurs in marine flysch deposits). *Nehvizdya obtusa* has often been found together with *Frenelopsis alata* in Bohemia, and *Eretmophyllum andegavense* (= *Nehvizdya obtusa andegavense*) occurs under similar conditions in the surroundings of Anjou where it is found together with marcasite (Pons, Boureau & Broutin, 1976; Hluštík, 1986). Similar environmental conditions were ascertained for *Frenelopsis oligostomata* Romariz emend. Alvin in the Cretaceous of Portugal (Pons & Broutin, 1978).

A summary appraisal of studies on the Cretaceous floras of western Europe and North Africa (e.g. Alvarez Ramis *et al.*, 1981) suggests that most of these floras are characterised by only a few species. In Spain only the Lower Cretaceous floras can be used for a comparison with other countries. The Štramberk flora of the Lower Cretaceous in Moravia (Czechoslovakia) has only *Zamites* spp. and *Cladophlebis albertsii* (Dunker) Brongniart in common with the Spanish flora. The genera *Brachyphyllum, Frenelopsis* and *Sphenopteris* are represented by different species (for a full account of the Moravian flora, see Purkyňová, 1980).

TERTIARY

The Eocene floras of Spain show important components of a mangrove vegetation, such as *Nipa burtinii* (Brongniart) Ettingshausen and *Acrostichum lanzeanum* (Visiani) Reid & Chandler (see Alvarez Ramis, 1982). *Nipa* is extensively represented along the Eocene shoreline from England through Belgium, France, Spain, Italy and Hungary to Russia (Tralau, 1964). The fern *Acrostichum* has a similar distribution (for details see Barthel, 1976). Whilst the fruit of *Nipa* is unrecorded from Bohemia, the fern leaves of *Acrostichum* have been found in the locality of Kučlín (Bůžek *et al.*, 1990).

The flora from Sarreal near Tarragona, in Catalunya (Fernández Marrón, 1973), shows similarities with the Upper Eocene flora of Häring in Austria (Ettingshausen, 1853). They share the presence of *Dryandra (Comptonia) schrankii* (Sternberg) Berry and *Zizyphus ungeri* Heer, as well as that of a number of forms with small leaves or leaflets, such as *Dalbergia, Acacia, Caesalpinia, Colutea, Podogonium, Citysus*, etc., all similar to the Leguminosae. The presence of the so-called *Callitris brongniartii* Endlicher is also noted, whereas *Fagus gautieri* Laurent & Marty has probably been wrongly identified since *Fagus* is unlikely to be present in this kind of assemblage. Anyway, the morphological features of the plant identified as such are quite different to those of the northern *Fagus*.

The Oligocene floras from Spain are not as rich as those in Bohemia which have a larger number of species. The data are summarised in the work of Fernández Marrón (1971). It is noted that Arctotertiary elements, which prevail in the Oligocene floras of Bohemia, are few and far between in the Spanish Oligocene. Genera such as *Cercidiphyllum, Ulmus, Tilia, Betula*, etc. are completely absent from the Spanish floras. Some of the leaves identified as *Salix* (a true Arctotertiary element) may be related forms, but not very likely *Salix* itself. Some leaves with entire margins may well belong to a Palaeotropical element of uncertain systematic affinity. Fan-shaped palm leaves mentioned as *Sabal* and *Flabellaria* from Sarreal and Ribesalbes in Catalunya show a resemblance to elements from older Tertiary floras (Eocene, lower Oligocene) in Central Europe (Häring, Geiseltal, Monte Promina, Staré Sedlo, Kučlín). It seems that palaeotropical elements are more prevailent in Spain than they are in the Oligocene floras of Bohemia.

The upper Eggenburgian is the most important warm interval during the Miocene (Knobloch, 1989; Bůžek & Kvaček, 1990). The Eggenburgian Stage forms the basal part of the Miocene in the area of the Paratethys and corresponds in age to the Aquitanian of the Mediterranean area. This extremely warm (subtropical) climatic oscillation is characterised by the well known

mastixioidean flora (both fruits and seeds) from Wiesa (Mai, 1964) and Schwandorf (Gregor, 1978) in Germany. The same kind of flora is known from Arjuzanx in southwestern France, but its age has been disputed (Gregor, 1990). The mastixioidean flora probably corresponds in age with the leaf flora from Lipovany in Slovakia (Němejc & Knobloch, 1973). These subtropical floras correspond to a wet environment and are quite different to the one found in the Znojmo locality of southern Moravia (Knobloch, 1969) which shows a prevailence of small leaves with entire margins or margins with small teeth. The latter are mainly sclerophyllous and correspond, most likely, to shrubs and trees growing under dry and hot climatic conditions. The Znojma flora seems ecologically and stratigraphically equivalent to the flora from Martorell (Catalunya) as described by Sanz de Siria Catalán (1981).

In the late Pontian (Messinian) the connection between the Atlantic Ocean and the Mediterranean was severed for a short time (c. 500,000 yrs). This create the so-called salinity crisis in the West Mediterranean Rögl & Steininger, 1983), a concept that needs to be examined. The Messinian flora from Korfu, as described by Heimann, Jung & Braune (1975) and Heimann & Jung (1976), contains some plants which may be regard as pre-Mediterranean elements. These are, for instance, *Cupressus sempervirens* Linné, *Berberis* sp., *Paliurus* cf. *spina-christi* Miller and *Pistacia* cf. *sativa* Miller. Besides, a number of plants are present that need a certain amount of humidity: *Populus, Ulmus, Persea, Taxodium, Platanus*, etc. This seems to confirm an observation made in the Badenian of northern Moravia (Knobloch, 1969) where a gypsum opencast mine yielded the leaves of *Fagus, Acer, Carpinus, Platanus* and *Buxus*. Neither these plants nor the Messinian flora reflect dry environmental conditions, and it appears that the theory of a circum-Mediterranean dry phase with sclerophyllous evergreens (Rögl & Steininger, 1983, p. 12) cannot be maintained on the palaeobotanical evidence. Also some floras found in gypsiferous sediments in Italy, fail to reflect dry conditions in either the leaf form or the nature of the genera (Roiron, 1984; Knobloch, unpublished information).

In the Upper Miocene and Pliocene floras the relation between the fossil and the modern leaves becomes important. Some genera, such as *Populus, Fagus, Quercus, Acer* and *Fraxinus* become prominent. With regard to *Populus*, there are similarities between the modern *Populus alba* and fossil leaves of *Populus tremula*; however, these are only similarities because the leaves are not identical. It is, therefore, clear that one cannot accept names like *Populus alba* Linné and *P. tremula* Linné for the leaves recorded by Roiron (1983, p. 692, textfigs 9-12). Neither can one accept *Populus tremula (pliocenica)* and *P. canescens* (Aiton) Smith *(pliocenica)* for the leaves ilustrated by Rérolle (1884, pl. IX, Figs. 8-9). It also seems unlikely that a flora with predominantly deciduous plants (*Acer, Populus, Quercus, Betula*, etc.) would contain as well *Zelkova crenata* Spach and the fossil *Z. subkeaki* Rérolle, as Rérolle recorded from Cerdanya. All the fossil leaves of the genus *Zelkova* belong to extinct species which are comparable but not identical to modern forms of *Zelkova*. The same situation exists with regard to *Acer, Populus, Betula* and others.

Although there are a few differences with regard to taxonomy and the ecology of leaves recorded from Seu d'Urgell and Cerdanya, the percentage of leaves with an entire margin is quite similar in both localities (40 % in Seu d'Urgell and 31 % in Cerdanya - see Alvarez Ramis, 1981, p. 562). To judge from the drawings and photographs of the Seu d'Urgell flora, this contains a higher proportion of smaller (and more poorly preserved) leaves than Cerdanya. Perhaps, a warm temperate climate is more likely than a subtropical one.

It seems that leaves recorded from Central Europe as *Castanea atavia, Quercus kubinyi*, and other denticulate forms, which are ubiquitous and characteristic of the Upper Miocene floras in this area (Knobloch, 1986), appear but rarely in France, whilst being apparently absent in Spain.

The palaeobotanical literature from Spain (mainly summarised by Alvarez Ramis & Fernández Marrón, 1983a) shows a generally poor preservation of leaf specimens. Therefore, the relevant detail is not always visible on the photographs.

It is noted that the South European floras of the Miocene (or Pliocene?) show a larger representation of Lauraceae than occurs in Central Europe. This is apparent from the Siurana flora (Girona province of Catalunya), as recorded by Sanz de Siria Catalán (1982), and also from Italy (Berger, 1958) where *Daphnogene polymorpha* (Al. Baum) Ettingshausen and *Oreodaphne heeri* Gaudin have been found. Only *Sassafras ferretianum* Massallongo occurs in the Pliocene of the Rhône Valley (Depape, 1922) as well as in the German localities of Willershausen (Strauss, 1930) and Berga (Mai & Walther, 1988).

Most important for a comparison with the Pliocene floras of Central Europe is the rich assemblage from Papiol (Catalunya) which is characterised by a large variety of dicotyledons, 140 taxa having been recorded by Alvarez Ramis & Fernández Marrón (1983b). A small collection from Papiol has been examined by the present writer during his stay at the Department of Palaeontology, Madrid University (Complutense). The genus *Daphnogene* was the prevailing element in this collection. This element of the Lauraceae is present in the flora from Cerdanya, but is lacking from the younger flora in Crespia. It also fails to occur in the Pliocene floras of Central Europe. It should be interesting to check on the various points of extinction of laurophyllous elements in the different localities in Spain.

The flora from Cerdanya (Rérolle, 1884) is regarded as late Miocene (Pontian) by Alvarez Ramis (1981), whereas that of Mont-Doré in France (Boulay, 1892) is assigned to the Pliocene, and that of Crespia to the Pliocene-Pleistocene (Roiron, 1983). All these floras are somewhat similar to the Pliocene flora of Willershausen (Strauss, 1930; Knobloch, 1990a-c). They all show the presence of Miocene relict forms, such as *Zelkova zelkovaefolia, Acer integerrimum, Parrotia pristina*, and the husks of *Carpinus* ex gr. *grandis* and of *Carpinus* ex gr. *kisseri* var. *orientalis*. Whereas the palaeotropical genus *Daphnogene* is present at Cerdanya, it is absent from Willershausen, Mont-Doré and Crespia. Differences are

also apparent in the representatives of *Acer* and *Quercus*.

There is a reasonable similarity between the flora from Willershausen and that from Cresia in Catalunya, but some differences are apparent. Roiron (1983) described some leaves as *Populus alba* and *P. tremula* from the Crespia locality, but it is quite certain that these fossil leaves are not the same as the Recent ones. The same problem exists with *Zelkova*. Why use the name of a modern species, *Zelkova crenata*, when it is impossible to prove that the fossil leaves show all the characteristic features of the Recent species? At Crespia as well as in Willershausen, *Carya minor, Acer integerrimum*, and the same representatives of *Tilia, Parrotia, Hedera* and *Sorbus* are present. *Platanus* and *Liquidambar* are lacking in both localities. The very important oaks are different in the two localities, but the Betulaceae are the same. *Fagus* is lacking in Crespia.

Some of the common species of Crespia are the same as in Willershausen. some of these are typical Miocene relicts, e.g. *Zelkova zelkovaefolia, Carya minor, Acer integerrimum, Parrotia saviana*, and *Tilia saviana*. For this reason one cannot very well accept Roiron's suggestion that the Crespia flora is partly of Pleistocene age. I assume that the flora from Willershausen belongs to the middle or upper Pliocene. If the Miocene relicts lasted into the Pleistocene, as is suggested by absolute age dating in the Massif de l'Escandorque near Lunas in Hérault, France (vide Roiron, 1983, p. 709), the age of the Willershausen flora would also come into question. All data will have to be taken into account for the definition of floral zones which do not necessarily conform to the standard zonation based on vertebrate palaeontology.

ACKNOWLEGEMENTS

The author is grateful to Professor C. Alvarez Ramis for organising his visit. To Dr. M. T. Fernández Marrón for being helpful is many way. To an anonymons referee for the improvement of the english manuscript.

BIBLIOGRAPHY

Álvarez Ramis, C. 1981. *Paleoclima de las cuencas pontienses del Pirineo catalán.* Anais II Congreso Latino-Americano de Paleontología, 553-564. Pôrto Alegre.

Álvarez Ramis, C. 1982. Sobre la presencia de una flora de Paleomanglar en el Paleógeno de la depresión central catalana (Curso medio del Llobregat). *Acta geológica Hispana*, **17**, 5-9.

Álvarez Ramis, C., Biondi, E., Desplates, D., Hughes, N. F., Koeniguer, J. C., Pons, D. et Rioult M. 1981. Les Végétaux (Macrofossiles) du Crétacé Moyen de l'Europe Occidentale et du Sahara. Végétations et Paléoclimats. *Cretaceous Research,* **2**, 339-359.

Álvarez Ramis, C. et Fernández Marrón, T. 1983a. *À propos des gisements espagnols qui ont fourni des macroflores tertiaires d'intérêt paléobotanique.* Comptes Rendus du 108e Congrès national des Sociétés savantes Grenoble 1983, Section des Sciences, fasc. I, Science de la Terre, II, 131-142.

Álvarez Ramis, C. et Fernández Marrón, T. 1983b. Les points de vue qualitatif et quantitatif en paléophytologie. Application à la connaisance du paléoclimat du gisement pliocène de Papiol, Espagne. *Paléobiologie continentale*, 14(2), 69-73.

Barthel, M. 1976. Eozäne Floren des Geiseltales. Farne und Cycadeen. *Abhandlungen des Zentralen geologischen Instituts,* **26**, 439-498.

Berger, W. 1958. Untersuchungen an der obermiozänen (sarmatischen) Flora von Gabbro (Monti Livornesi) in der Toskana. Ein Beitrag zur Auswertung tertiärer Blattfloren für die Klima und Floren geschichte. *Palaeontographica italica*, **51**, 1, 1-96.

Boulay, N. 1892. *Flore pliocène du Mont Dore (Puy-de-Dôme).* 116 pp. Paris.

Bůžek, Č, Fejfar, O., Konzalová, M. and Kvaček, Z. 1990. *Floristic changes around Stehlin's Grande Coupure in Central Europe.* Proceedings of the Symposium Paleofloristic and Paleoclimatologic Changes in the Cretaceous and Tertiary, Prague 1989, 167-181.

Bůžek, Č, Kvaček, Z. 1990. Floristic biostratigraphy of Tertiary basins in the Bohemian massif and correlation with Central Paratethys. *Geologica Carpatica*, **41**, 1, 3-14.

Colin, J. P. 1974. Quelques mégaspores du Cénomanien et du Turonien supérieur du Sarladais (Dordogne, France). *Revista Española de Micropaleontología,* 7(1), 15-23.

Depape, G. 1922. Recherches sur la flore pliocène de la vallée du Rhône. Flores de Saint-Marcel (Ardèche) et des environs de Théziers (Gard). *Annales des Science naturelles, Botanique,* **5**, 73-265.

Depape, G. et Doubinger, J. 1956-1960. La flore wealdienne d'Ortigosa (Espagne). *Anales Escuela Técnica*, **14**, 17-76.

Ettingshausen, C. v. 1853. Die tertiäre Flora von Häring in Tirol. *Abhandlungen der kaiserlich-königlichen Geologischen Reichsanstalt,* **2**, 1-118.

Fernández Marrón, M. T. 1971. *Estudio paleoecológico y revisión sistemática de la flora fósil del Oligoceno español.* Publicaciones de la Facultad de Ciencias Universidad Complutense. Ser. A., n.º 151 (Sección Biol.), 1-177, Madrid.

Fernández Marrón, T. 1973. Nuevas aportaciones a la sistemática y paleoecología de la flora oligocena de Sarreal (Tarragona). *Estudios geológicos*, **29**, 157-169.

Floquet, M. et Lachkar, G. 1979. Précisions stratigraphique, paléogéographiques et premiéres descriptions de mégaspores dans le Cénomanien supérieur en Espagne du Nord. *Revue de Micropaléontologie*, **22**, 3, 134-155.

Gregor, H. J. 1978. Die miozänen Frucht- und Samen-Floren der Oberpfälzer Braunkohle I. Funde aus den sandigen Zwischenmitteln. *Palaeontographica*, Abt. B, **167**, 8-103.

Gregor, H. J. 1990. Contributions to the Late Neogene and Early Quaternary Floral History of the Mediterranean. *Review of Palaeobotany and Palynology*, **62**, 309-338.

Heimann, K. O. und Jung, W. 1976. Palökologische und fazielle Untersuchungen an Gesteinen des Evaporitzyklus II bei Paghi/Nordkorfu (Griechenland). *Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie*, **16**, 105-111.

Heimann, K. O., Jung, W. und Braune, K. 1975. Schichtenfolge und Flora des Messinien in Nord-Korfu (Griechenland). *Mitteilungen der Bayerischen Staatssammlung für Paläontologie und historische Geologie*, **15**, 169-177.

Hluštík, A. 1986. Eretmophyllous Ginkgoales from the Cenomanian. *Acta Musei Nationales Pragae*, **42**, B, 99-115.

Knobloch, E. 1969. *Tertiäre Floren von Mähren.* Moravské museum, Muzejní spolek Brno, 201 pp.

Knobloch, E. 1984. Megasporen aus der Kreide von Mitteleuropa. *Sborník geologických věd*, Paleontologie, **26**, 157-195.

Knobloch, E. 1986. Die Flora aus der Oberen Süsswassermolasse von Achldorf bei Vilsbiburg (Niederbayern). *Documenta naturae*, **30**, 14-48.

Knobloch, E. 1989. Die biostratigraphische Stellung der tertiären Blattflora von Seussen und Wackersdorf (Oberpfalz). *Documenta naturae,* **55**, 79-89.

Knobloch, E. 1990a. *Willershausen*, 3. Teil. *Die Flora. Fossilien*, 1990, 216-222. Korb.

Knobloch, E. 1990b. *Willershausen*, 3. Teil. *Die Flora*. Zweiter Teil. *Fossilien*, 1990, 268-273. Korb.

Knobloch, E. 1990c. *Dicotyledonous leaves from the Pliocene of Willershausen, West Germany.* Proceedings of the Symposium Paleofloristic and Paleoclimatic Changes in the Cretaceous and Tertiary, Prague 1989, 265-268.

Lauverjat, J. et Pons, D. 1978. *Le gisement sénonien d'Esgueira (Portugal): Stratigraphie et flore fossile.* Comptes Rendus, 103è Congrès national des Sociétés savantes Nancy 1978, Section des sciences, fasc. II, 119-137.

Mai, D. H. 1964. Die Mastixioideen-Floren im Tertiär der Oberlausitz. *Paläontologische Abhandlungen*, B, **2**(1), 1-192.

Mai, D. H. und Walther, H. 1988. Die pliozänen Floren von Thüringen, Deutsche Demokratische Republik. *Quartärpaläontologie*, **7**, 55-297.

Menéndez Amor, J. 1955. La depresión ceretana española y sus vegetales fósiles, Características fitopaleontológicas del Néogeno de la Cerdaña española. *Memorias de la Real Academia de Ciencias Exactas, Físicas y Naturales*, Serie de Ciencias Naturales, **18**, 1-344.

Němejc, F. und Knobloch, E. 1973. *Die Makroflora der Salgótarjaner Schichtengruppe (Die Flora aus Lipovany). Chronostratigraphie und Neostratotypen*, M2, Ottnangien, 3, 694-759. Verl. Slowak. Akad. Wiss. Bratislava.

Pons, D., Boureau, E. et Broutin, J. 1976. Nouvelles études paléobotaniques des environs d'Angers. I. *Eretmophyllum andegavense* nov. sp. Ginggoale fossile du Cénomanien de l'Anjou. Actes du 97e Congrés national Societés Savantes (Nantes, 1972), *Sciences*, 4, 357-369.

Pons, D. et Broutin, J. 1978. Les organes reproducteurs de *Frenelopsis oligostomata* (Crétacé, Portugal). Actes 103e Congrés national sociétés Savantes, Nancy 1978, *Sciences*, fasc. II, 139-159.

Purkyně, E. 1980. Ein neuer Fundort mit den Unterkreide-Floren von Stramberk (Nordmähren, Tschechoslowakei). *Časopis Slezského muzea*, vědy přírodní, **29**, 245-248.

Rérolle, L. 1884-85. Études sur les végétaux fossiles de Cerdagne. *Revue des Science naturelle*, 3e sér., **4**, 167-191, 252-298, 368-386.

Rögl, F. und Steininger, F. 1983. Vom Zerfall der Tethys zu Mediterran und Paratethys. Die neogene Paläogeographie und Palinspastik des zirkum-mediterranen Raumes. *Annalen des Naturhistorischen Museums Wien*, **85** A, 135-163.

Roiron, P. 1983. Nouvelle étude de la macroflora plio-pleistocène de Crespià (Catalogne, Espagne). *Geobios,* **16**(6), 687-715.

Roiron, P. 1984. Les Macroflores Messiniennes de la Méditerranée Nord-occidentale et la crise de salinité. *Paléobiologie continentale*, **14**(2), 415-422.

Sanz de Siria Catalán, A. 1980. Estudio sistemático y paleoecológico de la flora miocénica de la cuenca de la Seu d'Urgell. *Paleontologia i Evolució*, **14**, 1-28.

Sanz de Siria Catalán, A. 1981. La flora Burdigaliense de los alrededores de Martorell (Barcelona). *Paleontologia i Evolució*, **16**, 3-13.

Sanz de Siria Catalán, A. 1982. La flora pliocénica de Siurana (Gerona). *Paleontologia i Evolució*, **17**, 3-14.

Straus, A. 1930. Dikotyle Pflanzenreste aus dem Oberpliozän von Willershausen (Kreis Osterode, Harz) 1. *Jahrbuch der Preussischen Geologischen Landesanstalt*, **51**(1), 302-336.

Teixeira, C. 1948. *Flora mesozóica Portuguesa* I parte. Direcção geral de Minas e serviços geológicos, 1-118. Lisboa.

Tralau, H. 1964. The genus Nypa van Wurmb. *Kunglige Svenska Vetenskapsakademiens Handligar*, Fjärde Ser., **10**(1), 1-29. Stockholm, Göteborg, Uppsala.

Manuscrito recibido: 22 de enero, 1992
Manuscrito aceptado: 7 de mayo, 1992