

## Sporomorphs isolated from pre-Quaternary sediments of "Barranco de Patones" (Spain)

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(with 2 figures and 4 plates)

### Summary

Three levels situated in one serie established "Barranco de Patones" were investigated palynologically. The lower level (N-1) is relatively rich in early brevaxonate pollen grains of *Probrevaxones* (*Bolchovitinaepollenites*), and *Normapollis* such as *Complexiopollis*, *Verruocolopollis*, *Papillopollis*, *Longanulipollis*, *Interporopollenites*, *Nudopollis* and *Vacuopollis*. *Postnormapollis* are represented mostly by "myricoid forms". This is a peculiar Senonian assemblage represented by mixed *Pronormapollis* and *Eunormapollis* taxa. The second level (N-2) is poor in sporomorphs, few saccate gymnosperm pollen grains were observed. The upper level (N-3) contains gymnosperms (*Pinus*, *Taxodiaceae-Cupressaceae*) and evolved *Postnormapollis* (*Alnipollenites*) and modern angiosperm taxa (*Chenopodiipollis*, *Pseudospinaepollis*, *Tubulifloridites*). This upper level differs palynologically from the lower one and it is similar to Tertiary assemblages.

Key words: Palynology, fossil, Upper Cretaceous, Tertiary, Spain.

### Introduction

The phylogenetical stages of the angiosperm pollen grains during the Cretaceous are well established in the publication of DOYLE (1978), HICKEY and DOYLE (1977) and HUGHES (1976). The lower, first stage is characterized by the *Longaxones*, the second one by the *Brevaxonate* angiosperm pollen grains. After the appearance of the first brevaxonate pollen grains an extraordinary differentiation happened within this group. The early *Brevaxones* were classed into the stemma *Normapollis* introduced by PFLUG (1953), but the basic morphological taxa were elaborated in the monograph of

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THOMSON and PFLUG (1953). From morphological point of view particularly interesting and complicated pollen grains of the *Normapolles* stemma were the subject of several further investigations, e.g. GÓCZÁN (1964), GÓCZÁN, GROOT, KRUTZSCH and PAČTOVÁ (1967), ZAKLINSKAYA (1962), SKARBY (1968). Using the TEM method cf. KEDVES, HEGEDŰS and PÁRDUTZ (1973), KEDVES (1990). Combined LM, TEM and SEM methods were first used for *Normapolles* taxa by STANLEY and KEDVES (1975).

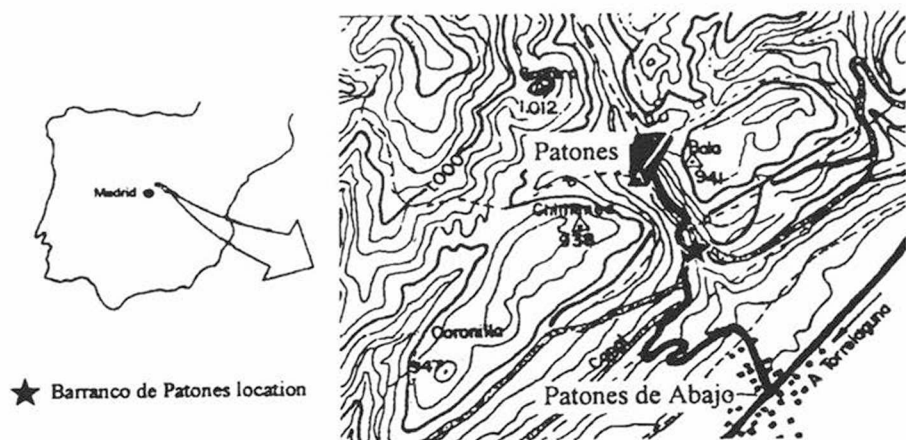


Fig. 1

The intensive differentiation process of the early brevaxonate pollen grains resulted well delineated palaeophytogeographical units, cf. ZAKLINSKAYA (1962), KRUTZSCH (in GÓCZÁN, GROOT, KRUTZSCH and PAČTOVÁ 1967), KEDVES (1985), etc. For the Northern Hemisphere the *Normapolles* and *Aquilapollenites* provinces were distinguished. Within these provinces further regions and sub-regions were established (KEDVES and DINIZ, 1983). Northern Spain was classed into the Pyrenean sub-region, the greatest part of Spain and Portugal into the Iberian sub-region.

During the last years several publications appeared dealing with Cretaceous palynomorphs of Spain and Portugal. In this way we have several assemblages for comparison.

This contribution represents one part of our palynological studies on Upper Cretaceous sediments of Spain. Several results about the macroflora and some Algae of Barranco de Patones were previously published: ALVAREZ RAMIS, FERNÁNDEZ MARRÓN and GOMEZ PORTER (1992), ALVAREZ RAMIS, KEDVES, FERNÁNDEZ MARRÓN, CLEMENTE BELMONTE and GÓMEZ PORTER (1996), ALVAREZ RAMIS, CLEMENTE BELMONTE and FERNÁNDEZ MARRÓN (1996) and CLEMENTE BELMONTE and ALVAREZ RAMIS (1996).

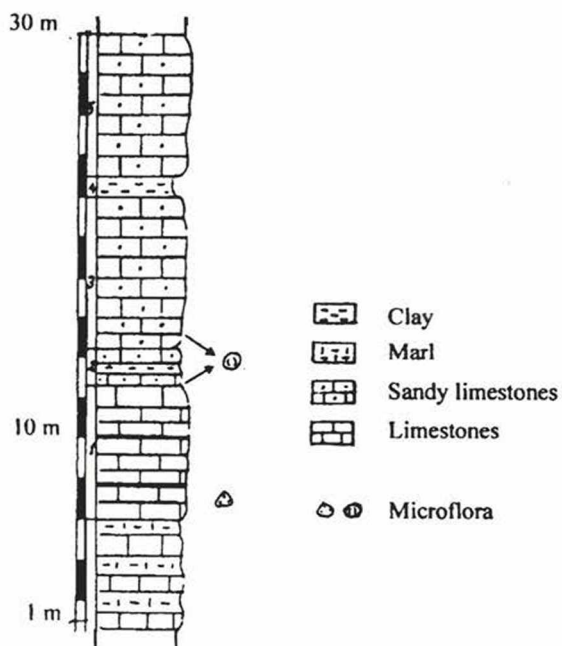


Fig. 2.

The aim of this paper is the following: based on the detailed palynological analysis of the three superposed levels we intent to meet the stratigraphical situation of Barranco de Patones series. We attempt also the reconstruction of the paleophytoassociation in the levels investigated.

### Materials and methods

The samples were collected by ALVAREZ RAMIS, FERNÁNDEZ MARRÓN and KEDVES from the three horizons of Patones in October 11, 1993. Patones is at North of the Madrid community, Spain (Fig. 1). The lower level is represented by limestone and is rich in impressions of *Glyptostrobus* macroremains. The second level is limestone and sandy marl. The third level are clay and limestone (Fig. 2). Samples for micropaleobotanical investigations were treated in Madrid and in Szeged with the following basic method: HCl - H<sub>2</sub>O - HF - H<sub>2</sub>O. The organic remnants for LM studies were mounted in glycerine-jelly hydrated of 39.6%. Investigations and microphotographs were taken also in both laboratories. The qualitative and quantitative data were summarized by the three different levels. The slides are deposited in Madrid and in Szeged.



## Results

The LM pictures of the most important sporomorphs are illustrated on plates I-IV.

Sample 1 (Plates 1, 2 and 3, Figs 1-19).

### Qualitative data

*Hystriochosphaeridae* indet.

Pteridophyta. - *Leiotriletes* fsp., *Laevigatosporites* fsp., *Polypodiaceae*.

Gymnospermatophyta. - *Pityosporites* fsp., *Abietaceae*, *Pityosporites pristinipollinius*, *Abietaceae*, *Pinus*, *Pityosporites* cf. *minimus*, *Abietaceae*, *Pinus*, *Sequoiapollenites minor*, *Taxodiaceae*, *Sequoia*, *Inaperturopollenites hiatus*, *Taxodiaceae* - *Cupressaceae*, *Ephedripites* fsp., *Ephedraceae*.

Angiospermatophyta

Longaxones

*Cupuliferoideaepollenites liblarensis*, *Cupuliferae*, *Cupuliferoipollenites pusillus*, *Fagaceae*, *Castanea* type.

Brevaxones

Probrevaxones

*Bolchovitinaepollenites miniverrucatus*, *B. punctatus*.

Normapolles

*Complexiopollis complicatus minor*, *C. praeatumesces*, *C. funiculus*, *C. cf. plicatus*, *C. ameromii*, *C. microrugulatus*, *C. patulus*, *C. vilaflorensis*, *C. concavus*, *C. megagerminatus*, *Atlantopollis verrucosus*, Cf. *A. fsp.* *Prezaipollenites concavus tetraexitum*, *Plicapollis sarta*, *P. pseudoexcelsus turgidus*, *P. pseudoexcelsus semiturgidus*, *Interporopollenites krempi*, *I. heteropolatus*, *I. stanleyi*, *Trudopollis granulosus*, cf. *Subtrudopollis subtrudens*, *Oculopollis pertrudoides*, *O. microoculus*, *Semioculopollis granulosus*, *S. praedicatus*, *S. croxtonae*, *S. fsp.*, *Verruoculopollis skarbyae*, *V. pflugii*, *V. fsp. 1*, *V. fsp. 2*, *V. fsp. 3*, *Bohemiapollis oebisfeldensis*, *Convexipollis convexigerminalis*, *Vacuopollis orthopyramis magna*, cf. *V. microconcavus*, *Longanulipollis fsp.*, *Krutzschipollis magnoporatus*, *Nudopollis terminalis cretacicus*, *Rocheipollenites triangulus*, *R. fsp.* *Minorpollis maestrichtiensis*, *Papillopollis pflugii*, *P. cf. weylandii*, *P. regulus*, *P. pittaueae*, *P. rugulatus*, *P. krutzschii*, cf. *Aveiropollenites triangulus*, cf. *Boltenhagenipollenites aradaensis*.

Postnormapolles

*Labraferoideaepollenites rurensis*, *L. bituitus*, *L. dilatus*, *Tripoporopollenites kleinoichingi*,

*Subtripoporopollenites palaeocenicus*, cf. *Chenopodiipollis fsp.*

### Quantitative data

*Hystriochosphaeridae* 1%, Pteridophyta 1%, Gymnospermatophyta *Pityosporites* fssp. 24%, *Inaperturopollenites* fssp. 9%, Angiospermatophyta Longaxones 1%, Brevaxones Probrevaxones *Samoilovichaepollenites* 2%, Normapolles Pronormapolles

*Complexiopollis* 12%, *Papillopollis* 21%, *Oculopollis* 3%, *Verruoculopollis* 6%, *Krutzschipollis* 2%, *Plicapollis* 1%, *Vacuopollis* 15%, *Rocheipollenites* 1%, Postnormapollis formes myricoides 5%, *Subtriporopollenites* 1%.

#### Sample 2 (Plate 3, Figs 20-30)

It is very poor in sporomorphs: *Pityosporites* fsp., *Pinus* diploxylon type, *Podocarpidites* fsp., *Cupuliferoideaepollenites quisqualis*.

#### Sample 3 (Plate 4)

##### Qualitative data

Algae, Chlorophyta

*Botryococcus braunii*

Gymnospermatophyta

*Pityosporites pristiniipollinus*, *P. minutus*, *P. labdacus*, *P. insignis*, *Piceapollis planooides*, *Abiespollenites dubius*, *Sciadopityspollenites* fsp., *Inaperturopollenites concedipites*, *Sequoiapollenites minor*, *Cupressacites insulipapillatus*, *Cycadopites microfollicularis*, *C. minimus*.

Angiospermatophyta

Longaxones

*Scabratricolpites* fsp., 1, *Sc.* fsp. 2, *Cupuliferoipollenites insleyanus*, *C. oviformis*, *Retitricolporites nagyae*, *R.* fsp. 1, *R.* fsp. 2, *Fususpollenites fusus*, *Cerceaupollenites* fsp., *Ilexpollenites erdtmani*, *Cyrillaceaeipollenites* fsp., *Lanagiopollis eocaenica* type.

Brevaxones

*Alnipollenites* fsp., cf. *Punctioratipollis* fsp., *Chenopodiipollis multiplex*, *Pseudospinaepollis pseudospinus*, *Ulmipollenites undulosus*, *Celtipollenites komloensis*, cf. *Caryophyllidites* fsp.

##### Quantitative data

*Botryococcus braunii* 1.5%, *Pinus* diploxylon type 28%, *Pinus varia* 2.5%, Piceoide forms 22.5%, *Abies* 5%, cf. *Taxodiaceae* 1.5%, *Ilex* 0.5%, *Cyrillaceae* 1.5%, *Chenopodiaceae* 5.5%, *Celtis* 5.5%, *Caryophyllaceae* 1%, *Quercus* 5.5%, cf. *Pasania*, 2%, cf. *Castanea* 3%, *Juglans* 0.5%, *Alnus* 1.5%, *Betula* 0.5%, *Salix* 5%, *Ericaceae* 2.5%, *Compositae* (tricolporate) 2%, *Compositae* (fenestrata) 1%, *Gramineae* 2%, cf. *Sparganiaceae* 1.5%. Dicotyledones varia 2.5%.

### Discussion and conclusions

Taking into consideration the aim of this paper we can point out the following:

#### 1. Lower level (N-1)

1.1. The early brevaxonate pollen grains of the samples of this level are heterogeneous from palynostratigraphical point of view. *Probrevaxones* (*Bolchovitinaepollenites*) and *Pronormapollis* (*Complexiopollis* fssp.) were isolated from the Upper Cenomanian and Lower Turonian sediments of the *Normapollis* province. It is worth of mentioning that the *Atlantopollis* fgen. is represented by some specimens.

1.2. Pollen grains of *Papillopollis* and *Verrucopollis*, *Semioculopollis* are common in the first place in the Santonian and or Campanian layers.

1.3. There are also so-called Maestrichtian-Danian forms. *Trudopollis hojrupensis*, *Semioculopollis daniensis*, *Nudopollis terminalis cretacicus*.

1.4. *Plicapollis pseudoexcelsus* is an Upper Cretaceous - Paleocene - Eocene evolved *Normapollis* type in all probability represents an early *Myricaceae* taxa.

1.5. The early Postnormapollis (*Subtriporopollenites constans*, *Labraferoidae-pollenites*) are characteristic for the uppermost part of the Upper Cretaceous and to the Lower Tertiary.

#### 2. Middle level (N-2)

We observed very few forms in a very bad preservation and they are not enough for any conclusions.

#### 3. Upper level (N-3)

3.1. The great quantity of the saccate gymnosperm pollen grains indicate an open swamp paleoecologic condition. For the riparian vegetation *Salix*, *Castanea*, *Quercus*, *Alnus*, *Celtis*, forest may be presumed. We have also observed some non-arbor pollen.

3.2. It is also important that in this level contaminations of the recent vegetation are perhaps possible. In some cases it is not easy to distinguish the fossil and the recent pollen grains.

4. Based on our up-to-date knowledges as final conclusions, we can emphasize as follows:

4.1. There are important differences in the organic microremains composition between the different levels investigated. The early brevaxonate pollen grains which are characteristic for the lower level (N-1) were not observed in the middle (N-2) and the upper (N-3) levels. In general the upper part may be characterized by so-called modern angiosperm pollen grains which are characteristic till middle Tertiary levels.

4.2. The above mentioned, so-called mixed *Normapollis* flora suggests the necessity of further investigations. By the way of the palynological study of the first level (N-1) by centimeters we will have the opportunity to definitively establish whether is it really a mixed *Normapollis* assemblage, or these are different palynoassociations within the lower lithostratigraphic unit.

5. From paleophytogeographical point of view the Upper Cretaceous forms of the lower level (N-1) are characteristically of European type of the *Normapollis* province. The observed forms of the form-genus *Papillopollis* are characteristic in the first place to the assemblages of the Iberian Peninsula. But some *Normapollis* taxa of our material is



abundant in the Carpathian sub-region also, cf. *Verruculopollis*, *Semioculopollis*, etc. These forms are also common in the Boreal region of the *Normapolles* province.

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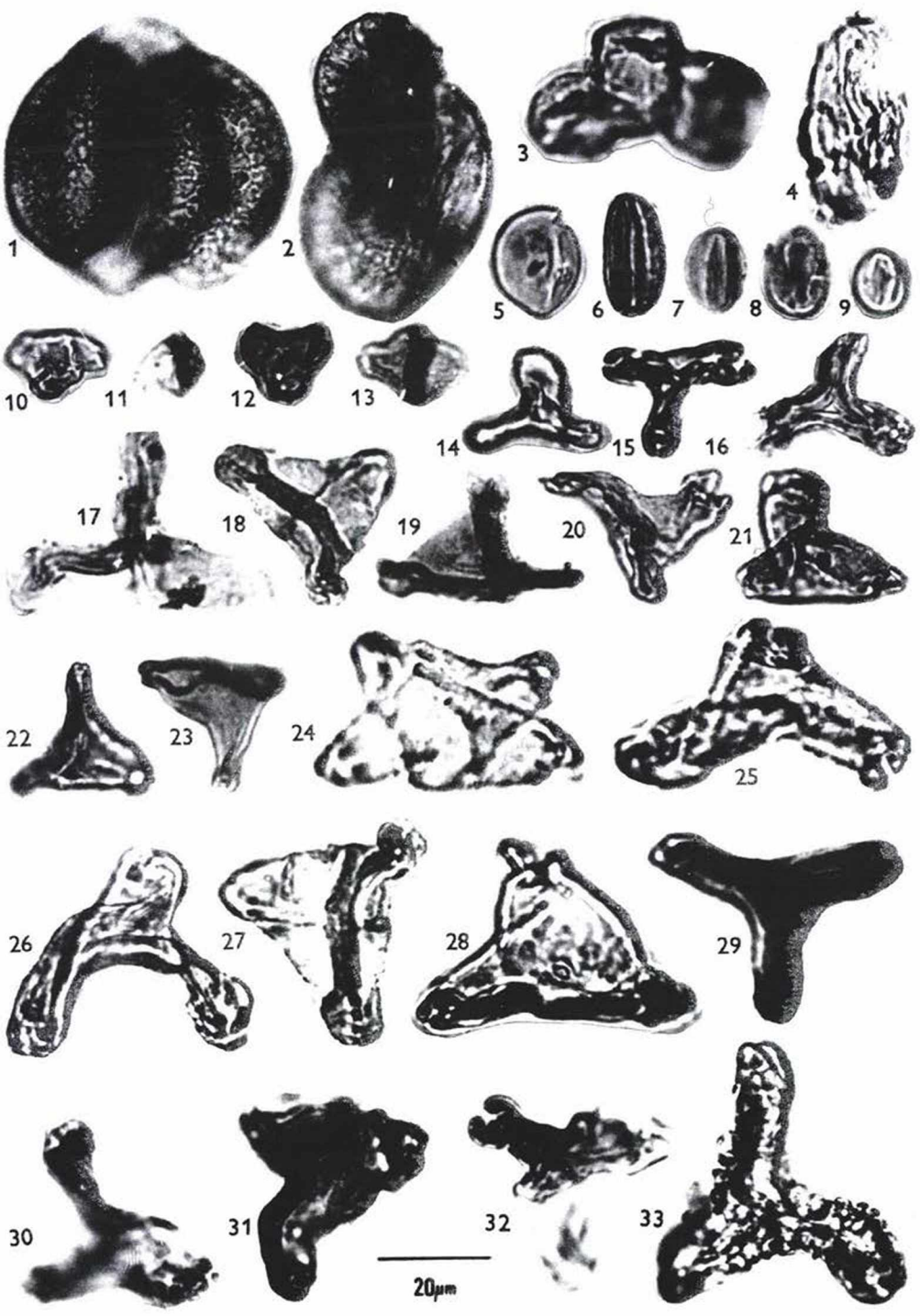
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## Plate 1

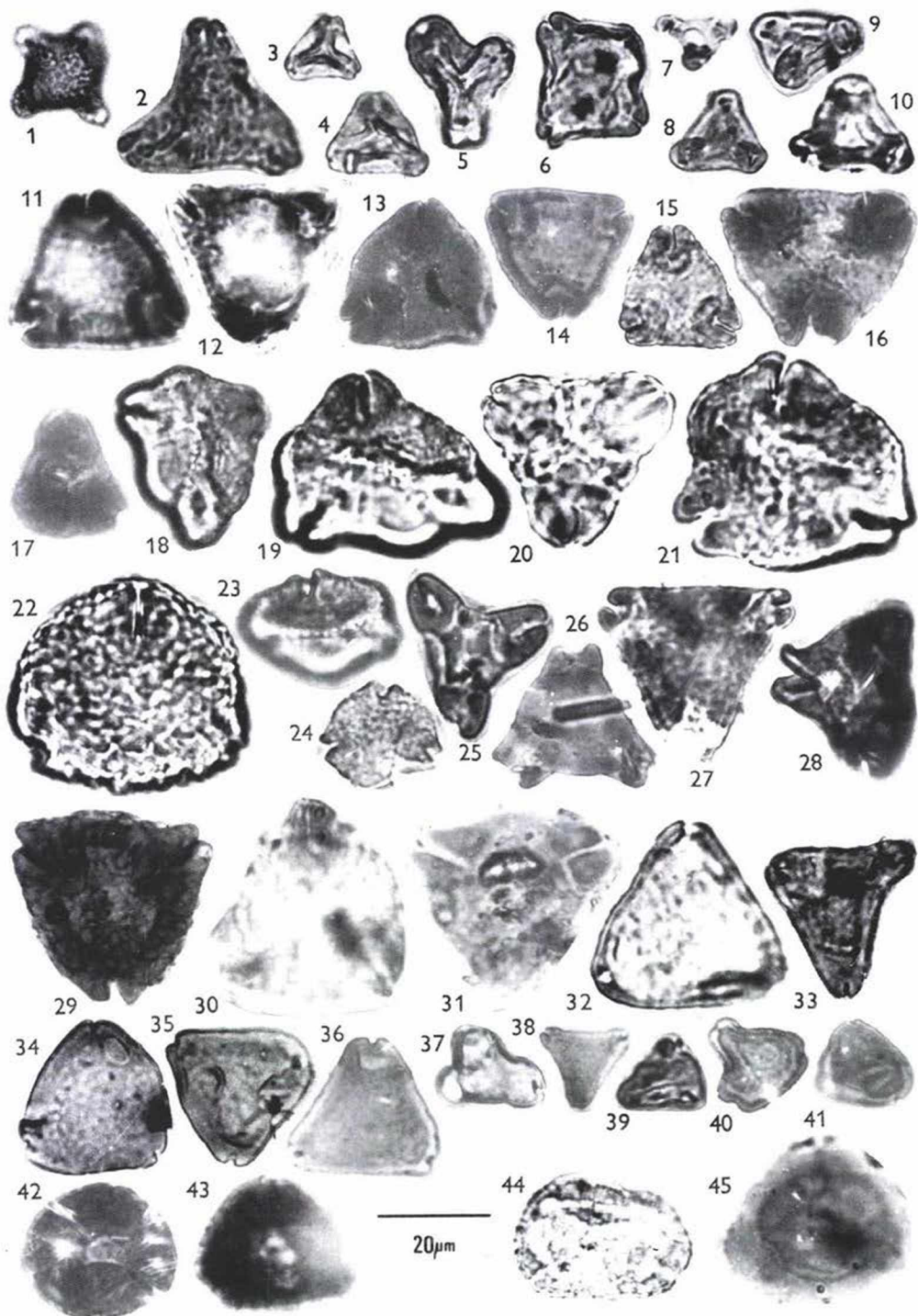
1. *Pityosporites* fsp., *Abietaceae*.
2. *Pityosporites pristiniipollinus* (TRAV. 1955) W. KR. 1971, *Abietaceae*, *Pinus*.
3. *Pityosporites* cf. *minimus* (ZAKL. 1957) W. KR. 1971, *Abietaceae*, *Pinus*.
4. *Ephedripites* fsp., *Ephedraceae*.
5. *Sequoiapollenites minor* W. KR. 1971, *Taxodiaceae*, *Sequoia*.
6. *Cupuliferoideaepollenites liblarensis* (THOMSON), in POTONIÉ, THOMSON and THIERGART, 1950) POTONIÉ 1960, *Cupuliferae*.
- 7-8. *Cupuliferoipollenites pusillus* (R. POT. 1934) R. POT. 1960, *Fagaceae*, *Castanea* type.
9. *Cupuliferoipollenites oviformis* (R. POT. 1931) TH. and PF. 1953 subfsp. *oviformis* (R. POT. 1931) TH. and PF. 1953, *Fagaceae*, *Castanea* type.
- 10-12. *Bolchovitinaepollenites miniverrucatus* KDS. and DIN. 1981.
13. *Bolchovitinaepollenites punctatus* KDS. and DIN. 1981.
14. *Complexiopollis complicatus* GÖCZ. 1964 f. *minor* DIN., KDS. and SICS. 1977.
- 15-16. *Complexiopollis praeatumescens* W. KR. 1959.
- 17-19. *Complexiopollis funiculus* TSCHUDY 1973.
- 20-21. *Complexiopollis* cf. *plicatus* KDS. 1980.
- 22-23. *Complexiopollis ameromii* KDS. 1980.
24. *Complexiopollis microrugulatus* KDS. 1980.
- 25-26. *Complexiopollis patulus* TSCHUDY 1973.
- 27-28. *Complexiopollis vilaflorensis* KDS. 1980.
- 29-31. *Complexiopollis concavus* KDS. 1980.
32. *Complexiopollis megagerminatus* KDS. 1980.
33. Cf. *Atlantopollis* fsp.





## Plate 2

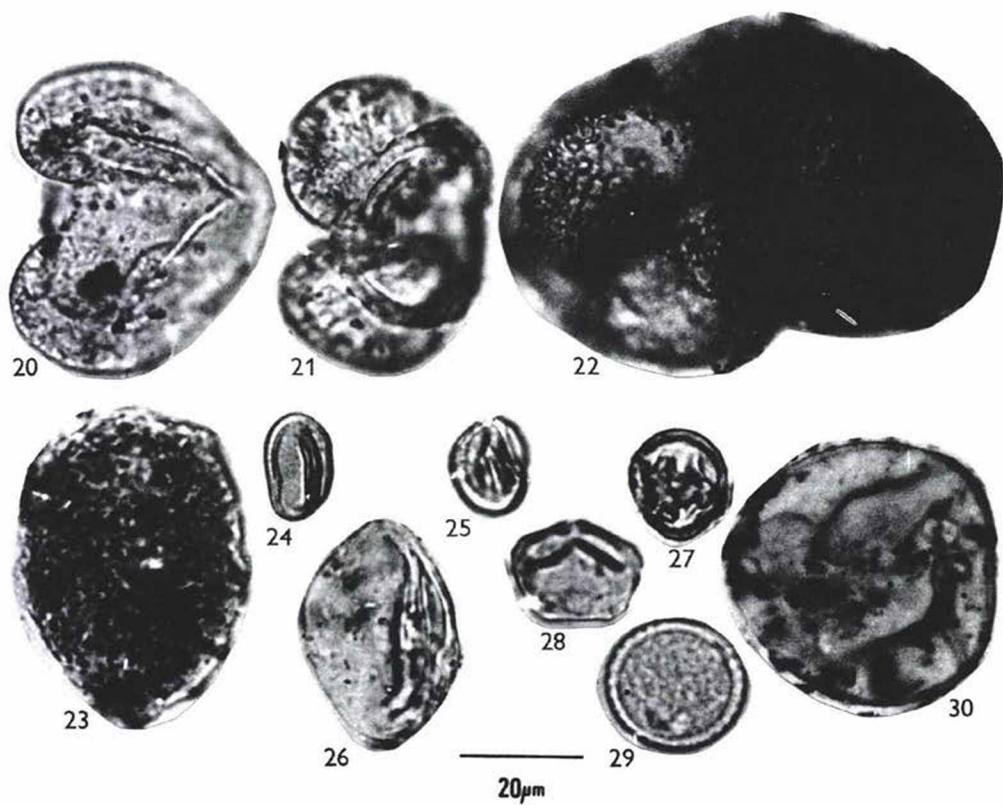
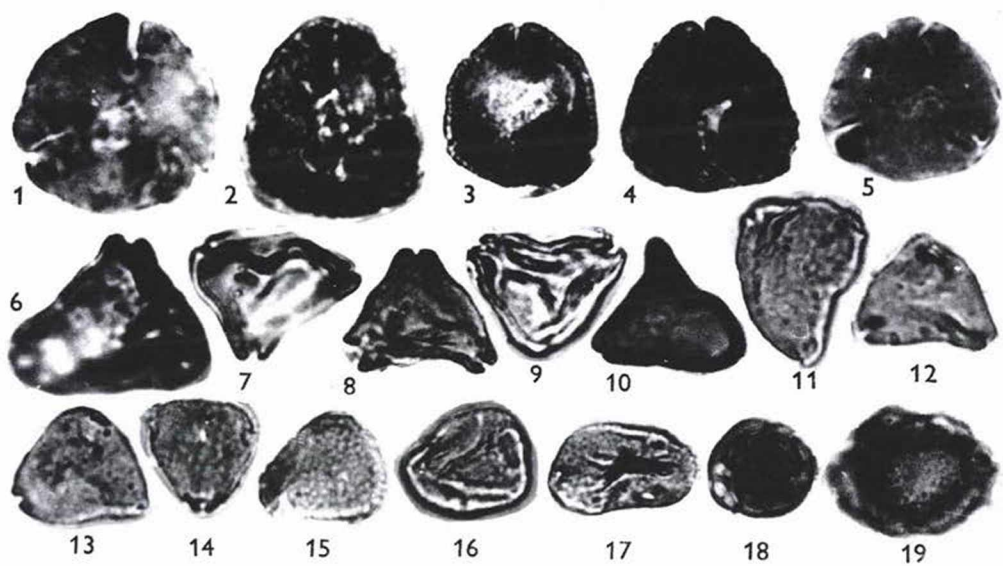
1. *Prezaipollenites concavus* f. *tetraexitum* KDS. and DIN. 1980/81.
2. *Atlantopollis verrucosus* (GROOT and GROOT 1962) W. KR. 1967.
- 3-4. *Plicapollis sarta* PF. 1953.
5. *Plicapollis pseudoexcelsus* (W. KR. 1958) W. KR. 1961 subfsp. *turgidus* PF. 1953.
6. *Plicapollis pseudoexcelsus* (W. KR. 1958) W. KR. 1961 subfsp. *semiturgidus* PF. 1953.
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- 13-14. *Oculopollis pertrudoides* W. KR. 1973.
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20. *Verruoculopollis skarbyae* KDS. and DIN. 1983.
21. *Verruoculopollis pflugii* KDS. and DIN. 1983.
22. *Verruoculopollis* fsp. 1.
23. *Verruoculopollis* fsp. 2.
24. *Verruoculopollis* fsp. 3.
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27. *Vacuopollis orthopyramis* PF. 1953 f. *magna* KDS. and DIN. 1980/81.
28. *Longanulipollis* fsp.
29. *Krutzschipollis magnoporatus* GÓCZ. 1967.
- 30-31. *Nudopollis terminalis* (PF. and TH. 1953) PF. 1953 subfsp. *cretacicus* KDS. and HERNGR. 1980.
32. *Rocheipollenites triangulus* KDS. and DIN. 1980/81.
33. *Rocheipollenites* fsp.
- 34-36. *Labraferoidaepollenites rurensis* (PF. and TH. 1953) KDS. 1980, *Myricaceae*.
37. Cf. *Vacuopollis microconcavus* PACLT. and W. KR. 1970.
- 38-39. Cf. *Subtrudopollis subtrudens* (PF. 1953) W. KR. 1967.
- 40-41. *Minorpollis maestrichtiensis* KDS. and HERNGR. 1980.
- 42-43. *Papillopollis pflugii* KDS. and PITT. 1979.
44. *Papillopollis* cf. *weylandii* KDS. and PITT. 1979.
45. *Papillopollis regulus* PF. 1953.





## Plate 3

1. *Papillopollis pittaue* KDS. and DIN. 1983.
2. *Papillopollis rugulatus* KDS. and PITT. 1979.
3. *Papillopollis krutzschii* KDS. and PITT. 1979.
4. Cf. *Aveiropollenites triangulus* KDS. and DIN. 1980/81.
5. *Papillopollis pflugii* KDS. and PITT. 1979.
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- 13-14. *Labraferoidaepollenites dilatus* (FAIRCH. 1966) KDS. 1982, *Myricaceae*.
15. *Tripoporollenites kleinoichingi* KDS. 1980, *Juglandaceae*.
- 16-17. *Subtripoporollenites palaeocenicus* KDS. 1980, *Juglandaceae*.
18. Cf. *Chenopodiipollis* fsp., *Chenopodiaceae*.
19. Cf. *Boltenhagenipollenites aradaensis* KDS. and DIN. 1980/81.
20. *Pityosporites insignis* (R. POT. 1931) W. KR. 1971, *Abietaceae*, *Pinus*.
21. *Podocarpidites piniverrucatus* W. KR. 1971, *Podocarpaceae*.
22. *Abiespollenites dubius* (CHLON. 1960) W. KR. 1971, *Abietaceae*.
23. *Sciadopityspollenites* fsp.
24. *Cupuliferoipollenites certus* FRED. 1973, *Fagaceae*.
25. *Cupuliferoipollenites oviformis* (R. POT. 1931) R. POT. 1960, *Fagaceae*, *Castanea* type.
26. *Intragranulitricolporites trevisanae* KDS. 1978.
27. *Tetracolporopollenites* fsp., *Sapotaceae*.
28. *Alnipollenites* fsp., *Betulaceae*, *Alnus*.
29. *Subtripoporollenites alpinus* (WOLFF 1934) TSCHUDY 1973, *Juglandaceae*.
30. *Caryapollenites simplex* (R. POT. 1931) RAATZ 1937 subfsp. *simplex* TH. and PF. 1953.



## Plate 4

1. *Piceapollis planoides* W. KR. 1971, *Abietaceae*, *Picea*.
2. *Pityosporites pristinipollinius* (TRAV. 1955) W. KR. 1971, *Abietaceae*, *Pinus*.
3. *Pityosporites minutus* (ZAKL. 1957) W. KR. 1971, *Abietaceae*, *Pinus*.
4. *Inaperturopollenites concedipites* (WODEH. 1933) W. KR. 1971, *Glyptostrobus* or other *Taxodiaceae* genera.
5. *Sequoiapollenites minor* W. KR. 1971, *Taxodiaceae*, *Sequoia*.
6. *Cupressacites insulipapillatus* (TREV. 1967) W. KR. 1971, *Cupressaceae*, *Juniperus* type.
7. *Cycadopites microfollicularis* W. KR. 1970.
8. *Cycadopites minimus* (COOKS. 1947) W. KR. 1970.
- 9-12, 22. *Scabratricolpites* fsp1., *Fagaceae*, cf. *Quercus*.
- 13-18. *Cupuliferoipollenites insleyanus* (TRAV. 1955) R. POT. 1960, *Fagaceae*.
- 19-20. *Cupuliferoipollenites oviformis* (R. POT. 1931) R. POT. 1960, *Fagaceae*, *Castanea* type.
21. *Scabratricolporites* fsp.
23. *Retitricolporites* fsp. 1, *Salicaceae*.
24. *Retitricolporites* fsp. 2, *Salicaceae*.
25. *Fususpollenites fusus* (R. POT. 1934) KDS. 1978, *Fagaceae*, *Castanopsis*.
26. *Cerceaupollenites* fsp., *Umbelliferae*.
27. *Ilexpollenites erdtmani* KDS. 1978, *Aquifoliaceae*, *Ilex*.
- 28-29. *Cyrillaceaeipollenites* fsp., *Cyrillaceae*.
- 30-32. *Retitricolporites nagyae* KDS. 1978, cf. *Oleaceae*.
33. *Lanagiopollis eocaenica* FRED. 1988, type.
34. *Alnipollenites* fsp., *Betulaceae*, *Alnus*.
35. Cf. *Punctioratipollis* fsp.
- 36,37. *Chenopodiipollis multiplex* (WEYL. and PF. 1957) W. KR. 1966, *Chenopodiaceae*.
38. *Pseudospinaepollis pseudospinus* W. KR. 1966, *Thymeliaceae*.
39. *Ulmipollenites undulosus* WOLFF 1934, *Ulmaceae*.
- 40-45. *Celtipollenites komloensis* E. NAGY 1969, *Celtis*.
- 46-47. Cf. *Caryophyllidites* fsp., *Caryophyllaceae*.



