

Early-Late Cretaceous (Aptian-Cenomanian) Palynomorphs

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Samples from 12 wells situated mainly in the northern part of the Cyrenaica Shelf of northeast Libya have yielded palynomorph assemblages of Aptian, Albian or Cenomanian aspect. The Aptian assemblages are dominated by land-plant remains and contain relatively few dinoflagellate cysts. By contrast, the latter are generally common in those from the Albian and Cenomanian samples. Deposition in near-shore marine environments is indicated for most of the Aptian succession whereas more open marine conditions are generally suggested for the younger strata. In places, however, a substantial terrestrial input was maintained during the accumulation of the Albian sediments.

Dinoflagellate cysts typically recorded from Aptian palynological preparations include *Aptea anaphrissa*, *Cyclonephelium* sp. 1, *Hystrichosphaerina schindewolfii*, *Muderongia simplex microperforata* and *Occisucysta* spp. Several species of *Cribroperidinium*, but especially *C. edwardsii* and *C. orthoceras*, usually form an important part of the Albian assemblages; *Kiokansium hydra* is also often present. Skolochorate cysts referable to *Coronifera* and *Florentinia* are abundant in both these and the Cenomanian preparations, with *Palaeohystrichophora infusorioides* and several species of *Canningia*, *Cyclonephelium*, *Oligosphaeridium*, *Spiniferites* and *Subtilisphaera* being among the most numerous of the associated forms. In general the assemblages compare closely with those of similar age described by Below (1981, 1982) and Williams (1978) from onshore and offshore Morocco respectively.

Although miospores are common in the Aptian preparations, they show relatively little morphological diversity. Smooth walled triradiate specimens, *Classopollis* and *Inaperturopollenites* are often the dominant forms. Angiosperm pollen grains are generally scarce and bisaccates only rarely encountered. A few of the Albian samples yielded moderately varied assemblages and several megaspores, mainly belonging to the genus *Balmeisporites*. Small spores of the *Perotrilites/Gabonisporis* group and pollen referable to *Ephedripites*, *Afropollis* and a number of tricolpate genera are among the most common Cenomanian taxa, but other palynomorphs which are also typical of the

mid-Cretaceous African-South American or Northern Gondwana palynofloral province (Herngreen, 1974; Brenner, 1976; Batten, 1984), such as *Elaterosporites klaszii* and *Elaterocolpites castelainii*, have been encountered as well. Previously published papers which discuss some of the species figured herein include Jardiné & Magloire (1965), Jardiné (1967), Reyre (1973), Regali *et al.* (1974) Saad & Ghazaly (1976), Saad (1978), Kotova (1978), Hochuli (1981), Doyle *et al.* (1982) and Schrank (1983).

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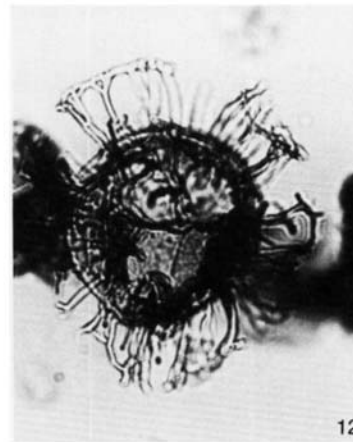
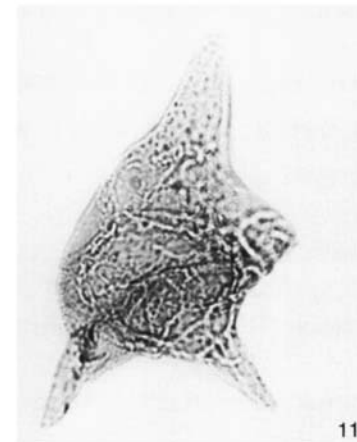
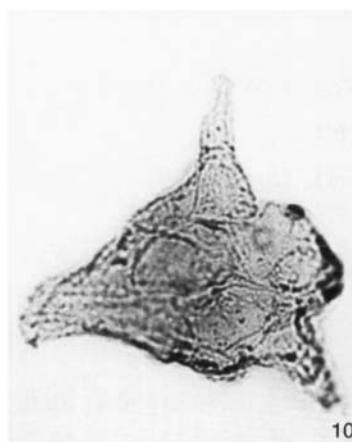
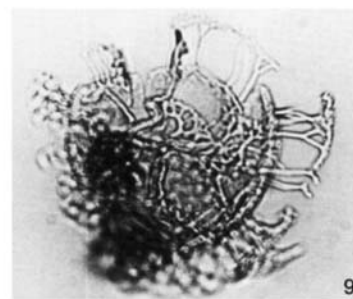
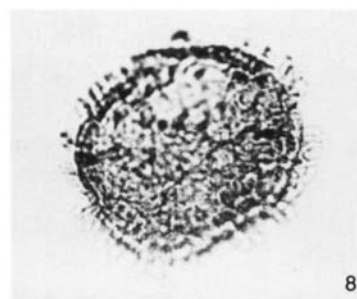
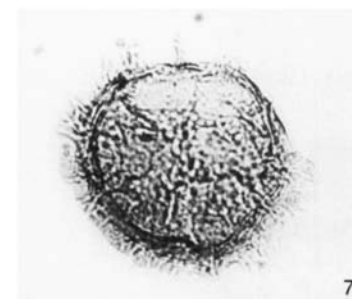
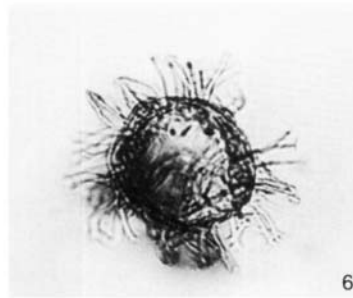
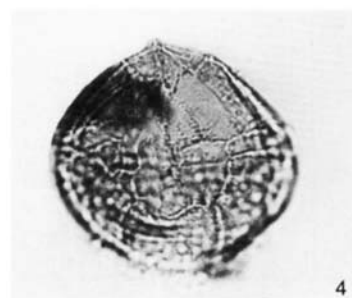
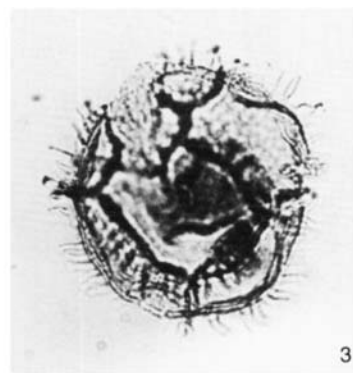
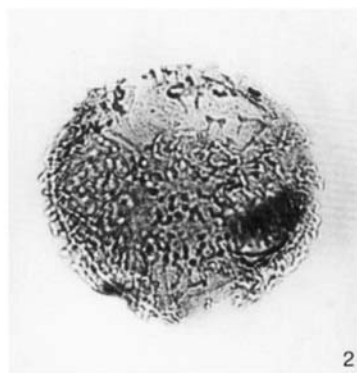
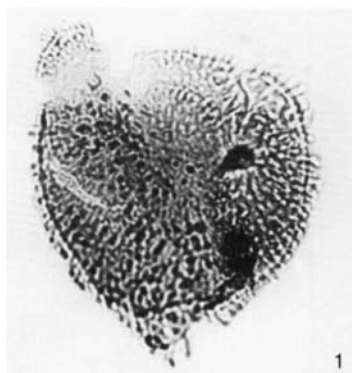
* P. J. R. U. acknowledges financial support from the Jersey Education Authority during the course of this study.

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Explanation of Plate 61

All figures are $\times 500$

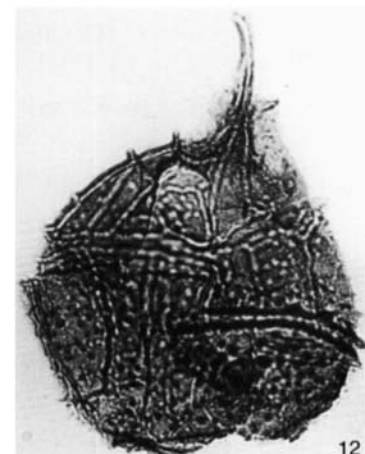
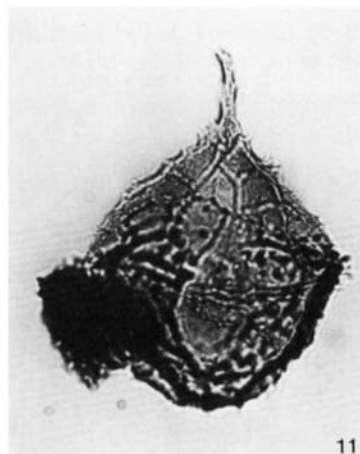
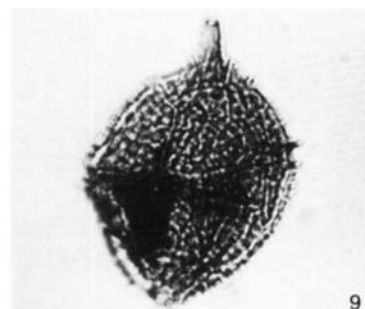
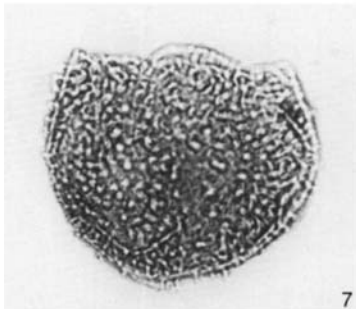
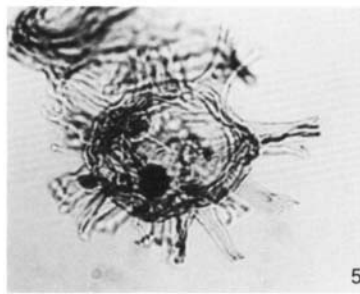
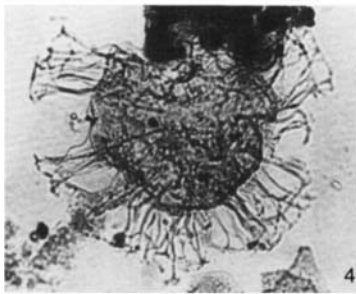
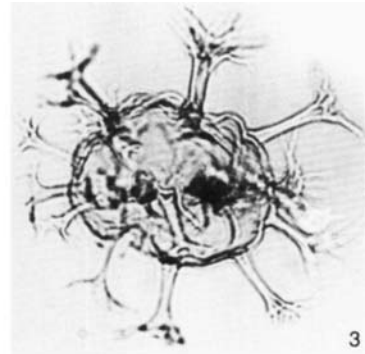
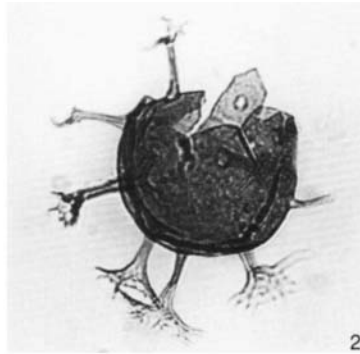
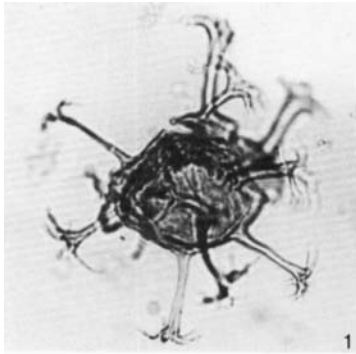
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- Fig. 2. *Cyclonephelium* sp. 1. C1–33, Core 4, 6944 ft., Slide 2, U37/3, AGC 676.
- Fig. 3. *Ctenidodinium elegantulum* Millioud, 1969, emend. Below, 1981. B1–2, 7450–7490 ft., Slide 3, X47/3, AGC 677.
- Fig. 4. *Occisucysta evittii* (Dodekova, 1969) Gitmez, 1970. C1–33, Core 4, 6947 ft., Slide 2, H34/0, AGC 678.
- Fig. 5. *Occisucysta* sp. cf. *O. sousensis* Below, 1981. C1–33, Core 4, 6947 ft., Slide 2, U24/1, AGC 679.
- Fig. 6. *Systematophora complicata* Neale & Sarjeant, 1962. C1–33, Core 4, 6957 ft., Slide 3, K46/4, AGC 680.
- Fig. 7. *Occisucysta* sp. C1–33, Core 4, 6944 ft., Slide 2, X15/4, AGC 681.
- Fig. 8. *Occisucysta* sp. C1–33, Core 4, 6947 ft., Slide 2, O56/4, AGC 682.
- Fig. 9. *Hystrichosphaerina schindewolfii* Alberti, 1961. C1–33, Core 4, 6957 ft., Slide 3, K29/2, AGC 683.
- Fig. 10. *Muderongia simplex* Alberti, 1961. subsp. *microperforata* Davey, 1982. C1–33, Core 4, 6944 ft., Slide 2, O16/3, AGC 684.
- Fig. 11. *Muderongia simplex* Alberti, 1961. subsp. *microperforata* Davey, 1982. C1–33, Core 4, 6944 ft., Slide 2, V41/1, AGC 685.
- Fig. 12. *Hystrichosphaerina schindewolfii* Alberti, 1961. C1–33, Core 4, 6957 ft., Slide 3, J39/4, AGC 686.



Explanation of Plate 62

All figures are $\times 500$

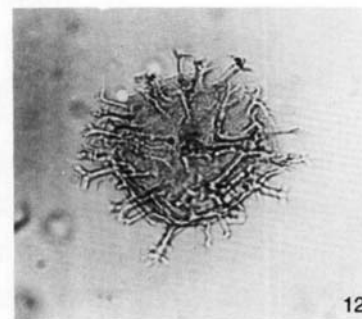
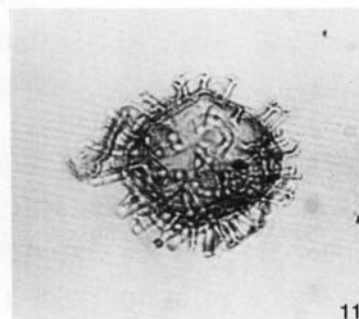
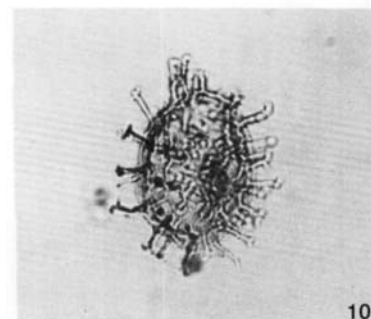
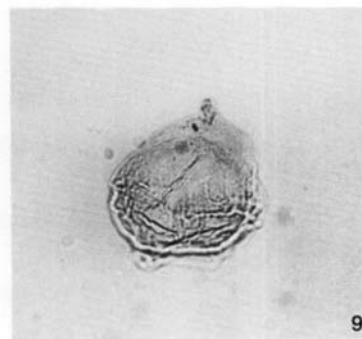
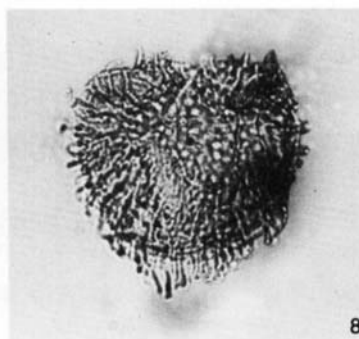
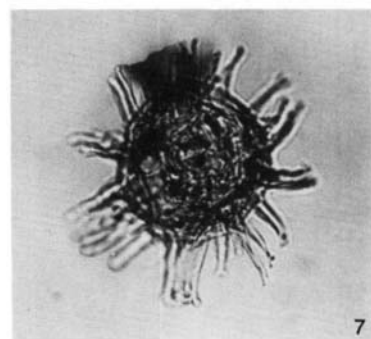
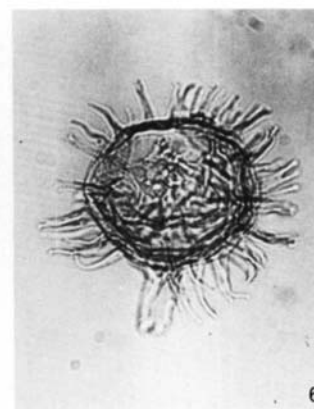
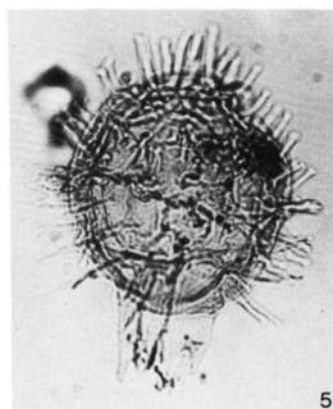
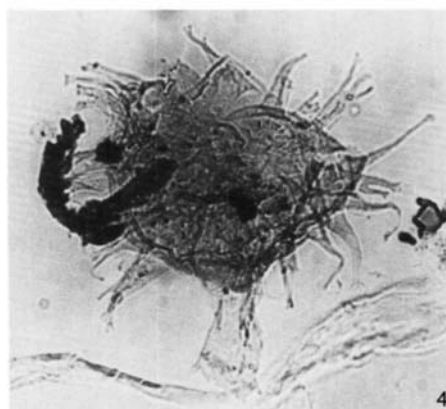
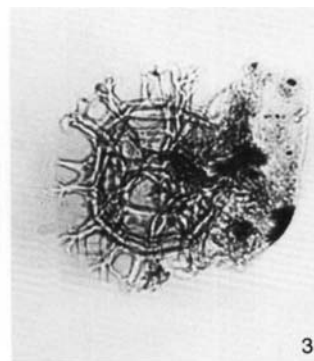
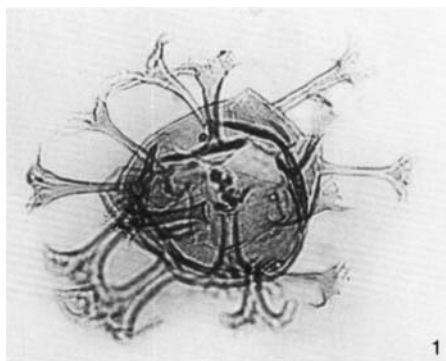
- Fig. 1. *Oligosphaeridium* sp. cf. *O. asterigerum* (Gocht, 1959) Davey & Williams, 1969. A1–19, 6160–6190 ft., Slide 2, G29/0, AGC 687.
- Fig. 2. *Oligosphaeridium pulcherrimum* (Deflandre & Cookson, 1955) Davey & Williams, 1966. F1–2, 7940–7950 ft., Slide 3, H23/0, AGC 688.
- Fig. 3. *Oligosphaeridium complex* (White, 1842) Davey & Williams, 1966. B1–36, Core 1, 1342 ft., Slide 2, W35/4, AGC 689.
- Fig. 4. *Hystrichosphaerina schindewolfii* Alberti, 1961. A1–NC92, 6300–6310 ft., Slide 4, O37/3, AGC 690.
- Fig. 5. *Kleithrisphaeridium eoinodes* (Eisenack, 1958) Davey, 1974. A1–28, Core 3, 3031 ft., Slide 2, F51/4, AGC 691.
- Fig. 6. *Perisseiasphaeridium insolitum* Davey, 1982. F1–2, 4740–4750 ft., Slide 3, W45/3, AGC 692.
- Fig. 7. *Cyclonephelium* sp. C1–33, Core 4, 6944 ft., Slide 2, W50/1, AGC 693.
- Fig. 8. *Pareodinia ceratophora* Deflandre, 1947 emend. Gocht, 1970. C1–33, Core 4, 6957 ft., Slide 3, P26/2, AGC 694.
- Fig. 9. *Cribroperidinium orthoceras* (Eisenack, 1958) Davey, 1969. A1–18, Core 9, 3843–3850 ft., Slide 3, J43/0, AGC 695.
- Fig. 10. *Cribroperidinium* sp. cf. *C. exilicristatum* (Davey, 1969) Stover & Evitt, 1978. A1–18, Core 3, 1771–1788 ft., Slide 3, P23/4, AGC 696.
- Fig. 11. *Cribroperidinium edwardsii* (Cookson & Eisenack, 1958) Davey, 1969. F1–2, 4450–4460 ft., Slide 3, O34/3, AGC 697.
- Fig. 12. *Cribroperidinium edwardsii* (Cookson & Eisenack, 1958) Davey, 1969. F1–2, 5020–5030 ft., Slide 3, O25/3, AGC 698.



Explanation of Plate 63

All figures are $\times 500$

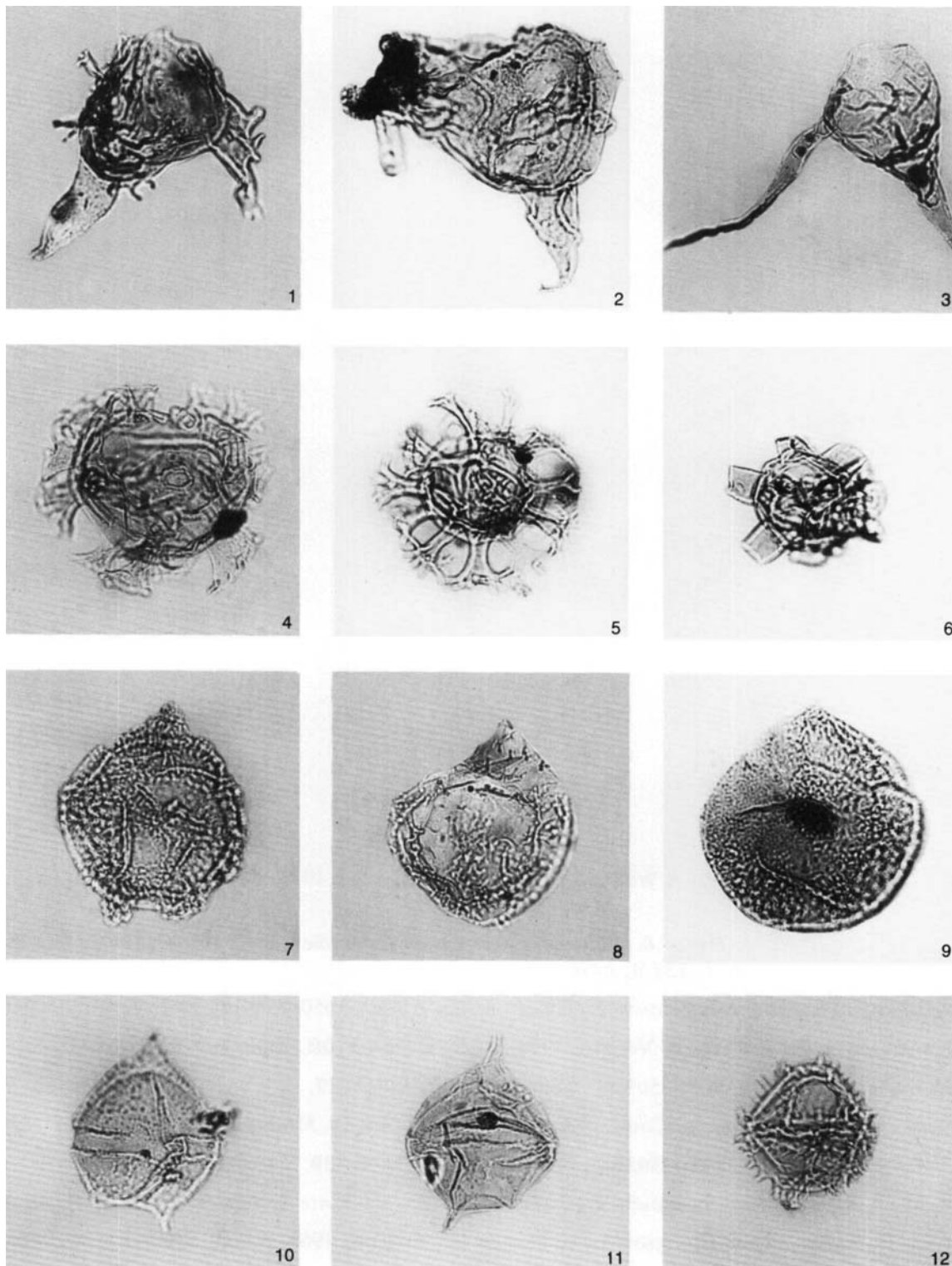
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- Fig. 2. *Oligosphaeridium* sp. cf. *O. pulcherrimum* (Deflandre & Cookson, 1955) Davey & Williams, 1966. A1–28, Core 3, 3047 ft., Slide 2, P38/2, AGC 700.
- Fig. 3. *Spiniferites ramosus* (Ehrenberg, 1838) Loeblich & Loeblich, 1966 subsp. *multibrevis* (Davey & Williams, 1966) Lentin & Williams, 1973. A1–45, Core 2, 5320 ft., Slide 3, P34/2, AGC 701.
- Fig. 4. *Florentinia radiculata* (Davey & Williams, 1966) Davey & Verdier, 1973 emend. Davey & Verdier, 1976. A1–NC92, 6080 ft., Slide 6, M38/2, AGC 702.
- Fig. 5. *Florentinia* sp. A1–28, Core 3, 3057 ft., Slide 2, P45/1, AGC 703.
- Fig. 6. *Coronifera albertii* Millioud, 1969. A1–28, Core 3, 3047 ft., Slide 2, G51/0, AGC 704.
- Fig. 7. *Coronifera albertii* Millioud, 1969. A1–28, Core 3, 3047 ft., Slide 2, H21/4, AGC 705.
- Fig. 8. *Cyclonephelium vannophorum* Davey, 1969. A1–45, Core 2, 5332 ft., Slide 3, E26/4, AGC 706.
- Fig. 9. *Subtilisphaera perlucida* (Alberti 1959) Jain & Millepied, 1973. A1–28, Core 3, 3047 ft., Slide 2, T54/3, AGC 707.
- Fig. 10. *Kiokansium hydra* (Duxbury, 1979) Below, 1982. A1–18, Core 10, 4520–4529 ft., Slide 2, D19/4, AGC 708.
- Fig. 11. *Kiokansium hydra* (Duxbury, 1979) Below, 1982. A1–18, 4520–4529 ft., Slide 2, N45/0, AGC 709.
- Fig. 12. *Kiokansium hydra* (Duxbury, 1979) Below, 1982. A1–18, Core 3, 1771–1788 ft., Slide 3, G33/0, AGC 710.



Explanation of Plate 64

All figures are $\times 500$

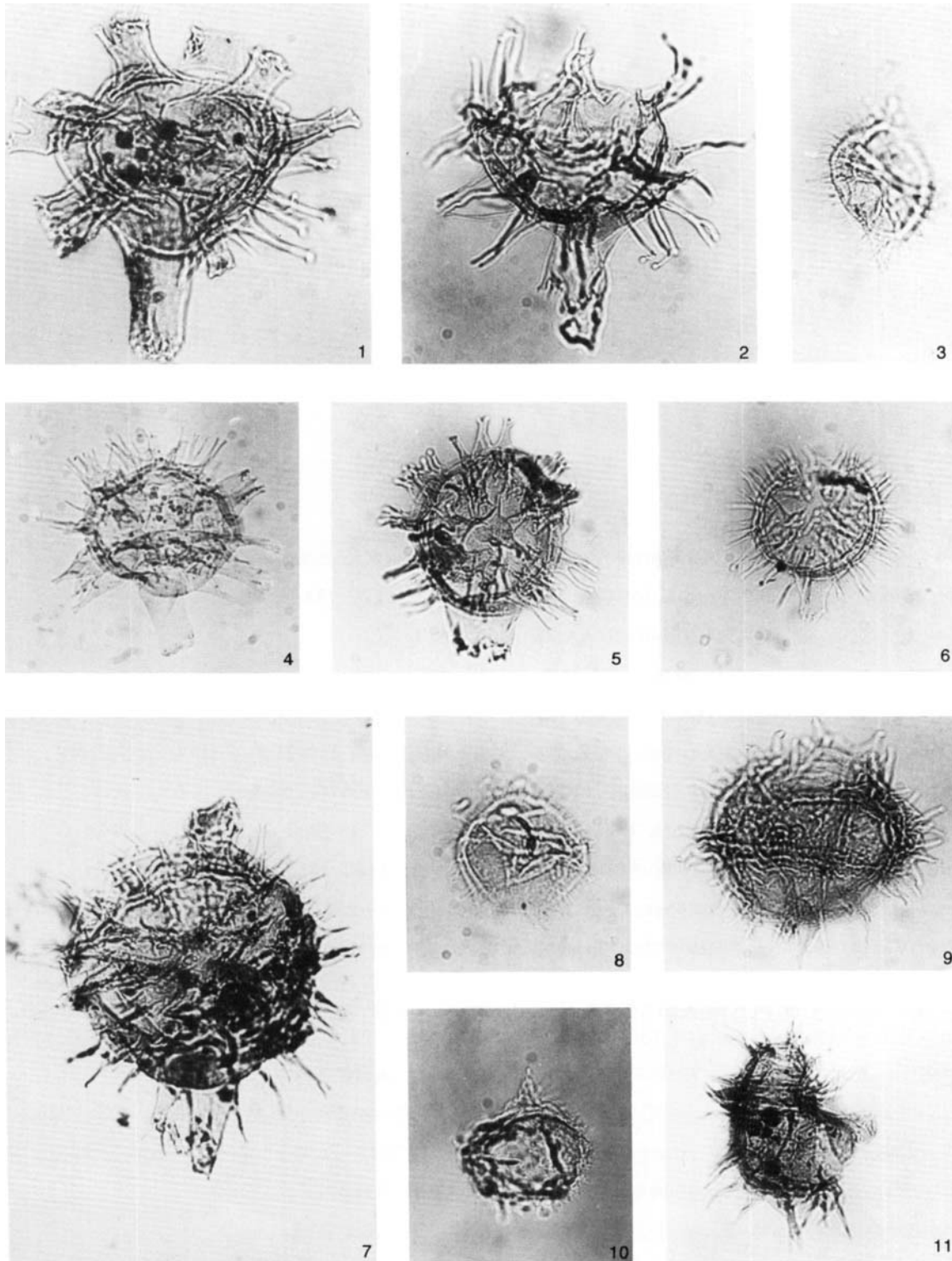
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- Fig. 2. *Xenascus ceratioides* (Deflandre, 1937) Lentin & Williams, 1973. A1–45, Core 1, 5229ft., Slide 3, O29/0, AGC 712.
- Fig. 3. *Odontochitina operculata* (O. Wetzel, 1933) Deflandre & Cookson, 1955. A1–45, Core 2, 5320ft., Slide 3, X33/4, AGC 713.
- Fig. 4. *Oligosphaeridium djenn* Below, 1982. B1–33, Core 1, 4944–4947ft., Slide 2, P35/1, AGC 714.
- Fig. 5. *Oligosphaeridium* sp. cf. *O. diliculum* Davey, 1982. A1–19, 5150–5190ft., Slide 2, N55/3, AGC 715.
- Fig. 6. *Litosphaeridium siphoniphorum* (Cookson & Eisenack, 1958) Davey & Williams, 1966. A1–45, Core 1, 5223ft., Slide 3, Q45/4, AGC 716.
- Fig. 7. *Cyclonephelium* sp. cf. *C. chabaca* Below, 1981. A1–19, 5100–5140ft., Slide 2, N46/3, AGC 717.
- Fig. 8. *Cyclonephelium paucispinum* Davey, 1969. A1–19, 5150–5190ft., Slide 2, U46/0, AGC 718.
- Fig. 9. *Cyclonephelium inconspicuum* Duxbury, 1983. A1–19, 5150–5190ft., Slide 2, W55/2, AGC 719.
- Fig. 10. *Subtilisphaera cheit* Below, 1981. A1–19, 5150–5190ft., Slide 2, P18/3, AGC 720.
- Fig. 11. *Subtilisphaera* sp. cf. *S. zawia* Below, 1981. A1–19, 5050–5090ft., Slide 2, G54/3, AGC 721.
- Fig. 12. *Spiniferites* sp. cf. *S. lenzii* Below, 1982. A1–19, 5050–5090ft., Slide 2, H33/1, AGC 722.



Explanation of Plate 65

All figures are $\times 500$

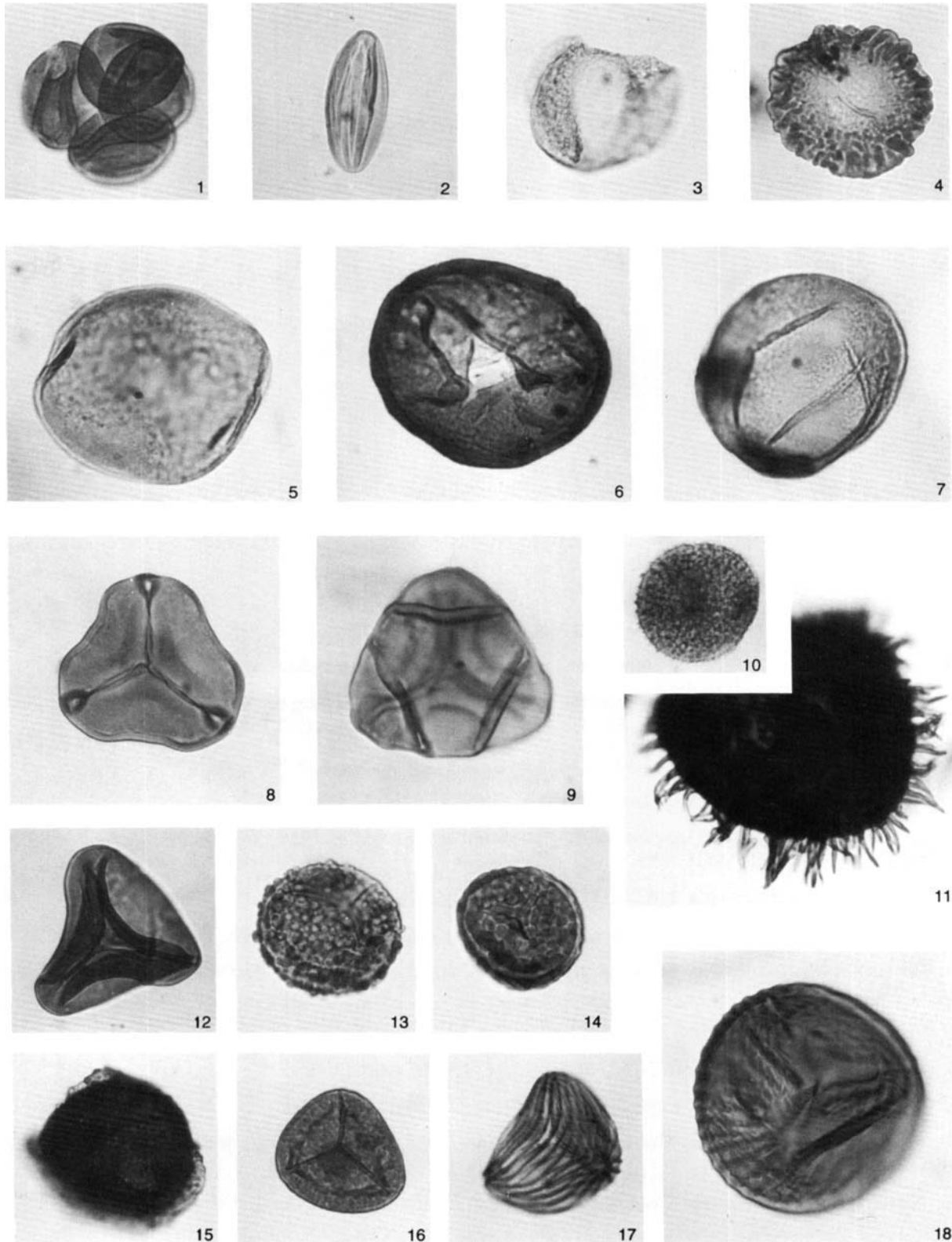
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- Fig. 2. *Florentinia radiculata* (Davey & Williams, 1966) Davey & Verdier, 1973 emend. Davey & Verdier, 1976. A–19, 5100–5140 ft., Slide 2, J57/0, AGC 724.
- Fig. 3. *Palaeohystrichophora infusorioides* Deflandre, 1935. A1–19, 5050–5090 ft., Slide 2, R53/0, AGC 725.
- Fig. 4. *Florentinia laciniata* Davey & Verdier, 1973. B1–2, 6300–6350 ft., Slide 1, Y39/4, AGC 726.
- Fig. 5. *Florentinia* sp. A1–19, 5050–5090 ft., Slide 2, V42/4, AGC 727.
- Fig. 6. *Coronifera* sp. cf. *C. tubulosa* Cookson & Eisenack, 1974. A1–19, 5150–5190 ft., Slide 2, H31/1, AGC 728.
- Fig. 7. *Florentinia* sp. A1–19, 4950–5020 ft., Slide 2, M36/0, AGC 729.
- Fig. 8. *Palaeohystrichophora infusorioides* Deflandre, 1935. A1–45, Core 1, 5223 ft., Slide 3, R41/0, AGC 730.
- Fig. 9. *Xiphophoridium alatum* (Cookson & Eisenack, 1962) Sarjeant, 1966. A1–19, 5100–5140 ft., Slide 2, M50/0, AGC 731.
- Fig. 10. *Palaeohystrichophora infusorioides* Deflandre, 1935. A1–45, Core 2, 5320 ft., Slide 3, O51/3, AGC 732.
- Fig. 11. *Hystrichodinium pulchrum* Deflandre, 1935. B1–2, 6300–6350 ft., Slide 1, J30/1, AGC 733.



Explanation of Plate 66

All figures are $\times 500$ unless otherwise indicated

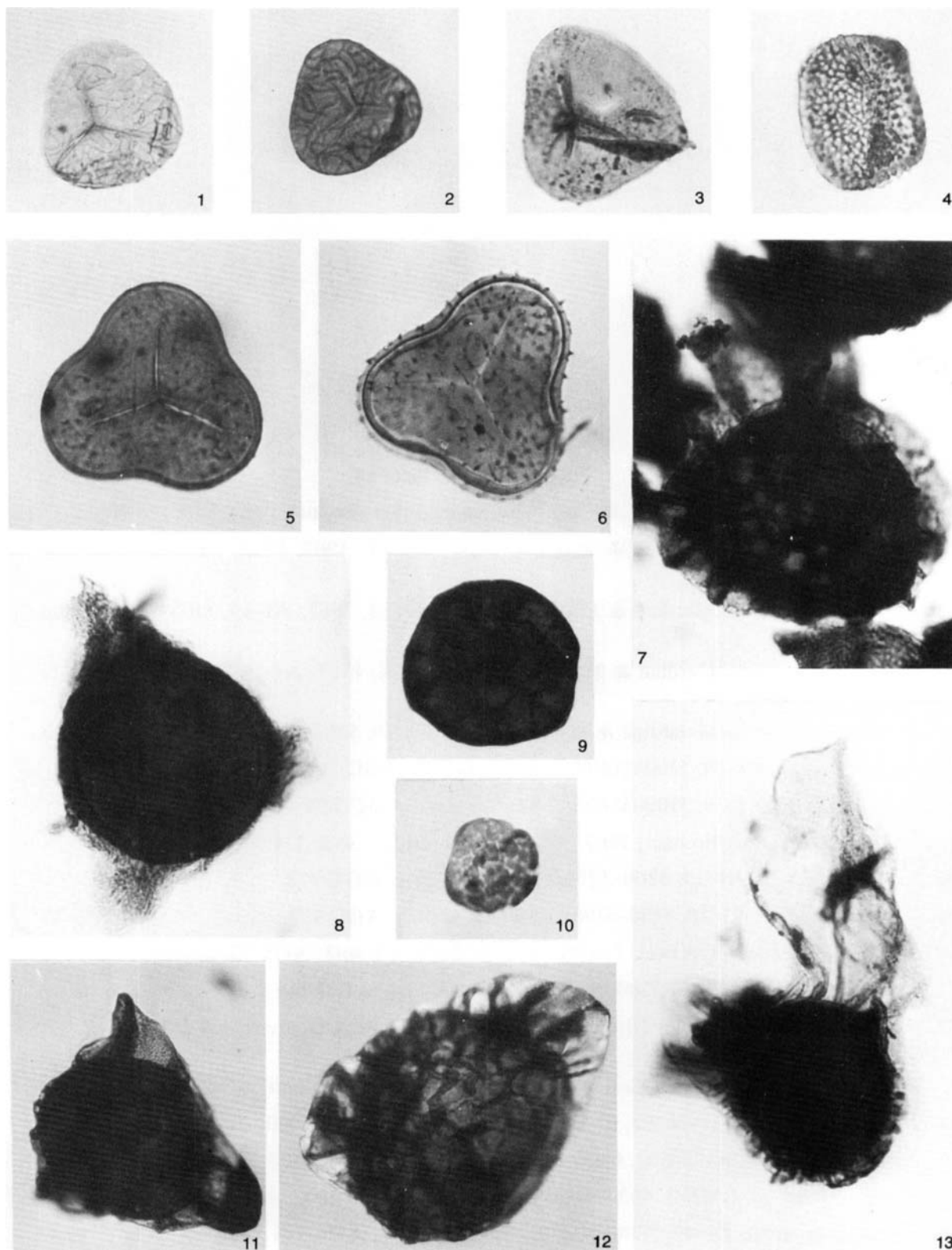
- Fig. 1. *Classopollis* sp. C1–33, Core 4, 6944 ft., Slide 2, G40/5, AGC 734.
- Fig. 2. *Ephedripites* sp. 1. B1–2, 6300–6350 ft., Slide 1, D28/0, AGC 735.
- Fig. 3. *Alisporites* sp. F1–2, 4450–4460 ft., Slide 3, C31/3, AGC 736.
- Fig. 4. *Tsugaepollenites dampieri* (Balme, 1957) Dettmann, 1963. B1–2, 7320–7370 ft., Slide 2, T30/3, AGC 737.
- Fig. 5. *Spheripollenites scabratus* Couper, 1958. C1–33, 6944 ft., Slide 2, N21/1, $\times 1000$, AGC 738.
- Fig. 6. *Inaperturopollenites limbatus* Balme, 1957. A1–28, Core 3, 3047 ft., Slide 2, K46/3, AGC 739.
- Fig. 7. *Araucariacites australis* Cookson, 1947. C1–33, Core 4, 6957 ft., Slide 3, N52/0, AGC 740.
- Fig. 8. *Dictyophyllidites* sp. F1–2, 4450–4460 ft., Slide 3, Z29/3, AGC 741.
- Fig. 9. *Gleicheniidites apilobatus* Brenner, 1963. B1–36, Core 9, 5310–5326 ft., Slide 2, H51/3, $\times 1000$, AGC 742.
- Fig. 10. *Reticulisporites* sp. cf. *Reticuliriletes heteroluminensis* Boltenhagen, 1975. C1–33, Core 3, 5891 ft., Slide 3, G16/0, AGC 743.
- Fig. 11. *Pilosisorites* sp. cf. *P.* type A in Saad & Ghazaly (1976) and *P.* sp. in Regali *et al.* (1974, Pl. 3, fig. 1) A1–18, Core 13, 6441–6451 ft., Slide 2, J35/4, AGC 744.
- Fig. 12. *Concavisporites* sp. F1–2, 7940–7950 ft., Slide 3, X40/2, AGC 745.
- Fig. 13. *Leptolepidites* sp. cf. *L. major* Couper, 1958. F1–2, 4450–4460 ft., Slide 3, N30/3, AGC 746.
- Fig. 14. *Verrucosisporites* sp. cf. *V. rotundus* Singh, 1964. F1–2, 7840–7850 ft., Slide 3, X48/3, AGC 747.
- Fig. 15. *Aequitriradites* sp. C1–33, 6944 ft., Slide 2, D20/4, AGC 748.
- Fig. 16. *Staplinisorites* sp. F1–2, 3920–3960 ft., Slide 2, W42/0, AGC 749.
- Fig. 17. *Cicatricosisporites* sp. 1. C1–33, Core 3, 5876 ft., Slide 1, O55/2, AGC 750.
- Fig. 18. *Cicatricosisporites* sp. 2 cf. *C.* sp. in Regali *et al.*, (1974, Pl. 6, fig. 4). F1–2, 4450–4460 ft., Slide 3, F48/3, $\times 1000$, AGC 751.



Explanation of Plate 67

All figures are $\times 500$ unless otherwise indicated

- Fig. 1. *Reticulisporites* sp. cf. specimens recorded as *Camarozonosporites insignis* Norris, 1959 (*sic*) in Saad (1978, p. 274 and Pl. 3, figs. 5, 6.) C1-33, Core 3, 5876 ft., Slide 1, O43/0, AGC 752.
- Fig. 2. *Reticulisporites* sp. (as in Fig. 1.) C1-33, Core 3, 5876 ft., Slide 3, R56/0, AGC 753.
- Fig. 3. *Granulatisporites* sp. C1-33, Core 3, 5876 ft., Slide 1, N53/0, AGC 754.
- Fig. 4. *Foraminisporis* sp. cf. *F. asymmetricus* (Cookson & Dettmann, 1958) Dettmann, 1963. C1-33, Core 3, 5876 ft., Slide 3, F22/0, AGC 755.
- Fig. 5. ?Cyatheaceous spore-type 1. C1-33, Core 3, 5876 ft., Slide 3, R21/3, AGC 756.
- Fig. 6. ?Cyatheaceous spore-type 1 (as in Fig. 5.) C1-33, Core 3, 5876 ft., Slide 1, Q52/3, AGC 757.
- Fig. 7. *Balmeisporites holodictyus* Cookson & Dettmann, 1958. C1-33, Core 3, 5881 ft., Slide 2, R42/0, $\times 330$, AGC 758.
- Fig. 8. *Perotrilites* sp. C1-33, Core 3, 5876 ft., Slide 3, L23/0, $\times 330$, AGC 759.
- Fig. 9. ?*Trochicola* sp. C1-33, Core 3, 5876 ft., Slide 1, J50/0, AGC 760.
- Fig. 10. *Patellasporites* sp. C1-33, Core 3, 5876 ft., Slide 1, L55/2, AGC 761.
- Fig. 11. *Balmeisporites holodictyus* Cookson & Dettmann, 1958. C1-33, Core 3, 5881 ft., Slide 2, V34/2, $\times 250$, AGC 762.
- Fig. 12. *Balmeisporites holodictyus* Cookson & Dettmann, 1958. C1-33, Core 3, 5876 ft., Slide 3, D55/2, $\times 330$, AGC 763.
- Fig. 13. *Balmeisporites* sp. C1-33, Core 3, 5876 ft., Slide 1, U51/3, $\times 330$, AGC 764.



Explanation of Plate 68

All figures are $\times 500$ unless otherwise indicated

- Fig. 1. *Elaterosporites klaszii* (Jardiné & Magloire, 1965) Jardiné, 1967. F1–2, 4450–4460ft., Slide 3, S34/4, AGC 765.
- Fig. 2. *Elaterosporites klaszii* (Jardiné & Magloire, 1965) Jardiné, 1967. A1–19, 5100–5140ft., Slide 2, J36/1, AGC 766.
- Fig. 3. *Elaterosporites klaszii* (Jardiné & Magloire, 1965) Jardiné, 1967. A1–19, 5200–5300ft., Slide 2, M32/4, AGC 767.
- Fig. 4. *Elaterocolpites castelainii* Jardiné & Magloire, 1965. A1–19, 5200–5300ft., Slide 2, K32/0, AGC 768.
- Fig. 5. *Gabonisoris* sp. A1–19, 5100–5140ft., Slide 3, O26/2, AGC 769.
- Fig. 6. *Gabonisoris* sp. A1–19, 5100–5140ft., Slide 3, L35/1, AGC 770.
- Fig. 7. *Perotrilites pannuceus* Brenner, 1963. A1–19, 5150–5190ft., Slide 2, C34/2, AGC 771.
- Fig. 8. *Crybelosporites* sp. A1–19, 5200–5300ft., Slide 2, F52/0, AGC 772.
- Fig. 9. *Ephedripites* sp. 2. A1–19, 5150–5190ft., Slide 2, M24/3, AGC 773.
- Fig. 10. *Gnetaceaepollenites* sp. A1a–117, 3880–3970ft., Slide 3, L40/3, AGC 774.
- Fig. 11. *Ephedripites* sp. 3. A1–19, 5200–5300ft., Slide 2, E25/0, AGC 775.
- Fig. 12. *Afropollis* sp. cf. *A. jardinus* (Brenner, 1963) Doyle, Jardiné & Doerenkamp, 1982. B1–2, 6300–6350ft., Slide 1, S23/3, $\times 1000$, AGC 776.
- Fig. 13. *Retimonocolpites* sp. C1–33, Core 3, 5876ft., Slide 1, V48/1, $\times 1000$, AGC 777.
- Fig. 14. *Clavatipollenites* sp. A1–NC92, 6200–6210ft., Slide 5, S26/3, $\times 1000$, AGC 778.
- Fig. 15. *Tricolporoidites* sp. A1–NC92, 6200–6210ft., Slide 5, P25/4, $\times 1000$, AGC 779.
- Figs. 16, 17. *Tricolpites* sp. 1. F1–2, 4630–4660ft., Slide 3, D43/0, $\times 1000$, AGC 780.
- Fig. 18. *Foveotricolpites* sp. A1–19, 5200–5300ft., Slide 2, H53/2, AGC 781.
- Fig. 19. *Tricolpites* sp. 2. A1–19, 5200–5300ft., Slide 2, N40/4, AGC 782.

