LEAF-CUTICLE AND OTHER PLANT MICROFOSSILS FROM THE MESOZOIC ROCKS OF ANDØYA, NORWAY

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ABSTRACT

The present paper describes a fragmentary leaf of *Thinnfeldia*, a Ginkgoalean type of leaf-cuticle, female cone-scales of *Sciadopitytes*, spores and pollen grains from Andøya, Norway.

INTRODUCTION

WHILE examining a collection of plant fossils from Andøya, in the Paleontologisk Museum, Oslo (collected on an expedition led by Dr. T. Ørvig, 1952), I came across a fragmentary carbonized leaf which looked different from all the leaves described by Johansson (1920) from the same locality. I selected out this specimen for cuticular preparation which, on examination under the microscope, looked like the cuticle of *Thinnfeldia* Ett. Along with this specimen I also sorted out a few samples of shales for maceration. When the shales were macerated in bulk, a large number of cuticle pieces were isolated along with a few female cone-scales of *Sciadopitytes*, spores and pollen grains. Most of the cuticle pieces either belong to the various species of *Sciadopitytes* described earlier by Johansson (1920) and Florin (1922) from this locality or to a species belonging to the Ginkgoales.

DESCRIPTION

? *Thinnfeldia* sp. (TEXT-FIG. 1C, E and TEXT-FIG. 2A-D)—Frond pinnate, none of the pinnae complete, only the basal regions of pinnae preserved. Lower basal angle of pinnae decurrent.

Cuticle fairly thick. Stomata present only on the lower side. Cells of the upper side square, rectangular or polygonal. Lateral wall fairly thick and almost straight. Surface wall unspecialized, sometimes slightly mottled. Lower surface shows a fairly broad non-stomatal zone (perhaps representing the mid-rib) and on either side of this two broad stomatal zones. Cells of the non-stomatal zone rectangular or polygonal, arranged in series. Lateral wall thick and straight, surface wall unspecialized. Stomata closely packed and irregularly orientated. Subsidiary cells of adjoining stomata touching each other, but two stomata never share a common subsidiary cell. Subsidiary cells mostly 6, sometimes 5 or 7. Guard-cells mostly not preserved, very thinly cutinized, a few with encircling cells. Trichomes absent. Ordinary epidermal cells between the stomata, polygonal. Lateral wall thinner than the cells of non-stomatal region.

In the distribution and shape of the stomata, the present cuticle is somewhat similar to the cuticle of *Thinnfeldia polymorpha* (Braun) described by Antevs (1914).

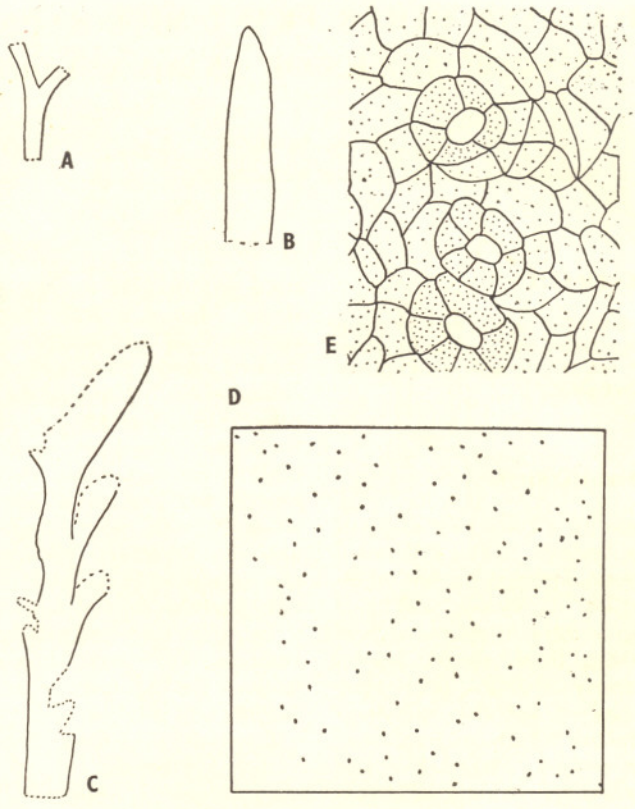
Locality — Andøya, Norway.

Age — Jurassic.

Collection — Specimen No. 66866 of Paleontologisk Museum, Oslo.

Ginkgoalean cuticle (TEXT-FIG. 1A, B, D and TEXT-FIG. 2A, B). Numerous pieces of cuticle were obtained by bulk maceration. All of them showed a surprising resemblance to the cuticle of *Baiera* Braun. One piece (TEXT-FIG. 1A) was even found to bifurcate near the tip. Largest piece (TEXT-FIG. 1B) is 1·5 cm. long, breadth varying from 1·5 to 6 mm.

Cuticle — Cuticle fairly thick, stomata present on both sides, more on the lower side than the upper. Upper cuticle showing long, narrow, rectangular cells along the veins and wider polygonal ones between the veins. Lateral and end-walls straight and fairly thick, surface flat. Shape of stomata same as on the lower side. Lower cuticle showing narrow and ill-defined zones along veins, with sometimes stomata occurring over them, and broad intervening zones with irregularly scattered stomata. Cells along the veins rectangular, a few elongate. Cells between veins variously shaped, mostly polygonal and transversely elongated. Lateral and end-walls thick and straight, surface unspecialized, sometimes slightly thickened or papillate. Stomata distantly placed and



TEXT-FIG. 1 — A, portion of a dichotomously branched Ginkgoalean leaf, Sl. No. 66844/20, × 2. B, another Ginkgoalean leaf, Sl. No. 66845/16, × 2. C, ? *Thinnfeldia* sp., Sl. No. 66866, × 2. D, lower cuticle of the specimen shown in Text-fig. B, showing the distribution of stomata, Sl. No. 66845/16. E, lower cuticle of ? *Thinnfeldia* sp., showing three stomata, Sl. No. 66866/1, × 250.

irregularly orientated. Subsidiary cells 4-6, papillate towards the inner side, forming a thickened ring round the opening. Guard-cells sunken, thinly cutinized, a few with encircling cells.

Florin (1922, p. 269) mentioned, "It should be noticed that *Sciadopitys* or *Sciadopitytes* are most frequently found together with *Ginkgo* not only in mesozoic but also in tertiary deposits (*Sciadopitys tertiaria* and *Ginkgo adiantoides* in the upper pliocene of western Germany). At the present time *Sciadopitys* as well as *Ginkgo* is an Asiatic type of gymnosperms. We thus find a remarkable analogy between the two groups in question." The present find further supports Florin's observation on the close association of *Sciadopitytes* and the *Ginkgo* family.

Locality — Andøya, Norway.

Age — Jurassic.

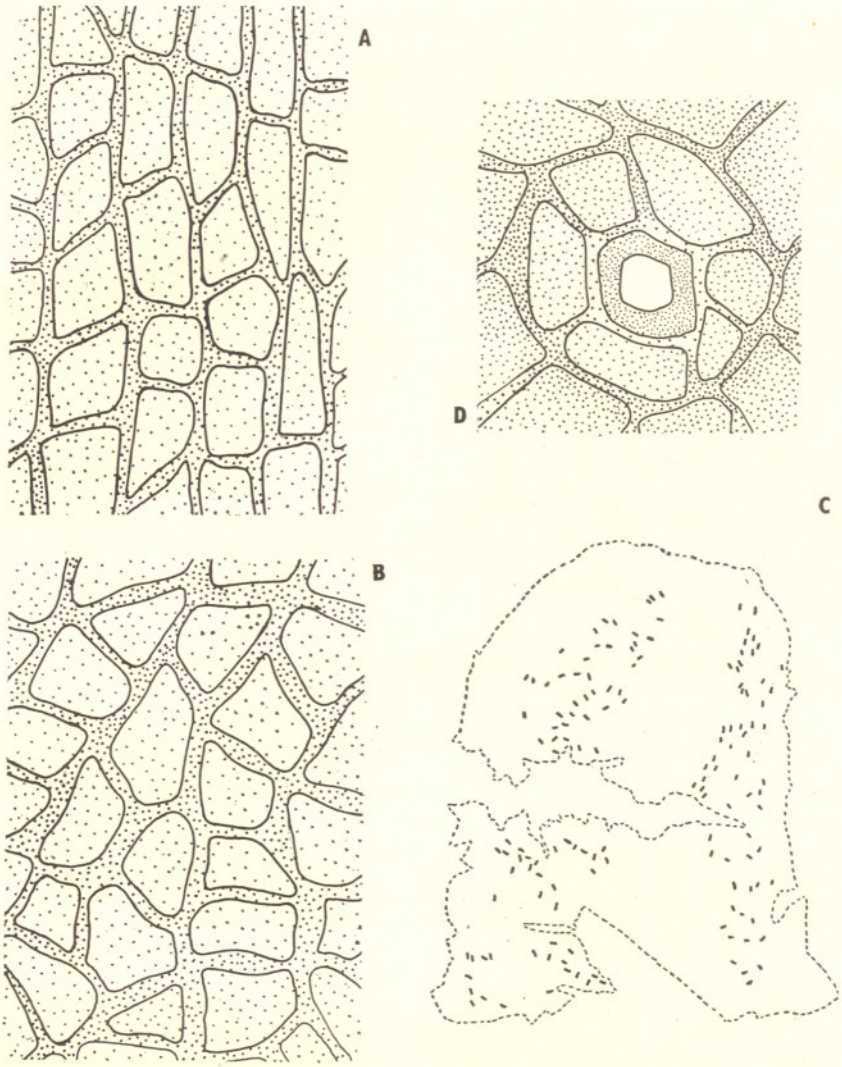
Collection — Slide No. 66844/20 of Paleontologisk Museum, Oslo.

Female cone-scales of Sciadopitytes (TEXT-FIG. 4A-G) — Only detached female cone-scales were obtained. Except two none of them seem to be complete.

Description — Fan-shaped, about 2 × 2 mm. in length and breadth. Distal end rounded, proximal end not well preserved. Cells on both the upper and lower surfaces rectangular and arranged in series. Lateral and end-walls fairly thick and conspicuous, straight. Surface wall smooth.

Seeds 3 on each scale, narrowly ovoid or elliptical, 1·5-2·5 mm. long and 0·2-0·5 mm. wide at the broadest region. In some a narrow, membraneous wing visible.

Epidermal cells resemble the upper epidermal cells of the leaves of *Sciadopitytes*. Cuticles of the cone-scales differ from the



TEXT-FIG. 2 — ? *Thinnfeldia* sp. A, lower cuticle, showing cells of mid-rib, Sl. No. 66866/2, × 300. B, upper cuticle, showing a few cells, Sl. No. 66866/3, × 300. C, lower cuticle, showing the distribution of stomata, Sl. No. 66866/1, × 20. D, a stoma, Sl. No. 66866/1, × 450.

leaves in lacking stomata. In this respect the present scales resemble the male cone-scales(?) of *Sciadopitytes* described by Bose (1955). The present cone-scales differ from the cone-scales of *Sciadopitys tertiaria* Menzel (1913) in being much smaller in size and in having only three seeds on each cone-scale. The cone-scales of the modern species *S. verticillata* Sieb. et Zucc. are also much bigger in size and they have 5-9 seeds.

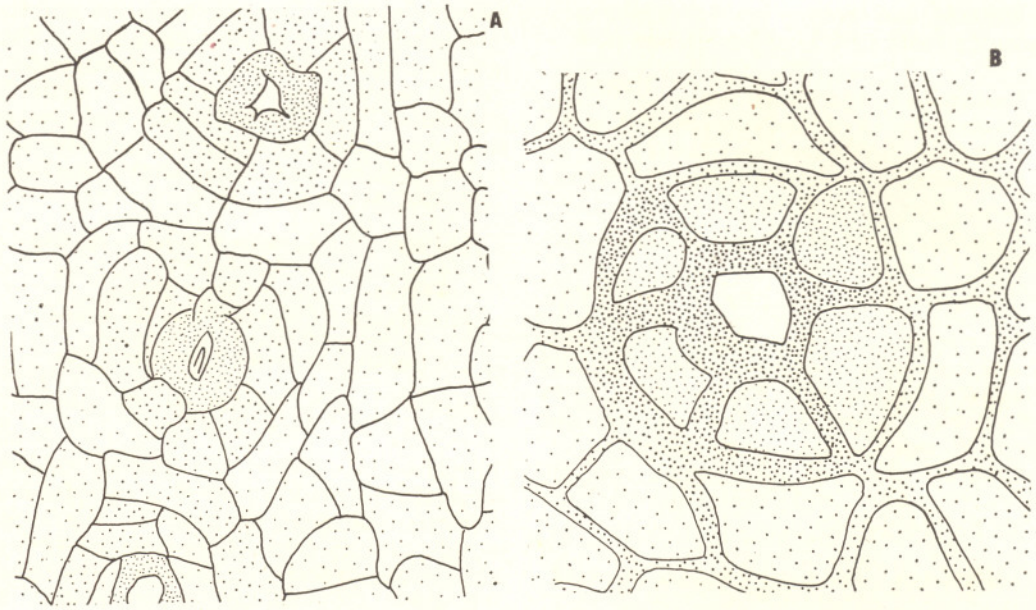
Locality — Andøya, Norway.

Age — Jurassic.

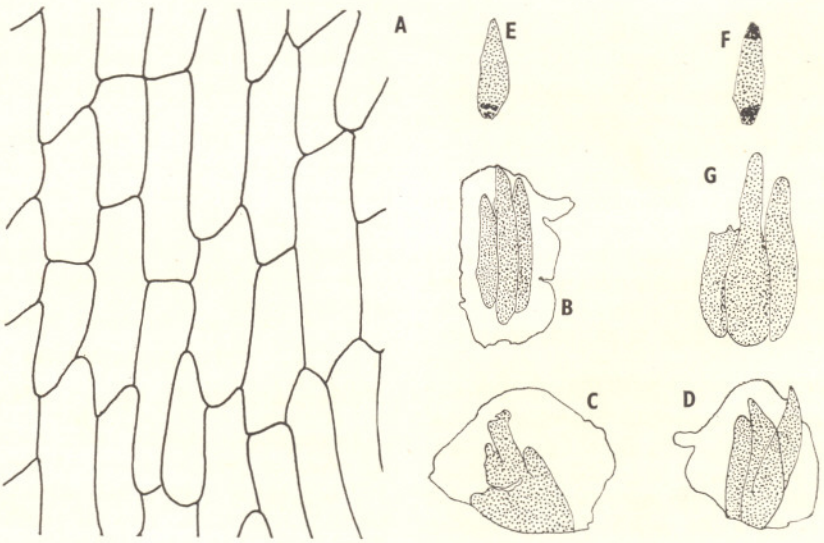
Collection — Slide No. 66844/18 of Paleontologisk Museum, Oslo.

SPORES AND POLLEN GRAINS

Maceration of the shales by $KClO_3+HNO_3$ yielded only a few spores and pollen grains. Of these quite a good many were infected with fungi. Here only a selected few are described. For their classification the system



TEXT-FIG. 3 — Ginkgoalean leaf. A, lower cuticle, Sl. No. 66845/14, × 300. B, a stoma, Sl. No. 66844/20, × 450.



TEXT-FIG. 4. Cone-scales and seeds of *Sciadopitytes*. A, cells of upper cuticle, Sl. No. 66844/18, × 250. B-D, cone-scales with three seeds each [except Fig. C, the margin of the other two (B & D) incomplete all around], Sl. No. 66844/18, × 10. E-F, two detached seeds, Sl. No. 66845/13, × 10. G, 3 detached seeds, sticking to each other, Sl. No. 66842/8, × 10.

of Potonié and Kremp (1955, 1956) and Potonié (1956, 1958) has been followed.

Anteturma ***Sporites*** **H. Pot.**
Turma ***Triletes*** **(Reinsch) Pot. & Kr.**
Subturma ***Azonotriletes*** **Luber**
Infraturma ***Laevigati*** **(Bennie & Kidston) Pot. & Kr.**

Laevigatisporites **(Bennie & Kidston) Ibrahim**

Laevigatisporites sp. (PL. 1, FIG. 1)

Description — Trilete spore, triangular, 47 μ in equatorial diameter. Apices broadly rounded, sides convex. Exine psilate, about 1·8 μ thick. Trilete mark distinct, extending almost to the periphery of the body.

Remarks — Only a single spore was obtained.

Sl. No. 66844/10.

Infraturma ***Apiculati*** **(Bennie & Kidston) Pot.**

Verrucosisporites **(Ibr.) Pot. & Kr.**

Verrucosisporites manumii n. sp. (PL. 1, FIGS. 4, 5)

Diagnosis — Trilete spore, triangular to subtriangular, 81-120 μ in equatorial diameter. Laesurae distinct, not reaching the periphery. Exine very thick, verrucose, with thick rounded or irregular warts, up to 4·3-8·6 μ high. In the more highly sculptured specimens the sculpture becomes almost pseudo-reticulate.

Remarks — *V. manumii* resembles very much *Triletes verrucatus* described by Couper (1953) from New Zealand in the nature of exine sculpturing. *V. manumii*, however, is much larger in its equatorial diameter and the warts are also more rounded.

The present spore has been named after Mr. S. Manum of Paleontologisk Museum, Oslo.

Holotype — Pl. 1, Fig. 5; Sl. No. 66844/8.

Infraturma ***Murornati*** **Pot. & Kr.**

Lycopodiumsporites **Thiergart**

Lycopodiumsporites sp. (PL. 1, FIGS. 6, 7)

Description — Trilete spore, rounded triangular, 12·5 μ in equatorial diameter, laesurae distinct, reaching almost to the periphery of the body, surface faintly reticulate, lumen of reticulum 10-15 μ across.

Remarks — The present species is much bigger in size than most of the already known species of *Lycopodiumsporites* and the reticulation is very faintly visible here. This may be a new species of *Lycopodiumsporites*.

The spore may be compared with *L. clavatoides* Couper (1958), but the present species is more than twice the diameter and the reticulation here is but faintly marked.

Sl. No. 66844/14.

Turma ***Zonales*** **(Bennie & Kidston) R. Pot.**
Subturma ***Zonotriletes*** **Waltz**
Infraturma ***Cingulati*** **Pot. & Klaus**

Cingulatisporites **(Thomson) Pot.**

Cingulatisporites heintzii n. sp. (PL. 1, FIGS. 2, 3)

Diagnosis — Trilete, equatorial contour triangular to rounded, 86-90 μ in equatorial diameter, laesurae reaching to the inner margin of cingulum. Cingulum 8·5-12·5 μ wide, smooth, polar areas smooth, exine thick.

Remarks — *C. heintzii* comes closest to *C. rigidus* Couper (1958).

The specific name has been given after Professor A. Heintz, of Paleontologisk Museum, Oslo.

Holotype — Pl. 1, Fig. 3; Sl. No. 66844/5.

Discisporites **Leschik**

? *Discisporites* sp. (PL. 2, FIG. 10)

Description — Equator ± circular, Y-rays not visible, about 94 μ in equatorial diameter. The proximal and distal portion thin and finely granulate. Equatorial region thick and opaque.

Remarks — Only a single spore was obtained. Due to the absence of Y-mark it is difficult to ascertain its correct generic position. It is only provisionally placed under *Discisporites* Leschik (1955).

Sl. No. 66844/10.

Turma ***Barbates*** **Mädler**

Thomsonia **Mädler**

Thomsonia arctica n. sp. (PL. 2, FIGS. 11, 12)

Diagnosis — Trilete megaspore, almost spherical or oval, diameter varying between 172 and 344 μ. Spore wall about 3-5 μ thick. Surface reticulate, area of meshes varying. Triradiate lamellae conspicuous, forming prominent and delicate plates, much convoluted, height of lamellae varying from 64 to 94 μ, outer part of lamellae forming irregular lace-work.

Remarks — The present species resembles most *Thomsonia phyllica* (Murray) Pot. described by Murray (1939) and Potonié (1956). The body ornamentation is different in *T. phyllica*. From *T. reticulati* Mädler (1954) the present species differs in having less prominent reticulation.

Holotype — Pl. 2, Fig. 12; Sl. No. 66845/12.

Turma ***Monoletes*** **Ibrahim**
Subturma ***Azonomonletes*** **Luber**
Infraturma ***Ornati*** **Pot.**

Schizaeoisporites **Potonié**

Schizaeoisporites hoegii n. sp. (Pl. 1, Figs. 8, 9)

Diagnosis — Monolete spore, measuring about 135×90 μ. Dehiscence mark clearly visible. Surface covered by more or less longitudinal ridges, only slightly spiral and about 4·5 μ broad. Furrows between them measure about 1-1·5 μ.

Remarks — As far as I know, this is the first record of a ribbed monolete spore belonging to the Schizaeaceae from the Jurassic. In surface feature it resembles *S. eocaenicus* Selling (1944), but the latter species is much smaller in size.

The specific name has been given after Professor O. A. Høeg of Universitetet, Oslo.

Holotype — Pl. 1, Fig. 8; Sl. No. 66844/1.

Anteturma ***Pollenites*** **Pot.**
Turma ***Saccites*** **Erdtman**
Subturma ***Disaccites*** **Cookson**
Infraturma ***Disacciatrileti*** **Leschik**

Pityosporites **(Seward) Pot. & Klaus**

Pityosporites sp. (Pl. 2, Fig. 13)

Description — Bisaccate pollen grain, measuring 94×68 μ. Body oval, 81 μ in equatorial diameter, thin, psilate. Bladders ± circular, measuring about 55×47 μ, inclined distally, very finely reticulate.

Remarks — Only a single spore was obtained.

Slide No. 66845/1.

Pityosporites sp. A. (Pl. 2, Fig. 14)

Description — Bisaccate pollen grain, oval, haploxylonoid in form, about 129×99 μ. Body broad, oval, with a narrow vertical slit, very finely reticulate. Bladders large, about 94·5×64·5 μ, almost covering the body, leaving only a narrow slit in between.

Remarks — Only a single spore was obtained.

Slide No. 66844/1.

Pityosporites cf. *P. grandis* (Cookson) Balme (Pl. 2, Fig. 16).

Description — Bisaccate pollen grain, oval, haploxylonoid in form, measuring about 172×112 μ. Body fairly thick, oval, with a narrow vertical slit, measuring 103×69 μ, irregularly reticulate. Bladders large, about 107×90 μ, each bigger than a semicircular in outline, exine reticulate.

Remarks — This spore may be compared with the spore described by Balme (1957) from the Mesozoic of Western Australia.

Slide No. 66844/10.

Infraturma ***Pinosacciti*** **(Erdtman) Pot.**

Abietineaepollenites **Pot.**

? *Abietineaepollenites* sp. (Pl. 2, Fig. 15)

Description — Bisaccate pollen grain, oval, 94·5×77·5 μ. Body broadly oval, with a thick crescent-shaped rim on each side, 77·5×47 μ. Sacs almost semicircular, approaching very close to each other, leaving a very narrow vertical opening in between. Exine reticulate.

Remarks — A number of pollen grains was isolated. All of them resemble in shape to some extent *Abietineaepollenites microalatus* Potonié (1951).

Slide No. 66844/17.

Turma ***Aletes*** **Ibr.**
Subturma ***Azonaletes*** **(Luber) Pot. & Kr.**
Infraturma ***Granulonapiti*** **Cookson**

Araucariacites **Cookson**

Araucariacites sp. (Pl. 2, Fig. 17)

Description — Pollen grain large, flattened, ± circular, 107·5 μ in equatorial diameter. Exine thin, very finely and closely granulated.

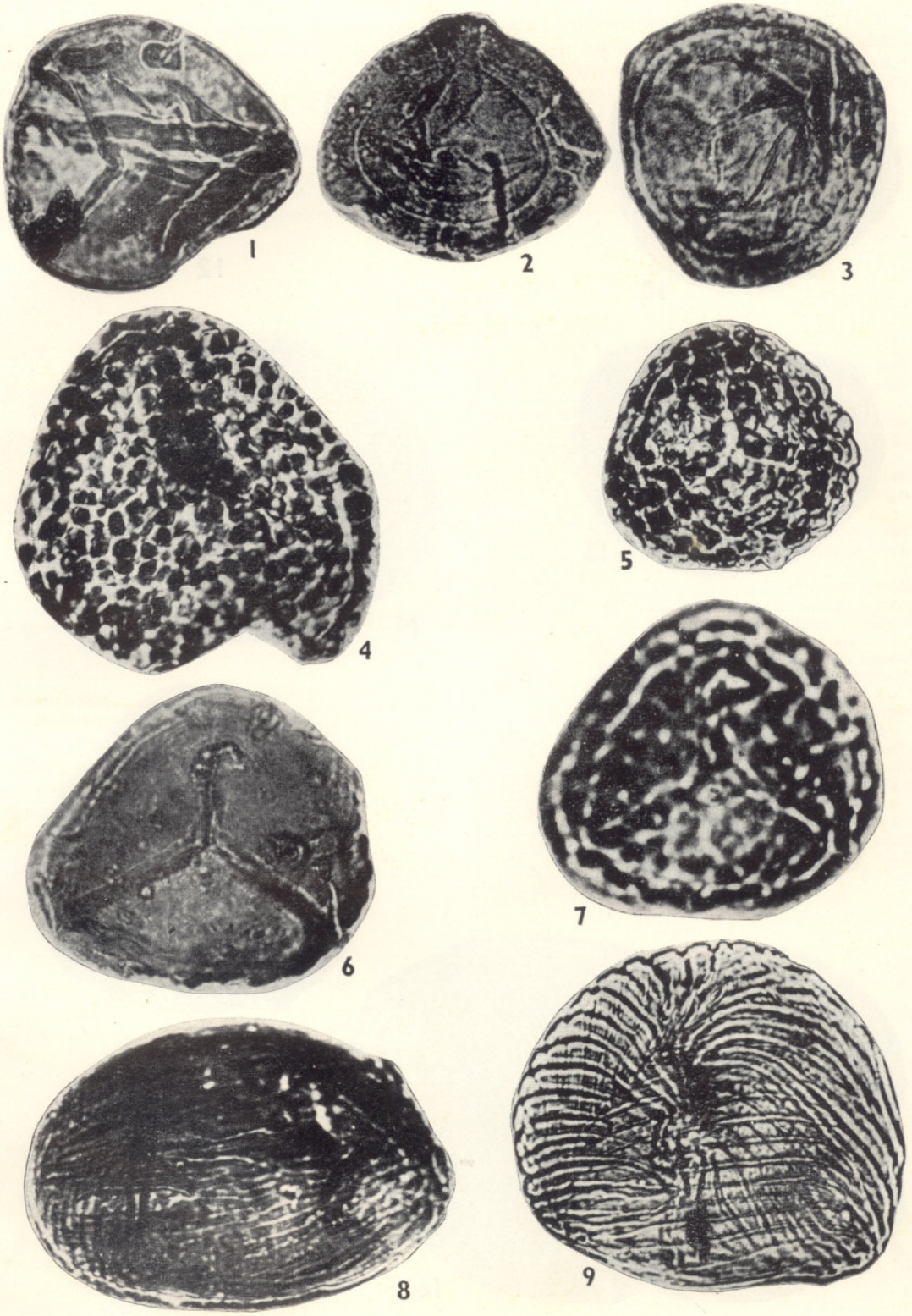
Remarks — Only a single specimen was obtained.

Slide No. 66844/6.

Sciadopityspollenites **Raatz**

Sciadopityspollenites ovalis n. sp. (Pl. 2, Fig. 18)

Diagnosis — More or less oval pollen grain, 64-75 μ in diameter. Ektexine thick and provided with coarse verrucose sculpturing. Verrucae small, variously shaped, apparently joining near the bases.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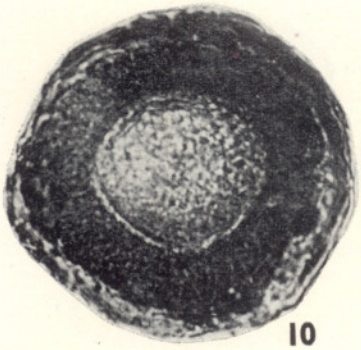

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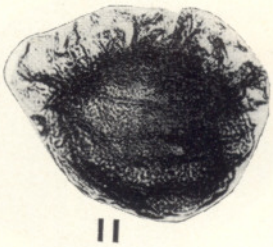

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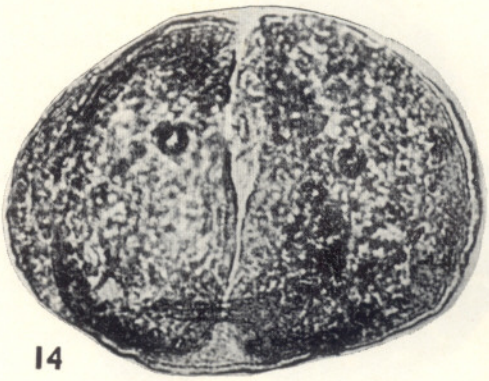

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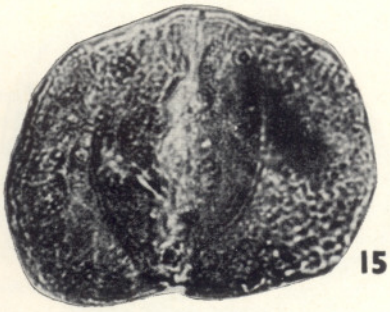

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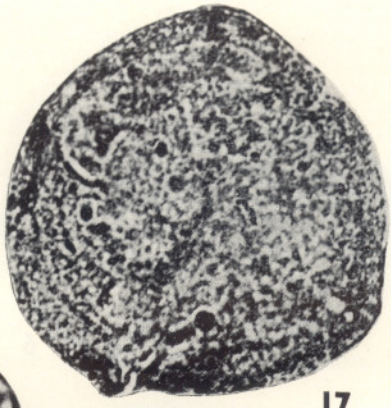

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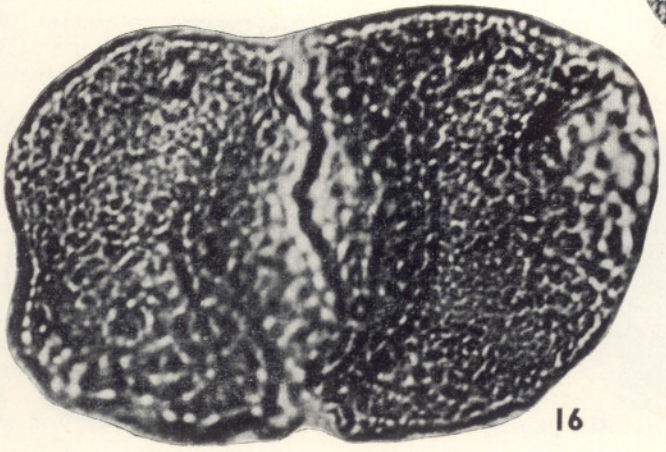

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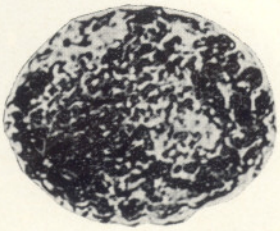

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Remarks — *S. ovalis* differs from *S. serratus* Raatz (1937) in shape and the sculpturing of the exine is different.

Holotype — Pl. 2, Fig. 18; Sl. No. 66841/17.

ACKNOWLEDGEMENT

I am grateful to Professor A. Heintz, Director, Paleontologisk Museum, Oslo, for the loan of the material. To Professor O. A. Høeg I am highly obliged for the valuable suggestions and for correcting the manuscript. I am also highly obliged to the authorities of the Norwegian ' Indiafondet ' and the Norwegian Ministry of External Affairs and Cultural Relations for the generous award of a scholarship, without which this work would not have been undertaken.

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EXPLANATION OF PLATES

PLATE 1

1. *Laevigatisporites* sp., Sl. No. 66844/10. × 500.

2-3. *Cingulatisporites heintzii* n. sp., Sl. No. 66844/5. × 500.

4-5. *Verrucosisporites manumii* n. sp., Sl. Nos. 66844/5, 66844/8. × 500.

6-7. *Lycopodiumsporites* sp. Fig. 7, showing the prominent trilete mark and Fig. 8 showing the reticulation. Sl. No. 66844/14. × 500.

8-9. *Schizaeoisporites hoegii* n. sp., Sl. Nos. 66844/1, 66844/12. × 500.

PLATE 2

10. ? *Discisporites* sp., Sl. No. 66844/10. × 500.

11-12. *Thomsonia arctica* n.sp., Sl. Nos. 66842/11, 66845/12. × 100.

13. *Pityosporites* sp., Sl. No. 66845/1. × 500.

14. *Pityosporites* sp. A., Sl. No. 66844/1. × 500.

15. ? *Abietineaepollenites* sp., Sl. No. 66844/17. × 500.

16. *Pityosporites* cf. *P. grandis* (Cookson) Balme, Sl. No. 66844/10. × 500.

17. *Araucariacites* sp., Sl. No. 66844/6. × 500.

18. *Sciadopityspollenites ovalis* n. sp., Sl. No. 66841/17. × 500.