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*The Northwest European Pollen Flora, 5*

# SPARGANIACEAE AND TYPHACEAE

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## LITERATURE

Beug (1961), Erdtman (1943, 1952), Erdtman et al. (1961, 1963), Faegri and Iversen (1950, 1964), Visset (1971), Wodehouse (1932, 1935).

## INTRODUCTION

Unlike previous parts of the Northwest European Pollen Flora the present part deals with two families together. The results show, that the pollen grains of *Typha angustifolia* are so similar to those of some *Sparganium* species that they have been included in a single pollen type. Also the two genera are taxonomically so close to one another that it seems not only logical but merely practical to combine them in one part.

## SPECIMENS EXAMINED

*Sparganium angustifolium* Michaux — Finland: Vervoort 268(U); France: Billot s.n.(L), Bouchard s.n.(L); Portugal: S. Fernandes et al. 4491(U), Rainha et al. 2175(U); The Netherlands: Docters Van Leeuwen 6796(U), Jansen en Wachter 18.478/79(L), Van der Voo 5964a(L), Van der Voo s.n.(L).
*Sparganium emersum* Rehman — Finland: Marklund s.n.(U); Great Britain: Howard 756(U); The Netherlands: Mennega s.n.(U), Van Steenis s.n.(U), Vegter s.n.(U), s.c, s.n. Botanical Museum 88587A(U); West-Germany: Stafleu s.n.(U).
*Sparganium erectum* L. ssp. *erectum* — Great Britain: Howard 757(U); The Netherlands: Buysman 1647(U), Gottenbos s.n.(U), Lieftinck s.n.(U), Punt (fresh material) 1964.
*Sparganium erectum* L. ssp. *microcarpum* (Neumann ex Krok) Hylander — The Netherlands Brand s.n.(L), Hunger s.n.(L), Oudemans 1203(L), Van der Voo 57.060(L).
*Sparganium erectum* L. ssp. *neglectum* (Beeby) Schinz et Thellung — Austria: Porta s.n. (Herb. Buysman 812) (U); Sweden: Samuelsson 67(L); The Netherlands: Jansen en Wachter 18480/81(L), Kern en Reichgelt 4845(L), A. G. de Wilde 56(L).
*Sparganium fluitans* (Morong) Robinson — Canada: Rolland-Germain 2868(L).
*Sparganium friesii* Beurling — Sweden: Weimarck s.n.(S), s.c., s.n. Anno 1922(S); U.S.S.R.: Fischer s.n.(L), Karo 488(L).
*Sparganium glomeratum* Laestiboudois — Norway: Biol. exc. 1965—245(U); Sweden: Brotheriez s.n.(L), Runne s.n.(S).
*Sparganium minimum* Wallroth — Germany: Gerhardt s.n.(L); Great Britain: Kirk 1144(L); The Netherlands: Hekking et al. s.n.(U), Holkema s.n.(L), Lanjouw s.n.(U), Van de Sande et al. s.n.(L), Van Steenis s.n.(U), Swart 790(U). Voorrips (fresh material) 1964.

*Typha angustifolia* L. — Sweden: Asplund s.n.(S), H. Fries s.n.(S); The Netherlands: Bakhuizen Van de Brink 4964(U), Van Dijk s.n.(U), Van Ooststroom 24690(U), Pfaeltzer s.n.(U), Van Royen 729(U), Rem (fresh material) 1951.
*Typha latifolia* L. — Austria: Porta s.n. (Herb. Buysman 818) (U); France: s.c., s.n. Montpellier 20224G; Germany: Behrendsen 2861(U); The Netherlands: Van Dijk s.n.(U), Rem (fresh material) 1951, Voorrips (fresh material) 1964.
*Typha minima* Funk — France: Lardière s.n.(L); Germany: Lahn s.n.(U); Austria: Behrendsen s.n.(U), Drobny s.n.(L).
*Typha shuttleworthii* Koch et Sonder — Rumania: Topa 2988(L); Switzerland: Shuttleworth s.n.(L).

## KEY TO THE POLLEN TYPES

(N.B.: All features of the ornamentation mentioned in the keys are based on the structures in the area opposite to the aperture.)

1.a. Pollen grains in tetrads . . . . . *Typha latifolia* type
b. Pollen grains in monads . . . . . 2
2.a. Tectate or distinctly microreticulate; lumina and perforations usually smaller than 1 μm, sometimes up to 1 μm . . . *Sparganium erectum* type
b. Reticulate; lumina wider than 1 μm, often up to 3 μm or more . . . . . *Sparganium emersum* type

## DESCRIPTION OF THE POLLEN TYPES

**Sparganium emersum type** (Plate I, 6; Plate II; Plate III; Plate IV, 3—5)

*Pollen class:* Monoporate.
*Apertures:* Ectoaperture — porus, more or less circular in outline, slightly sunken; margins distinct or indistinct; porus membrane beset with sexine elements. Endoaperture — porus, outline following that of the ectoaperture and therefore more or less congruent with it; no costae.
*Exine:* Exine of normal thickness. Sexine about as thick as nexine, sometimes slightly thinner and less frequently slightly thicker. Sexine 1 usually thinner than sexine 2. Sexine 1 consists of low, thin columellae. Sexine 2 is semitectate.
*Ornamentation:* Reticulate. Muri thick or thin; in a few species the muri are parallel sided, but in some other species they are slightly thicker towards the base, simpli- or duplicolumellate, often interrupted; in L—O analysis the columellae are not always distinct, outline circular; in high magnification the muri may have small excrescences (in *Sparganium*) or may be smooth (*Typha angustifolia*). The lumina are fine or coarse, and they vary considerably in width and outline. The largest lumina are found in the area opposite to the porus area, and they decrease distinctly towards the porus area.
*Outline:* The overall shape is rather irregular and the outline depends on the position of the grain. Usually the grains are mainly elliptic in outline with one side more convex than the other, or even slightly angular. If the position of the pollen grain does not show this angular-elliptic outline, it may be circular. A complete range of outlines between the two extremes is possible.

*Measurements:* Glycerine jelly — longest axis 25—36 μm; exine between 1.5 and 2.5 μm; diameter of pori up to 3 μm. Silicone oil — longest axis 23—31 μm.
*Species: Sparganium angustifolium, S. emersum, S. friesii, S. fluitans, S. glomeratum, S. hyperboreum, S. minimum*, some specimens of *S. erectum* s.l. (Van der Voo 57.060, Jansen en Wachter 18480/81, Porta s.n.) and *Typha angustifolia*

*Key to groups and species*

1.a. Lumina large, largest ones usually ca. 2 μm or more in diameter; in L—O analysis columellae usually distinct . . . . . 2
b. Lumina rather small, usually 1—2 μm; in L—O analysis columellae usually distinct . . . . . 3
2.a. Muri usually thin, usually not or only slightly interrupted; lumina often more or less elliptic in outline . . . . . *Sparganium emersum*
b. Muri usually thick, more or less interrupted; lumina irregular in outline . . . . . *S. minimum* group (*Sparganium glomeratum, S. hyperboreum, S. minimum*)
3.a. Muri in short, irregular curved sections, forming a rugulate pattern, not distinctly reticulate; sexine pattern running into porus . . . . . *Typha angustifolia*
b. Ornamentation more or less distinctly reticulate; porus without distinct sexine pattern . . . . . 4
4.a. Muri thin, usually simplicolumellate; lumina very angular in outline, usually angular-elongated . . . . . *S. friesii* group (*Sparganium angustifolium, S. friesii, S. fluitans*)
b. Muri thick, usually duplicolumellate; lumina more or less regular in outline, elliptic or circular . . . . . some specimens of *S. erectum*

*Comments*

Wodehouse (1932) noted that the pollen grains of *Sparganium* species are virtually indistinguishable from those of *Typha angustifolia.* Beug (1961) and Faegri and Iversen (1964) do not give any critical differences between *Typha angustifolia* and several European *Sparganium* spp. Erdtman et al. (1961) also stated that pollen grains in the Sparganiaceae are of the same type as the monads in the Typhaceae.

In the present study most of the *Sparganium* species are combined with *Typha angustifolia* in one type. At a magnification of 400 × it was difficult to separate the pollen grains of these two genera, but at a higher magnification it was quite possible to differentiate them. *Typha angustifolia is* characterized by its rugulate pattern and also at very high magnification (SEM) the muri of the reticulum are smooth, whereas most *Sparganium* species show blunt excrescences. The SEM-photomicrograph which Visset (1971) has given of *Typha angustifolia* does not show the rugulate pattern, but the muri are smooth and without excrescences.

Apart from this differentiation of *Typha angustifolia* from other species in this pollen type, it was possible to separate the *Sparganium* species into

two groups and two species. The differential characters are based on the width and outline of the lumina, the breadth of the muri and the presence of interrupted muri.

The *Minimum* group is best characterized by its thick and usually distinctly interrupted muri and, in addition to these two obvious characters, the pollen grains usually have indistinct pori.

The *Friesii* group, on the other hand, is best characterized by its rather small, irregular, often more or less elongated and angular lumina; the pori in this group are usually more distinct than those in the *Minimum* group.

The pollen grains of *Sparganium emersum* resemble those of the *Minimum* group very closely, but the muri are distinctly thinner and the lumina are often more regular.

The width of the lumina is always measured on the side of the grain opposite to the porus area. The width of the lumina around the pori and at the top of the ellipsoid may be considerably smaller.

Finally, the pollen grains of some specimens of *S. erectum* belonging to ssp. *microcarpum* and ssp. *neglectum* are differentiated by their more or less regular and rather small lumina together with the thick muri which are usually dupli-columellate. This group of pollen grains is quite different from those in the *Sparganium erectum* type and there are no transitional forms. This anomaly, which is partly taxonomic, cannot be solved within the scope of this project.

**Sparganium erectum type** (Plate I, 1—5)

*Pollen class:* Monoporate
*Apertures:* Ectoaperture — porus, more or less circular in outline, slightly sunken; margins rather distinct; porus membrane beset with granulate sexine elements. Endoaperture — porus, outline following that of the ectoaperture and therefore more or less congruent with it.
*Exine:* Exine varying in thickness, gradually thickening towards the porus area. Nexine about as thick as sexine, usually thicker near the porus. Sexine 1 thinner than sexine 2. Sexine 1 consists of short, thin columellae. Sexine 2 is a tectum or semitectum.
*Ornamentation:* Tectum perforatum or microreticulate. Muri thick, usually thicker than width of lumina; sometimes lumina wider than muri; muri thin at top and distinctly thicker towards the base. In L—O analysis columellae circular in outline; muri simpli- or duplicolumellate, at high magnification (SEM) provided with small and low excrescences. Perforations and lumina irregular in outline.
*Outline:* The overall shape is rather irregular and the outline depends on the position of the grain. Usually the pollen grains are mainly elliptic in outline with one side more convex than the other, or even slightly angular. If the position of the pollen grain does not show this angular-elliptic outline, it may be circular. A complete range of outlines between these extremes is possible.
*Measurements:* Glycerine jelly — longest axis 22—36 $\mu$m; exine ca. 1.5 $\mu$m;

diameter of the pori ca. 3 μm. Silicone oil — longest axis 21—26 μm.
*Species: Sparganium erectum* ssp. *erectum*, *S. erectum* ssp. *microcarpum*, *S. erectum* ssp. *neglectum*.

*Comments*

The *Sparganium erectum* type has not previously been recognized as distinct from the other species of *Sparganium*. In fact the type is characterized by a single differential character; viz. the tectum or microreticulum. This character, however, is so clear that the differentiation of the two types is justified. After a close examination of all slides this character appeared to be clear and constant and even visible at a magnification of 400 ×.

Some specimens of *Sparganium erectum* identified as ssp. *microcarpum* and ssp. *neglectum* (Van der Voo 57.060, Jansen en Wachter 18480/81, Porta s.n.) show lumina wider than 1 μm. These latter specimens have been placed in the *S. emersum* type (p.*78*).

The SEM-micrographs of Visset (1971) do not differ in size, shape or ornamentation features from those given here.

**Typha latifolia type** (Plate V, 1—2; Plate VI)

*Pollen class:* Tetrads. Single grains monoporate.
*Apertures:* Ectoaperture — porus, more or less circular in outline, slightly sunken; margins not sharply delimited; porus membrane beset with sexine elements similar to those occurring near the porus area, the ornamentation is running into the porus. Endoaperture — porus, outline following that of the ectoaperture and therefore more or less congruent with it.
*Exine*: Exine varying in thickness, gradually thicker towards the porus area. Nexine about as thick as sexine, sometimes slightly thicker, especially towards the porus area, often thinner than sexine in the area opposite to the porus area. Sexine 1 thinner than or about as thick as sexine 2. Sexine 1 composed of short columellae which are rather distinct in optical section. Sexine 2 is semitectate, consisting of capita which are more or less circular in outline.
*Ornamentation:* Reticulate, microreticulate or rugulate. Muri often interrupted, in *Typha minima* arranged in short, curved sections, simpli- or duplicolumellate; at high magnification without excrescences; in L—O analysis columellae distinct (*T. minima*) or indistinct. Lumina irregular in outline, often angular elongated. The single grains are attached to each other by several small connections. These connections are bridge-like, narrow and irregular in length and shape.
*Outline:* Single grains usually arranged in a more or less flat plane, often in squares or rectangles, but sometimes in a linear sequence. As the single grains are not exactly circular in outline but have a long and a short axis, the outline is more often rectangular with also longer and shorter sides. In the middle of the tetrad the fissurae are distinctly sunken; the angles are obtuse.
*Measurements:* Glycerine jelly — longest axis 30—55 μm; exine ca. 2 μm, up to 3 μm near the porus; porus ca. 5 μm wide. Silicone oil — 44—55 μm.

*Species: Typha latifolia, T. minima, T. shuttleworthii*

*Key to the species*

1.a. Ornamentation distinctly rugulate; muri distinctly interrupted in very short curved sections; in L—O analysis columellae rather distinct, circular in outline; nexine about as thick as sexine or often thicker . . . . . *Typha minima*

b. Ornamentation microreticulate or only slightly rugulate; in L—O analysis columellae usually distinct; nexine usually thinner than sexine except in the porus area . . . . . *Typha latifolia*
*Typha shuttleworthii*

*Comments*

*Typha laxmannii* Lepechine, mentioned by Beug (1961) does not occur in Northwest Europe (Graebner 1900), so this taxon has not been studied.

In Europe *T. shuttleworthii* seems to be limited to the valleys of the Alps and the Pyrenees, but the species is sometimes also found in South Germany. The pollen grains are similar in ornamentation to *Typha latifolia.*

*Typha minima* is more extensive in our area, and the pollen grains of this species seem to differ slightly from those of the other two species. The ornamentation is more distinctly rugulate and the muri are more interrupted. These muri are usually simplicolumellate and the columellae are not distinct in L—O analysis. In most grains the nexine was distinctly thicker than in the sexine, particularly in the porus area. The ornamentation of the undivided grains of the tetrad is very similar to that of the grains of *Typha angustifolia.*

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PLATE DESCRIPTIONS (all Plates × 2000, except as otherwise stated)

PLATE I (p.*82*)

*Sparganium erectum* L. ssp. *erectum* (Gottenbos s.n.)
1. Ornamentation at high focus.
2. Ornamentation at low focus; columellae rather indistinct.
3. Ectoporus.
4. Scanning electron micrograph; ornamentation (× 10,000).
5. Scanning electron micrograph; overall shape.

*Sparganium erectum* L. ssp. *neglectum* (Beeby) Schinz et Thellung (Porta s.n.)
6. Ectoporus.

PLATE II (p.*83*)

*Sparganium erectum* L. ssp. *neglectum* (Beeby) Schinz et Thellung (Porta s.n.)
1. Ornamentation at high focus.
2. Ornamentation at low focus; muri thick, dupli- to polycolumellate; columellae distinct.

*Sparganium emersum* Rehman (Botanisch Museum No. 88587A)
3. Ornamentation at high focus.
4. Ornamentation at low focus; muri thin, usually simplicolumellate.
5. Optical cross-section; outline.
6. Scanning electron micrograph; overall shape.

*Sparganium angustifolium* Michaux (Van der Voo 59619)
7. Ornamentation at high focus.
8. Ornamentation at low focus; lumina angular, very irregular, often elongated.

PLATE III (p.*84*)

*Sparganium friesii* Beurling (Karo 488)
1. Ornamentation at high focus.
2. Ornamentation at low focus.
*Sparganium angustifolium* Michaux (Bouchard s.n.)
3. Ectoporus.
4. Optical cross-section; outline.
*Sparganium minimum* Wallroth (Lanjouw s.n.: 5,6,8; Kirk 1144: 7)
5. Ornamentation at high focus.
6. Ornamentation at low focus; muri thick, often interrupted.
7. Optical cross-section; outline.
8. Ectoporus.

PLATE IV (p.*85*)

*Sparganium glomeratum* Laestiboudois (Hjelt s.n.)
1. Ornamentation at high focus.
2. Ornamentation at low focus; muri thick, often interrupted.
*Sparganium minimum* Wallroth (Lanjouw s.n.)
3. Scanning electron micrograph; outline and ectoaperture.
4. Scanning electron micrograph; ornamentation (× 10,000).
*Typha angustifolia* L. (Van Ooststroom 24690)
5. Scanning electron micrograph; ornamentation and ectoporus (× 10,000).
6. Scanning electron micrograph; overall shape and ectoaperture.

PLATE V (p.*86*)

*Typha latifolia* L. (Behrendsen 2861)
1. Optical cross-section; outline.
2. Ornamentation at high focus.
*Typha angustifolia* L. (Van Ooststroom 24690)
3. Ornamentation at low focus.
4. Ornamentation at high focus.
5. Scanning electron micrograph; ornamentation (× 10,000).

PLATE VI (p.*87*)

*Typha latifolia* L. (Behrendsen 2861)
1. Optical cross-section; outline.
*Typha minima* Funk (Behrendsen s.n.)
2. Scanning electron micrograph; overall shape (× 1,000).
3. Scanning electron micrograph; ornamentation (× 10,000).
*Typha latifolia* L. (Behrendsen 2861)
4. Ornamentation at high focus; connection between two monads at high focus.
5. Ornamentation at low focus; several connections at high and low focus.

PLATE I

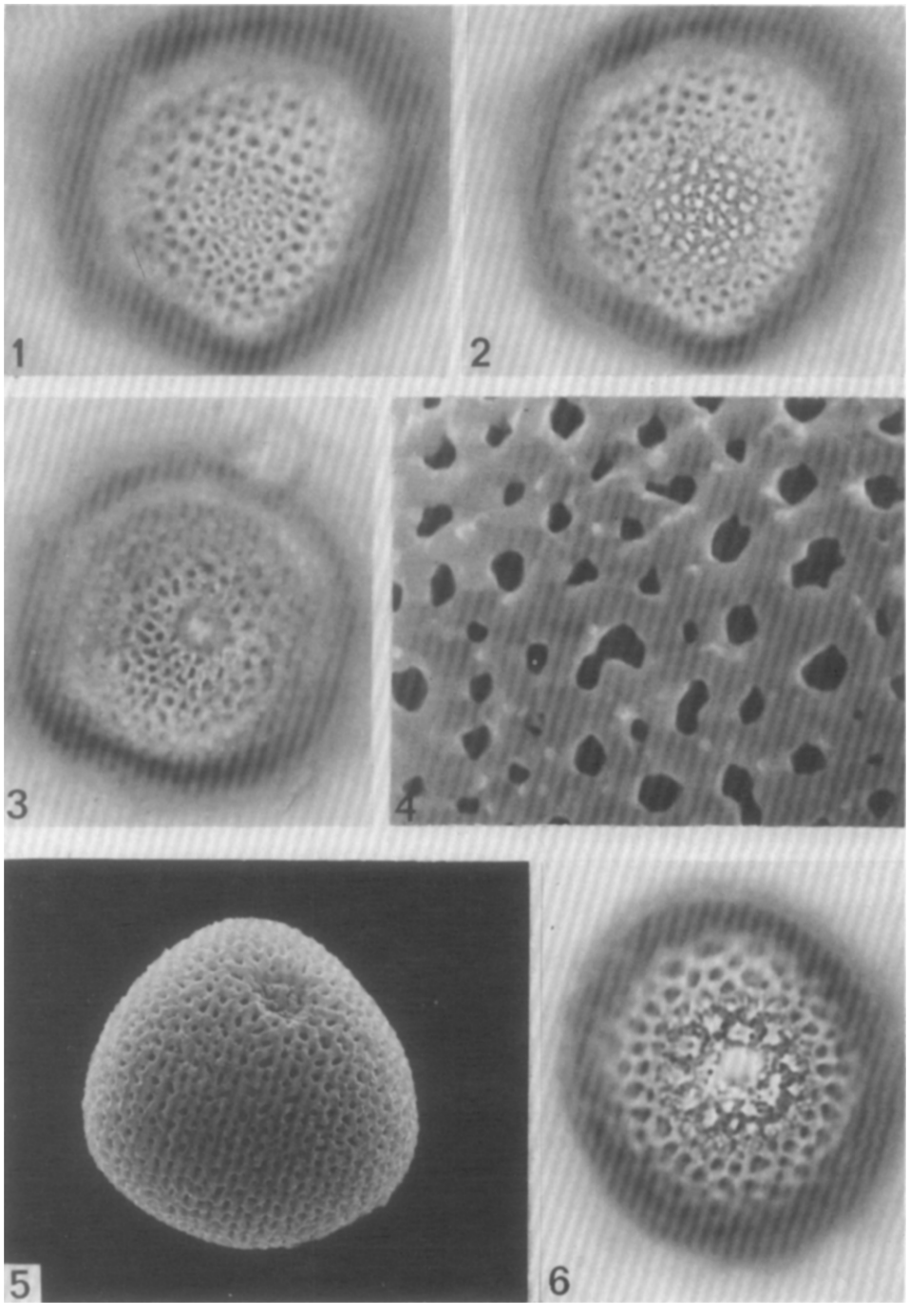


PLATE II

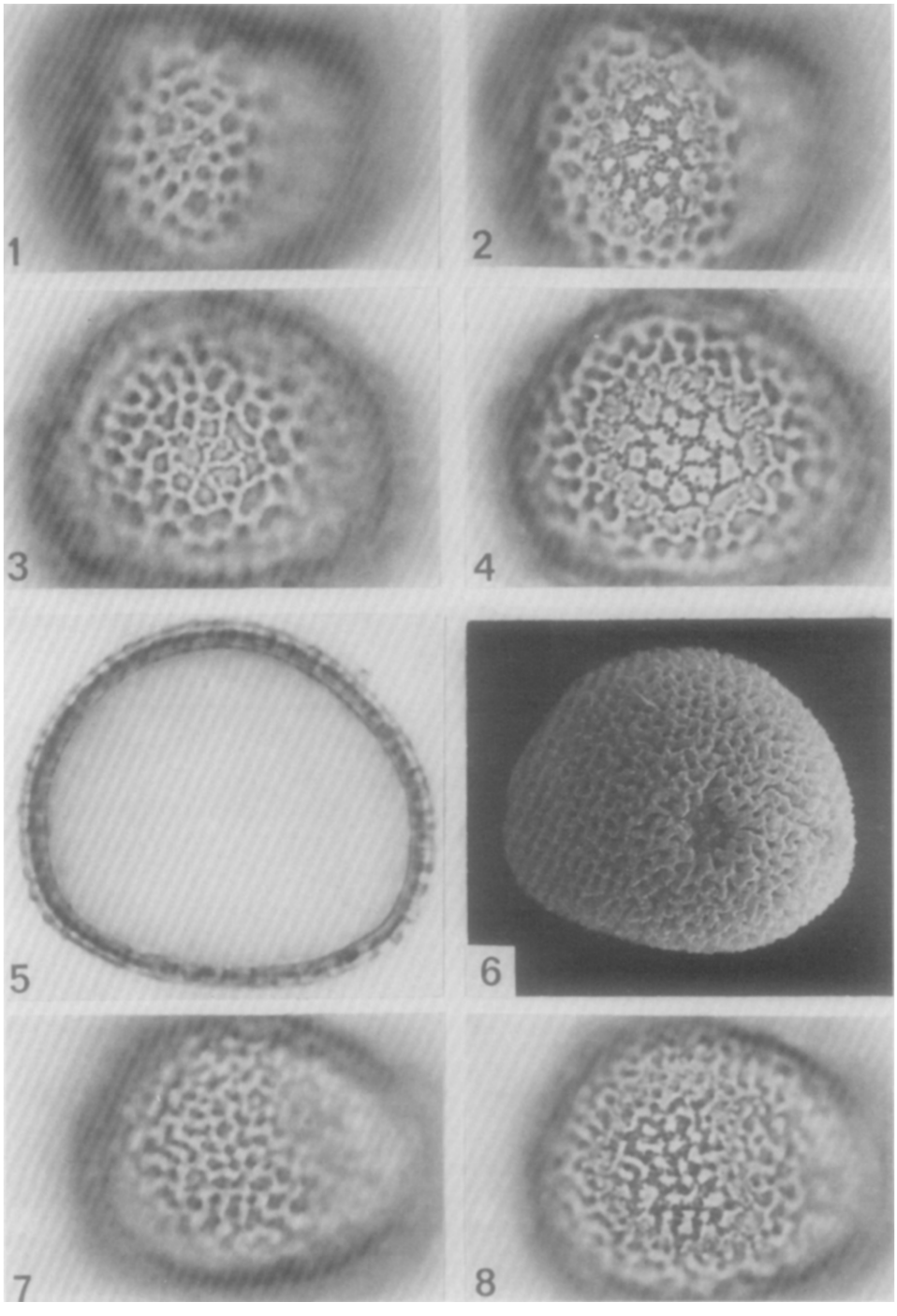


PLATE III

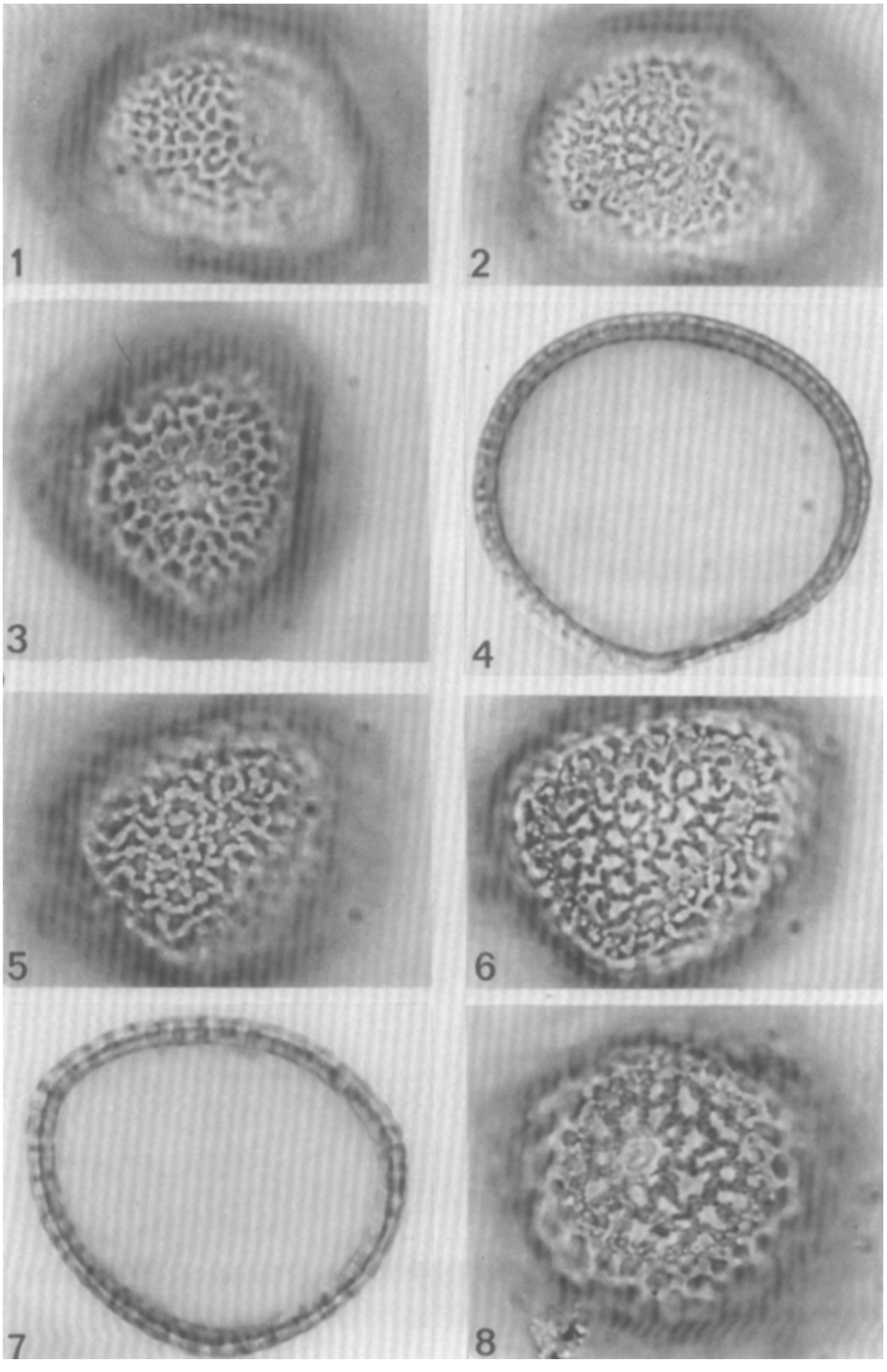


PLATE IV

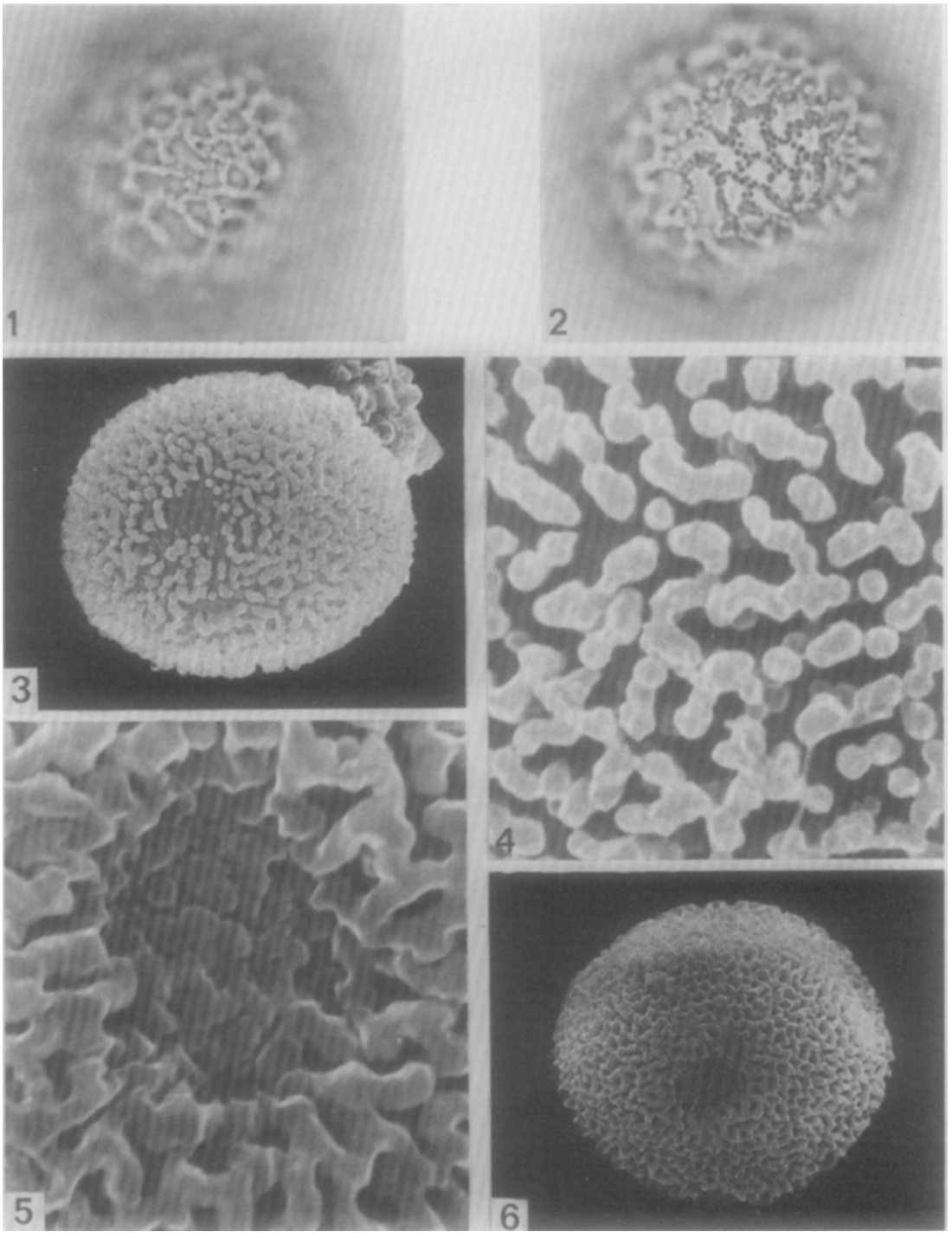


PLATE V

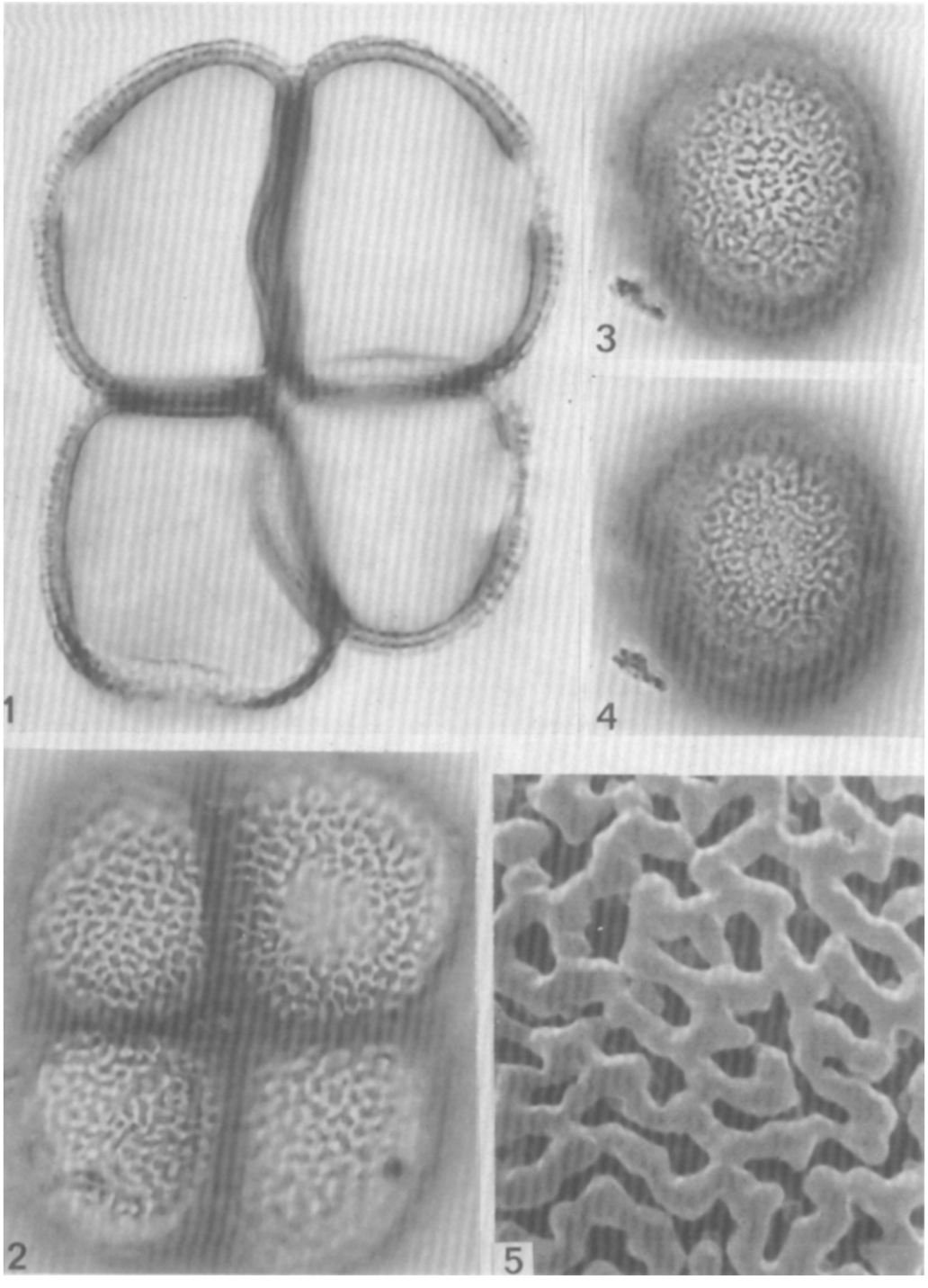
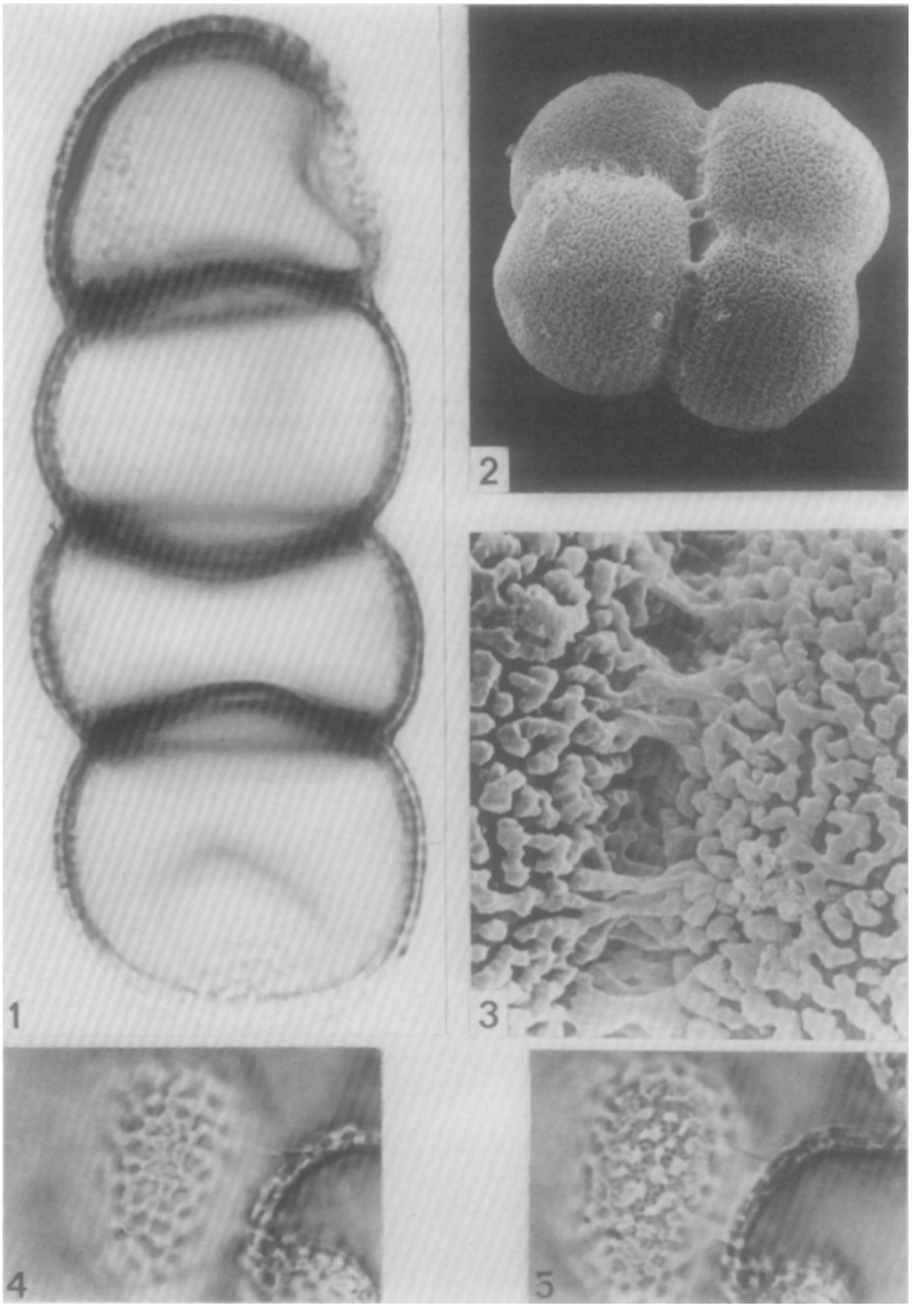


PLATE VI



## REFERENCES

Beug, H.-J., 1961. Leitfaden der Pollenbestimmung. Lieferung 1. Gustav Fischer Verlag, Stuttgart, 63 pp.

Cook, C. D. K., 1961. Sparganium in Britain. Watsonia, 5: 1—10.

Erdtman, G., 1943. An introduction to Pollen Analysis. Chronica Botanica, Waltham, Mass., 239 pp.

Erdtman, G., 1952. Pollen Morphology and Plant Taxonomy — Angiosperms. Almqvist and Wiksell, Stockholm, 1st ed., 539 pp.

Erdtman, G., Berglund, B. and Praglowski, J., 1961. An Introduction to a Scandinavian Pollen Flora, I. Almqvist and Wiksell, Stockholm, 92 pp.

Erdtman, G., Praglowski, J. and Nilsson, S., 1963. An Introduction to a Scandinavian Pollen Flora, II. Almqvist and Wiksell, Stockholm, 89 pp.

Faegri, K. and Iversen, J., 1950. Textbook of Modern Pollen Analysis. Munksgaard, Copenhagen, 169 pp.

Faegri, K. and Iversen, J., 1964. Textbook of Pollen Analysis. Munksgaard, Copenhagen, 2nd ed., 237 pp.

Graebner, P., 1900. In: A. Engler, Das Pflanzenriech, IV. 8. Typhaceae.

Van Ooststroom, S. J. and Reichgelt, Th. J., 1964. Flora Neerlandica, 1(6): 14. Sparganiaceae 227—238; 15. Typhaceae 239—242.

Visset, L., 1971. Quelques pollens actuelles en microscopie électronique à balayage. C. R. Acad. Sci. Paris, Ser. D., 273: 946—948.

Wodehouse, R. P., 1932. Tertiary pollen — I. Pollen of the living representatives of the Green River Flora. Bull. Torrey Bot. Club, 59: 313—340.

Wodehouse, R. P., 1935. Pollen grains. McGraw-Hill Book, New York and London, 574 pp.