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Taxonomic studies of Silenoideae (Caryophyllaceae) in Egypt. 3. Tribe Diantheae

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ABSTRACT

HOSNY, A. I. & N. EL HUSSEINI (1995). Taxonomic studies of Silenoideae (Caryophyllaceae) in Egypt. 3. Tribe Diantheae. *Candollea* 50: 1-14. In English, English and French abstracts.

The systematic revision of *Diantheae* in Egypt revealed the presence of the genera: *Gypsophila*, *Bolanthus*, *Dianthus* and *Vaccaria*, these comprising 10 species among which *Gypsophila antari* Post & Beauverd is a new record for the flora of Egypt. Seed coat and exine's sculpture were studied by SEM and proved to be of systematic value. A key for the species, their synonyms and notes on their distribution are provided.

RÉSUMÉ

HOSNY, A. I. & N. EL HUSSEINI (1995). Etudes taxonomiques des Silenoideae (Caryophyllaceae) d'Égypte. 3. Tribu des Diantheae. *Candollea* 50: 1-14. En anglais, résumés anglais et français.

La révision systématique de la tribu des *Diantheae* d'Égypte confirme la présence des genres *Gypsophila*, *Bolanthus*, *Dianthus* et *Vaccaria*, avec un total de 10 espèces. Parmi ces dernières, *Gypsophila antari* Post & Beauverd est une nouvelle citation pour la flore d'Égypte. L'étude du tégument des graines et de l'ornementation de l'exine au MEB fournit des critères d'intérêt taxonomique. Une clé des espèces, leurs principaux synonymes et des données sur leur répartition complètent l'étude.

KEY-WORDS: *Diantheae* — Egypt — Taxonomy — Biosystematics — Key for determination.

Introduction

According to PAX & HOFFMANN (1934), the tribe *Diantheae* comprises 8 genera of which the genus *Gypsophila* includes 8 subgenera; of these subgenera, *Bolanthus* and *Ankeropetalum* are regarded by BARKOUDAH (1962) as two distinct genera.

Four genera are present in Egypt viz. *Gypsophila*, *Bolanthus*, *Dianthus* and *Vaccaria*. *Ankeropetalum* (of the Mesopotamian subregion, Irano-Turanian region), and *Tunica* (an E Mediterranean taxon) which were reported by TACKHOLM (1974) are not likely to occur in Egypt. No materials of those two genera are known or have been seen by the authors from this country.

In this work, the native taxa of *Diantheae* will be systematically treated with special reference to some of the microcharacters viz. the sculpture pattern of seed coat and the exine of the pollen grains.

Material and methods

Ample herbarium materials from CAI and CAIM were examined; in addition, fresh materials for some taxa were considered.

For each taxon, at least 5 fully mature seeds by specimen and 10 well developed pollen grains by anther were examined under light microscope. Materials for SEM examination were mounted on stubs, coated with gold, examined and photographed by JEOL JSM-T20 Scanning Electron microscope of the Central laboratory at the National Research Center, Dokki, Cairo, Egypt.

Key of the Diantheae of Egypt

- 1a. Plant dwarf, 5-8 cm high, hirsute, flowers arranged in terminal capitate inflorescence, seeds comma-shaped, exine sculpture spinulose (Fig. 2.1) **Bolanthus hirsutus** var. **alpinus**
- 1b. Plant longer, 20-75 cm high, mostly glabrous, flowers solitary or in lax mono- or dichasial cymes, seeds ovoid, spherical or discoid, exine sculpture spinulose-punctate or tubuliferous-punctate 2
- 2a. Flowers solitary or few-flowered (2-3) monochasial cymes, each flower subtended by 4 or more bracteoles at the calyx base; seeds discoid, bilaterally compressed (Fig. 3.1), pores 10-12 3
- 2b. Flowers numerous in dichasial cymes, not subtended by bracteoles; seeds spherical or ovoid, not bilaterally compressed, pores 12-18 6
- 3a. Annual, bracteoles 4, equal or longer than calyx, ending with a rigid awn, awn 7-10 mm long **Dianthus cyri**
- 3b. Perennials, bracteoles 4-14, shorter than calyx, ending with acute or shortly awned apex, awn 2-6 mm long 4
- 4a. Leaves spatulate, attenuate towards the base into a petiole, petioles 10 mm long, bracteoles 4, with acute apex **Dianthus guessfeldtianus**
- 4b. Leaves linear or ovate, subulate, sessile, bracteoles 4-6 or 10-14, with awned apex 5
- 5a. Leaves linear, bracteoles 4-6, awn 2 mm long, calyx 14-18 mm long, petal limb dentate **Dianthus strictus**
- 5b. Leaves ovate, subulate, bracteoles 10-14 mm, awn 6 mm long, calyx 25-30 mm long, petal limb fimbriate **Dianthus sinaicus**
- 6a. Calyx ovoid or conical-shaped, with 5 green, protruding wing-like ribs, sepals united almost to the apex, forming 5-short calyx teeth, flowers 15 mm long; seeds spherical (Fig. 3.2) 2-2.5 mm diameter, seed coat cells isodiametric, randomly arranged (Fig. 3.2), pollen grain 30-42.5 μ m, exine sculpture tubuliferous-punctate (Fig. 2.2) 7
- 6b. Calyx campanulate, neither winged nor ribbed, sepals united till about half its length, flowers smaller, 4-5 mm long; seeds mostly ovoid (Fig. 3.3) 1-1.5 \times 0.8-1.3 mm, seed coat cells elongated in one direction, radially arranged (Fig. 3.4), pollen grain 22.5-30 μ m, exine sculpture spinulose-punctate (Fig. 2.3) 8
- 7a. Calyx teeth triangular, apex acute, surrounded by the membranous margin, cells of the seed coat are flat at lateral face, slightly papillolate at back face, anticlinal wall wavy, periclinal outer wall rugose (Fig. 4.1) **Vaccaria hispanica** var. **hispanica**

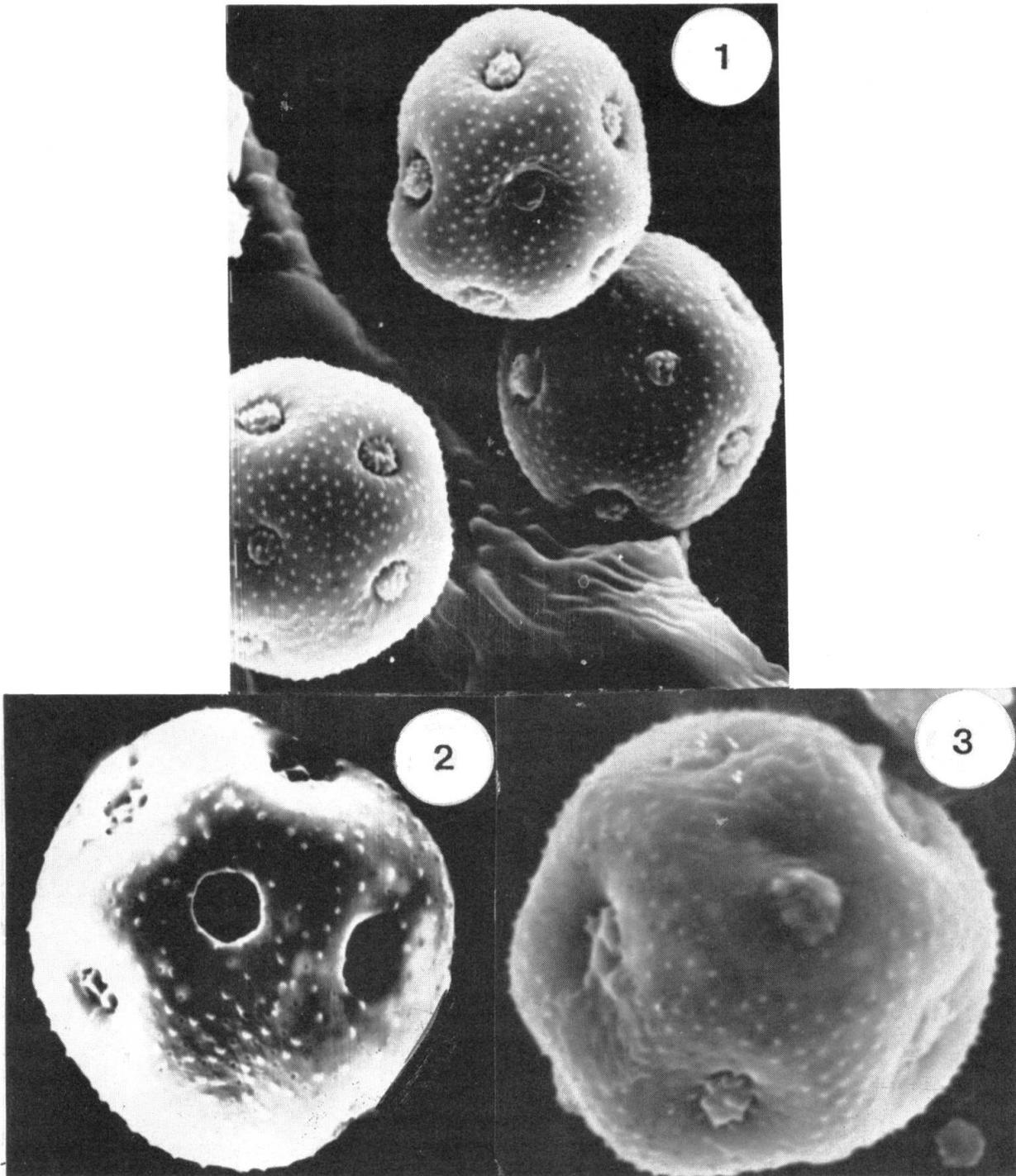


Fig. 1. — SEM micrographs of pollen grains.
1, *Bolanthus hirsutus* var. *alpinus* \times 2000; 2, *Dianthus cyri* \times 2000; 3, *Vaccaria hispanica* var. *oxyodonta* \times 2000.

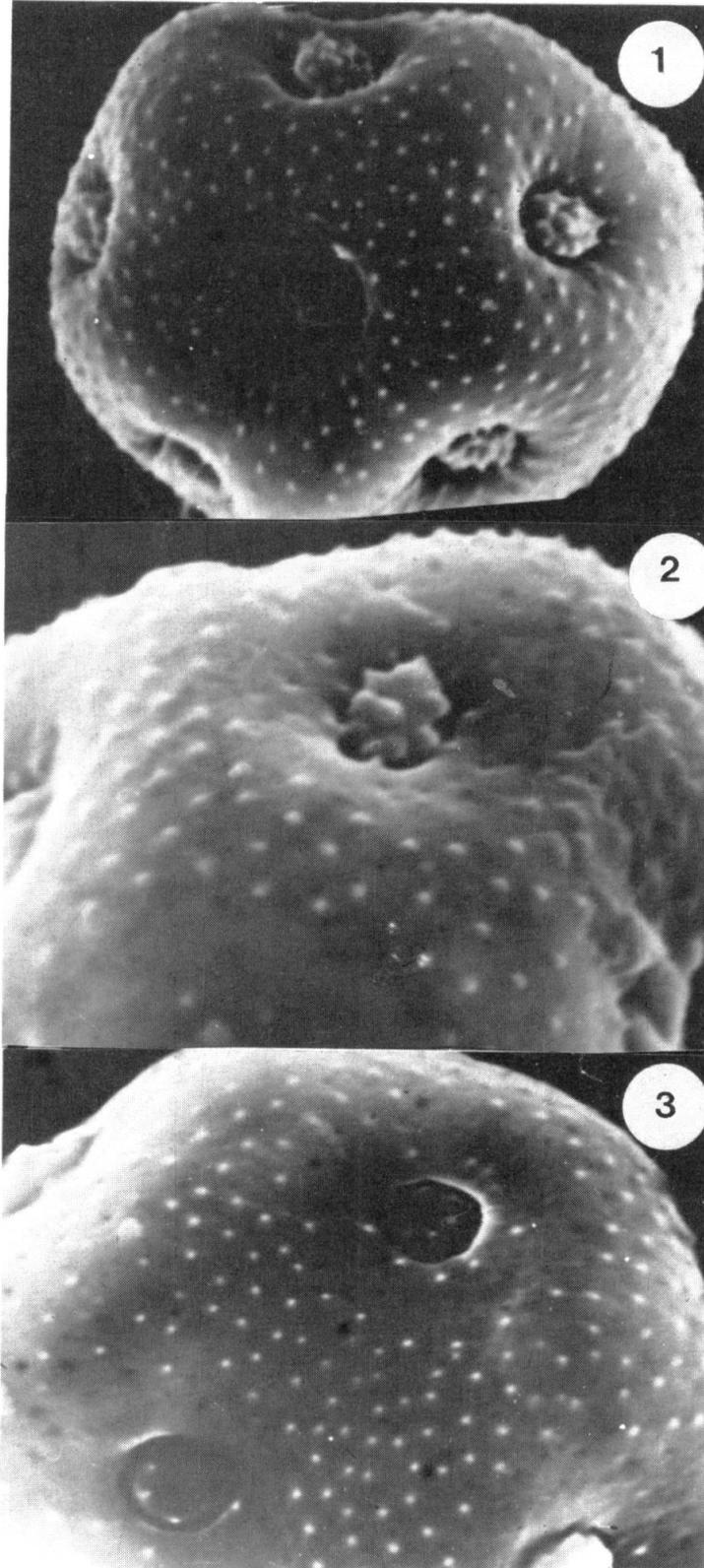


Fig. 2. — SEM micrographs of exine sculpture.
1, *Bolanthus hirsutus* var. *alpinus* \times 3500; 2, *Vaccaria hispanica* var. *oxyodonta* \times 3500; 3, *Gypsophila capillaris* \times 3500.

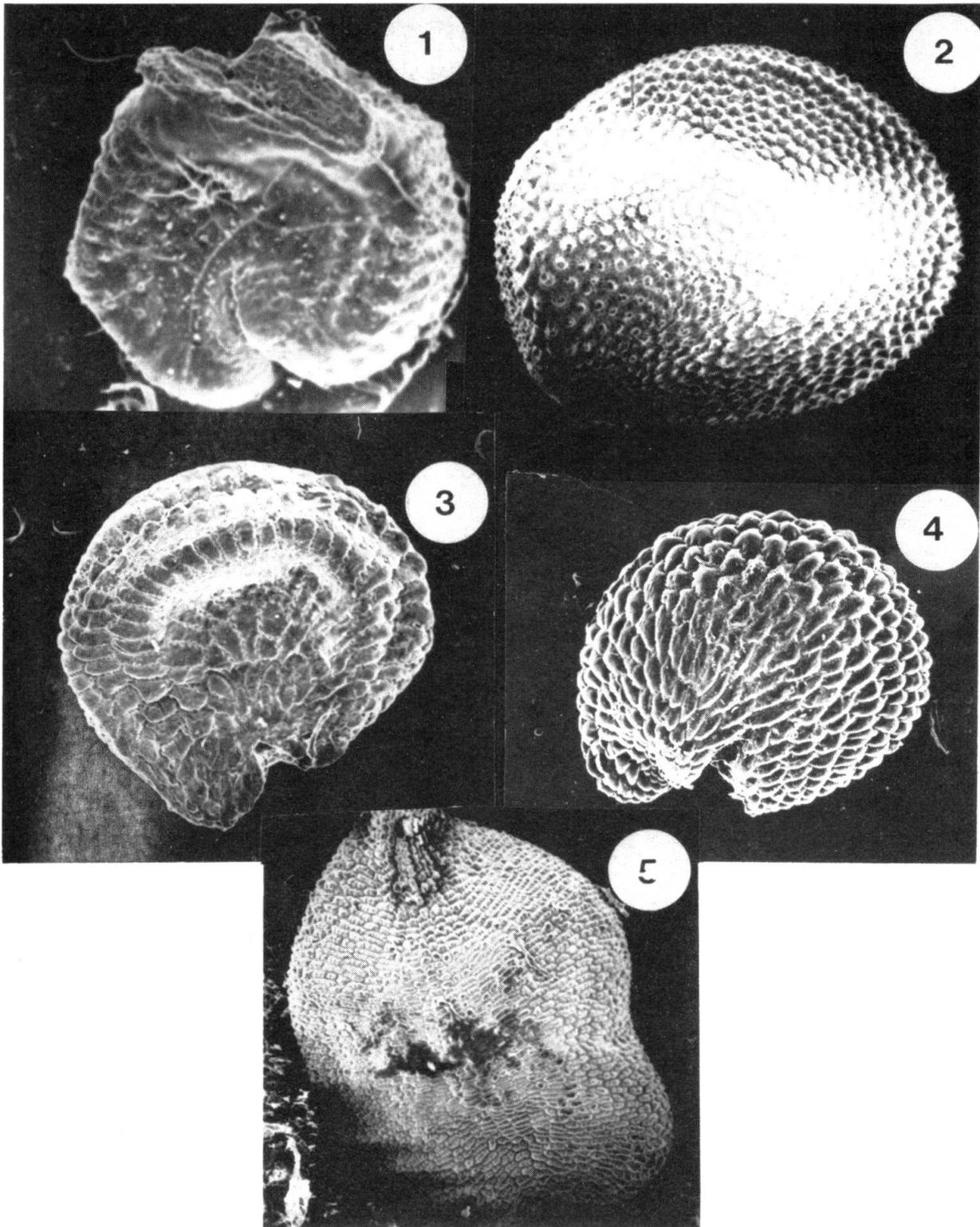


Fig. 3. — SEM micrographs of seed.

1, *Dianthus strictus* × 43; **2**, *Vaccaria hispanica* var. *oxyodonta* × 30; **3**, *Gypsophila viscosa* × 43; **4**, *Gypsophila capillaris* × 43; **5**, *Dianthus cyri* × 43.

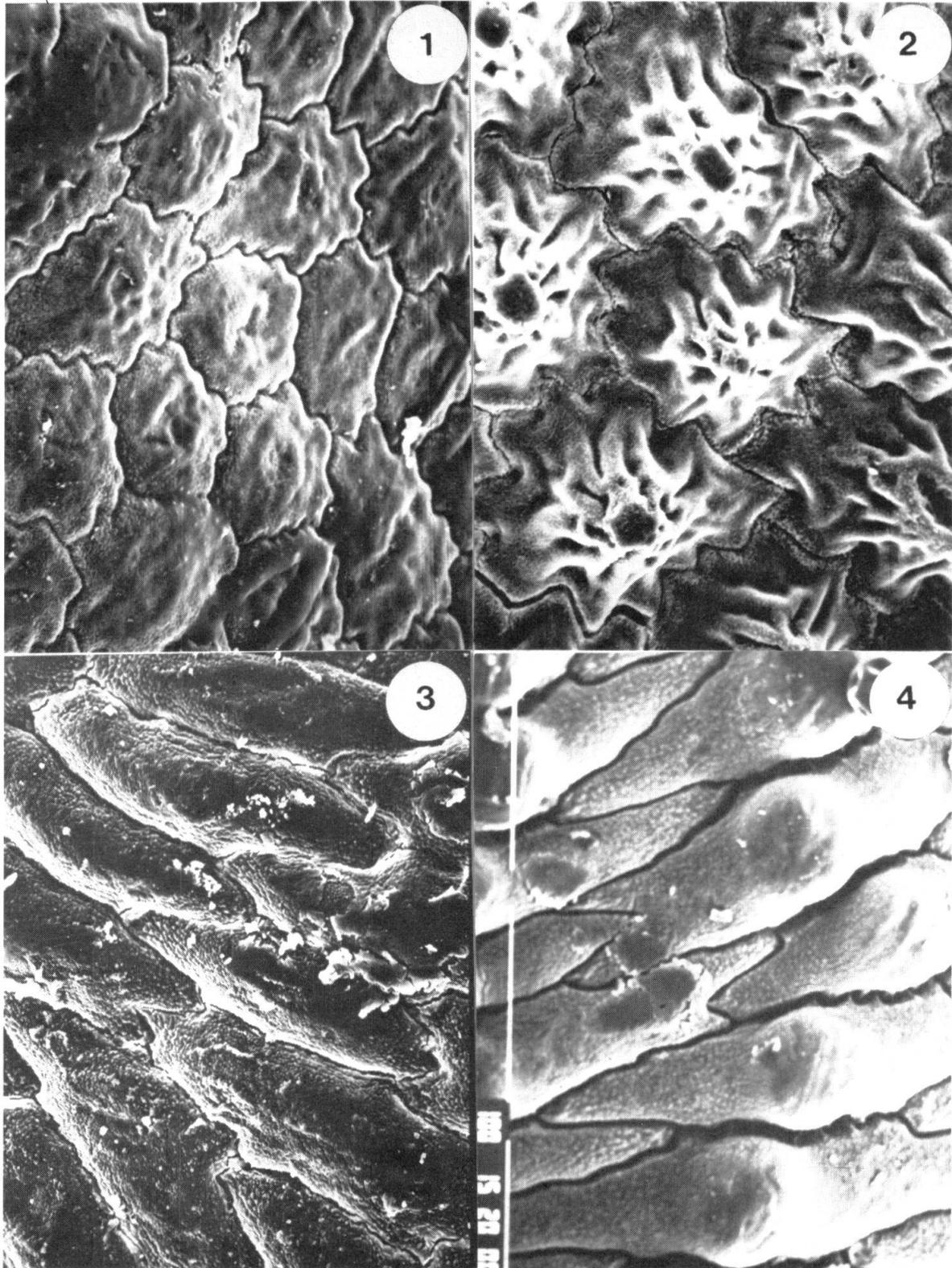


Fig. 4. — SEM micrographs of seed coat sculpture.
1, *Vaccaria hispanica* var. *hispanica* $\times 292$; 2, *Vaccaria hispanica* var. *oxyodonta* $\times 400$; 3, *Gypsophila capillaris* $\times 292$; 4, *Gypsophila arabica* $\times 292$.

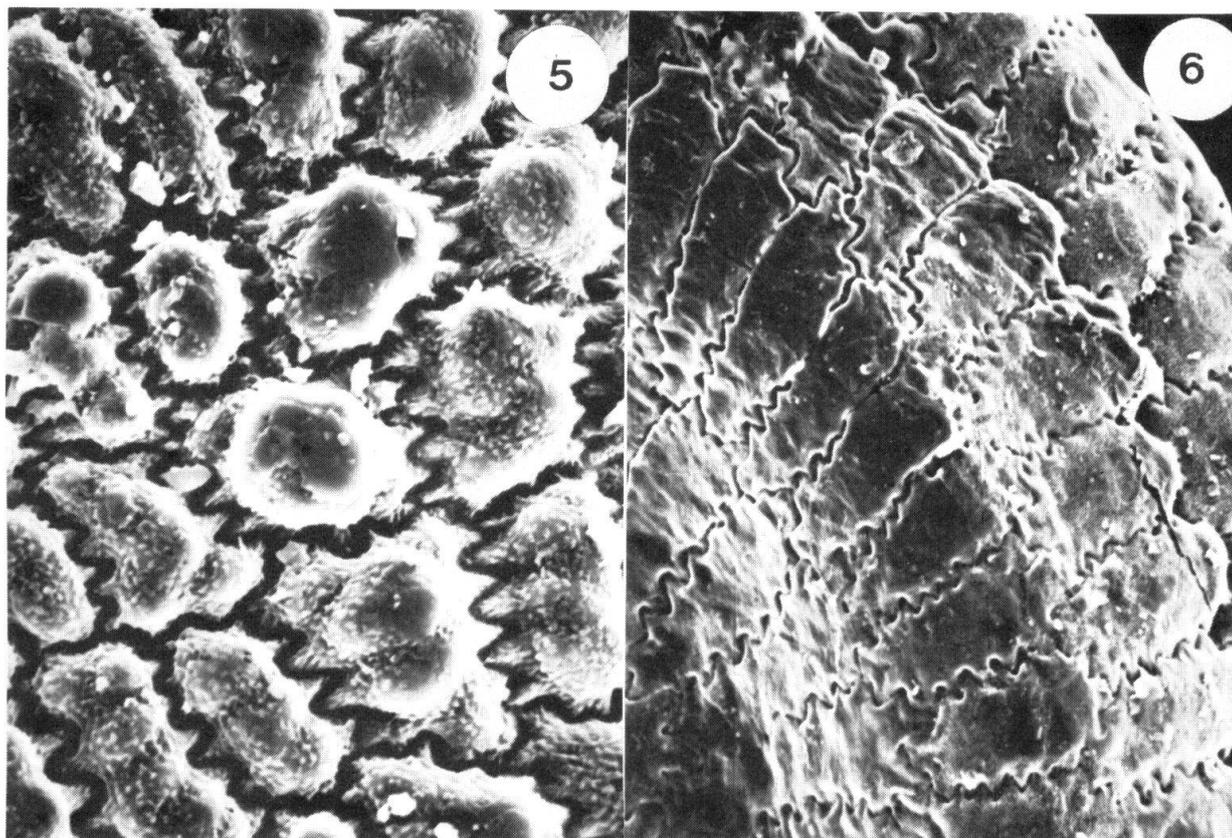


Fig. 4 cont. — SEM micrographs of seed coat sculpture.
 5, *Dianthus cyri* × 650; 6, *Gypsophila viscosa* × 175.

- 7b. Calyx teeth lanceolate, apex acuminate, without membranous margin, cells of the seed coat tuberculate at lateral and back faces, anticlinal wall acutely sinuous-stellate form, outer periclinal wall with thick interwoven ribs forming a reticulum along the tubercle (Fig. 4.2) **Vaccaria hispanica** var. **oxyodonta**
- 8a. Annual or biennial herbs, branches axillary, basal leaves elliptical or lanceolate, flowers small, 3.5 mm long, 20-35 flower by flowering branch 9
- 8b. Woody perennials, branches from the base, basal leaves narrow, flowers larger 4.5-6 mm long, more than 35 flowers by flowering branch 10
- 9a. Internodes 2.5 cm long, basal leaves elliptical, 3.5 × 1-1.5 cm, petiolate, petiole ca. 6 mm long, flower pedicel 1.5-2 cm long, sepals elliptical, 2-2.5 mm long, unequal, united till 1/4 its length, apex obtuse, bracts linear, leafy **Gypsophila antari**
- 9b. Internodes 6-6.5 cm long, basal leaves lanceolate, 4.5 × 1.3-1.5 cm, sessile, pedicel 2-4 cm long, sepals oblong 3 mm long, equal, united till 1/2 its length, apex acute, bract triangular, scarious **Gypsophila viscosa**
- 10a. Sepals oblanceolate, 3 mm long, united till 2/3 its length, apex acute. Capsule globoid, surrounded by the persistent calyx, pale brownish-green, opens by 4 valves to ca. half the length of the capsule, valves 2.5-3 mm long, with acute apex; seeds 1 × 0.8 mm, seed coat cells flat-convex at lateral face, papillolate at back face (Fig. 4.3)
Gypsophila capillaris

- 10b. Sepals oblong, 2 mm long, united till 1/3 its length, apex obtuse. Capsule turbinate-quadrangular, calyx deciduous, cream in colour becoming orange towards the apex, opens by 4 valves till the base of the capsule, valve 2 mm long, with obtuse apex; seeds 1.5×1.3 , seed coat cells centrally acutely tuberculate at lateral and back faces (Fig. 4.4)

Gypsophila arabica

1. *Gypsophila* L.

According to BARKOUDAH (1962) *Gypsophila* is an Eurasian genus comprising 125 species belonging to 3 subgenera of which subgenus *Gypsophila* is subdivided into 8 sections; only section *Dichoglottis* Boiss. is represented in Egypt. According to TÄCKHOLM (1974), *Gypsophila viscosa* and *G. capillaris* are known from mountainous Sinai and Galala Desert. DANIN & al. (1985) and HOSNY (1989) recorded *Gypsophila arabica* from Sinai; while *G. antari* Post & Beauverd is represented here as new record for the Flora of Egypt.

- 1.1. *Gypsophila viscosa* Murray**, Commentat. Soc. Regiae Sci. Gott. Recent. 6, Cl. Phys: 9, tab. 3 (1785).

Habitat. — Sandy soils in wadi beds and mountainous rocky slopes.

Distribution. — C & S Turkey, E Mediterranean region, Sinai (Egypt) (Map 1) and N Saudi Arabia.

Representative specimens. — S: S Sinai, Gebel Musa, 22.4.1983, *A. Hosny s.n.* (CAI); S Sinai, wadi el Talaa, 23.4.1983, *A. Hosny s.n.* (CAI); S Sinai, car track up to Catherine Mountain, 24.4.1983, *A. Hosny s.n.* (CAI).

- 1.2. *Gypsophila capillaris* (Forsskål) C. Chr.**, Dansk Bot. Ark. 4(3): 19 (1922).

Basionym: *Rokejeka capillaris* Forsskål, Fl. Aegypt.-Arab.: LXVI (1775).

Habitat. — Sandy deserts.

Distribution. — Known from the wadies of Galala Desert and mountainous S Sinai; believed to be endemic to Egypt (Map 1).

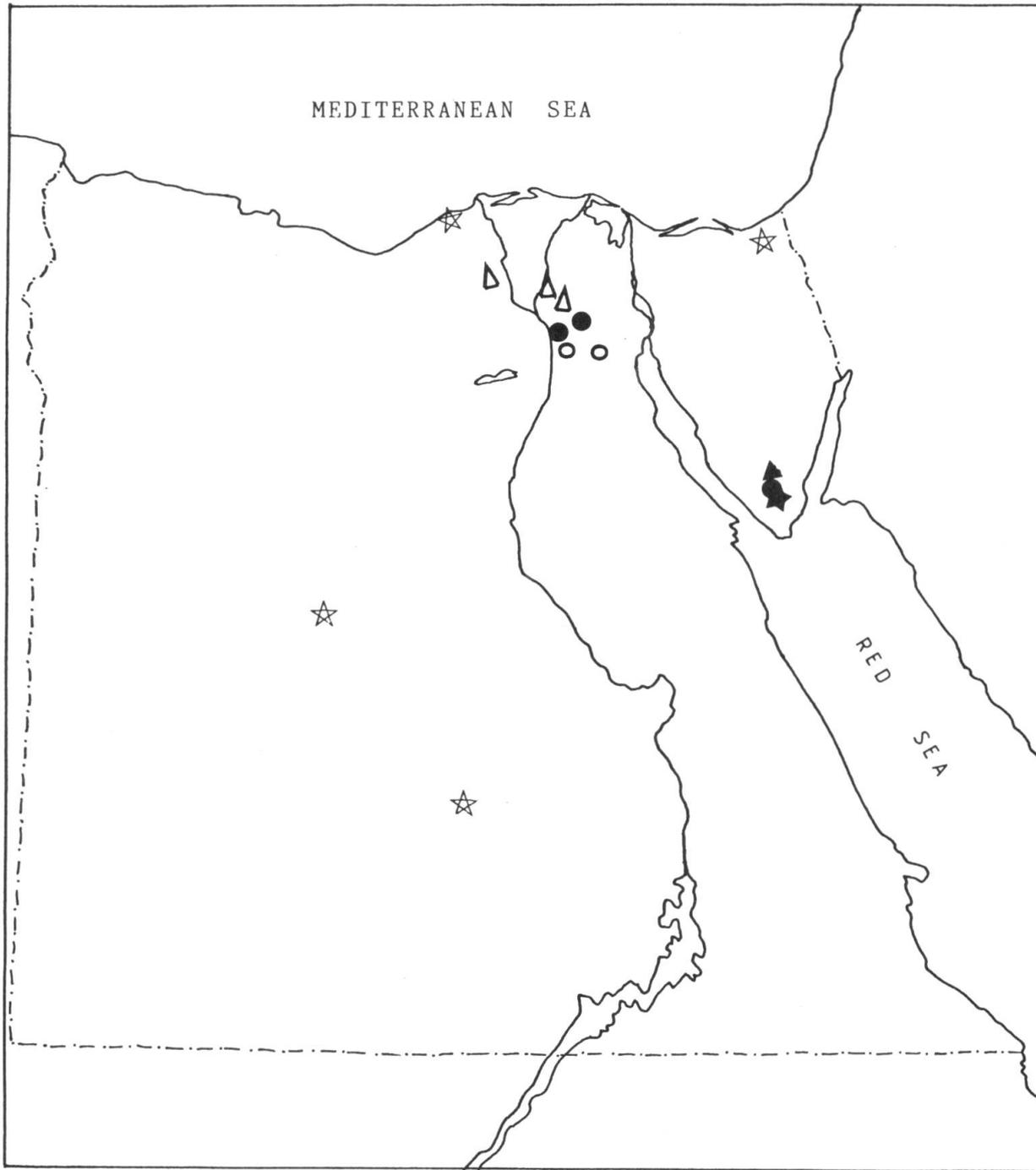
Representative specimens. — Dg: Hadaig Helwan, 19.8.1952, *Imam s.n.* (CAI); South of wadi Digla, 20.6.1960, *V. Täckholm & al. s.n.* (CAI); Wadi Hof, 29.10.1926; *G. Täckholm s.n.* (CAI); Wadi Hof, 22.5.1978, *El Bakry s.n.* (CAI); Cairo-Suez road, km 30, 29.5.1953, *V. Täckholm s.n.* (CAI). S: Gebel Catherine, on the way down to wadi el Arbaain, 24.4.1983, *A. Hosny s.n.* (CAI).

- 1.3. *Gypsophila arabica* Barkoudah**, Wentia 9: 139 (1962).

Habitat. — Sandy soil of wadi beds and dry hill slopes.

Distribution. — Known from Palestine, N Saudi Arabia and Egypt (Galala and Isthmic Deserts; mountainous S Sinai) (Map 1).

Representative specimens. — Dg: Wadi Saumur, near wadi Araba, s.dat., *Fossatei s.n.* (CAI); Cairo-Suez road, 8.1.1971, *Ibrahim & al. s.n.* (CAI). Di: Wadi el Maghara, 22.9.1988, *Hadidi & al. s.n.* (CAI). S: S Sinai, St. Catherine, wadi el Talaa, 23.4.1983, *A. Hosny s.n.* (CAI); S Sinai, wadi Tlah, 8.10.1983, *Hadidi & al. s.n.* (CAI).



Map 1. — Geographical distribution of ▲ *Gypsophila viscosa*; ● *Gypsophila capillaris*; ★ *Gypsophila arabica*; ○ *Gypsophila antari*; *Vaccaria hispanica* ☆ var. *hispanica*, △ var. *oxyodonta*.

1.4. *Gypsophila antari* Post & Beauverd in Dinsmore, Pl. Post. Dinsm. 1: 4 (1932).

Habitat. — Desert plain with sandy and stony soils.

Distribution. — Syria, E & S Iraq, Kuwait and N Saudi Arabia (BARKOUDAH, 1962: 140); rare in wadi beds of the Galala Desert of Egypt (Map 1).

Representative specimens. — Dg: Helwan desert, wadi Gerawi, 29.2.1960, V. Täckholm & al. s.n. (CAI); Wadi Angabiya, Cairo-Suez road, April 1960, Ibrahim el Sayed s.n. (CAI).

2. *Bolanthus* (Ser.) Reichenb.

According to BARKOUDAH (1962: 160) *Bolanthus* is a small genus of 8 species distributed in the area extending from Greece through S Turkey to coastal mountains of Syria, Lebanon and Palestine. In Egypt, the genus is represented by *Bolanthus hirsutus*.

2.1. *Bolanthus hirsutus* (Labill.) Barkoudah, Wentia 9: 168 (1962).

Basionym: *Saponaria hirsuta* Labill., Icon. Pl. Syr. 4: 9, tab. 4, fig. 3 (1812).

A polymorphic species, comprises 3 varieties, only *Bolanthus hirsutus* var. *alpinus* occurs in Egypt.

2.1a. *Bolanthus hirsutus* (Labill.) Barkoudah var. **alpinus** (Boiss.) Barkoudah, Wentia 9: 168 (1962).

Basionym: *Gypsophila hirsuta* (Labill.) Sprengel var. *alpina* Boiss., Fl. Orient. 1: 557 (1867).

Habitat. — Calcareous rocky slopes of hills and mountains.

Distribution. — Syria, Lebanon, Palestine, Saudi Arabia and mountainous Sinai of Egypt (Map 2).

Representative specimen. — Mt. Catharina, Sinai, Schimper 276 (BM!).

3. *Dianthus* L.

A large genus of about 300 species found in the Northern Hemisphere with strong concentration in the Mediterranean region.

TÄCKHOLM (1974) reported the presence of 6 species of which *Dianthus judaicus* and *D. libanotis* are not likely to occur in Egypt. No specimens are known or have been seen by the authors from this country. Four species are known to occur in Egypt viz. *Dianthus strictus*, *D. cyri*, *D. sinai-cus* and *D. guessfeldtianus*.

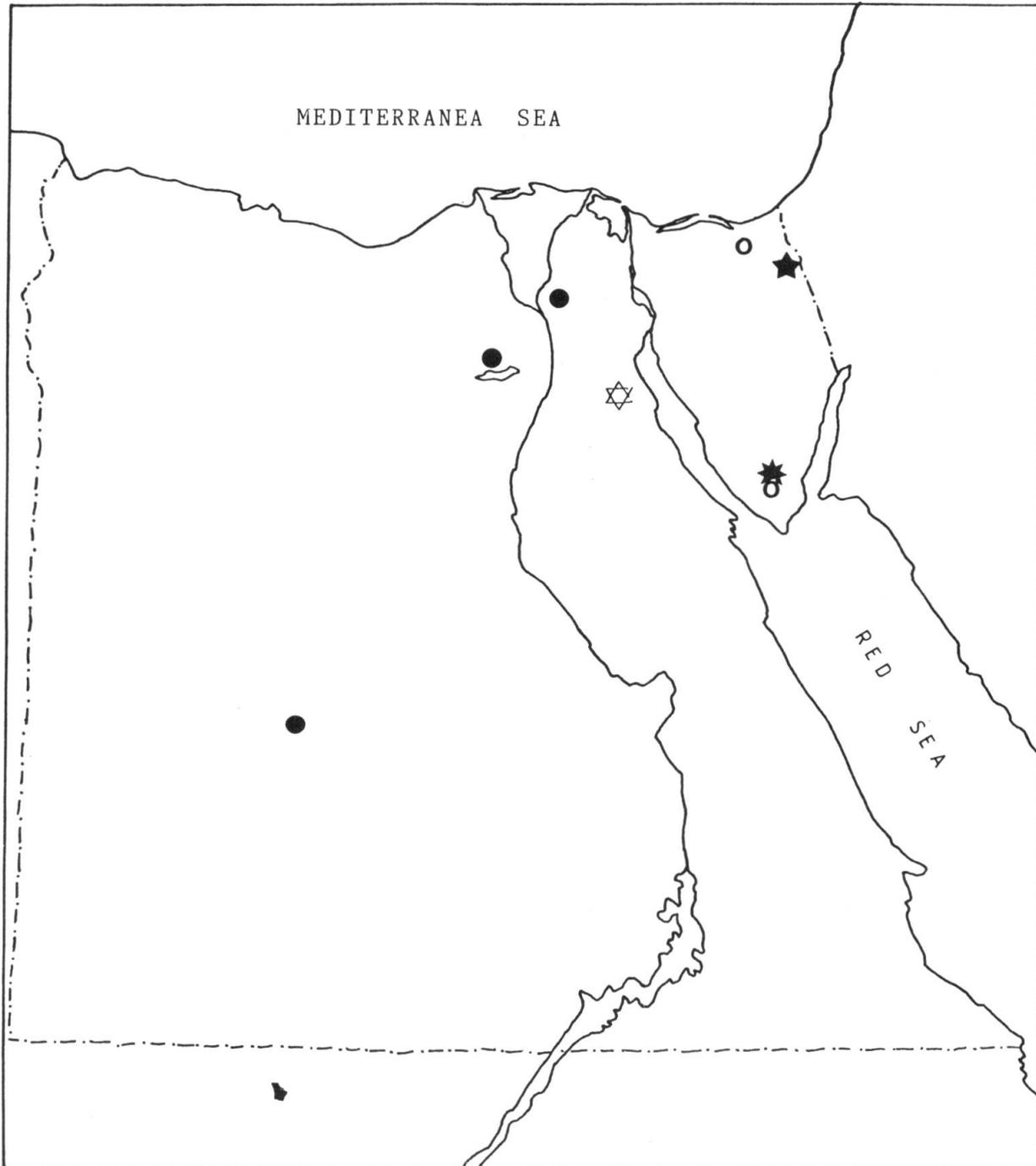
3.1. *Dianthus strictus* Banks & Solander in Russell, Nat. Hist. Aleppo ed. 2, 2: 252 (1794).

Synonym: *D. multipunctatus* Ser. in DC., Prodr. 1: 362 (1824).

Habitat. — Edges of cultivated ground of stony slopes.

Distribution. — E Mediterranean, extending towards adjacent area of the Irano-Turanian region; known from the Isthmic Desert of Sinai, Egypt (Map 2).

Representative specimens. — Di: Wadi Ein el Gedeirate, sept. 1928, Drar s.n. (CAIM); Ein el Gedeirate, Sinai, 7.5.1934, Priesner 2821 (CAIM).



Map 2. — Geographical distribution of * *Bolanthus hirsutus* var. *alpinus*; ★ *Dianthus strictus*; ☆ *Dianthus guessfeldtianus*; ● *Dianthus cyri*; ○ *Dianthus sinaicus*.

3.2. *Dianthus cyri* Fischer & C. A. Meyer, Index Sem. Hort. Petrop. 4: 34 (1838).

Habitat. — Weed, in heavy alluvial soil.

Distribution. — Turkey, Caucasia, Iran, Iraq, Palestine, Syria, Lebanon and Egypt (Map 2).

Representative specimens. — Nd: S of Abu Zaabal village, 2.5.1924, *Simpson 2801* (CAIM). Nf: Weed in field at Shakshouk, Faiyum, 5.5.1967, *Hadidi & al. s.n.* (CAI). O: Dakhla oasis, Hindaw, Bir el sheikh Badran, 6.3.1934, *Shabetai 4234* (CAIM); Dakhla oasis, Mut, 15.2.1937, *Hassib s.n.* (CAI); Dakhla oasis, Ezbet el Mauhub, in the field near the village, 16.3.1967, *Hadidi & al. s.n.* (CAI).

3.3. *Dianthus sinaicus* Boiss., Diagn. Pl. Orient. 1: 23 (1843).

Habitat. — Rocky slopes of mountains and hills.

Distribution. — Palestine and mountainous and Isthmic desert of Sinai, Egypt (Map 2).

Representative specimens. — Di: Sinai, wadi el Maghara, 22.9.1988, *Hadidi & al. s.n.* (CAI). S: Plantes du Sinai, Rimhan Fara, Aug. 1926, *Kaiser 211* (CAIM); Abu Log, 9.9.1926, *Kaiser 514* (CAIM); Sinai, wadi el Lya, near St Catherine, 6.5.1939, *Drar s.n.* (CAIM); Sinai, gebel el Deir, near the monastery of St Catherine, 11.5.1956, *Hadidi s.n.* (CAI).

3.4. *Dianthus guessfeldtianus* Muschler, Man. Fl. Egypt 1: 330 (1912).

Habitat. — Sandy soils and dry hill slopes.

Distribution. Known from Egypt, Galala deserts, believed to be endemic to Egypt (Map 2).

Representative specimens. — Dg: S Galala, wadi el Tin, 7.12.1944, *Shabetai 4225* (CAIM).

4. *Vaccaria* N. M. Wolf

A monotypic genus. *Vaccaria hispanica* is mainly a Mediterranean species with several varieties of which var. *hispanica* and var. *oxyodonta* are known in Egypt.

4.1. *Vaccaria hispanica* (Miller) Rauschert, Wiss. Z. Martin-Luther-Univ. Halle-Wittenberg, Math.-Naturwiss. Reihe 14: 496 (1965).

Basionym: *Saponaria hispanica* Miller, Gard. Dict. ed. 8: in err. (1768).

Synonym: *Vaccaria pyramidata* Medicus, Philos. Bot. 1: 96 (1789).

4.1a. *Vaccaria hispanica* var. *hispanica*

Habitat. — Grow as weed in moist fields.

Distribution. — Mediterranean, extended into Irano-Turanian and Euro-Siberian region (ZOHARY, 1966), known from Mediterranean coastal region and Oases of Egypt (Map 1).

Representative specimens. — M: Alexandria, Mex, 23.1.1928, *G. Täckholm s.n.* (CAI); El-Arish, Bir Lehfen, 21.3.1928, *G. Täckholm s.n.* (CAI). O: Farafra oasis, in town, near the camp, 21.3.1968, *Gun Romeé s.n.* (CAI); Kharga oasis, east Nasir village, 13.3.1967, *Hadidi & al. s.n.* (CAI).

4.1b. *Vaccaria hispanica* var. *oxyodonta* (Boiss.) Greuter & Burdet, Willdenowia 12: 191 (1982).
Basionym: *Vaccaria oxyodonta* Boiss., Diagn. Pl. Orient. ser. 2, 1: 68 (1854).

Habitat. — The same as the type variety.

Distribution. — The same as the type variety, in Egypt, in Nile Delta (Map. 1).

Representative specimens. — Nd: Nile delta, Ganaclis farms, 5.4.1972, *Ibrahim & al s.n.* (CAI); Along the road to Bilbeis, in field, 27.3.1968, *V. Täckholm s.n.* (CAI); South Tahrir, Geziret el Wabour, weed in banana field, 26.3.1987, *A. Soliman 7345* (CAI); Ballana, 1-4 km S. banha, 12.1.1964, *Boulos s.n.* (CAI).

Discussion

Pollen characters

The pollen grains of the studied taxa are generally spheroidal and pantoporate. The number of pores varied from (12) in *Bolanthus hirsutus*, (10-12) in *Dianthus cyri* and (12-18) among the other investigated taxa (Fig. 1: 1, 2, 3). The largest pollen grains are those of *Vaccaria hispanica* (diameter 33.5-42.5 μm), the smallest are those of *Bolanthus hirsutus* (diameter 22.5-28.5 μm). The largest distance between pores (8.5-12.5 μm) was that of *Dianthus cyri*, and the largest pore diameter (4.5 μm) was that of *Vaccaria hispanica*.

Three different exine sculpture patterns were observed by SEM: spinulose in *Bolanthus hirsutus*, spinulose-punctate in *Gypsophila* species and *Dianthus cyri*, and tubuliferous-punctate in *Vaccaria hispanica* (Fig. 2).

Seed characters

The seed characters among the investigated taxa of tribe *Diantheae* showed great variation in shape and seed coat sculpture on the generic, specific as well as infraspecific level.

Seeds are discoid in *Dianthus strictus*, spherical in *Vaccaria* species, comma-shaped in *Bolanthus* species and ovoid in *Gypsophila* species.

The seed coat sculpture was found useful in the separation of closely allied taxa. This is the case of *Vaccaria hispanica* var. *hispanica*, where the ridges are flat, slightly papillolate at back face, anticlinal walls are wavy, and the outer periclinal wall rugose (Fig. 4.1). In *V. hispanica* var. *oxyodonta* the ridges are tuberculate at lateral and back faces, anticlinal walls are sinuous-stellulate form, and the outer periclinal wall shows a thick interwoven ribs forming a reticulum along the tubercle (Fig. 4.2).

The closely allied species: *Gypsophila viscosa*, *G. capillaris* and *G. arabica*, could be easily separated through the characters of the ridges. In *Gypsophila arabica*, the ridges are tuberculate at lateral and back faces; these are flat at lateral and back faces in *G. viscosa* (Fig. 4.6) and flat-convex at lateral face, papillolate at back face in *G. capillaris*.

The arrangement of ridges varies from random, isodiametric in *Vaccaria* species (Fig. 3.2), radiating, elongated in *Gypsophila* species (Fig. 3.3 and 3.4) and parallel, isodiametric-elongated in *Dianthus cyri* (Fig. 3.5).

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