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The Pollen Morphology of Plants In Ankara Region
I. Compositae

by

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The Pollen Morphology of Plants In Ankara Region 
I. Compositae*

By

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SUMMARY

The pollen grains of 46 species Compositae collected from the vicinity of Ankara belonging to 6 tribes were morphologically investigated by light microscopy.

Exine stratifications of pollen grains of these species have been determined and illustrated as 9 types. Exine stratification of pollen grains of every species is more or less similar to one of 9 types. Spines have been found in three types.

INTRODUCTION

The pollen grains of Compositae were first examined by WODEHOUSE (1935). Further morphological details of pollen grains depending on preliminary survey of approximately 400 species have been given by ERDTMAN (1952). Exine stratification studies of Compositae pollen grains using ultraviolet microscopy which embraced 225 species were made by STIX (1960). SKVARLA and LARSON (1965) showed tribal relationships by means of electron microscopic examination of exine structures. SKVARLA and TURNER (1966) examined ultrastuctural features of pollen walls of Blennosperma and Crocidiun and placed them in the tribes Helenieae and Senecioneae and recognized three major pollen wall types, Anthemoid, Helianthoid and Senecoid. Thus they showed the utility of pollen wall characters in the systematic of this family. TOMP (1975) studied pollen wall morphology of Lactuceae by scanning and transmission electron microscopy.

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In this study the morphology of 45 species of *Compositae* pollen grains collected in the vicinity of Anara have been investigated by conventional light microscopy. Our aim is to be helpful in identifying pollen grains in pollen analysis and in taxonomic studies.

**MATERIALS and METHODS**

Poliniferous material was collected from the Herbarium of the Botanical sections of Hacettepe and Ankara Universities.

All species of Pollen preparations were made by method of WODEHOUSE (1935) and the acelotysis method of ERDTMAN (1966) as well. The microscopical investigations have been carried out with a Leitz Ortholux microscope. 10x micrometer and 100x oil immersion objective were used. Photomicrographs have been taken with the same microscope using the photografic outfits. Measurements of the pollen sizes have been made with an eve – piece micrometer (interval between two marks 1, 12 μ), At least ten grains of each species were measured.

**OBSERVATIONS ON POLLEN GRAINS**

The pollen grains of 46 species of *Compositae* exhibit differences in their morphological characters. They are trirporate, tricolporate, spheroidal, subprolate. The sculptures of exine are echinate, scabrate, and psilate. Ambs are circular semiangular intersemiaangular, interhexagonal.

The pollen grains stratifications of 46 species of this family have been determined and illustrated as 9 types (Fig 1). Every species of pollen stratification is more or less similar to one of nine types.

Spines have been found in three types in the pollens examined: conic, concave – conic and convex – conic (Fig. 2)

**Tribe: Inuleae**

Pollen grains tricolporate, oblate spheroidal. Ambs circular. Spines conic or convex-conic.
Helichrysum plicatum DC. subsp. plicatum (Fig. 4:1-3). Pollen grains tricolporate, oblate spheroidal, 19, 8 X 21 μ (W)*, 20, 7 X 23, 6 μ (E)*. Amb circular.

Exine 2,3 μ (W), 3,5 μ (E), echinate. Spines conic 2 μ (W) 3 μ (E) in length with base diameter of 2,9 μ (W) 4,2 μ (E). Stratification of exine like Logfia arvensis. Culumellae 1,7 μ (E) in length and extending into spines. Nexine two 2 μ (E), has cavea on it (Fig 1:5). Intine 0,8 μ.

Colpi 16, 2 X 6,3 μ (W), 17 X 2 μ (E), very narrow in asetolized grains. Ora lalongate, 10,5 X 8 μ (W). Colpi ends 9,4 (W), 6,5 μ (E) in distance. (Beypazarı – Mahya tepesi – Ankara 21.7. 1971 AKMAN, ANK).

Inula montbretiana DC, (Fig 4: 4–6). Pollen grains tricolporate, oblate spheroidal, 24, 5 X 25,4 μ (W); 27, 1 X 24,3 μ (E). Amb circular.

Exine 1,7 μ (W) 3 μ (E) thick, echinate. Spines conic or or convex – conic, 2,3 μ (W), 3,2 μ (E) in length, 3,1 μ (W), 4 μ (E). in base of diameters, rounded to pointed, usually with internal cavity, of 100 μ², 4 in equatorial region, of 100 μ², 8 in poles. Stratification of exine is like Doronicum orientale. There is cavea between nexine one and nexine two. Columella 1,1 μ (E) in and extending into spines. Nekzin 1 μ. Intine 0,7 μ (Fig 1:6).

Colpi 19, 2 X 8 μ (W), 18,1 X 2,6 μ (E) very narrow in asetolized grains. Ora lalongate 8 X ... μ (W), 10, 5X3, 8 μ (E), Colpi ends 9,3 μ (W), 10,4 μ (E) in distance (Beypazarı-Karaşaraltı – Ankara 26.6.1973 AKMAN, ANK).

Inula salicina L. (Fig 4: 7–9). Pollen grains tricolporate, oblate spheroidal 22, 2 X 24 μ (W), 25, 5 X 24, 9 μ (E). Amb circular.

Exine 1,9 μ (W), 2,9 μ (E), thinner in poles, echinate. Spines conic or convex–conic with an internal cavity, height 2,1 (W), 3,8

*(W) The measurements of pollen grains in slides have been made by WODEHO-USE method

(E) The measurementsof of pollen grains in slides have been made by ERDTMAN’s asetolysis method.
μ (E), with base diameter of 3.2 μ (W), 4.5 μ (E). Of 100 μ², 4. The stratification of exine is like *Doronicum orientale*. But columella are more rare than it. Columella 1.7 μ (E) in length and extending into the spines. Nexine two 1 μ. (E) has cavea on it (Fig 1–6). Intine 0.8 μ.

Colpi 18.8 X 7.8 μ (W), 16.2 X 3.2 μ (E) with distinct mar-gine. Ora lalongate 7.2 X ... (W), 4.3 X 10.9 μ (E) Colpi ends 12.1 μ (W), 11, 3 μ (E) in distance. (Beynam – Ankara 2.7.1970. AKMAN, ANK)

*Logfia arvensis* (L.) *Holub* (Fig 4: 10–12) Pollen grains trico-lporate, oblate sphaeroidal, 17 X 19, 1μ (W), 22, 8 X 20.6 μ (E). Amb circular.

Exine 2.5 μ (W), 3.5 μ (E) echinate. Spines conic, height 1.2 μ (W), 1.7 μ (E), with base diameter of 1.3 μ (W), 2.9 μ (E). Of 100 μ², 25. The stratification of exine is like *Tussilago farfara*, *Doronicum orientale*, *Senecio vernalis*. Columella 1.4 μ (E) in length, extending into spines. Nexine two 1 μ has cavea on it it (Fig 1:3). Intine 0.9 μ, thicker under the pores.

Colpi 1.9 X 3 μ (W), 20 X 1.9 μ (E) cith attenuate ends and distinct margines. Ora lalongate. Pore margines indistinct. distinct. 4 X ... μ (W), 7.5 X 2.5 μ (E). Colpi ends 8.2 (W), 7.2 μ (E) in distance. (Beynam – Ankara 8.6.1969 AKMAN, ANK).

**Tribe: Senecioneae**

Pollen grains tricolporate, oblate-spheroidal, spheroidal, Amb circular, spines conic or concav–conic.

*Doronicum orientale* Hoffm. (Fig 4: 13–15) Pollen grains trico-lporate, oblate spheroidal, 22.8 X 24, 9 μ (W) 23.1 X 24.6 μ (E). Amb circular.

Exine 1.9 μ (W), 2.4 μ (E), thinner in poles, echinate. Spines conic, with internal cavity, 3.3 μ (W), 4.7 μ (E), having a base of diameter 4.3 μ (W) 5.1 μ (E). Columella thin and extending into spines, 1.7 μ (E) in length. Nexine two 1 μ (E), has cavea on it (Fig 1:6). Intine 0.7 μ.
Colpi 20 X 2 μ (E) with indistinct margins. Ora lalongate 8.8 X ... μ (E), 4 X 5, 6 μ (E). Colpi ends 11.5 μ (W), 11.2 μ (E) in distance (Beypazarı – Ankara 26.5.1971 AKMAN, ANK).

Senecio vernalis Waldst. et Kit. (Fig 4: 16–19). Pollen grains tricolporate, oblate spheroidal, 25.3 X 25.9 μ (W), 23.1 X 22.2 μ (E). Amb circular.

Exine 2.2 μ (W), 3.1 μ (E), echinate. Spines concav–conic, 2.5 μ (W), 3.2 μ (E) in length with base diameter of 2.7 μ (W). 3.9 μ (E) of 100 μ². 4. Exine stratification is like pollen grains in Inuleae. Columella 0.8 μ (E) in length extending into spines. Nexine two 0.8 μ thick, has cavea on it (Fig 1:6) Intine 0.5 μ, thicker under pores.

Colpi 19.4 X 7.3 μ (W), 19.8 μ X 3.2 μ (E), margins are not very distinct. Ora lalongate 8.8 X 13.5 μ (W) 3.5 X 12.9 μ (E). The tip of colpi 10.1 μ (W), 8.9 μ (E) in distance (Beynam–Ankara 6.6.1969 İNCEOĞLU, HUB)

Tussilago farfara L. (Fig 4: 20–22) 99 % of pollen grains are heteromorphic. Few normal tricolporate pollen grains could be found in suitable position for measurements.

Heteromorphic pollen grains nonaperturate and spheroidal. 13–50 μ (E) in diameters. Only one diameter measured at random, Exine 3.1 μ (W), 3.5 μ (E) thick, echinate. Some spines conic shape with acicular or rounded ends, others dome-shaped. Spines 2.6 μ (W) 2.4 μ (E) in length with base diameter of 4.3 μ (W), 5 μ (E), of 100 μ², 3. Exine stratification similar Inula salicifolia. Columella 1.7 μ (E) in length, extending into spines. Nexine two 1.25 μ (E) thick with cavea on it. In some asetolized pollen grains, nexine two entirely separated from other layers. (Beynam – Ankara 11.4.1969. AKMAN, ANK).

Tribe: Eupatorieae

Pollen grains tricolporate, prolate spheroidal, echinate, spines concave-conic.

Eupatorium cannabinum L. (Fig 4: 23–25) Pollen grains tricolporate, prolate spheroidal 20. 1 μ X 19.7 μ (W), 25.6 X 22.3 μ (E). Amb circular.
Exine 2 μ (W), 2.7 μ (E). echinate, Spines concave – conic with acicular end, 3 μ (W), 4 μ (E) in length, with base diameter of 2.3 μ (W), 4.6 μ (E), of 100 μ², 8. Stratification of exine similar *Logfia arvensis*. Columella 1.1 μ (E) in length, extending into spines. Nexine two 1 μ (E), has cavea on it (Fig 1: 6). Intine 0.5 μ, thicker under pores.

Colpi 13 X 4.6 μ (W), 10, 8 X 3 μ (E). Ora lalongate 3.5 X 7.3 μ (W), ... X 6.5 μ (E). Tips of colpi 9 μ (W), 7.6 μ (E) in distance (Beynam – ANKARA 3.9.1970 AKMAN, ANK)

**Tribe: Anthemideae**

Pollen grains tricolporate, oblate spheroidal, echinate. Ambs intersemiangular. Spines conic or concave-conic with acicular ends. Spines generally have internal cavity. Intratectal columella are thin and short extending into spines, infratectal columella rare, distinct and branched. Tectum and infratectal columella measured somewhere between pole and equator in equatorial view. There is no cavea on nexine two.

Pores and colpi margins indistinct but visible in acetolized grains. Spines counted intercolpi.

*Achillea biebersteinii* Afan. (Fig. 4: 26–27, Fig 5:1) Pollen grains tricolporate, oblate spheroidal, 21.5 X 22.7 μ (W), 29, 6 X 29.9 μ (E). Amb intersemiangular.

Exine 4.3 μ (W), 4.5 μ (E), thinner in poles, echinate. Spines conic 3.2 μ (W), 4.2 μ (E), having a base diameter of 3.3 μ (W), 5.2 h (E). Tectum 0.6 μ (E), infratectal columella 1.7 μ (E) in length, (Big 1: 4). Intine 0.5 μ thick.

Colpi 17 X 2 μ (E) with attenuate ends and distinct margins in acetolized grains. Ora lalongate 2.5 X 6 μ (E). Colpi tips. 7 μ (W), 7.6 μ (E) in distance (BEYNAM-Ankara 10.6.1969 İNCE-OĞLU, HUB)

*Achillea phrygia* Boiss et Bal. (Fig 5: 2–4) Pollen grains tricolporate, oblate spheroidal, 25, 1 X 25.8 μ (W), prolate spheroidal 30, 3 X 27, 9 μ (E) in acetolized grains. Amb intersemiangular.
Exine 5.1 \( \mu \) (W), 5.3 \( \mu \) (E) thinner in equator. Spines conic, 3.7 \( \mu \) (W), 3.9 \( \mu \) (E) in length with base diameter of 4.2 \( \mu \) (W), 4.9 \( \mu \) (E). Tectum 0.6 \( \mu \) (E) thick, infractetal columnella, 9 \( \mu \) (E) in length (Fig 1:4). Intine 0.6, thicker under pores.

Colpi 11.5 X 7.6 \( \mu \) (W) 23 X 7 \( \mu \) (E) with distinct margins in acetalized grains. Ora lalongate, 8 X 3.5 \( \mu \) (E). Distance between colpi ends 5.8 \( \mu \) (W), 7 \( \mu \) (E) (Beynam – Ankara 8.6.1969, AKMAN, ANK).

*Achillea teretifolia* Wild. (Fig 5: 5–7) Pollen grains tricolporate oblate spheroidal, 19 X 21.5 \( \mu \) (W), 21.1 X 20, 7 \( \mu \) (E). Amb intersemiangular.

Exine 4.5 \( \mu \) (W), 4.7 \( \mu \) (E), thinner in poles, echinate. Spines conic, 2.4 \( \mu \) (W), 2.9 \( \mu \) (E) in length with base diameter of 3.4 \( \mu \) (W), 3.8 \( \mu \) (E) of 100 \( \mu^2 \), 4–5. Tectum 0.5 \( \mu \) (E) thick, infractetal columnella 1.6 \( \mu \) (E) in length. (Fig. 1: 4). Intine 0.8 \( \mu \) thicker under pores.

Colpi... X 5.6 \( \mu \) (W), 13.9 X 3.6 \( \mu \) (E) with distinct margins in acetalized grains. Ora lalongate 5X7 \( \mu \) (E). Distance between colpi ends 6.1 \( \mu \) (W), 6.7 \( \mu \) (E) (Beynam – Ankara, 18.6.1970 AKMAN, ANK).

*Achillea wilhelmsii* C. Koch (Fig 5: 8–10) Pollen grains tricolporate, oblate spheroidal, 28, 2 X 31.8 \( \mu \) (W), 29.9 X 31.3 \( \mu \) (E). Amb intersemiangular.

Exine 3–2 \( \mu \) (W), 5.5 \( \mu \) (E) thinner in poles, echinate. Spines conic, 3.3 \( \mu \) (W), 3 \( \mu \) (E) in length having a base diameter of 4.7 \( \mu \) (W), 5.6 \( \mu \) (E), of 100 \( \mu^2 \), 3–4. Tectum 0.6 \( \mu \) (E), infractetal columnella 1.6 \( \mu \) (E) in length, nexine two 1.6 \( \mu \) (E) Fig 1:4). Intine 0.7 \( \mu \), thicker under pores.

Colpi 20 X 4 \( \mu \) (E), with distinct margins only in acetalized grains. Ora lalongate. 4X8 \( \mu \) (E). Distance between colpi ends 11.4 \( \mu \) (W), 8.5 \( \mu \) (E). (Beynam – Ankara 10.5.1969 İNCEOĞLU, HUB).

*Anthemis cretica* L. (Fig 5: 11–13) Pollen grains tricolporate, oblate spheroidal, 22, 6 X 24. \( \mu \) (W), 25, 8 X 24.6 \( \mu \) (E). Amb intersemiangular.
Exine 4.4 μ (W), 4.8 μ (E), thinner in poles, echinate. Spines conic, 3.7 μ (W), 4 μ (E) in length with base diameter of 3.9 h (W), 4.2 μ (E). Tectum 0.5 μ (E), infratectal columellae 1.7 μ (E) in length, nexine two 1.1 h (E). Intine 1.1 h, thicker under pores (Fig 1: 4).

Colpi... X 6.7 μ (W), 15 X 2.7 μ (E) with distinct margins in acetolized grains. Ora lalongate, distinct in acetolized grains, Distance between colpi ends 7.8 μ (W), 7.3 μ (E). (Beynam – Ankara 26.5.1970 AKMAN, ANK)

Anthemis tinctoria L. (Fig 5: 14–16) Pollen grains tricolporate, oblate spheroidal, 24 X 24,1 μ (W), 27X26, 8 μ (E). Amb intersemiangular.

Exine 4.3 μ (W), 4.5 μ (E) thinner in poles, echinate. Spines conic, 3.3 μ (W), 4 μ (E) in length with base diameter of 4.1 μ (W), 4.4 μ (E). of 100 μ², 3. Tectum 0.6 u (E), Infratectal columellae 1.7 μ (E) in length, nexine two 0.8 u (E) thick. (Fig 1: 4). Intine 0.5 μ, thicker under pores.

Colpi 12, 5X5. 4 μ (W), 13 X 2.7 μ (E), with distinct margins in acetolized grains. Ora lalongate 5 X ... μ (W), 6X8 μ (E), distinct in acetolized grains. Distance between colpi ends 7.2 μ (W), 7.5 μ (E). (Beynam – Ankara 6.6.1969 İNCEOĞLU, HUB)

Artemisia santonicum L. (Fig 5: 17–18). Pollen grains tricolporate, a few grains tetracolporata and pentacolporate, oblate spheroidal, 21, 4X 24, 3μ (W), Subprolate 26, 2X24, 3 μ (E) in acetolized grains. Amb intersemiangular.

Exine 3.1 μ (W), 3.3 μ (E), thinner in poles, scabrate. Spinules smaller than 1 μ. Infratectal columellae indistinct, tectum 0.5 μ (E). Infratectal columellae 1.4 μ (E), nexine two 1.1 μ (E) thick. (Fig 1: 3). Intine 2μ, thicker under pores.

Colpi... X 8.0 μ (W), 20, 7 X 2.4 μ (E) with pointed ends. Colpi margins distinct in acetolized grains. Ora lalongate, 8.5 X... μ (W), 4X 9 μ (E). Distance between colpi ends 6 μ (W), 5.7 μ (E) (Hasanoğlan – Ankara 10.10.1069 İNCEOĞLU, HUB)
Tanacetum parthenium (L). Schultz Bip. (Fig 5: 19–21) Pollen grains tricolporate, oblate spheroidal, 17, 2X 19,5 μ (W), Amb intersemigular.

Exine 3,3 μ (W), 3,4 μ (E), thinner in poles, echinate. Spines conic, 2,1 μ (W), 2,6 μ (E) in length with base diameter of 2,3 μ (W), 3,6 μ (E), of 100 μ, 5–6. Tectum 0,6 μ (E), Infratectal columella very rare, 1,7 μ (E) in length. (Fig. 1:6) nexine two 0,8 μ (E). Intine 0,8 μ (W).

Colpi 13, 8 X 3 μ (E) with indistinct margins. Ora lalongate, 5 X... μ (W), 5 X 6 μ (E). Distance between colpi ends 6,2 μ (W), 5,9 μ (E). (Beypazari – Ankara 1.7.1971 AKMAN, ANK).

Tripleurospermum elongatum (Fisch et Mey.) Bornm. (Fig 5: 22–24) Pollen grains tricolporate, oblate spheroidal 19, 6 X 21 μ μ (W), 23,8 X 21 μ (E). Amb intersemigular.

Exine 2,9 μ (W), 3,6 μ (E), thinner in poles. Spines conic, 2,5 μ (W), 3,2 μ (E) in length with base diameter of 2,8 μ (W), of 100 μ; 4. Exine stratification is similar to Achillea and Anthemis Infratectal columella very distinct under spines, but indistinct interspinal region. Tectum 0,6 μ (E), Infratectal columella – 1,6 μ (E) in length, nexine two 1,1 μ (E). (Fig. 1: 6). Intine 0,6 μ thicker under pores.

Colpi 15, 4X 3,9 μ (E) with indistinct margins. Ora lalongate, 4X6, μ (E), Distance between colpi ends 7, μ (W), 6,9 μ (E). (Beypazari – Ankara 26. 6. 1973 AKMAN, ANK).

Tribe: Cardueae

Pollen grains of fourteen species investigated tricolporate, spheroidal, subprolate, echinate, scabrate, psilate. Exine stratification shows differences between different species. Tectum and infratectal columellae are measured in region between poles and equatorial view.

Carduus nutans L. (Fig 6: 1–3) tricolporate, oblate spheroidal; 38, 5 X 43, 4 μ (W); 47, 9 X 42,7 μ (E). Amb semiangular.

Exine 2,6 μ (W), 4,9 μ (E), thinner in poles, echinate. Spines conic or convex – conic 3,6 μ (W), 5,9 μ (E) in length with base
diameter of 5,8 μ (W), 8,2 μ (E) in diameter of base, of 100 μ², 1–2 usually have internal cavity. Exine stratification similar to Circium arevense and Crupina crupinastrum. Columellae 1,7 μ (E) long, extending into spines. Columellae generally free. Nexine 2 μ thick, with cavea on it. (Fig 1: 7) Sexine surface appeared granulated due to columellae tips. Intine 1 μ.

Colpi 31,4 μ X 15,9 μ (W); 30,2 μ X 2,7 μ (E), ora lalongate, 17,4 X... μ (W); 11,5 X 14,3 μ (E), margins distinct. Distances between colpi ends 16,4 μ (W), 21,4 μ (E). (Beynam – Ankara 10. 6. 1969 İNCEOĞLU, HUB)

Centaurea carduiformis DC. (Fig 6: 4–5) Pollen grains tricolporate, subprolate, 47,8 X 39,7 μ (W); 57,1 X 45,2 μ (E). Amb circular.

Exine 3,4 μ (W), 3,5 μ (E), thicker in the poles, sebbrate. Generally spinules shorter than 1 μ Columella thin and distinct, 2 μ (E) long. Some protrusions towards cavea from nexine one (Fig 1:9). Layer, dividing columellae indistinct. Intine 0,9 μ, thicker under pores.

Colpi 25 X 11 μ (W); 27,6 X 4,2 μ (E). Ora lalongate 10,3 X 15,2 μ (W); 5,1 X 22,7 μ (E). Colpi ends indistinct at polar view. (Beynam – Ankara 2.7.1970 AKMAN, ANK)

Centaurea depressa Bieb. (Fig 6: 6–9) Pollen grains tricolporate, subprolate, 37 X 29,1 μ (W), 40 X 30, 4 μ (E). Amb seminagular.

Exine 2,1 μ (W), 3,2 μ (E), thicker in equator, psilate. Exine stratification similar to C. triumfetti and C. pichieli. Tectum and infratectal columellae distinct. Tectum 0,8 μ (E) thick infratectal columellae 1,7 μ (E) in length, distinct and branched. Nexine two 1,1 μ (E), hasn’t cavea on it. (Fig 1:8) Intine 0,9 μ.

Colpi membrane granulate, margins more distinct than other investigated species of Centaurea, 25, 2 X 8,4 μ (W), 30,1 X 3,3 μ (E). Ora lalongate, 6,2 X 19,6 μ (W), ... X 18,7 μ (E) Distance between colpi ends 8,2 μ (W), 13,4 μ (E). (Hasanoğlan-Ankara 17.7.1969 İNCEOĞLU, HUB).

Centaurea drabifolia Sm. (Fig 6: 10–12) Pollen grains tricolporate in 98 % and stephanocalporate in 2 % prolate spheroidal,
29.3 X 35.5 µ (W). Asetolized grains subprolate. 44.8 X 38 µ (E). Amb circular.

Exine 2.1 µ (W), 3.5 µ (E), thicker in equator, scabrate. Exine stratification is similar to *Centaurea carduiformis*. Columellae thin, rather distinct, 1.7 µ (E) long. Nexine one, 0.6 µ (E), nexine two 1 µ (E) thick. No protrusions towards cavea from one (Fig 1:9). Exine layers distinct. Intratectal columellae and infratectal columellae likewise in length. Nexine very thick under pores in equatorial view, 3.3 µ (W) thick. Spinules 0.7 µ (E) long, of 100 µ², 32. Intine 1.4 µ.

Colpi long 33.7 X 10.1 µ (W), 35.3 X 5.3 µ (E). Ora lalongate, 9.4 X 16.4 µ (W), 4.9 X 16.9 µ (E). Distance between colpi ends 9.8 µ (W), 8.9 µ (E). (Beynam – Ankara 8.6.1969 AKMAN ANK).

*Centaurea pichleri* Boiss. *subsp. pichleri* (Fig 6: 13–15) Pollen grains tricolporate, prolate spheroidal, 48.6 X 44.8 µ (W). Acetolized grains subprolate, 48.9 X 40 µ (E). Amb intersemian- gular. Intine 1.5 µ.

Exine 3.4 µ (W), 5.2 µ (E) thick between equator and pole, thicker in equator and in poles well, 3.6 (W) 5.7 µ (E), psilate. Tectum 1.7 µ (E), intratectal columellae 2.3 µ (E) in length. Nexine two 1 µ (E), thicker in poles 1.8 µ (E). Intratectal columellae indistinct, intratectal columellae very distinct and branched. No cavea distinguished (Fig 1:8). Intine 1.5 µ. Aperture margin only distinct in acetolized grains. Colpi 42.2 X 14.6 µ (W), 34.8 X 4.7 µ (E). Ora lalongate 13.4 X 18.2 µ (W), 6.8 X 16.3 µ (E). Distance between colpi ends 16.1 µ (W), 12.1 µ (E). (Beynam – Ankara 6.61969 İNCOĞLU, HUB).

*Centaurea thracica* (Janka) Hayek (Fig 7: 1–3) Pollen grains tricolporate, prolate spheroidal, 42.7 X 41.8 µ (W), 42.7 X 37.6 µ (E). Amb circular.

Exine 1.9 µ (W), 4.3 µ (E), thicker in equator, 4.1 µ (W), 6.7 µ (E), echinate. Spines conic, generally small, more marked in equatorial region, 2 µ (E) in length with base diameter of long, 5 µ (E). Of 100 µ², 0–12, smaller and frequent in poles, of 100 µ²
40. Exine has many thin columellae 2,1 μ (E) long. Layer dividing columellae appears as a thin line. No protrusion from nexine one to cavea. (Fig 1:9) Nexine two 1,5 μ (E).

Intine 0,9 μ, thicker under aperture. Colpi 18,7 X 12 μ (W), 11,2 X 4,8 μ (E). Distance between colpi ends 14 μ (W), 12,7 μ (E). (Beynam – Ankara 15.7.1969 İNÇOĞLU, HUB).

Centaurea triumfetti All. (Fig 7: 4–7) Pollen grains tricolporate, subprolate, 46, 3 X 39, 6 μ (W). Acetolized grains prolate, 53,7 X 43,5 μ (E). Amb intersemiaangular.

Exine 4,5 μ (W), 5 μ (E), thicker in equator, 6,7 μ (W), psilate. Infratectal columellae very distinct and branched, 1,7 μ (W), 2,2 μ (E) in length. Tectum 1,4 μ (W), 1,7 μ (E) thick (Fig 1:8) Nexine two 2,2 μ (E). Intine 1,3 μ thicker under aperture.

Colpi margins indistinct, 37,5 X 14,1 μ (W), 38,3 X 5,4 μ (E) Colpi membrane granulate. Ora lalongate 10 X 17,2 μ (W), 9,8 X 5,4 μ (E). The distances between colpi ends 8,9 μ (W), 12,3 μ (E), (Beypaşar – ANKARA 3.5.1971 AKMAN, ANK)

Centaurea virgate Lam. (Fig 7: 8–11) Pollen grains tricolporate, oblata spheroidal 26,6 X 24,5 μ (W). Acetolized grains prolata spheroidal 29,2 X 27,5 μ (E). Amb circular.

Exine 1,9 μ (W), 4,1 μ (E) in equator. 1,5 μ (W), 3,3 μ (E) in poles; sebrate. Spinules 0,5 μ (E) in length, with base diameter of 0,8 μ (E). Columellae 1,7 μ long. Layer dividing columellae very distinct and rather thick. Nexine one 0,6 μ (E), nexine two 1,1 μ (E) Intine 0,8 μ.

Colpi long, 30,2 X 8,2 μ (W), 25,1 X 1,6 μ (E). Ora lalongate, only distinct in acetolized grains, 8,6 X ... μ (W), 4,8 X 12,5 μ (E). The distance between colpi ends 6,7 μ (W) 5,5 μ (E). (Hassanoglu – Ankara 11.8.1969 İNÇOĞLU, HUB).

Centaurea urvillei DC. (Fig. 7: 12–14) Pollen grains tricolporate, prolate spheroidal, 51, 2 X 44,6 μ (W). Acetolized grain subprolate 63,1 51,1 μ (E). Amb circular.

Exine 2 μ (W), 3,7 μ (E), thicker in equator, 3,5 μ (W), 8,4 μ (E), sebrate. Spinules greater and more rare around the colpi, 30 of them in 100 μ². Tectum 2,8 μ (E), not very distinct,
infratectal columellae 0.6 µ (E) in length. Nexine two 0.8 µ (E).
Intine 0.7 µ.

Colpi margin indistinct with an area without spinules around it, 26.2 X 12.5 µ (W), 33.1 X 1.5 µ (E). Ora lalontage distinct in only acetolized grains, 12.7 X 28 µ (W), 8.4 X 21.8 µ (E). (Bey-

nam – Ankara 10.5.1969 İNCEOĞLU, HUB)

*Circium arense* (L.) Scop. (Fig 8: 1–3) 75 % pollen grains tricolporate, 25 % stephanoccolporate, oblate spheroidal, 33 X 37.6 µ (W), 33.2 X 37.7 µ. Amb circular.

Exine 2.5 µ (W), 3.7 µ (E), thinner in poles, echinate. Spines conic or convex – conic, blunt ended, of 100 µ², 2–3, 2.8 µ (W), 3 µ (E) in length, base diameter of 4.8 µ (W), 5.3 µ (E). Columellae 1.7 µ (E) in length extending into spines. Spines have internal cavities. Very thin layer divides columellae laterally. Ne-

xine two 1.9 µ (W), have cavea on it. Protrusions not very distinct from nexine one and nexine two (Fig 1:7). Intine 0.8 µ, thicker under pores.

Colpi margins distinct with pointed ends, 22.9 X 9 µ (W), 25.9 X 5 µ (E). Ora lalontage distinct only in acetolized grains, 11.7 X ... µ (W), 5.3 X 15.6 µ (E). Distances between colpi ends 15.1 µ (W), 14.3 µ (E). (Beypazarı – Ankara 27.7.1972 AKMAN, ANK).

*CrupiQA crupinastrum* (Moris) *Vis.* (Fig 8: 4–5) Pollen grains tricolporate, oblate spheroidal, 42.8 X 46.9 µ (W), 45.5 X 46.8 µ (E) in diameters. Amb circular.

Exine 3.6 µ (W), 5.8 µ (E), thinner in poles, 2.8 µ (W), 4.5 µ (E), echinate. Spines conic, blunt ended, 2.3 µ (W), 2.8 µ (E) in length with base diameter of 2.9 µ (W), 3.2 µ (E), of 100 µ², 5. Exine stratification similar to *Carduus nutans*. Columellae thin and 3.3 µ (E) long. Layer dividing columellae laterally rather distinct. Nexine two 1.6 µ thick and have cavea on it (Fig 1:8). Intine 1, µ, thicker under apertures.

Colpi 21.2 X 9.1 µ (W), 21.2 X 7.7 µ (E) with distinct and regular margins. Colpi membrane psilate. Ora lalongate appears only in acetolized grains, 14.2 X ... µ (W), 8.4 X 13.3 µ (E).
Distance between colpi ends 16,7 μ (W), 25,2 μ (E). (Beypaşar-Ankara 27.5.1971 AKMAN, ANK).

_Jurinea pontica Hausskn. et Freyn_ (Fig 8: 6–8) Pollen grains tricolporate, prolate spheroidal, 36,7 X 34,7 μ (W), 47,1 X 43,1 μ (E). Amb semicircular.

Exine 4,2 μ (W), 6,3 μ (E), echinate. Spines conic and short, 1,4 μ (W), 1,4 μ (E) in length with base diameter of 2,1 μ (W), 2,5 μ (E), of 100 μ², 14. Exine stratification is similar to _Xeranthemum_. Infratectal columellae thin and distinct, extending into spines, 1,6 μ (E) long. Infratectal columellae very distinct, rarely branched. Nexine two 1 μ (E), thicker under pores, no cavea on it (Fig 8:4). Intine 0,8 μ.

Colpi 24,7 X 10 μ (W), 28,5 X 1,5 μ (E). Ora lalongate, only distinct in acetylated grains, 8,9 X ... μ (W)... X 17,9 μ (E). (Beynam – Ankara 2.7.1970 AKMAN, ANK).

_Xeranthemum annuum L._ (Fig 8: 9–11) Pollen grains tricolporate, prolate spheroidal, 27, 1 X 25,5 μ (W), 35,6 X 33,8 μ (E). Amb circular.

Exine 5,2 μ (8), 5,6 μ (E) echinate. Spines conic 2,3 μ (W), 2,5 μ (E) in length with base diameter of 2,4 μ (W), 3,1 μ (E), of 100 μ², 6. Exine layers distinct, tectum 1 μ (E) long. (Fig 1: 4) Infratectal columellae 3,8 μ (E) long. Intine 0,6 μ.

Colpi 15,5 X 10,7 μ (W), 15,6 X 2 μ (E). Ora lalongate distinct in acetylated grains 10,2 X... μ (W), 5X 10,4 μ (E). Distances between colpi ends 7,8 μ (W), 11,2 μ (E). (Ankara-Gölbaşı 23.7.1969 İNCEOĞLU, HUB)

_Xeranthemum cylindraceum Sm._ (Fig. 8: 12–13, Fig 9:1). Pollen grains tricolporate, prolate spheroidal, 30, 2 X 26,8 μ (W), 36,4 X 33,6 μ (E). Amb circular.

Exine 4,4 μ (W), 5,4 μ (E) thick, echinate. Spines conic, 2,6 μ (W), 3 μ (E) in length base diameter of 3,4 μ (W), 4 μ (E), of 100 μ², 7. Exine stratification similar to _Jurinea pontica_. Tectum 0,8 μ (E) thick, infratectal columellae 3,4 μ (E) in length. (Fig 1:4). Nexine one and nexine two in some thick. Intine 0,7 μ, thicker under pores 1,5 μ.
Colpi 17.9 X 10.7 μ (W), 23 X 5.1 μ (E). Ora lalongate, 10.3 X ... μ (W)), 7X9.6 μ (E) distinct only in acetalized grains. Distance between colpi ends 7.8 μ (W), 11, 2 μ (E). (Beypazarı Ankara 19.7.1972 AKMAN, ANK).

Tribe: Lactuceae (Cichorieae)

Fifteen pollen grains of species investigated. Pollen grains are triporate with 3 kinds of lacuna system. (Fig 3). Type A, Type B and Type C. Two kings of exine structures distinguished in ridges.

In the first kind exine is foraminated and complex in appearance but it is possible to see exine layes and columellae in many species (Fig 1:1). In the second kind columellae not very distinct, exine more complex and greatly foraminated in appearance (Fig 1:2). Both kinds of exine have cavea under columellae layer, Nexine two follows cavea.

Chondrilla juncea L. (Fig 9: 2–5) Pollen grains triporate, oblate spheroidal, 23 X 26.1 μ (W), 29.4 X 33.4 μ (E). Amb interhexogonal.

Exine 4 μ (W), 5.2 μ (E). Layers rather distinct in ridges. Columella 2.2 μ (E). Nexine two 1.2 μ (E) (Fig: 1:1). Intine 0.7 μ, thicker under pores. Lacuna system is type A (Fig 3:1) Aporal lacunae tetragonol, poral lacunae circular, spines concave conic (Fig 2:2) 1.9 μ (W), 2.5 μ (E) in length with base diameter of 2 μ (W), 2.5 μ (E). Generally spines single – rowed on fidges, sometimes two rowed. Polar thickening triangular in shape with spines scattered irregularly.

There are large, triporate grains 3 μ (W) in diameters, with 20 lacunae among normal grains. Tetraporate grains 25 (W) in diameters (Beynam – Ankara 2.9.1971 AKMAN, ANK).

Cichorium intybus L. (Fig 9: 6-9) Pollen grains triporate, oblate spheroidal 33, 9 X 39.5 μ (W), 42.6 X 49.5 μ (E). Amb interhexagonal.

Exine 4.9 μ (W), 8 μ (E). Layers distinct, columella 5 μ (E), nexine two 1.4 μ (E) in ridges (Fig 1:1). Lacuna system Type A.
(Fig 3:1) Abporal and paraporal lacunae pentagonal, poral lacunae hexagonal or circular. Spines very sharp and concave conic (Fig 2:2) 2,8 μ (W), 3,9 μ (E) in length with base diameter of 2,3 μ (W), 3,6 μ (E). Spine one-rowed on ridges. Polar thickening triradiate shape. Arms of triradiate thickening are narrower than those of polar thickening of Heieracium grains.

The diameters of abnormal grains vary between 27 μ–59 μ (E) (Hasanoğlau – Ankara 17.6.1969 İNCEOĞLU, HUB)

*Crepis foetida* L. *ssp. rhoeadifolia* (Bieb.) Celak. Fig 9: 10–14) Pollen grains triporate, oblata spheroidal, 24–27,6 μ (W), 27,7 X 31,6 μ (E). Amb interhexagonal.

Exine 3,9 μ (W), 4,8 μ (E). Exine stratifications is like Cichorium. (Fig 1:1) Lacuna system is Type A (Fig 3:1). Abporal and poral lacunae circular. Spines convex-conic (Fig 2:2) 2 μ (W), 2,2 μ (E) in length with base diameter of 1,8 μ (W), 1,8 μ (E). Spines one rowed on ridges, irregularly scattered on polar thickening. Polar thickening triradiate or triangular. Intine 0,7 μ

Pores lalongate, don’t occupy entire polar lacunae (Beypazari Ankara 27.5.1971 AKMAN, ANK).

*Crepis macropus* Boiss. et Heldr. (Fig 9: 15–18) Pollen grains triporate, oblata spheroidal 24,3 X 27 μ (W), 29,1 μ X 32,4 μ (E). Amb interhexagonal.

Exine 4,1 μ (W), 5 μ (E), Layers distinct Columellae 2,2 μ (S) Nexine two 1,1 μ (E) in ridges (Fig 1:1). Lacuna system is Type A (Fig 3:1). Abporal lacunae square or circular. Poral lacunae circular. Spines conic (Fig 2: 1) 2 μ (W), 2,3 μ (E) in length with base diameter of 1,7 μ (W) μ (E). Polar thickening triradiate, narrower than *Crepis foetida’s*. Intine 0,9 μ.


*Hieracium hoppeanum* Schult. *subsp. isauricum* Hub. *Mor.* (Fig 10: 1–4) Pollen grains triporate, suboblate, 21, 6X 25,4 μ (W), 25, 8 X 29,1 μ (E). Amb circular. Exine 3 μ (W), 4,2 μ (E). Columella very distinct, 3,3 μ (E) in length. Nexine two 1,1 μ
(E) in ridges (8:1). Lacuna system is Type A (Fig 3:1) Abporal and poral lacunae circular. 2–3 spines in paraporal lacuna (Fig. 10:3). Generally spines concave–conic, (Fig 2:2) sometimes convex–conic (Fig 2:3), 1,9 µ (W), 2,4 µ (E) in length with base diameter of 1,5 µ (W), 2 µ (E), one rowed on ridges, three rowed on the arms of polar thickening. Polar thickening triradiate. (Fig 10: 4). Intine 0,5 µ. thicker under pores, Heteromorphous grains has not been coincidence. (Beypazari Ankara 21.7.1972, AKMAN, ANK).

*Hieracium medianiforme* Litv. et Zahn Juxip (Fig 10: 5–5) Pollen grains triporate, oblate spheroidal. 23,9 X 26,1 µ (W), Amb interhexagonal.

Exine 3,9 µ (W), 4,7 µ (E), layers distinct, columella 3 µ (E) in length. Nexine two 1,6 µ (E) in ridges (Fig 1:1). Intine 0,7 µ. Lacuna system is Type A (Fig 3:1). Abporal lacunae square, poral lacunae circular, paraporal lacunae pentagonal. Generally paraporal lacunae have 1–2 spines. Spines concave-conic (Fig 2:2) 2,7 µ (W), 2,3 µ (E) in length, with base diameter of 1,9 µ (W), 2,3 h (E). Polar thickening triradiate with many spines irregularly scattered on it. 91 % of ollen grains are heteromorphous. Their diameters changes between 15,7 – 43,7 µ (W). Some of them inaperturate. Spines very long or absent. Ridges irregular or interrupted. Some area of grain’s surface is like polar thickening, granulata and without spines (Beypazari-Ankara 1.7.1971 AKMAN, ANK)

*Hieracium tuberculatum* Freyn et Sint. (Fig 10: 9-13) Pollen grains triporate, oblate spheroidal 24, 2 X 28,5 µ (W), 30,9 X 34,8 µ (E), Amb interhexagonal.

Exine 4,3 µ (W), 7 µ (E). Lacuna system is Type A (Fig 3:1) Abporal and poral lacunae circular, 1 X 7 spines in the middle of paraporal lacunae, with enlarged spinal base on paraporal ridges. Therefore paraporal ridges are rougher than others in appearance. Spines one-rowed on ridges concave–conic (Fig 2:2) 3,1 µ (W), 4,1 µ (E) in length with basal diameter of 2,7 µ (W), 3,4 µ (E) Polar, thickening triradiate with irregularly scattered spines on it. 60 – 70 % of pollen grains heteromorphous. Intine 0,7 µ. Some grains spheroidal, their diameters changes between
19 – 47 μ (W), Some grains oval shape, 34, 3 μ (W); 45.4 μ (E) in long axis, 29.4 μ (W), 40.8 μ (E) in short axis. Interlacunar gaps are also present in the other ridges of poral lacunae. Paraporal lacunae filled with spines entirely.

Pollen grains triporate, tetraporate or pentaporate, some of them without spines. Pentaporate grains with irregular lacuna system or without lacuna system. In contrast tetraporate grains have 20 lacunae, 4 poral, 8 paraporal 8 abporal. Some pores very large 10.1 μ (W) diameters.

Some grain surfaces covered with spines of grains without lacunae. Some pollen grain ridges irregular interrupted or curved. (Byenam – Ankara 23.7.1969 İNCEOĞLU, HUB)

*Lapsana communis L. subsp. intermedia (Bieb.) Hayek* (Fig 10: 14–18) Pollen grains triporate, oblate spheroidal 25.2 X 28.4 μ (W). Suboblate 26.9 X 31, 3 μ (E) in acetalized grains. Amb interhexagonal.

Exine 3 μ (W) 4,5 μ (E). Exine layer distinct columella 2,2 μ (E) in length. Nexine two 1.7 μ in ridges (Fig 1:1). Intine 0,6 μ. Lacuna system is Type A (Fig 3:2). Poral lacunae circular paraporal lacunae pentagonal. Spines convex – conic, (Fig 3:1) 1,6 μ (W) in length, with basal diameter of 2 μ (W), one rowed on ridges two-rowed on arms of polar thickening. Polar thickening triradiate. (Beypazarı, Ankara 1.7.1971 AKMAN, ANK).

*Leontodon asperimus (Willd.) J. Ball* (Fig 10: 19–20) Fig 11: 1-3) Pollen grains triporate, oblate spheroidal 28.8 X 32 μ (W), 33.4 X 37.8 μ (E). Amb interhexagonal.

Exine 4 μ (W), 5,5 μ (E). Exine layers distinct, columella 2,2 μ in length, nexine two 1,7 μ (Fig 1:1). Intine 0,6 μ. Lacunae system is Type A (Fig 3:1). Abporal lacunae circular. Spines concave-conic (Fig 2:2), 1,7 μ (W), 2,3 (E) in length with basal diameter of 2,2 μ (W) 1,7 μ (E). Polar thickening triradiate, with many spines irregularly scattered. (Beypazarı-Ankara 26.6 1973 AKMAN, ANK).

*Mycelis muralis (L.) Dum.* (Fig 11: 4–8) Pollen grains oblate spheroidal, 31 X 34, 4 μ (W), 32.4 X 36,2 μ (E) Amb inter-hexagonal.
Exine 3,3 μ (W), 5,9 μ (E), layers rather distinct. Colu-
mella 1,7 μ (E) in length. Nexine two 1,1 μ (E) in ridges. (Fig
Intine 0,9 μ thicker under pores. Lacuna system is Type A (Fig
3:1) Poral lacuna circular. Spines convex - conic (Fig 2:2), 2,8 μ
(W) 3,2 μ (E) in length, with basal diameter of 2,4 μ (W), 2,4
μ (E). Polar thickening triradiate. Thickness of arms of polar
thickening is similar to that of ridges with single or two-rowed

Pilosella piloselloides (Vill.) Sojak (Fig 11: 9-13) 96 % of
pollen grains triporate, 4 % stelonopordte. Oblate spheroidal
27 X 30 μ (W) 28, 6 X 27,8 μ (E). Amb interhexagonal.

Exine 3,3 μ (W), 4,7 μ (E). Layers are not distinct. Colu-
mella distinct under spines (Fig 1:1). Intine 0,6 μ. Lacunae sys-
tem is. Type A (Fig 3:1). Poral lacuna circular, abporal lacuna
square, 1–10 spines occur in paraporal lacuna. Spines concave-
conic (Fig 2:3) one-rowed on ridges, 1,9 μ (W) 2,2 μ (E) in length
with base diameter of 1,4 μ (W), 1,5 μ (E). Polar thickening
triradiate with irregularly scattered many spines.

Heteromorphous grains shows lacuna system irregularly
( Beypazari-Ankara 2,6.1973 AKMAN, ANK).

Scolymus hispanicus L. (Fig 11: 14–17) Pollen grains tri-
porate, oblate spheroidal, 41 X 44,4 μ (W). Acetolized grains
prolate spheroidal, 44,1 X 42 μ (E). Amb circular.

Exine 5,5 μ (W), 6,6 μ (E), exine layers not very distinct.
Columellae 5 μ (E) in length. Nexine two 1,9 μ (E) (Fig 1:1).
Intine 1 μ. Lacuna system is Type A (Fig 3:1). Gaps absent
between polar and abporal lacunae. 1–2 spines are always
close to equator in paraporal lacuna. Polar thickening triradiate
and thin armed. Spines concave-conic (Fig 2:2) 2,6 μ (W), 2,5 μ
(E) in length with base diameter of 2,2 μ (W), 2,3 μ (E) with
internal cavity one rowed on ridges and on polar thickening.
No heteromorphic grains can be found (Hasanoğlan-Ankara
11.8.1969 İNCEOĞLU, HUB)

Scorzonera eriophera DC. (Fig 11: 18, (Fig 12: 1–3) Polen
grains triporate, with Type A lacuna system, oblate spheroidal,
34.2 X 40.6 μ (W), 38.2 X 42.4 μ (E) a few grains abnormal. Amb semiangular.

Exine 4.3 μ (W), 6.2 μ (E) thick. Foraminate appearance in optic section. Columella indistinct. Nexine two 1.6 μ (E). (Fig 1:2) Intine 0.6 μ, thicker under pores. Lacuna system is Type B (Fig 3:2). Poral thickening hexagonal, surrounded by a row of dense spines. 6.8 spines scattered at the centre. Spines concave-conic, (Fig 2:2) 3.7 μ (W), 3.9 μ (E) in length, with base diameter of 3.4 μ (W), 3.5 μ (E) one-rowed on the ridges. (Beynam-Ankara 8.6.1969 AKMAN, ANK)

Scorzonera tomentosa L. (Fig 12: 4–7) Pollen grains triporate, oblate spheroidal, 38.7 X 43.5 μ (W), 42.8 μ (E). Amb semiangular.

Exine 5.3 μ (W), 6.7 μ (E) stratification is like Scorzonera eriophora Fig 1:2). Lacuna system is Type A (Fig 3:2) Ridge separating equatorial lacuna was sometimes absent or sometimes one spine appeared between two lacunae, thus two lacunae seemed single. Polar thickening larger than that Scorzonera eriophora and 11–14 spines scattered at the centre. Spines concave-conic, (Fig 2:2) 3.5 μ (W), 4.1 μ (E) in length with base diameter of 4 μ (W), 4.5 μ (E). One-rowed on the ridges. Foraminate exine was more distinct and larger than that of Scorzonera. Intine 0.8 μ, thicker under pores.

No heteromorphous grains were found. (Beynam-Ankara 8.6.1969 AKMAN, ANK).

Tragopogon latifolius Boiss. var angustifolius Boiss. (Fig 12: 8–15) Pollen grains triporate, suboblate, 34.2 X 41 μ (W), 36, 7 X 41.7 μ (E). Amb interhexahonal.

Exine 4.2 μ (W), 6.2 μ (E). Exine layers foraminate and complex in appearance, similar to Scorzonera (Fig 1:2). Intine 0.9 μ thicker under pores. Lacuna system is Type C (Fig 3:3). Polar thickening hexagonal with many spines. Spines concave-conic, 2.5 μ (W), 2.6 μ (E) in length with diameter of base 2.4 μ (W), 2.4 μ (E)

No heteromorphous grains were found. (Beypazarı-Ankara 25.5.1972 AKMAN, ANK)
RESULTS and DISCUSSION

Compositae have been described by ERDTMAN (1952) as a eurypolinous family. Sporoderm stratification is often very complicated. Light microscope is not efficient to differentiate exine layer properly. It is only possible to distinguish it roughly in contrast to electron microscopy investigations. Exine stratification is the most valuable pollen character of all. (STIX 1960, SKVARLA and LARSON 1965). However there are many species in Compositae the pollen wall stratifications of which are similar in appearance by ligyt mictoscopy according to our observations. So it is essential to refer to some other morphological features as well in order to distinguish between other pollens of different species. For example, Anthemideae pollen grains have some sharp, long spines. Pollens that we examined have three of spines: Conic, concave-conic and convex-conic (Fig 2). In our observations and findings spine shapes, numbers in 100 μ², length, base of of diameters are valuable diagnostic characteristics.

Pollen grains of 20 species have been examined in Lactuceae. Their exine stratification is more complicated than that of the other tribes. Two kinds of exine structures are distinguished in ridges. In first type (Fig 1:1), exine is foraminated in appearance and complex but it is possible to see exine layers and columella in many species. In the second type it is not possible to distinguish exine layers. This type is more complicated and largely foraminated in appearance than that of the first type TOMP(1975) examined Lactuceae pollen wall sections by transmission microscope, and found levels of columellae, a cavea and a foot layer. In lacunae the columellae are reduced to a single level and the caveae are often absent. Cavea could also be seen by light microscopy in our work.

Many Lactuceae species have heteromorphous grains. Hei racium medianiforme, Hieracium tuberculatum and Pilosella piloselloides containing many heteromorphous grains could be hybrid. According to MATSUDA (1928), AYTUG (1967) hybridity causes the occurrence of heteromorphous grains in Anthemideae there is no caveae in these tribus grains. In ultrastructural appe-
arence of *Anthemideae* grains are nonforaminated (SKVARLA and LARSON 1965). Exines that have not been framinated can also be seen by light microscopy. Intratetal columella extend into spines, but are reduced between spines. In *Artemisia santonicum* grains, spines are very short. Therefore, intratetal columella are of the same length in appearance. According to *Anthemideae* grains investigated, two kinds of exine stratifications have been distinguished. (Fig 1: 3–4)

The exine stratifications of *Achillea*, *Anthemis*, *Tanacetum* and *Tripleurospermum* are very similar to each other. Therefore it should be referred to other morphological features to identify the grains of these species.

The pollen grains of 14 species of *Cardueae* investigated appear to have some differences in between them. For example, *Jurinae*, *Xeranthemum* and some species of *Centaurea* have not caveae. In observations by transmission electron microscopy a cavea where columellae have separated from the nexine one can be seen in *Compositae* grains (SKVARLA and LARSON 1965). But it is difficult to distinguish these layers by light microscopy. Therefore caveae have been observed roughly between Nexine one and Nexine two in *Compositae* grains investigated (Fig 1).

The pollen grains of 8 *Centaurea* species investigated have 2 kinds of exine stratifications. In the first type *C. triumfetti*, *C. pichleri*, *C. depressa* included intratetal and no caveae have been seen (Fig 1:8). In the second type *C. drabifolia*, *C. urvillei*, *C. carduiformis*, *C. thracica* *C. virgata* included exine have only one distinct columellar layer which consists of dense and thin columella. Nexine one is found at the base of columella. There is cavea between nexine one and nexine two. *C. urvillei*, *C. carduiformis* have some short extentions from nexine one towards cavea. *C. drabifolia* and *C. tracica* do not have these extentions. The lack of cavea in exine stratification of *Xeranthemum cylindraceum*, *Jurinae pontica* and *Centaurea triumfetti*, *C. depressa*, *C. pichleri* is similar to *Anthemideae* pollens (Fig 1:4,8). *Carduus nutans*. *Crupina crupinastum*, *Circium arvense* have very distinct and free columella. (Fig 1:7). It is possible to distinguish a very thin layer hich divides the columella, STIX (1960) shows this layer distinctly in *Circium palustris* grain by transmission microscopic observations.
The pollen grains of Senecioneae and Inuleae species investigated have one columellar layer. Columella are not nor branched. These tribes have some species in which exine stratifications of pollen grains are very much similar. Two kinds of exine stratifications have been distinguished for these tribes. For example, exine stratification of Doronicum (Senecioneae), Inule (Inuleae) pollen grains are similar to each other and included the first type (Fig 1:5). Exine stratifications of Helichrysum (Inuleae) Logfia (Inuleae), Tussilago (Senecioneae) Senecio (Senecioneae) pollens are similar to each other and included to the second type, (Fig 1:6). In addition to the exine stratification of Eupatorium canna-binum the pollens are similar to Logfia pollen grains.

According to these observations, a detailed comparative study of the pollen morphology of different genera included in these tribes should be made, so as to obtain further data.

REFERENCES

ÖZET
Ankara civarından toplanan Compositae‘nin 6 tribusuna ait 46 spesiyes polenlerinin 19 mikroskobu ile morfolojik özelliklileri belirtildi.
Fig. 1: Exine stratifications have been based on light microscopy investigation, *Cichorium intybus* (1), *Ca; Caveae* (in the ridge), *Scorzonera tomentosa* (2), (in the ridge), *Artemisia santonicum* (3), *Anthemis tinctoria* (4), T: tectum Infr: Intratectal columella, infr: infratectal columella, N = Nexine one, N = Nexine two, *Helichrysum plicatum* (5), *Inula salicina* (6), *Crupina crupinastrum* (7) *Centaurea pickleri ssp. pickleri* (8), *Centaurea carduiformis* (9).

Fig. 2: Spine shapes, Conic (1), Concave-conic (2), convex – conic (3).
Type A

Type B

Type C

Fig. 3.—Lacuna systems in pollen grains of Cichorieae. Poral lacuna (a), Paraporal lacuna (b), Abporal lacuna (c), Equatorial lacuna (d) Interporal lacuna (e), Polar thickening (po. th.)
Fig. 6: *Carduus nutans* (1–3), *Centaurea carduiformis* (4–5) *C. depressa* (6–9), *C. drabifolia* (10–12), *C. pichleri subsp. pichleri* (13–15), X1000
Fig. 7: *Centaurea thracica* (1–3), *C. triumfetti* (4–7), *C. virgata* (8–11), *C. urvillei* (12–14), X1000
Fig. 8: Cirsium arvense (1-3), Crupina crupinastrum (4-5), Jurinea pontica (8), Xeranthemum annuum (9-11) X. cylindraceum (12-13), X1000,
Fig. 9: Xeranthemum cylindraceum (1), Chondrilla juncea (2–5), Cichorium intybus (6–9), Crepis foetida (10–14), C. macropus (15–18), a: Poral lakün, b: Paraporal lakün or Abporal lakün, X1000
Fig. 10: *Hieracium hoppeanum* (1–4), *H. medianiforme* (5–8), *H. tuberculatum* (9–13), *Lapsana communis subsp. intermedia* (14–18), *Leontodon asperrimus* (19–20), X1000
Fig. 11: Leontodon asperriums (1–3), Mycelis muralis (4–8), Pilosella piloselloides (9–13), Scolymus hispanicus (14–17) Scorzonerea eriophora (18), X1000
Fig. 12: Scorzonera eriophora (1–3), a: poral lakün, d: ekvatorial lakün, e: Interporal lakün, Scorzonera tomentosa (4–7), Tragopogon latifolius var, angustifolius (8–13) e: Abporal lakün, d: Ekvatorial lakün, e: Interporal lakün, X1000
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