SURYAKANTA*: Pollen morphological studies in the Humiriaceae

スリアカンタ*: Humiriaceae の花粉形態

The Humiriaceae is a typical tropical family with 8 genera and 49 species and many subspecies, varieties and forms.

Cuatrecasas (1961) in his taxonomic revision of the Humiriaceae has reviewed the literature pertaining to this family in detail. He has not only given a detailed historical account in chronological order but has also discussed the phenomena of drift wood, structure of the fruit, fossils, taxonomic relationship and evolutionary trends.

Planchon (1848) makes comparisons between *Humirium* and *Erythroxylon* and the Linaceae and shows their close relationship, nevertheless, he considers the Humiriaceae independent but connected with the Linaceae through *Roucheria*. Bentham (1853) gives the first synthetic account of this family and defines with precision and simplicity the 'order' and its subdivisions.

Bentham and Hooker (1862) define "Ordo XXXV Humiriaceae". They distinguish the genera *Vantanea*, *Humiria* and *Sacoglottis* according to the numbers of stamen. Bentham considers this order closely related to the Linaceae, series Ixonanthes but different from it because of the enlarged connective of the anthers. Several authors like Baillon (1874), Hallier (1921), Winkler (1931) and others have tried to establish the relationship of Humiriaceae with Linaceae and other families.

None of these systematic accounts provided any details of pollen morphology, except that given by Erdtman (1952); wherein he has described the genera *Humiria*, *Sacoglottis* and *Vantanea* under Linaceae. The present investigation was started with the intention of studying the pollen morphology of as many genera and species as possible. Due to the scarcity of material, however, the pollen grains of the genus *Hylocarpa* could not be investigated. Detail pollen descriptions of 25 taxa belonging to 7 genera

* Palynological Laboratory, Botany Department, Osmania University Hyderabad-500007, A.P., India.

are given and compared with the pollen descriptions of the families and genera having affinities with the Humiriaceae. Based on pollen morphology alone taxonomical suggestions have been made.

Materials and methods Dry polliniferous material has been obtained from the following herbaria: RB (1) Jardim Botanico, Rio de Janeiro; Brazil. US (2) National Museum of Natural History, Smithsonian Institute; Washington D. C., U.S.A.

The polliniferous material was suspended in glacial acetic acid and slides prepared in the way described by Erdtman (1960) and Bhoj Raj (1961). A Leitz-Wetzlar light microscope was used (apochromat 95×n.A. =1.32; eye-piece 10×periplan). Measurements were made with an oil-immersion eye-piece micrometer 10×(1 scale division=1.14 μ). The photomicrographs were taken on panchromatic 35 mm film (ORWO, 18 DIN) with a Leitz-Wetzlar microscope; using an oil immersion objective (100×n.A. =1.30, eye-piece 8×periplan) and through a medium of glycerin jelly (refraction index 1.474). The species are arranged on the plates according to alphabetical order. The figures as a rule, are the average of ten measurements. "About" is added if they are based on less than ten measurements. The terminology and the main morphological concepts are based on Erdtman (1952) and Erdtman *et al.* (1961, 1963).

Index of plants investigated:

Tribe I Vantaneoideae: 1. *Vantanea compacta* (Schnizl.) Cuatr. subsp. *compacta* var. *compacta* (RB), 2. *V. compacta* subsp. *compacta* var. *grandiflora* (Urb.) Cuatr. (RB), 3. *V. guianensis* Aubl. (RB), 4. *V. macrocarpa* Ducke (RB), 5. *V. obovata* (Nees et Mart.) Benth. (RB), 6. *V. paraensis* Ducke (RB), 7. *V. parviflora* Lam. var. *parviflora* (RB), 8. *V. parviflora* var. *puberulifolia* Cuatr. (RB)

Tribe II Humirioideae: 9. *Duckesia verrucosa* (Ducke) Cuatr. (US), 10. *Endopleura uchi* (Huber) Cuatr. (US), 11. *Humiria balsamifera* (Aubl.) St. Hil. var. *coriacea* Cuatr. (US), 12. *H. crassifolia* Mart. ex Urb. (US), 13. *Humiriastrum cuspidatum* (Benth.) Cuatr. var. *glabriflorum* (Ducke) Cuatr. (RB), 14. *H. dentatum* (Casar.) Cuatr. (RB), 15. *H. excelsum* (Ducke) Cuatr. (RB), 16. *H. glaziovii* (Urb.) Cuatr. (RB), 17. *H. villosum* (Froés) Cuatr. (RB), 18. *Schistostemon macrophyllum* (Benth.) Cuatr. (US), 19. *S. oblongifolium* (Benth.) Cuatr. (US), 20. *Sacoglottis amazonica*

Mart. (RB), 21. *S. guianensis* Benth. var. *guianensis* f. *guianensis* Cuatr. (RB), 22. *S. guianensis* var. *maior* Ducke (RB), 23. *S. mattogrossensis* Malme (RB), 24. *S. mattogrossensis* var. *mattogrossensis* f. *glabra* Cuatr. (RB), 25. *S. mattogrossensis* var. *subintegra* f. *puberula* Cuatr. (RB)

Pollen descriptions

Tribe I: Vantaneoideae

Vantanea compacta (Corcovada, Rio de Janeiro; Kuhlmann RB 47414) : 3-colporate (rarely 4-colporate) subprolate (31×25 μ). Apocolpium diameter about 5 μ. Colpi about 20×2 μ, with pointed ends, margins thickened; membrane densely granular. Ora lalongate (about 2×6 μ). Each mesocolpium provided with two, weak, exinous zones (in a few grains distinct, colpoid streaks are seen). Exine about 3 μ thick, sexine about 2 μ thick, punctitegillate. Tegillum smooth, densely punctate, supported by densely spaced, slender bacules. Nexine forms a homogeneous layer; inner margin uneven. Var. *compacta* (Santa Catarina; "Guaraparin" RB 24979) : 3-colporate, prolate spheroidal (32×30 μ). Exine about 3.6 μ thick. Sexine about 2 μ thick, punctitegillate. Var. *grandiflora* (Minas Gerias; Urb 82990) : 3-colporate, subprolate (46×36 μ). Exine about 3.5 μ thick. Sexine about 2 μ thick, punctitegillate.

V. guianensis (Amazonas; Ducke 23814) : 3-colporate, subprolate (46×38 μ). Exine about 2.5 μ thick. Sexine about 1 μ thick, punctitegillate.

V. macrocarpa (Amazonas; Ducke 30133) : 3-colporate, subprolate (44×35 μ). Exine about 3 μ thick. Sexine about 2 μ thick, punctitegillate.

V. obovata (Bahia; Edmundo RB 95938) : 3-colporate (rarely 4-colporate), subprolate (57×48 μ). Each mesocolpium provided with two, thin, long colpoid streaks. Exine about 8 μ thick. Sexine about 5 μ thick, punctitegillate.

V. paraensis (Amazonas; Ducke RB 23430) : 3-colporate subprolate (46×36 μ). Exine about 4 μ thick. Sexine about 3 μ thick, punctitegillate.

V. parviflora var. *parviflora* (Amazonas; Ducke 20426) : 3-colporate, prolate spheroidal (58×57 μ). Exine about 3 μ thick. Sexine about 2 μ thick, pertectate. Var. *puberulifolia* (Amazonas; Ducke 23425) : Fig. 19.—Pollen grains 3-colporate, prolate spheroidal (41×38 μ). Exine about 3 μ thick. Sexine about 2 μ thick, pertectate.

Tribe II: Humirioideae

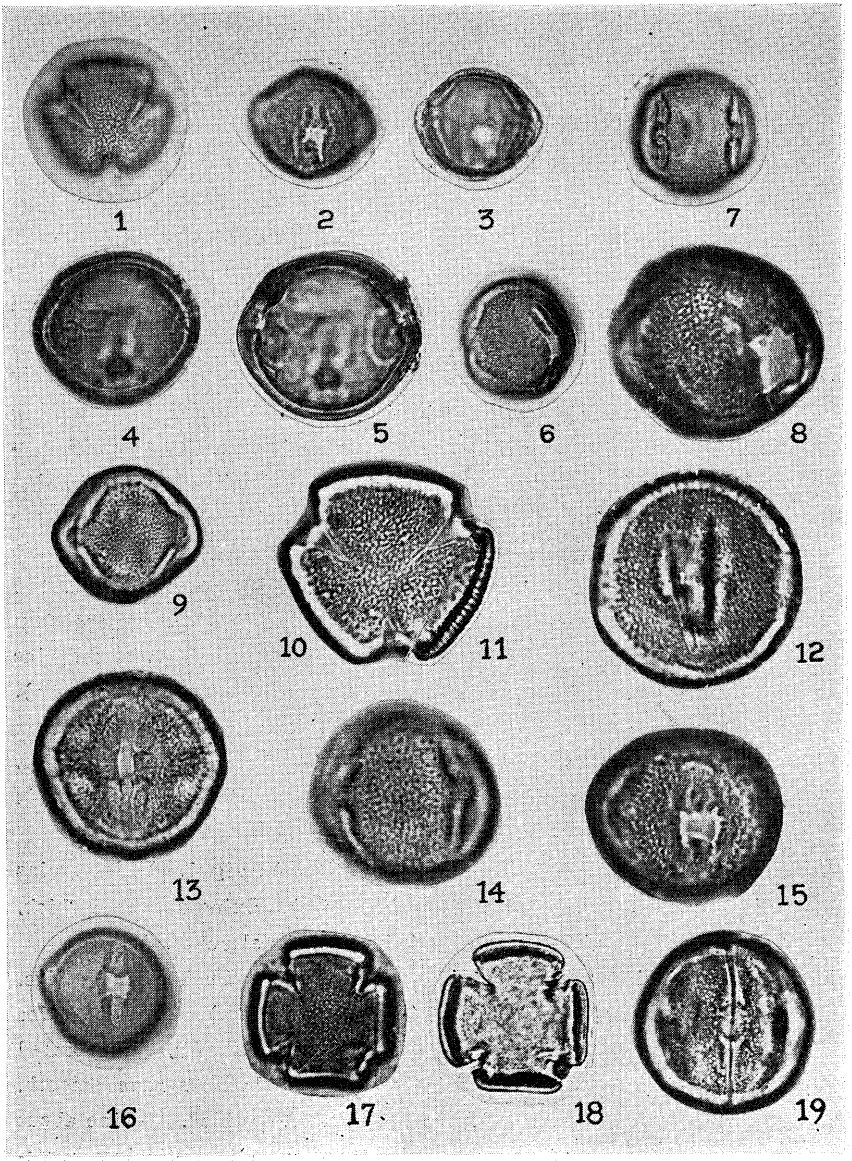
Duckesia verrucosa (Amazonas; Ducke 2108): Fig. 1.—Pollen grains 3-colporate, (rarely 4-colporate), suboblate (28×34 μ)—prolate (35×25 μ). Apocolpium diameter about 5 μ. Colpi about 22-29 μ×2-3 μ, with pointed ends, margins thickened, membrane smooth. Ora lalongate (about 3×5 μ-4×7 μ). Exine about 3 μ thick. Sexine about 2 μ thick, punctitegillate. Tegillum smooth, 0.5 μ thick, supported by densely spaced, very slender bacules. Nexine forms a homogeneous layer; inner margin uneven.

Endopleura uchi (Amazonas; Ducke 17779): Figs. 2 & 3.—Pollen grains 3-colporate (rarely 4-colporate), suboblate (about 27×34 μ)-subprolate (about 44×37 μ). Apocolpium diameter about 13 μ. Colpi about 32×4 μ, with pointed ends, margins uneven and faintly demarcated. Ora slightly lalongate—square shaped—lolongate (about 9×12-14 μ). Exine about 4 μ thick. Sexine about 1.5 μ thick, pertectate reticulate. Reticulum homobrochate. Muri±straight, about 0.5 μ wide, simplibaculate. Lumina smooth, circular (max. diam. about 0.5 μ). Nexine slightly incrassate at pores, forms a homogeneous layer; inner margin uneven.

Humiria balsamifera var. *coriacea* (Amazonas; Steyermart 59186): Figs. 4-6.—Pollen grains 3-colporate, subprolate (about 37×28 μ). Apocolpium diameter about 15 μ. Colpi about 16×3.5 μ, with broad ends, margins thickened (about 2 μ); membrane smooth. Ora lalongate (about 3×4 μ). Exine about 4 μ thick. Sexine about 1.5 μ thick, pertectate. Tegillum smooth, 0.5 μ thick, supported by densely spaced, very slender bacules. Nexine incrassate at pores, forms a homogeneous layer; inner margin smooth.

H. crassifolia (Colombia; Schultes and Cabrera 15054): Fig. 7.—Pollen grains 3-colporate, prolate spheroidal (about 32×31 μ). Exine about 3 μ thick. Sexine about 1 μ thick, pertectate (with occasional punctae).

Humiriastrum cuspidatum var. *glabriflorum* (Amazonas; Ducke 23436): Figs. 8 & 9.—Pollen grains 3-colporate (rarely 4-colporate), suboblate (27×32 μ). Apocolpium diameter about 9 μ. Colpi about 17×6 μ, with pointed ends; margins uneven, very faintly demarcated; membrane smooth. Ora lalongate (about 4.5×9 μ). Exine about 2.5 μ thick. Sexine about 1.5 μ thick, reticulate (in places retipilate—Ornate). Reticulum homobrochate. Muri±straight, about 1.5 μ wide, simplibaculate. Lumina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smooth, ±circular (max. diam. about 1 μ). Nexine forms a homogeneous layer; inner margin uneven.

H. dentatum (Fazenda; Wells Barrets, RB 32431): Figs. 10 & 11.—Pollen grains, 3-(4)-colporate, oblate spheroidal (about 29×32 μ). Exine about 5 μ thick. Sexine about 3 μ thick, faintly reticulate (in places retipilate —Ornate).

H. excelsum (Brazil; Ducke 17780): 3-colporate, subspheroidal (26×25 μ). Exine about 2.5 μ thick. Sexine about 1.5 μ thick, pertectate (there is a faint OL-pattern).

H. glaziovii (RB 42432): Fig. 12.—Pollen grains 3-4-colporate, suboblate (about 28×32 μ). Exine about 4 μ thick. Sexine about 2.5 μ thick, pertectate reticulate. The piloid elements which form the sexinous pattern are prominent and easily distinguished into bacules and capita in the above species, less prominent in *H. dentatum* and *H. excelsum* much less in *H. cuspidatum* var. *glabriflorum*.

H. villosum (Amazonas; Froés 22644): 3-colporate, subspheroidal (about 25 ×24 μ). Exine about 3 μ thick. Sexine about 2 μ thick, pertectate.

Schistostemon macrophyllum (Amazonas; Ducke 23432): 3-porate (there is an indication of a colpus with thickened margins at each aperture) subspheroidal (26×25 μ). Pores±circular to square-shaped (about 4× 4 μ); membrane granular. Exine about 3.5 μ thick. Sexine about 2 μ thick, punctitegillate. Tegillum slightly undulating, less than 0.5 μ thick, supported by densely spaced, very slender bacules. Nexine forms a homogeneous layer; inner margin uneven.

Fig. 1. *Duckesia verrucosa* (×1280), showing punctitegillate sexine. Figs. 2 & 3. *Endopleura uchi* (×890)—2, showing colporate aperture with thickened margins, broad ends and lalongate OS; 3, optical section. Figs. 4-6. *Humiria balsamifera* var. *coriacea* (×920)—4, surface pattern (faint LO); 5, optical section (slightly enlarged); 6, showing a colporate aperture lalongate OS. Fig. 7. *H. crassifolia* (×940)—surface view. Figs. 8 & 9. *Humiriastrum cuspidatum* var. *glabriflorum*—8, (×1520); showing colporate aperture, prominent OS and faintly demarcated colpus; 9, (×1110) showing surface pattern. Figs. 10 & 11. *H. dentatum* (×1600)—surface pattern (10), with a fragment of optical section (11). Fig. 12. *H. glaziovii* (×1640)—surface pattern and apertures. Fig. 13. *Sacoglottis amazonica* (×1170)—showing a porate aperture, a faint colpus also seen. Fig. 14. *S. guianensis* var. *guianensis* f. *guianensis* (×1290) —showing surface pattern. Fig. 15. *S. mattogrossensis* var. *mattogrossensis* f. *glabra* (×1400), porate aperture with an indication of a colpus. Figs. 16-18. *Schistostemon oblongifolium*—16 (×910), a porate aperture with a faint colpus; 17 & 18 (×1100), a 4-colporate grain in polar view; 17, showing surface pattern; 18, optical section. Fig. 19. *Vantanea parviflora* var. *puberulifolia* (×930), showing a colporate aperture.

S. oblongifolium (Amazonas; Froés 21090) : Figs. 16-18.—Pollen grains 3-(4)-porate (there is an indication of colpus at each aperture; cf. *Justicia*, Bhoj Raj 1961), suboblate ($27\times32\,\mu$). Exine about $3\,\mu$ thick. Sexine about $1.5\,\mu$ thick, pertectate (there is a faint OL-pattern). Nexine incrassate at pores.

Sacoglottis amazonica (Amazonas; Ducke 1055) : Fig. 13.—Pollen grains 3-porate (rarely 4-porate; there is an indication of a faint colpus at each aperture), prolate spheroidal ($34\times35\,\mu$)-subprolate ($36\times32\,\mu$). Pores lolongate—Circular—lalongate ($9\times6\,\mu$-$5\,\mu$-$2\times5\,\mu$). Exine about $2.5\,\mu$ thick. Sexine about $2\,\mu$ thick, ornate. Nexine forms a thin, homogeneous layer; inner margin uneven. F. *guianensis* (RB 10817) : Fig. 14.—Pollen grains 3-colporate, prolate spheroidal (about $31\times29\,\mu$). There is a thin transparent, colpoid streak, around the colpi. Exine about $2.5\,\mu$ thick. Sexine about $2\,\mu$ thick, punctitegillate. Var. *maior* (Amazonas; Ducke 23818) : 3-colporate, prolate spheroidal (about $28\times25\,\mu$), rarely oblate spheroidal (about $27\times28\,\mu$). There is a thin, transparent, exinous zone on either side of colpi. Exine about $3\,\mu$ thick. Sexine about $2\,\mu$ thick, pertectate (there is a distinct OL-pattern).

S. mattogrossensis (Espirito Santo; Kuhlmann RB 34223) : 3-colporate, oblate spheroidal (about $23\times25\,\mu$). Exine about $3\,\mu$ thick. Sexine about $2\,\mu$ thick, pertectate reticulate. F. *glabra* (RB 70947) : Fig. 15.—Pollen grains 3-porate (there is an indication of a faint colpus at each aperture), suboblate ($27\times31\,\mu$). Exine about $3\,\mu$ thick. Sexine about $2\,\mu$ thick, pertectate reticulate. F. *puberula* (RB 79932) : 3-porate (there is an indication of a colpus at each aperture), suboblate ($28\times30\,\mu$). Exine about $3.5\,\mu$ thick. Sexine about $2\,\mu$ thick, pertectate reticulate (in places retipilate).

Discussion of morphological features Out of the 25 taxa investigated belonging to 7 genera, the smallest grains are found in *Sacoglottis mattogrossensis* ($23\times25\,\mu$), and *Humiriastrum excelsum* ($26\times25\,\mu$) and the largest in *Vantanea parviflora* var. *parviflora* ($58\times57\,\mu$) and *V. obovata* ($57\times48\,\mu$). The shape of the grains varies from suboblate as in *Humiriastrum cuspidatum* var. *glabriflorum* (Fig. 9), *Sacoglottis mattogrossensis* var. *mattogrossensis* f. *glabra* (Fig. 15), to subprolate in *Vantanea guianensis* and *V. obovata*. Colporate and porate are the two types of apertures met within the Humiriaceae. The 3-colporate grains are found in *Humiriastrum excelsum*,

Vantanea parviflora var. *puberulifolia* (Fig. 19), *Humiria crassifolia* (Fig. 7), etc., 3-4-colporate in *Humiriastrum glaziovii* (Fig. 12), rarely 4-colporate in *Vantanea compacta* and *Humiriastrum dentatum*. The pollen grains of *Sacoglottis mattogrossensis* var. *mattogrossensis* f. *glabra* (Fig. 15) are 3-porate (there is an indication of a colpus at each aperture), 3-4-porate in *Schistostemon macrophyllum*, rarely 4-porate in *Schistostemon oblongifolium* (Figs. 16, 17 & 18) and *Sacoglottis amazonica*. The colpi are either long with pointed ends as in *Duckesia verrucosa* (Fig. 1), *Humiriastrum dentatum* (Figs. 10 & 11) or broad ends as in *Humiria balsamifera* var. *coriacea*. Colpi margins are usually thick in *Humiria balsamifera* var. *coriacea*. There is an indication of a colpus at each aperture in *Sacoglottis mattogrossensis* var. *subintegra* f. *puberula*, *Sacoglottis mattogrossensis* f. *glabra*. Colpoid streaks are met with in *Vantanea compacta*. A thin exinous zone is present on either side of the aperture in *Sacoglottis amazonica*, *S. quianensis*, etc. and a thin transparent exinous streak running round the aperture is seen in *Sacoglottis quianensis* f. *dolichocarpa*. The ora show various shapes, lalongate in *Vantanea compacta*, *Duckesia verrucosa*, lalongate—square shaped—lolongate, in *Endopleura uchi*, lolongate—circular—lalongate in *Sacoglottis amazonica*. The sexine pattern is pertectate in *Vantanea parviflora* var. *parviflora*, *Humiria balsamifera* var. *coriacea* (Figs. 4 & 6), pertectate reticulate in *Sacoglottis mattogrossensis* f. *glabra*, *Endoleura uchi* etc., or reticulate (in places retipilate–ornate), in *Humiriastrum cuspidatum* var. *glabriflorum* (Figs. 8 & 9). The sexine of majority of the pollen grains is punctitegillate as in *Vantanea compacta*, *Schistostemon macrophyllum*, etc. In *Schistostemon oblongifolium* nexine is incrassate at pores.

Taxonomical conclusions Cuatrecasas (1961) has described at length the relationships and evolution of the family Humiriaceae and concludes that "The Humiriaceae form a very natural, homogeneous, and compact group, well-defined and perfectly separable from the Linaceae". Erdtman (1952) has described the pollen grains of *Humiria*, *Sacoglottis* and *Vantanea* under the Linaceae. The present investigation has revealed that the morphology of the pollen grains differs from that of the general types in the Linaceae. The Linaceae genera closest to the Humiriaceae are *Ixonanthes*, *Octhocosmus* and *Ctenolophon*, but they differ in their pollen morphology. The pollen grains of *Ixonanthes*, although 3-colporate, differ from the

Humiriaceae in having spinules. The pollen grains of *Octhocosmus* are "crassisexinous" with "nexinous thickenings on both sides of equator", a feature not met with in the Humiriaceae. The pollen grains of *Ctenolophon* are of unique type (cf. Erdtman 1952, p. 244). Planchon (1848) compares *Humirium* and *Erythroxylon* and the Linaceae and shows their close relationship, nevertheless, he considers the Humiriaceae independent but connected with the Linaceae through *Roucheria*. The pollen grains of *Roucheria* (cf. *R. Laxiflora*, Bhoj Raj and Suryakanta 1968), are 3-colpate with a pertectate sexine having suprategillar pointed and blunt processes, a feature not met with in Humiriaceae. Erdtman (1952), described the pollen grains of Humiriaceae as 3-colporate, also 4-colporate, suboblate, oblate spheroidal, prolate spheroidal, exine not verrucose, tenuisexinous, and slightly similar to those in certain Celastraceae. Thus pollen morphology distinguishes the Humiriaceae from the Linaceae and supports the consideration of Hutchinson (1926) that Humiriaceae is an independent family of the order Malpighiales, in company with Malpighiaceae and Erythroxylaceae; and agreed by Cuatrecasas (1961).

Concerning relationship among the Humiriaceae, Cuatrecasas (1961) considers the genus *Vantanea* as the most primitive; *Duckesia* and *Hylocarpa* as more primitive than *Endopleura*; and *Humiriastrum* exhibiting an intermediate stage. Further, he considers *Schistostemon* and *Sacoglottis* as advanced. The latter having attained the maximum reduction in the androecium represents the most evolved genus, and *Humiria* remains as an independent line, not far from *Vantanea*. The above relationships and the primitive or advanced nature of the different genera find ample support palynologically. It has been pointed out by Bhoj Raj (1961) and Saad (1962), that the aperture development might have proceeded from a colporate to a porate status. Colporate, aperture being primitive and porate evolved. The same evolutionary trend can be traced to some extent in the genera of the Humiriaceae. Thus in the primitive genera *Vantanea* and *Duckesia*, the pollen grains are colporate. The pollen grains of *Endopleura* are also colporate, but the colpi margins are faintly demarcated, pointing at it being more evolved than *Vantanea* and *Duckesia*. The pollen grains of *Hylocarpa*, although not investigated, are in all probability, colporate and thus primitive. The pollen grains of *Humiria*, which are colporate with

thickened colpi margins, resemble those of *Vantanea*, and might represent an independent line not far from *Vantanea* as suggested by Cuatrecasas (op. cit.). Further, Cuatrecasas (op. cit.) considers *Humiriastrum* as exhibiting an intermediate stage. Palynologically there is not much of an evidence to support the above consideration, as the pollen grains are 3-colporate. However, the pollen grains are smaller in size with thinner exine, than those of the other primitive genera. The remaining genera *Schistostemon* and *Sacoglottis* considered the most evolved in the Humiriaceae, have colporate and porate grains. In the porate grains there is, however, an indication of a faint colpus. The above morphological feature points at the evolved nature of the above genera.

Further, it is obvious that pollen data within the family Humiriaceae indicate that the family is homogeneous and rightly considered as an independent family.

Acknowledgements I am grateful to the Director, National Museum of Natural History, Smithsonian Institution, Washington, D. C. for kindly sending me the material of *Duckesia*, *Endopleura*, *Humiria* and *Schistostemon*; and to Dr. L. Laxminarayana, Reader in Botany, Post-Graduate Centre, Warangal for the rest of the material of Humiriaceae.

I am equally thankful to Prof. M.R. Saxena, Head, Dept. of Botany, Osmania University for his encouragement and facilities provided to me. I am equally indebted to Dr. Bhoj Raj, Reader in Botany, Osmania University for his criticism and helpful suggestions.

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フミリア科植物の 7 属に属する 25 をかぞえる種，亜種，変種の植物の花粉を研究した。この科と他の科との関連が論議されたが，花粉の形態からみてこの科は一つの独立したまとまった科である。本科の各属の関連を研究した。また花粉の開孔部の形態からみて進化した属を指摘した。

○メリケンムグラの新帰化地（浅井康宏） Yasuhiro Asai: On a new locality of *Diodia virginiana* L. as an alien weed in Japan

アメリカ合衆国原産の 1 年草であるメリケンムグラ *Diodia virginiana* Linnaeus, Sp. Pl. 104 (1753) は，最初，杉本順一氏によって岡山市福島に帰化したものに基づいて報告 (1969) された。筆者も同地方の植物研究家として夙に令名ある西原礼之助氏のご好意により，岡山県吉備郡一の宮の生育地を再度に亘って訪れ，向陽の水湿草地に完全に帰化し，極めて旺盛な生育を示しているのを実見した。本種は米名 Large-button weed が示すように，全草が大形で，しかも狭長な花筒をもつ純白花をつける。なお西原氏によれば，該地における本種の存在は杉本氏の報告よりも，さらに古いものの由であった。

ところで筆者は最近，太田久次氏の三重県下での採集品を検定中，四日市で本種を採集 (1973 年 9 月 9 日) されているのに気付いたので，追加記録しておきたい。同氏からの書信によれば，やはりその生育地は向陽の湿性地である由である。従って本種は，既に我国の主に海岸の乾燥した砂地などに定着している近縁の *D. teres* Walter よりも，水湿地と云う比較的限定された生態条件を有するため，今後さらに生育地を拡げたとしても，例えば田畔などの局部的な帰化雑草となるに止まるものと思われる。

終りに，種々ご援助いただいた西原，太田両氏に厚く御礼申上げたい。

（東京歯科大学）