

# POLLENMORPHOLOGY OF *LYSIPOMIA* H.B.K. AND *RHIZOCEPHALUM* WEDD. (CAMPANULACEAE) AND THE REVISION OF THE POLLEN DETERMINATION "*VALERIANA STENOPHYLLA*" KILLIP

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## ABSTRACT

Van der Hammen, T. and Cleef, A.M., 1978. Pollenmorphology of *Lysipomia* H.B.K. and *Rhizocephalum* Wedd. (Campanulaceae) and the revision of the pollen determination "*Valeriana*" *stenophylla* Killip. Rev. Palaeobot. Palynol., 25: 367–376.

Fossil pollen grains from the Quaternary of Colombia, formerly provisionally indicated as "*Valeriana*" *stenophylla* Killip, have now been identified as those of the Andean genus *Lysipomia* H.B.K. (Campanulaceae).

In the genus *Lysipomia* s.l. (fide McVaugh) two considerably different pollen types are found: That of the *Lysipomia* s.s. and the *Rhizocephalum* type. The former was probably derived from the latter.

## RESUMEN

Granos de polen fósiles del Cuaternario de Colombia, antes indicados provisionalmente como "*Valeriana*" *stenophylla* Killip, pudieron ser determinados definitivamente como pertenecientes al género andino *Lysipomia* H.B.K. (Campanulaceae).

En el género *Lysipomia* s.l. (fide McVaugh) hay dos tipos de polen bastante diferentes, el tipo de *Lysipomia* s.s. y el de *Rhizocephalum*. El primero fue probablemente derivado del último.

## INTRODUCTION

When studying, years ago, the fossil pollen flora of the Quaternary sediments of the high plain of Bogotá, we regularly came across a very characteristic stephanocolp(or)ate striate type of unknown affinity. This type was also found in Holocene sediments of a lake at ca 3,500 m elevation in the Páramo de Palacio, a high area northeast of Bogotá. We then decided that the plant that produced that curious pollen, might still be growing there and during an excursion made for the specific purpose of identifying the taxon, a tiny plant with abundant white flowers, forming tight carpets or cushions was found, which had not previously been recorded from the area. A few

flowers were taken from the collection of fresh material and a pollen slide was prepared. The slide proved to contain pollen of the unknown type. The story of the identification of the plant and the resulting questions is mentioned in Van der Hammen and Gonzalez (1960a). We quote here literally what was written in that publication (pp.291–292):

“*Valeriana*” *stenophylla* (Pl.XI, 89–91)

Stephanocolp(or)ate, striate (and reticulate),  $\pm 45 \mu\text{m}$ . There are always 6 furrows, which are placed in pairs (the two furrows of each pair are nearer to each other than to the other furrows) (it may therefore appear that the grains are tricolp(or)ate operculate). Small herb of the high páramo.

We found these very typical pollen grains in the sediments of the Sabana de Bogotá (and in several páramo lakes of the Eastern Cordillera), before we knew the plant. Later we found the plant in the Páramo de Palacio, but it was not possible to determine it in Colombia, as no comparable material was present in the National Herbarium. Dr. A. Fernandez was so kind as to determine it in the U.S.A., where he found identical material described by Killip (Journ. Wash. Acad. Sc. 18; 1928) as *Valeriana stenophylla*. While there is no doubt that the plant has been described as *Valeriana stenophylla*, we like to express our doubt that the classification in the genus *Valeriana* or even in the same family is correct for the reasons given below.

The pollen grains of the genus *Valeriana*, including also other genera of the Valerianaceae, like *Phyllactis*, are all very similar tricolpate, (micro-)echinate and completely different from the type of “*Valeriana*” *stenophylla*.

For this reason it seems to be impossible to us that this species has some near relationship with the genus *Valeriana* or *Phyllactis*. The pollen type of “*Valeriana*” *stenophylla* seems to be more related to that of *Rhizocephalum* (Campanulaceae), although there are important differences.

It may be added here that, after the identification of the plant, we felt that it was necessary to verify if the pollen indeed belongs to this plant. Therefore, again some flowers were taken from the material collected in the Páramo de Palacio, with the same result. The mystery remained unexplained and in the meantime the pollen type, when found in fossil material, was referred to as “*Valeriana*” *stenophylla*.

Recently pollen slides were made of abundant plant material collected by the second author during a year and a half of study of páramo vegetation in the Colombian Eastern Cordillera and including *Valeriana stenophylla* Killip and species of the genus *Lysipomia* H.B.K. (Campanulaceae) from e.g., Páramo de Palacio. The first appeared to have typical *Valeriana* pollen, the second 6-colpate striate grains identical with those described above.

As *Valeriana stenophylla* Killip and *Lysipomia sphagnophila* Griseb. ex Wedd. ssp. *minor* McVaugh were often found to grow mixed in carpets and flat cushions (and have rather similar habitats and both have relatively small, white flowers; see Plate I, 2, Plate II, 6) it now becomes clear how the mistake was made. The original collection in the Páramo de Palacio must have contained a mixture of the two species. While Dr. Fernandez took *Valeriana stenophylla* to Washington, the flowers taken from plants with the same collector's number had been those of *Lysipomia*. Although in this way the wrong name was applied to a fossil pollen type, the existing doubt was expressed by placing the generic name between quotation marks. How important pollen

morphology may be for plant taxonomy is once more illustrated by the fact that in the original description of 1960, quoted above, a relationship to *Rhizocephalum* Wedd. was suggested; *Rhizocephalum* is now considered to be a subgenus of *Lysipomia* H.B.K. (Wimmer, 1937, 1953, 1968; McVaugh, 1955).

As *Lysipomia* is a genus restricted to the tropical Andes, its fossil occurrences may provide important data concerning the history of the Andean flora and vegetation. For that reason we list here all those places where its fossil occurrence is mentioned in the literature. Other data related to the history of the genus will be published separately.

*Lysipomia* pollen (indicated as "*Valeriana*" stenophylla) is mentioned in the following papers:

- Van der Hammen and Gonzalez (1960a): pp.191–292, Plate XI, 89, 90 and 91; long pollen diagram Sabana de Bogotá, section Ciudad Universitaria X, 21st curve from the right.
- Van der Hammen and Gonzalez (1960b): p.741 (zone I), p.743 (zone II); pollen diagram Laguna de la América, 14th curve from the right; pollen diagram Turbera PT I, 15th curve from the right; pollen diagram Turbera PT II, 17th curve from the right.
- Van der Hammen and Gonzalez (1964b): p.114, fig.1, Upper Quaternary; p.116, fig.3, 9th curve from the right.
- Van der Hammen and Gonzalez (1964a) (Spanish edition of 1960a): p.233, plate and pollen diagram: same as 1960a above.
- Gonzalez et al. (1966): p.176 (zone I); pollen diagram VL III, 18th curve from the right; pollen diagram Valle de Lagunillas V, 38th curve from the right.
- Van der Hammen and Gonzalez (1965): pollen diagram Ciénaga del Visitador, extreme right, samples 5, 15 and 31.
- Van der Hammen (1968): pollen diagram Sabana de Bogotá (Ciudad Universitaria), 9th curve from the right; pollen diagram Páramo de Palacio, 14th curve from the right.
- Van der Hammen et al. (1973): pp.21, 22, 24 (fig.15, zone Vc), 25, 26 (subzone Vc), 92; pollen diagram fig.16 (Bogotá CUY), 3rd curve right of general diagram; diagram fig.21, third curve from left and zone V.

## DESCRIPTION

All the material (unless otherwise indicated) is embedded in silicon oil.

*Valeriana stenophylla* Killip (Valerianaceae); Plate I, 1, 2  
Cleef 293 (H. de Vr. 3156)

Tricolpate, (micro-)echinate. Columellae rather coarse (ca. 0.3–0.5  $\mu\text{m}$ ), evenly distributed. Furrows very wide; membrane covered with ectexine elements and with well-marked border. Spines up to 1.3–1.6  $\mu\text{m}$  long. Pollen size: width ca. 30  $\mu\text{m}$ , length ca. 25  $\mu\text{m}$ . Exine 1.3–1.6  $\mu\text{m}$ . Form index ca. 0.8. Polar area index ca. 0.3. Width of furrows in equatorial area 7–10  $\mu\text{m}$ .

*Lysipomia* cf. *acaulis* H.B.K. (Campanulaceae); Plate II, 5  
Cleef 5560 (H. de Vr. 3163)

Stephanocolporate, striate (to reticulate-perforate). Columellae ca. 0.3  $\mu\text{m}$ , more or less in a striate pattern. Furrows relatively narrow, margins curving inwards. Six furrows, in pairs of two that are nearer to each other; two furrows

of a pair are often connected in the polar area, resembling a pollen of a tricolp(or)ate operculate type. Faint costae transversales, faint poroid zone. One could call this type tricolp(or)ate operculate, but each of the six furrows has a separate poroid area and costae transversales. Striae approximately parallel or slightly oblique to furrows. Pollen size: width ca 23  $\mu\text{m}$ , length ca. 30  $\mu\text{m}$ . Exine ca. 1.5–2  $\mu\text{m}$ . Form index ca. 1.3. Polar area index ca. 0.25.

*Rhizocephalum candollei* Wedd. (Campanulaceae); Plate I, 3, 4 (= *Lysipomia laciniata* A.DC.)

Cleef 9702 (H. de Vr. 3087); Cleef 2895 (H. de Vr. 3205)

Tricolporate, striate. Columellae ca. 0.3  $\mu\text{m}$ , more or less in a striate pattern. Furrows relatively wide: widest part up to 3.5  $\mu\text{m}$ , but often less. Striae parallel to strongly oblique to furrows. Costae colpi. Membrane of furrows covered with ectexine elements. Sometimes faint costae transversales are visible. Furrows sometimes slightly constricted in equatorial area. Pollen size: width ca. 28–32  $\mu\text{m}$ , length ca. 40–45  $\mu\text{m}$ . Exine 1.5–2  $\mu\text{m}$ . Form index ca. 1.4. Polar area index ca. 0.15. In another slide (H-695) the pollen grains (embedded in glycerine jelly) are larger (ca. 60  $\mu\text{m}$ ), and in some specimens the ectexine of the membrane of the furrows is almost intact and locally even striate.

*Other observed specimens and species (Plate II, 6, 7; Plate III)*

*Lysipomia sphagnophila* Griseb. ex Wedd. ssp. *minor* McVaugh (= *L. obliqua* Wimmer) (Cleef 8055; variety with large flowers; Sumapaz); Plate III, 8

Furrows of a pair not connected in polar area. Clearer costae transversales. Striae relatively faint, often more or less perpendicular to furrows. Pollen size ca. 35  $\mu\text{m}$ .

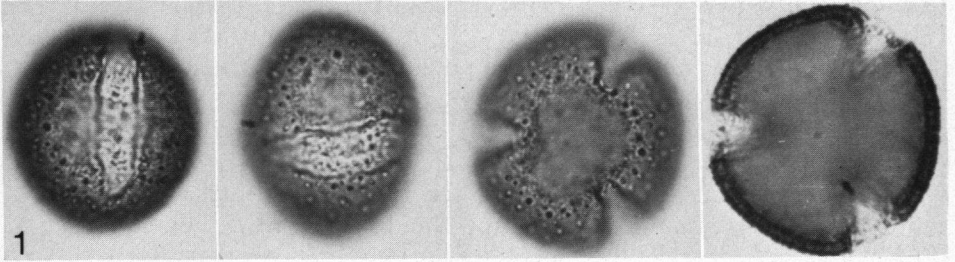
*Lysipomia sphagnophila* Griseb. ex Wedd. ssp. *minor* McVaugh (= *L. obliqua* Wimmer) (Cleef 5825; variety with small flowers; Cocuy); Plate III, 9

Furrows of a pair often connected in polar area. Pollen size ca. 34  $\mu\text{m}$ .

## PLATE I

1. Pollen grains of *Valeriana stenophylla* Killip (Valerianaceae). Coll. Cleef no.293.  $\times 1000$ .
2. Flat cushion of *Valeriana stenophylla* Killip (Cleef 3100), with white flowers, growing at 3,600 m near the shore of the Laguna El Verjón, Páramo de Cruz Verde, near Bogotá, Cordillera Oriental, Colombia. Photogr. A.M. Cleef.
3. Rosette of *Rhizocephalum candollei* Wedd. (= *Lysipomia laciniata* A.DC.) (Cleef 9521), in boggy páramo at 3,330 m in the head-waters of Río Cusiana near the Laguna de Tota (Dept. of Boyacá, Cordillera Oriental, Colombia). The showy whitish flowers have conspicuous small purplish dots on part of their zygomorph corollas. Photogr. A.M. Cleef.
4. Pollen grains of *Rhizocephalum candollei* Wedd. (= *Lysipomia laciniata* A.DC.) (Campanulaceae). Coll. Cleef no.9602.  $\times 1000$ .

PLATE I



*Lysipomia sphagnophila* Griseb. ex Wedd. ssp. *minor* McVaugh  
(= *L. obliqua* Wimmer) (Cleef 3948; variety with large flowers; Páramo de Palacio); Plate III, 10

Furrows of a pair not connected in polar area. Pollen size ca. 38  $\mu\text{m}$ .

*Lysipomia sphagnophila* Griseb. ex Wedd. ssp. *minor* McVaugh  
(Cleef 8817; variety with small flowers; Cocuy); Plate III, 11

Furrows of a pair mostly not connected in polar area. Striae relatively faint, more or less sub-parallel to perpendicular to furrows. Pollen size 30–35  $\mu\text{m}$ .

*Lysipomia sphagnophila* Griseb. ex Wedd. ssp. *minor* McVaugh (Cleef 7946a; variety with small flowers; Sumapaz); Plate III, 12

Furrows of a pair sometimes connected, sometimes not. Pollen size ca. 29  $\mu\text{m}$ .

*Lysipomia muscoides* Hook f. ssp. *simulans* McVaugh  
(Cleef 5320); Plate III, 13 and Plate II, 7

Furrows of a pair often more or less connected. Pollen size ca. 26  $\mu\text{m}$ .

## DISCUSSION

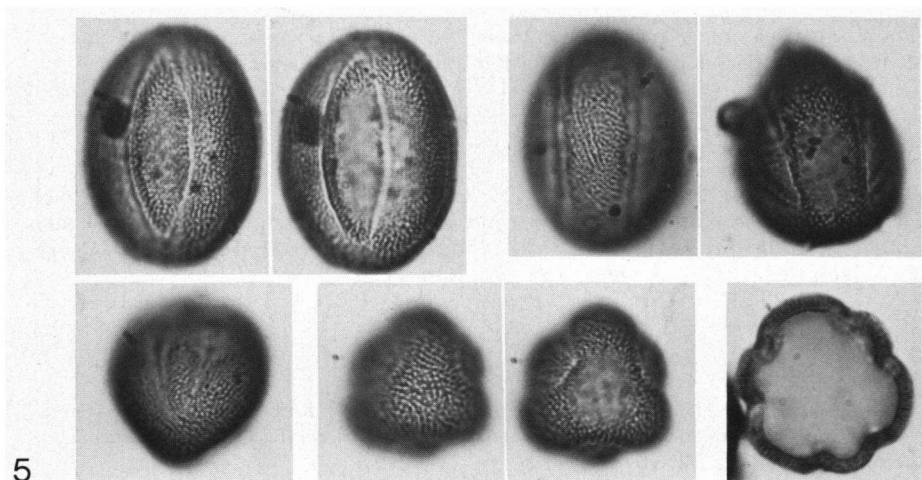
*Rhizocephalum* and *Lysipomia* are doubtless closely related. In view of the fact that in some species of *Lysipomia* the pairs of colpi may be connected in the polar area and that the colpus membrane of *Rhizocephalum* may sometimes resemble an operculum, a pair of colpi of *Lysipomia* may be homologous with a furrow of *Rhizocephalum*. The *Lysipomia* type would then have evolved from the *Rhizocephalum* type. *Rhizocephalum* as mentioned above, is actually considered to be a subgenus of *Lysipomia* (McVaugh, 1955). Within the subspecies *L. sphagnophila minor* there are probably several (as yet undescribed) varieties; the differences in morphology found amongst the pollen of different specimens might be related to this infraspecific variability.

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## PLATE II

5. Pollen grains of *Lysipomia* cf. *acaulis* H.B.K. (Campanulaceae) Coll. Cleef no. 5560  $\times 1000$ .
6. *Lysipomia sphagnophila* Grisebach ex Wedd. ssp. *minor* McVaugh. Detail taken from fresh plants collected by Van der Hammen and Jaramillo in 1975 in boggy páramo near the Laguna El Verjón, Páramo de Cruz Verde near Bogotá (Dept. Cundinamarca, Cordillera Oriental, Colombia), where it is growing associated with *Valeriana stenophylla* Killip. This plant came from the type locality of *Lysipomia obliqua* Wimmer and is similar to *L. obliqua*, characterized mainly by its large corolla. (Photogr. A. Kuiper).
7. Tiny cushions of *Lysipomia muscoides* Hook f. ssp. *simulans* McVaugh (Cleef 5320), bearing faint lilac flowers, growing on humid thin soil. Rocky slopes at 3,750 m of the crest between Páramo de Palacio and Chingaza (Dept. of Cundinamarca. Cordillera Oriental, Colombia). Photogr. A.M. Cleef.

PLATE II



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## ACKNOWLEDGEMENTS

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## ADDENDUM

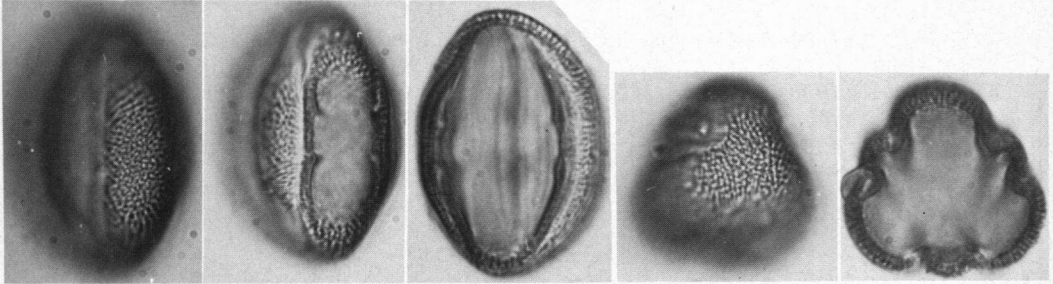
Recent cytological observation by Mr. H. 't Hart (Division of Biosystematics, Utrecht) showed the occurrence of three cytotypes in Colombian *Lysipomiinae*: *Rhizocephalum candollei* Wedd.  $2n = 24$ ; *Lysipomia sphagnophila* Griseb. ex Wedd. ssp. *minor* McVaugh (large flowers)  $2n = 22$ ; *Lysipomia muscoides* Hook. f. ssp. *muscoides*  $2n = 16$ .

## REFERENCES

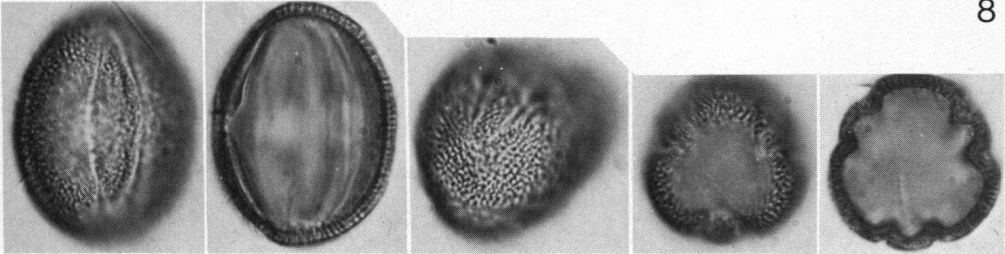
- Gonzalez, E., Van der Hammen, T. and Flint, R.F., 1966. Late Quaternary glacial and vegetational sequence in Valle de Lagunillas, Sierra Nevada del Cocuy, Colombia. Leid. Geol. Meded., 32: 157—182.
- McVaugh, R., 1955. A revision of *Lysipomia* (Campanulaceae, Lobelioideae). Brittonia, 8(2): 69—105.
- Van der Hammen, T., 1968. Climatic and vegetational succession in the Equatorial Andes of Colombia. Colloq. Geogr. 9: 187—194.
- Van der Hammen, T. and Gonzalez, E., 1960a. Upper Pleistocene and Holocene climate and vegetation of the Sabana de Bogotá (Colombia), South America. Leid. Geol. Meded., 25: 126—315.
- Van der Hammen, T. and Gonzalez, E., 1960b. Holocene and Late Glacial climate and vegetation of Páramo de Palacio (Eastern Cordillera), Colombia, South America. Geol. Mijnb., 39: 737—746.
- Van der Hammen, T. and Gonzalez, E., 1964a. Historia de clima y vegetación del Pleistoceno Superior y del Holoceno de la Sabana de Bogotá. Bol. Geol., 11: 189—266 (Spanish edition of 1960a).
- Van der Hammen, T. and Gonzalez, E., 1964b. A pollen diagram from the Quaternary of the Sabana de Bogotá (Colombia) and its significance for the geology of the Northern Andes. Geol. Mijnb., 43: 113—117.
- Van der Hammen, T. and Gonzalez, E., 1965. A late-glacial and Holocene pollen diagram from Cienaga del Visitador (dept. Boyacá, Colombia). Leid. Geol. Meded., 32: 193—201.
- Van der Hammen, T., Werner, J.H. and Van Dommelen, H., 1973. Palynological record of the upheaval of the Northern Andes; a study of the Pliocene and Lower Quaternary of the Colombian Eastern Cordillera and the early evolution of its high-Andean biota. Palaeogeogr., Palaeoclimatol., Palaeoecol., 16(1): 1—122.

## PLATE III

- 8.—12. Pollen grains of *Lysipomia sphagnophila* Grieseb. ex Wedd. ssp. *minor* McVaugh.  $\times 1000$ .
8. Cleef 8055.
9. Cleef 5825.
10. Cleef 3948.
11. Cleef 8817.
12. Cleef 7946a.
13. Pollen grains of *Lysipomia muscoides* Hook.f. ssp. *simulans* McVaugh (Cleef 5320).  $\times 1000$ .



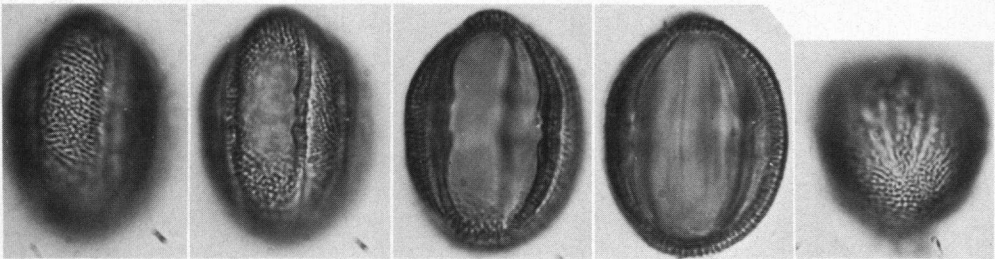
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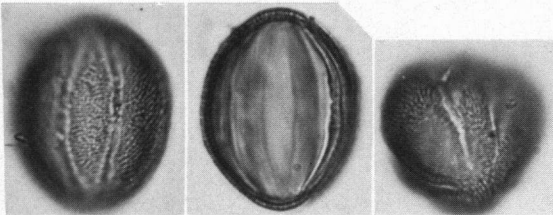
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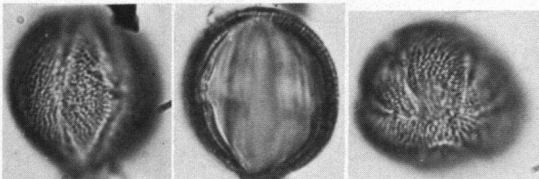
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- Wimmer, F.E., 1937. Lysipominae. In: Flora of Perú. Field Mus. Publ. Bot., 13(6, 2): 481—489.
- Wimmer, F.E., 1953. Lysipomiinae. In: Das Pflanzenreich IV (276b). Akademie Verlag, Berlin, pp.745—754.
- Wimmer, F.E., 1968. Lysipomiinae. In: Das Pflanzenreich IV (276c). Akademie Verlag, Berlin, pp.893—900.