

EPIDERMAL AND VENATION STUDIES IN APOCYNACEAE—II

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ABSTRACT

Epidermal characters and venation pattern of the leaves of nine species of Apocynaceae, viz. *Acokanthera oppositifolia* (Lam.) Codd (*A. venenata* G. Don), *Allamanda cathartica* Linn. (2 cultivars), *Alstonia scholaris* R. Br., *Carissa carandas* Linn., *Cerbera manghas* Linn., *Ervatamia coronaria* Stapf (2 cultivars—single and double flower forms), *Mascarenhasia variegata* Britt. & Renole (*M. elastica* K. Schum.), *Thevetia peruviana* (Pers.) Schum. and *Wrightia coccinea* Sims., have been described.

INTRODUCTION

The significance of epidermal and venation studies has already been briefly discussed by the present authors in the first paper of the series (*Chandra et al.*, in press). This communication being second of the series deals with the same characters of nine more species, viz., *Acokanthera oppositifolia* (*A. venenata*), *Allamanda cathartica*, *Alstonia scholaris*, *Carissa carandas*, *Cerbera manghas*, *Ervatamia coronaria*, *Mascarenhasia variegata* (*M. elastica*), *Thevetia peruviana* and *Wrightia coccinea*.

MATERIALS AND METHODS

Normal and mature fresh leaves were collected locally in the month of November, 1969. The same method, as described earlier (*Chandra et al.*, loc. cit.), was followed.

OBSERVATIONS

Acokanthera oppositifolia (Lam.) Codd (*A. venenata* G. Don)

Macro-characters: Leaves opposite or subopposite, simple, petiolate; petioles stout, 0.2-0.8 cm long, glabrous; lamina elliptic to oblong-elliptic, spinately acuminate, base mostly cuneate, occasionally nearly rounded, 3.5-10.0 cm × 1.8-4.5 cm, entire, coriaceous, upper surface shining dark green, glabrous, midrib impressed, lower surface pale green, punctulate, midrib prominently raised, main lateral nerves 14-20, nervation not very conspicuous.

Micro-characters: Epidermal cells usually pentagonal or hexagonal, straight walled, lower thick walled. Stomata confined to lower surface only, 31.7-35.3-40.0 × 28.3-31.3-35.0 μ, rubiaceous, cyclocytic stomata also present, stomatal index 3.5-2.8. Trichomes absent. Vein islets 7-9-10 per sq mm. Vein endings 12-12.5-14 per sq mm. Palisade ratio 5-7.1-9.

Allamanda cathartica Linn. (Cultivar 1)

Macro-characters: Leaves verticillate, mostly 4 or occasionally 5 at each node, simple, nearly sessile or shortly petiolate; petioles stout, upto 0.5 cm long, hairy; lamina oblanceolate or broadly oblanceolate or oblong-oblanceolate, abruptly narrowed at the apex, shortly caudate, acuminate, base cuneate, 5.5-13.5 cm × 1.8-5.5 cm, entire, undulate, coriaceous, upper surface shining dark green, sparsely hairy on the midrib otherwise glabrous, lower surface pale green, densely hairy on the midrib, less so on the main lateral nerves, sparsely hairy on the margin and punctulate on the surface, midrib prominently raised, main lateral nerves 18-24, nearly parallel, joining an intramarginal one, nervation inconspicuous.

Micro-characters: Epidermal cells usually tetra- to hexagonal, lower almost straight or slightly sinuous walled, upper straight walled and highly striated. Stomata confined to lower surface only, 25.0-26.0-26.7 × 16.7-17.3-20.0 μ, rubiaceous, rarely ranunculaceous, stomatal index 18-23.4-30. Trichomes simple, unicellular, nonglandular, unbranched. Vein islets 6-6.5-7.5 per sq mm. Vein endings 8-9.5-10 per sq mm. Palisade ratio 3-4.5-7.

A. cathartica Linn. (Cultivar 2)

Macro-characters: Leaves verticillate, mostly 3 or occasionally 4 at each node, simple, petiolate; petioles stout, upto 0.5 cm long, glabrous; lamina elliptic, oblong-elliptic or oblanceolate-elliptic, abruptly narrowed at the apex, shortly caudate, acuminate, base cuneate, slightly decurrent, 6.5-13.5 cm × 2.5-5.3 cm, entire, undulate, coriaceous, upper surface shining dark green, glabrous, lower surface paler, very sparsely hairy on the midrib only, punctulate, midrib prominently raised, main lateral

nerves 18-22, nearly parallel, joining an intramarginal one, nervation inconspicuous.

Micro-characters: Epidermal cells usually pentagonal or hexagonal, upper straight walled, lower almost straight walled or walls slightly curved. *Stomata* confined to lower surface only, $26.7-27.7-30.0 \times 16.5-16.7-18.3 \mu$, rubiaceous, stomatal index 14-20-25. *Trichomes* simple, unicellular, nonglandular, unbranched. *Vein islets* 3.8-4.9-6.2 per sq mm. *Vein endings* 7.2-8-8.5 per sq mm. *Palisade ratio* 6-9.5-12.

***Alstonia scholaris* R. Br.**

Macro-characters: Leaves verticillate, 3-8 at a node, simple, petiolate; petioles stout, 0.5-1.2 cm long, glabrous; lamina obovate, elliptic-oblong, oblong-lanceolate or oblanceolate, obtuse or retuse, base cuneate and faintly decurrent, 6.0-20.0 cm $\times$ 1.1-6.5 cm, entire, coriaceous, upper surface dark green, glabrous, lower surface rather pale and covered with a whitish bloom, glabrous, midrib prominently raised, main lateral nerves 50-60, close, nearly horizontal and parallel, joining an intramarginal one, nervation inconspicuous (in *A. macrophylla* Wall. ex DC. nerves distant, reaching nearly to the margin and then running almost parallel with it).

Micro-characters: Epidermal cells usually pentagonal or hexagonal, straight walled, upper striated, lower highly striated. *Stomata* confined to lower surface only, $20.0-21.0-23.4 \times 13.4 \mu$, rubiaceous and ranunculaceous, some giant stomata (size $33.5 \times 21.7 \mu$) also observed, stomatal index 5-7.5-12. *Trichomes* absent. *Vein islets* 3-4-5 per sq mm. *Vein endings* 16-18-20 per sq mm. *Palisade ratio* 3-4-6.

***Carissa carandas* Linn.**

Macro-characters: Leaves opposite, simple, shortly petiolate; petioles upto 0.3 cm long, glabrous; lamina elliptic to elliptic-oblong, obtuse or retuse, mucronulate or mucicous, base rounded or subcordate or rarely cuneate, 2.5-9.3 cm $\times$ 2.0-5.5 cm, entire, thinly coriaceous, upper surface shining dark green, glabrous, midrib impressed and laterals and tertiaries raised when dry, lower surface green, punctulate, midrib prominently raised, main lateral nerves 8-26, looping, nervation conspicuous.

Micro-characters: Epidermal cells slightly sinuate or almost straight walled. *Stomata* restricted to lower surface only, $16.7-19.7-21.7 \times 13.3-16.3-18.3 \mu$, rubiaceous, rarely ranunculaceous, stomatal index 9-12.5-15. *Trichomes* absent. *Vein islets* 9-9.2-10.5

per sq mm. *Vein endings* 13-14.5-17 per sq mm. *Palisade ratio* 5-5.8-8.

***Cerbera manghas* Linn.**

Macro-characters: Leaves alternate, simple, petiolate; petioles stout, 0.8-3.7 cm long, glabrous; lamina lanceolate, oblanceolate, oblong-elliptic or oblong-obovate, abruptly narrowed at the apex, shortly caudate, acute or acuminate, base cuneate, faintly decurrent, 7.0-25.0 cm $\times$ 2.5-6.2 cm, entire, undulate, thinly coriaceous, black when dry, upper surface shining bright green, glabrous, lower surface paler, glabrous, midrib prominently raised, main lateral nerves 15-40, nearly horizontal, arching near the margin, joining an intramarginal one, nervation conspicuous.

Micro-characters: Epidermal cells sinuous walled, upper striated. *Stomata* confined to lower surface only, $25.0-27.3-33.3 \times 16.7-17.7-20.0 \mu$, ranunculaceous and rubiaceous, the former more common, stomatal index 8-9.6-12. *Trichomes* absent. *Vein islets* 1-1.5-3 per sq mm. *Vein endings* 13-16-18 per sq mm. *Palisade ratio* 4-6-9.

***Ervatamia coronaria* Stapf (Cultivar 1—single flower form)**

Macro-characters: Leaves opposite, mostly unequal in each pair, simple, subsessile or petiolate; petioles upto 1.3 cm long, glabrous; lamina narrowly elliptic, elliptic-oblong, oblanceolate or broadly so, oblong-oblanceolate or rarely obovate, abruptly narrowed at the apex, shortly caudate, obtuse or somewhat acute, base cuneate, decurrent, 2.5-17.0 cm $\times$ 1.4-7.7 cm, entire, undulate, chartaceo-coriaceous, green when dry, upper surface glossy dark green, glabrous, lower surface pale green, glabrous, midrib prominently raised, main lateral nerves also raised, 12-24, nearly parallel, arching near the margin to run almost parallel with it, nervation inconspicuous.

Micro-characters: Epidermal cells usually pentagonal or hexagonal, straight walled. *Stomata* on lower surface $30.0-31.7-33.3 \times 20.0-20.7-21.7 \mu$, on upper surface rare, $30.1-31.7-33.4 \times 23.0-23.4-27.1 \mu$, rubiaceous, stomatal index (lower surface) 11-11.3-12. *Trichomes* absent. *Vein islets* 12-14.5-16 per sq mm. *Vein endings* 10-12-16 per sq mm. *Palisade ratio* 5-8-9.

***E. coronaria* Stapf (Cultivar 2—double flower form)**

Macro-characters: Leaves opposite, simple, petiolate; petioles 0.5-2.0 cm long, glabrous; lamina elliptic to oblanceolate-elliptic, abruptly narrowed

at the apex, shortly caudate, obtuse or acute, base cuneate, decurrent, 6.0-22.5 cm $\times$ 3.0-9.3 cm, entire, undulate, chartaceo-coriaceous, upper surface shining dark green, glabrous, lower surface pale green, glabrous, midrib prominently raised, main lateral nerves also raised, 12-20, nearly parallel, arching near the margin to run almost parallel with it, nervation inconspicuous.

Micro-characters: *Epidermal cells* lower slightly sinuate, upper straight walled and usually penta- or hexagonal. *Stomata* on lower surface 33.3-37.3-40.0 $\times$ 20.0-23.3-26.7 μ , upper surface rare, 33.3-37.7-40.0 $\times$ 23.3-25.7-28.3 μ , rubiaceous, stomatal index 9-10.3-12. *Trichomes* absent. *Vein islets* 4-4.5-5.5 per sq mm. *Vein endings* 10-11-13 per sq mm. *Palisade ratio* 4-5-6-8.

Mascarenhasia variegata Britt. & Renole (*M. elastica* K. Schum.)

Macro-characters: Leaves opposite, simple, petiolate; petioles 0.3-0.8 cm long, nearly glabrous or sparsely minutely puberulus; lamina oblong-elliptic or oblanceolate-elliptic, abruptly narrowed at the apex, shortly caudate, obtuse, base cuneate, 5.5-14.5 cm $\times$ 1.6-6.5 cm, entire, thinly coriaceous, upper surface pale green, glabrous, lower surface paler, glabrous, midrib prominently raised, main lateral nerves 20-26, nearly parallel, arching near the margin, nervation conspicuous.

Micro-characters: *Epidermal cells* slightly sinuate. *Stomata* restricted to lower surface only, 20.0-23.0-23.4 $\times$ 16.7-19.0-20.0 μ , rubiaceous, striations radiating from stomata present, stomatal index 12-16.7-21. *Trichomes* absent. *Vein islets* 4-6-7 per sq mm. *Vein endings* 11-12-13 per sq mm. *Palisade ratio* 1-2-3.

Thevetia peruviana (Pers.) Schum.

Macro-characters: Leaves alternate, becoming crowded towards the end of branches, simple, subsessile or shortly petiolate; petioles up to 0.3 cm long, glabrous; lamina linear or oblanceolate-linear, gradually narrowed towards the apex, obtuse or somewhat acute, base cuneate, 6.5-19.5 cm $\times$ 0.5-1.8 cm, entire, coriaceous, upper surface shining dark green, glabrous, lower surface pale green, glabrous, midrib prominently raised, nervation inconspicuous.

Micro-characters: *Epidermal cells* sinuous walled. *Stomata* restricted to lower surface only, 21.7-25.7-28.3 $\times$ 16.7-17.0-18.3 μ , rubiaceous and ranunculaceous, shrivelled stomata common, stomatal index

9-10.6-12. *Trichomes* absent. *Vein islets* 8-9-9.3 per sq mm, laterally elongated. *Vein endings* 6-7-8 per sq mm. *Palisade ratio* 6-8-10.

Wrightia coccinea Sims.

Macro-characters: Leaves opposite, simple, petiolate; petioles minute to 0.5 cm long, pubescent; lamina elliptic, elliptic-lanceolate or oblong-elliptic, caudate, obtuse, base cuneate, 7.5-17.0 cm $\times$ 5.0-7.0 cm, entire, chartaceous, dark brown when dry, upper surface minutely puberulus, more densely hairy along the midrib, lower surface pubescent on the veins, densely so on the midrib and lateral nerves, nerves raised, main lateral nerves 12-30, nervation conspicuous.

Micro-characters: *Epidermal cells* slightly sinuate, upper striated. *Stomata* restricted to lower surface only, 21.7-24.0-26.7 $\times$ 16.7-17.0-20.0 μ , rubiaceous, stomatal index 20-21.6-23. *Trichomes* simple, unicellular, nonglandular, unbranched. *Vein islets* 13-13.3-20 per sq mm. *Vein endings* 40-45.3-52 per sq mm. *Palisade ratio* 6-9-10.

DISCUSSION

The important data regarding the present study have been summarized in the Table.

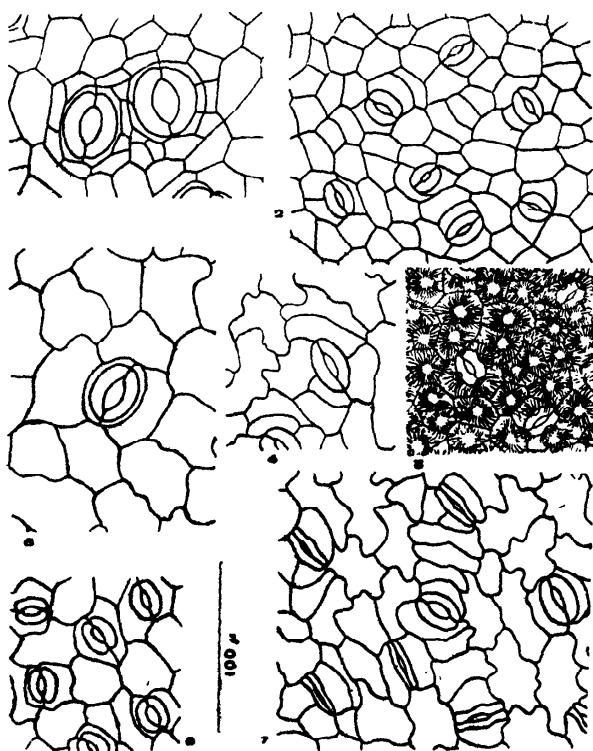
During the present investigation it has been marked that the epidermal cells when straight walled are generally penta- or hexagonal, a feature which was noted also in case of the species included in previous communication (Chandra *et al. loc. cit.*).

In the upper surface the epidermal cells are straight walled in *Acokanthera oppositifolia*, *Allamanda cathartica* (cultivars 1 & 2), *Alstonia scholaris* and *Ervatamia coronaria* (cultivars 1 & 2); slightly sinuous walled in *Carissa carandas*, *Mascarenhasia variegata* and *Wrightia coccinea*; and distinctly sinuous walled in *Cerbera manghas* and *Thevetia peruviana*.

In the lower surface the epidermal cells are straight walled in *Acokanthera oppositifolia*, *Alstonia scholaris* and *Ervatamia coronaria* cultivar 1; slightly sinuous or almost straight walled in *Allamanda cathartica* (cultivars 1 & 2), *Carissa carandas*, *Ervatamia coronaria* cultivar 2 (fig. 5), *Mascarenhasia variegata* (fig. 6) and *Wrightia coccinea*; and distinctly sinuous walled in *Cerbera manghas* (fig. 4) and *Thevetia peruviana* (fig. 7).

The stomata are as a rule restricted to the lower surface, the only exception being *Ervatamia coronaria* (cultivars 1 & 2) in which they may occur on the upper surface as well, though very sparsely

scattered. The stomata are generally rubiaceous but in *Alstonia scholaris* (fig. 2), *Thevetia peruviana*, and also rarely in *Allamanda cathartica* (cultivar 1) and *Carissa carandas* the ranunculaceous stomata



Figs. 1-7. Foliar epidermis (lower surface): 1. *Acokanthera oppositifolia*. 2 & 3. *Alstonia scholaris* (striations not shown in fig. 2). 4. *Cerbera manghas*. 5. *Ervatamia coronaria*—cultivar 2. 6. *Mascarenhasia variegata*. 7. *Thevetia peruviana*.

have also been observed intermingled with normal type. In *Cerbera manghas* (fig. 4), however, the ranunculaceous stomata are more common. In *Acokanthera oppositifolia* (fig. 1) cyclocytic stomata are quite frequent. A remarkable feature of *Thevetia peruviana*, noted here, is common occurrence of shrivelled stomata (fig. 7) on lower surface. Range of variation in stomatal index is quite considerable in *Acokanthera oppositifolia*, *Allamanda cathartica* and *Mascarenhasia variegata* while *Thevetia peruviana*, *Ervatamia coronaria*, *Wrightia coccinea* and *Cerbera manghas* show a little variation only.

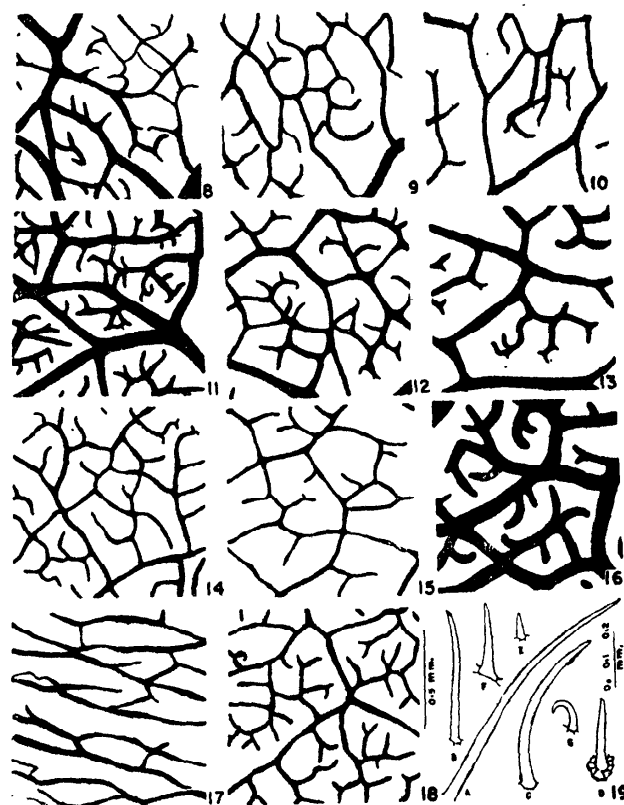
The venation pattern of all the species has been illustrated (figs. 8-18), as it sometimes greatly helps in identification. The laterally elongated vein islets, the characteristic feature of *Thevetia peruviana*, have not been seen in any other species of Apocynaceae so far studied by us. In *Cerbera*

manghas the vein islets are distinctly large, while in *Ervatamia coronaria* cultivar 1 and *Wrightia coccinea* the vein islets are very small in size. Similarly the number of vein endings per unit area is noticeably large in *Wrightia coccinea*.

The trichomes are absent in all the species but *Allamanda cathartica* (cultivars 1 & 2) and *Wrightia coccinea*. The trichomes are simple, unicellular, nonglandular and unbranched (figs. 19 A-G).

Cuticular striations are mostly present in the species studied here. Particular mention may be made of *Alstonia scholaris* where the lower surface is highly striated (fig. 3) obscuring epidermal cells and stomata. The striations are in general either radiating or/and parallel to stomata to form irregular pattern.

The three species of *Wrightia* so far studied by us do not show from species to species any remark-



Figs. 8-18. Venation pattern: 8. *Acokanthera oppositifolia*. 9. *Allamanda cathartica*—cultivar 1. 10. *A. cathartica*—cultivar 2. 11. *Alstonia scholaris*. 12. *Carissa carandas*. 13. *Cerbera manghas*. 14. *Ervatamia coronaria*—cultivar 1. 15. *E. coronaria*—cultivar 2. 16. *Mascarenhasia variegata*. 17. *Thevetia peruviana*. 18. *Wrightia coccinea*. Figs. 19(A-G). Trichomes: A. *Allamanda cathartica*—cultivar 1 (upper surface). B & C. *A. cathartica*—cultivar 1 (lower surface). D & E. *Wrightia coccinea* (upper surface). F & G. *W. coccinea* (lower surface).

TABLE
Cuticular structures and Venation pattern of some Apocynaceae plants

Sl. No.	Name of species	Type*	Stomata				Epidermal cell-wall		Venation		Palisade ratio (average)
			Stomatal Index		Average size in (μ)		Lower	Upper	Vein is-lets/sq mm (average)	Vein end-ing/sq mm (average)	
			Lower	Upper	Lower	Upper					
1.	<i>Acokanthera oppositifolia</i> (Lam.) Codd	Ru Cy	3-5.2-8	—	35.3×31.3	—	Straight (wall thick)	Straight	9	12.5	7.1
2.	<i>Allamanda cathartica</i> Linn. (cultivar 1)	Ru Ra (rare)	18-23.4-30	—	26.0×17.3	—	Almost straight or slightly sinuous	Straight	6.5	9.5	4.5
3.	<i>A. cathartica</i> Linn. (cultivar 2)	Ru	14-20-25	—	27.7×16.7	—	Almost straight	Straight	4.9	8.0	9.5
4.	<i>Alstonia scholaris</i> R.Br.	Ru Ra	5-7.5-12	—	21.0×13.4	—	Straight	Straight	4	18	4
5.	<i>Carissa carandas</i> Linn.	Ru Ra (rare)	9-12.5-15	—	19.7×16.3	—	Slightly sinuous or almost straight	Slightly sinuous or almost straight	9.2	14.5	5.8
6.	<i>Cerbera manghas</i> Linn.	Ra Ru	8-9.6-12	—	27.3×17.7	—	Sinuous	Sinuous	1.5	16	6
7.	<i>Ervatamia coronaria</i> Stapf (cultivar 1-single flower form)	Ru	11-11.3-12	Rare	31.7×20.7	31.7×23.4	Straight	Straight	14.5	12	8
8.	<i>E. coronaria</i> Stapf (cultivar 2-double flower form)	Ru	9-10.3-12	Rare	37.3×23.3	37.7×25.7	Slightly sinuous	Straight	4.5	11	5.6
9.	<i>Mascarenhasia variegata</i> Britt. & Renole	Ru	12-16.7-21	—	23.0×19.0	—	Slightly sinuous	Slightly sinuous	6	12	2
10.	<i>Thevetia peruviana</i> (Pers.) Schum.	Ru Ra	9-10.6-12	—	25.7×17.0	—	Sinuotus	Sinuous	9	7	8
11.	<i>Wrightia coccinea</i> Sims.	Ru	20-21.6-23	—	24.0×17.0	—	Slightly sinuous	Slightly sinuous	13.3	45.3	9

*Ru = Rubiaceae, Ra = Ranunculaceae, Cy = Cyclocytic

able variation in stomatal index or size of normal stomata on the lower surface but the number of vein endings per unit area can be used to distinguish them. The two species of *Alstonia* studied here while do not show any remarkable variation in the stomatal size and number of vein endings per unit area but do show enough variation, to distinguish them, in stomatal index and number of vein islets per unit area.

The study of the cultivars of *Allamanda cathartica* and *Ervatamia coronaria* bring out some interesting features. In *Allamanda cathartica* the cultivar 1 and cultivar 2 vary little in the stomatal size, and the minimum of stomatal index of cultivar 1 is considerably overlapped by the maximum of that of cultivar 2, the number of vein islets and that of vein endings per unit area on the other hand

exhibit little overlapping. In *Ervatamia coronaria* the stomata in cultivar 2 (double flower form) are longer than those of cultivar 1 (single flower form) and the number of vein islets per unit area show considerable distinction; stomatal index and number of vein endings per unit area are nearly similar.

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REFERENCE

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