

Studies on intraspecific variation in south Indian ferns III. Cytomorphology of *Stegnogramma pozoi* (LAG.) K. IWATS.

V. IRUDAYARAJ, V. S. MANICKAM & S. DOMINIC RAJKUMAR

Botany Research Centre, St. Xavier's College, Palayamkottai - 627 002, Tamilnadu - India;
fax: +91-462-72845.

IRUDAYARAJ V., MANICKAM V. S. & DOMINIC RAJKUMAR S. (1996): Studies on intraspecific variation in south Indian ferns III. Cytomorphology of *Stegnogramma pozoi* (LAG.) K. IWATS. – Thaiszia - J. Bot., Košice, 5: 111-119. – ISSN 1210-0420.

Abstract: *Stegnogramma pozoi* (LAG.) K. IWATS. from the Nilgiris, (from where *Gymnogramma totta* var. *mollissima* KUNZE had been described) is tetraploid ($n=72$), which corresponds to the report from Madeira. Morphological analysis of 27 gatherings of *S. pozoi* (LAG.) K. IWATS. from south India showed that they are variable in many characters. The south Indian plants, including those from the Nilgiris, do not match any intraspecific taxon of previous reports due to the presence of continuous variation among individuals. It is suggested that an intraspecific division within this species is of no practical value.

Keywords: *Stegnogramma*, cytomorphology, south India.

Introduction

The genus *Stegnogramma* s.l. includes 12 species (IWATSUKI 1963). These species are differently treated under different taxa by different authors, viz. as four distinct genera (*Stegnogramma*, *Haplogramma*, *Leptogramma* and *Dictyocline*) (PICHISERMOLLI 1977, CHING 1963) or subgenera (CHRISTENSEN 1913) or sections (IWATSUKI 1963). COPELAND (1947) united *Leptogramma* with *Lastrea*, considering *Stegnogramma* to be a distinct genus of a relative of *Cyclosorus*. The intraspecific taxa are also treated in the same way i.e. as subspecies, varieties or forma.

The taxonomy of *Stegnogramma pozoi* (LAG.) K. IWATS. and the related species *S. himalaica* (CHING) K. IWATS. in India is still obscure, due to many problems, of which

two are: 1. Generally they are very rare in occurrence except Palni Hills, Nilgiris (south India) and Assam (north east India) (BEDDOME 1883, KHULLAR et al. 1983, MANICKAM & IRUDAYARAJ 1992). 2. The type specimen of *Gymnogramma totta* var. *mollissima* Kunze (1851) has been lost (FRASER-JENKINS 1984). Both IWATSUKI (1963) and SLEDGE (1981) could not examine the type specimen of the var. *mollissima* of KUNZE, even after making efforts to search for it at Berlin.

IWATSUKI (1963) treated Kunze's var. *mollissima* as a subspecies of *S. pozoi* by distinguishing it from *S. pozoi* var. *pozoi* by the presence of unreduced basal pinnae and of pinnae with mostly short hairs, the long hairs being rare. SLEDGE (1981) treated both *Leptogramma petiolata* CHING and Kunze's var. *mollissima* as two varieties of *S. pozoi* doubtfully. The variety *petiolata* (CHING) SLEDGE is characterised by the presence of many (up to 9 pairs) of basal free pinnae; the pinnae are smaller in size (3-4 cm), proportionately broader and more abruptly narrowed into a blunt or sub-acute apex. The cytological reports show that the Indian and Madeira plants are tetraploids (KHULLAR et al. 1983, MANTON et al. 1986, MANICKAM & IRUDAYARAJ 1988, IRUDAYARAJ & MANICKAM 1987) and the plants from Sri Lanka are diploid (MANTON & SLEDGE 1954).

Thus *Stegnogramma pozoi* (LAG.) K. IWATS. in general is a species complex, consisting of two cytotypes and at least three morphotypes. The present attempt aims mainly at studying the intraspecific variation among south Indian plants, the cytology of the var. *mollissima* from its type locality, the Nilgiris, south India and testing the validity of its taxonomic rank. The taxonomy of *S. himalaica* (CHING) K. IWATS., a related species, is also discussed on the basis of the observation of the type specimen and a few other specimens.

Material and methods

The present study is mainly based on herbarium specimens collected from south India by MANICKAM and IRUDAYARAJ during 1984-1994. For cytological analysis the young sporophylls were fixed in a mixture of alcohol, chloroform and acetic acid in 6:3:1 ratio and the usual acetocarmine squash technique was followed. Morphological analyses were done using stereo microscope. All the vouchers are in St. Xavier's college herbarium (XCH), Palayamkottai. Duplicate specimens of RHT are also present in RHT (Rapinat Herbarium Tiruchirapalli). For spore morphology spores were mounted in glycerine and observed under a compound, research microscope. Thirty measurements were taken for each sample.

Specimens examined:

Palni Hills (S. India): Shembaganur, Silver cascade, 1800 m, MANICKAM, Feb. 7, 1985 (RHT 31913); Gundar shola, 2100 m, MANICKAM, May 2, 1985 (RHT 32581); Dec. 7, 1985 (RHT 34903); Bear shola west, 2100 m, MANICKAM, May 4, 1985 (RHT 32668); Berijam road, 2200 m, MANICKAM, May 8, 1985 (RHT 32773); Berijam road shola opposite to thoppi thukki parai, 2160 m, MANICKAM, May 11, 1985 (RHT 32823); Berijam shola, 2050 m, MANICKAM, May 11, 1985 (RHT 32837); Pambar, 2000 m, MANICKAM, Dec. 5, 1985 (RHT 34845); Shola between tower and Berijam lake, 2300 m, MANICKAM, Dec. 6, 1985 (RHT 34871); Pulavachiaru, 2050 m, MANICKAM, Jan. 8, 1987 (RHT 35027); Kodaikanal-Munnar road, 2400 m, MANICKAM, Jan. 9, 1987 (RHT 35035).

The Nilgiris (S. India): Forest bungalow, 2200 m, MANICKAM, Dec. 25, 1991 (XCH 456); Valley after Belvue, Terrace estate, 2200 m, MANICKAM, Oct. 26, 1991 (XCH 495, 523); Stream on the way to Governor shola, 2200 m, MANICKAM, Nov. 19, 1991 (XCH 716); Avalanche road, 2200 m, MANICKAM, Nov. 20, 1991 (XCH 728); Muthorai, 2100 m, MANICKAM, Nov. 20, 1991 (XCH 743); Ooty - Kothagiri road, 2000 m, MANICKAM, Nov. 21, 1991 (XCH 778); Avalanche forest, 2100 m, MANICKAM, Dec. 6, 1991 (XCH 837); Dec. 7, 1991 (XCH 865, 891); Rolliah Dam, 1800 m, MANICKAM, Jan. 26, 1992 (XCH 1359); Kothagiri, Longwood shola, 1700 m, MANICKAM, Feb. 11, 1992 (XCH 1395); Kothagiri, Honnet shola, 1800 m, MANICKAM, Feb. 13, 1992 (XCH 1451).

Anamalais (S. India): Valparai, 1850 m, MANICKAM, Feb. 6, 1986 (RHT 34445); Vaguvarai-Eravikulam path, 2000 m, MANICKAM, March 6, 1986 (RHT 34479).

Munnar Hills (S. India): Silent valley, 1600 m, MANICKAM, Feb. 28, 1985 (RHT 32291).

Western Himalayas: Shimla, J. BLISS, Sept. 1886 (NY 1635); Chamba estate, Ravi Valley, MC DONELL (NY 1636); Garhwal Himalaya, S. S. BIR, Aug. 1994 (XCH 3527).

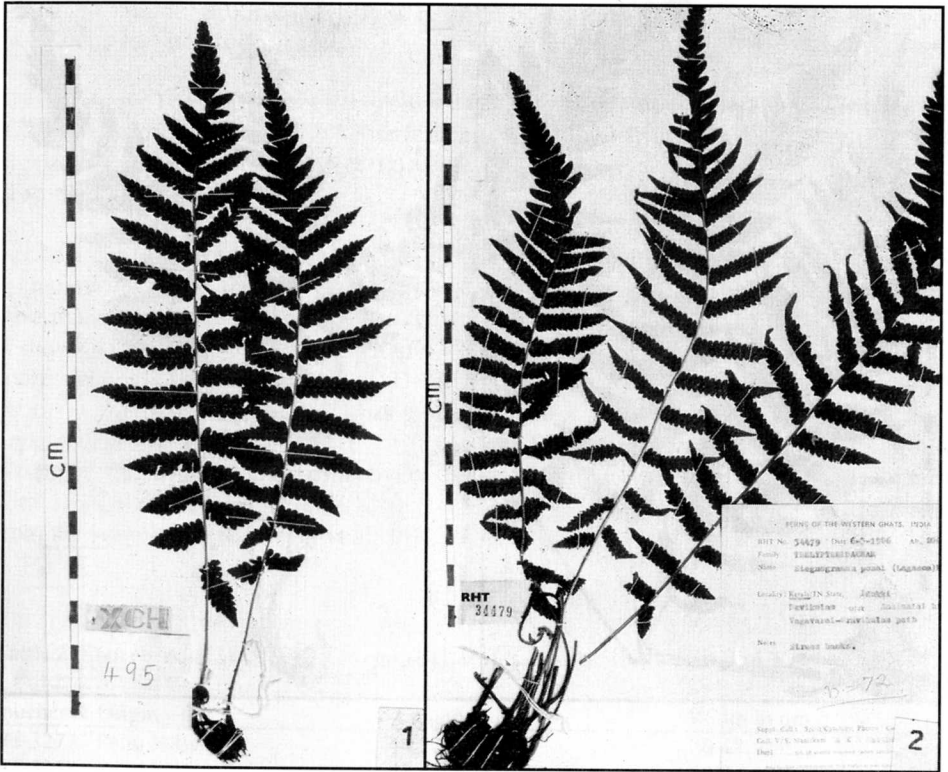


Fig. 1. *Stegnogramma pozoi*. Specimen showing the elliptic lamina with four pairs of reduced basal pinnae.

Fig. 2. *S. pozoi*. The cytologically verified tetraploid (n=72) plant (RHT 34479).

Table 1. Cytology of *Stegnogramma pozoi* (LAG.) K. IWATS.

Geographical region	Chromosome number ('n')	Reference
South India:		
Shevaroy Hills	72	GHATAK 1977
Palni Hills	72	MANICKAM & IRUDAYARAJ 1988, 1989.
Anamalais	72	MANICKAM & IRUDAYARAJ 1988, 1989.
Nilgiris	72	Present study
Western Himalayas	72	KHULLAR et al. 1983
Sri Lanka	36	MANTON & SLEDGE 1954
Madeira	72	MANTON et al. 1986.

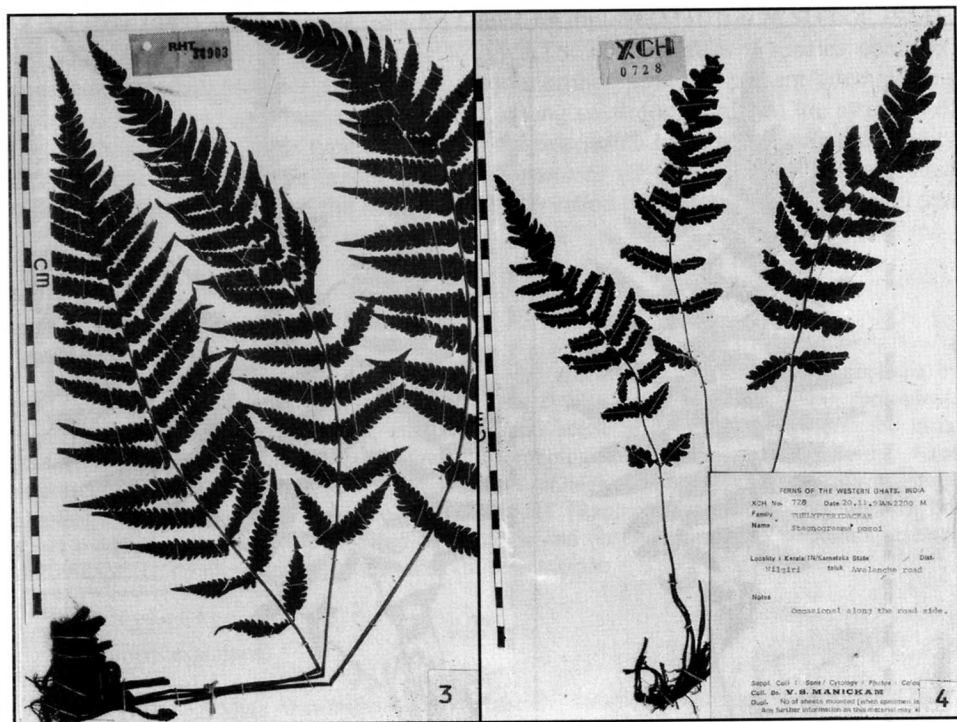


Fig. 3. *Stegnogramma pozoi*. A Palni Hills plant with very slightly reduced basal pinnae (RHT 34903).

Fig. 4. *S. pozoi*. A Nilgiri's plant (XCH 728) showing short, acute and shallowly lobed pinnae.

Results

Distribution And Ecology: *Stegnogramma pozoi* is common on Palni Hills and Nilgiris in south India, Assam in eastern India, but rare on Anamalais (south India) and the w. Himalayas. In south India it is usually found as terrestrial fern on fully or partially exposed wet or marshy places along roadsides or stream banks between 1,600 m and 2,500 m.

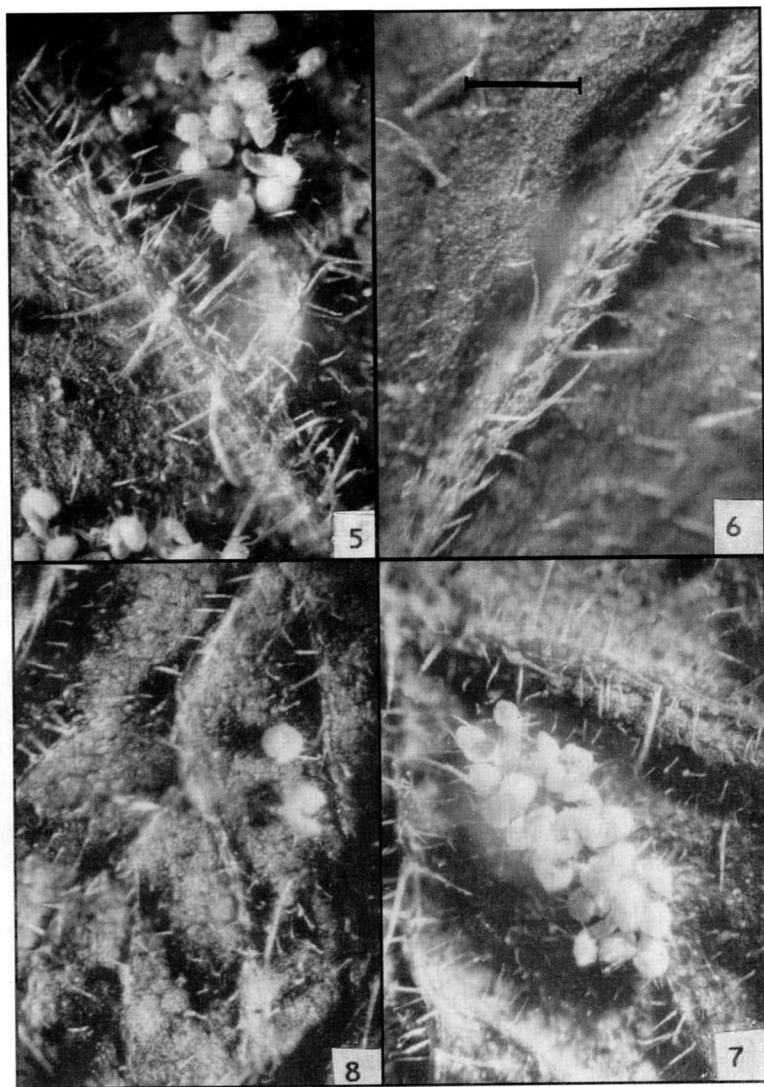
Morphology: The general description of *Stegnogramma pozoi* from south India has been provided by MANICKAM & IRUDAYARAJ (1992) based on the specimens from western Ghats, south of Palghat gap. The present study reveals the size of the plant and parts of the frond to be highly variable. The number of basal reduced pinnae varies from 0-4 pairs (Figs. 1-4). The depth of lobing of pinnae is 1/3 - 1/2 way to the costa. Venation is free in all the specimens examined in the present study. Regarding pubescences (Figs. 5-12), long appressed hairs are dense on costa above, sparse below. Short hairs are sparse on lower intervenal areas, rare on upper intervenal areas. Five to ten pairs of pinnae are free but they are sessile or subsessile. Rarely 1-2 pairs of pinnae are with up to 1 mm long petiole.

Cytology: The cytological study on two different populations from the Nilgiris shows the presence of 72 bivalents in spore mother cells (Fig. 14). It is in conformity with the previous report by MANICKAM & IRUDAYARAJ (1988) (Fig. 13) from the Palni Hills. (Tab. 1).

In order to detect the presence of a diploids among south Indian populations, simply by measuring spore size, all the specimens with healthy, mature spores were analysed (five plants). The size of the spores of these five gatherings has been tabulated in Tab. 2. It shows 43.66-49.35 × 28.22-31.75 µm. There is no major difference in the size of the spores among these five gatherings. The Palni hills plants are tetraploid (MANICKAM & IRUDAYARAJ 1988). DEVI (1977) has given 24 × 40 × 28 µm and 28 × 44 × 32 µm for *Leptogramma mollissima* (KUNZE) CHING and *Stegnogramma aspidioides* BL. from Assam (E. India) and Japan respectively. Spores from the western Himalayan plants are with 36.2-39.6 × 21.6-25.2 µm (KHULLAR et al. 1983) which is significantly different from the tetraploids (KHULLAR et al. 1983).

Table 2. Spore size of *Stegnogramma pozoi* (LAG.) K. IWATS. from south India

Voucher & Origin	Length in µm	Width in µm
RHT 32773 Palni Hills	44.22 ± 3.14	30.48 ± 2.6
RHT 32581 Palni Hills	43.66 ± 5.2	29.74 ± 5.6
RHT 32668 Palni Hills	43.72 ± 4.27	28.22 ± 3.56
RHT 34845 Palni Hills	46.80 ± 4.53	31.32 ± 3.5
RHT 34903 Palni Hills	49.35 ± 3.5	31.75 ± 3.5



Figs. 5. & 7. *Stegnogramma pozoi* (XCH 865). Lower surface of a pinna lobe showing dense, long, patent hairs on the costa (Fig. 5) and costules (Fig. 7).

Figs. 6 & 8. *S. pozoi* (XCH 865). Upper surface of a pinna lobe showing dense long appressed hairs on the costa (Fig. 6) and short sparse hairs on the costule and intervenal spaces (Fig. 8). (Scale represents 1 mm).

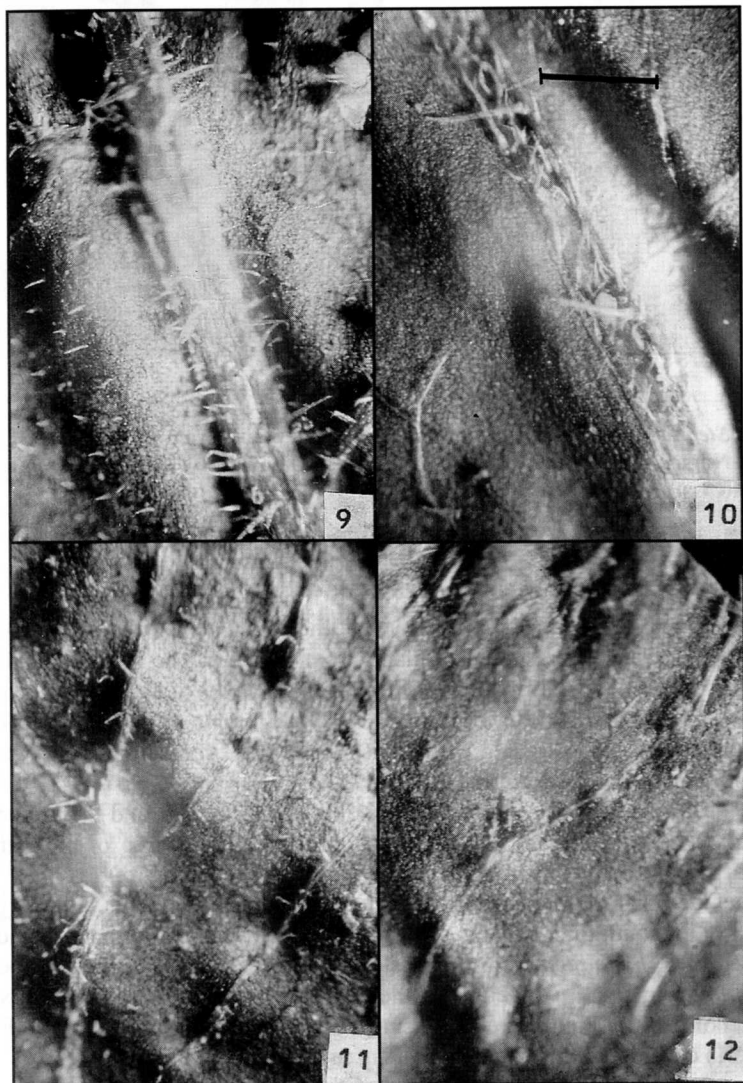


Fig. 9 & 11. *Stegnogramma pozoi* (XCH 523). Lower surface of a pinna lobe showing sparse, short, stiff, patent hairs on the costa and interveinal areas (Fig. 9) and rare, short hairs on costules and interveinal areas (Fig. 11).

Fig. 10 & 12. *S. pozoi* (XCH 523). Upper surface of a pinnae lobe showing long, sparse, appressed hairs on costa (Fig. 10) and short, rare hairs on costule (Fig. 12). (Scale represents 1 mm.)

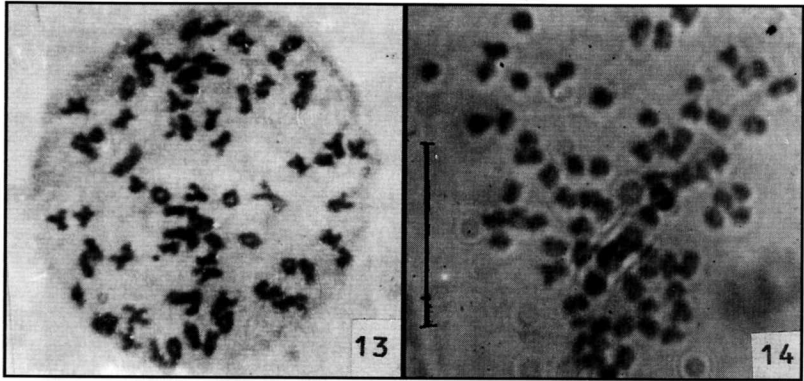


Fig. 13 & 14. *Stegnogramma pozoi*. Spore mother cells of plants from Anamalai (RHT 34479) (Fig. 13) and Nilgiris (IRUDAYARAJ 1992, PUN) (Fig. 14) showing 72 bivalent chromosomes in each cell. Scale represents 10 μ m.

Discussion

From the present observations, it is clear that the south Indian plants of *S. pozoi* are tetraploids ($n=72$), which corresponds to plants from Madeira. The majority of the south Indian plants (4x) resemble closely but not fully the plants (4x) of Madeira. Morphotypes corresponding to both the subsp. *pozoi* and subsp. *mollissima* of IWATSUKI (1963) are represented by several south Indian gatherings. There are even some plants with short petiole resembling the var. *petiolata* of Sri Lanka.

SLEDGE (1981) doubtfully assigned the plants of Sri Lanka and south India into varietal level. SLEDGE and HOLTUM (pers. comm.) identified three of our gatherings (RHT 31350, 32668, 32837) without giving any intraspecific rank.

It is concluded that the intraspecific treatment of *S. pozoi* is of no value in general, and particularly for south Indian plants. The observation of three specimens including the type specimen of *S. himalaica* from the western Himalayas shows that these specimens are distinct in having small pinnae and in the presence of dense short, soft hairs on the lower surface of pinnae. Pinnae are also acute as in the case of var. *petiolata*. FRASER-JENKINS (1991) considered this taxon equivalent to *S. pozoi*.

Acknowledgements

We are grateful to Rev. P. J. UBELMESSER, s. j., Germany, Rev. HUBERT HANGGI, Zürich and Jesuit Provincial of Paris, France, for financial assistance to carry out the present project on the ferns of the western Ghats of south India. We are thankful to the late Professors R. E. HOLTUM and W. A. SLEDGE for identification of some specimens in the present study. We also thank Professor S. S. BIR, Punjabi University, Patiala for allowing us to study two specimens on loan from New York Herbarium (NY).

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Received: 2 March 1995

Revised: 23 June 1995

Accepted: 26 June 1995