

ON The Phytogeography of the Tribe *Isachneae* (*Poaceae*)

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The tribe *Isachneae* is apparently a natural assemblage of 5 genera namely, *Isachne*, *Coelachne*, *Limnopo*a, *Sphaerocaryum* and *Heteranthoecia*. The latter 3 genera are monotypic; *Limnopo*a is endemic to South India, *Sphaerocaryum* is distributed in Southeast Asia and *Heteranthoecia* is confined to tropical Africa. The genus *Coelachne* comprising ca 10 species, extends from tropical East Africa eastward to Japan and northern parts of Australia. *Isachne* is the largest genus of the tribe comprising 110 species and extending to tropical and subtropical regions of both hemispheres. The geographical range of the above genera and distribution patterns of species are discussed in detail. The study reveals that (i) the tribe is concentrated in the tropical and subtropical regions of the world (ii) concentration is lower in the western hemisphere than in the eastern hemisphere (iii) centre of diversification is Southeast Asia and (iv) region of maximum abundance is Indo-Malaysia which is a positive indication that the tribe might have originated in this region.

Originally the tribe *Isachneae* was established by Bentham (1881) with 7 genera; *Prionachne* Nees, *Isachne* R. Br., *Zenkeria* Trin., *Micraira* F. V Muell., *Coelachne* R. Br., *Airopsis* Desv. and *Eriachne* R. Br. Hubbard (1943) modified the circumscription of the tribe *Isachneae* and included 5 genera: *Isachne* R. Br., *Coelachne* R. Br., *Limnopo*a Hubb., *Sphaerocaryum* Nees ex Hook. f. and *Heteranthoecia* Stapf. Subsequent studies on morphology, taxonomy, cytology, anatomy (Potzta, 1952; Tateoka, 1957; Bor, 1960; Metcalfe, 1960; Ved Prakash & Jain, 1984) have revealed that the tribe *Isachneae* (sensu C.E.Hubbard) was apparently a natural assemblage of 5 genera namely, *Isachne*, *Coelachne*, *Limnopo*a, *Sphaerocaryum* and *Heteranthoecia* which show affinity in most characters and constitute a well-defined natural and distinct group. The members of the tribe are mostly hygrophilous or occur in forests and their margins in the tropics and subtropics, from sea level to ca 3000 m altitude.

Morphologically the tribe *Isachneae* differs from all other tribes of *Poaceae* and particularly from its nearest tribe *Paniceae* in structure and articulation of the spikelet. In *Paniceae* the glumes are unequal (lower glume is small to very small compared with the upper glume or sometimes it is even absent) and the spikelets have an articulation below the glumes so that the spikelet falls entire along with glumes at maturity. But, in the tribe *Isachneae* the glumes are almost subequal and the spikelets are articulated above the glumes so that the spikelets break up at maturity above them and between the florets. Although glumes are not persistent in most of the species of *Isachneae*, they often fall separately at maturity leaving scars on the lowest internode of the rachilla.

Distribution Pattern - An outline of the geographical distribution of the genera *Isachne*, *Coelachne*, *Limnopo*a, *Sphaerocaryum* and *Heteranthoecia* is shown in Fig.1 and in Table.1. The last three genera are monotypic.

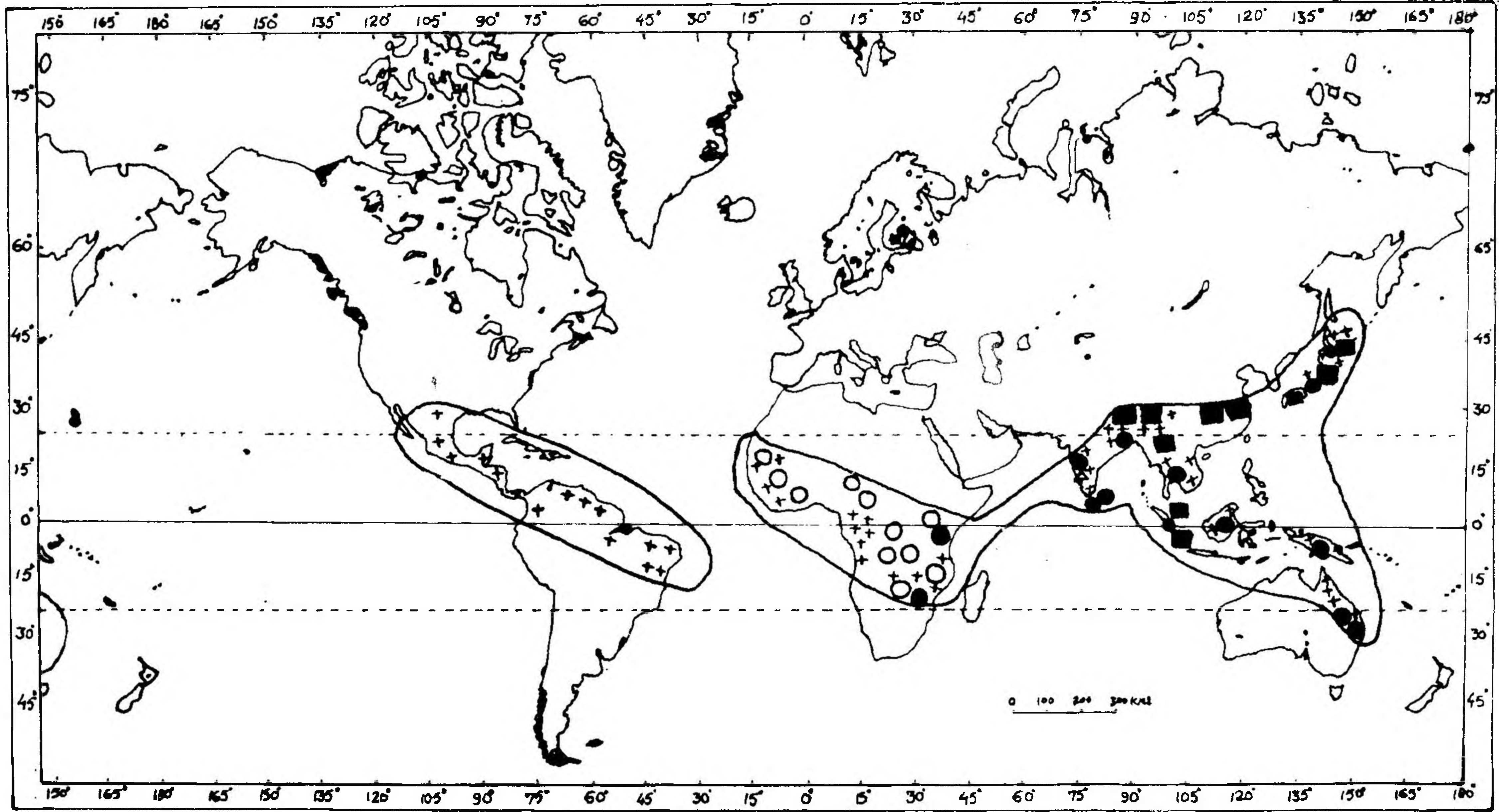


Fig.1. Distribution of *Coelachne* ●, *Isachne* +, *Heteranthoecia* ○, *Limnopoia* △, *Sphaerocaryum* ■

Table 1 Distribution of Genera of tribe *Isachneae*

| Genera | Distribution | Species in world | Species in India |
|-----------------------|---|------------------|------------------|
| <i>Isachne</i> | Tropics & Sub-tropics of both hemispheres | 100-110 | 29 |
| <i>Coelachne</i> | In Old World tropics & Sub-tropics | 10 (+1) | 3 |
| <i>Limnopoa</i> | India (Kerala and Karnataka) | 1 | 1 |
| <i>Sphaerocaryum</i> | Tropical Asia | 1 | 1 |
| <i>Heteranthoecia</i> | Tropical Africa | 1 | |

Table 2 World Distribution of Species of *Coelachne*
Distribution (In old world)

| Species | Africa | Asia | Australia |
|---------------------------------|-------------------|----------|---|
| <i>Coelachne africana</i> | | | . |
| Pilger | +, Rhodesia | (-) | (-) |
| <i>C. friesiorum</i> Hubb. | + | Kenya | (-) |
| <i>C. infirma</i> Buse | (-) | + | Java, Sumatra (-) |
| <i>C. hackleii</i> Merr. | (-) | + | Philippines (-) |
| <i>C. japonica</i> Hack | (-) | + | Japan (endemic)(-) |
| <i>C. minuta</i> Bor | (-) | + | India (endemic) (-) |
| <i>C. paludosa</i> Peter | +, East Africa | Tropical | (-) |
| <i>C. perpusilla</i> Thw. | (-) Sri Lanka | + | India (S.India), (-) |
| <i>C. pulchella</i> R.Br. | (-) | - | +, Queensland |
| <i>C. simpliciuscula</i> Benth. | (-) | + | Widely distributed in South east Asia (-) |
| <i>C. soerensenii</i> Bor | (-) | + | Thailand (endemic) (-) |

+ = present ; - = absent

The type species of *Limnopoa*, *L. meeboldii* (Fischer) Hubb. is endemic to India.

It is a very rare grass and was known to occur only in Ernakulam district of Kerala. Recently, it is reported from Trichur and Cannanore districts of Kerala (Nair *et al.*, 1985) and south Kanara district of Karnataka (Bhatt, 1986). It grows in tanks forming thick mass of tangled stems on the surface of water.

Sphaerocaryum malaccense (Trin.) Pilger is distributed in southeast Asia. In India it occurs only in Assam, Meghalaya and Nagaland.

The genus *Heteranthoecia* is confined to tropical Africa.

The genus *Coelachne* comprising *ca* 10 species, extends from tropical East Africa eastward to Japan and to the northern parts of Australia. No species of *Coelachne* occurs throughout the geographical range of the genus. However *C. simpliciuscula* (Wt. & Arn. ex Steud.) Benth. is distributed widely in Southeast Asia. There are 3 species of *Coelachne* in India. Of these *C. minuta* Bor is endemic to India (Western Ghats). The distribution of *Coelachne* species in the world is shown in Table 2.

Isachne is the largest genus of the tribe Isachneae, comprising *ca* 110 species, and extending to tropical and subtropical regions of both hemispheres. It is well-represented in Africa and Asia. However, the centre of main distribution and diversification is Southeast Asia, particularly Indo-Malaysian region. Only a few species of *Isachne* are wide. None extends throughout the geographical range of the genus.

The genus has not yet received a critical monographic treatment for its entire range. We have recently studied the taxonomy and phytogeography of the Indian taxa, and have made an attempt to provide the geographical distribution of the whole genus, based mainly on literature.

Based on the distributional patterns, the

species of *Isachne* can be divided into 3 main groups:

1. Species of New World - There are *ca* 12 species of *Isachne* in the New World (Hitchcock, 1920; Hitchcock & Chase, 1917; Chase & Niles, 1962). The majority of species are distributed from South Mexico to Brazil through Central America. There is no species of *Isachne* in the temperate regions of the New World. It is remarkable that all the species of the New World are confined to that region.

The following species of *Isachne* are native to the New World: (1) *I. angustifolia* Nash (2) *I. arundinacea* (Swartz) Griseb. (3) *I. brasii* Hitchc. (4) *I. dispersa* (Lam.) Doell. (5) *I. leer-sioides* Griseb. (6) *I. ligulata* Swallen (7) *I. polygonoides* Lam. (8) *I. pubescens* Swallen (9) *I. pygmaea* Griseb. (10) *I. rigens* (Swartz) Trin. (11) *I. rigidifolia* (Pair) Urban and (12) *I. villosa* (Hitchc.) Reeder.

2. Species of Africa - There are *ca* a dozen species of *Isachne* in Africa (Stapf & Hubbard, 1930-1934; Clayton, 1972). Of these, the majority of species occur in the mountains of tropical West Africa especially in the Congo region. *I. biflora* (Lam.) O.Ktze and *I. vaughanii* Boiv. ex A. Camus and *I. longifolia* C. Cardem. are found in the Reunion Islands. About 5 species are reported from Malagasy.

It is remarkable that all the African species are confined to that region. The following species are native to the mainland of Africa: *I. angolensis* Rendle., *I. angusta* Stapf *I. bomoensis* Vand., *I. brixhii* Vand. *I. buettneri* Hack., *I. gossweileri* Stapf & Hubb. *I. guineensis* Stapf & Hubb., *I. kidumaensis* Vand. *I. kingundaensis* Vand., *I. kiyalaensis* (Vand.) Robyns, *I. mauritiana* Kunth., *I. mayocoensis* Vand., *I. mortehani* Vand. *I. nervata* Franch. and *I. scandens* Hubb.

3. Species of Eurasia, Australia and Pacific Islands - There are *ca* 60-70 species of *Isachne* in these regions (Chase & Niles, 1962;

Gilliland, 1971; Honda, 1930; Jansen, 1953; Keng, 1965; Froideville, 1968; Merrill, 1926; Ohwi, 1947; and Vansteenis, 1979). However there is no species of the genus in Europe and the Mediterranean region. An analysis of the species of these regions reveals that distribution patterns-wise, there are again 3 categories.

a) Indo-Australian wide species :- Species belonging to this category occur widely in Southeast Asia and Australia. *I. globosa* (Thunb.) O.Ktze and *I. confusa* Ohwi are the only species of this category. *I. myosotis* Nees is widely distributed in Malaysian region and Australia but not reported from the mainland of Asia.

b) Indo-Malaysian wide species :- Species of this category differ from the first only in that the species concerned do not occur in Australia. There are ca 10-12 species belonging to this category which are widely distributed in Southeast Asia. These are *I. albens* Trin., *I. beneckeii* Hack., *I. dispar* Trin., *I. hirsuta* (Hook.f.) Keng, *I. kinabalunsis* Merr., *I. kunthiana* Wt. & Arn. ex Thw., *I. miliacea* Roth ex Roem. & Schult., *I. pulchella* Roth ex Roem. & Schult. Some species are not wide spread. *I. walkeri* (Arn. ex Steud.) Thw. is known from India and Sri Lanka; *I. himalaica* Hook.f. is known from India and Pakistan; *I. nipponensis* Ohwi is known from China and Japan and *I. debilis* Rendle is known from China and the Phillipines.

c) Endemic species :- A large number of species belong to this category and are confined to one particular country or region. Many species are restricted and occur only within a single floristic region. It is remarkable that 18 species are endemic to India. Of these, 14 are confined to Peninsular India. India, thus takes the first place in number of endemic species of *Isachne*. About 12 species are confined to Malaysian region and 7 to China. Some species are endemic to Sri Lanka, Japan, Thailand, Formosa and the Fiji Islands. A list of species endemic to various countries is given below:

Species endemic to India: - *I. angladei* Fischer, *I. bicolor* Naik, *I. borii* Hemadri, *I. bourneorum* Fischer, *I. clarkei* Hook.f. *I. deccanensis* Bor, *I. dimyloides* Bor, *I. elegans* Fischer, *I. fischeri* Bor, *I. gracilis* Hubb, *I. lisboae* Hook.f., *I. meeboldii* (Fischer) Hubb, *I. mysorensis* Raghavan, *I. oreades* (Domin) Bor, *I. scabrosa* Hook.f., *I. setosa* Fischer, *I. sikimensis* Bor, *I. swaminathaii* Ved Prakash & Jain.

Species endemic to Malaysian regions: - *I. albomarginata* Jansen, *I. arfakensis* Ohwi, *I. clementis* Merr., *I. diabolica* Ohwi, *I. longkawiensis* Jansen, *I. oblecta* Reeder, *I. pangerangensis* Zoll. & Mor., *I. pauciflora* Hack., *I. saxicola* Ridl., *I. surgens* Jansen, *I. sylvestris* Ridl., *I. trachycaula* Ohwi.

Species endemic to China: - *I. ciliatiflora* Keng, *I. hainanensis* Keng, *I. hoi* Keng, *I. repens* Keng, *I. Schmidtii* Hack., *I. tenuis* Keng, *I. truncata* A. Camus.

Species endemic to other countries: - *I. arisanensis* Hayata (Japan); *I. cambodiensis* Ohwi (Cambodia); *I. fauriei* Ohwi (Formosa); *I. multiflora* (Thw.) Ferg. (Sri Lanka); *I. pallens* Hillebr (Hawaiian Islands); *I. petelotii* A. Camus (Laos Indochina); *I. puberula* Bor and *I. smitinandiana* A. Camus (Thailand); *I. subglobosa* Hatusima & Koyama (Japan); *I. vitiensis* Rendle (Fiji Islands).

DISCUSSION The above account of the tribe Isachneae reveals the following conspicuous features in geographical distribution.

(i) **Concentration of the tribe in the tropical and sub-tropical regions of the world:** All the species of *Isachneae* occur only in the tropical and subtropical parts of the world. Hartley (1958) pointed out that the grasses of the panicoid group (Andropogoneae & Paniceae) are mainly distributed in tropical-subtropical habitat and reach their highest development in hot moist climate. The geographical survey of the tribe *Isachneae* also supports the conclusion

Table - 3 Occurrence of the tribe *Isachneae* Benth. in India

| Species | Endemic(E) Wide(W) | Botanical regions of India | | | | | | | |
|---|-----------------------|----------------------------|----------------|----------------|----------------|-----------------|----------------|----------------|----------|
| | | Deccan- bar | Mala- Plain | Indus Plain | Ganga Plain | Assam Himal. | East Himal. | West Himal. | Andamans |
| <i>Isachne</i> R.Br. | | | | | | | | | |
| <i>albans</i> Trin. | W | | | | | + | + | + | |
| <i>angladei</i> Fischer | E | + | | | | | | | |
| <i>bicolor</i> Neak | E | | + | | | | | | |
| <i>borii</i> Hemadri | E | | + | | | | | | |
| <i>bourneorum</i> Fischer | E | | + | | | | | | |
| <i>clarkii</i> Hook.f. | E | | | | | + | + | | |
| <i>confusa</i> Ohwi | W | | | | | | | | + |
| <i>deccanensis</i> Bor | E | + | | | | | | | |
| <i>dimyloides</i> Bor | E | | | | | | + | | |
| <i>elegans</i> Dalz. | E | | + | | | | | | |
| <i>fischeri</i> Bor | E | | + | | | | | | |
| <i>gracilis</i> C.E. Hubb. | E | + | + | | | | | | |
| <i>globosa</i> (Thunb.) O.Ktze | W | | | | + | + | + | + | + |
| <i>himalaica</i> Hook.f. | W | | | | | | + | + | + |
| <i>hirsuta</i> (Hook.f.) Keng | W | | | | | | + | | |
| <i>kinabaluensis</i> Merr. | W | | | | | | + | | |
| <i>kunthiana</i> Wt. & Arnex Thw | W | | + | + | | | | | |
| <i>lisboae</i> Hook.f. | E | | | + | | | | | |
| <i>meeboluii</i> (Fischer) Hubb. | E | | | + | | | | | |
| <i>miliacea</i> Roth ex Roem. & Schult. | W | | | + | | | + | + | + |

Table -3 Contd.....

mysorensis Sundararaghavan

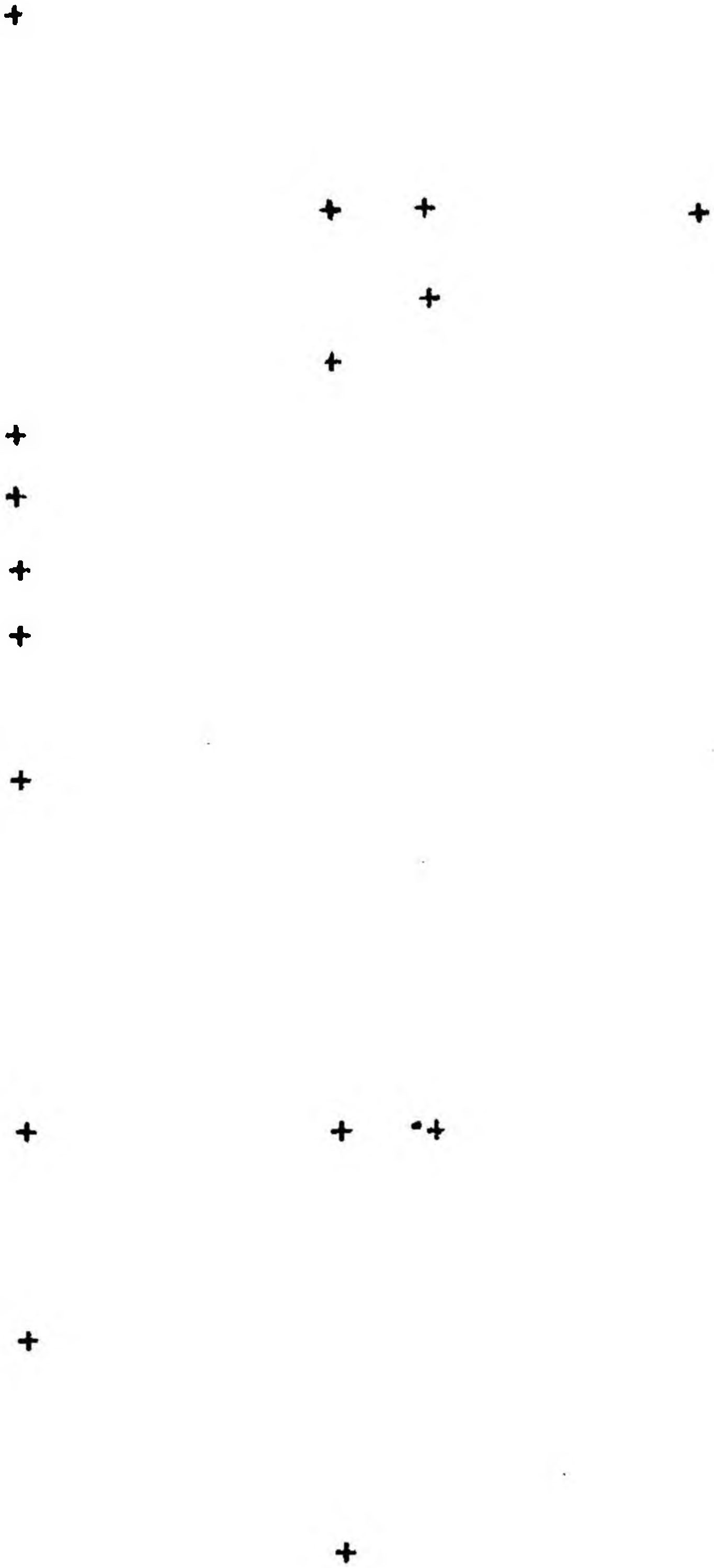
Table -3 Contd.....

| | | |
|--|----------------|---|
| <i>mysorensis</i> Sundararaghavan | E | |
| <i>oreades</i> (Domin) Bor | E | + |
| <i>pulchella</i> Roth ex Roem & Schult. | W | + |
| <i>sikkimensis</i> Bor | E | |
| <i>Scabrosa</i> Hook.f. | E | |
| <i>setosa</i> Fischer | E | + |
| <i>Swaminathanii</i> Ved Prakash & Jain | E | |
| <i>veldkampii</i> Bhatt & Nagend. | | |
| <i>walkeri</i> Wt. & Arn.ex Thw. | W ¹ | + |
| <i>Coelachne</i> R.Br. | W | |
| <i>Minuta</i> Bor | E | |
| <i>perpusilla</i> (Arn.ex Steud.) Thw. | W ¹ | + |
| <i>perpusilla</i> var.nila-girica Ved Prakash-& Jain | E | + |
| <i>simpliciuscula</i> (Wight & Arn.) Munro ex Benth. | W | + |
| <i>Limnopoa</i> C.E.Hubb. | E | |
| <i>meeboldii</i> (Fischer) C.E. Hubb. | E | |
| <i>Sphaerocaryum</i> Nees ex Hook. f. | W | |
| <i>malaccense</i> (Trin.) Pilger | W | |

W¹ = Occur only in India & Sri Lanka

l = Phytogeographical divisions after Maheshwari *et al.*, (1965).

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drawn from morphological, anatomical and cytological evidences that the tribe is panicoid in nature.

(ii) **Concentration lower in the western hemisphere than in the eastern hemisphere :** The tribe *Isachneae* is represented in the Western hemisphere by only one genus out of 5 genera and 10-12 species out of ca 125 species of the genus. This suggests that the tribe *Isachneae* has not reached its full development in this region and that it has spread to the American continent comparatively recently from a centre or centres of origin in the Old World.

(iii) **Centre of distribution in Asia and Africa:** The tribe *Isachneae* is well represented in Asia and Africa. There are ca 25 species of *Isachne* and 3 species of *Coelachne* in Africa. The monotypic genus, *Heteranthoecia* is endemic to Africa. The number of species of *Isachne* and *Coelachne* is greater in Asia than in Africa. Moreover, the two genera, *Sphaerocaryum* and *Limnopoia* are endemic to Southeast Asia. At present there is no strong evidence that the tribe has spread to Africa from a centre of origin in Asia. It is probably that somewhat parallel evolution occurred in Africa and in Asia but spread to other regions retaining its tendency to attain maximum diversification in the regions of Southeast Asia.

It is, therefore, of interest to consider whether the two regions of distribution are sufficiently distinctive to indicate that they may be independent centres of distribution for the tribe.

(iv) **The region of maximum abundance in Indo-Malaysia:** The highest number of species of *Isachneae* occur in the Indo-Malaysian region. These include ca 60-70 species of *Isachne*, ca 8 species of *Coelachne* and the monotypic genera *Limnopoia* and *Sphaerocaryum*. The greater relative abundance of *Isachneae* in this region is a positive indication that the tribe may have originated here.

We recognize 29 species of *Isachne*, 3

species and 1 variety of *Coelachne* and 1 species of *Limnopoia* and *Sphaerocaryum* from India. The tribe shows high degree of endemism in India. It is seen that 18 species of *Isachne* and 1 species and 1 variety of *Coelachne* and the genus *Limnopoia* are endemic to India. Most of the species are confined to the Western Ghats. Only two species of *Isachne* are endemic to Sikkim and 2 to Khasi Hills (Meghalaya). Several species of *Isachne* are so restricted that they are hitherto known only from their type locality and thus they are very rare and threatened (Ved Prakash & Jain, 1983). The occurrence of tribe *Isachneae* in India is shown in Table 3.

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