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THE STUDIES ON THE FERNS OF PENINSULAR INDIA—A REVIEW

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It is difficult to review the overwhelming bulk of literature on Peninsular Indian ferns the publications of Blatter (1911), Agharkar (1938), Mehera & Chowdhury (1958), Narayanaswami (1961, 65) Maheshwari & Kapil (1963), Chowdhury (1971), Mahabale (1973) and Bir (1977) cover considerable number of references on this subject.

Charaka Samhita (*c.* 600 B.C.) refers to some Peninsular Indian ferns. Sen (1902-1905) gave a translation of this ancient Sanskrit work and George King gave the scientific names for the plants. Ayurvedic literature is replete with names like *Raktapadi, Sancharini, Sutapadika, Mayurasikha* and several others. *Sancharini* may be the Walking Fern *Adiantum. Mayurasikha* may be *Actiniopteris.* The 14th Century work of Madanapala known as Madanapala Nighantu and its commentary of Ravidatta also mention some names of ferns. Kirtikar and Basu (1941) gave the medicinal importance of some ferns found in the area. Earlier, Watt (1882-1896) also gave the economic importance of a few species. Dymock *et al.* (1890-1893) dealt with pharmacographic aspects. Chopra (1933) mentioned some species common to the region. S. L. Nayar and Chopra (1951) gave an account of British Pharmacopeal Drugs and their substitutes found in India. Lushington (1915) gave the vernacular names of a number of species found in the erstwhile Presidency of Madras.

The first illustrated account on the ferns of Peninsular India is that of van Rheede (1703) has included illustrations of a few ferns and fern allies from the Malabar Coast, which Linnaeus has referred to while naming them in his Species Plantarum (1753). Koenig, (1785) while stationed at Tranquebar (present day Tharagambadi in Thanjavur District) made some observations on ferns. He also sent specimens to Linnaeus and Retzius (*see* Burkill, 1965). Burman (1768) described some ferns from the region. Among other earlier collections are those of Rottler, Russel, Metz, Hutchinson, Gardner and Levinge. In the introductory part of Wight's Illustrations of Indian Botany (1831), W. J. Hooker and Burkill in Chapters on the History of Botany in India (1965), give some details regarding the collections of earlier explorers and naturalists. Unfortunately, most of those collections are not available in India.

In the first taxonomic book devoted to ferns Swartz (1806) mentioned some species from Peninsular India. So did Willdenow (1810). Roth's (1821) *Nova Plantarum* included some ferns distributed in the area. Roxburgh's collections and data formed the basis for the fourth part of *Flora Indica* (ed. W. Griffith, 1844). Wallich (1828, 1829) gave a list of the herbarium sheets present in the East India Company's Museum at London. Some of the duplicates are present in CAL. Zenker (1835), J. Graham (1836), Agardh (1839), Miquel (1850-1852) and several others contributed to the study of ferns in Peninsular India. Fée (1844-1866) has included some Peninsular Indian

ferns in his eleven volumes work on ferns. Gardner (1847) described *Anemia wightiana* Gardn., from Nilgiris, while Kunze (1851) gave an account of the fern collections from there. Cleghorn (1853) mentions some indigenous and naturalised plants of Madras. Brown (1862) gave brief descriptions of seven ferns from the neighbourhood of Madras. De Vriese (1853) described *Angiopteris wightiana* de Vriese from Peninsular India.

References to the ferns of Peninsular India can be found in W. J. Hooker's Icones Plantarum (1837-1854), Species Filicum (1846-1864), A Century of Ferns (1854), Filices Exoticae (1857-1859), A Second Century of Ferns (1864), Hooker and Greville's Icones Filicum (1829-31), Hooker and Baker's Synopsis Filicum (1865-68), J. Smith's Historia Filicum (1875) and Ferns British and Foreign (1866) and Baynes' Album of Indian Ferns (1887). Thomas Moore's (1857-1862) Index Filicum (the first index to ferns; not continued after *Goniophlebium*) is another work of importance.

Based on field observations and collections, Beddome published Ferns of Southern India (1863-73). Following this, he published Ferns of British India (1865-70) and Supplement to the Ferns of Southern India and British India (1876). All these accounts are illustrated. Based on the above works as well as on the works of Hooker and Baker, Hooker and Greville, and Smith, Beddome prepared his digest —Handbook to the Ferns of British India in 1883. Further critical studies on difficult groups enabled him to publish a supplement to the Handbook in 1892. Since then concepts of various taxonomic groups of ferns have considerably changed. Nevertheless, the Handbook, with its supplement, still remains 'handy' for the identification of Peninsular Indian ferns. B. K. Nayar and Surjit Kaur have brought out a companion volume (1974), which though useful in some respects, is inadequate in other ways (Nair, 1975 b; Holttum, 1975).

Christensen's Index Filicum (1906), its three supplements (1913, 1917, 1934) and the fourth supplement compiled by Pichi Sermolli *et al.* (1965) are very useful for taxonomic researches on ferns of the region.

After Beddome's work, emphasis began to be given to intensive explorations of smaller areas. Beddome's (1908 b) Sketch Flora of the Nilgiri District, has included ferns also. Bosch and Goddin (1919) reported *Trichomanes schmidiana* Zenk. from Nilgiris.

Ferns of various places in the erstwhile Presidency of Bombay were studied by several workers including Birdwood (1886, 1887), Birdwood and Cooke (1897), Gray (1886), Macpherson (1890) and Blatter (1908). Blatter and D' Almeida's book on the Ferns of Bombay (1922) provides critical notes. In 1932, Ewbank described and annotated 23 species out of 35 collected from Mahabaleshwar. Pandit and Mulay (1931) gave an account of *Azolla* of Khandala. According to Mulay (1939) there may be two or three varieties of *Azolla pinnata* in India. Mahabale (1933) discovered the prothalli of four species of *Ophioglossum* L., and (1938) also gave the distribution and habit of nine members of the Ophioglossaceae of Bombay Presidency.

In other areas also ferns were attracting attention. An account of the ferns of Pachmarhi and Mahendragiri was given by Gamble (1892). Pachmarhi ferns were studied by Graham (1915) and later by R. S. Rao and Narayanaswami (1960). Patel *et al.* (1962) recorded *Botrychium* as a new record from Pachmarhi. Prain's Bengal Plants (1903), Haine's Botany of Bihar and Orissa (1921-1925) and Mooney's Supplement (1950) contain accounts of ferns. D' Almeida (1926 b, c) studied the ferns of High Way Mountains in Madurai District and described a new species.

After the reorganization of the Botanical

Survey of India, several floristic lists containing ferns have been published (*see* bibliography). Shevroy Hills, Cumbum Valley and Pachakumachi Hills were explored by Subramanyam and his fellow workers during 1960-61. Panigrahi *et al.* (1964), N. C. Nair and R. K. Ghosh (1975, 1978) made some observations on the ferns of Orissa and several new records for the state and one new record for India (*Pteris heteromorpha* Fée) were reported. Panigrahi and Dixit (1966) have noted some new records for Madhya Pradesh. They have also (1969 a-c, 1973) revised Ophioglossaceae, Osmundaceae and Gleicheniaceae of India. N. C. Nair and S. R. Ghosh (1975-78) have made some new additions to the Indian fern flora and new records for Peninsular India. Among them, mention may be made of *Pteris confusa* Walker, *P. praetermissa* Walker, *P. roseolilacina* Heiron, *P. tremula* R. Br. and *Asplenium grevellei* Wall. ex Hook. et Grev., which are of phytogeographical interest. N. C. Nair and S. R. Ghosh (1976 b, c) have described two new species : *Cheilanthes keralensis* Nair et S. R. Ghosh and *Pteris furunculata* Nair et S. R. Ghosh. They (1973) have also reported *Ophioglossum gramineum* from Kerala. What was formerly considered to be *Adiantum aethiopicum* L., in this region is *A. thalictroides* Willd. ex Schl. (*see* N. C. Nair and S. R. Ghosh 1978). N. C. Nair's (1972) work on *Pteridium* Gl. ex Scop., in the Indian sub-continent includes Peninsular Indian species. He (1972) has also shown that *Polystichum aculeatum* (L.) Roth and *P. setiferum* (Forsk.) Moore ex Woynar exist in Southern India. Ghatak (1964) discovered *Trichomanes latealatum* (v. d. B.) Christ from Shevroy Hills. Bhargavan (1973) added *Doodia dives* Kuntze to the Indian flora. He (1974) also reported *Tectaria vasta* (Bl.) Copel. Balakrishnan and Hajra (1964) recorded *Asplenium rockii* C. Chr. from Sankarimetta in Andhra Pradesh. While N. C. Nair and S. R. Ghosh (1975) reported two species of *Pityrogramma* Link from Peninsular India. Panigrahi (1975) added one more. Kammathy (1968) reported about the rapidly spreading aquatic weed *Salvinia auriculata* Aubl. in Kerala. Later workers consider this plant to be S. *molesta* Mitchell. (Cook, C. D. K. 1976 ; Nayar & Madhusoodanan, 1979). Sharma *et al.* (1977) have enumerated the ferns of Nilgiri District. Kammathy *et al.* (1967) have listed twenty species of ferns for the Biligirirangan hills.

Workers other than those from the Botanical Survey of India have also taken active interest in the taxonomy of ferns of the region. Kolhatkar (1957) described *Marsilea poonensis* Kolh. from Pune which was later reduced to a synonym of *M. minuta* L. by Gupta (1962) whose account also deals with other Peninsular Indian species. Mirashi and Paradekar (1961) enumerated nine species of ferns from Nagpur. Tiwari (1964) gave a list of ferns of Madhya Pradesh. Nayar and Kaur (1963, 1964 a, b) reported *Peranema cyatheoides* Don and a few species of *Egenolfia* Schott Nayar and Chandra (1964) discovered two new species of *Bolbitis* from the Western Ghats. According to Nayar (1964) the genus *Kaulinia* Nayar is also found in Peninsular India. Agashe (1968) listed the ferns of Kolhapur. Gopal (1968) described a new species *Marsilea maheshwarii* Gopal from Pondicherry. Swamy and Rao (1969) reported three new records of *Ophioglossum* L., from Andhra Pradesh. Bir and Vasudeva's (1971) account of the ferns of Kodaikanal includes several new distribution records. They have also (1972) made some observations on the ferns of Pachmarhi. Razi and Rao (1971) gave an artificial key to the pteridophytes of Mysore City and its neighbourhood, indicating the medicinally important taxa. Chandrasekhar (1972) gave an illustrated account of the wild ferns of Madras City and its immediate neighbourhood. Manickam and Ninan (1976) listed the ferns of Pulney Hills. Recently, Bole and Almeida (1977) added three new species to the fern flora of India ; *Pteris almeidiana* Bole

et Alm., *Schizolegnia indica* Bole et Alm. and *S. santavadiensis* Bole et Alm. The figure and description of *Pteris almeidiana* Bole et Alm., appears to be very similar to that of *P. heteromorpha* Fée.

Several workers while studying the ferns of countries neighbouring India, have paid attention to those of Peninsular India also. Ching's (1933, 1934, 1935a, 1935b, 1936, 1940, 1957, 1963, 1964a, 1964b) contribution dealing with several species of the area is very significant. In flora of Hassan District, Holttum gave an account of ten species of the Thelypteridaceae of the area (*see* Saldanha and Nicolson 1976). Walker (1957) described a new genus *Idiopteris* and gives the distribution of *I. hookeriana* Walker as Malabar. Sledge (1956) described a new taxon *Athyrium praetermissum* Sledge var. *praetermissum* which has a distribution in South India. He also clarified the taxonomic problems relating to *Dryoathyrium boryanum* (Willd.) Ching and other Athyrcid ferns of Peninsular India. According to Sledge (1956c) only *Microlepia speluncae* (L.) Moore and *M. trapeziformis* (Roxb.) Kuhn are found in Peninsular India. 21 species of *Asplenium* L., have been reported from South India by Sledge (1965). The genus *Elaphoglossum* Schott according to Sledge (1967) is represented only by six species in Peninsular India and the two described by Biswas (1939) *E. kranginae* Biswas and *E. ballardianum* Biswas from Nilgiris as new species are identical to *E. angulatum* (Bl.) Moore and *E. stigmatolepis* (Fée) Moore respectively. Sledge (1968) also points out that *Hymenophyllum denticulatum* Sw., *H. javanicum* Sw., *H. polyanthos* Sw., *Trichomanes bimarginatum* v. d. B., *T. exiguum* (Bedd.) Bak., *T. kurzii* Bedd., *T. obscurum* Bl., *T. plicatum* Bedd., are some of the Hymenophyllaceae members found common with Ceylon. The Hymenophyllaceae members reported from India are to be re-examined in the light of the work of Morton (1969). Kramer (1967a) reports that *Tapeindium pinnatum* (Cav.) C. Chr. occurs in Kerala. He also (1972) recorded *Lindsea heterophylla* Dry., *L. ensifolia* Sw., *L. orbiculata* var. *commixta* (Tagawa) Kram., *L. malabarica* (Bedd.) Bak. and *L. odorata* Roxb. from Peninsular India. According to him (1967b) the plant hitherto under *L. cultrata* (Willd.) Sw., is *L. odorata* Roxb.

Holttum (1965) made some observations on the genus *Cyathea* Smith. According to Tryon (1970) the Peninsular Indian species formerly assigned to *Cyathea* Sm., belong to *Alsophila* R. Br. (*see also* Holttum and Tryon, 1977). Holttum's treatment of the Thelypteridaceae (1969, 1971a, 1972, 1973, 1976b) include Peninsular Indian elements also. Of the various genera having a distribution in India, only *Ampelopteris* Kunze, *Pseudophegopteris* Ching, *Macrothelypteris* Ching, *Metathelypteris* (Ito), Ching, *Cyclosorus sensu* Holttum, *Thelypteris* Schm., *Sphaerostephanos sensu* Holttum, *Pronephrium* Presl., *Dimorphopteris* (Tagawa et Iwatsuki) Holttum, *Trigonospora* Holttum. *Pneumatopteris* Nakai *sensu* Holttum and *Christella* Leveille are found in Peninsular India. *Pneumatopteris* and *Pronephrium* are represented by a single species each, *Sphaerostephanos* by three species and *Christella* by 4 or 5 species.

Taxonomy represents the synthesis of all biological knowledge (Pichi-Sermolli, 1959) and it is the focal point of biology (1942). Hence, we must also consider other branches of investigations in ferns in addition to explorations, identification and nomenclature in accordance with the ICBN.

Very little has been done with regarding the anatomy of Peninsular Indian ferns. Almost similar is the case with Geobotany and Ecology of the ferns of this area.

After the publication of Manton's book on Problems of Cytology and Evolution in the Pteridophyta (1950) some interest has been generated in cytological studies of South Indian

ferns. It is significant that the largest chromosome number as yet known in the plant kingdom (2n = 1262 and 10 fragments) is in *Ophioglossum reticulatum* L. (Abraham & Ninan, 1954) from this region. According to Abraham *et al.*, (1962) cytological evolution in ferns is proceeding faster in the tropics than in the temperate regions. Ninan's study (1956a, b, c, 1958) of Ophioglossaceae, Marattiaceae and Osmundaceae has given interesting results. Out of nearly 325 species which exist in Peninsular India, cytological data are available for only about 130.

Spore morphology can be a useful aid in taxonomy (*see* P. K. K. Nair, 1964) Bir (1967); Devi (1977 and lit. cited therein). On the basis of spore morphology it is easy to recognise different species of *Polypodium* or separate the species of *Asplenium, Athyrium* and *Diplazium* from related taxa (*see* Mahabale, 1973). Nayar (1961a, b, c, 1962d) and Devi (1977) touched upon the spore morphology of some Peninsular Indian taxa. Spore morphology also helps in phylogeny eg., ridges on the spores in *Ceratopteris, Mohria* and *Anemia* show close relationship. Study of spore morphology can also indicate adaptive modification towards a land habit (*see* Mehra, 1968). Electronmicroscopic studies on exine sculpture is yet to make a start in Peninsular India.

Nayar (1956) found some correlation between the trichomes of gametophytes and sporophytes. Such correlative studies might provide useful information.

Atkinson (1973) suggests that "the gametophyte of ferns is not an overly plastic, taxonomically useless body but may be an entity of considerable value in the study of relationships among ferns" Although the early developmental pattern in different fern taxa are somewhat similar, the adult forms reached by them are dissimilar (Nayar & Kaur, 1971). Our information along this line is very meagre. Similar is the case with ecology of prothalli. Though they flourish during the Monsoons, some are perennial. Microclimatic studies on prothalli can be another promising line of investigation.

Walker (1958, 1960) has shown how interference in environment can influence fern hybridization in bringing out taxonomic categories. Although his work is based on Ceylonese material, Peninsular Indian conditions are not far different. N. C. Nair and S. R. Ghosh (1974) have brought out this point for Kerala. Genetical studies in ferns have opened a new line of work along which if pursued actively may lead to the discovery of several hybrid swarms.

With polyploidy or hybridization, changes in the gametophytic and sporophytic characters such as spore size, stomatal index, shape of pinnae, size of the plants etc., occur. Study along these aspects is still to make a headway.

It is now known that the haploid complex (spore) and the diploid complex (zygote) can give rise to two extremely different plants varying in size, shape and potentialities. This is a very complex problem related to taxonomy, and a challenge to the experimental morphogeneticists of Peninsular India.

Chemotaxonomy, studies on apomixis and apogamy are other paths open before us. Future research in numerical taxonomy also may help.

As forests from various parts of Peninsular India are in a process of rapid dwindling, several fern taxa are fast disappearing or becoming extremely rare or absent in those localities. Many of them are represented by one or two earlier collections only in MH as well as other Peninsular Herbaria and CAL. This needs strong conservation measures. Several regions in Peninsular India are either unexplored or only partially explored and therefore, there should not be any slackening in organised field

trips and expeditions not only to increase the wealth in our herbaria and prepare our fern flora but also to locate threatened species and introduce them and conserve them in our gardens for posterity. More enthusiasm is to be generated among the university students in the study of ferns, for which the syllabi are to be reformed considerably. Few decades ago there were but three universities in Peninsular India. Now, in every state, there are not less than three universities each and there are numerous postgraduate institutions, and a few research laboratories. Books and journals are not big problems today. Our live fern collections are very poor indeed and we have to improve them with, all enthusiasm, not only in our National and State Botanic Gardens but also in the gardens of universities, post-graduate institutions and research centres.

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