CHEILANTHES Swartz

Introduction

It is one of the most puzzling genera among ferns, since, let alone species, even the generic limit is not yet decided. From a perusal of the existing disagreement in literature about the generic limits, the writer has followed Alston and Bonner (1956) and Alston (1959) who consider *Cheilanthes* as including *Aleuritopteris* and excluding *Natholesana*. As such confounded, Clarke (1880) reported 9 taxa (6 species and 3 varieties) from the Himalayas, out of which two taxa, namely *C. argentea* Kze. and *C. argentea* var. *sulphurea* Hk. are not represented in Darjeeling and Sikkim range. The rest of the element, except *C. belangeri* Hk., has been gathered and a critical taxonomic analysis of the present collection has revealed 9 distinct species. It may be added that except *C. tenuifolia*, the rest belong to section *Aleuritopteris*.
CYTOLOGY

Chromosome determinations of 9 species of Cheilanthes from Eastern Himalayas are summarized in Table XX, which also includes the previous reports (if any) about them. For most species, these are the first reports. The observations confirm the previously reported base numbers (28, 29, 30) in the genus (cf. Manton and Sledge, 1954; Manton, 1959). Furthermore, it is rather interesting to note that all the Himalayan species are diploid and excepting one (C. tenuifolia Sw.), the rest reproduce sexually as determined from the normal output of 64 spores per sporangium. It may be added that C. tenuifolia is reported to be tetraploid sexual from Ceylon (M & S, 1954) and S. India (Abraham et al, 1962), whereas the Himalayan samples are undoubtedly apogamous. In addition, only C. farinosa (s. lato) has been previously investigated from other latitudes (cf. M & S, 1954; M, 1959; Abraham et al, 1962) and remarkably enough the higher grades are reported only from tropical regions.

CYTOTAXONOMICAL OBSERVATIONS

Cheilanthes farinosa (sensu lato)

Blanford (1886) segregated three species in it, namely C. farinosa Kaulf. (s.s.), C. aniceps Blanf. and C. grisea Blanf. Unfortunately Blanford (1886) himself later reduced the two new species to varieties of C. farinosa. Hope
Cheilanthes chrysophylla Hk.

So far, the species has been regarded as a variety of *C. farinosa* (cf. Beddome, 1892; Clarke, 1880; Christensen, 1906; Dickason, 1946). Presently, the form (Fig. 224) with thick deep golden yellow powder on the undersurface is gathered from Tonglu-Gairabas road (Darjeeling, 3,000 m) in moist habitats. It is decidedly distinct from *C. farinosa* both in morphology, architecture of frond and distribution. It is smaller, distinctly triangular lanceolate and with numerous narrowly linear stiff hair pointed deep brown scales (Fig. 225) extending on to the stipe. Moreover, the deep brown spores are smooth or faintly granulate (Fig. 226) as compared to broadly verrucose in *C. farinosa* (Fig. 227).

The haploid chromosome complement as determined at meiosis is 30 (Fig. 228).

*Cheilanthes alhombarginata* Clarke

The species possesses a deltoidly-lanceolate lamina and is closely related to *farinosa* group, but is easily separated by nearly bicolorous and white margined scales present all over the stipe, rachis, costae and veins. Involucre is highly lacerate. The species is variable as regards size, large sized individuals possessing lax pinnae with less farina (cf. also Hope, 1901). It is exceedingly common throughout India and is plentiful in E. Himalayas between 1,200 - 2,000 m. The entire Darjeeling populations especially studied from below
Ging and Darjeeling are diploid sexual with $n = 29$ (Fig. 229).

*Cheilanthes dalhousiae* Hk.

It is a very distinct species characterized by acute lanceolate lamina (Fig. 230), without white powder at any stage of growth and broadly lanceolate-ovate light brown distinctive scales (Fig. 231), extending sparsely on to the stipe, which are unlike *Cheilanthes farinosa*. The species occurs throughout the Himalayas, usually above 2600 m. and the present investigation is based on ample collection beyond Lachen (N. Sikkim, 2700 m.) from which valley incidentally Sir J.D. Hooker collected it (cf. Clarke, 1880).

North Sikkim populations gathered beyond Lachen (much below Samdong) show $n=30$ (Fig. 232) and a normal output of 64 tetrahedral spores per sporangium.

*Cheilanthes rufa* Don

The species hardly needs any introduction since being characterized by highly tomentose (woolly) undersurface, stipe and rachises. Ample collections have been made from rock crevices of the Government House Walls at Darjeeling and on limestone beyond Singhik (N. Sikkim). Both gatherings are cytologically alike, being diploid sexual, with $n = 29$ (Fig. 233).
The species is represented throughout the Himalayas but presently was collected once beyond Chungthang in N. Sikkim and from a single fixation dependable preparations could not be obtained. However, it is a diploid sexual with $n = 29-30$.

**Cheilanthes subvillosea** Hk.

It is a well known widely ranging species, characterized by gubtripinnate fronds with elliptic pinnules crenated extending downwards and protected slightly when young by stiff hairs, by which character it was placed in the genus

**Cheilanthes trichophylla** Bak.

The Yunnan endemic *Cheilanthes trichophylla* is characterized by elongate-deltoid tripinnatifid lamina. The species is excellently figured and described by Ching (1935). The present collection from E. Sikkim beyond Karponang (3,300 m.) is a new record for the Himalayas. The haploid chromosome number is $n=30$ (Fig. 234).

**Cheilanthes tenuifolia** (Burm.) Swartz

It is a well known widely ranging species, characterized by subtripinnate fronds with elliptic pinnules crenated at apex, sori being confined to separate vein endings (rarely extending downwards) and protected slightly when young by reflexed unmodified margin (Figs. 235, 236). The fronds are usually herbaceous and bear throughout scattered 2-3-celled stiff hairs, by which character it was placed in the genus *Cheilosoria* Trev. The latter genus is treated synonymous with *Cheilanthes* by Copeland (1947) and in fact by every fern taxonomist.
The Himalayan populations gathered near Manjitar bridge (200 m.) on red soil and in crevices below Badamtam Police Check Post (400 m.) show at meiosis c. 56 bivalents. 56 chromosomes are also observed at archesporial mitosis (Figs. 237, 238). A sporangium yields 32 black nearly smooth tetrahedral spores suggesting the Himalayan material convincingly to be diploid apogamous. This inference by itself is in strong contrast to the earlier report of tetraploid (n = 56) from Ceylon by Manton and Sledge (1954) and from S. India by Abraham et al. (1962).

Spores from the Himalayan material were germinated and as expected apogamous sporophytes arose with small tannin coloured scales on the apogamous bud and 2-3-celled glandular tipped hairs on the stipe and lamina (Figs. 239-242); thus establishing a positive evidence of apogamy.

Fully understanding the evolutionary implications of the present report, it was desired to study the Ceylon and S. Indian material. Dr. W.A. Sledge kindly sent two specimens (Herb. Kew No. 293) representing the duplicates of the Ceylon tetraploid reported by Manton and Sledge (1954). These specimens resemble exactly the Himalayan diploid apomict as regards general aspect and morphology, hair and stomatal dimensions, spore output (32 to a sporangium) and spore diameter. During this time three very old collections from Ceylon were received through the courtesy of Dr. J.E. Senaratna (Herb. Peradeniya), all of which on examination proved to be akin to the Himalayan samples. The specimens from S. India lying
in the Central National Herbarium, Howrah, are also similar. Obviously the interest centres round the original specimens of Prof. Irene Manton (Z 18, p.105, p. 427), although in the face of the evidence quoted above, it appears that Himalayan, Ceylon and S. Indian and G. tenuifolia are all diploid apogamous.

DISCUSSION

( Species-complexes )

None of the E. Himalayan taxa exists in more than one cytotype and consequently no species-complex occurs within this region. Morphologically the taxa are distinct.

Broadly speaking, there are only two species for which previous cytological reports occur in literature, namely G. farinosa and G. tenuifolia. These very two species are incidentally species-complex, the former known earlier from tropical latitudes and the later discovered so with the present report ( cf. Table XX ).

As already pointed out in the text, Blanford (1886) segregated three species from the Himalayan populations, namely G. farinosa ( s.s.), G. anceps Blanf. and G. grisea Blanf., which treatment has been accepted by Panigrahi (1955) as well as by Alston and Bonner (1956); and has also been confirmed by the writer. However, the cytological reports in literature have so far been mentioned against G. farinosa ( s.l. ) and it is hard to decide in each case the exact taxon...
involved. Without a critical taxonomy of the taxa, it is not proper to enter into any discussion concerning evolutionary relationships. It can only be stated that the species is dibasic (x = 29, 30) and is diploid in the Himalayas, diploid and tetraploid in Ceylon, tetraploid in S. India, and diploid, tetraploid and triploid apogamous in W. Tropical Africa (cf. Table XX). The entire complex is in need of a thorough revision and it is only then that it would be possible to ascertain whether the cytotypes belong to C. farinosa (s.s.) or each of the segregate represents a sub-complex.

**C. tenuifolia complex**

The species is diploid apogamous in E. Himalayas (present report) and is also reported in literature to be tetraploid in S. India and Ceylon. Unfortunately, since no authentic specimens of the tetraploid are available to the author for critical comparisons, further discussion is not possible.

Furthermore, three basic numbers are known in *Cheilanthes*. The numbers 29 and 30 are common and widespread, while x=28 is inferred only from n=2m=56 in *C. tenuifolia*. This kind of cytological aberration is sometimes useful in cytotaxonomy particularly when it is known that this species belongs to the former genus *Cheilosoria* Trev. (presently merged with *Cheilanthes* by all taxonomists). It would be worthwhile to investigate the entire element of *Cheilosoria* in *Cheilanthes* so as to ascertain the role of cytology in the re-evaluation of the genus *Cheilosoria*. Morphologically *C. tenuifolia* is atypical in *Cheilanthes* possessing an unmodified reflexed margin to protect the sori in younger stages.