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FOREWORD - I

It is indeed a pleasure for me to find "Chromosome Atlas of Indian Pteridophytes" in print - an event long overdue. This assignment was entrusted - long back by Late Dr. T. N. Khoshoo, the then Secretary, Department of Environment and Forests, Government of India, to Professor S. S. Bir (Patiala) and Professor S. C. Verma (Chandigarh), both of them being scientists of international fame with immense expertise in Pteridology. The authors undertook this responsibility with utmost seriousness as one could imagine and completed the work by the end of last century, but due to lack of response from the sponsoring authority for various reasons, the publication did not materialize. However, Prof. S. S. Bir, a distinguished Fellow of our Academy (INSA) along with his co-author Prof. S. C. Verma took up the challenge, though located at different centres, and continued the work under heavy odds and prepared this document. This atlas including about 910 species (c. 1,100 taxa) under 185 genera grouped into 49 families, with references up to the end of 2008, ultimately has seen the light of the day. The areas of distribution covered whole of this subcontinent ranging from terai to high altitude of Himalayas.

The group Pteridophytes holds a unique position in the Plant Kingdom. Its status in the evolutionary hierarchy between the ancient aquatic haplontic algae to highly developed diplontic modem day higher plants make this assemblage a wonderful model for the study of evolution for students of plant sciences. This group hardly has any parallel in view of its potential of independent existence of both gametophyte and sporophyte - the gamete bearing and spore bearing generations respectively. Moreover, the theory of recapitulation involving ontogeny repeating phylogeny is wonderfully reflected in its stellar system from Lycopsids to other groups of Pteridophytes. Similarly, the origin of heterospory from monospory as well as the origin of sexuality are of great importance in the strategy of evolutionary progress. Finally, the development of stress resistance - a matter of ecological adaptation is a feature of special importance in ferns. The chromosome database, of this group of plants which shows remarkable progress in features of morphology, anatomy, reproduction and ecological adaptation, needless to say, is essential for any scientist interested in the basics of plant evolution. The job undoubtedly has been very well done.

The authors clearly brought out the wide range of chromosome numbers from low to extremely high, unlike in angiosperms, obviously including aneuploidy to extreme polyploidy. This document would serve as the base for studies of fern evolution indicating possible correlation of chromosomal characteristics with progressive changes in morphological and reproductive features.

Professor Bir ably assisted by Professor Verma has devoted a considerable period of their entire career in the study of Pteridophytes and rightly succeeded in unravelling the intricacies of chromosome evolution and evolution *per se* in Pteridophytes. I am sure, that this volume would not only serve as an essential desk copy for anyone interested in plant evolution, but would bear testimony to the immense patience, skill and genuine love of the authors for this unique group of plants.

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FOREWORD - II

Pteridophytes have always been an evolutionary intrigue in many respects. The most important among them is that, these are amongst the earliest vascular plant which originated on planet Earth. These have obviously survived many cataclysmic changes through millions of years of the existence. Polyploidy occurs both in the heterosporous and homosporous pteridophyta, and characterises the intragametophytic – selfing species. It is considered that polypolidization has been a key evolutionary mechanism in some of the pteridophytes. The duplicated loci of polyploid taxa are considered to mitigate the expression of recessive lethal alleles and the mutations that follow Natural Selection. On the other hand, self-fertilization of these monoecious gametophytes ensures the maintenance of genetic variation in high polyploids. Studies indicate that polyploidy in pteridophytes plays a major role in shaping their diversity, however the evolutionary history of many polyploid species remains poorly understood.

Chromosome Atlas preparation is the first step, and vital towards understanding the genetic variation, phylogeny, as well as in studies on genome sizes, ploidy levels and nuclear architecture. I consider this book "Chromosome Atlas of the Indian Pteridophytes" by S.S. Bir and S.C. Verma as a milestone publication in the Indian pteridophytes research. This valuable book includes references to 185 genera, belonging to 49 families and 910 species with c.3520 entries, is an evidence for understanding the subject appropriately.

I congratulate the authors for this important and well organized contribution. I am sure that this book will serve the need of researchers, academicians and students of plant biology.

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FOREWORD - III

Cytological surveys do not just happen, they are generated. And such generation can take a lifetime of dedication to see to completion. A cell displaying its chromosomes at their stage of maximal contraction and separation is a short-lived stage in any cell, including those of fern sporangial cells which are undergoing meiosis and destined to become the spores. For this is cytologically the most informative stage of the fern life-cycle to intercept. Only at this stage are the chromosomes short and dense enough to be separated with great care under the microscope, and therefore accurately counted. Only at this stage too is their ability to form regular bivalents or not (typically paired in species, but not necessarily in hybrids), most faithfully, demonstrably and repeatably, displayed.

The fern chromosome numbers thus-presented are an exceedingly rich source of interpretive information. This makes the endeavour of their capture so importantly worth-while. For firstly, their base numbers fall into groupings within a very broad array, within which individual numbers follow lines of particular generic affinities and limits. So the chromosome base-numbers offer an objective way of assessing the actuality of generic affinities of species. Such assessment is entirely independent of morphological studies, confirming existing generic identities or further amending these as necessary. Why different genera of ferns are characterised by different chromosome numbers, no one knows. But in drawing taxonomic interpretations in Pteridophyta, it is exceedingly to scientific benefit that they do.

But secondly, most interestingly, and building upon this, fern chromosome counts offer an additional fresh insight into evolutionary progress of species within their genera, and thereby into whole floras. They do this by displaying the degree of polyploidy which has, or has not, occurred. Here we use the great tendency which ferns have for undergoing the process of allopolyploidy, as a measure of their past (and usually still-continuing) evolutionary activity. In this perspective, ferns are uniquely sensitive evolutionary indicators. By surveying these degrees of polyploidy within fern species of whole floras, an objective measure of the degree of evolutionary process that has, of has-not, already taken place within the plants of that region, can be thus objectively assessed. When compared with the ploidy-spectrum of ferns of other floras, such inter-regional comparisons then give valuable insights into relative degrees of evolutionary activity. In this way, ferns can therefore act as especially sensitive bio-monitors, looking outward from Pteridophyta themselves, to understand details of overall evolutionary progress within whole floristic regions. This latter study, uniquely drawn from such primary fern chromosomal surveys, has yet to be bettered by any newer techniques, and therefore remains a supremely valuable interpretive outcome of fern cytology.

But seeking such primary cytological information in ferns is itself always a long and time-consuming process. For anyone cell of one fern species, such a search can consume days of time. Much of this time is often spent fruitlessly seeking that one cell at that perfect stage which displays its full complement of chromosomes adequately to be accurately counted. Indeed, even arriving at this stage has also taken many hours of cultural back-up, in finding living material to sample, of an authenticated its species, and then gaining sporanigial material at that precise early stage of development when meiotic cell division is actively occurring.