SUMMARY

INTRODUCTION

With 12,000 species of fern profusely growing and sporulating in large tracts of land, air borne spores of ferns may contribute significantly towards viable particulates polluting air. Therefore, this aspect has been studied in detail. The literature on fern spores has been reviewed, especially the aerobiological aspects and allergenic effects. From this the areas of lacunae in the environmental biology of ferns have been identified. On this basis a multidisciplinary study of fern spores as allergens, involving, morphology, dispersal, human response allergic factors and experimental animal effects and related aspects has been undertaken.

2. MORPHOLOGY

A light and scanning electron microscopic morphology of native and acetolysed spores of the 42 ferns concerned have been studied. A comparative discussion of the salient morphological differences among various species has been given.
3. SPOR\text{E} DIS\text{P}ERSION, RELEASE AND MOVEMENT

A pilot study of the day to day distribution of spores of about 20 species in the NBRI fern house was undertaken. In a 12 month study, 5 x 2 cm glycerine coated slides were kept at 3, 6, 9 and 12' height and the spores trapped identified and counted. \textit{Pteris vittata}, \textit{Drynaria}, \textit{Theypterus}, \textit{Cyrtomium}, \textit{Tectaria}, \textit{Microsorium} and \textit{Christella} were the abundant ones. Considerable day to day and seasonal variations were observed. The spore size and degree of ornamentation were found to have a prominent role in dispersal. The highly ornamented spores were more abundant at lower heights than smoother ones. In summer, there was a tendency for upward movement. The ambient spore content has been correlated with period of spore matura-
tion. The spore release potential for different species were assessed by counting the number of spores per sporangia, number of sporangia in each sorus, number of sori in each leaflet, number of leaflets, number of fronds and number of plants in a statistically designed way. \textit{Pteris vittata} with over $10^9$ spores per plant had the highest where \textit{Colysis} with $5 \times 10^5$ had the lowest. With such profuse spore production, the pollution load by several plants in a limited, area, is enormous.
4. STUDIES ON INCIDENCE OF FERN SPORES IN AMBIENT AIR

In exploratory survey of the possible incidence of fern spores in ambient air, aeroScope slides from Shillong, Gauhati, Calicut and Lucknow were examined for various species. Considerable qualitative and quantitative variations in spore distribution was detected. Also seasonal variations were evident. These data clearly indicated that fern spores are present in ambient air in many places in India necessitating the need for testing potential allergenic effects.

5. ALLERGENIC POTENTIAL OF FERN SPORES

In order to understand the allergenic potential of fern spores, studies were conducted on the patients of the allergy clinic, K.G. Medical College, Lucknow. Allergens were prepared from whole spores, spore coat and protoplasm by the standard methods and tested by intradermal application on the patients. The erythema and induration in each case was scored and the allergenicity index calculated. Diplazium osculcentum tested as a whole spore preparation were found to have marked allergenic effect. Fractionation studies showed the allergenicity was shown by spore coat and protoplasm in both lipid and non lipid fractions with quantitative variations. The lipid fractions from allergic spores showed an additional spot on their layer chromatography as compared to inert ones. The water soluble fractions of allergic spores were rich in proteins. Even
though the causative principles were not identified, the results clearly indicated that fern spores from ambient air could elicit allergy in sensitive individuals.

6. DERMAL PATCH TESTING ON ANIMALS FOR FERN SPORES EFFECTS

The clinical observations of fern spore allergy can be best confirmed by studying the dermal reaction in experimental animal models. For this 50 mg of spores each of the various species were applied as patch on the shaved skin of albino rats. The pathomorphological alterative, especially erythema and oedema after 24 hrs were rounded. Also histopathological lesions were tested by haemotoxylin eosin stain. Different spores adversely affected the stratum corneum and the extent of dermal lesion of each spore tallied with the human response. Thus skin contact with fern spores could cause dermal toxicity.

7. EFFECT OF SYNTHETIC DETERGENTS ON GERMINATION OF FERN SPORES

In order to study as whether pollutants have any effect on fern spores or not, the effect of synthetic detergents is one of the most serious among water pollutants on the germination of spores under laboratory conditions has been studied. In liquid culture, linear alkyl benzene sulphonate pH 7.0 incorporated with the medium retarded the initiation of germination and subsequent sporeling, especially at concentrations above 0.008 ppm. Even lower concentration caused
decrease in rhizoidal length, as compared to detergent free controls. In solid culture also, inhibition of germination and retardation of growth. The potential toxicity of detergent pollution of fern spores may have implication in ecological aspects of water pollution as aquatic pteridophytes. Also fern spore germination could be developed as a simple sensitive test system for screening pollutants for phytotoxicity.

8. ASSOCIATION BETWEEN SPORES OF PTERIDOPHYTES AND FUNGI IN THE ENVIRONMENT

Among a large number of fern spores tested, a significant proportion was found to have several species of fungal spores associated with. Based on morphological characteristics and growth pattern, the species were identified. SEM studies revealed that fern spores with well ornamented sporoderm, harboured the fungal spores. The association between mature fern spores and the fungi, cannot be explained by any pathological condition of the ferns or from the mycospora of the soil or air of the fern house. Even though the origin and biological significance of this association is not clear, it may have environmental significance, such as dispersal of spores of both and fern spores acting as symptomless carriers of pathogens. Also the biological effects of such combinations like allergy, may be different from that of the individual spores.
9. CONCLUSIONS

The environmental significance of fern spores could be in three ways, as evident from the present study. Firstly that is species-environment interaction with profuse sporulation potential fern spores could be put among viable particulate air pollutants. The allergy detected in humans and dermal toxicity in animals indicate the potential risk due to fern spore pollution of air. In the second direction of intra species relation, the natural association between fern and fungal spores may be significant. Thirdly, the quality of environment itself may affect the species as evident from the inhibition of germination by synthetic detergents.

The above studies have emphasized the need for including fern spores in aerobiological surveys and allergy testing in the vicinity of their natural habitats, and also elucidated the processes involved in dispersal of fern spores in the environment. Further, the role of spore morphology in the identification of aerial spores, dispersal and association with fungi indicates the importance of taxonomical and morphological studies in environmental sciences, since different spores differ in biological effects. Thus pteridophytes form a fascinating field of study for environmental biologists, a fact emerging from the various lines of exploratory studies in this dissertation.