Chapter I

INTRODUCTION

Pollen, a term first introduced by Linnaeus (Knox 1979). This minute morphological structure is responsible for the transfers of the entire male genetic material generation after generation in the spermatophytic plants. This is the highly reduced male gametophyte of higher plants that develop within the anthers of flowers. In an individual pollen, the intine is the last layer to get developed (Brewbaker 1959) indicating the inbuilt mechanism for the protection of the haploid genome by various layers within the flower. Sporopollenin, an incredibly resistant substance being the major structural component of the outer most layer of the pollen grains (exine), protects the grains from external decay. Besides protection, the exine possesses unique structural attributes that are highly stable and genetically controlled, helping in the identification of the mother plant (Rowley 1959).

After the discovery of the compound microscope by Robert Hook in 1667, the structural appearance of the pollen grain came into vision. Subsequently, the pollen study was initiated with a few scattered investigations. The starting of the practical research on pollen morphology became marked via the publication of the book 'Pollen Grains' by Wodehouse in 1935. A complete concept approximately the pollen research like pollen form and size, exine structure, aperture was presented in this book. The main foundation of this subject was laid by the single contribution by Erdtman in 1952 with the publication of his '*Pollen Morphology of Angiosperms*'.

The contemporary tempo of this study turned into performance at some time in the twentieth century with advances in optical technology. Scanning electron microscopy and infrared microscopy supplied a higher know-how of pollen studies. The popularity of pollen morphological studyimmerged as a distinct discipline by itself and the term 'Palynology' was coined by Hyde and Williams (1945). Extremely high resolution images of pollen grains produced by different typesof electron microscopes added extra advantages in the field of taxonomy particularly for identification of taxa and clarifying systematic relationships and phylogeny of higher plants**.**

1.1 Pollen Morphological Characters in Tracing Phylogeny of Different Taxa

For the purpose of successful dispersion and germination, the pollen grains bear genetically controlled and very stable unique architectural attributesrendering themvery characteristicand thuscan be used to handle the complicated taxonomic nicks and corners.

Foremost among the pollen morphological study, the aperture characters are considered to be of utmost importance (Nair 1970; Walker 1976). The exine characters comes second, while other characters like symmetry, polarity, shape, size comes after that.

As cited earlier, a pollen grain is the precise structural characteristic in the lifestyles cycle of a plant that will become a genotype in addition to a phenotype. This can be explained by the fact that the pollen wall has the virtue of combining the function of protection and possessing valuable characters for diagnosis of the source plant (Rowley 1959).

For external pollen morphological studies two groups of widely variable characters are of primary importance, (i) structure and distribution of apertures and (ii) exine structure and morphology.

1.1.1 Aperture

The aperture demarcates the region formed by thinning of the exine, through which the pollen tube usually, but not always emerges during the time of germination and also facilitates the process of harmomegathy (i.e., a process that involves volume change of the pollen grains due to change in the humidity). The grains can either bewith apertures (aperturate) or without any aperture (inaperturate). In case of aperturate grains the shape of the aperture may be a furrow (colpus/ colpi) or a pore (porus/ pori).

The aperture (colpus or porus) is mostly marked by the changes in the thickness of the sexine as well as nexine or sometimes only one. When the changes occur in the sexine it forms the ectoaperture (ectocolpus or ectoporus) and the change in the thickness of the nexine forms the endoaperure (endocolpus or endoporus/ora).

The opening is usually covered by a formerly thin, delicate layer, and this layer has many characters that can be useful in studying the morphology of the grain. In contrast with the thinning of the exine at the apertural regions, the intine is usually thickened at this region than elsewhere on the grain (Moore & Webb 1978). In contrast with the thinning of the exine at the apertural regions, the intine is usually thickened at this region than elsewhere on the grain (Moore & Webb 1978).

1.1.2 Exine morphology

The outermost covering that surrounds the complete pollen floor except the germinal aperture, wherein it's far both noticeably decreased or absent is called the exine. The exine consists of essentially specific layers (i) outer sexine and (ii) internal nexine (in keeping with Erdtman 1969). The sexine embodies unique morphological attributes that are considered to be significant in the characterization of the lower taxonomic levels including the varieties and cultivars (Nair 1979).

These features act as supplementary tool in the identification of most of the genera of the eurypalynous families and helps in the categorisation of different genera and species of the stenopalynous families (Nair & Sharma 1965). Considering the line of evolution in case of exine stratification, the semi-tectate (or sub-tectate) or intectate grains evolved from the atectate grains through the granular, incipient columellate, tectate columellate and tectate perforate grains (Walker & Skvarla 1975). According to Takhtajan (1980) the psilate or foveolate surface pattern is thought to be the most primitive and the surface pattern with external projections is considered to be more advanced.

1.2 Application of Pollen Characters

Comparing to the quantity of pollen required for successful fertilization, a massive quantity of grains is wasted. But, actually not anything is wasted in nature. Further, these grains migrate into different environmental systems in the and assist in the various research works of applied palynology.

Erdtman (1943) categorized this study of palynology into two distinct divisions, namely (i) basic palynology and (ii) applied palynology. The former being concerning the morphology of pollen grains and spore and the latter comprising all the applied areas of the subject like palynotaxonomy (both extinct and extant) and palaeopalynology, aeropalynology, melissopalynology, pollen biology, pharmacopalynology, copropalynology, forensic palynology, palynostratigraphy and also hydrocarbon exploration.

The branch dealing with fossil pollen grains is known aspalaeopalynology. The highly resistant sporopollenin helps the pollen to get well preserved during fossilization. These fossil pollens provide useful data about the past vegetation pattern andclimatological history of an area. The palaeopalynological data from a sediment are used as a proxy for the reconstruction of the past vegetation and climate (Erdtman 1952). This is of immense value in palaeoecology, palaeoanthropology and archaeology as it helps to draw a basic scenario of the vegetational pattern in which the human beings and animals manifested themselves. Webb (1980) suggested a possible mathematical relationship between climatic variables (e.g., July mean temperature) and fossil pollen data (e.g., percentage oak pollen), which in turn helps to reconstruct the past isotherms. However, rebuilding vegetation remains an increasingly difficult task, as it faces resistance to competition before it can reach equilibrium with the climate. Pollen analysis provides useful evidence to reconstruct earlier vegetation types and past climates with different geographic variations. In fact, the early days of Scandinavia focused on pollen analysis with emphasis on climate restructuring. The general influence of climatic factors on global vegetation scenarios supports this approach, but when influencing decisions such as human influences and local soil profiles must be taken into account (Moore *et al*. 1991).

Another principal feature of studying the stratified fossil-pollen data from lake and peat sediments is tracing the history of the plant communities or even individual plant. The precision of such studies depend on the accuracy of identification of pollen grains. The arrival, expansion, and sometimes contraction of major tree community structures such as birch, pine, beech and oak have been studied in detail. Bennett (1983) has made such a study of early Holocene forest trees in eastern England. Not only the origin and extension, but also the decline of some plant taxa can be studied with this method. The reduction of *Castanea dentata* and *Tsuga canadensis* in the north eastern United States has been studied by Allison *et al*. (1986).

Aeropalynology is another important branch of palynology that deals with the air-borne pollen grains, which finds its way to the human respiratory tracts and causes bronchial ailments, hay fever and other respiratory ailments. This study focuses on the modes of transport of pollen grains, their intermittent distribution, and their chemical nature (Moore *et al*. 1991). Knox (1979) reported that pollen grains in Sweden are the second most powerful factor responsible for a range of allergies (30%), while the fur and skin of various animals are the most common dominant (45%). Other sources of allergies are food (16%) and house dust and mites (11%). Grass pollen is abundant in Aeroflora and causes problems with other pollen types, plantain, ragweed and birch pollen (Moore *et al.* 1991). The preparation and proper use of a pollen calendar helps to effectively identify the source of allergens, which in turn helps treat the disease.

Melissopalinology is concerned with the study of pollen grains extracted from honey. Colonization of bees gives 20 to 40 kg of pollen on average season (Moore *et al.* 1991). Pollen enhances nutritional value through the proteins, minerals and vitamins of honey, so honey is used by various ethnic communities as a dietary supplement. The pollen grains foraged by the honey bees helps to determine the plant scenario of the origin of the honey. (Moore *et al*. 1991). This evaluation of the pollen content material of the honey in addition to the pollenload of the honey bees had been proved to have monetary significance to the apiarists along with the food industry (Cowan1988). Besides, assisting in the pollen foraging and pollination, pollen evaluation of the honey samples additionally offers sufficient facts for judging the adulteration and mislabelling of the honey (Moore *et al*. (1991).

The variety of habitats where the pollen grains are found and their ecological richness makes the pollen grains a reliable proxy which is used to solve many forensic cases. Pollen grains derived from washing litter, dirt, dust, hair, clothing, shoes or nails help to rebuild pollen vegetation from where they were born (Moore *et al*. 1991). The Austrian murder case is solved by using pollen technique (Erdmann 1969).

In pollen biology, various biotechnology techniques are used to engineer pollen-specific genes for crop improvement and other related economic applications.

1.3 Need of the study

Considering this background the subject of a need of the study of pollen morphology of the arboreal members of Terai and Dooars region of West Bengal, India was felt seriously. The extravagance of the vegetation of Terai and Dooars is notable and it is adjacent with the greenery of the contiguous Darjeeling hill-slopes, a piece of the Eastern Himalaya. There are numerous big and small human settlement, including townships dispersed in the area and numerous people in the entire area suffer from respiratory allergy (Samanta & Das 2002) and for that a basic pollen morphological manual is essential and the present work will fill-up that gap.