REVIEW OF LITERATURE

A: Aerobiological works:

In Abroad:

During recent years significant contributions have been made by several aerobiologists and clinicians from India and abroad who reviewed the research extensively from time to time. Systematic aerobiological surveys carried out in various parts of the World have highlighted the significance of aero allergens. The aerobiological investigations have been carried out extensively in countries like United Kingdom, USA, New Zealand, Australia, Canada etc.

Bernstein and Feinberg in 1942 surveyed the daily fungal spore components of the air over Chicago. Gregory (1946 and onwards) in United Kingdom, Hyde and Williams (1949) studied a census of mould spores in the atmosphere of Cardiff. Ambler and Vernon (1951) studied the atmospheric load with reference to the mould spores in Auckland city and suburban area. Dye and Vernon (1952) conducted a two years survey for the air borne mould spores at 23 different localities in New Zealand. Hirst (1952 onwards) in United Kingdom, Ainsworth (1952) studied incidence of air borne Cladosporium spp. in London region. Collins, Williams and Best (1955) reported atmospheric count in Toronto (Canada). De-Meena (1955) studied the airspora of Dunedin (New Zealand). Cammack (1958) studied the seasonal changes in the airspora components of Southern Nigeria. Pady, Kramer and co-workers (1957, 1965 and onwards), in United States surveyed aeromycoflora over Kansas. Meredith (1961 and onwards), studied airspora over West Indies. Davis et al., (1963) studied the comparison between summer and autumn airspora at London and Liverpool. Rees (1964) studied the airspora of Brisbane. Shapiro et al., (1965) studied the importance of field studies and meteorological factors in mould survey of southern California.


Other noteworthy contributions on aeromycological studies were Gregory and Hirst (1957) on airspora of Rothamsted, Dransfield (1968) on airspora of Samaru, Turner (1966) on airspora of Hong Kong, Long and Kramer (1972) on airspora of two contrasting sites in Kansas.


**Aeropalynological work:**

Systematic Aeropalynological surveys carried out in various parts of the world have highlighted the significance of aeroallergence. A systematic survey on airborne pollen in U.K. was initiated by Hyde and Williams (1944 and 1945) at Cardiff. Hyde with co-workers provided the atlas of airborne pollen grains and reviewed the work done in U.K. (Hyde et al., 1958; Adams et al., 1965; Hyde, 1952 and 1969). Other investigators in U.K. were Davies et al., (1973) and Mullins, (1977).

Atmospheric survey in France was initiated by Charpin et al., in 1977. Nilson et al., (1977) provided atlas of airborne pollen in Northern Europe. Ghazaly et al., (1984) have been carried out aeropalynological works in Stockholm. Significant aeropalynological works have been done by many workers of whom mention may be made of the following, Pinto (1954) conducted aeropalynological survey in Lisbon; Kessler (1958) from Isreal; Feinberg et al., (1959) from Jerusalem; Leuschner (1974)

In USA, Durham (1954) initiated atmospheric survey. Information on airborne pollen in North America was reported by Feinberg (1946) and Durham in 1954, while, Naranjo (1958) reported airborne pollen from Central and South America. During recent years significant aeropalynological researches in different parts of USA have been taken place and have been reviewed by various workers like Hall (1998); Hurtado (1998); Levetin (1998) and Lewis (1984, 1998); Maria Martha Binanchi et al., (2006) and Daniela S. Nitiu (2006); Maria Gabriela Murray et al., (2007) surveyed airborne pollen sampling in a Wild Life Reserve in Argentina.


In Australia, Mercer (1939, 1941); Moss (1965); Derrick (1966) and Boyed et al., (1998), reported major pollen types from the atmosphere. In Japan, Sugaya (1972) have contributed much information about airborne pollen. Halwagy (1988) reported airborne pollen in Kuwait.

**Aerobiological work done in India:**

In India, Cunningham (1873) for the first time initiated aerobiological survey of the atmosphere of Calcutta and established a correlation between the number and types of airborne microbes and diseases. After a period of long gap studies on aerobiological investigation was initiated by Kasliwal et al., (1958) at Jaipur and Shivpuri et al., (1960) at Delhi. During the last decades, aerobiological studies have been made at different parts of India. There was no coordinated national programme of aerobiological survey in India till 1979. It was in February 1978, an “All India Coordinate Project on Aerobiology” (AICP) was planned, organized and implemented under the joint auspices of the National Botanical Research Institute (NBRI), Lucknow and Council of Scientific and Industrial Research (CSIR), Centre for Biochemicals. The coordinator was P.K.K.Nair, NBRI, and Lucknow. The AICP was planned and jointly proposed by three laboratories and financed by CSIR. In 1980 aerobiologists from different parts of India met at the “Workshop on Modern Trends in Aerobiology with particular reference to Plant Pathology and Medicine” held at Bose Institute, Calcutta, where the Indian Aerobiological Society (IAS) was formed and started functioning from 31st January, 1980 (Chanda and Gupta, 1989). Recently, Ministry of Environment and Forest, Govt. of India, New Delhi sponsored All India Coordinate Project on “Aeroallergence and Human Health” to emphasize on the aerosols of biological origin, specially pollen and fungal spores present in the outdoor and indoor environment. It started working from 1994. Dr. A.B. Singh, CBT, New Delhi, was the coordinator of this project.

In India aerobiological works have been done in different parts of the
country. For presentation of aerobiological survey, India could be divided in the following biozones viz., Eastern zone, Western zone, Northern zone and southern zone.

**Aeromycological work done in India:**

**Eastern Zone:**

In the eastern part of India, after Cunningham (1873), aerobiological studies were initiated by Baruah (1961), Baruah and Chetia (1966) used slide and culture plates in Gauhati and recorded the presence of spores of *Cladosporium, Penicillium, Curvularia, Alternaria* etc. Later, Bora and Baruah (1980), Sarma and Sarma (1993), Sarma and Bora (1996), Devi and Sarma (2002), Kakati (2005), have revealed the high incidence of fungal spores of Guwahati round the year. Sharma and Dutta (2001) studied the aeromycoflora of indoor working environment of Greater Silchar. Kakati, Baishya and Sarma (2007) studied the airmycofloral population of West Guwahati and observed the most dominant genera were *Cladosporium, Aspergillus, Penicillium, Mucor* and *Curvularia*. Devi, Deka and Sarma (2007) surveyed fungal spora in the industrial unites of Guwahati Refinery (IOCL) and total 14 fungal spore types were identified. Debnath and Baruah, (2008), surveyed airmycoflora over tea plantation in Jorhat district, Assam, and confirmed the occurrence of *Nigrospora* sp., *Pestalotia* sp. and *Trichoderma* sp. etc. S. Buragohain, R.B. Sarma and G.C. Sarma, (2009), surveyed the aeromycoflora of sunflower (*Helianthus annus* L.) field in Kamrup district, Assam. Singh and Singh (1987-1988) reported the fungal airspora over a rice field in Imphal and its seasonal fluctuations associated with changes in weather condition. They further observed that *Pyricularia* spore concentration in the air over rice field and correlated with growth phases of crop and variations in meteorological parameters. Further extensive research work in the
field of aerobiology in Manipur was initiated by Singh (1985-1987) over rice field, open field in Imphal, mustard field, broad bean and tomato field in Manipur. Devi, A.P. (1998) studied the indoor aerobiology of certain working environment in Imphal area Manipur. Devi, A.P. and Singh (1997), Singh and Singh (1988), Singh et al., (2003), Singh and Singh (2005) etc., Devi and Singh (2007) studied aerobiology, epidemiology and forecasting of blast disease of rice in Thoubal district, Manipur. Bebe and Singh (2007) studied the environmental factors affecting the development of fungal diseases in marketed fruits and as many as 20 types of fungi were observed. Devi, Singh and Singh (2009), studied the concentration of pathogenic spore load in the air and there correlation with disease incidence severity, meteorological parameters and growth phages of rice crop in Thoubal district, Manipur.

Chakravarty and Nandi (1972-1981) surveyed the seasonal periodicity of Cladosporium in Calcutta. Majumder and Barui (2005) investigated the aeromycoflora of Residential House in Kolkata and reported the spores of Aspergillus sp. Penicillium sp. Cladosporium sp. were most dominant. Curvularia tuberculata and Curvularia lunata were reported in air of West Bengal (Chakravarty, 1974).

Aeromycoflora of Indian Botanical Garden (Calcutta) was studied by Chakravarty (1976). Seasonal periodicity of Cladosporium in Shillong was recorded by Singh et al., (1979-1981). Occurrences of 178 spore types from 90 genera of fungi were reported by Saha et al., (1980). Sen et al., (1991) investigated different areas of Calcutta. Incidence of allergenically significant fungal aerosol in a bakery of West Bengal was recorded by Adhikari et al., (2000). Measuring indoor fungal contaminants in rural West Bengal with reference to allergy symptoms was recorded by Bhattacharya et al., (2001). Mazumder and Hazara (2005) investigated fungal contaminants in the Libraries of Presidency College Kolkata where 31 spore types
belonging to 17 genera of fungi were reported. Chakravarti et al., (2007) aero-
mycological studies over an agricultural field near Kolkata, West Bengal and recorded
36 major fungal spore types and 19 mould types were recorded. Majumdar and Ghara,
(2008), studied the indoor aeromycoflora of school buildings in Kolkata and 22
different spore types were recorded. Chakrabarti and Bhattacharya (2010) studied
variations in the viable air-borne fungal spore population in two different outdoor
working environments of Kolkata and found most frequent spore types were
*Cladosporium* sp. and *Ganoderma* sp.

Aerobiological studies on paper related Industries were carried out by
Sarma and Dutta (2001), observed on the aeromycoflora of indoor working
environment of Greater Silchar. He surveyed aeromycoflora under the varied
occupational environment i.e. HPCL (Paper Mill), F.C.I. Godown, etc. Majumder and
Bhattacharya (2004) studied the measure of indoor fungal contaminants causing
allergy among the workers of paper related industries of West Bengal. Kukreja and
Saoji (2007) studied on the analysis of aeromycoflora at different stages of pulp and
paper processing and aerial survey of Paper mill area of Nagpur.

**Western Zone:**

In Maharashtra however aerobiological studies were first initiated at Pune in
Army Medical College, by Kalra and Dumbrey (1957). Later on Karnik (1962),
Chaubal and Deodikar (1964), Chitalay (1977) surveyed airspora of Nagpur in
relation to allergic diseases.

But in Marathwada and Maharashtra the credit for developing the
aerobiological research work goes to Tilak. His long and sincere dedication to the
research and development of this subject has yielded into an active school of
aerobiologist in Aurangabad under his competent leadership and this centre emerged
as one of the main aerobiological research centres in India.

Tilak et al., (1967 and onwards) actively engaged in the field of aerobiology and studied airspora over sugarcane, maize, jowar, bajra, cotton, vegetable, arhar, groundnut, vegetable market and banana plantation of Aurangabad. In addition, Tilak and his co-workers (1967 and onwards) also studied airspora over orange, moong, hybrid jowar (CSH-1) and wheat field from Nanded and Vaijapur respectively.


allergenic fungal aerobiopollutants over potato fields and total 77 types of airborne biopollutants were trapped. Cholke and Mahajan (2008), surveyed aeromycoflora inside poultry shed in Pune. Jadhav and Kunjam (2009) studied the airmycoflora of a tribal area in Chattisgarh. Lohare and Kareppa (2010) studied the airspora over onion field.

North zone:

Rajan and others (1952) surveyed the atmosphere of Kanpur and reported 38 species of fungi. Gupta et al., (1960) reported airborne spores from Jaipur. Singh (1994) studied the fungal airspora in extramural and intramural environments in Delhi.


Seasonal variations in the air borne fungal spores had been studied by Mishra and Kamal (1971), at Gorakhpur. Mishra and Srivastava (1971) at Gorakhpur observed the spore contents over paddy, wheat and barley fields.

The airspora of Lucknow was studied by Vishnu et al., (1973) and Singh et al., (1980) who reported the presence of number of fungal spores. Some spores of fungi imperfecti were detected from the air of Allahabad by Nautiyal et al., (1978).


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Dahiya and Gupta (1999-2000) studied the aeromycoflora of Rohtak city Haryana and reported the presence of dominant fungi were Cladosporium sp., Alternaria sp., and Aspergillus sp.

Arora and Jain (2003) studied the fungal airspora of Bikaner (Rajasthan) and reported the presence of the species of Cladosporium, Alternaria, Curvularia, Aspergillus, Penicillium and Mucor, Rhizopus in both the years.

Kulshrestha and Chauhan (2003) surveyed the aeromycoflora around various historical monuments of Agra and reported the maximum concentration of fungal spores was encountered from Taj Mahal followed by Dayal Bagh Temple, Sikandra and Red Fort. Verma and Trikey (2009) studied the airborne fungal spores in Netaji Subhash Chandra Bose Medical hospital Jabalpur. Pathak and Verma (2009) studied the airmycocflora of different environment.

South zone:

Padmanabhan (1953) studied the incidence of the conidia of Helminthosporium oryzae in the airspora over paddy field of Cuttak and gave useful information about the epidemiology of blast diseases.

Sreeramulu and Seshavataram (1962) studied the airspora over paddy fields at Pentapadu in A.P. Sreeramulu and Vittal (1966) carried out their air monitoring work over rice fields. Sreeramulu studied the airspora over the fields of rice, groundnut, sugarcane, sorghum and banana plantation of coastal districts of A.P. and the relevance of aerial transmission of airborne fungal pathogen and disease epidemics. Nair (1963) surveyed the fungal flora of Vellore. Ramalingam (1971) reported airborne fungal spore types from Mysore.

Reddy (1970-1974), reported 21 fungal spore types from the air of Anakapalle and Visakhapatnam.
Survey of airspora of an agricultural farm was carried out by Vittal and Krishnamurthy (1989). He also worked out aeromycoflora of Madras city. Agashe (1983) surveyed the air of Bangalore and showed the dominance of Deuteromycetes. Other reports are of Saroia and Bhagyalakshmi (2002) studied aeromycology of Hyderabad and reported *Penicillium* sp., *Chaetomium* sp., *Aspergillus* sp. and *Fusarium* sp. were dominant. Bhaskar Rao and Mallaiha (1981) carried out extensive aero mycological studies over black gram fields at Nagarjun Nagar (A.P.).

Sobha Rani and Umabala (2005) studied fungi isolated from indoor objectives and identified the species of Aspergillus, *Penicillium*, *Cladosporium* etc. Udaya Prakash *et al.*, (2007) studied aeromycoflora of a suburban village near Chennai, Tamil Nadu and 32 fungal species belonging to 18 genera were isolated from the sampling. Saroja *et al.*, (2007), surveyed micoflora of Hyderabad and 110 spore types were identified. Nayak and Nanda (2009), studied on airborne fungal spores of a college library in an industrial city of Tamil Nadu. Usha *et al.*, (2010) studied the seasonal periodicity of airborne fungi in indoors and outdoors of a rural agricultural village in Pondicherry region and found 39 sporulating fungal types.

**Aeropalynological work done in India:**

**Eastern zone:**

Aerobiological studies were initiated after Cunningham (1873), by Baruah and Chetia (1966). They reported 17 pollen types from the atmosphere of Guwahati. Later, Bora (1969); Bora and Baruah (1980); Sarma (1984); Devi *et al.*, (2002) reported incidence of airborne pollen at Guwahati. Devi *et al.*, (1996) prepared flowering calendar of tree species of Guwahati. Devi (2007) studied the incidence of airborne pollen grains in central Guwahati with special reference to their allergenic significance and some allergenically significant pollen recorded were, *Amaranthus*-
Chanda and Nandi (1971) prepared a preliminary report on incidence of airborne pollen of Calcutta. Chanda and Sarkar (1972); Chanda (1973) and Chanda and Mandal (1980) reported incidence of grass pollen in high frequency from the atmosphere of Greater Calcutta and Falta. The same result were observed by Chanda and Mandal (1978); Mandal and Chanda (1979, 1981a, 1981b) in Kalyani. Banik et al., (1986), conducted aeropalynological survey at Dumdum and adjacent areas of West Bengal. Banik and Chanda (1986) also made an aeropalynological survey at Calcutta. Studies on allergenic pollen of West Bengal were carried out by Mandal (1979) and Bhattacharya et al., (1981).

Aeropalynological survey from various parts of West Bengal was carried out by different workers, Nandi et al., (1985) at Krishnapur and again Bhattacharya et al., (1987) at Jalpaiguri. Boral and Bhattacharya (1999) carried out ecofloristic survey of Berhampur town with a view to reflect aeropalynological scenario of that area and identified a total of 25 airborne pollen types.


Western zone:

In western region of India, Kalra and Dumbrey (1957) investigated aeropalynology from Army Campus at Pune. Chauhal and Deodikar (1964) made a three year aeropalynological survey at Poona. Atmospheric pollen survey of Jalgoan was carried out by Karnik (1962) and analyzed the rain water. Tripathi et al., (1977) reported atmospheric pollen at Bhopal. Tripathi (1978), recorded the incidence of tree pollen in the air were dominant over pollen of herbs and shrubs. Tripathi with Oomachan (1981) prepared pollen calendar for that area. Deshpande and Chitaley (1976) and Chitaley (1977) reported occurrence of airborne pollen at Nagpur and prepared a pollen calendar for the same. Patil (1981) reported airborne pollen from


**Northern zone:**

In the northern region of India, Sanghvi et al., (1957) for the first time carried out aeropalynological survey in Jaipur. Kasliwal et al., (1959), made a pollination calendar. Lakhanpal and Nair (1958) reported the incidence of airborne pollen grains from the atmosphere of Lucknow and later Vishnu- Mittre and Khandelwal (1973) and Chaturvedi et al., (1981) carried out atmospheric pollen survey at Lucknow. Lakhanpal and Nair (1960) studied the atmospheric pollen flora of Almora. Nautiyal and Midha (1978) carried out aeropalynological survey in

Dua and Shivpuri (1962) carried out aeropalynological survey at Delhi and showed that atmosphere of Delhi was never free of pollen. Shivpuri and coworkers studied aeropollen flora in more details and later proposed a pollination calendar. Singh et al., (1978) studied the diurnal periodicities of airborne pollen of Delhi. Later Singh and Babu (1980a) reported the high amount of grass pollen in the atmosphere of Delhi. Subsequently, Singh and Babu (1980 b, c; 1982), Singh (1984) and Singh et al., (1992, 1994) studied aerobiological and allergological aspects of Delhi with their special reference to seasonal periodicities, productivity etc. Singh and Gangual (1986) recorded an account of the sampling distribution pattern of allergens in the atmosphere.

Gorakhpur. Sinha and Mishra (1988) and Pandey et al., (2002) analysed the airborne pollen grains of rural area of Gaya and Banda. Pandey et al., (2002) surveyed atmospheric pollen flora from three different sites at Attarra, U.P. and 79 pollen types were identified and maximum number of pollen were contributed by Asteraceae followed by Fabaceae.


An aeropalynological investigation was carried out at various localities of Srinagar city (Kashmir) by Munshi (1992). Sahney and Chaurasia (2008) reported qualitative survey of airborne pollen grains at Allahabad.

Ahlawat et al., (2010) surveyed prevalence of airborne pollen in the atmosphere of Rohtak City and 31 pollen types were identified and major contributor were, the pollen of Cannabis, Poaceae, Amaranthas etc.

**Southern zone:**

Aeropalynological investigation was initiated by Saha and Kalyansundram (1962). For the first time they prepared pollination calendar for Pondicherry. Nair (1963) initiated aeropalonological works in Vellore. Incidence of airborne pollen in the atmosphere of Visakhapatnam was carried out by Ramalingam (1966-67); Sreeramu and Ramalingam (1966); Reddy (1974); Janakibai and Reddi (1980 and1982) and Atluri et al., (1992). Reddy (1970) also worked out on the incidence of atmospheric pollen grains from Anakapalle. Appanna and Reddi (1978) and later Appanna (1980) carried out a preliminary aeropalynological survey of Vijaywada and
a pollination calendar of potentially allergic pollen producing plants of Vijaywada.


A survey of compilation of Indian aeropalynological works was published by Nair et al., (1986); Chanda and Gupta (1989); Singh and Malik (1992); Gupta and
B: Significance of Aero-allergenic fungal spore and Pollen grains

Since the time of Blackley (1873) it has known that certain forms of human allergy such as hay fever, asthma and sometimes eczema were associated with certain airborne pollen grains and spores. The term allergy was first coined by Anton Von Pirquest in 1906 (cit. Tilak, 1998). It is derived from two Greek words “Allos” (different or change) and Ergos (work or action).

According to Shivpuri (1964) the cause of human allergy like hay fever, asthma and rarely eczema are due to certain microbiological matter like bacteria, viruses, pollen grains, spores and detached parts of plants and animals present in the atmosphere. The pollen grains and fungal spores have been considered to be of special significance for their role in the cause of certain forms of human allergy. Shivpuri (1964), states that “Hay fever is an incorrect terminology only sanctified by history and ancient tradition. It is a disorder in which there is neither fever nor it is caused by hay. It would be more scientific and correct to call it “Seasonal Allergic Rhinitis” and give up the misleading name of ‘Hay fever’ or ‘Summer Catarrah’ or ‘Rose Fever’ which are the other ancient synonyms of this symptom complex, characterized by the seasonal occurrence of attacks of excessive sneezing, itching and running of nose, being sometimes accompanied by itching and watering of the eyes or irritation of the palate or throat. The term “pollinosis” he used to indicate to disorders of seasonal allergy caused by inhalation of pollen grains.

The symptoms induced by pollen grains are also termed as “Pollinosis”. The pollen grains with a mean diameter of 20μ and more are deposited in nasal pharynx and leach out allergenic proteins or glycoprotein of molecular weight ranging...
from 5,000 to 90,000 Daltons. The allergenic principles of allergic disorders however differ with species of plants as well as their environment and seasonal changes. Berger and Hansen in 1931 indicated (i) the strict specificity of the various families of plants, (ii) the probable existence of specificity of the various genera within the same plant family and (iii) the close antigenic interrelationship of various species of the same plant genus.

The term allergy is defined as altered reactivity to a substance that is harmless in itself but induces synthesis of antibodies in susceptible human beings on first and subsequent exposures. Antigens responsible for such reactions are known as allergens. Some people may possess a kind of constitutional defect in human immune system producing some harmful anti-substances known as sensitizing antibodies against the exposure of some allergens like pollen grains, fungal spores, feathers, chemicals etc. Studies have been shown that due to the allergen-antibody reaction certain mediators of allergy are released e.g. histamine, 5-hydroxytryptamine, SRS-A (slow reacting substance of Anaphalasia) some kinins etc. These mediators are responsible for the precipitation of symptoms of allergic disorders such as breathlessness in the patients of asthma, sneezing and running nose in the patients of rhinitis and itching and rashes in the patients of uriticaria etc. (Shivpuri and Agarwal, 1974). Five classes of immunoglobulins (proteins with antibody property) are known to exist in human immune system of which IgE and IgG play an important role in atopic pollen allergy. IgE antibodies have been unique property to bind mast cells and basophils. On contact with an allergen, the cell bound IgE antibodies mediate the release of active amines, like histamine from the mast cells and basophils, thus causing symptoms of allergy. Depending upon their route of exposure they are classified as a) Inhalants, b) Injectants c) Ingestants and d) Contactants. Coombs and
Gell (1963) classified allergic reactions into four types: Type I, Type II, Type III, and Type IV. Type I, IgE dependent; Type II, cytotoxic tissue specific antibody: Type III, due to toxic antigen-antibody complexes with activated complement and Type IV, due to T lymphocyte cell mediated hypersensitivity. The role of Type I allergy for vast majority of cases of allergic rhinitis, bronchial asthma, atopic dermatitis, actute urticaria, and recently of Type III allergy for a small minority of cases of asthma is well established, whereas role of Type IV in contact dermatitis and Type II in some hemolytic anemias, leucopenias and thrombocytopenias is also well known.

Type I allergy is the basic immunology reaction underlying the majority of common allergy diseases. Type I allergic reaction occurs within 5-30 minutes after exposure to the allergen depending on the route of entry and dose.

The antibody involved, also called reagin belongs to the immunoglobulin class, IgE which is glycoprotein. The reaction begins within minutes of the union of inhaled or circulating antigens and the reagins bound to the surface of the tissue mast cells located beneath the respiratory mucosa. The union activates an enzyme leading to degranulation of mast cells. The extruded granules rupture releases histamine with the production of odema and vaso-dilation. Other vaso-active substances such as slow-reacting substance of anaphylaxis (SRS-A) and possibly kinins are also released causing increased activity of mucous glands and prolonged broncho-constriction. There is no cell destruction and complement is not involved.

Asthma can also produced by Type III immune response involving the heat stable, precipitating antibody which belongs to IgG and IgM class of immunoglobulin. Immune complexes are large molecular aggregates formed by the union of antigen and precipitating antibody and, at times, complement.

These immune complexes when formed in moderate antigen excess
fix the C3 component of the complement. Complexes larger than 19-S seems to become entrapped beneath the endothelial cells, along the basement membrane or internal elastic lamina of arteries where complement is activated enzymetically. Fractions 5, 6 & 7 of complement attack polymorphonuclear leucocytes which are destroyed causing them to release lysozymes which in turn induce inflammation or necrosis in blood vessels or adjacent structures.

Immune-complexes seem capable of liberating histamine from mast cells which causes increased permeability, with resultant production of symptoms & signs of asthma. Liberation of potent mediators such as anaphylotoxins may be important in some of the tissue reactions of Type III allergy. Eosinophilia often accompanies immune complex diseases in the lungs. The preceding Type I reaction mediated by reaginic antibody which seem to be an important precursor of Type III (Arthus) reaction. Such a Type III reaction may cause irreversible tissue damage.

Type III reaction appears a little late and becomes evident 4-5 hours after the test, being maximal at 7-8 hours and resolves slowly within 36 hours. This type of reaction can be easily detected in intradermal as well as bronchial sensitivity tests using specific antigens. Dual reactions (Type I and Type III) are often observed on such tests in many cases of asthma (Tilak 1987).

Allergy means development of hypersensitivity to harmless substances which act as toxin for that individual and are called allergens. The common harmless allergens are house dust, pollen of flowers which are usually wind pollinated and spores of fungi which are usually saprophytic. Antibodies are produced in the blood of human beings due to infection of proteinous substances such as pollen, spores and bacteria. Antibodies are protective in nature and are responsible for acquired immunity against the fungal and bacterial infections. In the clinical sense,
the word “Allergy is used to mean the same as hypersensitivity with special reference to the hypersensitivity observed in human beings”.

The difference between hypersensitivity and immunity seems to be in the concentration of free-circulating antibodies. The hypersensitive animals become immune when the concentration of free-circulating antibodies is increased. Elliston (1831) was the first to suggest that hay fever was caused by pollens, but this was proved only by Blacklay’s demonstration on the nasal mucous with the pollen extract 1873. Dunbar (1905) produced an antitoxin which he believed as the poisonous element in pollen of cereal by injecting into horses. Noon (1911), in England, Cook and Vander Veer (1916) and Walker (1917-1950) in U.S.A. in 1911 to 1917 made simultaneous discoveries that persons may be sensitized to foreign proteins when they come in contact with them. The introduction of allergic disorder due to inhalation of pollen grain (pollinosis) and fungal spores has been noted by many workers; Von Leween, 1951; Hyde, Richards and Williams, 1956; Shivpuri, 1964; Von Leeween, 1924, proved 0.5-1% of the population island of Zui Beveland suffered from asthma due to the inhalation of fungal spores present in the air. Hopkins, Bentham and Kastin, (1930), reported a case due to species of Alternaria. According to Dutkiewicz, (1997); the inhalation of organic agricultural and industrial dust is the principal source of occupational allergy. D’Amato, G. & Spiekman, F. Th. M. (1995) Studied Aerobiological & Clinical aspects of mould allergy; Lopez, M. B.; Salvaggio, J.A.; & Butcher, B.T. (1976) studied allergenicity and immunogenic of Basidiomycetes. Herxheim, H. et al., (1969), reported allergic asthma caused by Basidiomycetes. Burge, H.A. & Rogers, C.A. (2000), studied outdoor allergens. Meo, S.A., (2004) worked on occupational allergy. Lugusukas, A. et al., (2004), studied on airborne fungi in Industrial environment potential agents of respiratory diseases.
It has been reported that, about 15-20% of the world population were estimated to suffer from major allergic diseases, while in India, it is more than 10% of the population (Singh & Mallik, 1992). Recently, Singh et al., (1997) reported that the scenario is becoming alarming as up to 60% of workers in Delhi suffer from respiratory disorders.

The fungal content of the airsora has been analyzed in several allergens in disease epidemiological studies leading to a pattern of distribution of air spora have been done. It is known that certain forms of human allergy such as hay fever, asthma, uriticaria and occasionally eczema and certain disease of animals such as allergic foot and mouth disease of domestic and commercial animals, ephemeral fever in cattle and fowl; putrient meritis in cows; facial eczema are associated with certain air-born fungal spores. The allergic disorders due to inhalation of fungal spores has been noted by many workers viz. Hyde and Williams,(1949,1956); Gregory (1952); Agbayani, et al., (1967); Ozkaragoz, (1967); Nakayama, et al., (1967); Frankland and Gregory, (1953); Ordman, (1970), Agarwal and Shivpuri, (1974); Chakravarty, (1974); Yungingen, Roberts and Gleich, (1976), Shivpuri (1980), Mandal & Chanda (1981); Agashe and Anand, 1982; Solomon (1988); Chanda and Gupta (1989); Ellis et al., (1992); Agarwal and Shivpuri, (1994); Adhikari et al., (1996); Bora et al., (1996); Shah (1997) and Singh et al., (1997).

As a result of various investigations it is now possible to conclude that atmospheric airsora constitutes an important cause of inhalant allergy. This view also supported the impression that allergy to mould spores is a rarity and is confined to individuals with specific residential or occupational exposure (Richards, 1954; Feinberg, 1935), however opposed view having noted that fungal allergens were commonly found in his clinic and stated that outside air was the important source of
allergens which were of plant origin.

From time to time, numerous surveys have also sustained the fact that atmospheric fungi constitute a world wide problem for respiratory allergic human disease. Among the various fungal genera, the genus *Aspergillus* is important, as it has been found to effect man and animals alike studies in this aspect have been conducted by Ellis *et al.*, (1992); Shrestha and Sharma, (1996); Singh *et al.*, (1998); Singh and Singh, (1999), Borha and Purohit, (2003); Gupta, Bhattacharya *et al*, (2005). *Aspergilli* are mostly saprophytes, although one or two species have been described as parasitic to human body. The genus *Aspergillus* includes a large number of species of low virulence, which are common to the environment and to which man is constantly exposed. As a result, a variety of clinical conditions are seen, both normal individuals and in the compromised host. The more serious forms of infection; usually caused by *A. fumigatus*, include invasive disease, in which there is extensive growth of the organism in tissues and aspergillomas or fungal balls, in which there is localized growth of the organism in performed cavities. Invasive aspergillosis, most frequently seen in patients with leukemia, is usually, pulmonary and is associated with extensive necrosis and destruction of the functional tissue (Mizuki *et al*, 1994). The two specie, *A. flavus* and *A. fumigatus* are known to effect animals produce aflatoxins as referred earlier. Moreover, two species- *A. niger, A. nidulans* along with the previous two i.e., *A. flavus* and *A. fumigatus* have been associated with ABPA i.e., Allergic Broncho Pulmonary Aspergillosis, in men by Ellis *et al.*, 1992; Sing *et al*, 1995; Shash, (1997). ABPA has been established to be an immunologically mediated lung diseases, resulting from hypersensitivity to *Aspergillus* antigens (Shah, 1997). The disease caused by different *Aspergillus* species known as Aspergillosis (Mori *et al*, 1998). The intensity of effect is varied, depending on the species, the duration and
nature of exposure and the amount of spores inhaled by the patient. *A. nidulans* has also been associated with pulmonary, oxalosis by Nakagawa *et al.*, (1999). *Aspergillus* sp. is the most abundant in indoor as well as outdoor environment and is the prime etiologic agent in Allergic Broncho Pulmonary Aspergillosis (ABPA), (Salvaggio and Aukrust, 1981). Charles Blackley in 1873 indicated the bronchial catarrh, caused by *Penicillium glaucum* and *Chaetomium* sp.

Bovilla *et al.*, (1961) conducted those fungi imperfecti are the most clinically significant in their role in allergic diseases. Fungi imperfecti are the most important class of fungi to cause IgE mediated allergy to man. *Alternaria* sp. is well known to be highly allergenic.

Bovilla *et al.*, (1961) concluded that fungi imperfecti are the most clinically significant in their role in allergic diseases. Reddy (1974), observed allergenic potentials of the various kinds of plant spores in terms of their numerical and volumetric incidence, Frankland and Gregory, (1953); investigated allergenic and agricultural implications of airborne ascospores concentration from a fungus, *Didynella exitialis*.

The study of the cause of allergic diseases has not been neglected in India. The information on inhalant allergens present in the air available only for Jaipur, Kasliwal, Sanghvi, Gupta and Sogani, (1959a); Kasliwal and Solomon, (1958); Kasliwal, Sogani and Sethi, (1959b). In Delhi, Dua, (1962); Shivpuri and Dua, (1963); Shivpuri, (1964); Shivpuri and Singh, (1979), where antigen test on patients have been carried out. In other places of India like Lucknow, Aligarh, Poona, Almora, Vellore, Nagpur, Mysore, Calcutta and Kalyani only airspsora have been made out. However in Guwahati, Baruah and Bora, (1966) investigated the clinical aspects of airspsora serologically. Devi, Saha, Sharma; (1996) studied Flowering Calender of tree
species of Guwahati with special reference to their allergic significance.

It has been reported that, about 15-20% of the world population are estimated to suffer from major allergic diseases, while, in India, it is more than 10% of the population (Singh and Malik, 1992). Recently, Singh (1997) reported that the scenario is becoming alarming as up to 60% of workers in Delhi suffer from respiratory disorders.

In India, Shivpuri et al., (1960) was the first to initiate research on pollen allergy in Delhi and Kasliwal and co-workers in Jaipur (1958, 1959 and 1961). Shivpuri (1964) enumerated airborne pollen of plant species responsible for pollinosis in India. Clinical investigations on pollen were carried out by Shivpuri and Dua (1963), Shivpuri and Singh (1979); Chanda et al., (1975); Shivpuri (1980); Agashe et al., (1982) and Kundu et al., (1988).

Singh et al., (1994) suggested that avoidance is the best treatment to get ride of allergic diseases, however, it is also difficult to avoid pollen completely as they are omnipresent in the atmosphere. The patient may be suggested to alter their work place during peak pollen period although it is not possible to do so every time. The patients may stay indoor and inhale filtered air in order to reduce pollen load. Immunotherapy is another method used against allergic diseases to develop blocking antibodies (IgE) against antigens. Immunotherapy in the pollen allergy is recommended only with immediate type of hypersensitivity (type I allergy). A third method is the use of pharmacotherapy drugs.

The principles which govern aeropalynological studies with particular reference to allergy are- (i) Pollen grains are discharged into the air from different flowers. The pollens are disseminated into the air through various medium like air, water or insect. (ii) Pollen grains that discharge into the air are not only from the
anemophilous flowers but may be also from entomophilous ones, thus contribute to atmospheric pollen flora. (iii) Through air, these pollens find entry into bronchial tract. (iv) The exine of pollen carries distinct morphological characters which are the main criteria for the identification and recognition of the family or spores represented by the pollen in the air. (v) The pollen grains discharged in the air are distributed almost everywhere. The airborne pollen grains and spores are known to be the main cause of allergy in human beings which warrants the understanding of the air spora as an essential pre-requisite to the clinical practice of allergy.