Ladies and Gentlemen and dear Colleagues

It give me a great pleasure to give this oration on “Medical Mycology in India: Past, Present and Future” at the 6th Conference of SIHAM. I wish to sincerely thank the members of the Organizing Committee for kindly accepting my offer to give this lecture. I chose this topic as I thought this is an appropriate occasion to have a look at the history and development of medical mycology in India, including our important contributions, and the future goals and perspectives. I wish to dedicate this oration to the memory of late Dr. Libero Ajello. Dr. Ajello was not only a great and pioneer medical mycologist but also an embodiment of humility and kindness. With his qualities of head and heart, he helped numerous medical mycologists around the globe in their mycological research. At this moment, my memory lane goes back to June 1975, when he gave a presidential oration on “Milestones in the development of medical mycology” at the Congress of ISHAM held in Tokyo. I had the privilege to attend this inspiring and wonderful lecture.

Coming to the theme of the present lecture, I wish to start with the early interaction of humans with fungi and the origin of the scientific study of fungi in India. The interaction of Indians with fungi started thousands of years ago. There is scientific evidence that the mushroom, Amanita. muscaria may have been the oldest of the hallucinogens used by the Aryans, and may possibly be the most widely used cryptic symbolism in the Rig Veda. There are references to the use of mushrooms as foods and medicines in India in the ancient medical text, Charaka Samhita (3000+500 BC). However, their scientific study of mushrooms is of recent origin. In the 18th century, Koening got his collection from Tamil Nadu State identified as Podaxis pistillaris (L.:Pers) Mosse by Linnaeus. Subsequently Sir, J.D. Hooker made a collection from hills led to a series of papers by an English mycologist, Reverend M.J. Berkley. This first phase lasted up to 1899. A significant feature of the second phase (1900-1960) was the involvement, besides European and American workers, of several Indian workers on larger as well as micro-fungi.

Earlier medical mycological and plant pathological work in India

The earliest record of a mycotic disease is in Athara Veda (About 2000-100 BC), of mycetoma described under the name “Padalvalmita” (Foot anthill) (Saran et al 1972). Gill, an English physician working in a dispensary in Madura in South India first described a probable case of mycetoma in 1842 in his dispensary report, Godfrey, a Garrison surgeon working in Bellary first described mycetoma (as “morbus “tuberculosis pedis”) in 1846 in medical literature (Lancet 1: 593-594). In 1859, Eyere, one of Godfrey’s colleagues described 40 cases treated between 1844 and 1848. It was Carter, who in 1861 first suggested the fungal etiology of the disease (Trans Med Phys Soc Bombay 1861; 7: 206-221) and later in 1874 published a monograph ”On Mycetoma and
Fungus Diseases of India" (J & Churchill Ltd.). Carter also described the pathological features of mycetoma, caused by the organism now known as Madurella mycetomatis. The first isolation of the causative organism was made by Brumpt in 1906. Powell reported ringworm from Assam in 1904. Medical mycological research in India started in 1920 under Lt. Col. H.W. Acton (with C. McGuire, G. Panja & K.P. Banerjee) as a part of Pathology & Microbiology Department in Calcutta School of Tropical Medicine, Calcutta. Acton in 1926 described red-grained mycetoma.

It may not be irrelevant to mention that the work on fungal diseases of plants in India was started by E.J. Butler, a British physician at Pusa, Bihar in 1903 with the publication of monograph on “Potato diseases of India” (Agr Ledger 4: 112-119.). Appointed as Imperial Plant Pathologist) Butler worked at the Indian Agricultural Research Institute in Pusa (Bihar) from 1905-1921 and established a strong school of mycology and plant pathology. Butler published an authoritative list of Indian fungi in collaboration with G.R. Bisby (Butler & Bisby, 1930). This publication has been continuously updated until the last edition by Sarabhoy et al (1993). Butler is aptly called the father of “Indian Plant Pathology”. Before departing from India, he published in 1918 a book on “Fungi and Diseases in Plants”, which remains a classic on the subject till today. Three plant diseases epidemics due to fungi, viz. Helminthosporium blight of rice resulting in Bengal famine of 1942, wheat rust to Puccinia triticina causing severe wheat shortage in Madhya Pradesh in 1946-1947, and the red rot of sugarcane, caused by Colletotrichum falcatum in several parts of northern India in 1938-1942 stimulated greatly the research on fungal diseases of plants. There was no such thing then to stimulate research in human fungus infections. However, the advent of global epidemic of AIDS and manifestation of certain opportunistic infections as indicator diseases in AIDS in the past two decades has promoted the study of human fungus infections to a great extent in developed countries and to some extent in developing countries including India.

Establishment of separate Departments/ Sections/ Units of Medical Mycology.
The creation and staffing of Medical Mycology sections/units/Departments in some of the Institutions and Universities is described below.

Calcutta School of Tropical Medicine, Calcutta: A separate Department of Dermatology & Medical Mycology was established in 1931 with A. Maplestone as in-charge and NC Dey, D Panja and LN Gosh as associates. An independent Medical Mycology Department was established in 1960 with Dr. SR Bose as head. Later Drs. Maya Sanyal, N. Basu, A Thammayya, and worked as a team for nearly three decades with other associates, mainly Drs. P.K. Maiti, A. Ray, PK Haldar and others in RG Kar Medical College and University College of Medicine, Kolkatta.

Vallabhbhai Patel Chest Institute (VPCI), University of Delhi, Delhi: Mycological work started in the institute in 1957 with investigation of role of fungi in Baggasosis under an Indian Council of Medical Research (ICMR) Project. Prof R. Viswanahan, the founder Director of VPCI established the Department of Medical Mycology in 1959 with appointment of Dr. H. S. Randhawa as foundation staff; later Dr. R.S. Sandhu and Dr. S.C. Chakrabarty joined the Department. Other Faculty staff who worked in the
Department include Dr. Z.U. Khan (1974-1992) and Dr. H.C. Gugnani (1997-2004). Dr. A. Chowdhary, who joined in 2001 is currently the Head of Department. Dr. Randhawa is continuing to work in the Dept. (after retirement in 1998) as Senior Emeritus Scientist of Indian National Science Academy (INSA). It is from this centre that Candida viswanathii was reported as a new species (named after Viswananthan)

**Madras Medical College, Chennai & Government General Hospital, Chennai**

The Mycology Section was started in 1960 under Dermatology Dept. as brain child of Prof. A. S. Thambiah with Dr. P.V. Venugopal, and Dr. A. Kamalam. Other faculty staff who worked were Dr. G. Sentamilselvi, VR Jamaki and C.Janaki as academic staff. The section is presently headed by Dr. C. Janaki.

**Post-graduate Institute of Medical Education & Research (PGIMER) Chandigarh:**

Mycology laboratory in the Department of Microbiology was established in 1964 by Dr. Pushpa Talwar and raised to Divisional status in 1979. Dr. A. Chakrabarti joined as Faculty staff in 1988. The laboratory was raised to the status of Division in 1979. Dr. Chakrabarti took over the reins of the Division in 1991 after retirement of Dr. Talwar, and is currently supported by another faculty staff, Dr. Shiva Prakash

**All India Institute of Medical Sciences (AIIMS), New Delhi:**

Mycology section established under the leadership of Col. Prof. S.L. Kalra, Head Dept. of Microbiology in with Dr. L.N. Mohapatra as Faculty Staff in charge, later joined by H.C. Gugnani in 1962 as ICMR Project Staff. It is from this laboratory that the first strain of Arthrographis kalrae (named after S.L. Kalra) was isolated (by Ram P. Tiwari, a visiting worker). Later the Mycology section was headed by Dr. R. Kumar and more recently by Dr. Uma Banerjee.

**National Institute of Communicable Diseases (NIDC), Delhi:**

The Section of Medical Mycology was established in 1964 (under the Division of Microbiology) with H.C Gugnani (research officer) as the foundation staff, later joined by S.K. Shome (as assistant director) in 1967. Later Drs Z.U. Khan, R. Rajendran and K. Chandrasekhar worked for varying periods. Currently the Division of Med. Mycology is headed by Dr. Chandrasekhar.

**Department of Biological Sciences, Rani Durgawati University, Jabalpur**

The work in medical mycology in this centre in MP (in Central India) was pioneered by Dr. S. M. Singh in 1978 in the Department of Biological Sciences under the stewardship of Prof. G.P. Agarwal, the then Head of Department. The medical mycology laboratory has been has been providing diagnostic services in human fungal diseases to the hospitals in and around Jabalpur for the past twenty years. His current team in the Department includes Dr. Jayshree Naidu and Dr. Nwage Rao.

**Lokmanya Tilak Municipal Medical College and General Hospital, Mumbai**

Mycology section was established in the Department of Microbiology in 1979 by Dr. Lina Deodhar, then Professor and Head of Dept. and Dr. V.B. Ambekar, Reader in the Department. With the expanding medical mycological work and research, Dr. Uma
Tendolkar, Associate Professor assumed the charge of the section in 1984 and is still working in the Dept.

**Society for Indian Human and Animal Mycologists (SIHAM)**

SIHAM was founded in 1995 with the tenuous efforts of Prof. S.M. Singh and other colleagues with only 17 members. Since then the society has steadily grown to substantial membership. The first annual Conference was held at Rani Durgawati University, Jabalpur-MP (the birth place of the Society with Prof. Singh as the mid-wife) in February 1996. Subsequent Conferences were held in Jodhpur (Rajasthan), Chennai, Annamalai Nagar (Tamil Nadu), and Chandigarh, and we are now attending the sixth Conference in Hyderabad today. The SIHAM has become a good forum for exchange of academic ideas and mutual collaboration efforts in organizing training workshops in different regions of the country. The Newsletter of the Society was started in 2002 with the laudable efforts of Dr. A. Chakrabarti (who is also its Editor), and with financial support of M/S Pfizer, India. It has continued to serve as a commendable source of valuable information and educational material on mycoses. SIHAM is planning to publish its own journal

**Important contributions to research in medical mycology**

**New species of pathogenic fungi**

*Candida viswanathii* a new species recovered from the cerebrospinal fluid of patient of meningitis (Viswanathan & Randhawa 1959), and later from sputum (Sandhu & Randhawa, 1962).

*Artrogrpahis kalrae* (Tewari & Macpherson) Sigler & Carmichael, originally recovered from sputum, proved pathogenic for laboratory mice (Tewari & Macpherson 1971). It was then named as *Oidiodendron kalrai*. The species is known to cause cutaneous and systemic infections.

*Saksenaea vasiformis*: Saksena discovered in 1953 a new genus, with *S. vasiformis* as the type species (also the only known species). It is known to be a world-wide saprobe in soil and has emerged as an important human pathogen, often associated with cutaneous and subcutaneous infections.

*Apophysomyces elegans*: Misra with his associates Srivastava and Latas (1979) discovered a new mucoraceous fungus, with *A. elegans* as the type species (the only known species of the genus). It was initially isolated from soil samples collected from a Mango orchard from Northern India (Misra, Srivastava & Latas, 1979) and is known to have a wide tropical and subtropical distribution. It has emerged as an important human pathogen of immunocompetent and immunocompromised hosts.

*Aspergillus nidulans* var. *dentatus* from nail (Sandhu *et al.* 1963).
Novel pathogenic fungi

*Ustilago maydis* as etiological agent of a unique case of brain mycosis, manifesting as brain tumour with symptoms of blindness and raised intracranial tension (Randhawa, Tandon & Smetana, 1959). This fungus is a well-known plant pathogen causing smut of maize.

First report of association of *Candida tropicalis*, a human commensal and pathogen, with maize stalk rot (Lalaramani et al. 1974).

*Ascotrihca chartarum* as a causal agent of human infection (maxillary sinusitis) (Singh et al. 1990)


First report of *Nodulisporium* sp as an etiological agent of human infection (cerebral phaeohyphomycosis) (Umabala et al 2001).

*Cylindrocarpon* sp as an etiological agent of mycetoma (Hemashettyar et al. 2002).

*Aspergillus versicolor* as the causal agent of cerebral abscess (Venugopal et al 1978).

*Emericella quadrilineata* (anamorph *Aspergillus tetrazonus*) as an etiological agent of onychomycosis (Gugnani et al. 2004).

Development of rapid/novel diagnostic techniques

Use of sesame oil as a substitute of olive oil in isolation of *Malassezia furfur* (Sanyal & Thammayya 1975.)

Application of paraffin bait technique for isolation of *Nocardi a asteroidis* from clinical specimens (Mishra & Randhawa, 1969)

Modified inositol assimilation test by *Cryptococcus neoformans*, yielding results within 48 hrs as against 14 days by Adams-Cooper technique (Paliwal et al, 1979 Canad J Microbiol 25: 346-348

Use of Berthiolate color reaction for rapid detection of urea hydrolysis by *C. neoformans* and other yeasts (Paliwal et al. 1977 Environ Microbiol 33:219-220). It yields results within 30-50 minutes compared with 8-72 hrs usually required the conventional technique using Christensen urea agar.

Use of L-DOPA pigmentation test for development of mouse-grey violaeous black pigment diagnostic of *C. neoformans*. When the fungus is inoculated in phosphate-buffered liquid medium incubate at 37 °C, the characteristic pigment forms within 15-30 minutes as compare with over 5 hrs using the test described by Hopfer & Groschel (1975) (Paliwal & Randhawa, 1978 Antonie van Leeuwenhoek 44:261-264).

Simplified Staib’s medium (bird seed /niger seed agar), eliminating brown pigment diagnostic of *C. neoformans* (Paliwal et al. 1979 J Clin Microbiol 7: 346-348).
A new medium, tobacco agar, for pigment production of *Cryptococcus neoformans* (Tendolkar *et al.* 2003). This has led to a new use of the medium i.e. differentiating *Candida dubliniensis* from *Candida albicans* (Khan *et al.* 2004).

Cotton seed agar (7% aqueous seed extract of *Gossypium hirsutum* or *G. arboareum*) as an inexpensive but efficacious medium for *in vitro* conversion of *Blastomyces dermatitidis* to yeast form (Chaturvedi *et al.* 1990 *J Med Vet Mycol* 28: 139-145).

**Contributions to epidemiology of endemic and emerging mycoses**

**Dermatophytosis**
Demonstration of soil as a natural source and rodents (mainly *Meriones hurrine*, *Suncus murinus*) as animal reservoirs of *Trichophyton simii* (Padhye *et al.* 1966; Gugnani *et al.* 1967; Gugnani *et al.*, 1975). The dermatophyte was first described as a new species recovered from monkeys imported from India in England (Stockdale *et al.* 1965).

First report of an epizootic of dermatophytosis in poultry due to *Trichophyton simii* (Gugnani & Randhawa, 1973)

Detection of endemic microfoci of geographically restricted dermatophytes: *Trichophyton schoenleini* infection in the Kashmir valley (Hajni *et al.* 1987), and *T. yaoundei* in pockets of Maharashtra and Karnataka. (Hemashettar *et al.* 1993)

Association of *Trichophyton mentagrophytes* with the bark of *Eucalyptus* tree (*E. camaldulensis*) (Musa *et al.* 2000).

**Oculomycosis**
The first report of mycotic keratitis due to a basidiomycete, *Rhizoctonia* sp. (Srivastava *et al.* 1968; *Sabouraudia* 15: 125-131.). Other novel fungi reported as etiological agents of mycotic keratitis by these workers were *Paecilomyces lilacinus*, *Colletotrichum* state of *Glomerula singulata*, and *Arachiiphialophora fusispoa*.

First report of Mycotic keratitis due to *Cephaloiphora irregularis* Thaxter (Mathews & Kurioleose, 1995).

**Histoplasmosis**
Isolation of *Histoplasma capsulatum*, the etiological agent of histoplasmosis from one of the three samples of soil admixed with bat guano collected from an abandoned room of a 350-year old palatial building infested with insectivorous bat, *Scotophilus heathi* (Sanyal & Thammayya, 1975).

**Blastomycosis**
Recovery of *Blastomyces dermatitidis*, from the visceral organs of bats (*Rhinopoma hardwickei hardwickei*), thus implicating these flying mammals as an additional host or a vector of this dimorphic pathogen. (Khan *et al.* 1982; Randhawa *et al.* 1985) These findings and the report of the first autochthonous case of blastomycosis in India (Randhawa *et al.* 1983.) established the endemicity of this disease in India.
**Penicilliosis marneffei**
Detection of first four authocthonous cases followed by detection of numerous cases of the disease form Manipur State in northeast India (Singh et al. 1999 J Clin Microbiol 37: 2699-2702; Ranjana et al. 2002). Establishment of Cannomys badius as a natural host of *Penicillium marneffei* (the etiological agent of penicilliosis marneffei) in Manipur State in India. It was also the first conclusive evidence that bamboo rats, *Cannomys badius* may share with humans genetically similar strains of *Penicillium marneffei* (Gugnani et al. 2004). These findings thus established Manipur State as an important focus of this life threatening infection.

**Coccidioidomycosis**
First authentic case (originating from Arizona in USA) reported from India (Baruch et al. 1996 Lancet; 348: 1313) followed by another such case (Verghese et al. 2002 Med Mycol 40: 307-309.)

**Zygomycosis**
First case of lymph node invasion by *Conidiobolus coronatus* and it spore formation in vivo (Kamalam & Thambiah, 1978).

First case of muscle invasion by *Basidiobolus ranarum* (haptosporus) (Kamalam & Thambiah, 1984).

Isolation of *Basidiobolus ranarum* form the intestinal contents of an insectivori bat, *Rhinopoma hardwickei hardwickei* (Chaturvedi et al. 1984).

Detection of a large number (maximum number of cases in the world from a single center) of *Aphysomyces elegans* infection, with some cases of newer clinical spectrum (renal and rhino-orbitocerebral involvement), thus highlighting this emerging infection (Chakrabarti et al. 2003).

**Aspergillosis**

Association of virulence with p-aminobenzoic acid deficiency in *Aspergillus fumigatus* (Sandhu et al 1976).

Identification, cloning, and expression of a 44 Kda novel allergen/antigen of *A. fumigatus* with sequence homology to L3 ribosomal protein with a probable role in resistance of the fungus to antifungal drugs (Saxena et al. 2003).

Identification and establishment of the role of surfactant proteins SPA-A, SP-D and MBL in the host defense against allergic and invasive aspergillosis by in vitro and in vivo studies (Madan et al. 2005)

**Infections due to yeasts and yeast-like fungi and their ecology**
A nosocomial outbreak of infection due to an unusual yeast *Pichia anomala* involving 379 neonates and children; molecular studies suggested that the 40 isolates including those from patients and the healthcare worker’s hands were clonal (Chakrabarti *et al.* 2001).

First report of nosocomial outbreak of candidemia due to *Candida tropicalis* in neonates documenting clonal origin of isolates. (Chowdhary *et al.* 2003).

First report of lymphadenitis due to *Rhodotorula mucilaginosa* (Satyanarayana *et al.* 2003).

*Malassezia furfur* as a possible etiological agent of onychomycosis (Chowdhary *et al.* 2005).

Association of *Cryptococcus gatti* from Eucalyptus trees (*E. camaldulensis* and *E. terreticornis*) (Padhye *et al.* 1993; Gugnani *et al.* 2005) and *Cryptococcus neoformans* var. *grubii* with trees of and *Syzygium cumini, Ficus religiosa, Buta monosperma, Tamarandus indica Euclayptus camaldulensis* (Randhawa *et al.* 2001; 2003, Gugnani *et al.* 2005)

**Mycetoma**
Several investigators from different parts of India have made significant contributions on the prevalence and etiology of mycetoma in the country. Some of the studies are by Klokke *et al.* 1968; Desai *et al.* 1970; Koshi *et al.* 1972; Dasgupta *et al.* 1974; Taralakshmi & Pankajlaksmi, 1977; Kamalam & Thambiah, 1987; Joshi *et al.* 1987; Venugopal & Venugopal 1995; Sanyal *et al.* 1976; Sentamilselvi *et al.* 1997). Among the several notable contributions on the etiology were first isolations of *Leptospaeria senegalensis* and *L. tompkinsii* outside of Africa (Pankajlakshmi & Taralkshmi *Int J Dermatol* 1979).

**Molecular diagnosis of fungal infections in India**
Use of PCR in the diagnosis of fungal endophthalmitis from Sankar Netralaya, Chennai (Anand *et al.* 2001)
Demonstration of usefulness of PCR in laboratory diagnosis of systemic fungal infections in a study from Mumbai (Iyer *et al.* 2002)
We need to evaluate PCR in greater number of laboratories before confirming the usefulness of this technique.

**Future needs in medical mycology in India**

*Teaching and diagnostic services in medical mycology* Although there has over recent years been a marked rise in the incidence of serious fungal infections, many of which are prevalent in developing countries, few facilities exist for diagnosis and research in medical mycology. In most medical colleges, medical mycology is not taught adequately
to medical students; only very few lectures/practical classes are organized, even for postgraduate students. Consequently there is little awareness of the importance of fungal infections active engagement of the teacher in medical mycological work will enhance teaching and research.

Clinicians, surgeons, pathologists, microbiologists and others involved in the care of patients need to be trained and educated to make them aware that mycoses may be responsible for many chronic and undiagnosed and there is frequent possibility of opportunistic fungal infections in AIDS patients. Model teaching programmes need to be developed. Practical knowledge of mycoses, their diagnosis and treatment and also basic mycology can be disseminated through well-constructed courses and workshops. Formalized training in mycology research also needs to be introduced. To achieve all of this, expertise and additional resources need to be made available. In this regard, ISHAM could help.

**The need for Quality Control Programme**

It is essential to have a good quality control programme to ensure reliable diagnostic services and correct identification of clinical isolates of fungi. One of us initiated it on his own and about 20 faculty staff, residents, Ph.D. students participated for about 2 years; it could not be continued due to lack of administrative and financial support. Indian Association of medical microbiologist (IAMM) also included some inputs for mycology in its quality assurance assignments for the participating laboratories. A regular Quality Control Programme should be undertaken under the auspices of SIHAM in collaboration with IAMM with possible financial support from some government and non-government agencies

**Research in medical mycology in India**

This should focus on epidemiology of common fungus infections and investigation on modalities of prevention strategies. Collaborative studies should be undertaken to determine the prevalence of important fungus infections in different population groups. A few suggestions are made here.

**Investigations on Epidemiology of common fungus infections**

**Dermatophytosis and other superficial mycoses:** It is estimated that about 20-30% of population suffer from ringworm. There are few comprehensive studies of mycoses based on hospital records (e.g. Kamalam & Thambiah *Sabouraudia* 1976) but there is need to estimate the prevalence of dermatophytosis and other superficial fungus infections in different population and occupational groups, especially in rural areas. One such study by Klokke et al (1968) is noteworthy in this context. Investigation should be conducted on modalities of prevention strategies including health education campaigns (as a part of general health education) and determining their effect on reduction of incidence of superficial mycoses e.g. pityriasis versicolor, dermatophytosis. Scientific investigation of herbal formulations in treatment of superficial mycoses is also called for.

**Mycotic keratitis:** It is very frequent serious ophthalmic problem, often resulting in the loss of eyes. There is need for formulating effective and affordable anifungal
combinations for early treatment of corneal ulcers caused by fungi. There is also need for instituting preventing chemotherapy in individuals like farmers, carpenters and other categories of workers, particularly in rural areas, who frequently sustain corneal injuries for prevention of development of corneal ulcers. Fungal infection is only a part of the overall problem of the loss of eyes from suppurative keratitis. It should now be possible to produce a combined antifungal antibacterial preparation for widespread and immediate prophylactic first aid use after corneal trauma, especially in rural areas. Surveys are, however, needed to define the causes of suppurative keratitis leading to loss of eyes in various regions. These include Gram-positive and Gram-negative bacteria, a variety of fungi, especially, *Aspergillus* species, *Fusarium* species, fresh water pathogenic amoebae and probably some anaerobic bacteria. These studies may require provision and distribution of kits for diagnostic cultures. Excellent centers of ophthalmic research in India, like Dr. Rajender Prasad Centre for Ophthalmic Sciences, LV Prasad Institute of Ophthalmology should explore this problem with a missionary zeal.

**Mycetoma:** Pilot surveys should be conducted to estimate the prevalence of mycetoma in rural areas representing different geographic areas of India. It is not difficult to work our on modalities of prevention strategies including health education campaigns. Development and standardization of myco-serological/molecular techniques to detect early cases of mycetoma. Scientific investigation of herbal formulations for treatment of early and progressive cases of mycetoma.

Further, there should be provision of facilities for identification and the measurement of antimicrobial sensitivities. National and international collaboration can contribute in this endeavour.

**Epidemiology of Penicilliosis marneffei:**
Numerous cases of this mycosis have been recognized in Manipur State northeast. Investigations should be undertaken to determine the prevalence of infection in other northeastern States, where foci of infection possibly exist. Simplified mycological and serological procedures for laboratory diagnosis of this disease should be developed.

**Surveillance for AIDS associated mycoses in India:** Oropharyngeal candidiasis and cryptococcosis are reported frequently but extensive studies are required to estimate their prevalence. We should look for other markers of AIDS, e.g. proximal subungual onychomycosis as reported in some countries, seborrheic dermatitis and pityriasis versicolor due to *Malassezia furfur* (Marques et al. 2000). A recent study from south India recorded a relatively high incidence (13.5%) of pityriasis versicolor in AIDS patients (Kavisaran et al. 2001).

**Initiation of fungal taxonomists into medical mycology**
It is desirable to recruit mycologists with sound training in taxonomy into the medical mycology units/sections/departments of premier medical institutions. Working in close interaction with medical mycologists and clinicians, they would learn diagnostic skills and contribute to the development of the discipline. The taxonomist can also look after the culture collection of the department. Where do we find a taxonomist, as they are hard to come by? With the introduction of facilities for molecular techniques and sequencing of microbial genomes, young scientists with training in fungal taxonomy should choose medical mycology as their area of research.
Development of rapid methods of laboratory diagnosis
Some progress has been made in the serological and molecular methods of diagnosis of certain fungal infections. We must innovate to develop and standardize relatively inexpensive rapid serological and molecular methods of laboratory diagnosis of common fungal infections, such as systemic candidiasis, cryptococcosis, aspergillosis, penicilliosis marneffei and *Pneumocystis* pneumonia.

National Reference Centers
The need for National Reference Centers for medical mycology cannot be overemphasized. It is encouraging to learn that very recently a National Reference Center has been established in the Mycology Division in the Dept. of Microbiology, Post-graduate Institute of Medical Research, Chandigarh. There is need for at least one more reference Center to be located in another part of the country, possibly south India. Such centers could help in rendering identification service for isolates of pathogenic fungi and conduct regular practical workshops in medical mycologists and others involved in the diagnosis of fungal infections. The centre should also render service for in vitro antifungal testing, when requested by the laboratories, which do not have facilities to conduct these tests by standard methods.

National Culture collection of pathogenic fungi and actinomycetes
At present only some institutes maintain their pathogenic fungi culture collection e.g. PGIMER, Chandigarh and VPCI, Delhi. The need for a National Centre of Culture Collection (as a non-profit organization) is obvious. It would serve as repository of cultures of pathogenic fungi including novel pathogens. This kind of centre would supply authentic cultures of pathogenic fungi and actinomycetes at a very reasonable cost to workers engaged in medical mycological teaching and research.

Lastly in conclusion, I wish to say that we have done a good bit for the development and progress of medical mycology in India but a lot more needs to be done. There is no dearth of manpower with basic training, and such staff with additional practical training in the laboratory diagnosis of fungal infections can provide leadership not only to workers in India but also other countries in Southeast Asia. For this we must work cooperatively and make efforts to involve physicians, surgeons and pathologists in our teaching and research programmes in medical mycology.

I wish to sincerely thank you all for your kind presence and patience.

Harish C. Gugnani

Selected References

Agarwal A, Singh SM. A case of cutaneous phaeohyphomycosis caused by *Exorhizium rostratum*, its in vitro susceptibility and review of literature. *Mycopathologia* 1995; 131:


Brumpt. E. Les Mycetomas. *Arch Parasitol* 1906; **16**: 489-564

Butler EJ. Potato diseases of India. *Agr. Ledger* 1903; **4**: 112-119.

Butler EJ. *Fungi and disease in plants*. Thacker, Spink & Co., Calcutta, 1918; 547 pp


Carter HV. *On Mycetoma and the Fungus Diseases of India*. J & Churchill Ltd., 1874;


Chaturvedi *et al.* Cotton seed agar for in vitro conversion of *Blastomyces dermatitidis* to yeast form *J Med Vet Mycol* 1990; **28**: 139-145


Desai SC., Padmanni DS, Kher YR, Sreedevi, N, Wagle UD, Nair GM. Therapeutic investigations on actinomycteam. *Ind J Surg* 1970; **32**: 448-461.


Gill*R, IndianArmyMedicalReports.1842.


Gugnani HC, Shrivastav JB and Gupta NP. Occurrence of *Athroderma simii* in soil and hair of small mammals. *Sabouraudia* 1967; **6**: 77-80.

Gugnani HC, Randhawa H.S. An epizootic of dermatophytosis in poultry due to *Trichophyton simii* 1973 *Sabouraudia* **11**: 1-3.)

Gugnani HC, Wattal BL, Sandu RS. Dermatophytes and other ketratinophilic fungi recovered from small mammals in India. *Mykosen* 1975; **18**: 529-536.


Hemashettar BM; Siddaramappa B; Padhye AA; Sigler L; Chandler FW. White grain mycetoma caused by a *Cylindrocarpon* sp. in India. *J Clin Microbiol* 2000 **38**:4288-91.


Jaishree N, Singh SM. Hyalohyphomycosis due to *Paecilomyces variotii*, a case report, animal pathogenicity and *in vitro* sensitivity. *Antonie van Leeuwenhoek* 1992; **62**: 225-230,


Kamalam A, Thambiah AS. Muscle invasion by *Basidiobolus haptosporus* *Saubouradia* 1984 ; **22**: 273-277.

Kamalam A, Thambiah AS. A clinico-pathological study of actinomycotic mycetoma caused by *Actinomadura madurae* and *Actinomadura pelleterii* *Mycopathologia* 1975; **97**: 151-163.


Khan ZU, Randhawa HS, Lulla M. Isolation of *Blastomyces dermatitidis* from the lungs of a bat, *Rhinopoma hardwickei hardwickei* Gray in Delhi. *Saubouradia* 1982; **20**: 137-144.


Mishra S, Randhawa HS. Application of paraffin technique to the isolation of *Nocarida asteroides* from clinical specimens. *Appl Microbiol* 1969; **18**: 686-687.

Mussa AY, Randhawa HS, Khan ZU, Padhye A and Ajello L. Occurrence and significance of *Trichophyton mentagrophytes* var. *mentagrophytes* on the bark of *Eucalyptus camaldulensis* in India. *J Mycol Medicae* 2000; **10**: 136-139.


Randhawa HS, Khan ZU, Gaur SN. *Blastomyces dermatitidis* in India: First report of its isolation from clinical material. 1983; *Sabouraudia* **20**: 137-144.


Randhawa HS, Mussa AY, Khan ZU. Decaying wood in the tree trunk hollows as a natural substrate of *Cryptococcus neoformans* and other yeast like fungi of clinical interest. *Mycopathoogia* 2001; **151**: 63-69.

Randhawa HS, Kowshik, Khan ZU. Decayed wood of Syzgijun cumini and *Ficus religiosa* living trees in Delhi/New Delhi metropolitan area as natural habitat of *Cryptococcus neoformans*. *Med Mycol* 2003; **41**: 199-203.

Ranjana KH, Priyuokumar K, Singh TJ *et al*. Disseminated *Penicillium marneffei* infection. 2002 *J infect* **45**: 268-271


Sanyal M, Thammaya A. Isolation of *Histoplasma capsulatum* from the soil of indoganganic plain in India. *Indian J Med Res* 1975; 63: 1020-1028


Saran HS, Narula IMS et al. *Indian J History Med* 1972; 17: 1-7

Satyanarayan, Gugnani, HC, Kalghatgi T, Murlidha M. Lymphadnitis due to *Rhodotorula mucilignosa* 2003, 13


Stockdale Pm, Mackenzie DWR & Austwick PKC. Arthroderma simii spp. nov. The perfect state of *Trichophyton simii* comb nov. *Sabouraudia* 4: 112-123.


Viswanathan R, & Randhawa HS. *Candida viswanathii* sp. nov. isolated from a case of meningitis *Sci & Cult* 1959; 25: 86-87

Venugopal PV; Venugopal TV. Pale grain eumycetomas in Madras. *Australas J Dermatol* 1995; 36: 149-151