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The South African National Collection of Fungi: celebrating a centenary 1905-2005

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Abstract: The international acronym PREM denotes the South African *National Collection of Fungi*, which houses approximately 60 000 specimens. The collection includes material from outside South Africa and contains representatives of all the major groups of fungi excluding the yeasts and pathogens of larger animals and man. The name PREM was derived from the city in which the collection is situated, Pretoria (PRE), and the M defines the collection as being mycological. The background information and historical facts presented in this paper are based on an unpublished manuscript, prepared by the co-author and then head of the collection A.P. Baxter, for the 90th celebration of PREM.

The collection was established in 1905, when South Africa was still a British colony. The vision and hard work of the earlier scientists associated with it paved the way for the establishment of a number of present-day national research bodies. One of these, the Plant Protection Research Institute, is currently the custodian of the collection. Over time activities at PREM were influenced by socio-economic and political events, and most recently, the South African government's commitment to international biodiversity initiatives. Although the basic goals and needs to maintain PREM remained intact throughout, various phases in terms of research focus can be recognised over the past century. In the early days the emphasis was on collecting and recording of fungi, then pioneering research was done on mycotoxins and later there was an increased demand for public-good services and innovation. Since the 1980's sophisticated molecular techniques have aided in the discovery of true phylogenetic relationships of fungi, a fundamental field of systematics, that was previously impossible to explore by any other means. Against these advances, the value of reference collections is often questioned.

New technologies should, however, not be pursued in isolation from other relevant factors. Improvement of agricultural practices, knowledge sharing and the protection and conservation of biota will always be important. Even so, the success and future of natural history collections depends on continued support from governing bodies, appreciation for our biological heritage and on inputs from the scientific community.

Key words: Biosystematics, history, National Collection of Fungi, natural history collection.

WHY KEEP REFERENCE COLLECTIONS?

When we realise that fungi have an immense impact on our lives, we also are aware that it is important to know more about them. The information that we require is gathered through scientific study and, eventually, all the knowledge about a specific fungus is linked to its name. Names, therefore, are the tools that make it possible to successfully store or retrieve data. Consequently, it is essential to identify organisms accurately and to name them correctly.

In fungi, the true identity of the organism can be fully captured only in an actual sample of that organism. To confirm the identity of any fungus on which research is published, it is necessary to preserve reference material. Type material and other voucher specimens must be carefully preserved in a reputable reference collection, where they are available for study by the international scientific community. Living fungi are increasingly used to develop new technologies, and they are important in research and teaching. Conditions for the maintenance of fungi must therefore prevent morphological, physiological or genetic changes while preserving the ability of the fungus to grow when again placed in suitable conditions. Reference collections also reflect the biodiversity of the region that they represent, and contain a wealth of information — such as the range of hosts or substrates on which a particular fungus can be found, where it occurs in that region, and the conditions under which it prospers. It is fully justified, then, to regard a National Collection of Fungi as part of a country's natural history and heritage.

HISTORY OF THE COLLECTION

History hinges on people, so as a tribute to mentors, colleagues and predecessors, this article makes frequent reference to personalities who over the years have been affiliated with PREM. As background, and to demonstrate the development and relevance of activities at the collection during the last century, notes on historical and contemporary issues are included. Various political and social events in South Africa directly influenced the inception of, and scientific priorities that had to be set at the collection. The events also contributed to the development of prominent research institutions in South Africa, namely the Plant Protection Research Institute, the South African National Department of Agriculture and the National Botanic Gardens (Gunn 1971).

Early collectors: visiting explorers and pioneering residents

A publication by Pole Evans (1916), referring to the eras before and after Darwin, provides details and insights into the development of mycology in South Africa before his time. Botanical explorers from Europe were

the first to collect southern African fungi for scientific study, venturing to the subcontinent in the late 1700s. The earliest recordings of fungi include the flamboyant fly agaric *Amanita muscaria* (L.) Lam. collected by Carl Thunberg in the vicinity of Cape Town (Doidge 1950). This mushroom was thought to have been brought here as a mycorrhizal associate of trees imported from Europe. Thunberg also gathered the first record of a plant pathogen on an indigenous host in South Africa, the conspicuous ascomycete *Corynelia uberata* Fr. on a yellow-wood tree, a species of *Podocarpus* (Knox-Davies 1977). The earliest detailed account of such efforts appeared in 1843 as M.J. Berkeley's *Fungi collected by Herr Zeyher in Uitenhage* (Pole Evans 1916).

In the mid-1800s resident-collectors such as John Medley Wood (Fig. 1) were the first to systematically preserve specimens for taxonomic study. Medley Wood settled in Natal in 1852. He and Peter MacOwan (Fig. 2), a teacher who arrived in Grahamstown in 1861, compiled sets of *Fungi austro-africani* for overseas herbaria (Doidge 1950). Duplicates of many of these specimens remained in the country. MacOwan and Medley Wood obtained the collaboration of renowned British and European mycologists such as K. Kalchbrenner and F. von Thümen, who started publishing on South African fungi by 1875 (Pole Evans 1916). Other less extensive collections were made by the visiting collectors C.F. Ecklon, C. Zeyher, J. Niven, W.J. Burchell, S. Garside, J.F. Drège, J.A. Wahlberg, W.M. Quinzius, F. Kraus, W.H. Barvey, Miss Amstrong (no initial mentioned by Doidge 1950), H. Wawra, A. Tellinck, A.E. Eaton, and Dr Hooker (no initials offered by Doidge 1950), as well as P. Bachmann.

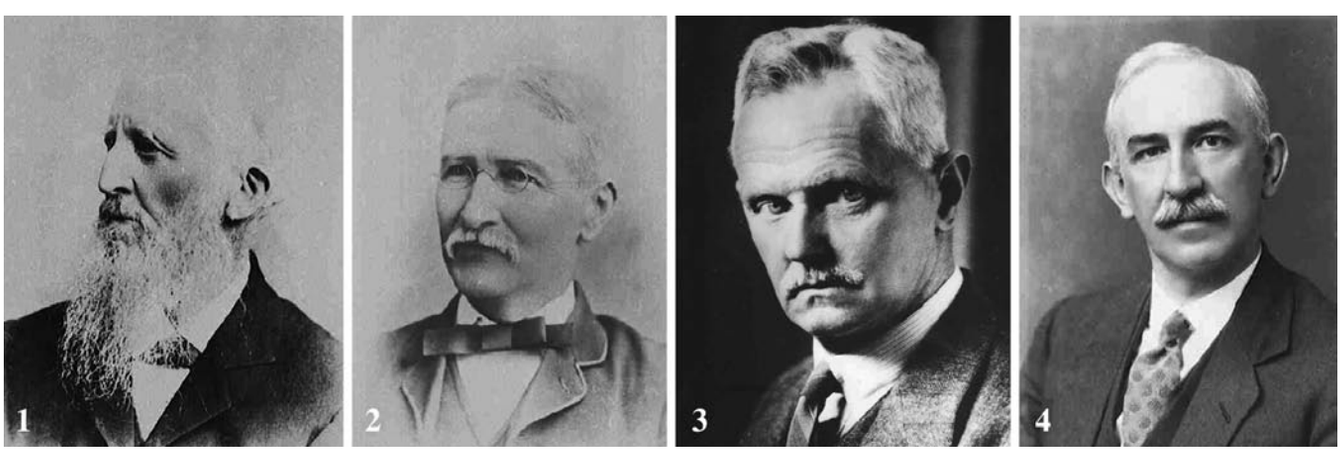
By 1850 the concept of pathogenicity was generally accepted in the scientific world (Ainsworth 1981). Besides being the first recognised phytopathogens, fungi were acknowledged as the most important, so colonial plant pathologists came to be known as mycologists (Ainsworth 1981). In South Africa, plant pathology as a science formally began in 1887 with the appointment of Peter MacOwan as the consultant in economic botany to the Cape Government (Doidge 1950, Knox-Davies 1973). MacOwan retired in 1905 and was succeeded by Illtyd Buller Pole Evans (Fig. 3) in the same year (Doidge 1950).

Destruction of agriculture during the Anglo Boer war: the start of the National Collection of Fungi

The second Anglo-Boer War from 1899 to 1902, followed by a period of droughts, brought widespread hardship to South Africa (Lantern 1955, 1960). Apart from the drought, agriculture had been profoundly influenced by the British so-called "scorched earth" policy during this war (Pretorius 1985). The British destroyed farms, killed livestock, burned crops and removed civilians from their land to concentration camps in an effort to contain the guerilla tactics of Boer soldiers (Pretorius 1985). After the war, the British started reconstruction of the country. A large amount of money was committed to resettling farmers, and they were supplied with implements and seeds to rebuild their farms (Anonymous 1915, Pretorius 1985).

Pole Evans was the first mycologist officially appointed by the British colonial authorities and his appointment was the first official recognition of mycology as a distinct branch of research in the country (Anonymous 1915, Bottomley 1929). Pole Evans in 1905 became the Head of Mycology and Plant Pathology in the newly established Transvaal Department of Agriculture, and Chief of the Division of Botany for the whole of South Africa (Pole Evans 1916). In the same year he established a plant-pathological reference collection, thus initiating today's National Collection of Fungi. He began to catalogue fungi on cultivated and indigenous plants and published more than 25 papers on this subject (Doidge 1950).

Before 1905 the only fungal collections available to Pole Evans were those of MacOwan and Medley Wood, comprising 765 specimens. At that stage, the MacOwan material was housed in the Albany Herbarium in Grahamstown, the South African Museum in Cape Town and the Natal Herbarium in Durban (Pole Evans 1916). Subsequently, various small collections of fungi were started around the country: the collections of P.A. van der Bijl (Fig. 4) at the University of Stellenbosch, that of Len Verwoerd at the Stellenbosch-Elsenburg College of Agriculture, the collections of J. Medley Wood in the Natal Herbarium and that of A. Duthie at the Bolus Herbarium in Cape Town, while the Timber Research Laboratories collections were kept at the Chamber of Mines in Johannesburg, and there were collections of South African fungi housed in several European herbaria.



Figs 1–4. 1. J. Medley Wood. 2. P. MacOwen. 3. I.B. Pole-Evans. 4. P.A. van der Bijl.

Fig. 5. The herbarium in 1923.

Fig. 6. Side-view of the current herbarium.

By 1913 the cryptogamic herbarium (as part of the Division of Botany's National Herbarium) contained over 9000 specimens of fungi (Anonymous 1915). Pole Evans persisted in his quest for a properly equipped mycological laboratory and moved from the *Volkstem Building* to a house on *Meintjes kop* suitably situated near the centre of Pretoria. Due to financial hardship, Edward Meintjes, the owner of a farm, sold the property to the government (Knox-Davies 1973). As government property and before housing the reference collection of Pole Evans, the spacious ten-roomed farm house gave residence to various government officials, notably the magistrate and tax collector Carl Ziervogel, and later the Minister of Justice, General Barry Herzog (Marasas *et al.* 1976, Knox-Davies 1977, Gorter 1988). Two stands previously also belonging to the farm *Meintjes kop*, were set aside for the Union Buildings, which are still occupied by the South African government today (Gorter 1982).
The modified farm house and surrounding buildings occupied by Pole Evans in 1913 is commonly known as *Vredehuis* (House of Peace) (Gunn 1971, Roux 1990) and today have the address 590 Vermeulen Street, Arcadia (Fig. 5). Due to the large numbers of collections added to the Division of Botany's National Herbarium, the fungal specimens had to be moved several times to larger spaces. The last of these moves was to the second storey of an addition to the National Herbarium building at *Vredehuis*, with a large room dedicated for the cryptogam collections (Fig. 6) (Job 1987). A hundred years further on and still situated in these buildings, the biosystematics division echoes Pole Evans's requests for better facilities than those that the now aged *Vredehuis* can offer.

The very competent Pole Evans soon became the Chief of the Division of Plant Industry and had to direct research in an amazing diversity of agricultural fields (Gunn & Codd 1981). He also initiated publications such as the *Botanical Survey Memoirs* in 1919, *Flowering Plants of South Africa* in 1920 and *Bothalia* in 1921 (Gunn & Codd 1981). Under his leadership, research on the plant sciences in the Department of Agriculture greatly expanded (Gunn 1971). His rapidly escalating administrative duties meant that by 1929, however, he was not able to continue his mycological work (Bottomley 1929, Doidge 1950).

Ethel Mary Doidge: rapid expansion of the collection

Appointed on probation in 1908 to assist Pole Evans, Ethel M. Doidge (Fig. 7), like her chief, had a far-reaching impact on South African mycology (Fourie pre-1970). Later employed as Principal Plant Pathologist of the Phytopathological Section in 1929 (now the Mycology Unit), she became the successor to Pole Evans and apart from specialists in other disciplines, the cryptogam collection then had a complement of three mycologists (Doidge pre-1945). Under Doidge's direction the collection rapidly grew (Fig. 8): she made numerous collecting trips often under extremely difficult circumstances (Fig. 9), exposed to personal danger, as well as obtaining many sets of named duplicate specimens from international authorities. Reference material identified in collaboration with overseas mycologists provided her an essential research base and this still forms a substantial part of PREM.

Fig. 7. The young E.M. Doidge.

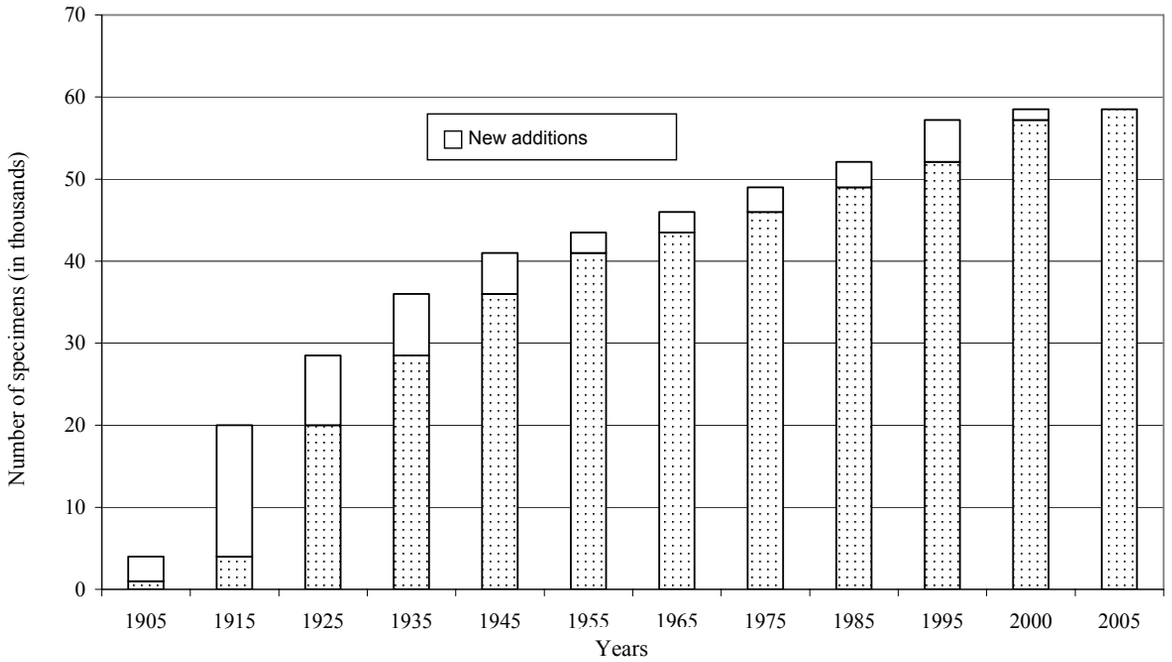


Fig. 8. Cumulated number of accessions in PREM from 1905 to 2005.

Doidge's vision was not limited to collecting. She firmly believed in the value of basic research, stating in her *"Scope of the Phytopathological Section"* that only a thorough knowledge of indigenous and exotic organisms would allow optimal utilization of the natural resources of South Africa, and that this goal was not possible without fundamental research (Doidge pre-1945). She used the work of Pasteur and Mendel to support her statements. During the 1940's the science of plant pathology was applied almost entirely to diseases caused by fungi: consequently the term "plant pathology" was practically synonymous with "fungus disease of plants".

Her contribution to mycology spanned some 40 highly productive years until she retired in 1942 (Gunn 1967). Although her legacy includes over 100 semi-popular papers relating to plant disease, she is best remembered for her contribution to systematic mycology. She published 30 major works covering a wide range of fungi, including rusts, powdery mildews, sooty moulds, pythiaceous fungi, *Ascomycetes*, the genera *Fusarium* and *Synchytrium*, as well as checklists of plant pathogens of South Africa (Gunn 1967). Four years after official retirement, Doidge (Fig. 10) completed her monumental treatise, *The South African fungi and lichens to the end of 1945* (Gunn 1967). This comprehensive scientific catalogue is prefaced by a detailed history of the development of mycology on the subcontinent, and of the people involved. Although it was based on records in the cryptogam section of the National Herbarium, it includes data from other South African collections. The most notable were those of Edith Stephens, Augusta Duthie, Alice Pegler, the South African Museum, the Stellenbosch-Elsenburg College of Agriculture phytopathological material assembled by Len Verwoerd and B.J. Dippenaar, the Timber Research Laboratory fungi from mining timbers, rust fungi from M. Pole Evans née Thomson, and V.A. Putterill, helminthosporic fungi, and fungi associated with fruit decay from V.A. Putterill, fungi attacking locusts and other insects from E.E. Shaefer and S.H. Skaife, numerous plant pathogens and *Polyporaceae*, larger fungi from W.G. Rump, and various other ad hoc collections from G. Joubert, L.C.C. Liebenberg, A.O.D. Mogg, S.J. du Plessis and J.P.H. Acocks. Among Doidge's colleagues in Pretoria were Paul A. van der Bijl, known for his pioneering work on polypores or bracket fungi, Averil M. Bottomley, who documented South African *Gasteromycetes*, and V.A. Wager, who investigated pythiaceous plant pathogens (Doidge 1950).

Fig. 9. A field trip with E.M. Doidge.

Although local researchers, such as those mentioned, described and named increasing numbers of fungi, much was still done in co-operation with European, British and American collaborators such as Sydow in Berlin, E.M. Wakefield at Kew, and C.G. Lloyd, the notoriously eccentric American (Bottomley 1929). With Pole Evans retiring from active service in 1939 and Averil Bottomley soon after

Doidge had completed her catalogue (Gunn & Codd 1981), a momentous era marked by extensive collecting and recording of South African fungi ended around 1940.

Patric Henry Brabazon Talbot: fungal systematics versus plant pathology

During the period 1940 to 1960, the intense recording of fungal diversity made way for the first exclusively systematic mycological studies, and also marked the time that plant pathology grew in prominence.

The first purely systematic mycologist at PREM was P.H.B. Talbot (Fig. 11), appointed in 1940. After doing war duty, Talbot served as liaison officer at Kew until 1948 and then became head of the Mycology Unit (MU) (Gunn & Codd 1981). During the twenty-odd years that Talbot spent at PREM, he greatly strengthened the status of systematic mycology by creating enthusiasm for the subject, and shaping the minds of up-coming mycologists. A student at that time and later the mentor of a significant number of staff members at PREM, Konrad van Warmelo (Fig. 12) often visited Talbot in his spare time. Largely shaped by Talbot's approach to fungal systematics, Van Warmelo later took up a position at the MU but soon moved on to become Professor of Mycology at the Rand Afrikaans University (now the University of Johannesburg). Talbot's book written in 1971, "*Principles of fungal taxonomy*", became the formal prescribed text used by Van Warmelo. Van Warmelo became the mentor of E. van der Linde, I.H. Rong, M. van Reenen and C. Roux, all of whom were later employed at PREM. In 1960 Talbot left South Africa for a post at the Waite Institute in Australia but not before he completed his pioneering monographic work on South African resupinate and stereoid *Hymenomycetes*. The second edition of "*Principles of fungal taxonomy*" had failed to materialise because Dr Talbot died in 1980 (Van Warmelo 1990).

In contrast to Talbot and working in the same period, Eric E. Schaefer provided the plant-pathological element that became very prominent during the 1960s and 1970s and which is still prevalent today. He started his career at PREM in 1934, reporting to E.M. Doidge. This self-taught plant pathologist (educated as a zoologist) was deeply appreciated by fellow scientists, amongst them Talbot's successor G.C.A. van der Westhuizen. Schaefer's enthusiasm for his subject was immense. Late in his career he also moved on from PREM, to join the Horticultural Research Institute at Roodeplaat, near Pretoria.

Government restructuring: the Plant Protection Research Institute (PPRI) and biosystematic services

Some important events at PPRI, an institute established in 1962, illustrated two major insights gained from this period in the history of PREM: firstly, the strategic importance of biosystematic services and, secondly, the value of interaction and collaboration between scientists.

With the proclamation of the Republic of South Africa in 1960, government departments were extensively reorganised. One result of this restructuring was the merger of the former Divisions of Plant Pathology and Entomology of the Department of Agriculture in

Fig. 10–17. 10. E.M. Doidge in later years. 11. P.H.B. Talbot. 12. K.T. van Warmelo. 13. J.E. Vanderplanck. 14. G.C.A. van der Westhuizen. 15. W.F.O. Marassas. 16. A.P. Baxter. 17. C. Roux.

1962 to form the Plant Protection Research Institute (PPRI). The first director of PPRI was the renowned J.E. Vanderplanck (Fig. 13). The plant pathologist G.C.A. van der Westhuizen (Fig. 14) was appointed in 1947 and became the head of a group of three, making up the MU. Numerous investigations, mostly of an applied nature, faced van der Westhuizen and his small team. Amongst many other activities, the unit was asked to assist in the identification of a severe outbreak of rust on *Populus deltoides* grown for the production of matches, in Natal. The causal fungus, *Melampsora laricis-populina* Kleb., had not previously been recorded in South Africa. Grégoire Hennebert in Belgium confirmed the identification.

At first Van der Westhuizen only had the reference work of Doidge (1950) and specimens in the collection as aids to perform identifications. There was a critical lack of systematic knowledge at the unit and van der Westhuizen left the country to spend time with Mildred Nobles at the Plant Research Institute of Agriculture in Canada. There he had the privilege to work with 12 other mycologists and shared facilities with two post-doctoral fellows, Bryce Kendrick and Grégoire Hennebert. The particular office he occupied was previously that of Bob Shoemaker, the expert on *Helminthosporium* Link.

Back in South Africa, in 1974 an outbreak of maize southern leaf blight required his urgent attention. The much-feared disease caused by *Bipolaris maydis* (Y. Nisik. & C. Miyake) R. Shoemaker (then *Helminthosporium maydis*) was identified in Mpumalanga, the eastern part of the area previously known as Transvaal. The fungus identified at the MU was sent to M.B. Ellis at the Commonwealth Mycological Institute (now the International Mycological Institute) who confirmed the identification. The Secretary for Agricultural Technical Services was informed about the outbreak and briefed about the implications to the maize industry. Extensive meetings with government officials and other role players resulted in the withdrawal of all breeding lines containing the Texas type cytoplasm (male sterility) from the maize breeding programme. The use of this maize type was prohibited in South Africa. This judgment was deemed drastic and caused considerable disruption in the maize breeding programme as well as losses for some seed dealers, but in the end, the maize industry and the country as a whole benefited. The fast, accurate identification and the knowledge provided were indispensable to manage the disease.

Collaboration and applied research

In 1962 the fungus collection was separated from the National Botany Herbarium (PRE), with which it had always had close links, and largely became alienated from mainstream herbarium activity. Its last full-time curator was Beatrice Louwrens, assistant in the mycology section from 1931 until she retired in 1969 (Gunn & Codd 1981). The Division of Botany, which had become the Botanical Research Institute (now the National Botanical Institute), moved to new buildings in the Pretoria National Botanic Gardens in 1973.

Due to the demand for expertise, the scientific capacity at the MU had to be expanded. The government of the time also introduced a new concept to research, namely management through projects. Two mycologists, Konrad van Warmelo and Wally Marasas (Fig. 15), were appointed to a project entitled *The mycobiota of stock-feeds*. Numerous stock feed- and mycotoxin-related investigations followed. Most noticeable were the studies on the fungus *Phomopsis leptostromiformis* (J.G. Kühn) Bubák (Van Warmelo *et al*. 1970), *Pithomyces chartarum* (Berk. & M.A. Curtis) M.B. Ellis (Marasas & Schumann 1972, Kellerman *et al*. 1980, Roux 1986) and *Fusarium verticillioides* (Sacc.) Nirenberg (Kellerman *et al.* 1972, Marasas *et al.* 1976).

Wally Marasas from the MU, Fanie Kellerman (who held a degree in plant pathology and is a qualified veterinarian) from the Toxicology Section at Onderstepoort, in collaboration with the chemists Piet Steyn and Robert Vleggaar at the then National Chemistry Research Laboratory at the Centre for Science and Industrial Research (CSIR), became a formidable team in mycotoxin research. This multidisciplinary team of mycologists, veterinary toxicologists and organic chemists, subsequently gained international recognition as leaders in the field. They diagnosed, amongst others, leukoecephalomalacia of horses feeding on maize cobs, a disease previously only known from New Zealand and Australia, did the ground work for resolving lupinosis and discovering the structure of phomopsin A, for establishing the aetiology of tremorgenic diseases caused by mycotoxins of *Aspergillus,* and started research on facial eczema of sheep.

In July 1970, a well-known disease in the veterinary literature, leukoencephalomalacia, caused extensive losses of horses just outside Potchefstroom. At that time the cause of this devastating disease was unknown; for some years it had caused the death of thousands of horses in the United States, Egypt, China and other places. Research by Marasas and the rest of the team over an 18-year period discovered that the causal organism is *F. verticillioides.* The compound responsible was isolated at the Medical Research Council where Marasas continued his work from 1975 onward, and was finally resolved in 1988 when it was chemically characterised with the help of Robert Vleggaar at the CSIR. This compound was named fumonisin, subsequently shown to occur all over the world in maize, and containing 28 carcinogens. The work started by Marasas at the MU established him as a world expert on mycotoxins and the diagnosis of *Fusarium* species. The difficulties experienced with diagnosing fumonisin-producing *Fusarium* species highlighted the need to continually develop new and better diagnostic methods.

On departing to the Medical Research Institute in 1975, Wally Marasas handed over the investigations of facial eczema, a major disease called ‘geeldikkop’ of sheep to Cecilia Roux who had joined the staff as a technician. Within three weeks, Roux made a break-through in isolating the fungus *Pithomyces chartarum*

on *Tribulus terrestris*. The work continued until, in 1979, feeding trials by Dr Kellerman illustrated the production of sporidesmin in *P. chartarum* cultures isolated from *T. terrestris.* From trials conducted at the Onderstepoort veterinary facility, the aetiology of the disease was finally demonstrated. Unfortunately, similar fruitful collaboration would soon become more difficult due to competition between the various research councils that were subsequently established, as Marasas had foreseen (1990).

Even though the MU developed a significant reputation as a mycology centre of expertise, research had significantly veered away from biosystematics. In-depth taxonomic studies lost ground to plant pathology (van der Westhuizen 1977, 1978, van der Westhuizen & Holtzhausen 1980) and other applied problems (Van Warmelo 1967, Kellerman *et al.* 1980, van der Westhuizen *et al.* 1985), a trend that was to continue for several years.

According to Van der Westhuizen (1990), a number of mycologists were appointed to attend to problems of an applied nature, some leaving the MU for various unrelated reasons only after short periods of service. Even so, this period was characterised by good liaison with workers at South African universities as well as other institutes of the Department of Agriculture and its regional offices. Hettie Greyling née Bezuidenhout worked on fungi from *Cenchrus ciliaris* pastures; Cecilia Roux on the distribution of *Pithomyces chartarum;* Alice Baxter (Fig. 16) received the Junior Captain Scott medal from the South African Biological Society for her M.Sc. on *Colletotrichum;* Alistair Thompson surveyed the diseases of lucerne and studied *Pythium, Phytophthora* and other root-rotting fungi; and Mike Holtzhausen researched sunflower diseases and seed-borne pathogens. As a research fellow from Scotland, Jim Deacon joined De Buys Scott, then also at the MU, and worked on root-inhabiting fungi of maize and wheat. George Herd, who had been head of Plant Protection in Zimbabwe, joined the staff to work on seed treatments for the prevention of seed-borne fungi. In 1983, Alan Phillips from the United Kingdom joined the MU to work on *Sclerotinia sclerotiorum* (Lib.) de Bary and its control since there was a vast outbreak of this fungus on various crops in the country. Rupert Anelich started a survey of *Fusarium*. There was a steady flow of papers from the Unit but a very low growth in the collection. For approximately 12 years following Van der Westhuizen's retirement in 1984, activities continued in the same manner.

Systematics gains new impetus

The PREM collection showed little growth between the late 1960's to the early 1980's (Fig. 1) due to research veering away to more applied issues (Eicker & Baxter 1999). After his retirement, Van der Westhuizen (1991) eloquently stated that taxonomic research had become endangered because its economic and scientific importance is underestimated. Ironically, it was precisely the availability of biosystematic expertise at PREM and the multidisciplinary approach that had made the high quality research done during that period possible.

In the 1980s biosystematics slowly started to move back to a prominent position on international and national agendas (du Plessis 1984). Concerns about conservation and environmental protection precipitated an international rethinking of biological research. A General Assembly of the International Union of Biological Sciences (IUBS) passed resolutions in 1973, 1979 and 1982 calling on governments to strengthen taxonomy and to provide infrastructure for the training of taxonomists (du Plessis 1984). The South African government supported these trends and committed itself to international initiatives such as the Convention on Biological Diversity, promulgated in 1992, and the International Plant Protection Convention (Environmental Conventions 2005). At the Plant Protection Research Institute (PPRI), taxonomy also gained impetus when in 1984 the MU and PREM become an integral part of the restructured Institute, then still part of the National Department of Agriculture. Shortly before this restructuring and due to dwindling support for the collections, an initiative by Cecile Roux (Fig. 17) saw the start of a culture collection. Fellow researchers were encouraged to deposit voucher material (Baxter 1986 & 1990, Baxter & Rong 1992). The culture collection (official acronym PPRI) was affiliated to the World Federation of Culture Collections and the name *National Collection of Fungi* (NCF) replaced *Mycology Herbarium* as a more accurate reflection of the status of the collections. Guidelines were published regarding submission, identification and loan of specimens (Baxter *et al*. 1991). The success of these moves can be gauged by the subsequent increase in accessions (Fig. 1).

At that stage, with the exception of the W.G. Rump collection of larger fungi of Natal at the University of Natal, Pietermaritzburg, and an unknown number of specimens in European collections (Wakefield 1936a–c), all major South African fungal specimens were drawn together at the NCF. Some 40 % of PREM's holdings also comprise foreign *exsiccatae* obtained at the start of the collection, as a reference base from renowned early 20th century mycologists (Baxter 1994). This makes PREM a valuable source of scientific material and biological information. The views supported by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) is that type specimens be regarded as part of a nation's cultural heritage and that such specimens must be deposited in their country of origin (Sigler & Hawksworth 1987). The removal of specimens from the country of origin is a practice that still continues today, however, in contravention of this rule.

New initiatives

During the late 1980's to mid 1990's, activities at PREM were significantly influenced by political events in South Africa (Agricultural News 1990). The changes were directly related to the first democratic national elections and the advent of political freedom in the country. In 1992, three years before this milestone event in South African history, PPRI together with a number of other institutes from government departments, was

transferred to the autonomous corporate Agricultural Research Council (ARC). This brought about a move away from the old Civil Service dispensation to market-driven activities. Incorporation of the NCF together with the National Collections of Arachnids, Insects and Nematodes, into the Biosystematics Division of PPRI, reaffirmed our original strategic needs-driven functions: provision of identification- and information services and directed biosystematic research backed by representative reference collections.

Rapid changes in management structures, directives for agricultural research and a cut in parliamentary grants, however, severely impeded the continuation of meaningful research. Increasingly the MU had to express its functions in a more generally marketable form, culminating in the presentation of various training courses (see ARC web page <http://www.arc.agric.za>) and the expansion of diagnostic and information services. Training is provided in the form of courses, training manuals (Staff of the National Collection of Fungi 1994, Baxter & van der Linde 1999) and support to formal students in the form of experiential training and internships provided by the National Department of Science and Technology (DST). Demand for such training comes from countries of the Southern African Development Community (SADC), Universities, ARC institutions, national and provincial government departments, and industry.

Within the developing countries of southern Africa, and the sub-Saharan region, PPRI has become recognised as a major source of biosystematic expertise and highly relevant reference material (Jones 1995). The significance of the collection can be measured, in part, by the accession and loan rates from PREM (Fig. 18). Annually, on average 60 specimens are sent out for research purposes. During the past 15 years specimens were sent not only to various institutions in South Africa, but also internationally, to destinations such as Argentina, Australia, Belgium, Canada, Germany, India, Norway, the People's Republic of China, Portugal, Spain, Sweden, the Netherlands, United Kingdom and the United States of America. In the same period the collection grew by 17 %. The most significant contributions of foreign material to PREM in the past decade have been a donation of Czechoslovakian *Polyporaceae*, collected by P. Vampola, and nearly 1000 duplicate specimens of smut fungi from across the world, received from K. Vanký, Germany. The most notable submissions of South African fungi, made by mycologists not currently employed by the Mycology Unit, were those of basidiomycetous fungi. These were donated by G.C.A. van der Westhuizen (post retirement) and F. Wolfaardt in 1995. Noteworthy contributions of fungi from indigenous plants, isolated from members of the *Proteaceae*, were received from P.W. Crous and J.E. Taylor. The conspicuous number of accessions in 1995 (Fig. 8) was indicative of the approximately 700 specimens received from the South African Museum (SAM) collection in Cape Town. This action finally consolidated the available South African material collected by P. McOwan and preserved in PREM. In addition, extensive contributions of various plant-pathogenic ascomycetous fungi, mostly pathogens of forestry trees, of the genera *Cercospora* and allied fungi, notably *Leptographium, Mycosphaerella* and *Ophiostoma,* have been received from M.J. Wingfield, P.W. Crous and their students since 1995.

The South African government is still the largest client of the ARC and as such our activities are being guided by National Science Policies. These policies include the seven *Presidential Imperatives* (rural development, job creation, regional integration, urban renewal, human resource development, HIV/AIDS, and crime prevention), the *New Partnership for Africa's Development* (NEPAD), and the directive of the ARC's line Department, namely the Department of Agriculture

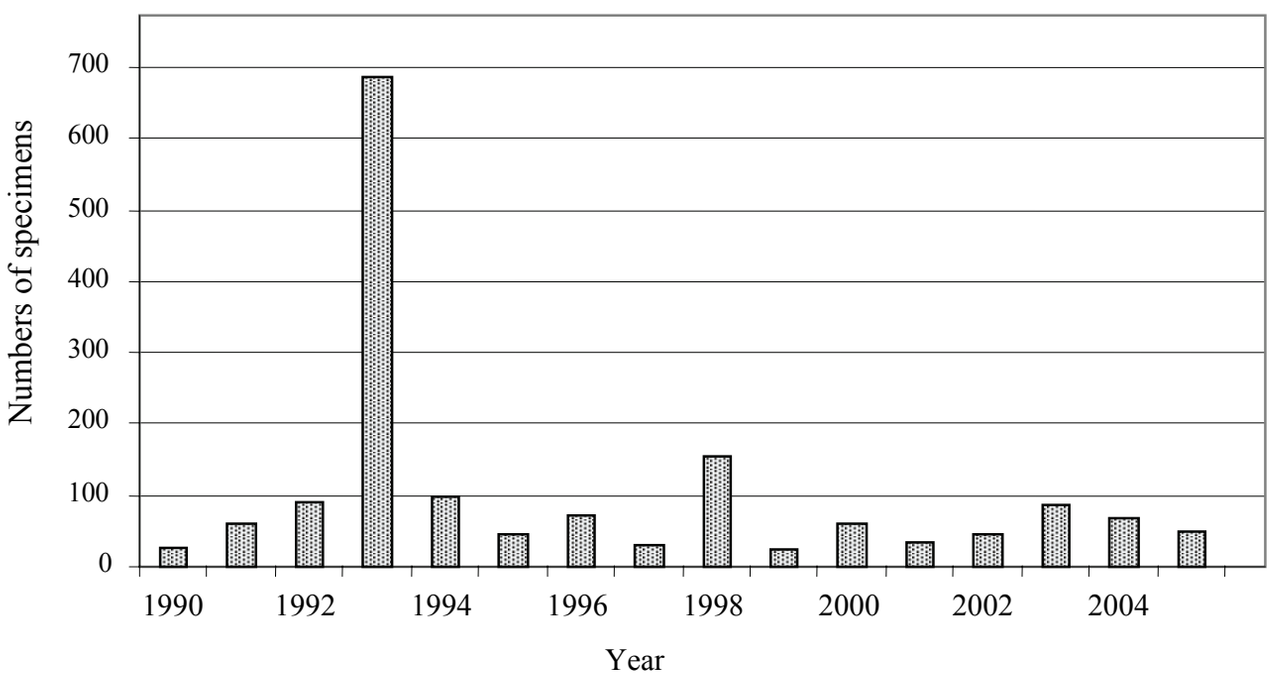


Fig. 18. Number of specimens send out on loan from PREM since 1990.

(DoA). A good example of the strategic services provided to government came about with the report by Crous *et al*. (2001) of the first appearance of the smut disease Karnal Bunt in South Africa. The PPRI MU became the only recognised laboratory that the Department of Agriculture permitted to analyse wheat samples for this disease. Subsequently, the MU has participated in the annual National Karnal Bunt Survey (KB) on a contract basis, and by the end of the 2004/2005 wheat growing season, had processed a total of 9300 samples (O'Brien & Rong 2005). As a consequence, the disease could be prevented to spread in South Africa.

Currently, the NCF is involved in exciting, new national and international initiatives in the fields of systematics, biodiversity, conservation and bioinformatics: international partnerships include the Global Biodiversity Information Facility (GBIF, see SABIF <www.sabif.ac.za>), the Barcode of Life and BioNet-International, a global technical cooperation network concerned with biosystematics of invertebrates and microorganisms. Participation in national initiatives includes the Agricultural Geo-Referenced Information System (AGIS, <www.agis.agric.za>), the South African Biodiversity Initiative (SABI) and inputs to the initiatives of the newly formed South African National Biodiversity Institute (SANBI).

CONCLUSION

The primary mandate of PREM, namely biosystematic research on agro-environmentally important fungi, has remained valid. It is an exciting challenge to meet the broadened and more complex responsibilities of the new century: staying sufficiently focused on biosystematic research but also providing demand driven research within the framework of the government set priorities. Due to growing demands for biosystematic services, it is crucial to maintain the necessary systematic capacity and backup systems. With sustained capacity and governmental support, activities at PREM will continue to be highly relevant within the science community. There is a huge scope for inputs in multidisciplinary investigations since very little is known about endophytes, soil populations in various agricultural systems, fungi with other beneficial properties, populations in extreme environments and pathogens of indigenous crops. With the exception of one or two studies, investigations of fungi related to indigenous biota have also been neglected over the past 20 years. Research projects where different datasets such as host preferences, descriptive morphology, environmental data, biochemical- and molecular characterisation are integrated should provide valuable products to the end-users of this science.

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CHRONOLOGY

Significant events mentioned in this celebratory publication are listed here, as well as associated noteworthy incidents and the appointment dates of the present Staff members of the Mycology Unit.
Acronyms and abbreviations used are the following:

PPRI, Plant Protection Research Institute, of which the
MU, Mycology Unit, the staff which maintain the
NCF, the National Collection of Fungi, incorporating
PREM, the collection of dried specimens, and
PPRI, the culture collection in
SA, South Africa.

1652	Jan van Riebeeck starts a Dutch settlement at the Cape.
1729	Pier Antonio Micheli discovers that fungi possess reproductive bodies in contrast to the then current beliefs that the origin of fungi was from spontaneous generation.
1773	C.P. Thunberg collects *Corynelia uberata* on *Podocarpus* sp.: earliest recorded pathogenic fungus on an indigenous host in S.A.
1843	The first detailed, systematic account of South African fungi is published, by M.J. Berkeley: *Fungi collected by Herr Zeyher in Uitenhage*, in Hooker's London Journal of Botany.
1845-49	Potato blight epidemic in Ireland.
1852	J. Medley Wood, SA's first resident fungus collector, settles in Durban.
1853	Pretoria founded.

1854 Charles Darwin's *The Origin of Species by Means of Natural Selection, or The Preservation of Favoured Races in the Struggle for Life* usually referred to as *The Origin of Species,* is published.

1861 P. MacOwan settles in Grahamstown, collaborates with J Medley Wood in assembling sets of Fungi austro-africani.

S.J. Meintjes obtains 'Arcadia' from Andries du Toit. Arcadia forms part of the farm Meintjeskop where Vredehuis was built.

1880-81 First Anglo-Boer War; the Pretoria Convention signed in August after three months of negotiations.

1887 P. MacOwan appointed as consultant in economic botany to the Cape Government: plant pathology formally begins as a science in S.A.

1889 A house on the Vredehuis site appears on the map published by J. van Vooren and J.H. Oerder, South African Republic, Department of Mines, Pretoria.

1904 The Centraalbureau voor Schimmelcultures established in Utrecht, later Baarn, Utrecht.

1905 P. MacOwan retires. I.B. Pole Evans becomes the first officially designated mycologist appointed in S.A, establishes PREM.

1908 Ethel M. Doidge appointed as assistant to I.B. Pole Evans.

1910 Union of S.A. established; construction of parliamentary buildings commences on Meintjeskop, Pretoria.

1911 P.A. van der Bijl appointed as mycologist and phytopathologist; First attempt at biological pest control in S.A.

1912 I.B. Pole Evans becomes Head of newly formed Division of Mycology and Plant Pathology, responsible for researching plant diseases in the Union of S.A.

1913 The Transvaal Colonial Herbarium (now PRE) was transferred from central Pretoria to Vredehuis at 590 Vermeulen Street, Arcadia on 26 January; Averil M. Bottomley appointed as mycologist; I.B. Pole Evans becomes Head of the newly formed Division of Mycology and Plant Pathology, which paves the way for the fungus collections (now PREM) to become part of the National Herbarium (now PRE); The Division of Botany and Division of Mycology and Plant Pathology amalgamated.

1920 Imperial Bureau of Mycology founded in London (now the International Mycological Institute of CABI Bioscience).

1921 P.A. van der Bijl becomes the first professor of plant pathology in South Africa; I.B. Pole Evans initiates *Bothalia,* a local journal named for the first Union of South Africa Premier and Minister of Agriculture, General Louis Botha – as a medium for publications on material in the National Herbarium (including the fungus collection, now PREM).

1923 New single-storied building erected at 590 Vermeulen Street for National Herbarium

1927 Adrianus Pijper, a pathologist practicing in Pretoria, was the first to recover an undecided yeast species from a South African source. The type strain of *Hanseniaspora guilliermondi,* Pijper was deposited with the then recently established CBS Yeast Division which, incidentally, was headed by his brother-in-law, Albert Jan Kluyver.

1928 J.E. Vanderplanck appointed.

1929 Ethel M. Doidge becomes Principal Plant Pathologist; plant pathology laboratories built at 590 Vermeulen Street.

1933 Beatrice A. Louwrens appointed as assistant in mycology section of National Herbarium.

1934 E.E. Schaefer appointed to MU.

1939 I.B. Pole Evans retires.

1940 P.H.B. Talbot appointed as systematic mycologist in Plant Pathology Section, Division of Botany and Plant Pathology.

1942 E.M. Doidge retires, stays on to complete a catalogue of southern African fungi and lichens.

1945-48 P.H.B. Talbot becomes liaison officer for the National Herbarium, at the Royal Botanic Gardens Herbarium, Kew.

1946 G.J.M.A. Gorter appointed.

1947 G.C.A. van der Westhuizen appointed to MU, A.M. Bottomley retires.

1950 The South African fungi and lichens to the end of 1945. By E.M. Doidge, Published as Bothalia Volume 5.

1953 Plant Pathology raised to the status of a Division and thus separated from the Division of Botany.

1960 P.H.B. Talbot moves to Waite Agricultural Research Institute, University of Adelaide, Australia, G.C.A. van der Westhuizen becomes Head of MU.

1961-63 G.C.A. van der Westhuizen leaves on study trip to Canada. EE Schaefer transferred to Transvaal Region, Horticultural Research Institute at Roodeplaat near Pretoria.

1962 PPRI formed, with J.E. Vanderplanck as its first director; includes the Division of Plant Pathology, thus also MU (and PREM) with G.C.A. van der Westhuizen as Head. Division of Botany becomes the Botanical Research Institute; W.F.O. Marasas appointed: commences full-time MSc training at University of Pretoria.

1964 K.T. van Warmelo transferred from the Natal Region to PREM.

1965 Ethel M. Doidge dies in Anerly, Natal.

W.F.O. Marasas goes to U.S.A. for Ph.D. studies at the University of Wisconsin.

1968 I.B. Pole Evans dies in Umtali, Rhodesia (now Mutare, Zimbabwe).

1969 Beatrice A. Louwrens retires; W.F.O. Marasas returns from the U.S.A. with a Ph.D.

International breakthrough: *Phomopsis leptostromiformis* identified as cause of ovine lupinosis; this is reproduced with pure cultures for the first time.

1970 International breakthrough: *Fusarium moniliforme* implicated in equine leukoencephalomalacia; reproduced with pure cultures for the first time.

Facial eczema breaks out: first record outside New Zealand and Australia.

K.T. van Warmelo joins Rand Afrikaans University.

1971 *Principles of fungal taxonomy* by P.H.B. Talbot published.

1973 Botanical Research Institute moves from Vredehuis to new buildings in the Pretoria National Botanic Garden, Brummeria; J.E. Vanderplanck retires as director, PPRI; E.E. Schaefer retires.

1974 Southern leaf blight outbreak, caused by *Drechslera maydis*, rocks South African maize industry and illustrates the importance of accurate identifications.

Cecilia Roux and Hettie Bezuidenhout appointed to MU.

1975 W.F.O. Marasas joins Medical Research Council.

M.A. Holtzhausen appointed to MU.

1977 Alice P. Baxter and A.H. Thompson appointed to MU.

Hettie Bezuidenhout leaves MU.

Index of plant pathogens and the diseases they cause in cultivated crops by G.J.M.A. Gorter appears.

1979 Symptoms of geeldikkop induced in sheep, demonstrating the involvement in this disease of *Pithomyces chartarum* on *Tribulus terrestris*.

An annotated checklist and selected bibliography of South African fungi by G.J.M.A. Gorter appears.

P.H.B. Talbot dies in Australia.

1981 *Index of plant pathogens II and the disease they cause in wild growing plants* by G.J.M.A. Gorter appears. J.W. Deacon of University of Edinburgh, Scotland, research fellow at MU.

1982 G.W. Herd joins MU.

1983 L. Schutte rejoins MU.

D.B. Scott leaves MU to join the then Small Grain Centre, Free State.

R.Y. Anelich and A.J.L. Phillips appointed to MU.

1984 G.C.A. van der Westhuizen retires.

A.P. Baxter appointed head of MU.

1986 E.J. van der Linde student of K.T. Van Warmelo, Rand Afrikaans University (RAU; now the University of Johannesburg) appointed.

1988 R.Y. Anelich leaves MU, A.H. Thompson leaves PPRI.

1989 I.H. Rong student of K.T. van Warmelo, RAU appointed.

1991 MU and NCF incorporated in PPRI's newly formed Biosystematics Division.

1992 PPRI becomes part of the newly formed Agricultural Research Council, with A.P. Baxter as manager of the Biosystematics Division's project on economically important fungi (comprising MU and NCF).

1994 A life time of work by G.C.A. van der Westhuizen and A. Eicker published in '*Field guide: Mushrooms of southern Africa*'.

1995 First free democratic elections in South Africa; A.J.L. Phillips leaves for Portugal.

1997 L. Schutte resigns; O. O'Brien a student of K.T. van Warmelo Rand Afrikaans University appointed.

1999 A.P. Baxter leaves MU and takes up a post of Assistant Director in the Department of Agriculture; I.H. Rong appointed head of MU.

2000 Karnal Bunt disease reported in South Africa, MU becomes the only recognised laboratory to analyse wheat samples for this disease; An updated list, '*Phytopathogenic fungi from South Africa*' by P.W. Crous, A.J.L. Philips, and A.P. Baxter is published.

2003 C. Roux retires.

2004 Funding acquired for the electronic capture of PREM collection data; A. Jacobs, PhD student of M.J. Wingfield at the University of Pretoria, appointed.

2005 O. O'Brien resigns; Centenary of the South African National Collection of Fungi.