(2465–2466) Proposals to conserve *Blastomyces* Gilchrist & W.R. Stokes against *Blastomyces* Costantin & Rolland and *Ajellomycetaceae* against *Paracoccidioidaceae* (*Ascomycota*: *Onygenales*)

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DOI http://dx.doi.org/10.12705/655.19

(2465) ***Blastomyces*** Gilchrist & W.R. Stokes in J. Exp. Med. 3: 76. 1898, nom. cons. prop.
Typus: *B. dermatitidis* Gilchrist & W.R. Stokes.

(H) *Blastomyces* Costantin & Rolland in Bull. Soc. Mycol. Fr. 4: 153. 1889, nom. rej. prop.
Typus: *B. luteus* Costantin & Rolland.

(2466) ***Ajellomycetaceae*** Unter. & al. in Mycologia 96: 819. 2004, nom. cons. prop.
Typus: *Ajellomyces* McDonough & A.L. Lewis.
(=) *Paracoccidioidaceae* Redaelli & Cif. in Mem. Cl. Sci. Fis. Mat. Nat. Accad. Italia 8: 595. 1937, nom. rej. prop.
Typus: *Paracoccidioides* F.P. Almeida.

In current medical literature, the fungal genus *Blastomyces* Gilchrist & W.R. Stokes (l.c.) is known as one of the classical dimorphic agents of systemic mycoses. The dimorphic systemic fungi belong to the order *Onygenales*, cause inhalation mycoses, and have a double life cycle: they occupy an environmental, mostly terrestrial niche where their saprophytic phases reside, and have an invasive phase which is expressed in a warm-blooded mammal host. Five genera of dimorphic fungi are distinguished, i.e., *Coccidioides* G.W. Stiles*, Emmonsia* Cif. & Montemartini, *Histoplasma* Darling and *Paracoccidioides* F.P. Almeida in addition to *Blastomyces*. Four of these belong to a single family, the *Ajellomycetaceae* Unter., J.A. Scott & Sigler (l.c.), whereas *Coccidioides* is phylogenetically remote and has been classified in the *Onygenaceae* E. Fisch. in Engler & Prantl, Nat. Pflanzenfam. I(1): 293. 1897. Natural life cycles are not completely understood, but the current hypothesis is that the mammal vector enhances dispersal of the fungus within its environmental niche, coinciding with the natural niche of the vector. Infection is thus favorable to the fungus, which increases its fitness by using a dedicated mammal vector for dispersal within the environment where the fungus is able to survive. Hence, despite the preponderance of an environmental life cycle where, in some species, an elaborate sexual phase seems to occur, these fungi are judged to be true pathogens rather than opportunists.

For *Blastomyces dermatitidis* the preferred animal vector is uncertain, but in endemic areas, dogs and beavers are frequently found to be infected (Saccente & Woods in Clin. Microbiol. Rev. 23: 367–381. 2010). As with most environmental pathogens, *B. dermatitidis* has a sloppy fitness space and hence non-optimal mammals including humans occupying the same area can also be infected, leading to a pulmonary, cutaneous or systemic disease known as Blastomycosis, sometimes also referred to as North American Blastomycosis, Gilchrist's Disease, or Chicago Disease. After inhalation, propagules transform into large, thick-walled yeast-like cells which resist phagocytosis. The fungus may remain asymptomatic, but frequently disseminates through blood and lymphatic tissues, leading to infections of skin, bone, genitourinary tract, and brain. The infection can be acute or chronic and may take a fatal course when left untreated. The disease is particularly prevalent in temperate North America, where several thousands of cases have been recorded (Chapman & al. in Clin. Infect. Dis. 46: 1801–1812. 2008).

The generic name *Blastomyces* was first introduced by Costantin & Rolland (l.c.) for a different fungus, a single species, *Blastomyces luteus*, for which type material has not been preserved. Carmichael (in Canad. J. Bot. 40: 1160. 1962) placed *Blastomyces luteus* Costantin & Rolland in synonymy under *Chrysosporium merdarium* (Ehrenb.) J.W. Carmich., the current name for *Chrysosporium corii* Corda, the type of *Chrysosporium* Corda. *Blastomyces luteus* was isolated from bear dung and it produces intercalary "aleuriospores", characteristics that support the synonomy with *C. merdarium*. **We hereby designate as lectotype of *B. luteus*, plate XXIII by Costantin & Rolland (in Bull. Soc. Mycol. Fr. 4: 153–157, t. XXIII. 1889).**

Phylogenetically, *Chrysosporium merdarium* (as *Gymnoascus uncinatus* Eidam, previously designated neotype CBS 408.72 = UAMH 3913; see Oorschot in Stud. Mycol. 20: 13. 1980) is placed in the *Gymnoascaceae* Baran. and separated from *B. dermatitidis* (as *Ajellomyces dermatitidis* McDonough & A.L. Lewis) and other members of the *Ajellomycetaceae* (Vidal & al. in Rev. Iberoam. Micol. 17: 22–29. 2000; Sigler & al. in J. Clin. Microbiol. 51(10): 3338–3357. 2013). Additionally, *Chrysosporium merdarium* var. *roseum* W. Gams & Domsch (ex-type strain CBS 388.68 = UAMH 5339) is allied to *Pseudogymnoascus* Raillo (*Pseudeurotiaceae* Malloch & Cain, *Leotiomycetes* O.E. Erikss. & Winka) (Pitt & al. in IMA Fungus 4(2): 229–241. 2013).

When Gilchrist & Stokes (l.c.) described *B. dermatitidis* they neither indicated that they were describing a new genus nor did they supply a generic description separate from the single species description. In fact the title of their article all in capital letters was "A CASE OF PSEUDO-LUPUS VULGARIS CAUSED BY A BLASTOMYCES" and the running head similarly had "*Pseudo-Lupus Vulgaris Caused by a Blastomyces*", wording which could be taken to suggest that they considered that the generic name *Blastomyces* existed already and was not being newly introduced by them in this 1898 publication. However, it seems virtually certain that they were generally using "blastomyces", not as a scientific name but as a term for "yeast" ("budding fungus"), as the word was not distinguished typographically, e.g., by italic or an initial capital, anywhere in the paper (save in the formal publication of "*Blastomyces dermatitidis*") and on page 72 they stated, "… we now prefer to designate the parasite as a blastomyces rather than an oidium", which in present-day terminology would mean whether it is either a yeast or a filamentous fungus. It would appear that in the fully capitalized title, the running head and the lower case use of "blastomyces" on several pages that they were merely referring to blastic versus schizolytic growth-forms. Moreover, although Gilchrist & Stokes gave extensive references to previous work on yeast fungi causing human disease (e.g., Busse in Centralbl. Bakteriol. Parasitenk. 14: 175–180. 1894; San Felice ["Sanfelice"] in Centralbl. Bakteriol. Parasitenk. 18: 521–526. 1895), they did not refer either to Costantin or Rolland, nor was any such reference found in their cited publications, in many of which "blastomycete" was also used rather than "yeast" for the pathogen being studied. Indeed San Felice (l.c.), whom Gilchrist and Stokes refer to as "the most prolific writer upon the subject of pathogenic yeasts", referred throughout his paper to the organisms involved as "Blastomyceten", but named his "hier beschriebenen Blastomyceten" as *Saccharomyces lithogenes*. Moreover, although some of his species were later recognized as referable to *Blastomyces* (presumably that of Gilchrist and Stokes), San Felice did not describe any species under that generic name. It may be noted that Costantin & Rolland applied *Blastomyces* to a filamentous environmental fungus, which, as appears from the above citations, was a research area remote from that of yeast-like human pathogens.

Gilchrist and Stokes on page 76 definitely introduced the name *Blastomyces dermatiditis* in bold italicized lettering as a new taxon. *Blastomyces* Gilchrist & W.R. Stokes has, by consensus, been generally accepted as being validly described as an independent generic name a second time in 1898 (De Hoog & al., Atlas of Clinical Fungi, ed. 2. 2000), which makes it an illegitimate later homonym of *Blastomyces* Costantin & Rolland. Type material of *B. dermatiditis* is not known to have been preserved, but in medical literature *B. dermatitidis* as the agent of human blastomycosis is distinct from *Chrysosporium merdarium* (= *Blastomyces luteus* Costantin & Rolland) (Vidal & al., l. c.) which is not associated with vertebrate disease. Therefore, medical mycologists (and physicians) would need to abandon the

generic name *Blastomyces* if the name is not conserved as based on *B. dermatitidis*. Further confusion was generated by the transfer of *Blastomyces dermatitidis* to *Blastomycoides* Castellani, an illegitimate generic name typified by *Blastomycoides immitis* (G.W. Stiles) Castellani (in Amer. J. Trop. Med. 8: 385. 1928), type of the earlier generic name *Coccidioides* and currently known as *Coccidioides immitis* Rixford & Gilchrist, the above-mentioned dimorphic systemic pathogen in the family *Onygenaceae*. In order to ensure stability in the application of the generic name *Blastomyces* and its long accepted authorship (Gilchrist & W.R. Stokes), we are here proposing to conserve the generic name against its earlier homonym. **We hereby designate as lectotype of *Blastomyces dermatitidis*, plate VI by Gilchrist & W.R. Stokes (in J. Exp. Med. 3: 53–78, pls. IV–VIII. 1898).**

The genus *Zymonema* Beurm. & Gougerot (in Tribune Méd. (Paris) 42: 503. 1909) was based on *Cryptococcus gilchristii* Vuill. (*Zymonema gilchristii* (Vuill.) Beurm. & Gougerot in Guéguen, Champ. Paras. Homme: 108. 1904). Despite the absence of type material this name is generally taken to have been applicable to *Blastomyces dermatitidis*. Van Oorschot (in Stud. Mycol. 20: 1–89. 1980) considered *Zymonema* as the oldest available name for *Blastomyces* Gilchrist & W.R. Stokes assuming that the latter name was validly published but illegitimate. The name of the species indicating the type of *Zymonema* is confusing, since Brown & al. (in PLoS ONE 8: e59237. 2013) described *Blastomyces gilchristii* E.M. Brown & al. as a *Blastomyces* sibling species molecularly different from *B. dermatitidis*, and *Z. gilchristii* may apply to either of these species. In contrast, Redaelli & Ciferri (l.c. 1937) listed "*Zymonema* Auct. p.p., non De Beurmann et Gougerot" as synonym of *Paracoccidioides*, based on *Zymonema brasiliensis* Splendore (≡ *Paracoccidioides brasiliensis* (Splend.) F.P. Almeida). A further generic name introduced to replace the supposed illegitimate name *Blastomyces* Gilchrist & W.R. Stokes was *Gilchristia* Cif. & Redaelli (in Boll. Soc. Ital. Biol. Sperim. 9: 960. 1934), based on the same type, *B. dermatitidis*. The rationale for this was their supposition that *Zymonema* would be synonymous with *Paracoccidioides*, but De Beurmann & Gougerot's (l.c.) selection of type was referable to *Blastomyces*, as explained above. *Gilchristia* is younger than *Zymonema*, has been totally forgotten in the medical literature, and is illegitimate (Art. 52.1) as it was based on the same type as *Blastomyces*.

The sexual life cycle of *B. dermatitidis* was elucidated in 1968, leading to the description of the teleomorphic species *Ajellomyces dermatitidis* McDonough & A.L. Lewis (in Mycologia 60: 77. 1968). Given the fact that mating experiments on specialized media and competent mating partners are required to reveal this phase, this name has only rarely been applied in clinical practice. In the framework of current single name nomenclature for fungi (Art. 59), the oldest, widely used name of the fungus has priority. **We hereby designate the cryopreserved isolate deposited at CBS, CBS 674.68 (= ATCC 18188 = UAMH 3539) as epitype of *B. dermatitidis*.** This isolate represents mating type A of *Ajellomyces dermatitidis*, isolated from human patient, U.S.A. by E.S. McDonough.

Recent phylogenetic data (Brown & al. in PLoS ONE 8: e59237. 2013; Schwartz & al. in PLoS Pathog. 11: e1005198. 2015) have shown that the generic name *Blastomyces* has been applied to a heterogeneous group of species but as currently applied to a phylogenetically defined generic level clade it includes several species, among which is *E. parva* (C.W. Emmons & Ashburn) Cif. & Montemart., the type of *Emmonsia* Cif. & Montemart., as represented by the neotype strain CBS 139881 (= UAMH 130) (K. Dukik & al., in prep.). In vivo, as well as in vitro at 37°C, *E. parva* forms non-replicating inflated cells known as adiaspores, different from the thermo-dependent phase of *B. dermatitidis*, which shows broad-based budding. In contrast *Emmonsia crescens* C.W. Emmons & Jellison producing very large, multinucleate adiaspores, is phylogenetically remote and cannot be maintained in the same genus.

The name *Blastomyces* is well-established in medical mycology for human and animal blastomycosis. Given the significance of the disease caused by this fungus we propose conservation of *Blastomyces* to protect it against the later homotypic synonym, *Gilchristia* and the heterotypic synonyms *Zymonema*, *Ajellomyces* and *Emmonsia*. Failure to conserve the name would lead to adoption of a long forgotten name, *Gilchristia.* Ambiguity exists over the status of both *Gilchristia* and *Zymonema*, and thus abandoning *Blastomyces* would be destabilizing to the medical literature.

We further note that the currently accepted family name *Ajellomycetaceae*, is typified by *Ajellomyces*, a generic name that will be synonymized with *Blastomyces* if the conservation proposal presented here is accepted. The family name itself is superfluous although not illegitimate (Art. 59.1) because when described it included the type, *Paracoccidioides* (Splend.) F.P. Almeida, of the older family name *Paracoccidioidaceae* Redaelli & Cif. (l.c. 1937). The type, *Paracoccidioides*, was an anamorph typified generic name and the family name itself was published well before 2013 and its legitimacy is therefore protected by Art. 59.1. We further note that the name "*Blastomycetaceae*" (Locquin, Mycol. Gén. Struct.: 200. 1984) exists in the literature but was never validly published (Art. 32.1(c)). For reasons of stability because of current common use in medical literature, we prefer to continue to use the name *Ajellomycetaceae* via conservation of that name for the fungal family comprising *Blastomyces, Histoplasma, Paracoccidioides* and related genera and rejection of the name *Paracoccidioidaceae* Redaelli & Cif.