

Taxonomic notes on the Geastraceae, Tulostomataceae, Nidulariaceae and Sphaerobolaceae (Gasteromycetes) *sensu* Bottomley, in southern Africa

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ABSTRACT

Bottomley's (1948) *Gasteromycetes of South Africa* is still widely used for identification purposes. However, as a result of developments since 1948, the work has become outdated in many respects. Entries in the Geastreae (Lycoperdaceae), Tulostomataceae, Nidulariaceae and Sphaerobolaceae *sensu* Bottomley (1948) that require updating are listed and briefly commented on.

INTRODUCTION

Although Bottomley's (1948) *Gasteromycetes of South Africa* was, in her own words, '... not in any sense a critical revision...' but '... merely an assembling of the known records of these fungi in Southern Africa', it still remains the standard source of reference with regard to the identification and classification of the Gasteromycetes of the region. However, errors in the original work, changes to the International Code of Botanical Nomenclature (ICBN) and particularly, considerable changes in Gasteromycete systematics since 1948, contributed to an unfortunate situation in which current users of Bottomley (1948) are at considerable risk of ending up with incorrect identifications or outdated names. In the families considered in this paper more than 70% of the entries in Bottomley (1948) are affected to a greater or lesser degree.

Since a comprehensive revision of the southern African Gasteromycetes is still some years in the offing, there is a need for an interim guide listing those entries in Bottomley (1948) which may lead to the inaccurate identification and classification of specimens. In this first instalment, the Geastreae (Lycoperdaceae), Tulostomataceae, Nidulariaceae and Sphaerobolaceae *sensu* Bottomley (1948) are considered. It is emphasized that this paper is primarily a reflection of views and ideas expressed in the literature since 1948, and that it does not claim to be a critical re-appraisal of any of the taxa concerned. The principle objective is to provide an interim aid towards the more effective use of Bottomley (1948).

The order of arrangement of the taxa listed below follows Bottomley (1948), and the taxon name and author citation heading each entry have been taken, unchanged, from that publication. The number in brackets following each heading refers to the relevant page number in Bottomley (1948). Entries in Bottomley (1948) which, to our present knowledge, do not require comment, are not included in the list. This also applies to names in which

the only 'error' to be corrected is the outdated use of the capital letter in epithets derived from personal names (e.g. *Batarrea Stevenii* instead of *Batarrea stevenii*). Suggested taxon names are supplied in bold. Unless stated otherwise, references to ICBN articles and recommendations pertain to the Tokyo Code (Greuter *et al.* 1994). Author citations are abbreviated according to Brummitt & Powell (1992).

ANNOTATED LIST OF TAXA

1. Geastreae (586)

The tribe Geastreae *sensu* Bottomley (1948) has subsequently been treated at the family level (**Geastraceae** Corda; order Lycoperdales) by most eminent gasteromycete taxonomists (Zeller 1949; Eckblad 1955; Kreisel 1962; Demoulin 1968; Ponce de León 1968; Dring 1973; Calonge & Demoulin 1975; Demoulin & Dring 1975; Demoulin & Marriott 1981; Sunhede 1989; Mornand 1993). Exceptions include Dörfelt and co-workers who place these organisms in the order Geastrales (Dörfelt & Müller-Uri 1984; Dörfelt & Bumzaa 1986; Dörfelt & Heklau 1987).

1.1 Geastrum *Persoon* (586)

In accordance with the changes to the ICBN enacted in 1981 (Korf 1983), the appropriate author citation, indicating the sanctioned status of this name, is **Geastrum** *Pers.*: *Pers.*

De Villiers (1994) has recently completed a revision of the genus *Geastrum* in South Africa, providing an updated key to their identification.

1.1.1 *Geastrum pectinatum Persoon* (588)

According to Korf (1983) the author citation as used in Bottomley (1948) is acceptable in non-taxonomic works only. In taxonomic treatments authors are strongly advised to use the more informative **Geastrum pectinatum** *Pers.*: *Pers.*

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1.1.2 *Geastrum bryantii* Berkeley (589)

Ponce de León (1968) dismissed both *Geastrum bryantii* Berk. and *Geastrum striatum* DC. as mere variations of *Geastrum pectinatum* Pers.: Pers. His view, however, has not been widely accepted and subsequent authors (Dörfelt & Heklau 1987; Sunhede 1989; Mornand 1993) treat *G. striatum* and *G. pectinatum* as separate species. According to Dörfelt & Heklau (1987), Sunhede (1989) and De Villiers (1994), however, *G. bryantii* Berk. is a synonym of ***Geastrum striatum* DC.**

1.1.3 *Geastrum nanum* Persoon (589)

Ponce de León's (1968) merging of *Geastrum nanum* Pers. with *G. pectinatum* does not seem to have found widespread acceptance and recent authors have retained the two as separate species (Dörfelt & Heklau 1987; Sunhede 1989; Mornand 1993). As pointed out by Dörfelt & Heklau (1987) and Sunhede (1989), however, *G. nanum* Pers. is an illegitimate name to be replaced with ***Geastrum schmidelii* Vittad.**

1.1.4 *Geastrum ambiguum* Montagne (591)

Bottomley (1948) and Ponce de León (1968) regard *Geastrum drummondii* Berk. and *Geastrum ambiguum* Mont. as the same species. Dring (1964) and Sunhede (1989), however, both expressed the view that more material should be examined before such a conclusion is drawn. According to Sunhede (1989) both of these species are very similar to *Geastrum campestre* Morgan. Demoulin & Dring (1975), on the other hand, state that *G. ambiguum* in Bottomley (1948) is the same as the *G. drummondii* of Dring (1964) and Dring & Rayner (1967), and that it differs from the type specimens of *G. ambiguum* and *G. drummondii*. They adopt the name *Geastrum schweinfurthii* Henn. for this fungus. Bottomley (1948) and Ponce de León (1968) regarded *G. schweinfurthii* as conspecific with *G. ambiguum*. De Villiers (1994) does not follow Demoulin & Dring (1975) in recognizing *G. schweinfurthii* as a separate species, stating that '...there is not (sic) doubt that the southern African collections of *G. ambiguum* have been correctly identified by Bottomley ...'. The last word on the identity of this fungus has probably not been spoken.

1.1.5 *Geastrum quadrifidum* Persoon (591)

According to Korf (1983) the author citation as used in Bottomley (1948) is acceptable in non-taxonomic works only. In taxonomic treatments authors are strongly advised to use the more informative ***Geastrum quadrifidum* Pers.: Pers.**

1.1.6 *Geastrum dissimile* n. sp. (592)

According to Dissing & Lange (1962), Dring & Rayner (1967), Sunhede (1989), De Villiers (1994) and De Villiers & Eicker (1996), this is a good species and not a synonym of *Geastrum minimum* Schwein. as reported by Ponce de León (1968). The name, correctly cited, therefore, is ***Geastrum dissimile* Bottomley.**

1.1.7 *Geastrum limbatum* Fries (594)

Ponce de León (1968), Calonge & Demoulin (1975) and Sunhede (1989) all regard *Geastrum limbatum* Fr. as a synonym of ***Geastrum coronatum* Pers.: Pers.**

According to Sunhede (1989), *Geastrum limbatum sensu* Coker & Couch is the same fungus as the one described by Lloyd as *Geaster limbatus*, cited by Bottomley (1948) as a good description of *G. limbatum* Fr. *G. limbatum sensu* Coker & Couch, however, is generally accepted to be a synonym of *Geastrum smardae* V.J.Staněk (Ponce de León 1968; Sunhede 1989).

A comparison of the descriptions in Bottomley (1948) and Sunhede (1989) indicates that Bottomley's fungus might be *G. coronatum* rather than *G. smardae*. This view has recently been confirmed by De Villiers (1994).

1.1.8 *Geastrum triplex* Junghuhn (595)

Ponce de León (1968), Smith & Ponce de León (1982) and, according to Sunhede (1989), several other authors have regarded *Geastrum indicum* (Klotzsch) Rauschert as the legitimate name for *Geastrum triplex* Jungh. Other authors such as Sunhede (1977), Dörfelt & Müller-Uri (1984), Dörfelt & Heklau (1987) and Sunhede (1989), however, all argue that *G. indicum* should be rejected as a *nomen dubium* and that *G. triplex* should be retained as the correct name for this species, as has also been done by Mornand (1993).

Geastrum lageniforme Vittad. and *Geastrum morganii* Lloyd, cited by Bottomley as synonyms of *G. triplex* are, however, accepted as good species by Sunhede (1989). De Villiers (1994) also accepts a distinction between *G. lageniforme* and *G. triplex*.

According to Dörfelt & Müller-Uri (1984), *Geastrum capense* Thüm., also cited as a synonym of *G. triplex* by Bottomley (1948), is a later synonym of *Geastrum saccatum* Fr. However, De Villiers (1994) regards *G. capense* as a synonym of *G. lageniforme*.

1.1.9 *Geastrum mirabile* Montagne (598)

It is generally accepted (Zeller 1948; Dring & Rayner 1967; Ponce de León 1968; Demoulin & Dring 1975; De Villiers 1994) that *Geastrum mirabile* Mont. is a synonym of ***Geastrum schweinitzii* (Berk. & M.A.Curtis) Zeller.**

1.1.10 *Geastrum velutinum* Morgan (599)

Ponce de León (1968) regarded *Geastrum velutinum* Morgan as synonym of the earlier described *Geaster javanicus* Lév., and created the new combination *Geastrum javanicum* (Lév.) P.Ponce de León. As explained in Demoulin (1984), however, *Geaster* is merely an orthographic variant of *Geastrum*, which makes Ponce de León's combination superfluous. According to Dring & Rayner (1967), as well as Sunhede (1989), a thorough revision of *G. velutinum* and related taxa is desirable. De Villiers (1994) accepts *G. velutinum* as the correct name,

but if this fungus is indeed conspecific with *G. javanicum*, the correct spelling and citation will be *Geastrum javanicum* Lév.

This fungus must have confused Bottomley (1948) as well, since, while she regards it as a good species on p. 599, she also lists the name *Geastrum velutinum* as a synonym under *G. saccatum* on p. 597.

1.1.11 *Geastrum arenarium* Lloyd (600)

Ponce de León (1968) considers this to be a synonym of *Geastrum minimum* Schwein. Despite Sunhede's (1989) acknowledgment of the similarity between *Geastrum arenarium* Lloyd and *G. minimum*, he prefers to retain them as separate species (Sunhede 1986, 1989), a view endorsed by De Villiers (1994). According to the latter author, Bottomley (1948) correctly referred her material to *G. arenarium*.

1.1.12 *Geastrum mammosum* Chevallier (600)

Ponce de León (1968) treats this fungus as *Geastrum recolligens* (Sowerby) Desv. which, according to Sunhede (1989), should be *Geastrum recolligens* (With.) Desv. According to Dörfelt & Bumzaa (1986), however, both *Geastrum mammosum* Chevall. and *G. recolligens* [the latter as *G. recolligens* (Woodw.) Desv.] should be treated as synonyms of *Geastrum corollinum* (Batsch) Hollós. Sunhede (1989) gives a detailed explanation for this. Mornand (1993) also accepts that the correct name for both *G. mammosum* and *G. recolligens* should be ***Geastrum corollinum*** (Batsch) Hollós.

1.1.13 *Geastrum fornicatum* (Hudson) Fries (601)

Ponce de León (1968) regards this as a synonym of *Geastrum quadrifidum* Pers.: Pers., but Sunhede (1989), followed by De Villiers (1994), accepts *Geastrum fornicatum* and *G. quadrifidum* as separate species. Sunhede (1989) also explains why the correct author citation for *G. fornicatum* should be ***Geastrum fornicatum*** (Huds.) Hook.

1.1.14 *Geastrum floriforme* Vittadini (602)

The combination *Geastrum floriforme* (Vittad.) G. Cunn. as cited in Ponce de León (1968) is superfluous and the name used in Bottomley (1948) is correct. *Geastrum hungaricum* Hollós, cited by Bottomley (1948) as well as Ponce de León (1968) as a synonym of *G. floriforme*, is, however, considered to be a good species by several authors, including Dörfelt & Bumzaa (1986) and Sunhede (1989).

1.1.15 *Geastrum hygrometricum* Persoon (603)

The transfer of this fungus to the genus *Astraeus* Morgan and its placement in the family **Astraeaceae** V.J.Staněk (order **Sclerodermatales**) seems to be generally accepted (Dring 1973; Calonge & Demoulin 1975; Demoulin & Marriott 1981; Sunhede 1989; Mornand 1993). The correct name and author citation are ***Astraeus hygrometricus*** (Pers.: Pers.) Morgan.

1.1.16 *Geaster MacOwani* Kalchbr. (604)

Geaster is an orthographic variant of *Geastrum* (Demoulin 1984). According to ICBN article 60.11 and recommendation 60C.1.(b), the orthography of the epithet also needs to be corrected to ***Geastrum macowanii*** Kalchbr.

Ponce de León (1968) regards this fungus, listed in Bottomley (1948) as a 'Doubtful Species', as conspecific with *G. quadrifidum* Pers.: Pers. According to Dring & Rayner (1975), however, the true identity of *G. macowanii* remains unknown.

1.2 *Myriostoma coliforme* (Dickson ex Persoon) Corda (605)

The author citation is incorrect, according to Sunhede (1989) and Mornand (1993). The correct citation should be ***Myriostoma coliforme*** (With.: Pers.) Corda.

1.3 *Geasteropsis Conrathii* Hollós (606)

According to Sunhede (1989) and article 60.11 of the ICBN, the correct orthography should be ***Geasteropsis conrathii*** Hollós.

Long (1945) placed this fungus in the genus *Trichaster* Czer. as *Trichaster conrathii* (Hollós) Long, while Ponce de León (1968) created the new combination *Geastrum conrathii* (Hollós) P.Ponce de León. In his authoritative revision of the Geastraceae, however, Sunhede (1989) is absolutely convinced that this fungus has no place in any of the above two genera and that it should be retained in the genus *Geasteropsis* Hollós. Sunhede (1989) warns, however, that his inclusion of *Geasteropsis* in the Geastraceae, as accepted also by De Villiers (1994), is tentative, pending further studies.

2. Tulostomataceae (607)

Bottomley (1948) places this family in the order Lycoperdales but it is now widely recognized (Dring 1973; Calonge & Demoulin 1975; Demoulin & Dring 1975; Demoulin & Marriott 1981; Moreno *et al.* 1992b; Mornand 1993) that it is more appropriately placed in the order **Tulostomatales** erected by Demoulin (1968). Bottomley provides no author citation for this family, which, according to David (1993), should be cited as **Tulostomataceae** E.Fisch.

In her key to the genera of the Tulostomataceae, Bottomley (1948) included the genus ***Schizostoma*** Ehrenb. ex Lév. emend. Lloyd, although it had not yet been recorded from southern Africa at the time. ***Schizostoma laceratum*** (Fr.) Lév. has, however, been recorded since then (Talbot 1958) and appears to be fairly common.

2.1 *Tulostoma Persoon* (608)

The appropriate author citation, indicating the sanctioned status of this name, is ***Tulostoma*** Pers.: Pers.

From Wright (1987) it is evident that serious shortcomings exist in Bottomley's descriptions of the southern

African *Tulostoma* species and that numerous specimens cited in Bottomley (1948) have been incorrectly identified. A taxonomic reassessment of the *Tulostoma* specimens at PREM should therefore be a worthwhile exercise.

2.1.1 *Tulostoma album* Masee (610)

Wright (1987) regards this as a doubtful species, but accepts *Tulostoma macalpinianum* Lloyd, which Bottomley (1948) cites as a synonym of *Tulostoma album* Masee, as a validly published species. As far as could be ascertained, *T. macalpinianum* has not been recorded in southern Africa yet. The specimen listed by Bottomley (1948) as *T. album* (PREM 28528) is, however, ***Tulostoma lesliei*** Van der Byl (Wright 1987).

2.1.2 *Tulostoma purpusii* Henn. (611)

According to Wright (1987), PREM 11690, listed in Bottomley (1948) as *Tulostoma purpusii* Henn., is in fact *Tulostoma adhaerens* Lloyd. The identity of the rest of the material cited in Bottomley (1948) requires verification.

2.1.3 *Tulostoma albicans* White (611)

This name is to be cited as ***Tulostoma albicans*** V.S.White. Wright (1987), however, regards *T. albicans* as '...an ill-defined species, easy to mistake for others...', and excludes Africa from its distributional range. PREM 8764, listed in Bottomley (1948) as *T. albicans*, has been described as a new species under the name *Tulostoma exasperatosporum* J.E.Wright (Wright 1983), while PREM 28638 is *Tulostoma involucreatum* Long (Wright 1987).

2.1.4 *Tulostoma bonianum* Patouillard (612)

According to Wright (1987) *Tulostoma bonianum* Pat. is a synonym of ***Tulostoma pusillum*** Berk.

However, with two exceptions, Wright (1987) referred all of the specimens cited under *T. bonianum* in Bottomley (1948) (PREM 1344; 1969; 20378 & 30617), to *Tulostoma verrucosum* Morgan, which, in turn, is a synonym of *Tulostoma squamosum* (J.F.Gmel.: Pers.) Pers. (Moreno *et al.* 1992a). Wright (1987) regards *T. pusillum* as a fungus of tropical rain forests and does not include southern Africa in its distributional range. In the light of this, the status of *T. pusillum* in southern Africa requires verification.

2.1.5 *Tulostoma brumale* Persoon (613)

In accordance with the changes to the ICBN enacted in 1981 (Korf 1983), the appropriate author citation, indicating the sanctioned status of this name, should be ***Tulostoma brumale*** Pers.: Pers.

According to Wright (1987), *T. brumale* is a typical European species not occurring in southern Africa. He diagnosed PREM 20946 & 31371, cited as *T. brumale* in Bottomley (1948), as *Tulostoma rufum* Lloyd and

Tulostoma nanum (Pat.) J.E.Wright respectively. In the light of this the identity of the other specimens cited as *T. brumale* in Bottomley (1948) is suspect and requires verification.

2.1.6 *Tulostoma squamosum* (Gmelin) Persoon (613)

Cf. *T. bonianum* above.

According to Korf's (1983) interpretation of the changes to the ICBN that were enacted in 1981, the authorship of this name would be more appropriately cited as ***Tulostoma squamosum*** (J.F.Gmel.: Pers.) Pers.

2.1.7 *Tulostoma cyclophorum* Lloyd (615)

According to Wright (1987) the specimens cited by Bottomley as *Lloyd Myc. Coll. 28934, 28958* are in fact *Tulostoma purpusii* Henn. The identity of the rest of the material cited in Bottomley (1948) requires verification.

2.1.8 *Tulostoma obesum* Cooke et Ellis (616)

According to Wright (1987) this is merely a variety of *Tulostoma volvulatum* I.G.Borshch., namely ***Tulostoma volvulatum*** var. ***obesum*** (Cooke & Ellis) J.E.Wright.

Although the closely related *Tulostoma volvulatum* var. *elatum* Har. & Pat. has been reported from Namibia, Africa is not included in the distributional range of *T. volvulatum* var. *obesum* (Wright 1987). Bottomley (1948) mentions a single collection of this fungus from southern Africa, but hastens to add that no material had been available for examination. Unless Bottomley's (1948) record can be verified, the status of this fungus in southern Africa should be regarded as doubtful.

2.1.9 *Tulostoma MacOwani* Bresadola (617)

Orthographic error. According to ICBN article 60.11 and recommendation 60C.1.(b), the spelling of the epithet should be corrected. The correct spelling and author citation for this name, first published in Petri (1904), therefore is ***Tulostoma macowanii*** Bres. ex Petri.

2.1.10 *Tulostoma australianum* Lloyd (617)

According to Wright (1987), PREM 27501 is not *Tulostoma australianum* Lloyd as stated in Bottomley (1948), but might be ***Tulostoma vulgare*** Long & S.Ahmad.

2.1.11 *Tulostoma adherens* Lloyd (618)

Orthographic error. The correct spelling (Lloyd 1923), used also by Wright (1987), is ***Tulostoma adhaerens*** Lloyd.

Although *T. adhaerens* does occur in South Africa (PREM 11690; 41432), the specimen cited in Bottomley (1948) under this name is *Tulostoma caespitosum* Trab. ex Sacc. (Wright 1987).

2.1.12 *Tulostoma angolense* Welwitsch et Currey (618)

According to Bottomley (1948), who lists this as a doubtful species, Welwitsch & Currey (1870) remarked that *Tulostoma angolense* Welw. & Curr. is possibly not distinct from *Chlamydompus meyenianus* (Klotzsch) Lloyd. This is unlikely, however, considering its smooth spores (Wright 1987). Wright (1987) accepts this as a good species, although he classifies it as 'critical', but also mentions the possibility that it might well be *Tulostoma volvulatum* var. *elatum* Har. & Pat.

2.2 *Batarrea* Persoon (619)

As discussed in Coetzee & Eicker (1992) this name has been spelled in various ways. Bottomley (1948) used Persoon's original spelling which lends itself to correction as provided for by article 60 of the ICBN. In a number of recent works, *Battarraea* has been the preferred form of spelling (Rauschert 1986; Wright 1987; Mornand 1993 and several other authors cited in Martin & Llimona 1994). Another school of thought, however, strongly opposes this (Martin & Llimona 1994), recognizing *Battarraea* as the correct spelling. Until this matter is resolved, we prefer to use the original spelling of this name, to be cited as **Batarrea** Pers.: Pers.

2.2.1 *Batarrea phalloides* (Dickson) Persoon (619)

According to Korf's (1983) interpretation of the changes to the ICBN enacted in 1981, the authorship of this name would be more appropriately cited as **Batarrea phalloides** (Dicks.: Pers.) Pers.

2.2.2 *Batarrea Diqueti* Patouillard et Hariot (621)

The transfer of this fungus to the genus *Battarreoides* Herrera (Heim & Herrera 1961) has been widely accepted (Dring 1973; Hawksworth *et al.* 1983; Miller & Miller 1988; Coetzee & Eicker 1994; Moreno *et al.* 1995). The correct name and author citation is **Battarreoides diquetii** (Pat. & Har.) R.Heim & T.Herrera.

2.3 *Phellorina* Berkeley (622)

Orthographic error. According to Farr *et al.* (1979) *Phellorina* is an orthographic variant, the correct spelling being **Phellorinia** Berk.

2.3.1 *Phellorina inquinans* Berkeley (623)

According to the description in Bottomley (1948) this is the 'scaly' form of *Phellorinia herculeana* (Pall.: Pers.) Kreisel, which, according to Dring (1964) and Dring & Rayner (1967), is **Phellorinia herculeana** (Pall.: Pers.) Kreisel subsp. *herculeana*.

2.3.2 *Phellorina strobilina* Kalchbrenner (624)

According to the description in Bottomley (1948) this is the 'warty' form of *Phellorinia herculeana* (Pall.: Pers.) Kreisel, which, according to Dring (1964) and Dring & Rayner (1967), is **Phellorinia herculeana** subsp. *strobilina* (Kalchbr.) D.M.Dring.

2.4 *Dictyocephalos* Underwood (626)

White (1901) attributed the name *Dictyocephalos* to Underwood. It is, however, not easy to determine from the original publication whether this should be treated as an 'in' or 'ex' case as discussed in ICBN article 46 (Greuter *et al.* 1994). We therefore accept the citation suggested in Greuter *et al.* (1993), namely **Dictyocephalos** Underwood *ex* V.S.White.

2.5 *Podaxis* Desvaux (627)

Bottomley's (1948) placement of this genus in the family Tulostomataceae (order Lycoperdales) has definitely not found widespread acceptance. Most authors, including Zeller (1949), Dissing & Lange (1962), Dring (1964, 1973), Dring & Rayner (1967), De Villiers (1988) and Miller & Miller (1988), place it in the family **Podaxaceae** Corda which Zeller (1949), Dring (1973), De Villiers (1988) and Miller & Miller (1988) believe belongs in the order **Podaxales**.

2.5.1 *Podaxis pistillaris* (Linnaeus *ex* Persoon) Morse (628)

In terms of article 47.1 of the Tokyo Code, the re-assessment of this species by Morse (1933) '... does not warrant a change of author citation for the name of the taxon', as has been done by Bottomley (1948). The appropriate citation, as employed in Dring & Rayss (1964), Binyamini (1973) and De Villiers *et al.* (1989), adapted here to reflect the changes to the ICBN enacted in 1981 (Korf 1983), is **Podaxis pistillaris** (L.: Pers.) Fr. *emend.* Morse.

One of the specimens listed in Bottomley (1948) as *P. pistillaris* (PREM 27280), has been described as a new species by De Villiers *et al.* (1989), namely *Podaxis rugospora* De Villiers *et al.*

3. Nidulariaceae Fries (631)

According to David (1993) this family name is not attributable to Fries. It should be cited as **Nidulariaceae** Dumort.

3.1 *Crucibulum* Tulasne (631)

Stafleu & Cowan (1986) point out that L.R. Tulasne's brother, Charles, co-authored the work on the Nidulariales and according to Greuter *et al.* (1993), the correct author citation for this name should be **Crucibulum** Tul. & C.Tul.

3.1.1 *Crucibulum vulgare* Tulasne (632)

This name, correctly cited as *Crucibulum vulgare* Tul. & C.Tul., is incorrect (Eckblad 1955; Brodie 1975) and *Crucibulum laeve* is widely accepted as the correct name for this fungus (Eckblad 1955; Brodie 1975; Calonge & Demoulin 1975; Ortega & Buendia 1986; Kreisel 1990; Mornand 1993). All of the aforementioned authors, however, use different author citations. The present authors agree with Kreisel (1990) who cites the name as **Crucibulum laeve** (Huds.) Kambly.

3.2 *Cyathus Haller ex Persoon* (633)

According to Greuter *et al.* (1993) the name *Cyathus* is attributable to Persoon, but, as indicated by Bottomley (1948) and Brodie (1975), the name dates from much earlier. In accordance with the changes to the ICBN enacted in 1981 (Korf 1983), the appropriate author citation, indicating the sanctioned status of this name, should be ***Cyathus Haller: Pers.***

3.2.1 *Cyathus dasypus Nees* (634)

Brodie (1975) regards this as a synonym of *Cyathus olla* (Batsch: Pers.) Pers., stating that '*Cyathus dasypus* from South Africa is surely a form of *C. olla* with extra large irregular peridioles'. The peridiole measurements given in Verwoerd (1928) and Bottomley (1948) are, however, considerably smaller than the dimensions given for *C. olla* in Bottomley (1948), Eckblad (1955), Brodie (1975) and others. In the light of this, Brodie's statement does not make sense and might be worth investigating.

3.2.2 *Cyathus minutosporus Lloyd emend. Verwoerd* (634)

In his authoritative monograph of the Nidulariaceae, Brodie (1975), apparently unaware of the amplified description of this fungus by Verwoerd (1928), lists it as a doubtful species which, according to him, '... cannot legally be recognized as a valid species, but if found again it should be easily recognized by collectors of African material because of the minute spores'.

3.2.3 *Cyathus microsporus Tulasne* (635)

Stafleu & Cowan (1986) point out that L.R. Tulasne's brother, Charles, co-authored the work on the Nidulariales, and consequently, names published therein should be attributed to both brothers. The correct author citation for this name therefore is ***Cyathus microsporus Tul. & C.Tul.***

3.2.4 *Cyathus olla Persoon* (636)

When Persoon (1801) transferred this fungus to the genus *Cyathus*, he simultaneously sanctioned the basionym (Korf 1983). Following Korf's (1983) interpretation of the 1981 changes to the ICBN, the correct author citation for this name therefore is ***Cyathus olla (Batsch: Pers.) Pers.***

3.2.5 (*C. stercoreus*) forma *Leseurii Tulasne* (638)

Spelling error and incorrect author citation. *Cyathus lesueurii* Tul. & C.Tul. has been reduced to synonymy under *Cyathus stercoreus* (Schwein.) De Toni (Lloyd 1906; Brodie 1948; Eckblad 1955; Brodie 1975). Since Lloyd (1906) first assigned it to the form *lesueurii* (Brodie 1948), the correct name and author citation are ***Cyathus stercorius* forma *lesueurii (Tul. & C.Tul.) Lloyd.***

3.2.6 *Cyathus Poeppigii Tulasne* (639)

For the reason stated in 3.2.3 this name should be cited as ***Cyathus poeppigii Tul. & C.Tul.***

3.2.7 *Cyathus Montagnei Tulasne* (640)

For the reason stated in 3.2.3 this name should be cited as ***Cyathus montagnei Tul. & C.Tul.***

3.2.8 *Cyathus Berkeleyanus Tulasne* (640)

Brodie (1975) explains that the Tulasne brothers regarded this as a variety of *C. microsporus*, calling it *Cyathus microsporus* var. *berkeleyanus* Tul. & C.Tul. If it is to be treated as a separate species, however, the correct author citation would be ***Cyathus berkeleyanus (Tul. & C.Tul.) Lloyd.***

4. Sphaerobolaceae *Schroeter* (641)

Although this family has traditionally been treated in the order Nidulariales (Zeller 1949; Eckblad 1955; Dring 1973; Brodie 1975; Dominguez de Toledo 1993), there seems to be an increasing tendency to place it in the order Sclerodermatales (Demoulin 1968; Calonge & Demoulin 1975; Demoulin & Marriott 1981; Ing 1984; Herrera & Perez-Silva 1987; Mornand 1993). According to David (1993) the correct author citation for this family is ***Sphaerobolaceae J.Schröt.***

4.1 *Sphaerobolus Tode ex Persoon* (641)

In accordance with the changes to the ICBN enacted in 1981 (Korf 1983), the appropriate author citation, indicating the sanctioned status of this name, is ***Sphaerobolus Tode: Pers.***

4.1.1 *Sphaerobolus stellatus Tode ex Persoon* (641)

In accordance with the changes to the ICBN enacted in 1981 (Korf 1983), the appropriate author citation, indicating the sanctioned status of this name, and used by authors such as Herrera & Perez-Silva (1987), Hjortstam *et al.* (1993) and Mornand (1993), is ***Sphaerobolus stellatus Tode: Pers.***

REFERENCES

- BINYAMINI, N. 1973. Gasteromycetes of the Sinai desert. *Israel Journal of Botany* 22: 33–37.
- BOTTOMLEY, A.M. 1948. Gasteromycetes of South Africa. *Bothalia* 4: 473–810.
- BRODIE, H.J. 1948. Variation in fruit bodies of *Cyathus stercoreus* produced in culture. *Mycologia* 40: 614–626.
- BRODIE, H.J. 1975. *The bird's nest fungi*. University of Toronto Press, Toronto.
- BRUMMITT, R.K. & POWELL, C.E. 1992. *Authors of plant names*. Royal Botanic Gardens, Kew.
- CALONGE, F.D. & DEMOULIN, V. 1975. Les Gastéromycètes d'Espagne. *Bulletin de la Société Mycologique de France* 91,2: 247–292.
- COETZEE, J.C. & EICKER, A. 1992. *Battarraea, Battarraea, Battarraea or...???* *The Mycologist* 6,2: 61–63.
- COETZEE, J.C. & EICKER, A. 1994. *Battarraeoides diquetii* (Gasteromycetes, Tulostomatales) in southern Africa. *Mycotaxon* 50: 19–25.
- DAVID, J.C. 1993. Fungal family names in current use. In W. Greuter, NCU-1. Family names in current use for vascular plants, bryophytes and fungi. *Regnum Vegetabile* 126: 71–95. Koeltz Scientific Books, Königstein.
- DEMOULIN, V. 1968. Gastéromycètes de Belgique: Sclerodermatales, Tulostomatales, Lycoperdals. *Bulletin du Jardin botanique national de Belgique* 38: 1–101.

- DEMOULIN, V. 1984. Typification of *Geastrum* Pers.: Pers. and its orthographic variant *Geaster* (Gasteromycetes). *Taxon* 33: 498–501.
- DEMOULIN, V. & DRING, D.M. 1975. Gasteromycetes of Kivu (Zaire), Rwanda and Burundi. *Bulletin du Jardin botanique national de Belgique* 45: 339–372.
- DEMOULIN, V. & MARRIOTT, J.V.R. 1981. Key to the Gasteromycetes of Great Britain. *Bulletin of the British Mycological Society* 15: 37–56.
- DE VILLIERS, J.J.R. 1988. 'n Elektronmikroskopiese studie van die basidiospore van sommige Suid-Afrikaanse Gasteromycetes. M.Sc. thesis, University of Pretoria.
- DE VILLIERS, J.J.R. 1994. A reassessment of the southern African Geastraceae using morphological features. Ph.D. thesis, University of Pretoria.
- DE VILLIERS, J.J.R. & EICKER, A. 1996. Notes on the type material of *Geastrum dissimile* Bottomley (Gastraceae). *South African Journal of Botany* 62: 117–120.
- DE VILLIERS, J.J.R., EICKER, A. & VAN DER WESTHUIZEN, G.C.A. 1989. A new section and two new species of *Podaxis* (Gasteromycetes) from South Africa. *South African Journal of Botany* 55: 159–164.
- DISSING, H. & LANGE, M. 1962. Gasteromycetes of Congo. *Bulletin du Jardin botanique national de Belgique* 32: 325–416.
- DOMINGUEZ DE TOLEDO, L. 1993. Gasteromycetes (Eumycota) del centro y oeste de la Argentina. I. Analisis critico de los caracteres taxonomicos, clave de los generos y orden Podaxales. *Darwiniana* 32: 195–235.
- DÖRFELT, H. & BUMZAA, D. 1986. Die Gasteromyceten (Bauchpilze) der Mongolischen Volksrepublik. *Nova Hedwigia* 43: 87–111.
- DÖRFELT, H. & HEKLAU, H. 1987. Beitrag zur Systematik der Geastrales. II. *Feddes Repertorium* 98: 357–368.
- DÖRFELT, H. & MÜLLER-URI, C. 1984. Beitrag zur Systematik der Geastrales. *Feddes Repertorium* 95: 701–711.
- DRING, D.M. 1964. Gasteromycetes of West tropical Africa. *Mycological Papers* 98: 1–60.
- DRING, D.M. 1973. Gasteromycetes. In G.C. Ainsworth *et al.*, *The Fungi: an advanced treatise*. Vol 4B: 451–478. Academic Press, New York.
- DRING, D.M. & RAYNER, R.W. 1967. Some Gasteromycetes from eastern Africa. *Journal of the East Africa Natural History Society* 26: 5–46.
- DRING, D.M. & RAYSON, T. 1964 (dated 1963). The Gasteromycete fungi of Israel. *Israel Journal of Botany* 12: 147–178.
- ECKBLAD, F.-E. 1955. The Gasteromycetes of Norway. The epigaeal genera. *Nytt magasin for Botanikk* 4: 19–86.
- FARR, E.R., LEUSSINK, J.A. & STAFLEU, F.A. (eds) 1979. Index nominum genericorum (plantarum), Vol. III. *Regnum Vegetabile* 102. Bohn, Scheltema & Holkema, Utrecht.
- GREUTER, W., BRUMMITT, R.K., FARR, E., KILIAN, N., KIRK, P.M. & SILVA, P.C. 1993. NCU-3. Names in current use for extant plant genera. *Regnum Vegetabile* 129. Koeltz Scientific Books, Königstein.
- GREUTER, W., BARRIE, F.R., BURDET, H.M., CHALONER, W.G., DEMOULIN, V., HAWKSWORTH, D.L., JØRGENSEN, P.M., NICOLSON, D.H., SILVA, P.C., TREHANE, P. & MCNEILL, J. 1994. International Code of Botanical Nomenclature (Tokyo Code). *Regnum Vegetabile* 131. Koeltz Scientific Books, Königstein.
- HAWKSWORTH, D.L., SUTTON, B.C. & AINSWORTH, G.C. 1983. *Ainsworth and Bisby's dictionary of the Fungi*, 7th edn. Commonwealth Mycological Institute, Kew.
- HEIM, R. & HERRERA, T. 1961. Una nueva especie de *Podocrea* y una nueva combinacion el nombre de un hongo Mexicano del genero *Battarreoides*. *Anales del instituto de biología de la universidad nacional de México* 32: 29–31.
- HERRERA, T. & PEREZ-SILVA, E. 1987. *Sphaerobolus*: record of a new genus of Gasteromycetes for Mexico. *Mycotaxon* 28: 413, 414.
- HJORTSTAM, K., RYVARDEN, L. & WATLING, R. 1993. Preliminary checklist of non-agaricoid macromycetes in the Korup National Park, Cameroon and surrounding area. *Edinburgh Journal of Botany* 50: 105–119.
- ING, B. 1984. A provisional census catalogue of British Gasteromycetes. *Bulletin of the British Mycological Society* 18: 98–104.
- KORF, R.P. 1982a. Citation of author's names and the typification of names of fungal taxa published between 1753 and 1832 under the changes in the code of nomenclature enacted in 1981. *Mycologia* 74: 250–255.
- KORF, R.P. 1982b. Mycological and lichenological implications of changes in the code of nomenclature enacted in 1981. *Mycotaxon* 14: 476–490.
- KORF, R.P. 1983. Sanctioned epithets, sanctioned names and cardinal principles in 'Pers.' and 'Fr.' citations. *Mycotaxon* 16: 341–352.
- KREISEL, H. 1962. Die Lycoperdaceae der Deutschen Demokratischen Republik. *Feddes Repertorium* 64: 89–201.
- KREISEL, H. 1990. *Crucibulum laeve* (Huds.) Kambly, Tiegeltuerling. *Boletus* 14,2: front & inside front cover.
- LLOYD, C.G. 1906. The Nidulariaceae or 'bird's nest fungi.' *Mycological Writings* 2: 1–32.
- LLOYD, C.G. 1923. *Tylostoma adhaerens* from Dr J. Burton Cleland, South Australia. *Mycological Writings* 7: 1199.
- LONG, W.H. 1945. Studies in the Gasteromycetes XI. The genera *Trichaster* and *Terrostella*. *Mycologia* 37: 601–608.
- MARTIN, M.P. & LLIMONA, X. 1994. Gasteromycetes checklist of the northeastern Iberian peninsula and Balearic islands. *Mycotaxon* 51: 289–312.
- MILLER, O.K. & MILLER, H.H. 1988. *Gasteromycetes. Morphological and development features with keys to the orders, families and genera*. Mad River Press, Eureka.
- MORENO, G., ALTÉS, A. & WRIGHT, J.E. 1992a. *Tulostoma squamosum*, *T. verrucosum* and *T. mussooriense* are the same species. *Mycotaxon* 43: 61–68.
- MORENO, G., ALTÉS, A. & WRIGHT, J.E. 1992b. *Tulostoma pseudopulchellum* sp. nov. (Tulostomatales, Gasteromycetes) and allied species. *Mycotaxon* 43: 479–486.
- MORENO, G., ALTÉS, A., OCHOA, C. & WRIGHT, J.E. 1995. Contribution to the study of the Tulostomataceae in Baja California, Mexico. I. *Mycologia* 87: 96–120.
- MORNAND, J. 1993. Contribution à la connaissance des champignons de Maine-et-Loire. 2—Gastéromycètes. *Bulletin de la Société Mycologique de France* 109,3: 149–163.
- MORSE, E.E. 1933. A study of the genus *Podaxis*. *Mycologia* 25: 1–33.
- ORTEGA, A. & BUENDIA, A.G. 1986. Contribucion al catalogo micologico de Sierra Nevada (Grenada, Espana). *International Journal of Mycology and Lichenology* 3: 17–54.
- PERSOON, C.H. 1801. *Synopsis methodica fungorum*. Dieterich, Göttingen.
- PETRI, D.L. 1904. Sul valore diagnostico del capillizio nel genere 'Tylostoma' Pers. *Annales Mycologici* 2: 412–438.
- PONCE DE LEÓN, P. 1968. A revision of the family Geastraceae. *Fieldiana, Botany* 31: 303–349.
- RAUSCHERT, S. 1986. Proposal to conserve the spelling *Battarraea* (Fungi: Gasteromycetes). *Taxon* 35: 733–736.
- SMITH, C.W. & PONCE DE LEÓN, P. 1982. Hawaiian geastroid fungi. *Mycologia* 74: 712–717.
- STAFLEU, F.A. & COWAN, R.S. 1986. Taxonomic literature, edn 2, Vol. VI *Regnum Vegetabile* 115. Bohn, Scheltema & Holkema, Utrecht.
- SUNHEDE, S. 1977. Morphology and intraspecific variation in *Geastrum triplex* Jungh. *Botaniska Notiser* 130: 403–416.
- SUNHEDE, S. 1984. Notes on the type material of *Geastrum hieronymi* Hennings. *Windahlia* 14: 69–75.
- SUNHEDE, S. 1986. Notes on the type material of *Geastrum arenarium*. *Windahlia* 15: 35–43.
- SUNHEDE, S. 1989. *Geastraceae (Basidiomycotina). Morphology, ecology and systematics with special emphasis on the North European species. (Synopsis Fungorum 1)*. Fungiflora, Oslo.
- TALBOT, P.H.B. 1958. New and interesting records of South African fungi. Part III. *Bothalia* 7: 109–115.
- VERWOERD, L. 1928. Aanteekening oor 'n paar minder bekende Suid-Afrikaanse swamme. *South African Journal of Science* 25: 237–239.
- WELWITSCH, F. & CURREY, F. 1870. Fungi Angolenses. A description of the fungi collected by Dr. Friedrich Welwitsch in Angola during the years 1850–1861. *Transactions of the Linnean Society of London* 26: 279–294.
- WHITE, V.S. 1901. The Tylostomaceae of North America. *Bulletin of the Torrey Botanical Club* 28: 421–444.
- WRIGHT, J.E. 1983. *Tulostoma exasperatosporum*, a new species with reticulate spores from South Africa. *South African Journal of Botany* 2: 126–128.
- WRIGHT, J.E. 1987. The genus *Tulostoma* (Gasteromycetes)—a world monograph. *Bibliotheca Mycologica* 113: 1–338.
- ZELLER, S.M. 1948. Notes on certain Gasteromycetes, including two new orders. *Mycologia* 40: 639–668.
- ZELLER, S.M. 1949. Keys to the orders, families and genera of the Gasteromycetes. *Mycologia* 41: 36–58.