

NOTES ON SOME TYPE MATERIALS OF DISCISEDA  
(LYCOPERDACEAE)

G. MORENO<sup>1</sup>, A. ALTÉS<sup>1</sup> & C. OCHOA<sup>2</sup>

Type collections of four species of *Disciseda* have been carefully re-examined. This has led us to propose the synonyms *Disciseda pedicellata* = *D. hyalothrix* and *D. arida* = *D. verrucosa*. Our findings are supported by photographs of the macroscopic characters and spore ornamentation with scanning electron microscope of the collections studied.

*Disciseda* Czern. 1845 is a widely distributed genus of the family Lycoperdaceae (Gasteromycetes) and comprises 15 species (Kirk et al., 2001) originating from different continents. The genus was created with the type species *Disciseda collabescens* Czern. 1845, in addition to *D. compacta* Czern. 1845, and subsequently included species of the genus *Catastoma* Morgan (Morgan, 1892), a later synonym.

The principal character which distinguishes *Disciseda* from similar genera (i.e. *Abstoma* G. Cunn. 1926, *Bovista* Pers. 1794 : Pers.) is the particular mode of development of the basidiomes (Morgan, 1892; Lloyd, 1903; Smith, 1951; Mitchel et al., 1975). According to these authors the stoma in this genus typically develops in the basal zone of the peridium. When the basidiomes reach maturity, their exoperidia fissure in a way more or less irregularly circumscissile, leaving the lower half in the substrate with the remainder forming a kind of cap enclosing the upper part of the endoperidium. The weight of the substrate, which usually remains agglutinated in the said upper cap, facilitates the overturning of the liberated basidiomes, thus exposing the stoma in the 'apical zone' to achieve an effective spore dispersal. The difficulty of verifying these details *in situ*, has, however, caused some authors to doubt this character or, indeed, to attribute it only to certain species of *Disciseda* (Coker & Couch, 1928; Cunningham, 1942).

Although species of *Disciseda* have been included in numerous works, hardly any have been revised or comparisons have been made between the described taxa. This therefore implies that a number of taxonomic problems still have to be resolved in this genus. In this contribution the type collections of four species of *Disciseda* originating from Australia, New Zealand (Australasia), Europe and North America are revised. The object has been to study and to redefine their differential macro- and microscopical characters in order to ascertain whether they can be maintained as independent species. In this sense, although it is not a problem exclusive to *Disciseda*, we must emphasize the sparsity of characters which can be used in the taxonomy of this genus. These are

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K(M): 56042 HERB. HORT. BOT. REG. KEW

Australia : Victoria

*Disciseda hyalothrix* (Cooke & Masee) Hollos

N.W. Of Lake Allacutya

Alt.(m):

Coll. C. French

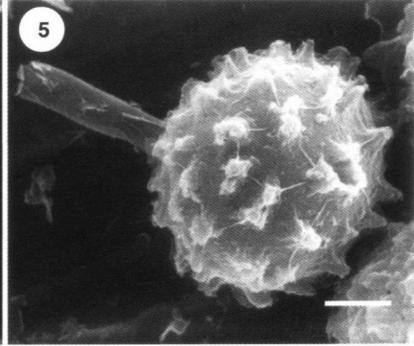
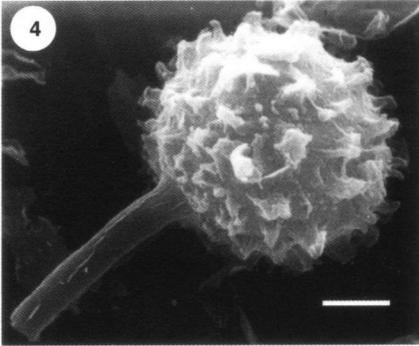
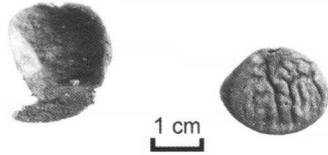
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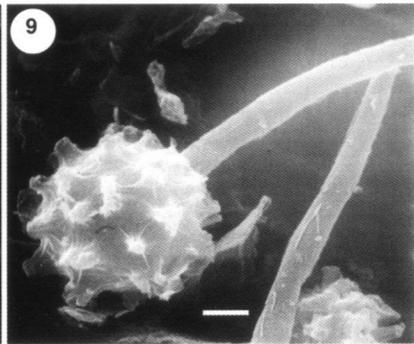
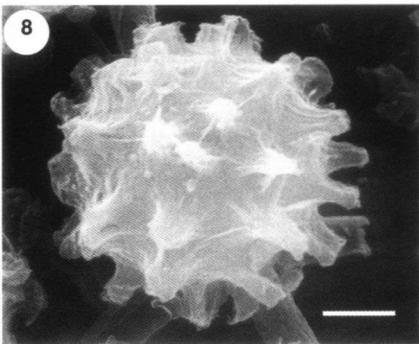
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6 From  
A. P. Morgan  
*Catantonus pedicellatum*,  
Hickon S. C.  
Digit. H. W. Ravenel.



Figs. 1–5. *Disciseda hyalothrix* (holotype of *Bovista hyalothrix*, K 56042). 1. Label of the collection; 2, 3. basidiomes (2 with exposed remains of gleba); 4, 5. spores under SEM. — Figs. 6–9. *D. pedicellata* (holotype of *Catantoma pedicellatum*, NY). 6. Label of the collection; 7. sectioned basidiome 8, 9. spores under SEM. — Scale bars: 4, 5, 8, 9 = 2  $\mu$ m; 7 = 5 mm.

primarily the morphology and spore ornamentation, and secondarily the structure of the stoma. In the case of the species studied here, the absence of significant differences between some of them has led us to propose their synonymy.

#### MATERIAL AND METHODS

The type collections studied originate from the herbaria K, NY, PDD and PRM. Other material included in this revision, collected in Spain and Mexico, is deposited in AH, BCMEX and CESUES.

The items examined under the optical microscope (OM) were mounted in water or lactophenol cotton blue. All spore measurements include the ornamentation. Scanning electron micrographs (SEM) were obtained using the technique described in Moreno et al. (1995).

#### DESCRIPTIONS

##### 1. *Disciseda hyalothrix* (Cooke & Masee) Hollós — Figs. 1–5

*Disciseda hyalothrix* (Cooke & Masee) Hollós, *Növény. Közl.* 1 (1902) 107.

*Bovista hyalothrix* Cooke & Masee, *Grevillea* 16 (1888) 73.

*Catastoma hyalothrix* (Cooke & Masee) Lloyd, *The Lycopodaceae of Australia, New Zealand and Neighbouring Islands* (1905) 27.

The type material comprises one complete globose to subglobose basidiome and half of another, practically without any gleba (Figs. 2, 3), 20–22 mm in diameter and 17–19 mm high. Exoperidium sparse and consisting only of a thick basal patch of typical hyphae mixed with remains of the substrate. Endoperidium very finely membranaceous, brown to purple when dry, remaining entire at maturity, opening by a small plane and irregular stoma. Gleba pulverulent, greyish brown, somewhat purplish.

Spores 8–9  $\mu\text{m}$  in diameter, globose, brown to dark ochraceous; hilar appendage very evident and persistent, 4–6  $\mu\text{m}$  long (Figs. 4, 5); ornamentation subhyaline but obvious, formed by spinose elements with a truncated apex (Figs. 4, 5) which measures approximately 1  $\mu\text{m}$  in height, and which are apparently formed by several fused fine spines. Capillitium 3–4  $\mu\text{m}$  in diameter, abundant, formed by easily fragmented filaments, frequently sinuated, branched, without pores or septa.

*Specimen examined.* AUSTRALIA: N.W. of Lake Allacutya, Victoria, *C. French* (K 56042, holotype).

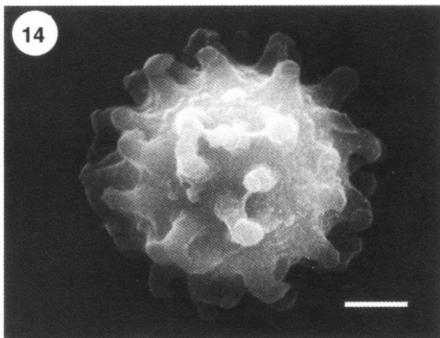
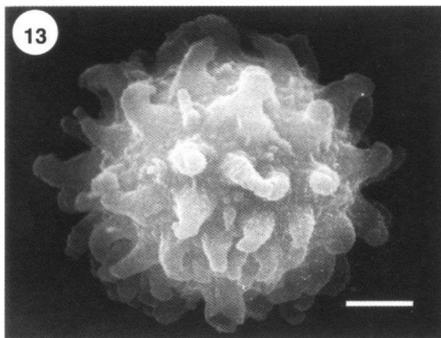
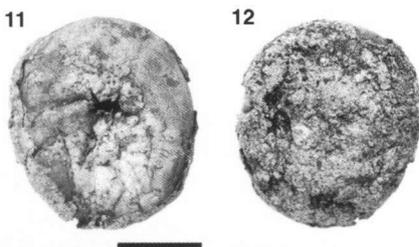
##### 2. *Disciseda pedicellata* (Morgan) Hollós — Figs. 6–9, 24–28

*Disciseda pedicellata* (Morgan) Hollós, *Természetr. Füzet.* 25 (1902) 103.

*Catastoma pedicellatum* Morgan, *J. Cincinn. Soc. Nat. Hist.* 14 (1892) 143–144.

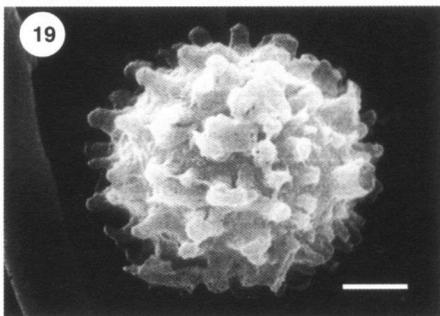
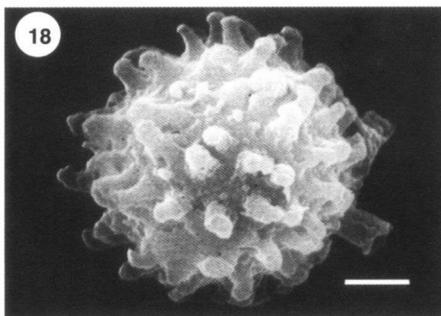
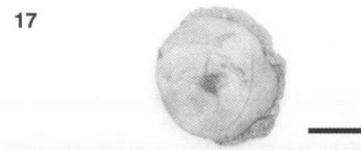
The type collection consists of a flattened half basidiome (Fig. 7) with part of the gleba still preserved, 20 mm in diameter. Exoperidium reduced to some sparse hyphal remains mixed with substrate in the basal part of the spore sac. Endoperidium consisting of a rather thin and fragile layer, purple in its more basal half and glossy greyish in the remainder, with the dense trama of the capillitium of the gleba exposed where it has disappeared. However, as the specimen had been sectioned, it was not possible to ascertain the type of stoma. Gleba pulverulent and brown.

HERBARIUM OF THE PLANT DISEASES DIVISION,  
 10 NEW ZEALAND  
 6593 Ex Herbarium of Dr. G. H. Cunningham  
 3/2/13/3  
 No. *Disciseda verrucosa* G.H.Cunn.  
 on  
 ground  
 District: Otago Date: January 1920  
 Locality: Milford Track  
 Collector: E.H. Atkinson Det. by Type  
 Collection  
 Not to be used for exchange.



15 *Typus*  
 Herb. Kryptogamologicum Musei Nat. Pragae  
 Collectio Jungermann J. Velenovsky  
 Acc. No. 29/1947  
 Flora bohemica No. 154108  
*Disciseda arida* Vél.  
 Habitat: *Stenactis*  
*In terra arenosa arida collis.*  
 Die X. 1954 Leg. et det. J. Velenovsky

16 *Disciseda arida*  
 det./corr. *Stenactis*  
 Herb. Univ. Halensis



Figs. 10–14. Holotype of *Disciseda verrucosa* (PDD). 10. Label of the collection; 11, 12. basidiome (stoma up and down, respectively); 13, 14. spores under SEM. — Figs. 15–19. Holotype of *D. arida* (PRM 154108). 15, 16. Labels of the collection; 17. basidiome; 18, 19. spores under SEM. — Scale bars: 11, 12 = 10 mm; 17 = 5 mm; 13, 14, 18, 19 = 2  $\mu$ m.

Spores 7–9.5  $\mu\text{m}$  in diameter, globose and clearly ornamented, brown, with long pedicels whose length usually amply surpasses the spore in diameter (normally about 10  $\mu\text{m}$  long, some to 15  $\mu\text{m}$ ); ornamentation formed by apically truncate spinose hyaline elements, which appear to comprise groups of strongly fused thin spines (Figs. 8, 9). Capillitium 3–5  $\mu\text{m}$  in diameter, sinuous to spiralled, subhyaline, with thin walls which allow a wide lumen, with very fragile filaments which disintegrate into a crowd of small fragments, branched, with sparse septa but pores not observed.

The remainder of the studied collections, some very well preserved, agree very well with all their characters (Figs. 24–28, a Mexican collection). The dimensions of these basidiomes vary between 20 and 31 mm in diameter. These collections allow us to observe that the stoma of this species is plane and irregular (Figs. 24, 25).

*Specimens examined.* MEXICO: Baja California, El Rosario, Km 71 of San Quintín-Cataviña highway, con *Euphorbia californica* y *Pachycereus pringlei*, 2.III.1986, I. Manjarrez (BCMEX 3462); *ibidem*, 26.II.1991, C. Ochoa (BCMEX, ex AH 14355); *ibidem*, Cataviña, terreno arenoso con Cactaceae y *Prosopis* sp., 30.I.1999 (AH 25196); *ibidem*, Sierra Juárez, La Cholla, con vegetación xerófila, 960 m, 13.III.1998, C. Ochoa 1061 (BCMEX 5757); Sonora, Municipio San Javier, Km 137.5 of Hermosillo-Yécora road, 9.VI.1996, A. Armenta, A. Núñez & R. Santos (CESUES 2768). — USA: South Carolina, H. W. Ravenel, NY; *ibidem*, Aiken, H. W. Ravenel (NY, holotype); Alabama, Auburn, VII.1896, L. M. Underwood (NY); *ibidem*, IX.1896, L. M. Underwood (NY); *ibidem*, XII.1972, Weber (NY); Texas, W. H. Long 2002 (NY).

### 3. *Disciseda verrucosa* G. Cunn. — Figs. 10–14

*Disciseda verrucosa* G. Cunn., Trans. Proc. N.Z. Inst. 57 (1926) 205.

The type collection consists of a single flattened and very mature basidiome (Figs. 11, 12), of 27 mm in diameter. Exoperidium well preserved with the agglutinated substrate forming a cup at the base of the spore sac (Fig. 12). Endoperidium greyish, similar to *Disciseda bovista* (Klotzsch) Henn. 1903, but basally with yellowish brown to reddish brown tones. Stoma plane and irregular (Fig. 11), becoming laciniate. Gleba pulverulent, dark brown.

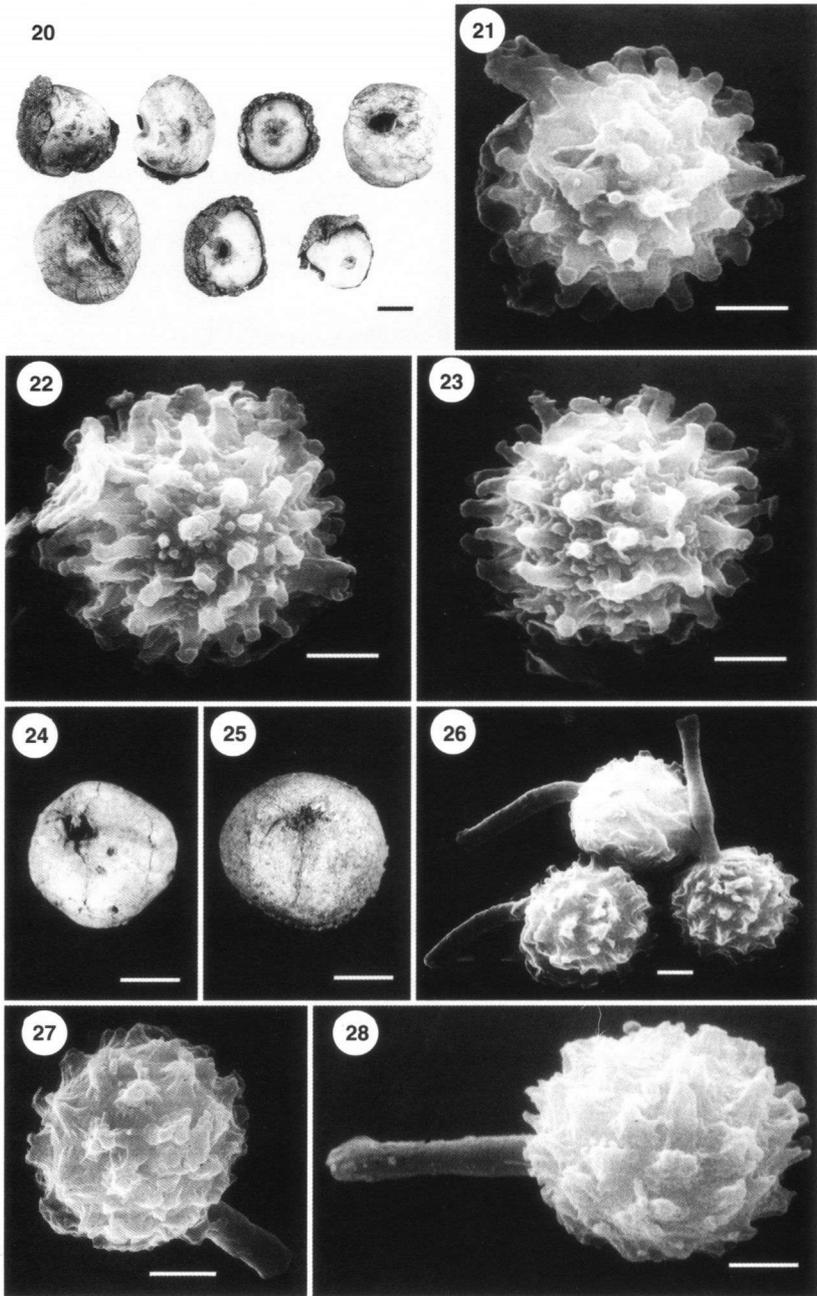
Spores 8.5–10  $\mu\text{m}$  in diameter, globose, ochraceous, with a short, hyaline pedicel, up to 1  $\mu\text{m}$  long, with a conspicuous ornamentation formed by large obtuse elements (digitiform), frequently curved at the extremity, up to 2  $\mu\text{m}$  long (Figs. 13, 14). Capillitium 3–5  $\mu\text{m}$  in diameter, formed by yellowish filaments, branched, sinuous, with some septa but pores not observed.

*Specimens examined.* NEW ZEALAND: Milford Track, Otago, 7.I.1920, E. H. Atkinson (Herb. Cunningham 8593, PDD, holotype). — MEXICO: Sonora, Municipio Alamos, Las Uvalamas, 12.IX.1994, E. Pérez-Silva, M. Esqueda & I. Buendía (CESUES 1778).

### 4. *Disciseda arida* Velen. — Figs. 15–23

*Disciseda arida* Velen., Novit. Mycol. (1939) 169.

The material consists of a flattened basidiome of 13 mm in diameter (Fig. 17). Exoperidium persistent at the base of the spore sac, where it forms a thick and wide cup by the agglutination of the substrate. Endoperidium greyish brown. Stoma plane and irregular. Gleba pulverulent, dark brown.



Figs. 20–23. *Disciseda arida* from Spain (AH 21919). 20. Basidiomes; 21–23. spores under SEM. — Figs. 24–28. *D. pedicellata* from Mexico. 24, 25. Basidiomes (AH 14355 and BCMEX 3462, respectively); 26, 27. spores under SEM (BCMEX 3462); 28. spore under SEM (AH 14355). — Scale bars: 20 = 10 mm; 21–23, 26–28 = 2  $\mu$ m; 24, 25 = 5 mm.

Spores 8–10  $\mu\text{m}$  in diameter (somewhat smaller than the description by the author of the species), globose, ochraceous, with a short pedicel, ornamented with conspicuous digitiform elements of 1.0–1.5  $\mu\text{m}$  long, normally curved at their extremities (Figs. 18, 19). Capillitium 2–4  $\mu\text{m}$  in diameter, with thick walls, subhyaline, sinuous, very broken, with some small pores and sparse septa.

The numerous basidiomes collected in the province of Guadalajara, Spain, agree very well in all their characters with the type of *Disciseda arida*. These collections extend the known distribution of this species, which was previously only known from former Czechoslovakia.

*Specimens examined.* CZECH REPUBLIC: Čechy, Stránčice, in terra arenosa arida, X.1934, J. Velenovský (PRM 154108, holotype). — SPAIN: Guadalajara, Tamajón, pradera abierta, 5.XI.1997, G. Moreno, C. Illana & A. Altés (AH 21919); *ibidem*, Valdeaveruelo, Urbanización Sotolargo, arroyo Morcuera, pasto nitrificado sobre arenas ácidas, 27.V.2000, F.J. Rejos & G. Rodríguez (AH 25240).

#### DISCUSSION

The revision of the type collections of these four species of *Disciseda* allow us to reach some conclusions which correct and simplify their taxonomic situation. The first two, *D. hyalothrix* and *D. pedicellata*, are well differentiated from the remainder by their spores having characteristic long pedicels, normally 10  $\mu\text{m}$  or more in length. Cunningham (1942) mentioned this character in his study of the Gasteromycetes of Australia and New Zealand, establishing the difference between both species in some minor details. The most important difference is, without doubt, the spore sizes: 8–10  $\mu\text{m}$  in diameter in *D. pedicellata* and 10–13  $\mu\text{m}$  in *D. hyalothrix*. Taking into account the scarcity of available morphological characters to distinguish the different taxa of *Disciseda* more clearly, we might justify the separation of the two species by their different spore sizes. However, the spores we observed in the type of *D. hyalothrix* are smaller (8–9  $\mu\text{m}$  in diameter, including the ornamentation) than given by Cunningham (1942). It is true that there is a certain difference in the length of the spore pedicels between the two species, being normally somewhat longer in *D. pedicellata*. But this difference of length is not so clear as Cunningham indicated, in no case exceeding 15  $\mu\text{m}$  in length. The length of the pedicels is a variable character in these species of *Disciseda*, probably dependent on the degree of ripening of the gleba and the conditions under which it was observed. In relation to this, Coker & Couch (1928) gave a measurement for the spore pedicels in the type collection of *D. pedicellata* of up to 6  $\mu\text{m}$  long, markedly lower than described here, while Bottomley (1948) mentioned pedicels up to 37.4  $\mu\text{m}$  long in South African material. In this way, the principal differential features between the two species disappear. The variation which, according to Cunningham (1942), exists in the other characters, does not appear important to us but is probably the result of ripening and preservation of the material. For example, Cunningham considers the type of stoma found in each species to be different: a plane and poorly defined aperture in *D. pedicellata*, and a tendency towards a lacinated-denticulated stoma in *D. hyalothrix*. In our experience in the study of *Disciseda*, the stomata, in the process of ripening of the basidiomes, have a tendency to tear into small lacinia or teeth (sometimes a simple mechanical tear). This does not therefore appear to be a good taxonomic character for distinguishing the two species. Examination of the morphology of the spore ornamentation (Figs. 4, 5, 8,

9), which is the most important character to take into account in the taxonomy of this genus, shows no considerable differences, though the ornamentation is slightly more developed in *D. pedicellata*. For these reasons, we consider no justification in maintaining of these two independent taxa, and thus propose the synonymy of *D. pedicellata* and *D. hyalothrix*.

*Disciseda pedicellata* has been reported in North America, Africa, Australia (Bottomley, 1948; Moravec, 1958) and Europe (Rydberg, 1949) though the European report is somewhat doubtful according to the illustration of its spores and the short description of the specimen given by Rydberg, as already mentioned by Eckblad (1955). Known only from Australian records (Cunningham, 1942), *D. hyalothrix* appears to have a rather restricted distribution.

With respect to the other two species, *D. verrucosa* and *D. arida* are characterized by having large spores, up to 10  $\mu\text{m}$  in diameter, sparsely pedicellate and ornamented with digitiform elements up to 2  $\mu\text{m}$  long. This last feature distinguishes them from other species of *Disciseda*. Until now, the records of *D. arida* are scarce and exclusively from former Czechoslovakia (Moravec, 1958). Despite the foregoing, Moravec believed the previously mentioned Swedish record of *D. pedicellata* to be *D. arida*. Only SEM examination of its spores can confirm this. The Spanish collections studied, which perfectly fit the description of *D. arida*, significantly extend its area of distribution in Europe.

Though also little known, *Disciseda verrucosa* actually has a larger distribution, having been reported in New Zealand, Australia (Cunningham, 1942), South Africa (Bottomley, 1948) and Mexico (Aparicio-Navarro et al., 1994; Pérez-Silva et al., 2000). Comparative study of the type collections of these two taxa, and also of material originating from Mexico and Spain, has allowed us to conclude that in neither case exist sufficiently important morphological differences to justify their maintenance as independent species. Certainly, the digitiform elements ornamenting the spores of the type of *D. verrucosa* are somewhat more developed. However, more important is that the morphology of this ornamentation is very similar in both species, and we consider this to reflect variation within a single taxon. In the remaining material studied, it is also possible to observe these small differences in the degree of development of the spore ornamentation, which reinforces our opinion. Consequently, it appears to us appropriate to synonymize *D. verrucosa* and *D. arida*.

In conclusion, the proposed taxonomic results of this revision are as follows:

***Disciseda hyalothrix* (Cooke & Masee) Hollós, Növénýt. Közlem. 1 (1902) 107.**

*Bovista hyalothrix* Cooke & Masee, Grevillea 16 (1888) 73.

*Catastoma hyalothrix* (Cooke & Masee) Lloyd, The Lycopodaceae of Australia, New Zealand and Neighbouring Islands (1905) 27.

*Catastoma pedicellatum* Morgan, J. Cincinnati Soc. Nat. Hist. 14 (1892) 143–144.

*Disciseda pedicellata* (Morgan) Hollós, Természetrzaji Füz. 25 (1902) 103.

***Disciseda verrucosa* G. Cunn., Trans. & Proc. New Zealand Inst. 57 (1926) 205.**

*Disciseda arida* Velen., Novitates Mycologicae (1939) 169.

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