

MACOWANITES CANDIDUS, A NEW COMBINATION FOR HYDNANGIUM CANDIDUM TUL. ET C. TUL.

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ABSTRACT. *Macowanites candidus*, a new combination for *Hydnangium candidum* Tul. et C. Tul. As a result of the study of type herbarium material of *Elasmomyces mattirolianus* Cavara, *Hydnangium candidum* Tul. et C. Tul., *Octaviania moravica* Velen., *Secotium krjukowensis* Bucholtz and *S. michailowskianum* Bucholtz, only two species are recognized, viz. *Macowanites mattirolianus* (Cavara) T. Lebel et Trappe and *Macowanites candidus* (Tul. et C. Tul.) J.M. Vidal *comb. nov.* (= *O. moravica*, = *S. krjukowensis*, = *S. michailowskianum*). With the addition of the study of recent collections, and an exhaustive bibliographical research, the two species are redescribed and compared; at the same time, new data regarding its ecology, phenology, and distribution in Europe are provided. Also, a key to European species of the genus *Macowanites* Kalchbr. is furnished.

Key words: Russulales, *Elasmomyces*, *Macowanites*, chorology, taxonomy, Europe.

RESUMEN. *Macowanites candidus*, una nueva combinación para *Hydnangium candidum* Tul. et C. Tul. Como resultado del estudio del material de herbario tipo de *Elasmomyces mattirolianus* Cavara, *Hydnangium candidum* Tul. et C. Tul., *Octaviania moravica* Velen., *Secotium krjukowensis* Bucholtz y *S. michailowskianum* Bucholtz, sólo dos especies son reconocidas: *Macowanites mattirolianus* (Cavara) T. Lebel et Trappe y *Macowanites candidus* (Tul. et C. Tul.) J.M. Vidal *comb. nov.* (= *O. moravica*, = *S. krjukowensis*, = *S. michailowskianum*). Con el estudio complementario de recolecciones recientes y de una exhaustiva investigación bibliográfica, se describen y comparan ambas especies, a la vez que se proporcionan nuevos datos sobre su ecología, fenología y distribución en Europa. También se proporciona una clave de determinación para las especies europeas del género *Macowanites* Kalchbr.

RESUM. *Macowanites candidus*, una nova combinació per *Hydnangium candidum* Tul. et C. Tul. Com a resultat de l'estudi del material d'herbari tipus d'*Elasmomyces mattirolianus* Cavara, *Hydnangium candidum* Tul. et C. Tul., *Octaviania moravica* Velen., *Secotium krjukowensis* Bucholtz i *S. michailowskianum* Bucholtz, només dues espècies són reconegudes: *Macowanites mattirolianus* (Cavara) T. Lebel et Trappe i *Macowanites candidus* (Tul. et C. Tul.) J.M. Vidal *comb. nov.* (= *O. moravica*, = *S. krjukowensis*, = *S. michailowskianum*). Amb l'estudi complementari de recol·leccions recents i d'una exhaustiva recerca bibliogràfica, es redescríuen i comparen ambdues espècies, a la vegada que es proporcionen noves dades referents a la seva ecologia, fenologia i distribució a Europa. També es proporciona una clau de determinació per a les espècies europees del gènere *Macowanites* Kalchbr.

INTRODUCTION

The genus *Macowanites* Kalchbr. is characterized by its secotioid basidiomata, morphologically similar to a minute *Russula*, of angiocarpic or hemiangiocarpic development, gleba loculate or sublamelliform, percurrent stipe-columella, and microscopic characters as them of *Russula*: suprapellis forming a trichoderm, a turf or with undifferentiated hyphae (TRAPPE *et al.*, 2002), context and hymenial trama heteromerous, and heterotropic or orthotropic spores, with suprahilar plage or without it, but deprived of active ballistospory. The genus was described by KALCHBRENNER (1876) on a collection of *M. agaricinus* Kalchbr. from South Africa. Some years later, CAVARA (1897) described from Italy the genus *Elasmomyces* Cav., without any mention to the genus *Macowanites*. SINGER & SMITH (1960) established the differentiation between *Elasmomyces* and *Macowanites* on the apparent lack of sphaerocytes in the hymenial trama of *E. mattirolianus* Cav., and the presence of them in *M. agaricinus* Kalchbr. PEGLER & YOUNG (1979), as a result of their research on sporal symmetry of some gasteroid Russulales, proposed a new

family Elasmomycetaceae Locquin ex Pegler et Young to accommodate the genus *Elasmomyces* and the remaining genera with orthotropic spores, but they retained the genus *Macowanites* in the family Russulaceae Lotsy, because of the presence of heterotropic spores. MILLER & MILLER (1988) and MILLER (1988), after a research of the sporal ontogeny of some hypogeous and gasteroid Russulales, reached the conclusion that, in the gasteroid Russulales, the sporal symmetry is not a good character to differentiate genera or families. They grounded this view on their observation of a continuous gradation from orthotropic to heterotropic spores in a same species or even in a same specimen. This gradation could be related with the stage of its development. They concluded, in consequence, that the sporal symmetry must not be considered a good phylogenetically informative character. Recently LEBEL & TRAPPE (2000), after the observation of sphaerocytes in the hymenial trama of *E. mattirolianus*, the type species of the genus, put *Elasmomyces* in synonymy with *Macowanites*. Currently, 40 species of *Macowanites* are accepted. They are very irregularly distributed and scarcely studied. Most of them has been found in Northern Hemisphere, 28 in North America (ZELLER & DODGE, 1935; ZELLER, 1947; SINGER & SMITH, 1960; SMITH, 1963; PEGLER & YOUNG, *op. cit.*; TRAPPE *et al.*, 2002; MILLER, 2004), 2 in Mexico (GUZMÁN, 1988), 6 in Europe (SINGER & SMITH, 1960; MOSER *et al.*, 1977; LLISTOSELLA & VIDAL, 1995; LEBEL & TRAPPE, 2000; CALONGE & VIDAL, 2001; VIDAL *et al.* 2002), and only few in the Southern Hemisphere, 1 in South Africa (KALCHBRENNER, *op. cit.*), 2 in Australia (BOUGHER, 1997; LEBEL & CASTELLANO, 2002) and 1 in New Zealand (McNABB, 1971). From the 6 European species, 4 grow in the Mediterranean region (*M. ammophilus*, *M. galileensis*, *M. messapicoides* and *M. vinaceodorus*) and 2 in the Eurosiberian region (*M. krjukowensis* and *M. mattirolianus*).

MATERIAL AND METHODS

The present work has been grounded upon the study of dry material sent in loan by the following public herbaria: FH (Cambridge, USA), IB (Innsbruck, Austria), M (München, Germany), PC (Paris, France), PRM (Praha, Czech Republic), NY (New York, USA); and by the personal herbaria of L. Gori (LG), A. Montecchi (AM), M. Sarasini (MS) and Z. Lukács. Small fragments of some collections has been separated from the mentioned personal herbaria and conserved in the public herbarium BCN (Barcelona, Spain), with the indication JMV in the label. The colours has been referred following the colour guide of KORNERUP & WANSCHER (1978), after the indication K&W. The O.M. measurements and photographs has been made on material previously rehydrated with chloral hydrate or KOH. Measurements include neither ornamentation nor the hilar appendix.

RESULTS

After the revision of a large amount of herbarium material of *Elasmomyces mattirolianus* Cavara, *Hydnangium candidum* Tul. et C. Tul., *Octaviania moravica* Velen., *Secotium krjukowensis* Bucholtz and *S. michailowskianum* Bucholtz, we find appropriate to accept only two species, both belonging to the genus *Macowanites* Kalchbr. One of them is *M. mattirolianus* (Cavara) T. Lebel et Trappe. The second of them, *M. candidus* (Tul. et C. Tul.) J.M. Vidal, is a new combination for *Hydnangium candidum*, that we find necessary to propose here.

***Macowanites candidus* (Tul. et C. Tul.) J.M. Vidal, *comb. nov.* (Figs. 1-2)**

Basionym.- *Hydnangium candidum* Tul. et C. Tul., *Ann. Sci. Nat. Bot.*, Ser. II, 19: 376 (1843).

Syn.- *Secotium (Elasmomyces) krjukowense* Bucholtz, *Hedwigia* 40: 314 (1901) (*syn. nov.*)-
Secotium (Elasmomyces) michailowskianum Bucholtz, *Hedwigia* 40: 315 (1901) (*syn. nov.*)-
Elasmomyces krjukowensis (Bucholtz) Sacc. et D. Sacc., in P.A. Saccardo, *Syll. Fung.* 17: 218 (1905).- *Elasmomyces michailowskianus* (Bucholtz) Sacc. et D. Sacc., in P.A. Saccardo, *Syll. Fung.* 17: 218 (1905).- *Secotium (Elasmomyces) krjukowense* forma *pleurotopsis* Bucholtz, *Bull. Soc. Imp. Nat. Moscou* 4: 463 (1907) (*syn. nov.*)- *Octaviania candida* (Tul. et C. Tul.) Lloyd, *Mycol. Writ.* 7, *Mycol. Not.* 67: 1142 (1922).- *Bucholtzia (Elasmomyces) krjukowensis* (Bucholtz) Lohwag, *Österr. Bot. Zeitschr.* 73: 173 (1924).- *Arcangeliella krjukowensis* (Bucholtz) Zeller et C.W. Dodge, *Ann. Mo. Bot. Gard.* 22: 368 (1935)-

Arcangeliella krjukowensis var. *michailowskiana* (Bucholtz) Zeller et C.W. Dodge, *Ann. Mo. Bot. Gard.* 22: 368 (1935).- *Sclerogaster candidus* (Tul. et C. Tul.) Zeller et C.W. Dodge, *Ann. Mo. Bot. Gard.* 23: 570 (1936).- *Octaviania moravica* Velen., *Novit. Mycol. noviss.*: 95 (1947) (*syn. nov.*).- *Hydnangium krjukowense* (Bucholtz) Svrček var. *krjukowense*, *Flora ČSR B1, Gasterom.*: 206 (1958).- *Hydnangium krjukowense* var. *moravicum* (Velen.) Svrček, *Flora ČSR B1, Gasterom.*: 208 (1958).- *Macowanites krjukowensis* (Bucholtz) Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 77 (1960).

Misappl.- *Elasmomyces mattirolianus* sensu Hollós, *Ann. Mus. Nat. Hung.* 6: 318 (1908); Hollós, *Magyarország földalatti gombái, szarvasgombaféléi*: 81 (1911); Lohwag, *Burgenland* 3: 136 (1930); Lohwag, *Schweiz. Zeitschr. f. Pilzk.* 11(6): 82 (1933); Knapp, *Schweiz. Zeitschr. f. Pilzk.* 19(4): 57, 19(5): 74 (1941); Bánhegyi *et al.*, *Magyarország nagygombái*: tab. 60 (1953); Szemere, *Die Unterirdischen Pilze des Karpatenbeckens*: 197 (1965); Gross, *Zeitschr. f. Pilzk.* 34(1-2): 27 (1968); De Vries, *Lejeunia* 86: 2 (1977); Pegler & Young, *Trans. Br. Mycol. Soc.* 72(3): 368 (1979); Jülich, *Kleine Kryptogamenflora II b/1, Basidiomyceten*: 548 (1984); Eckblad & Lange, *Nordic Macromycetes II, Polyporales, Boletales, Agaricales, Russulales*: 401 (1992); Cetto, *I funghi dal vero* 7: 2899 (1993); Gori, *Il Micologo* 26(81): 38 (1994); Krieglsteiner, *Die Großpilze Baden-Württembergs* 2: 203 (2000).

Excl.- *Sclerogaster candidus* sensu Szemere, *Die unterirdischen pilze des Karpatenbeckens*: 248 (1965) (= *Gymnomyces mistiformis?*).- *Sclerogaster candidus* sensu Calonge & Almeida, *Bull. Soc. Mic. Madrid* 16: 100 (1992) (= *Macowanites ammophilus*).

ICON. AND BIBL. SEL.- TULASNE & TULASNE (1843: 376, pl. 17/20, ut *H. candidum*); TULASNE & TULASNE (1851: 75, tab. 21/2, ut *H. candidum*); QUÉLET (1873: 375, pl. 4/3, ut *H. candidum*); ROUMEGUÈRE (1870-73: fig. 376, ut *H. candidum*); QUÉLET (1886: 247, ut *H. candidum*); DE TONI (1888: 176, ut *H. candidum*); BUCHOLTZ (1901: 314-315; 1902: 142-144, tab. 3/1-11; 1903: 164-165, tab. 5/1-11; all ut *S. krjukowense* & *S. michailowskianum*); SACCARDO & SACCARDO (1905: 218, ut *E. krjukowensis* & *E. michailowskianus*); HOLLÓS (1908: 318-319, ut *E. mattirolianus*; 1911: 81-82, tabs. III/1-3, V/12, ut *E. mattirolianus*); LLOYD (1922: 1142, fig. 2171, ut *O. candida*); FISCHER (1933: 112, fig. 84e-g, ut *E. krjukowensis*); DODGE & ZELLER (1936: 570-571, ut *S. candidus*); ZELLER & DODGE (1936: 626-627, ut *A. krjukowensis* & var. *michailowskiana*); COSTANTIN & DUFOUR (1947: 201, pl. 57/1766, ut *H. candidum*); VELENOVSKY (1947: 95, ut *O. moravica*); NEUWIRTH (1949: 3: 20, ut *H. candidum*); KNAPP (1941: 61, tab. II/71, ut *E. mattirolianus*); VACEK (1950: 91-92, figs. 1-4, ut *O. moravica*); BÁNHEGYI *et al.* (1953: tab. 60, ut *E. mattirolianus*); KNAPP (1958: 157-159, ut *E. mattirolianus*); SVRČEK (1958: 187, ut *S. candidus*; 206-208, figs. 40/3, 43/2, ut *H. krjukowense* var. *krjukowense* & var. *moravicum*); SINGER & SMITH (1960: 77-78, figs. 83-85, ut *M. krjukowensis*); STEINMANN (1963: 64-65, ut *E. krjukowensis*); SZEMERE (1965: 197, tab. 7c, ut *E. mattirolianus*); GROSS (1968: 27-32, figs. 1-7, ut *E. mattirolianus*); SOSSIN (1973: ut *E. krjukowensis*); DE VRIES (1977: 2-4, fig. 1, ut *E. mattirolianus*); KERS (1978: 75-82, figs. 1-3, ut *E. krjukowensis*); PEGLER & YOUNG (1979: 368, figs. 61-63, spores, ut *E. mattirolianus*); KREISEL (1983: 105, tab. 16, ut *E. krjukowensis*); MOSER (1983: 460, ut *M. krjukowensis*); JÜLICH (1984: 548, ut *E. mattirolianus*); RYMAN & HOLMÅSEN (1984: 603, ut *E. krjukowensis*); WEHOLT (1988: 114-116, fig. 1, ut *E. krjukowensis*); ECKBLAD & LANGE (1992: 401, fig. 1012, ut *E. mattirolianus*); CETTO (1993: vol. 7, pl. 2899, ut *E. mattirolianus*); GORI (1994: 38-39, fot. p. 41, ut *E. mattirolianus*); MOSER & FURRER-ZIOGAS (1994: IV *Macowanites* 1, ut *M. krjukowensis*); KRIEGLSTEINER (2000: 203-204, ut *E. mattirolanus*).

Basidioma angiocarpic, 0,5-3,5-(4) cm broad, initially globose or subglobose, with a rudimentary basal stipe, finally, on expanding, applanate to depressed, lobate, sometimes slightly open in the base, exposing the stipe partially. Peridium thin, separable from the gleba, initially pruinose and pure white, attached to stipe, then yellowish white (K&W 4A2) and maculated of light brown (K&W 6D7) to dark brown (K&W 6F7), brown in exsiccatum (K&W 6F6), finally disintegrated in the perimarginal zone and exposing partially the loculated hymenium. Stipe-columella percurrent, rarely branched near de surface, much variable in size, 0,6-1,5 x 0,15-0,4 cm, generally half stipe, half columella, cylindric to clavate, central or lateral, straight or curved, sometimes located in a position very lateral and, in consequence, almost invisible, pure white, pruinose, brown on the basis, attached to humus with a short white rhizomorph. Context white, not changing on exposure to air. Gleba loculated, labyrinthiform, annexed to stipe-columella, basal chambers later partially free, white to light orange (K&W 5A4), brown to dark brown in exsiccatum (K&W 6D7-6F7). Spore mass in the locules yellowish white. Odour fruity, taste mild.

Spores subglobose to broadly elliptical, (8)-10-12,5-(15) x (6,5)-7,5-11,25 µm, heterotropic to subheterotropic, pale yellow under O.M., echinulate; warts amiloid, 1,5-2-(2,5) µm high, isolated, cylindrical and straight, with rounded apex; hilar appendix 1-2,5 x 1,2 µm, straight, cylindric to

conic, at times retaining a sterigmal appendage; suprahilar plage not seen. Basidia 2-4 spored, clavate, 28-42 x 14-18 μm . Basidioles claviform, 20-24 x 10-16 μm . Macrocystidia cylindrical, lanceolate or fusiform, rostrate, narrowly acute or mucronate, 45-70 x 8-12 μm , with amorphous content, ready collapsing. Hymenial hairs (paracystidia) absent. Subhymenium cellular. Hymenial trama 40-50 μm wide, of hyaline hyphae 1,5-10 μm in diam., with frequent enlargements up to 16 μm and abundant sphaerocytes of 15-40 μm in diam. Oleiferous hyphae 3-5 μm in diam., present in trama and context. Context of stipe-columella heteromerous, composed of densely interwoven narrow hyphae mixed with nests of sphaerocytes. Stipitipellis a turf of repent to erect hyphal tips, mixed with dermatocystidia. Peridiopellis 80-250 μm thick, thinning in the perimarginal zone; suprapellis 50-80 μm thick, consisting in a trichoderm of yellow, cylindrical dermatocystidia, 15-70 x 3-8 μm , mixed with the gelatinized tips of the mediopellis hyphae, that collapses soon in a brown granular slimy mass; mediopellis 60-100 μm thick, that consists in an ixocutis of intricate hyphae, 2-6 μm in diam., with numerous septate hyphae similar to laticifers, 4-5 μm in diam., that finish in dermatocystidia; subpellis 50-120 μm thick, formed by a subixocutis of intricate hyaline hyphae, 2-4 μm in diam., connecting with the pileus context and hymenial trama.

HABITAT AND DISTRIBUTION.- Solitary or gregarious, epigeous or semihypogeous, on rich humus of deciduous woods, preferably of *Carpinus*, but also of *Betula*, *Corylus*, *Fagus*, *Populus*, *Quercus*, *Tilia*, mixed with *Acer*, *Fraxinus*, *Sambucus*, *Ulmus*, on calcareous soil, from summer to autumn. Widely distributed in the temperate regions of Central and North Europe: France (TULASNE & TULASNE, 1851; QUÉLET, 1873), Italy (DODGE & ZELLER, 1936; GORI, 1994), Switzerland (KNAPP, 1958; PEGLER & YOUNG, 1979), Austria (LOHWAG, 1930, 1933), Hungary (HOLLÓS, 1908; BÁNHEGYI *et al.*, 1953; SZEMERE, 1965), Belgium (DE VRIES, 1977), Germany (STEINMANN, 1963; GROSS, 1968; KRIEGLSTEINER, 2000), Czech Republic (VELENOVSKÝ, 1947; NEUWIRTH, 1949; SVRČEK, 1958), Ukania (SOSSIN, 1973), Russia (BUCHOLTZ, 1901), Sweden (KERS, 1978; RYMAN & HOLMÅSEN, 1984; ECKBLAD & LANGE, 1992), Finland (ECKBLAD & LANGE, 1992) and Norway (WEHOLT, 1988).

COLLECTIONS EXAMINED.- CZECH REPUBLIC: Bohemia, Černošice, in silva frondosa, under *Carpinus*, *Crataegus* and *Cornus*, 4-7-1950, and under *Carpinus*, *Tilia* and *Acer*, 9-7-1950, all *leg.* and *det.* V. Vacek as *Elasmodermis krjukowensis*, and *rev.* M. Svrček as *Hydnangium krjukowense* var. *krjukowense* (PRM 619107, 619106); Moravia, in silva Ždanice prope Bučovice, 7-1941, *leg.* F. Neuwirth (PRM 151648, holotypus of *Octaviania moravica*); *Ibid.*, in silva Ždanice prope Zdravá Voda, in silva frondosa, 7-1960, *leg.* K. Kříž, *det.* M. Svrček as *E. krjukowensis* (PRM 620134); *Ibid.*, Súčov, under *Carpinus*, *Quercus* and *Fagus*, 8-7-1953, *leg.* K. Kříž, *det.* M. Svrček as *H. krjukowense* var. *moravicum* (PRM 619108, Šmarda Herb.).- FRANCE: Vienne, Couhé-Verac, 10-1841, solitary under *Carpinus*, *leg.* Tulasne (PC, holotypus of *Hydnangium candidum*).- GERMANY: Saar, Sitterswald, under *Fagus*, Muschelkalk, 4-7-1967, 31-8-1967, 18-7-1968, 10-7-1969, *leg.* G. Gross #79, 84, 159, 303; *Ibid.*, Eschringen, under *Fagus*, *Quercus* and *Fraxinus*, 3-9-1967, *leg.* G. Gross #85; *Ibid.*, Erfweiler/Ehlingen, under *Fagus* and *Carpinus*, 9-8-1968, Muschelkalk, *leg.* G. Gross #177; *Ibid.*, Bebelshelm, under *Fagus*, *Carpinus* and *Quercus*, Kalkiger Lehm, 27-8-1967, 12-7-1968, 26-8-1969, *leg.* G. Gross #82, 157, 323; *Ibid.*, Honzrath, under *Fagus*, *Carpinus* and *Corylus*, Muschelkalk, 27-6-1968, *leg.* G. Gross #176; *Ibid.*, Ballweiler, under *Fagus*, *Carpinus* and *Quercus*, Kalkiger Lehm, 19-7-1968, *leg.* G. Gross #161; *Ibid.*, Gerlängen, under *Fagus*, *Carpinus* and *Quercus*, Muschelkalk, 20-7-1968, *leg.* J. Schmitt and G. Korn, Gross #164, 164a; *Ibid.*, under *Betula* and *Fagus*, 10-8-1968, *leg.* G. Gross #179; *Ibid.*, Gerlafingen, under *Fagus*, *Carpinus*, *Quercus* and *Acer*, 26-7-1968, *leg.* G. Gross #171; *Ibid.*, Eimersdorf, under *Carpinus*, *Fagus* and *Quercus*, Muschelkalk, 15-8-1968, *leg.* Derbsch and Gross, Gross #188; *Ibid.*, 6-9-1969, *leg.* J. Schmitt, Gross #335, all *det.* G. Gross as *E. mattirolianus* (M-Gross Herb.); Altbach/Neckar, *Carpinetum*, 23-10-1961, *leg.* and *det.* H. Steinmann as *Hydnangium krjukowense*, *rev.* M. Svrček (PRM 616208).- HUNGARY: Litke, 20-8-1996, under *Carpinus*, on calcareous soil, *leg.* Z. Lukács as *E. krjukowensis* (JMV800073); Tötökmező, 250 m, 1-8-1996, under *Carpinus*, on calcareous soil, *leg.* Z. Lukács as *E. krjukowensis* (JMV800074).- ITALY: Toscana, Lucca, Roggio-Vagli di Sotto, 900 m, 4-7-1993, gregarious under *Corylus avellana*, *leg.* G. Bernardini and L. Gori, *det.* L. Gori LG930704-1 as *E. mattirolianus* (JMV800185); Lombardia, Monza, Viale Reale, 15-10-1989, under *Carpinus*, *leg.* M. Sarasini MS394 (JMV800003); *Ibid.*, Viale Romano, 15-10-1992, under *Carpinus*, *leg.* and *det.* M. Sarasini MS467 as *E. mattirolianus* (JMV 800004); *Ibid.*, Viale Romano, 19-9-1994, under *Carpinus*, *leg.* M. Sarasini & G. Imperatori, *det.* M. Sarasini MS619 as *E. mattirolianus* (JMV800005).- RUSSIA: Moskva, Krjukovo station, 18-7-1898, *leg.* F. Bucholtz (FH, lectotypus of *Secotium (Elasmodermis) krjukowense*; NY, slide of lectotypus); Moskva, Podolsk district, Michailowskoje station, 20-7-1899, *leg.* F. Bucholtz #290 (FH, holotypus of *Secotium (Elasmodermis) michailowskianum*).

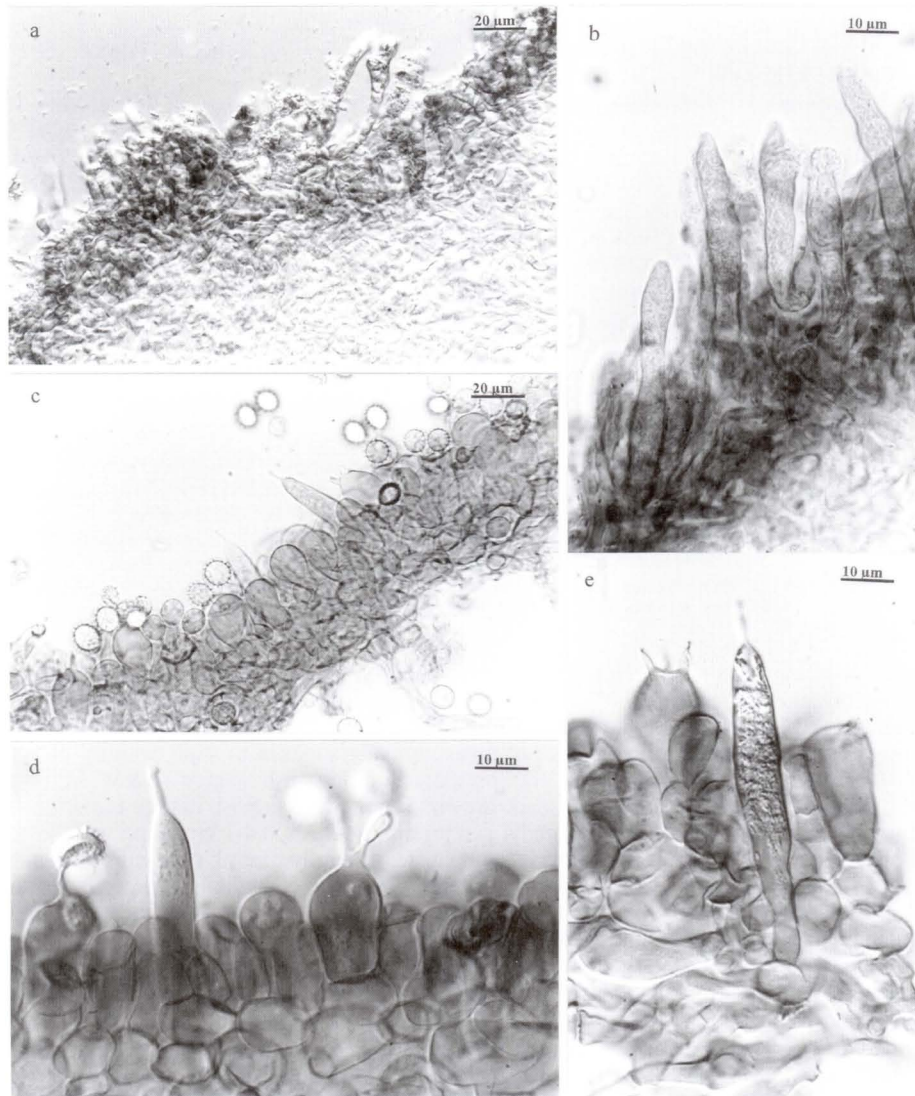


Fig. 1.- *Macowanites candidus*.- a-b. Suprapellis (MS467). c-e. Hymenium (spores, basidia, basidioles and macrocystidia) (MS467).

Macowanites mattirolianus (Cavara) T. Lebel et Trappe, *Mycologia* 92: 1194 (2000)

(Fig. 3)

Basionym.- *Elasmomyces mattirolianus* Cavara, *Malpighia* 11: 426 (1897).Syn.- *Secotium mattirolianum* (Cavara) Fischer, in Engler & Prantl, *Naturl. Pflanzenfam.* 1: 302. (1900).Misappl.- *Arcangeliella borziana* sensu Singer & Smith, *Mem. Torrey Bot. Cl.* 21: 71 (1960); Pegler & Young, *Trans. Br. Mycol. Soc.* 72(3): 365 (1979); Lebel & Trappe, *Mycologia* 92(6): 1190 (2000).Excl.- *Elasmomyces mattirolianus* sensu Hollós, *Ann. Mus. Nat. Hung.* 6: 318 (1908); Hollós, *Magyarország földalatti gombái, szarvasgombaféléi*: 81 (1911); Lohwag, *Burgenland* 3: 136 (1930); Lohwag, *Schweiz. Zeitschr. f. Pilzk.* 11(6): 82 (1933); Knapp, *Schweiz. Zeitschr. f. Pilzk.* 19(4): 57, 19(5): 74 (1941); Bánhegyi et al., *Magyarország nagygombái*: tab. 60 (1953); Szemere, *Die Unterirdischen Pilze des Karpatenbeckens*: 197 (1965); Gross, *Zeitschr. f. Pilzkunde* 34(1-2): 27 (1968); De Vries, *Lejeunia* 86: 2 (1977); Pegler & Young, *Trans. Br. Mycol. Soc.* 72(3): 368 (1979); Jülich, *Kleine Kryptogamenflora II b/1, Basidiomyceten*: 548 (1984); Eckblad & Lange, *Nordic Macromycetes II, Polyporales, Boletales, Agaricales, Russulales*: 401 (1992); Cetto, *I funghi dal vero* 7: 2899 (1993); Gori, *Il Micologo* 26(81): 38 (1994); Krieglsteiner, *Die Großpilze Baden-Württembergs* 2: 203 (2000) (= *Macowanites candidus*).- *Elasmomyces mattirolianus* sensu Singer & Smith, *Mem. Torrey Bot. Cl.* 21: 59 (1960). *Macowanites mattirolianus* sensu Lebel & Trappe, *Mycologia* 92(6): 1194 (2000) (= *Arcangeliella borziana*).

ICON. AND BIBL. SEL.- CAVARA (1897: 414-428, tab. VII, ut *E. mattirolianus*); SACCARDO & SYDOW (1899: 258, ut *E. mattirolianus*); FISCHER (1900: 302, fig. 150, ut *S. mattirolianus*); PETRI (1909: 30-31, figs. 6-7, ut *E. mattirolianus*); BATAILLE (1923: 185, ut *E. mattirolianus*); FISCHER (1933: 111, fig. 84a-d, ut *E. mattirolianus*); ZELLER & DODGE (1936: 602, ut *E. mattirolianus*); HEIM (1959: 95, fig. 1M, spores, ut *E. mattirolianus*); SINGER & SMITH (1960: 71-72, figs. 75-79, ut *A. borziana*); PEGLER & YOUNG (1979: 365, figs. 47-49, spores, ut *A. borziana*); MOSER (1983: 460, ut *E. mattirolianus*); MONTECCHI & LAZZARI (1993: 330, ut *E. mattirolianus*); MONTECCHI & SARASINI (2000: 584-586, fot. 585, ut *E. mattirolianus*); LEBEL & TRAPPE (2000: 1190-1191, figs. 2-3, ut *A. borziana*).

Basidioma hemiangiocarpic, russuloid, with a developed basal stipe. Pileus 1-3 cm broad, initially subglobose, angiocarpic, promptly expanding and then hemisphaerical, applanate to depressed, open in the base, exposing the gleba and the stipe, margin involute. Peridium thin, pruinose, separable from the gleba and attached to the margin of pileus, initially annexed to stipe, whitish, pale yellow (K&W 4A3) to light yellow (K&W 4A4), maculated of brownish orange (K&W 5C5), finally brownish red (K&W 8D7), maculated of dark brown (K&W 8F6), greyish orange to dark brown in exsiccatum (K&W 5B5-6F7). Stipe-columella percurrent, 0.8-2.2 x 0.4-1 cm, stipe well developed, 2-3 times longer than the columella, cylindrical to attenuate, generally central, often curved, pure white, pruinose, maculated of yellow on the basis. Context white, not changing on exposure to air, but yellow in the cortical zone in old exemplars. Gleba loculated, labyrinthiform, initially annexed to stipe-columella, but ready free and exposing the sublamellate and radiate external gleba, initially whitish, yellowish white to pale yellow (K&W 4A2-4A3), then light yellow (K&W 4A5), finally titian red (K&W 7D6), cinnamon brown in exsiccatum (K&W 6D6). Spore mass in the locules yellowish white. Odour and taste not recorded.

Spores globose, variable in size, 10.5-15.5-(17) x 10-15 µm, heterotropic to subheterotropic, ochraceous under O.M., warty; warts amiloid, 1.5-2.5-(3) µm high, isolated, cylindrical, straight or curved, with rounded apex; hilar appendix well developed, cylindrical to conic, 2-3.5 x 1.5 µm, straight; suprahilar plage not seen. Basidia 2-4 spored, broadly clavate, 45-65 x 17-23 µm; sterigmate conical, 4-8 µm long. Basidioles cylindrical to subclaviform, 26-34 x 9-15 µm. Macrocytidia cylindrical, lanceolate or fusiform, with rostrate, acute or mucronate apex, 70-125-(180) x 15-18 µm, more abundant and long in the basal locules, with abundant granular content, refractive in KOH. Hymenial hairs (paracystidia) plenty, 12-24 x 5-12 µm, cylindrical or subclaviform, with 0-2 septa. Subhymenium cellular. Hymenial trama 45-100 µm wide, of interwoven hyaline hyphae, 2-3 µm in diam., with scattered inflated hyphae up to 5.5 µm in diam., and scattered nest of sphaerocytes 15-25 µm in diam. Oleiferous hyphae 2-5 µm in diam., present in trama and context. Context of stipe-

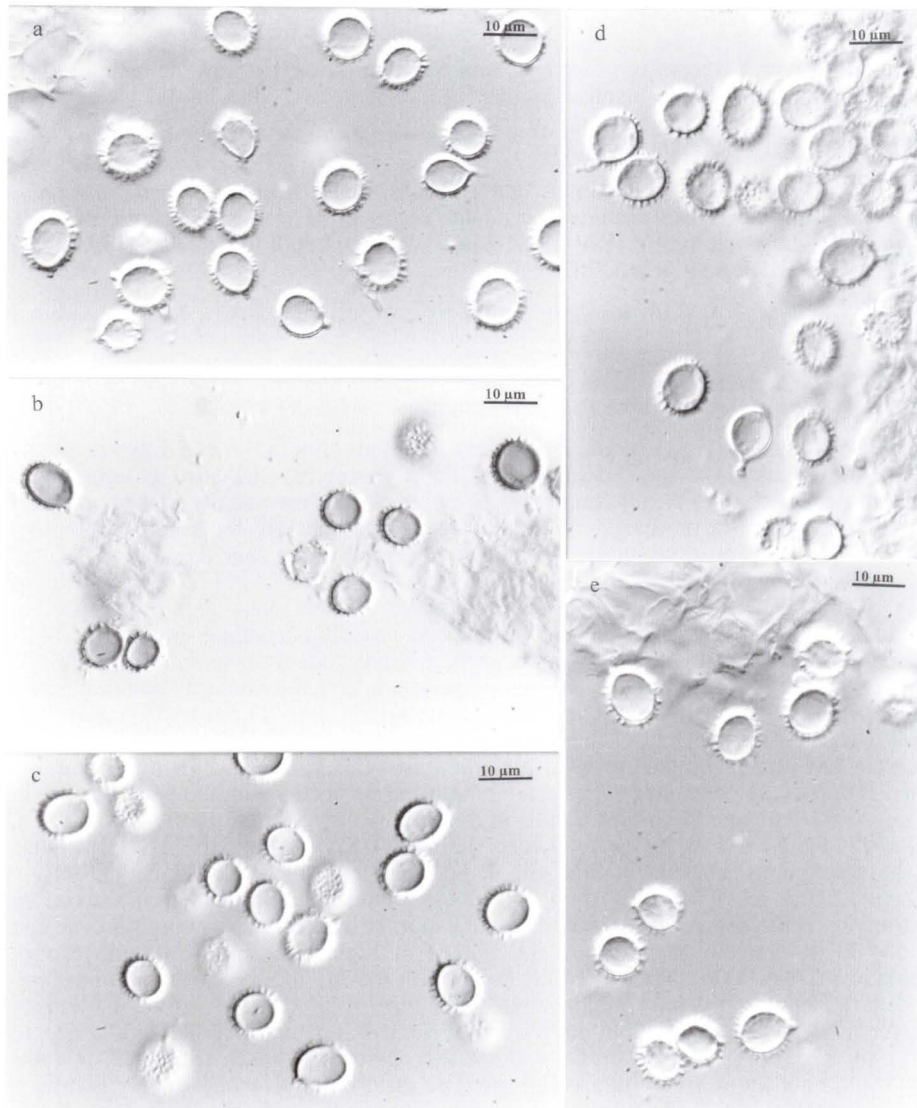


Fig. 2.- *Macowanites candidus*.- Spores: **a.** MS467. **b.** *H. candidum* (PC, holotypus). **c.** *H. krjukowense* (PRM 619106). **d.** *S. michailowskianum* (FH, holotypus). **e.** *O. moravica* (PRM, holotypus).

columella heteromerous, composed of densely interwoven, narrow hyphae 2-3,5 µm in diam., mixed with nests and columns of sphaerocytes 14-26 µm in diam. Stipitipellis a turf of repent to erect hyphal tips, 12-26 x 2-4 µm. Peridiopellis 100-250 µm thick; suprapellis a trichoderm of erect and repent dermatocystidia, 30-60 x 3-6 µm, with yellow granular contents, mixed with the gelatinized hyphal tips of the mediopellis, 7-25 x 1,5-3 µm, that collapses soon in a brown granular slimy mass; mediopellis an intricate and compact ixocutis of hyaline hyphae, 2-4 µm in diam., with abundant septate hyphae similar to laticifers, 3-7 µm in diam., that finish in dermatocystidia; subpellis a subixocutis of intricate hyaline hyphae 2-4 µm in diam., connecting with the pileus context and hymenial trama.

HABITAT AND DISTRIBUTION.- Gregarious and epigeous, under *Abies alba* and *Picea abies*, on siliceous soil, from the end of summer to autumn. Seems to be restricted to Italy, in the Tusco-Aemilian Apennine range (CAVARA, 1897; MATTIROLLO, 1900; MONTECCHI & LAZZARI, 1993; MONTECCHI & SARASINI, 2000).

COLLECTIONS EXAMINED. ITALY: Toscana, Firenze, Tosco-Romagnolo Apennine Mountains, Vallombrosa forest, under *Abies alba*, summer 1898, leg. F. Cavara (FH-Dodge Herb. #2087 & NY-Zeller Herb. #1671, as isotypus of *Arcangeliella borziana*); *Ibid.*, Vallombrosa forest, 24-11-1899, leg. and det. O. Mattirollo, rev. F. Cavara (FH-Bucholtz Herb. #275); Emilia Romagna, Reggio Emilia, Civago, Emiliano Apennine Mountains, Abetina Reale forest, 1600 m, 5-8-1988, under *Picea abies*, on siliceous soil, leg. and det. A. Montecchi AM825 (JMV800038).

Close examination of the type material labeled as *Elasmomyces mattirolianus* Cavara, preserved in the New York Botanical Garden Herbarium (S.M. Zeller Herb.), have led us to the conclusion that it has been misidentified, since the microscopical characters of the preserved material do not match with the species described in the protologue. We find it more concordant with the features of *Arcangeliella borziana* Cavara. This putative misidentification is reflected in the later descriptions of the same material published by SINGER & SMITH (1960) and LEBEL & TRAPPE (2000), which highlight the same set of characters: peridium lacking gelatinized hyphae, lacks of macrocystidia, cystidia ventricose, clavate or cylindrical, 22-37 x 7-12 µm, and broadly ellipsoidal spores, 10-12-(15) x 9-11,5-(13,5) µm. In contrast with the taxon mentioned above, *Macowanites mattirolianus* (Cavara) T. Lebel et Trappe has gelatinized hyphae in the peridium, contains abundant macrocystidia in the hymenium, 70-125-(180) x 15-18 µm, and has globose spores, 10,5-15,5 x 10-15 µm. As SINGER & SMITH (*op. cit.*) comment: "The macroscopic characters were described entirely from our observations and do not coincide with Cavara's data, particularly as far as the interpretation of the hymenial elements are concerned." The same putative error occurs with the type material labeled as *Arcangeliella borziana* Cavara preserved in the Farlow Cryptogamic Herbarium (C.W. Dodge #2087) and in the New York Botanical Garden Herbarium (S.M. Zeller #1671), on which has been based the descriptions included in SINGER & SMITH (*op. cit.*), PEGLER & YOUNG (1979, spores) and LEBEL & TRAPPE (*op. cit.*), which belongs to neither of the abovementioned species. This attribution is the consequence of a misidentification, and, after our own revision, we conclude that it should be correctly identified as the isotype of *Elasmomyces mattirolianus* Cavara (see discussion in VIDAL, 2004). After ZELLER & DODGE (1936), the sheet of *E. mattirolianus* kept in the Zeller's Herbarium is only a duplicatum of the type material preserved in the Herbarium of the Università degli Studi di Napoli, but it was not studied in detail by Zeller and Dodge, as they include only a short description of *E. mattirolianus*, essentially taken from that of CAVARA (1897). We do not know where the rest of the type material of *E. mattirolianus* is now stored, probably in Mattirollo's Herbarium of the Università degli Studi di Torino, as the Napoli Herbarium curators have informed us that it is not longer conserved there.

DISCUSSION

In the French region of Vienne, TULASNE & TULASNE (1843) collected under *Carpinus* a gasteroid fungus of pale colour, sessile and looking as deprived of stipe-columella, with echinulate spores, and they give it the name of *Hydnangium candidum*. Only three further collections were being to be reported under this binomium, one of them from the French region of the Jura (QUÉLET, 1873), a second from the Czech region of Moravia (NEUWIRTH, 1949), and a third from the Italian region of Tuscany (ZELLER & DODGE, 1936), all of them under broadleaf trees

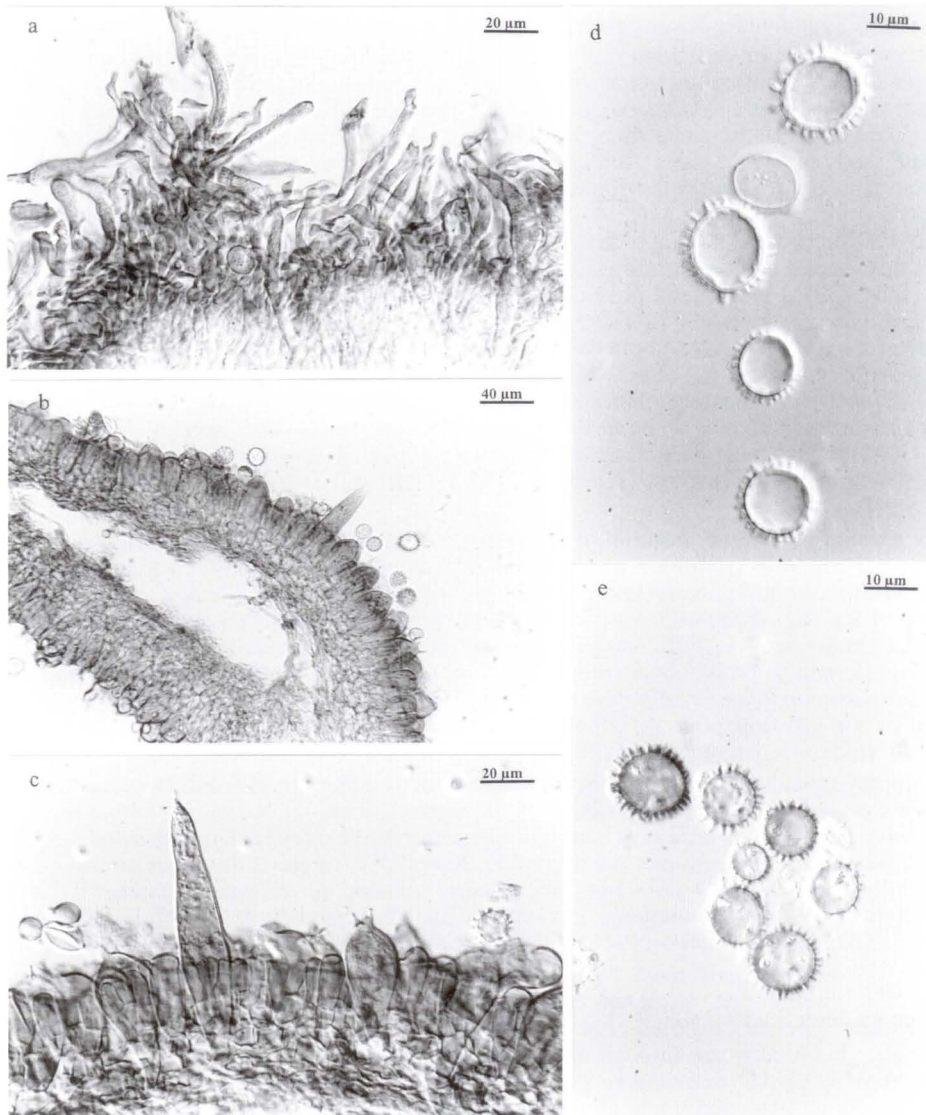


Fig. 3.- *Macowanites mattirolianus*.- a. Suprapellis (AM825). b-c. Hymenium (spores, basidia, basidioles, paracystidia and macrocystidia) (AM825). d. Spores (AM825). e. Spores (NY, as isotypus of *A. borziana*).

and all are told to have sessile basidiomata. The collection of NEUWIRTH (*op. cit.*), that shows an evident columella, had been published two years before by VELENOVSKY (1947) under the name of *Octaviania moravica* and was later recombined by SVRČEK (1958) as *Hydnangium krjukowense* var. *moravicum*. *Hydnangium candidum* was successively recombined under *Octaviania* by LLOYD (1922) and under *Sclerogaster* by ZELLER & DODGE (*op. cit.*).

Half a century later, in the Italian region of Tuscany, CAVARA (1897) collected under *Abies* a fungus of evident secotioid aspect, russuloid habit and hemiangiocarpic development. He gave it the name of *Elasmomyces mattirolianus*. Some years later MATTIROLO (1900) reports a new collection. Almost at the same time, BUCHOLTZ (1901), after some collections made under broadleaf trees in the Moskva Russian region, describes two also secotioid fungi exhibiting different degrees of stipe-columella development. They are given the names of *Secotium krjukowense* and *S. michailowskianum*. Both species are very resembling, but the stipe-columella was more developed in *S. michailowskianum*. The strong variability in the position and size of the stipe of this species induces the same BUCHOLTZ (1907) to describe the form *pleurotopsis*, with a stipe fully shifted to a lateral position. Both Bucholtz's species were later recombined in the genus *Elasmomyces* by SACCARDO & SACCARDO (1905), and in *Arcangeliella* by ZELLER & DODGE (1936). The last authors degraded *Secotium michailowskianum* to a simple variety of *Arcangeliella krjukowensis*. Later, SVRČEK (1958) synonymizes *Secotium michailowskianum* with *S. krjukowense* and recombines the last in the genus *Hydnangium*. SINGER & SMITH (1960) transfer definitively *Secotium krjukowense* into the genus *Macowanites*. Finally, GROSS *et al.* (1980) synonymize *Macowanites krjukowensis* with *Elasmomyces mattirolianus*, a view followed by a number of authors (JÜLICH, 1984; ECKBLAD & LANGE, 1992; CETTO, 1993; GORI, 1994).

After a revision of the type material of *Hydnangium candidum*, *Octaviania moravica*, *Secotium krjukowensis* and *S. michailowskianum*, we reach the conclusion that those taxa correspond to no more than different morphological aspects of the same species, only different in the disposition and size of the stipe-columella, and this apparent heterogeneity induced probably the successive authors to treat them as different species. So, the stipe-columella is fully developed in *S. michailowskianum*, is progressively reduced in *S. krjukowensis*, and disappears almost completely in *Hydnangium candidum*. In all of them, the hymenial development is neatly angiocarpic. Only at the end of the growing period, in the perimarginal zone surrounding the stipe peridium, that previously covered it, becomes partially disgregated exposing the peripheral layer of chambers.

At the microscopical level, any significative difference is either appreciated. In consequence, we conclude that this group of taxa belong to the same species, included in *Macowanites*, with *Macowanites candidus* as prioritary binomious. An excellent work devoted to this species, treated under *Elasmomyces krjukowensis*, in that by KERS (1978), where it describes almost perfectly this species, and affords at the same time a very valuable set of data regarding its variable morphology. Excellent photographic illustrations may be found in RYMAN & HOLMÅSEN (1984), CETTO (1993), GORI (1994) and MOSER & FURRER-ZIOGAS (1994, Hausknecht).

Macowanites mattirolianus must be treated as a different species, with an hemiangiocarpic development, where the hymenial part close to the stipe-columella, that is typically sublamelliform, becomes exposed after the aperture of the peridium and before the completion of the ripening, and in any case through the disgregation of the peridium, as in *M. candidus*. At the microscopical level, *M. mattirolianus* has globose spores, most of them heterotropic, 10,5-15,5 x 10-15 µm, and an hymenial trama almost devoid of sphaerocytes. Conversely, *M. candidus* has subglobose or broadly elliptical spores, subheterotropic, of smaller size, 10-12,5 x 7,5-11,25 µm, and a lot of sphaerocytes in the hymenial trama.

After Cavara and Bucholtz, we find further reports of *Elasmomyces krjukowensis* (SVRČEK, 1958; STEINMANN, 1963; SOSSIN, 1973; KERS, 1978; RYMAN & HOLMÅSEN, 1984; WEHOLT, 1988), mainly afforded by nordeuropean authors, more influed by Bucholtz than by Cavara, and also some quotations of *Elasmomyces mattirolianus* (HOLLÓS, 1908, 1911; LOHWAG, 1930, 1933; KNAPP, 1941, 1958; BÁHEGYI *et al.*, 1953; SZEMERE, 1965; GROSS, 1968; DE VRIES, 1977; PEGLER & YOUNG, 1979; ECKBLAD & LANGE, 1992; CETTO, 1993; MONTECCHI & LAZZARI, 1993; GORI, 1994; SARASINI & BINCOLETTO, 1997; KRIEGLSTEINER, 2000; MONTECCHI & SARASINI, 2000), most of them given by centroeuropean authors, in this case more influed by Cavara. From all this new reports adscribed to

E. mattirolianus, only the collections made under conifers by MONTECCHI & LAZZARI (*op. cit.*) and MONTECCHI & SARASINI (*op. cit.*) in Italy, in the Tusco-Aemilian Apennine range, must be considered correctly identified, and the photographic images afforded by the mentioned authors are the only of this species we have seen. The remaining collections, made under broadleaf trees, must be considered as belonging to *Macowanites candidus*.

Table 1. Comparison between some characters of *Macowanites candidus* and *M. mattirolianus*

Characters	<i>M. candidus</i>	<i>M. mattirolianus</i>
Development	Angiocarpic	Hemiangiocarpic
Stipe	Reduced, often excentric	Well developed, central
Peridium	A long time white	Promptly yellowish
Gleba	Loculate, orange	Loculate to sublamellate, yellow
Hymenial trama	With abundant sphaerocytes	With scarce sphaerocytes
Spores	Subglobose, 10-12,5 x 7,5-11,25 µm	Globose, 10,5-15,5 x 10-15 µm
Macrocytidia	45-70 x 8-12 µm	70-125-(180) x 15-18 µm
Hymenial hairs	Lacking	Plenty, 12-24 x 5-12 µm
Habitat	Deciduous woods	Conifers

KEY TO EUROPEAN SPECIES OF *MACOWANITES*

- 1 a)** Basidioma hemiangiocarpic, external hymenium sublamellated, stipe well developed; spores globose **2**
b) Basidioma angiocarpic, external hymenium loculated, rarely sublamellated, stipe little developed; spores globose to subglobose..... **3**
- 2 a)** Pileus 1-3 cm, pale yellow to light yellow; spores 10,5-15,5 x 10-15 µm, warted, heterotropic to subheterotropic. In subalpine coniferous woods of *Abies* and *Picea* (Italia):
M. mattirolianus (Cavara) T. Lebel et Trappe
b) Pileus 3-6-(8,5) cm, pinkish white to violet brown; spores 7-11 x 6-9,5 µm, subreticulated, heterotropic. In littoral sand dunes, under *Pinus* (Spain):
M. vinaceodorus Calonge et J.M. Vidal
- 3 a)** Pileus more than 2 cm, white, yellowish white, orange white to dark brown **4**
b) Pileus very small, 0,5-1,8 cm, deep yellow coloured; spores globose, 8-10 x 7,5-9,5 µm, subreticulated, heterotropic. In sclerophyllous woods of *Quercus* (Spain):
M. messapicoides Llistosella et J.M. Vidal
- 4 a)** Pileus 1-5 cm, white to yellow brown; spores globose or subglobose, (8)-10-12,5-(15) µm; under planifolious..... **5**
b) Pileus 2-7 cm, orange white to dark brown; spores subglobose, 7-9 x 5,5-7,5 µm, warted, heterotropic. In littoral sand dunes, under *Pinus* (Portugal, Spain):
M. ammophilus (J.M. Vidal et Calonge) J.M. Vidal et Calonge
- 5 a)** Pileus 1-3,5 cm, white, yellowish white to dark brown; spores subglobose, 10-12,5 x 7,5-11,25 µm, warted, heterotropic to subheterotropic. In continental deciduous woods (North and Central Europe):
M. candidus (Tul. et C. Tul.) J.M. Vidal, *comb. nov.*
b) Pileus 1,5-5 cm, white, cream to pale umber; spores globose, 8,5-11-(12) x 8-10,25 µm, subreticulated, heterotropic. In sclerophyllous woods of *Quercus* (Israel):
M. galileensis Moser, Binyamini et Avizohar-Hershenzon

COLLECTION EXAMINED of *Macowanites galileensis*.- ISRAEL: Mt. Carmel, Horshat Ha'arbaim, near Haifa. 12-12-1972, under *Quercus calliprinos*, leg. M. Moser, N. Binyamini and Z. Avizohar-Hershenzon #72/401 (IB-M72.340, isotypus).

ACKNOWLEDGEMENTS

My gratitude to the curators of the herbaria consulted: E.W. Wood (FH), M. Moser † (IB), D. Triebel (M), B.M. Thiers (NY), G. Mascarell (PC) and J. Holec (PRM). To A. Sánchez-Cuxart, curator of BCN Herbarium, for the help to the request of loan. To L. Gori, Z. Lukács, A. Montecchi (AM) and M. Sarasini (MS) for the exsiccata loan. To M. Candusso, I. Király, Z. Lukács, P.A. Moreau and F.D. Calonge for the bibliographical assistance, to the friends M.A. Pérez-de-Gregorio and J. Llistosella for the diverse aid afforded, and particularly to X. Llimona for the revision and English translation of the text. This work has received support from the Institut d'Estudis Catalans.

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