

# **ARCANGELIELLA BORZIANA AND A. STEPHENSII, TWO GASTEROID FUNGI OFTEN MISTAKEN. A TAXONOMIC REVISION OF LACTARIUS-RELATED SEQUESTRATE FUNGI**

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**ABSTRACT.** *Arcangeliella borziana* and *A. stephensii*, two gasteroid fungi often mistaken. A taxonomic revision of *Lactarius*-related sequestrate fungi. As a result of the study of type material of *Arcangeliella borziana* Cavara, *A. volemoides* K. et A. Mader, *Hydnangium stephensii* Berk., *H. galathejum* Quéf., *H. soehneri* Zeller et C.W. Dodge, *H. soehneri* var. *ettenbergii* Soehner, and recent new collections attributed to *Arcangeliella borziana* Cavara and *Zelleromyces stephensii* (Berk.) A.H. Sm., only two gasteroid, non-secotioid species are recognized, viz. *Arcangeliella borziana* Cavara (= *A. volemoides*) and *A. stephensii* (Berk.) Zeller et C.W. Dodge (= *H. galathejum*, = *H. soehneri*, = *H. soehneri* var. *ettenbergii*). Both species are redescribed, illustrated and compared, at the same time as the known data regarding its ecology, phenology and distribution in Europe are enriched and summarized. On the other hand, the genus *Zelleromyces* Singer et A.H. Sm. is synonymized with *Arcangeliella* Cavara to include only the gasteroid, non-secotioid species related to *Lactarius*; and the genus *Gastrolactarius* R. Heim ex J.M. Vidal is validated to accommodate the secotioid species. As a result, 26 new combinations are realized: 13 into the genus *Arcangeliella*, 12 into *Gastrolactarius* and 1 into *Gymnomyces*. Likewise, *Zelleromyces hispanicus* Calonge et Pegler is synonymized with *Z. josserandii* Malençon.

**Key words:** Russulales, *Lactarius*-related sequestrate fungi, *Arcangeliella*, *Gastrolactarius*, *Hydnangium*, *Zelleromyces*, taxonomy.

**RESUMEN.** *Arcangeliella borziana* y *A. stephensii*, dos hongos gasteroides a menudo confundidos. Una revisión taxonómica de los hongos secuestrados relacionados con *Lactarius*. Como resultado del estudio del material tipo de *Arcangeliella borziana* Cavara, *A. volemoides* K. et A. Mader, *Hydnangium stephensii* Berk., *H. galathejum* Quéf., *H. soehneri* Zeller et C.W. Dodge, *H. soehneri* var. *ettenbergii* Soehner, y de recientes nuevas recolecciones atribuidas a *Arcangeliella borziana* Cavara y a *Zelleromyces stephensii* (Berk.) A.H. Sm., sólo dos especies gasteroides, no secotioides, han sido reconocidas: *Arcangeliella borziana* Cavara (= *A. volemoides*) y *A. stephensii* (Berk.) Zeller et C.W. Dodge (= *H. galathejum*, = *H. soehneri*, = *H. soehneri* var. *ettenbergii*). Ambas especies son descritas, ilustradas y comparadas. Al mismo tiempo, los datos referentes a su ecología, fenología y distribución en Europa han sido complementados y resumidos. Por otra parte, se sinonimiza el género *Zelleromyces* Singer et A.H. Sm. con *Arcangeliella* Cavara, para incluir en él sólo las especies gasteroides, no secotioides; y para las secotioides, se valida el género *Gastrolactarius* R. Heim ex J.M. Vidal. Como resultado, se han realizado 26 nuevas combinaciones: 13 en el género *Arcangeliella*, 12 en *Gastrolactarius* y 1 en *Gymnomyces*. Asimismo, se sinonimiza *Zelleromyces hispanicus* Calonge et Pegler con *Z. josserandii* Malençon.

**RESUM.** *Arcangeliella borziana* i *A. stephensii*, dos fongs gasteroides sovint confosos. Una revisió taxonòmica dels fongs segrestats relacionats amb *Lactarius*. Com a resultat de l'estudi del material tipus d'*Arcangeliella borziana* Cavara, *A. volemoides* K. et A. Mader, *Hydnangium stephensii* Berk., *H. galathejum* Quéf., *H. soehneri* Zeller et C.W. Dodge, *H. soehneri* var. *ettenbergii* Soehner, i de recents noves recol·leccions atribuïdes a *Arcangeliella borziana* Cavara i a *Zelleromyces stephensii* (Berk.) A.H. Sm., només dues espècies gasteroides, no secotioides, han estat reconegudes: *Arcangeliella borziana* Cavara (= *A. volemoides*) i *A. stephensii* (Berk.) Zeller et C.W. Dodge (= *H. galathejum*, = *H. soehneri*, = *H. soehneri* var. *ettenbergii*). Ambdues espècies són redescrites, il·lustrades i comparades. Així mateix, les dades referents a la seva ecologia, fenologia i distribució a

Europa han estat enriquides i resumides. Per altra banda, es sinonimitza el gènere *Zelleromyces* Singer et A.H. Sm. amb *Arcangeliella* Cavara, per incloure-hi només les espècies gasteroides, no secotioïdes; i per a les secotioïdes, es valida el gènere *Gastrolectarius* R. Heim ex J.M. Vidal. Com a resultat, 26 noves combinacions han estat realitzades: 13 dins del gènere *Arcangeliella*, 12 dins *Gastrolectarius* i 1 dins *Gymnomyces*. També, es sinonimitza *Zelleromyces hispanicus* Calonge et Pegler amb *Z. josserandii* Malençon.

## INTRODUCTION

The sequestrate fungi related with the genus *Lactarius* Pers. are currently grouped in two genera: *Arcangeliella* Cavara and *Zelleromyces* Singer et A. H. Sm. *Arcangeliella* was erected by CAVARA (1900) to accommodate *A. borziana* Cavara, an angiocarpic fungus producing latex, provided with a small sterile base and a columella. It comprises, in the current concept, all the secotioïd, latex-producing species; the remaining, non-secotioïd, sessile species are grouped in the genus *Zelleromyces*. The genus *Arcangeliella* has a world-wide distribution, with some 15 accepted species, that are known from Europe, North America, Australasia and Africa (CAVARA, 1900; ZELLER & DODGE, 1935; ZELLER, 1947; SINGER & SMITH, 1960; PEGLER & YOUNG, 1979; THIERS, 1979, 1984; PEGLER, 1982; MADER & MADER, 1992; LEBEL & CASTELLANO, 2002), all of them stipitate, except the two european species (*A. borziana* and *A. volemoides*), that are sessile. The genus *Zelleromyces* embraces more than 25 species, distributed across North America, South America, Eurasia and Australasia (SINGER & SMITH, 1960; SMITH, 1962; MALENÇON, 1975; PEGLER & YOUNG, 1979; BEATON *et al.*, 1984; TAO *et al.*, 1993; CALONGE & PEGLER, 1998; MORENO-ARROYO *et al.*, 1998a, b; MILLER & LEBEL, 1999; LEBEL & TRAPPE, 2000; FOGEL & STATES, 2001; TRAPPE *et al.*, 2002), 6 of them European (*Z. giennensis*, *Z. hispanicus*, *Z. josserandii*, *Z. meridionalis*, *Z. soehneri* and *Z. stephensii*).

## MATERIAL AND METHODS

The present work has been based upon the study of exsiccata material sent in loan by the following public herbaria FH (Cambridge, USA), K (Kew, UK), M (München, Germany), MA (Madrid, Spain), NY (New York, USA), UPS (Uppsala, Sweden) and WU (Wien, Austria), and from the personal herbaria of A. Montecchi (AM), P.A. Moreau (PAM), E. Rubio (ER), G. Meyer, Z. Lukács and I. Király, and from recent collections found by the author, all labeled JMV and kept in the herbarium BCN. The colours has been identified following the colour guide of KORNERUP & WANSCHER (1978), after the indication K&W. The measurements and the O.M. photographs has been made on material previously rehydrated with chloral hydrate, KOH or Melzer. Measurements include neither ornamentation nor the hilar appendix.

## RESULTS

As a result of a revision of type herbarium material of *Arcangeliella borziana* Cavara, *A. volemoides* K. et A. Mader, *Hydnangium stephensii* Berk., *H. galathejum* QuéL., *H. soehneri* Zeller et C.W. Dodge, *H. soehneri* var. *ettenbergii* Soehner, and a number of recent collections attributed to *Arcangeliella borziana* Cavara and *Zelleromyces stephensii* (Berk.) A.H. Sm., two species of *Arcangeliella* are recognized.

***Arcangeliella borziana*** Cavara, *Nuovo Giorn. Bot. Ital.*, Nuov. Ser., 7(2): 126 (1900)

(Figs. 1-2)

Syn.- *Octaviana borziana* (Cavara) Svrček, *Flora ČSR B1*, *Gasterom.*: 740 (1958).- *Arcangeliella stephensii* var. *borziana* (Cavara) Krieglsteiner, *Zeitschr. f. Mykol.* 57(1): 19 (1991).- *Arcangeliella volemoides* K. et A. Mader, *Öst. Zeitschr. f. Pilzk.* 1: 5 (1992).- *Lactarius borzianus* (Cavara) Verbeken et Nuytinck, in Nuytinck *et al.*, *Belg. Journ. Bot.* 136(2): 151 (2003).

Misappl.- *Hydnangium stephensii* sensu Soehner, *Zeitschr. f. Pilzk.* 2: 153 (1923); Soehner, *Krypt. Fors. Bayern Bot. Ges. München* 1(16): 394 (1924); Fischer, *Fests. C. Schröder*,

Veröff. Geobot. Inst. Rübel Zürich 3: 571 (1925).- *Arcangeliella stephensii* sensu Fischer, *Nat. Pflanzenf.*, II Aufl., 7a: 31 (1933); Soehner, *Zeitschr. f. Pilzk.*, N.F., 21(3): 14 (1949); Knapp, *Schweiz. Zeitschr. f. Pilzk.* 36(10): 153 (1958); Reijnders, *Persoonia* 9(1): 74 (1976).- *Zelleromyces stephensii* sensu Jülich, *Kl. Kryptog. II b/1, Basidiom.*: 550 (1984); Miller & Miller, *Mycol. Helvet.* 2(1): 60 (1986) pro parte; Montecchi & Lazzari, *Riv. Micol. AMB* 31(1-2): 89 (1988); Cetto, *I funghi dal vero*: pl. 2536 (1989).- *Elasmomyces mattirolianus* sensu Singer & Smith, *Mem. Torrey Bot. Cl.* 21: 59 (1960).- *Macowanites mattirolianus* sensu Lebel & Trappe, *Mycologia* 92(6): 1194 (2000).

Excl.- *Arcangeliella borziana* sensu Montecchi & Lazzari, *Atl. fot. Fung. Ipog.*: 337 (1993) pro parte; Gori & Bernardini, *Atti 4<sup>e</sup> Giornate Confederaz. Europ. Micol. Mediter. (a.e.)*, Poggibonsi: 69 (1996); Vidal, *Rev. Cat. Micol.* 20: 36 (1997); Montecchi & Sarasini, *Fung. Ipog. Europ.*: 612 (2000) pro parte (= *Arcangeliella stephensii*).- *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) (= *Macowanites mattirolianus*).

ICON. AND BIBL. SEL.- CAVARA (1900: 117-128, tab. VII); SACCARDO & SYDOW (1902: 256); PETRI (1909: 32-33, figs. 8-9); ZELLER & DODGE (1919: 53-54); LLOYD (1922: 1142, fig. 2175); BATAILLE (1923: 184); SOEHNER (1923: 153-156, figs. 1-7, ut *H. stephensii*); FISCHER (1925: 573, ut *H. stephensii*); MALENÇON (1931: figs. 6 & 18, spores); FISCHER (1933: 31-32, fig. 24, & ut *A. stephensii*); ZELLER & DODGE (1936: 628); SOEHNER (1949: 14-15, figs. 26-33, ut *A. stephensii*); KNAPP (1958: 153-156, ut *A. stephensii*); SVRČEK (1958: 194-195, ut *O. borziana*); SINGER & SMITH (1960: 59-60, ut *E. mattirolianus*); SZEMERE (1965: 271); REIJNDERS (1976: 74-75, ut *A. stephensii*); GROSS *et al.* (1980: 93 & 158, ut *Z. stephensii*); MOSER (1983: 461); JÜLICH (1984: 549-550, & ut *Z. stephensii*); MILLER & MILLER (1986: 60-62, figs. 1-6, ut *Z. stephensii*); MONTECCHI & LAZZARI (1988: 89-90, ut *Z. stephensii*); CETTO (1989: 6/2536, ut *Z. stephensii*); GROSS (1990: 240-243); KRIEGLSTEINER (1991: 17-20, ut *A. stephensii* var. *borziana*); MADER & MADER (1992: 5-9, figs. 2-12, ut *A. volemoides*); MONTECCHI & LAZZARI (1993: 334-337 pro parte, 334 only fig. inf.); MEDARDI (1996: 16-17, fig. 2 left); AYER (1998: 240-241, figs. 1-3); LEBEL & TRAPPE (2000: 1194-1195, figs. 6-7, ut *M. mattirolianus*); MONTECCHI & SARASINI (2000: 612-615 pro parte, 613 only fig. inf., spores); MEYER *et al.* (2003: 145-153, fot. & figs., ut *Gymnomyces subochraceus*); NUYTINCK *et al.* (2003: 148, fig. 1a-d, ut *L. borzianus*).

Basidioma angiocarpic, 1-4 cm, subglobose to irregular, tuberiform, often bilobed, sessile, with a minute sterile base attaching to soil. Peridium dry, first smooth, then areolate, initially yellowish white (K&W 2A2), pale yellow (K&W 3A3), light yellow (K&W 4A5), then brownish orange (K&W 7C7), and finally reddish brown (K&W 8E8) to dark brown (K&W 8F8); evanescent near the sterile base, and exposing the laminar primordia, radially located around the base. Gleba loculate, labyrinthoid, 4-7 chambers per mm, initially yellowish white (K&W 2A2), light yellow (K&W 4A4), finally light brown (K&W 7D7); columella evident only in young exemplars, percurrent or branched. Spore mass in the locules yellowish white (K&W 4A1-2). Latex scanty, first colourless to milky white, then yellow, in low quantity in the gleba, more abundant in the columella and the peridium. Young basidiomata emit a characteristic smell of wild bug (*Nazara viridula*), and when ripening, they propagate a musky or tasty smell; the taste is unpleasant and, after a time, bittery.

Spores subglobose to broadly ellipsoidal, 9,5-13(15) x 8-10(11) µm, clearly heterotropic, hyaline seen in O.M., warts amiloid, 1-1,5 µm high; hilar appendix conic, 1-1,5 µm long, sometimes with a short sterigmal appendage, 1-3 µm long; suprahilar plage not seen. Basidia 30-65 x 10-15 µm, cylindrical or subclavate, often sinuous, 4-spored, seldom 2-3-spored; sterigmata conical, curvate, 5-8 µm long. Basidioles claviform, 34-45 x 8-9 µm. Hymenial hairs (paracystidia) abundant, 15-40 x 5-12 µm, cylindrical or slightly claviform, sometimes subglobose, often 1-2 septate. Cystidia very infrequent, 20-50 x 4-6 µm, septate, cylindrico-rostrate to ventricos-rostrate, acuminate, mucronate or penicillate, difficult to notice in some collections or absent, but abundant in the sterile laminar hymenium. Macrocystidia not found. Pseudocystidia not observed. Subhymenium cellular, formed by prismatic cells, 8-25 µm in diam. Hymenial trama homoiomerous, 25-75-(100) µm thick; hyphae 2-6,5 µm in diam., with subglobose thickenings, reaching 12 µm in diam. in the intersections. Some collections with isolated sphaerocytes in the hymenial trama and subpellis, 15-30 µm in diam., more abundant and grouped in rosettes or chains in the context of the columella. Oleiferous hyphae abundant in young collections, 2-8 µm in diam. Laticiferous hyphae rare, 2,5-10 µm in diam. Peridiopellis 100-250 µm thick; suprapellis varying from a trichoderm to an oedotrichoderm, formed by an internal layer of prismatic hyphae reaching 15 µm in diam., and by an external layer of cylindrical and sinuose, septate hairs, 10-40 x 3-6 µm,

mixed with lanceolate dermatocystidia like those of the sterile hymenium, that collapses soon in a brown mass; subpellis a cutis, with the same composition of the hymenial trama, plenty of laticiferous hyphae.

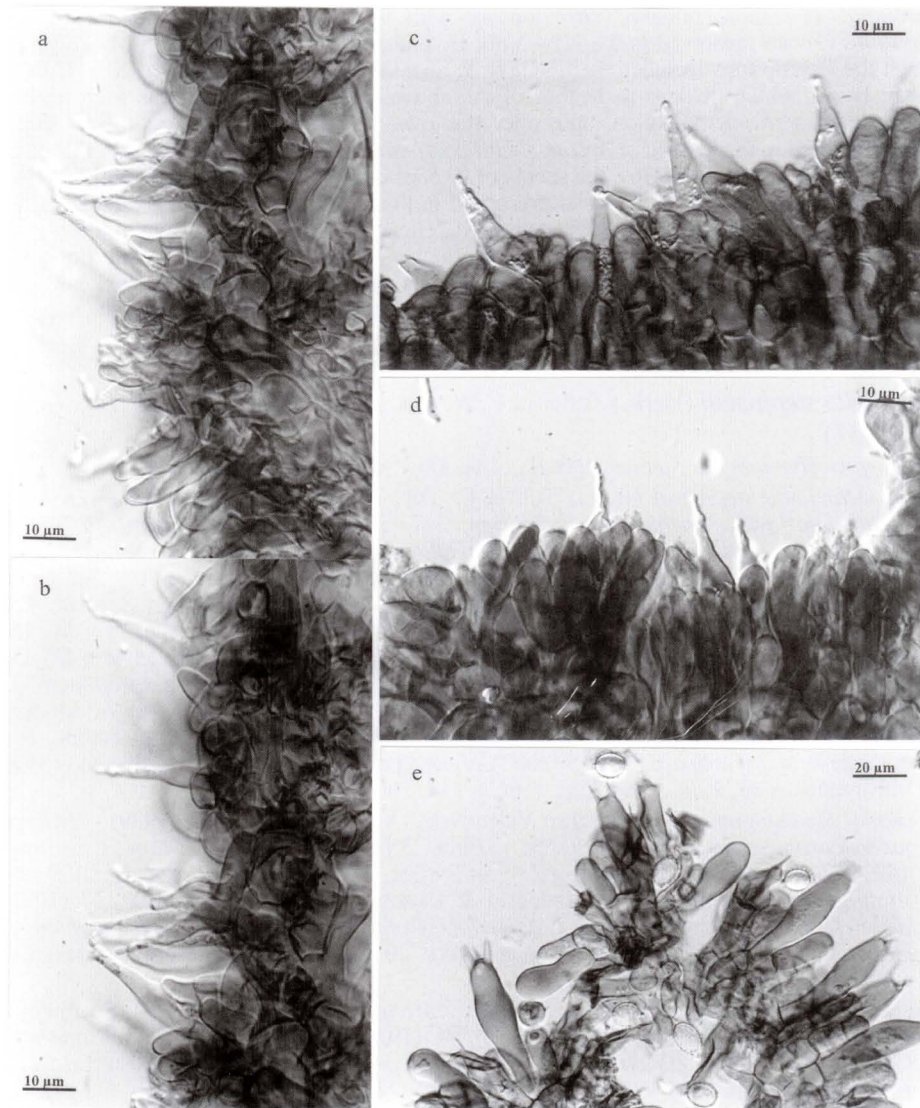
**HABITAT & DISTRIBUTION.**- Frequently gregarious, hypogeous or semihypogeous under acicules, in subalpine conifer woods of *Abies alba* and *Picea abies*, between 1.000-1.800 m, on siliceous soil, in summer and autumn. Rare and localized. Distributed along the Alps and Appenine Mountains. Found in France, Italy (CAVARA, 1900; MONTECCHI & LAZZARI, 1988, 1993; MONTECCHI & SARASINI, 2000), Austria (MADER & MADER, 1992), Switzerland (MILLER & MILLER, 1986; AYER, 1998; MEYER *et al.*, 2003) and Germany (SOEHNER, 1923, 1949; GROSS, 1990).

**COLLECTIONS EXAMINED.**- AUSTRIA: Niederösterreich, Gföhl, near Dorf Brunn, under *Picea abies*, 12-9-1970, *leg.* A. & K. Mader (WU-10875, holotypus of *A. volemoides*).- FRANCE: Savoie, Héry-sur-Ugine, Réserve Naturelle du Nant Pareu-Merdassier, 1.450 m, under *Picea abies*, near *Lactarius aurantiofulvus*, on siliceous soil, 13-8-2002, *leg.* & *det.* P.A. Moreau (PAM02081305, 6).- ITALY: Toscana, Firenze, Tosco-Romagnolo Appenine Mountains, Vallombrosa forest, Gualberto, San Giovanni, 9-1896, semihypogeous under fallen needles of *Abies alba*, *leg.* F. Cavara (NY-Zeller Herb., as isotypus of *Elasmomyces mattirolianus*); Emilia Romagna, Reggio Emilia, Civago, Emiliano Appenine Mountains, Abetina Reale forest, 1.300-1.600 m, 5-8-1999, under *Abies alba*, on siliceous soil, *leg.* and *det.* A. Montecchi AM1973 (JMV800239).- SWITZERLAND: Bern, Diesse, Jura Mountains, La Rochalle, 940 m, under *Abies alba*, *Fagus* and *Corylus*, 19-VII-202, *leg.* & *det.* G. Meyer as *Gymomyces xanthosporus* (JMV800246).

*Arcangeliella borziana* was discovered by CAVARA (1900) in the Tosco-Romagnolo Appenine Mountains, near Firenze, in the Italian region of Tuscany, under *Abies alba*. Later after Cavara report, we found rare quotations referred to *A. borziana* (GROSS, 1990; MONTECCHI & LAZZARI, 1988, 1993; GORI & BERNARDINI, 1996; VIDAL, 1997; AYER, 1998; MONTECCHI & SARASINI, 2000), but only those based on material collected under conifers do belong to the true *A. borziana*. Thus, the data in VIDAL (*op. cit.*) and the collections of GROSS (*op. cit.*), GORI & BERNARDINI (*op. cit.*), MONTECCHI & LAZZARI (1993) and MONTECCHI & SARASINI (*op. cit.*), under planifolious, must be assigned to *A. stephensii*. Recently, MADER & MADER (1992) has published a new species of *Arcangeliella*, collected under *Picea abies* in the Austrian Alps. After examination of the type material of *A. volemoides* K. et A. Mader, we don't have observed any microscopic nor macroscopic difference with *A. borziana*, and consequently, we consider that both taxa are conspecific. Excellent colour pictures of *A. borziana* are in MONTECCHI & LAZZARI (1993), where the sterile, sublamelliform and loculated base is easy to be appreciated, as is the case with the poor lactescence of the adult gleba. See also CETTO (1989, as *Z. stephensii*), where a group of still young specimens are illustrated.

*A. borziana* is a typically silicicolous species, that grows in the subalpine coniferous woods submitted to a high pluviometry (about 2.000 mm). In the Italian region of the Tuscano-Emilian Appenine Mountains, it may be found sharing the habitat with *Macowanites mattirolianus* Cavara. Molecular studies by PETER *et al.* (2001) show a high phylogenetic affinity with *Lactarius* subgenus *Russularia*.

Close examination of 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), 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 the material more concordant with the features of *Elasmomyces mattirolianus* Cavara. This putative misidentification is repeated in later descriptions of the same material, published by SINGER & SMITH (1960), PEGLER & YOUNG (1979) and LEBEL & TRAPPE (2000), which highlight the same set of characters: presence of percurrent stipe-columella, suprapellis of (ixo)trichoderm type, subpellis of ixocutis type, hymenial trama and peridium containing nests of sphaerocytes and laticiferous hyphae, hymenium rich in macrocystidia (mistaken for pseudocystidia by LEBEL & TRAPPE, *op. cit.*), and globose, large, ochraceous spores, 9-15 x 10-13 µm. If we exclude the presence of active laticiferous hyphae, this set of features fits well with *Macowanites mattirolianus* (Cavara) T. Lebel et Trappe. In contrast with the overmentioned taxon, *Arcangeliella borziana* is devoid of stipe-columella, its peridium lacks gelatinized hyphae, the hymenial trama and the peridium rarely contain sphaerocytes, sometimes represented only by isolated globose



**Fig. 1.-** *Arcangeliella borziana*.- **a-b.** Suprapellis (JMV800246). **c-d.** Sterile hymenium (paracystidia and cystidia) (AM1973). **e.** Hymenium (spores, basidia, basidioles and paracystidia) (AM1973).

elements, but never forming nests of sphaerocytes, the hymenium lacks macrocystidia, cystidia are only present in the sterile hymenial part, and the spores are broadly ellipsoidal, hyaline, 9.5-13 x 8-10 µm. The presence of many laticiferous-looking hyphae in the hymenial trama and in the peridium may have led the abovementioned authors to conclude they were dealing with authentic material of *A. borziana*. The same putative error occurs with the type material labeled *Elasmomyces mattirolanus* Cavara preserved in the New York Botanical Garden Herbarium (S.M. Zeller Herb.), on which the descriptions included in SINGER & SMITH (*op. cit.*) and LEBEL & TRAPPE (*op. cit.*) were based, 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 *Arcangeliella borziana* Cavara (see discussion in VIDAL, 2004). After ZELLER & DODGE (1936), the sheets of *A. borziana* kept in Dodge's and Zeller's Herbaria are only a duplicate of the type material preserved in the Herbarium of the Università degli Studi di Napoli, and they were not studied in detail by Zeller and Dodge, as they include only a short description of *A. borziana*, essentially taken from that of CAVARA (1900). We do not know where the rest of the type material of *A. borziana* is now kept, but it might be in Mattirollo's Herbarium of the Università degli Studi di Torino, as the Herbarium curators in Naples have informed us that it is not longer conserved there.

***Arcangeliella stephensii* (Berk.) Zeller et C.W. Dodge, in Dodge, *Ann. Mo. Bot. Gard.* 18: 463 (1931) (Figs. 3-4)**

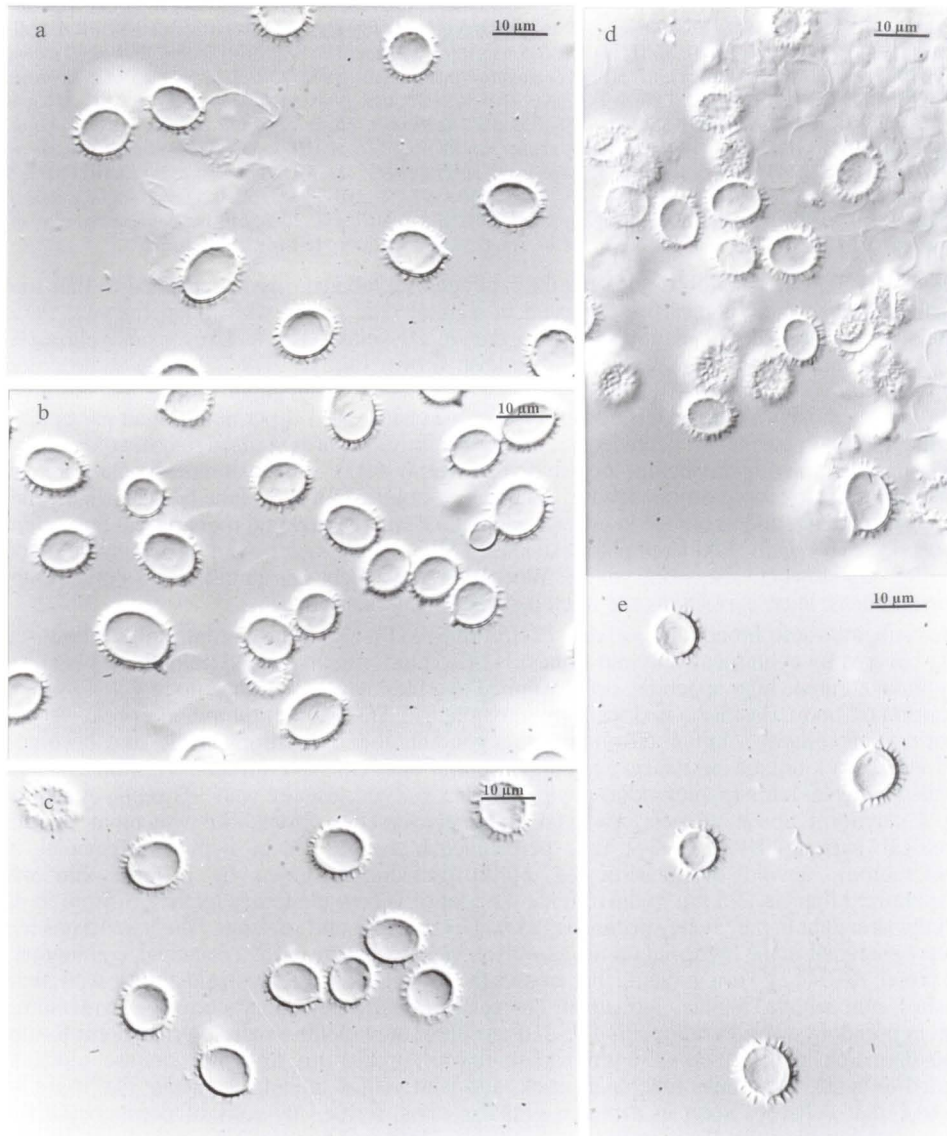
Basionym.- *Hydnangium stephensii* Berk., *Ann. Mag. Nat. Hist.* 13: 352 (1844).

Syn.- *Octaviania stephensii* (Berk.) Tul. et C. Tul., *Fung. Hypog.*: 78 (1851).- *Hydnangium galatheium* Quélet., *Enchiridion Fungorum*: 247 (1886).- *Octaviania galatheja* (Quélet.) De Toni, in Sacc., *Syll. Fung.* 7: 491 (1888).- *Octavianina stephensii* (Berk.) Kuntze, *Rev. Gen. Pl.* 3(2): 501 (1898).- *Hydnangium soehneri* Zeller et C.W. Dodge, *Ann. Mo. Bot. Gard.* 22: 372 (1935) (*syn. nov.*).- *Hydnangium soehneri* var. *ettenbergii* Soehner, *Zeitschr. f. Pilzk.* 20(3-4): 110 (1941) (*nom. nud.*) (*syn. nov.*).- *Octaviania soehneri* (Zeller et C.W. Dodge) Svrček, *Flora ČSR B1, Gasterom.*: 200 (1958).- *Martellia soehneri* (Zeller et C.W. Dodge) Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 31 (1960).- *Zelleromyces stephensii* (Berk.) A.H. Sm., *Mycologia* 54: 635 (1962).- *Martellia stephensii* (Berk.) K. et A. Mader, *Öst. Zeitschr. f. Pilzk.* 1: 4 (1992).- *Zelleromyces soehneri* (Zeller et C.W. Dodge) Trappe, T. Lebel et Castellano, *Mycotaxon* 81: 205 (2002).- *Lactarius stephensii* (Berk.) Verbeke et Walley, in Nuytinck et al., *Belg. Journ. Bot.* 136(2): 151 (2003).

Misappl.- *Hydnangium carneum* sensu Velenovský, *Novit. Mycol.* 1: 171 (1939).- *Hydnangium monosporum* sensu Soehner *Zeitschr. f. Pilzk.* 20(3-4): 109 (1941); Vacek, *Čes. Mykol.* 4: 140 (1950).- *Octaviania monospora* sensu Svrček, *Flora ČSR B1, Gasterom.*: 199 (1958).- *Arcangeliella borziana* sensu Montecchi & Lazzari, *Atl. fot. Fung. Ipog.*: 337 (1993) pro parte; Gori & Bernardini, *Atti 4<sup>e</sup> Giornate Confederaz. Europ. Micol. Mediter. (a.e.), Poggibonsi*: 69 (1996); Vidal, *Rev. Cat. Micol.* 20: 36 (1997); Montecchi & Sarasini, *Fung. Ipog. Europ.*: 612 (2000) pro parte.

Excl.- *Hydnangium stephensii* sensu Soehner, *Zeitschr. f. Pilzk.* 2: 153 (1923); Soehner, *Krypt. Fors. Bayern Bot. Ges. München* 1(16): 394 (1924); Fischer, *Fests. C. Schröder, Veröff. Geobot. Inst. Rübel Zürich* 3: 571 (1925). *Arcangeliella stephensii* sensu Fischer, *Nat. Pflanzenf.*, II Aufl., 7a: 31 (1933); Soehner, *Zeitschr. f. Pilzk.*, N.F., 21(3): 14 (1949); Knapp, *Schweiz. Zeitschr. f. Pilzk.* 36(10): 153 (1958); Reijnders, *Persoonia* 9(1): 74 (1976). *Zelleromyces stephensii* sensu Jülich, *Kl. Kryptog. II b/1, Basidiom.*: 550 (1984) pro parte; Miller & Miller, *Mycol. Helvet.* 2(1): 60 (1986) pro parte; Montecchi & Lazzari, *Riv. Micol. AMB* 31(1-2): 89 (1988); Cetto, *I funghi dal vero*: pl. 2536 (1989) (= *Arcangeliella borziana*).- *Octaviania soehneri* sensu Svrček, *Flora ČSR B1, Gasterom.*: 200 (1958) (= *Octaviania asterosperma*).

ICON. AND BIBL. SEL.- BERKELEY (1844: 352, ut *H. stephensii*); TULASNE & TULASNE (1851: 78, pl. 21/6, ut *O. stephensii*); ZOBEL (1854: 36, tab. VII/67, ut *O. stephensii*); QUÉLET (1875: 446, ut *H. stephensii*; 1886: 247-248, ut *H. stephensii* & *H. galatheium*); DE TONI (1888: 159, ut *O. stephensii*; 491, ut *O. galatheja*); MASSEE (1889: 31-32, fig. 3, ut *O. stephensii*); PATOULLARD (1910: 199-201, fig. 1, ut *H. galatheium*; 1914: 348, ut *H. stephensii*); LLOYD



**Fig. 2.-** *Arcangeliella borziana*.- Spores: **a.** PAM02081306. **b.** AM1973. **c.** JMV800246. **d.** as isotypus of *E. mattirolianus* (NY). **e.** *A. volemoides* (WU, holotypus).

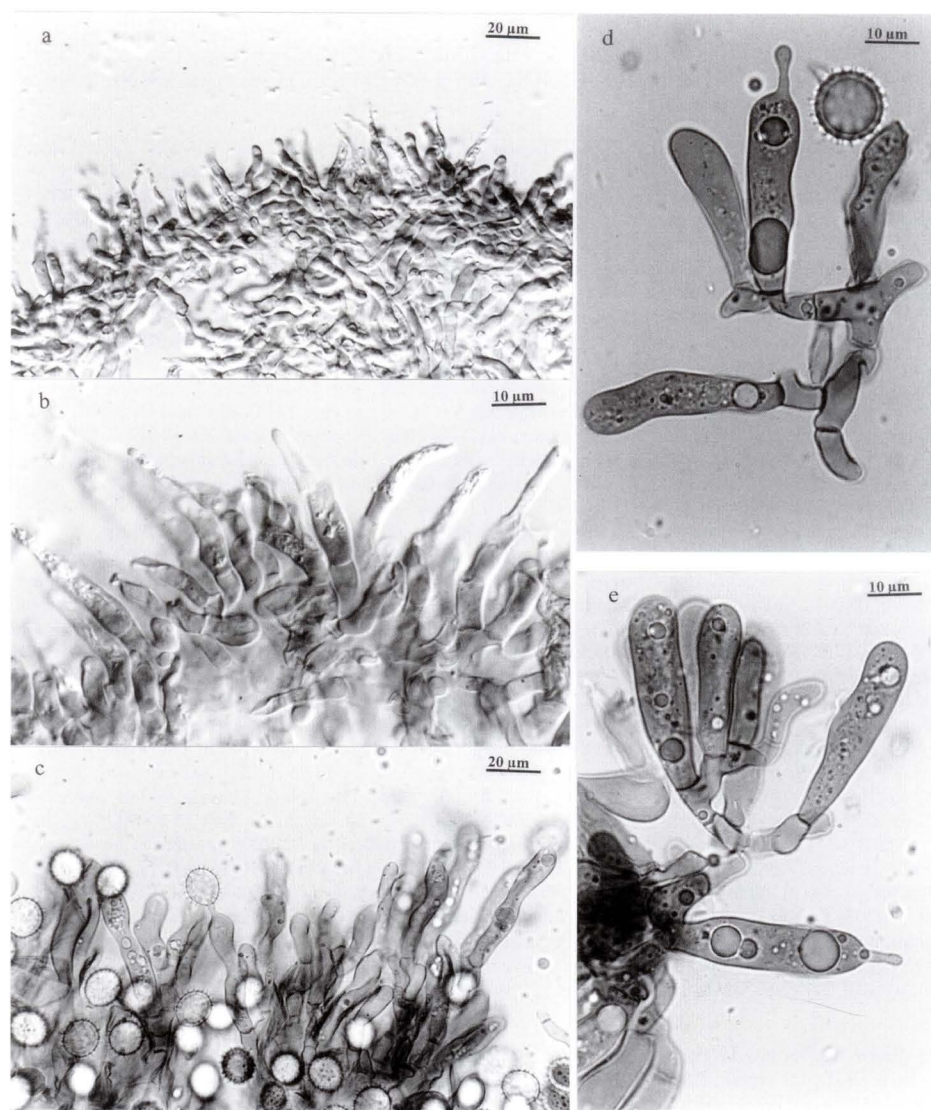
(1922: 1140, fig. 2159, ut *O. stephensii*); REA (1922: 28, ut *O. stephensii*); BATAILLE (1923: 184, ut *H. stephensii*); ZELLER & DODGE (1935: 372, ut *H. soehneri*); DODGE & ZELLER (1936: 595, ut *H. soehneri*); ZELLER & DODGE (1936: 613-614, ut *A. stephensii*); SOEHNER (1941: 109, fig. 2, ut *H. monosporum*; 109-110, fig. 6a-b, ut *H. soehneri*; 110, fig. 6c, ut *H. soehneri* var. *ettenbergii*); VACEK (1950: 137-141, figs. 1-4, ut *H. galatheium*; figs. 5-7, ut *H. monosporum*); HAWKER (1954: 517-519, fig. 25q-z, ut *Z. stephensii*); PETITBERGHIEN (1956: 120, ut *H. galatheium*); SVRČEK (1958: 197-198, fig. 40/7, ut *O. stephensii*; 199, fig. 40/6, ut *O. monospora*); SINGER & SMITH (1960: 31, fig. 29, ut *M. soehneri*); SMITH (1962: 635-636, ut *Z. "stephansii"*); SZEMERE (1965: 266, ut *H. soehneri*; 270); COSTANTIN & DUFOUR (1967: 301, ut *O. galatheja*); HAWKER (1975: 125, pl. 31/5, spore, ut *Z. stephensii*); DE VRIES (1977: 4-5, fig. 2); PEGLER & YOUNG (1979: 373-375, figs. 79-81, ut *Z. stephensii*); MOSER (1983: 460, ut *M. soehneri*); PÁZMÁNY & LASZLO (1985: 33, ut *Z. stephensii*); ELLIS & ELLIS (1990: 251, fig. 543, ut *Z. stephensii*); AUGUADRI *et al.* (1991: 292, ut *O. stephensii*); MORENO *et al.* (1991: 230, figs. 95-98, ut *Z. stephensii*); MADER & MADER (1992: 4-5, fig. 1, ut *M. stephensii*); HINTZ (1993: 58); MONTECCHI & LAZZARI (1993: 334 basidiomata fig. sup., ut *A. borziana*); PEGLER *et al.* (1993: 197-199, fig. 30D-G, pls. 12D, 26R, ut *Z. stephensii*); VIDAL (1997: 36-38, fig. 5c-e, ut *A. borziana*); MONTECCHI & SARASINI (2000: 613 basidiomata fig. sup., ut *A. borziana*); WALLEYN (2003: 40, f.1); NUYTINCK *et al.* (2003: 145-151, fig. 1e-i, ut *L. stephensii*).

Basidioma 1-3,5 cm, subglobose or irregular, anfractuose, lobated, sessile, attached to thin roots of the substrate by a little conical base located in a basal little cavity with radial furrows. Peridium smooth, viscid, easily detached, at first whitish, then maize yellow (K&W 4A6), oxide yellow (K&W 5C7), carrot red (K&W 6B7), and finally reddish brown (K&W 7D8-7E8), the same colour of *Lactarius rufus*. Reaction with KOH negative. The base, by disgregation, forms evident alveoles. Gleba loculated, labyrinthic, with irregularly elongated chambers, 1-4 per mm; tramal plates 120-175 µm thick. Initially white or ochraceous; when ripening, acquires a ferruginose colour, like the peridium. Spore mass in the locules greyish orange (K&W 5B5). When young exemplars are cut, the gleba exudes a latex more or less aqueous, abundant, changing in a short time to the citrine yellow in contact with the air, and to orange in contact with KOH; with a bitter and more or less hot taste, as in *Lactarius chrysoorheus*. Old exemplars exudates a white latex, sweet, with an immutable colour or changing very slowly to the citrine yellow. When young, the gleba has a mild smell, similar to that of *L. chrysoorheus*; later, in ripening, the smell becomes intense and fruity.

Spores subglobose to broadly ellipsoidal, 12-15-(18,5) x 11-13(15) µm, orthotropic, yellow seen in O.M., covered by cylindrical, amyloid spines, 1-2-(2,5) µm, usually curved. Suprahilar plage absent. They show a minute hilar appendix, usually united to a fragment of sterigma, up to 4 x 2,5 µm, and a big central oil body. Basidia cylindrical, stright or sinuose, 35-70 x 6-10 µm, monosporic, very rarely bisporic, soon collapsed. Initially hyaline, with a good number of oil drops inside, they become later filled with a dark orange substance. Sterigmata central or lateral, 4-6 µm long. Basidioles similar to basidia. Hymenial hairs (paracystidia) plenty, 20-60 x 6-8 µm, usually with 1-3 septa, cylindrical or with a claviform apical element. Cystidia and macrocystidia absent. Subhymenium formed by cylindrical hyphae, 10-30 x 3-9 µm, perpendicular to the trama hyphae. Hymenial trama homoiomerous, devoid of sphaerocytes, 60-90 µm thick, formed by hyaline, thin walled, subgelatinized hyphae, 2-5 µm in diam. It shows a lot of yellow oleiferous hyphae, 3-5 µm in diam., specially abundant in the young specimens; later, they collapse and vanishes. The laticiferous hyphae are very abundant in the hymenial trama, as well as in the peridium, with a principal, continuous part, very broad, 8-10-(12,5) µm in diam., that crosses the peridium and the hymenial trama, with plenty of branches, non septate, thinner, 3-5 µm in diam.; sometimes, they penetrate to the hymenium, and finish in pseudocystidia. Peridiopellis 150-250 µm thick; suprapellis a palisadotrichoderm formed by brown dermatocystidia, 20-60 x 3-6 µm, with thick walls up to 1 µm, straight to sinuose, septate, with rounded to acute, sometimes mucronate apex, and with yellow granular contents, like those of the laticifers, that collapses soon in a brown granular mass, formed by rests of dermatocystidia and yellow granules; the subpellis is an ixocutis made by gelatinized hyphae, 2-6 µm in diam., crossed by some oleiferous hyphae and abundant laticiferous hyphae. Sterile locules covered by a trichopalisade with the same composition of the suprapellis.

HABITAT & DISTRIBUTION.- Usually gregarious, hypogeous or semihypogeous under humus, in deciduous montane woods of *Corylus*, *Carpinus*, *Fagus*, *Populus*, *Quercus*, *Tilia*, mixed with *Acer*, *Buxus*, *Cornus*, *Fraxinus*, *Sambucus*, *Ulmus*, between 500-1.000 m, on calcareous soil, from



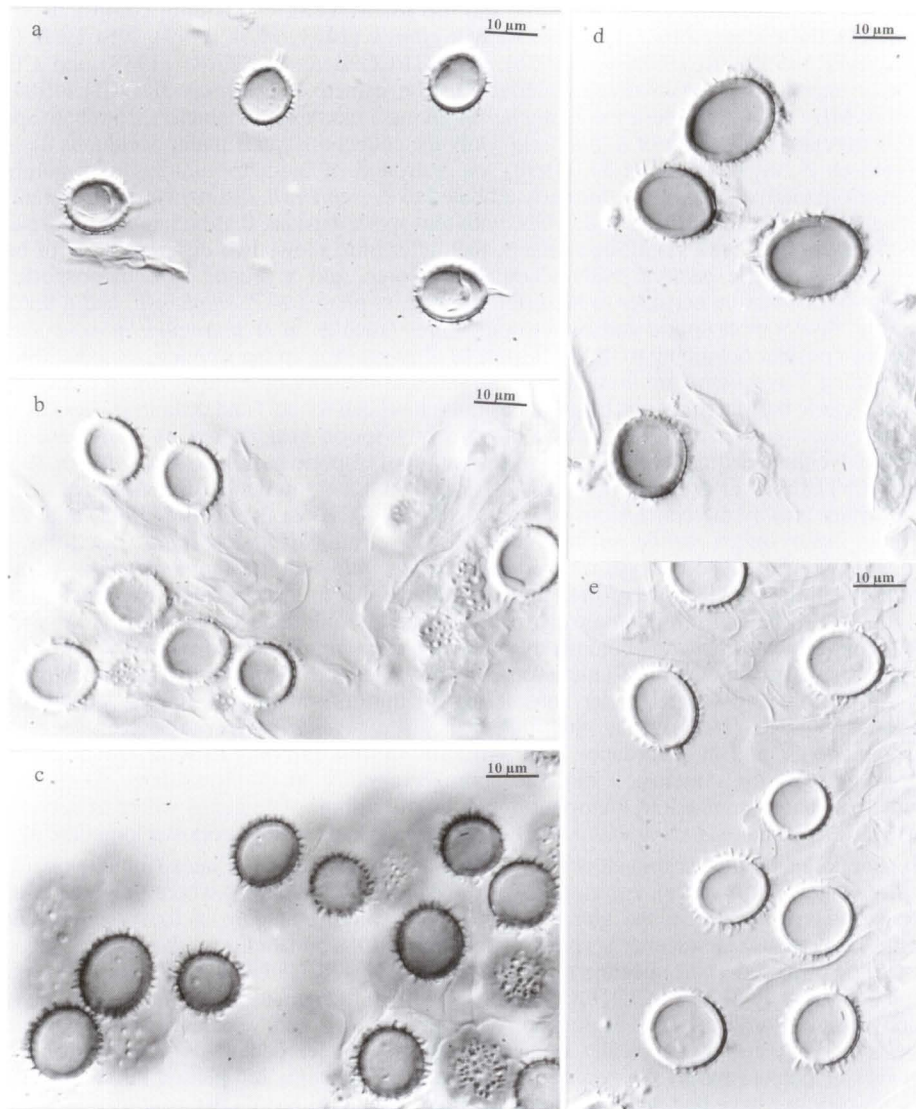


**Fig. 3.-** *Arcangeliella stephensii*.- a-b. Suprapellis (JMV20010609-1). c-e. Hymenium (spores, basidia, basidioles and paracystidia) (JMV970830-1).

summer to autumn. Fairly frequent. Widely distributed in the temperate regions from Central to South Europe: U.K. (BERKELEY, 1844; HAWKER, 1954; PEGLER *et al.*, 1993), Germany (SOEHNER, 1941; GROSS, 1990; HINTZ, 1993), Belgium (DE VRIES, 1977; FRENCKEN, 1979; THOEN & SCHULTHEIS, 2003; WALLEYN, 2003), Czech Republic (VELENOVSKÝ, 1939; VACEK, 1950; SVRČEK, 1958), Hungary, Rumany (PÁZMÁNY & LASZLO, 1985), France (TULASNE & TULASNE, 1851; QUÉLET, 1875, 1886; PATOUILLARD, 1910, 1914; ZELLER & DODGE, 1935, 1936; PETITBERGHIEN, 1956), Italy (AUGUADRI *et al.*, 1991; MONTECCHI & LAZZARI, 1993; GORI & BERNARDINI, 1996; MONTECCHI & SARASINI, 2000), Spain (VIDAL, 1997).

COLLECTIONS EXAMINED.- CZECH REPUBLIC: Moravia, Žďárský, Žarošice, 8-1937, *leg.* V. Vacek, *det.* J. Velenovský as *Hydnangium carneum* (PRM 154169, J. Velenovský Coll.); *Ibid.*, Žarošice, in silva frondosa, 31-8-1948, *leg.* VI. Vacek and V. Vacek, *det.* V. Vacek as *Hydnangium stephensii* (PRM 685988); *Ibid.*, Dolní Věstonice, Děvičky, in *Acereto-Carpineteto*, *leg.* K. Kříž, *det.* M. Svrček as *Octaviania stephensii* (PRM 719216); *Ibid.*, Veverská Bitýška, Krmec, under *Carpinus betulus* and *Cornus mas*, 10-8-1955, *leg.* K. Kříž, *det.* M. Svrček as *Octaviania stephensii* (PRM 719217); *Ibid.*, Žarošice, in silva frondosa, under *Carpinus*, *Tilia*, *Quercus*, *Fraxinus* and *Larix*, 24/25/29-8-1949, 31-8-1950, 9-9-1950, *leg.* and *det.* V. Vacek as *Hydnangium galatheium* (PRM 619118, 685990, 685992, 685993, 685994, 685996); Bohemia, Karlštejn, in silva frondosa, under *Carpinus*, *Fagus*, *Quercus*, *Acer*, *Tilia*, 10/17-7-1949, *leg.* and *det.* V. Vacek as *Hydnangium monosporum* (PRM 619116, 685987).- FRANCE: Hérimoncourt, Jurassic calcareous hills, 8-1892, *leg.* L. Quélet (UPS{F-013405};190419, authentic material of *H. galatheium*); Jura, Abbévillers, *leg.* L. Quélet as *H. galatheium* (UPS).- GERMANY: Bayern, Pupplinger Heide, near Wolfratshausen, Führenwald, 21-10-1928, *leg.* E. Soehner #1081 as *Hydnangium carneum* (M, lectotypus of *H. soehneri*; FH-Dodge Herb. & NY-Zeller Herb., isolectotypus; all selected here); *Ibid.*, Wolfratshausen near München, Pupplinger Heide, 19-8-1919, *leg.* E. Soehner #1374 as *Hydnangium monosporum* (M-Soehner Herb.); Oberbayern, Eitenberg, near Berchtesgaden, 1.100 m, under *Abies alba*, 8-1925, *leg.* E. Soehner #1041 (M-Soehner Herb., holotypus of *H. soehneri* var. *ettenbergii*).- HUNGARY: Budapest, Normafa, under *Tilia* sp., 25-8-1995, *leg.* I. Király as *A. borziana* (JMV800071).- ITALY: Emilia Romagna, Reggio Emilia, Febbio, under *Populus alba*, 30-10-1991, *leg.* A. Montecchi AM1042 as *A. borziana* (JMV800036); Toscana, Lucca, Nozzano Castello, under *Populus alba*, 31-7-1993, *leg.* G. Bernardini and L. Gori ELG 930731/1 as *A. borziana* (JMV800170); *Ibid.*, Montuolo, under *Populus alba*, 1-11-1993/28-11-1993, *leg.* G. Bernardini and L. Gori ELG 931101/2, 931128/2 as *A. borziana* (JMV800171, 800169).- SPAIN: Asturias, Somiedo, under *Corylus avellana* and *Tilia*, on calcareous soil, 12-10-2001, *leg.* E. Rubio, P. Juste and F. Garcia ER-2548, B-1788 (JMV20011012-1); Barcelona, Vidrà (Osona), puig de Palou, 1.100 m, under *Corylus avellana*, *Quercus humilis*, *Fagus sylvatica* and *Buxus sempervirens*, 29-9-2002, *leg.* J.M. Vidal and F. Rodriguez (JMV20020929-2); Girona, Montagut (Garrotxa), Sant Miquel de Pera, 700 m, under *Corylus avellana*, *Quercus humilis*, *Populus tremula* and *Buxus sempervirens*, on calcareous soil, 12-10-1995, *leg.* and *det.* J.M. Vidal as *A. borziana* (JMV951012-1); *Ibid.*, Sant Privat d'en Bas (Garrotxa), бага de les Olletes, 700 m, under *Corylus avellana*, *Populus tremula*, *Acer* and *Buxus sempervirens*, on calcareous soil, 19-10-1996, *leg.* and *det.* J.M. Vidal as *A. borziana* (JMV961019-1); *Ibid.*, la Vall de Bianya (Garrotxa), vall del Bac, bac de Mariner, 900 m, under *Corylus avellana*, *Fagus sylvatica*, *Quercus humilis* and *Buxus sempervirens*, on calcareous soil, 30-8-1997, *leg.* and *det.* J.M. Vidal as *A. borziana* (JMV970830-1); *Ibid.*, Camprodon (Ripollès), la Ral, 900 m, under *Corylus avellana*, *Tilia platyphyllos*, *Quercus pubescens* and *Fraxinus*, 4-10-1998, *leg.* J.M. Vidal (JMV981004-2); *Ibid.*, Vallfogona del Ripollès, 1.000 m, under *Corylus avellana*, *Quercus humilis* and *Acer*, on calcareous soil, 17-7-1999, *leg.* J.M. Vidal (JMV990717-4); *Ibid.*, Albanyà (Alt Empordà), Serra de Corsavell, Can Padern, 800 m, under *Corylus avellana*, on calcareous soil, 9-6-2001, *leg.* J.M. Vidal (JMV20010609-1).- U.K.: England, Somerset, Clifton, near Bristol, Leigh Woods, 6-8-1843, *ex* C.E. Broome Herb. (K{M}69330, lectotypus of *H. stephensii*); *Ibid.*, 1844, *leg.* H.O. Stephens (K{M}69331, original material of *H. stephensii*); *Ibid.*, Bristol, *leg.* Berkeley (PRM 719218, Corda Herb.).

*Hydnangium stephensii* Berk. is a lactescent gasteroid fungus, devoid of percurrent stipe-columella, only with a vestigial sterile base. It was described by BERKELEY (1844) after an English collection from Leigh Woods (a deciduous wood in the neighborhood of Bristol, in the Somerset region), but without giving any indication of the host plant. A century later, it was still collected at the same place by HAWKER (1954), under *Tilia*. *Hydnangium stephensii* was successively recombined in the genera *Octaviania* Vittad. (TULASNE & TULASNE, 1851), *Zelleromyces* Singer et A.H. Sm. (SMITH, 1962) and *Martellia* Mattir. (MADER & MADER, 1992). In the original description of Berkeley, little attention is paid to the microscopic features of this species, and this explains why later authors described a number of similar gasteroid taxa, such as *Hydnangium galatheium* Quélet, *H. soehneri* Zeller et C.W. Dodge and *H. soehneri* var. *ettenbergii* Soehner, which, following a detailed analysis of their microscopic characters has shown to be conspecific with *Zelleromyces stephensii*. All those taxa have abundant laticiferous hyphae, lacks of hymenial cystidia, the basidia are



**Fig. 4.-** *Arcangeliella stephensii*.- Spores: **a.** JM V970830-1. **b.** *H. stephensii* (K, lectotypus). **c.** *H. galathejum* (UPS, authentic material). **d.** *H. soehneri* (M, lectotypus). **e.** *H. soehneri* var. *ettenbergii* (M, holotypus).

monosporic and the spores are orthotropic and spine-bearing. *Hydnangium soehneri* is characterized by its bigger spores, 15-18,5 x 13-15  $\mu\text{m}$ . The remaining features are identical with those of *Z. stephensii* and, in consequence, we will consider it as a macrosporic form, deprived of taxonomical value, of the last species. *Zelleromyces stephensii* shows a strong similitude, in colour and morphology, with *Arcangeliella borziana*, and this has lead easily to a lot of confusions. In fact, we found that the concept of *Z. stephensii* of SOEHNER (1923, 1924, 1949), FISCHER (1925, 1933), KNAPP (1958), REIJNDERS (1976), MONTECCHI & LAZZARI (1988) and CETTO (1989) is erroneous, and the involved material must be named *A. borziana*. JÜLICH (1984) and MILLER & MILLER (1986) describe *Z. stephensii* giving a mixture of characters from both species, most of them related with those of *A. borziana*. Only the collections made under deciduous trees may be reported as *Z. stephensii*. GROSS (1990), on a ground of biometric studies of a number of collections from Germany and Italy, formerly attributed to *Z. stephensii*, distinguishes 3 different taxa: one of them associated with *Picea* and *Abies*, with tetrasporic basidia, that he names *A. borziana*; a second one, associated with planifolious plants, that, after him, shows two different types of basidia and spores, a first type bisporic with heterotropic spores, and a second type monosporic with orthotropic spores, that he consider to be different maturity phases of *Z. stephensii*; and a third one, with basidia always monosporic and orthotropic spores (such as in *Hydnangium monosporum*, he says), that he consider belonging to the adult state of *Z. stephensii*. In our opinion, the conclusions of Gross regarding *Z. stephensii* are inexact, as in all states of maturity of *Z. stephensii*, we have always found monosporic basidia (only one bisporic basidium has been found!) and orthotropic spores, never heterotropic ones; conversely, *A. borziana* do present bisporic basidia, but its spores are always heterotropic. Neither adequate seems to us the attribution of bisporic basidia to *Z. stephensii*, as stated by KRIEGLSTEINER (1991) and PEGLER *et al.* (1993). Later, and under the influence of Jülich, Miller & Miller and by the conclusions of Gross, MONTECCHI & LAZZARI (1993) and VIDAL (1997) puts *Zelleromyces stephensii* in synonymy with *Arcangeliella borziana*. But following a detailed analysis of the type material of *Arcangeliella borziana* and *Hydnangium stephensii*, and its comparison with new collections of both taxa, we believe that in fact, there are two truly different species, despite of beeing morphologically very similar. In adult state, both species are gasteroid, sessile, devoid of percurrent stipe-columella, sometimes only with a reduced columella and a minute sterile base; they also show a lot of laticiferous active hyphae, the hymenial trama is hyphal and the spores are amyloid and warty. After considering all this information available, and against the PEGLER & YOUNG (1979) thesis, that include in *Arcangeliella* only subagaricoid species with heterotropic spores, and in accordance with MILLER (1988) and MILLER & MILLER (1988) which has reached the conclusion that the sporal symmetry in the Russulales is not a valid taxonomic character, we reach to the opinion that the most appropriate genus where to accommodate *Zelleromyces stephensii* is *Arcangeliella*, as DODGE (1931) had already proposed long time ago.

In fresh material, a good discriminant character is the exudation of a lot of latex (initially opalescent, later milky white when mature), contrasting with *Arcangeliella borziana*, where the latex is almost incolorous and very scarce in the gleba, and just some more abundant in the peridium and the columella. This copiose lactescence secreted by the gleba of *Arcangeliella stephensii* after sectioning it is easy to be observed in the specimens illustrated by MONTECCHI & LAZZARI (1993, fig. sup. as *A. borziana*) and by MONTECCHI & SARASINI (2000, fig. sup. as *A. borziana*), belonging to a collection under *Populus*. The ecological requirements of both species is very discordant. *Arcangeliella stephensii* is a typically calcicolous species, under deciduous trees; conversely, *A. borziana* is silicicolous, and lives associated with conifers. During the last phase of the elaboration of the present work, we have had the opportunity to read the work of NUYTINCK *et al.* (2003), kindly communicated to us by R. Walley. It matches fairly well with the present work in a lot of points, whose molecular studies shows that *Arcangeliella stephensii* shows deep similitudes with *Lactarius* subgenus *Piperites*.

**Table 1.** Comparison between some characters of *Arcangeliella borziana* and *A. stephensii*

Characters	<i>A. borziana</i>	<i>A. stephensii</i>
Columella	Present in young exemplars	Absent
Latex	Scanty	Copious
Basidia	(2)-4 spored	1-(2) spored
Spores	Heterotropic	Orthotropic
Cystidia	Sometimes present	Absent
Subhymenium	Cellular	Hyphal
Peridium	Oedotrichoderm	Palisadotrichoderm
Habitat	Conifers	Deciduous woods

## DISCUSSION

Recently, as a result of a good deal of molecular research on the phylogenetic relationships in the different taxonomic groups (families, genera, species, etc.), and specially as a result of their application to the sequestered fungi and their ancestra, we assist to a gradual vanishing of the secotioid and gasteroid genera in favour of the agaricoid ones. Two cases illustrating this tendency are the inclusion of *Endopychum* Czern. in *Chlorophyllum* Masee (VELLINGA, 2002) and *Thaxterogaster* Singer in *Cortinarius* (Pers.) Gray (PEINTNER *et al.*, 2002). A recent exemple, that shows very well the type of taxonomic doubts generated by the new integrating tendency we are discussing, is the case of *Lactarius rubriviridis* Desjardin, Saylor et Thiers (DESJARDIN, 2003). It is a gasteroid fungus segregating a dark red latex and still retaining active ballistospory, and as a consequence, included in the *Lactarius* subgenus *Dapetes*, with them it shows a probable relationship, and in avoidance of its inclusion in a genus with gasteroid species. In fact, BUYCK (1995) has already predicted the future disappearing of the gasteroid genera related with the Russulales when a good global vision of the ecological, morphological and phylogenetic relationships between the sequestrate and the agaricoid species of the order would be assessed, and specially when a lot of tropical species, still undescribed, would be well known. We believe that the apparition of sequestrate forms is a very important evolutive step, involving deep ontogenetic and reproductive modifications, of a taxonomic significance more important than the difference between the agaricoid genera *Lactarius* and *Russula*, that are only grounded on the active or non active condition of the laticiferous hyphae and in the absence or presence of abundant sphaerocytes in the trama. In consequence, we prefer to accept that the ontogeny deserves a special importance and, in accordance with it, to conserve the generic rank to name the secotioid and gasteroid forms.

The genus *Arcangeliella* Cavara was initially described as lactescent, sessile, astipitate, non-secotioid, with only a little sterile base and with a reduced columella (CAVARA, 1900). A number of later authors (SACCARDO & SYDOW, 1902; PETRI, 1909; ZELLER & DODGE, 1919; BATAILLE, 1923; MALENÇON, 1931; KNAPP, 1958) kept this concept almost intact, but some others (SOEHNER, 1923, 1949; FISCHER, 1933; ZELLER & DODGE, 1936; SMITH, 1951) gave an exaggerated importance to the sterile base and the columella, and described them as a percurrent stipe-columella; this allowed them to add to the genus the secotioid forms, and this led to a change in the original concept of *Arcangeliella*. The last step was the emmendment of the genus *Arcangeliella* made by SINGER & SMITH (1960), to include in it only the secotioid species, and they moved the remaining species to the genus *Zelleromyces* Singer et A.H. Sm., a new concept that was followed by the later authors (SMITH, 1962, 1963; SMITH & SMITH, 1973; SUNDBERG & TRAPPE, 1975; PEGLER & YOUNG, 1979; THIERS, 1979, 1984; GROSS *et al.*, 1980; JÜLICH, 1981, 1984; PEGLER, 1982; BEATON *et al.*, 1984; ARORA, 1986; CASTELLANO *et al.*, 1989; PEGLER *et al.*, 1993; GRGURINOVIC, 1997; MILLER & LEBEL, 1999; LEBEL & CASTELLANO, 2002). A good example of the taxonomic doubts generated by its new concept is in ZHANG & YU (1990), that include in *Zelleromyces* only the taxa having

reticulate spores, and the remaining gasteroid *Lactarius*-related species having spinose spores are included by them in *Gymnomyces* Massee et Rodway or in *Martellia* Mattir.

The generic void regarding the secotioid fungi related with *Lactarius* was clearly detected by HEIM (1959), when he described *Elasmomyces densus* R. Heim from Thailand. *E. densus* is a secotioid, lactescent fungus, that Heim describes as a "Gastrolactarié", with angiocarpic ontogeny and spores slightly heterotropic, but devoid of any visible suprahilar area. Heim accommodates this new species, after a lot of doubts, in the genus *Elasmomyces* Cavara, and it reports its important similitude with *Arcangeliella lactarioides* Zeller, described some years ago by ZELLER (1947), but he refuses to include it in the genus *Arcangeliella*, where he had previously put it (HEIM, 1958), because he consider this genus must only contain the gasteroid, non-secotioid species. He also says that *E. densus* would be the type species of a possible new genus, containing the secotioid fungi related with *Lactarius*, and where *A. lactarioides* would be accommodated. Some years later, Heim resurrects the adjective "Gastrolactarié" in a discussion held with Smith about the origin of the higher Basidiomycetes (SMITH, 1971), an adjective that was later used as a generic name, *Gastrolactarius*, but it never was validated. After all this information, and in complete accordance with the view of LEBEL & TRAPPE (2000), we consider that all the species remaining in the genus *Arcangeliella* must only be the sessile ones, devoid of stipe-columella. We propose also that, in the same way that it is accepted that the sequestrate fungi related with *Russula* are distributed in three genera (*Macowanites* for the secotioid fungi, *Gymnomyces* for the sessile, non-secotioid ones, and *Cystangium* for the sessile or secotioid, having an epitelium (TRAPPE *et al.*, 2002), two genera are used to accommodate the sequestrate fungi related with *Lactarius*. In consequence, we propose a genus *Gastrolactarius* to include the secotioid species, as suggested by Heim, with *G. densus* as the type species. We suggest also that both genera, *Arcangeliella* and *Gastrolactarius*, include species with spinose as well with reticulate spores, according with the presence of both ornamentation types in *Lactarius* and in *Russula*. Accordingly, *Zelleromyces* must be considered a synonym of *Arcangeliella*. We must also accept in both genera the presence of species with heterotropic spores as well as species with orthotropic spores, according with the current concept that the sporal symmetry in the Russulales is not considered a valuable taxonomic character, as shown by MILLER (1988) and by MILLER & MILLER (1988).

After the above discussion, we give a description of the genera *Arcangeliella* and *Gastrolactarius*, and we afford an emendation of the species accepted by us, each of them with mention of its synonyms.

#### ACCEPTED GENERA, SPECIES, NEW COMBINATIONS, AND SYNONYMS OF *LACTARIUS*-RELATED SEQUESTRATE SPECIES

***Arcangeliella*** Cavara, *Nuovo Giorn. Bot. Ital.*, Nuov. Ser., 7(2): 126 (1900).

=*Zelleromyces* Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 18 (1960).

Basidioma angiocarpic, 1-5 cm in diam., globose or irregular, gasteroid, non-secotioid, sessile, sometimes with a minute sterile base, often with a simple or branched reduced columella in young exemplars. Stipe absent. Gleba loculate to labyrinthoid, with empty chambers. Latex almost always present. Spores globose to ellipsoidal, 7-16 µm long, hyaline or yellowish, orthotropic or heterotropic, statismosporic, ballistospory rarely active; with an eusporial ornamentation of a partial to complete reticulum, or echinate, covered with an amyloid myxosporium, with or without a suprahilar plate; hilar appendix conic to cylindrical. Basidia inflated to clavate or cylindrical, 1-4 spored. Cystidia and macrocystidia present or not, pseudocystidia sometimes present. Subhymenial layer pseudoparenchymatous. Hymenial trama generally homoiomerous, never conspicuously heteromerous; laticiferous hyphae always present; clamp-connections absent. Peridiopellis variable, with a repent epicutis, a trichodermium or an epitelium, rarely absent, but frequently disintegrated near the sterile base. Habitat & distribution.- Hypogeous or subhypogeous, ectomycorrhizal with trees, world-wide. Phylogenetical relationship: *Lactarius* Pers. Type species.- *Arcangeliella borziana* Cavara.

According with the original concept of CAVARA (1900), and in opposition with that of SINGER & SMITH (1960) and later authors, we keep only in *Arcangeliella* the gasteroid fungi related with

*Lactarius* which are sessiles and devoid of percurrent stipe-columella. We include also in the same genus all the lactescent *Zelleromyces*.

SPECIES WITH ECHINATED SPORES:

*Arcangeliella borziana* Cavara, *Nuovo Giorn. Bot. Ital.*, Nuov. Ser., 7(2): 126 (1900). (see synonyms above)

*Arcangeliella lactifera* (B.C. Zhang et Y.N. Yu) J.M. Vidal, *comb. nov.*

Basionym.- *Gymnomyces lactifer* B.C. Zhang et Y.N. Yu, *Mycol. Res.* 94(4): 457 (1990).

=*Zelleromyces lactifer* (B.C. Zhang et Y.N. Yu) Trappe, T. Lebel et Castellano, *Mycotaxon* 81: 204 (2002).

*Arcangeliella nanjingensis* (B. Liu et K. Tao) J.M. Vidal, *comb. nov.*

Basionym.- *Martellia nanjingensis* B. Liu et K. Tao, in Tao & al., *Acta Mycol. Sinica* 12(2): 103 (1993).

=*Gymnomyces nanjingensis* (B. Liu et K. Tao) Trappe, T. Lebel et Castellano, *Mycotaxon* 81: 200 (2002).

*Martellia nanjingensis* is a laticiferous species (TAO *et al.*, 1993) and, in consequence, it must to be placed into the genus *Arcangeliella* Cav.

*Arcangeliella oregonensis* (Singer et A.H. Sm.) J.M. Vidal, *comb. nov.*

Basionym.- *Zelleromyces oregonensis* Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 19 (1960).

*Arcangeliella papyracea* (Singer et A.H. Sm.) J.M. Vidal, *comb. nov.*

Basionym.- *Octavianina papyracea* Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 13 (1960).

=*Zelleromyces papyraceus* (Singer et A.H. Sm.) Trappe, T. Lebel et Castellano, *Mycotaxon* 81: 205 (2002).

*Arcangeliella ramispina* (B.C. Zhang et Y.N. Yu) J.M. Vidal, *comb. nov.*

Basionym.- *Martellia ramispina* B.C. Zhang et Y.N. Yu, *Mycol. Res.* 94(4): 459 (1990).

=*Zelleromyces ramispinus* (B.C. Zhang et Y.N. Yu) Trappe, T. Lebel et Castellano, *Mycotaxon* 81: 205 (2002) (ut "*ramisporus*").

*Arcangeliella scissilis* Zeller et C.W. Dodge, *Ann. Mo. Bot. Gard.* 22: 369 (1935).

=*Martellia scissilis* (Zeller et C.W. Dodge) Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 45 (1960).

=*Zelleromyces scissilis* (Zeller et C.W. Dodge) Trappe, T. Lebel et Castellano, *Mycotaxon* 81: 205 (2002).

=*Zelleromyces gilkeyae* Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 21 (1960). (sec. TRAPPE *et al.*, 2002)

*Arcangeliella sculptispora* (S. Miller) J.M. Vidal, *comb. nov.*

Basionym.- *Zelleromyces sculptisporus* S. Miller, in Miller & Lebel, *Mycotaxon* 72: 21 (1999).

*Arcangeliella stephensii* (Berk.) Zeller et C.W. Dodge, in Dodge, *Ann. Mo. Bot. Gard.* 18: 463 (1931). (see synonyms above)

SPECIES WITH RETICULATED SPORES:

*"Zelleromyces" albellus* (Singer et A.H. Sm.) Trappe, T. Lebel et Castellano, *Mycotaxon* 81: 204 (2002).

Basionym.- *Martellia albella* Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 38 (1960).

Nor SINGER & SMITH (1960), nor HORAK (1964) report the presence of laticiferous hyphae or the latex exudation, and in consequence, this species would deserve to be included in the genus *Gymnomyces* Masee et Rodway.

**"*Zelleromyces*" *alveolatus*** (Singer et A.H. Sm.) Trappe, T. Lebel et Castellano, *Mycotaxon* 81: 204 (2002).

Basionym.- *Gymnomyces alveolatus* Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 51 (1960).

If our taxonomic concept is accepted, a new name would be necessary for this species, because of the existence of an older homonym: *Arcangeliella alveolata* (Cooke et Masee) Zeller et C.W. Dodge.

***Arcangeliella australiensis*** (Berk. et Broome) C.W. Dodge, *Ann. Mo. Bot. Gard.* 18: 463 (1931).

Basionym.- *Hydnangium australiense* Berk. et Broome, *Trans. Linn. Soc. London, Bot. Ser.*, 2 (2): 66 (1883).

=*Octaviania australiensis* (Berk. et Broome) Berk., in Cooke, *Handb. Austral. Fung.*: 246 (1892).

=*Zelleromyces australiensis* (Berk. et Broome) Pegler et T.W.K. Young, *Trans. Br. Mycol. Soc.* 72(3): 371 (1979).

=*Martellia australiensis* (Berk. et Broome) A.H. Sm., *Mycologia* 54: 630 (1962).

=*Octaviania alveolata* Cooke et Masee, *Grevillea* 16: 2 (1887).

=*Hydnangium alveolatum* (Cooke et Masee) Rodway, *Paps. & Proc. Roy. Soc. Tasmania* 1919: 112 (1920).

=*Arcangeliella alveolata* (Cooke et Masee) Zeller et C.W. Dodge, *Ann. Mo. Bot. Gard.* 18: 463 (1931).

=*Martellia alveolata* (Cooke et Masee) A.H. Sm., *Mycologia* 54: 630 (1962).

=*Zelleromyces alveolatus* (Cooke et Masee) Trappe, T. Lebel et Castellano, *Mycotaxon* 81: 204 (2002).

=*Hydnangium brisbanense* Berk. et Broome, in Cooke, *Handb. Austral. Fung.*: 247 (1892). (nom. illeg., nom. superfl.)

=*Octaviania brisbanensis* (Berk. et Broome) G. Cunn., *Proc. Linn. Soc. N.S. Wales* 60: 119 (1935).

=*Hydnangium glabrum* Rodway, *Pap. & Proc. Roy. Soc. Tasmania* 1920: 157 (1921).

=*Octaviania glabra* (Rodway) G. Cunn., *Proc. Linn. Soc. N.S. Wales* 60: 119 (1935).

=*Martellia berkeleyi* A.H. Sm., *Mycologia* 54: 630 (1962).

***Arcangeliella curtisii*** Zeller et C.W. Dodge, *Ann. Mo. Bot. Gard.* 22: 367 (1935).

=*Hydnangium ravenelii* ss. Farlow, in Foerste, *Bot. Gaz.* 19: 37 (1894).

***Arcangeliella daucina*** (G.W. Beaton, Pegler et T.W.K. Young) J.M. Vidal, *comb. nov.*

Basionym.- *Zelleromyces daucinus* G.W. Beaton, Pegler et T.W.K. Young, *Kew Bull.* 39(4): 686 (1984).

***Arcangeliella gardneri*** (Zeller et C.W. Dodge) Zeller et C.W. Dodge, *Ann. Mo. Bot. Gard.* 22: 367 (1935).

Basionym.- *Gymnomyces gardneri* Zeller et C.W. Dodge, *Ann. Mo. Bot. Gard.* 6: 54 (1919).

=*Zelleromyces gardneri* (Zeller et C.W. Dodge) Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 23 (1960).

***Arcangeliella giennensis*** (Moreno-Arroyo, J. Gómez et Calonge) J.M. Vidal, *comb. nov.*

Basionym.- *Zelleromyces giennensis* Moreno-Arroyo, J. Gómez et Calonge, *Crypt., Mycol.* 19(1-2): 108 (1998).

COLLECTIONS EXAMINED.- SPAIN: Jaén, La Aliseda, subhypogeous under *Pinus halepensis*, 28-2-1994, leg. J. Gómez and B. Moreno (MA-Fungi 38674, holotypus); Ciudad Real, El Viso del Marqués, under *Halimium ocyroides*, on siliceous soil, 23-11-1993, leg. T. Pérez-Jarauta (JMV931123-1); Zamora, Tábara, 825 m, under *Pinus pinaster*, on siliceous soil, 4-2-2001, leg. P. Juste and F. García (JMV20010204-1).



Non-lactescent species, having an hyphal hymenial trama, without any sphaerocytes, and with plenty of oleiferous hyphae and scattered laticiferous hyphae.

***Arcangeliella glabrella*** Zeller et C.W. Dodge, *Ann. Mo. Bot. Gard.* 22: 368 (1935).

Basionym.- *Hydnangium glabrellum* (Zeller et C.W. Dodge) G. Cunn., *N. Zeal. Jour. Sci. & Techn.* 22: 300B (1941).

=*Zelleromyces glabrellus* (Zeller et C.W. Dodge) Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 22 (1960).

***Arcangeliella josserandii*** (Malençon) J.M. Vidal, *comb. nov.*

Basionym.- *Zelleromyces josserandii* Malençon, *Rev. Mycol.* 39: 303 (1975).

=*Zelleromyces hispanicus* Calonge et Pegler, *Crypt., Mycol.* 19(1-2): 100 (1998). (*syn. nov.*)

COLLECTIONS EXAMINED.- SPAIN: Madrid, Cercedilla, Dehesas, in granitic soil under *Pinus sylvestris*, 27-11-1996, leg. F.D. Calonge and C. Garcia-Ruz (MA-Fungi 37498, holotypus of *Z. hispanicus*); *Ibid.*, 23-11-1996, leg. J. Daniel et J.M. Santos (MA-Fungi 37497, paratypus of *Z. hispanicus*); *Ibid.*, 16-11-1997, leg. R. Cifuentes (MA-Fungi 3811, paratypus of *Z. hispanicus*).

We treat *Zelleromyces hispanicus*, recently described by CALONGE & PEGLER (1998), as a synonym of *Z. josserandii*, because after the description given by MALENÇON (1975), both species share all their morphological features, as well the macroscopical as the microscopical ones. Both shows an orange coloration, latex white, immutable in colour, reticulate spores, 8,6-10,8-(11,2) x 7,2-8,6 µm (excluding the ornamentation) in *Z. josserandii*, 9-12-(14) x 8-10 µm (including the ornamentation) in *Z. hispanicus*, cystidia (cystidioles after Malençon) acuminate, and suprapellis forming an oedotrichoderm, as in *Lactarius fulvissimus* Romagn. described by HEILMAN-CLAUSEN *et al.* (1998). Both taxa has been found in silicicolous coniferous woodlands, with submediterranean climate: North Morocco (Atlas), under *Cedrus atlantica*, France (Corsica), under *Pinus nigra* subsp. *salzmannii*, and in Continental Spain (Central Mountain System), under *Pinus sylvestris*.

***Arcangeliella majus*** (J.W. Cribb) J.M. Vidal, *comb. nov.*

Basionym.- *Hydnangium majus* J.W. Cribb, *Pap. Dept. Bot. Univ. Queensland* 3: 252 (1958).

=*Zelleromyces majus* (J.W. Cribb) A.H. Sm., *Mycologia* 54: 636 (1962).

***Arcangeliella malaiensis*** Corner et Hawker, *Trans. Br. Mycol. Soc.* 36: 128 (1953).

=*Zelleromyces malaiensis* (Corner et Hawker) A.H. Sm., *Mycologia* 54: 636 (1962).

***Arcangeliella pterospora*** (E. Horak) J.M. Vidal, *comb. nov.*

Basionym.- *Martellia pterospora* E. Horak, *Sydowia* 17: 310 (1964).

=*Zelleromyces pterosporus* (E. Horak) Trappe, T. Lebel et Castellano, *Mycotaxon* 81: 205 (2002).

***Arcangeliella ravenelii*** (Berk. et M.A. Curtis ex Tul. et C. Tul.) C.W. Dodge, *Ann. Mo. Bot. Gard.* 18: 463 (1931).

Basionym.- *Octaviania stephensii* var. *ravenelii* Berk. et M.A. Curtis ex Tul. et C. Tul., *Fung. Hypog.*: XVII (1851).

=*Hydnangium ravenelii* (Berk. et M.A. Curtis ex Tul. et C. Tul.) Berk. et M.A. Curtis, in M.A. Curtis, *Bot. North Carolina*: 110 (1867).

=*Hydnangium stephensii* var. *ravenelii* (Berk. et M.A. Curtis ex Tul. et C. Tul.) Berk., *Grevillea* 2: 33 (1873).

=*Octaviania ravenelii* (Berk. et M.A. Curtis ex Tul. et C. Tul.) Lloyd, *Mycol. Notes* 67: 1140 (1922).

=*Zelleromyces ravenelii* (Berk. et M.A. Curtis ex Tul. et C. Tul.) Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21: 20 (1960).

=*Zelleromyces cinnabarinus* Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 19 (1960). (sec. MILLER & LEBEL, 1999)

***Arcangeliella rogersonii*** (Fogel et States) J.M. Vidal, *comb. nov.*

Basionym.- *Zelleromyces rogersonii* Fogel et States, *Mycotaxon* 80: 323 (2001).

**"*Lactarius*" *rubriviridis*** Desjardin, Saylor et Thiers, *Mycologia* 95(1): 148 (2003).

In our opinion, because of its gasteroid morphology, this species deserves to be excluded from the genus *Lactarius*, and probably the more appropriate genus where to accommodate it is *Arcangeliella*. Two relevant features of this species is the absence of peridium, a character of *Gautieria*, also present, curiously, in a secotioid fungus related with *Lactarius*, still undescribed, and the presence of a still active ballistospory.

**"*Zelleromyces*" *sinensis*** B. Liu, K. Tao et Chang, in Tao *et al.*, *Acta Mycol. Sinica* 12(2): 104 (1993).

This species, despite of showing reticulate spores (TAO *et al.*, 1993), appears in the original description as devoid of latex and laticiferous hyphae. Also lacking are the description of the hymenial tramal structure. This insufficient information makes dubious its permanence in the genus *Zelleromyces*.

**"*Octaviania*" *striata*** G. Cunn., *Proc. Linn. Soc. N.S. Wales* 60: 119 (1935). (*nom. nud.*)

=*Zelleromyces striatus* (G. Cunn.) G.W. Beaton, Pegler et T.W.K. Young, *Kew Bull.* 39(4): 684 (1984). (*comb. inval.*)

*Octaviania striata* is an invalid name but, if its inclusion in *Arcangeliella* is accepted, following our proposal, the binomen needs to be validated previously.

***Arcangeliella versicaulis*** (S. Miller) J.M. Vidal, *comb. nov.*

Basionym.- *Zelleromyces versicaulis* S. Miller, in Miller & Lebel, *Mycotaxon* 72: 19 (1999).

***Gastrolactarius*** R. Heim ex J.M. Vidal, *gen. nov.*

*Gastrolactarius* R. Heim in A.H. Smith, in R.H. Petersen (ed.), *Evol. Higher Basidiom.*: 503 (1971). (*nom. nud.*)

*Basidiomata lactarioidea, 1-8 cm in diam., secotioidea, hemiangiocarpica, epigaea vel subepigaea. Gleba sublamelliformis, radiata vel loculato-labyrinthiformis. Stipes-columella percurrentis. Latex semper praesens. Sporae amyloides, globosae vel late ovoideae, 8-15 µm in diam., heterotropae vel suborthotropae, hyalinae aut flavescens, reticulatae vel spinosae. Basidia claviformia, 2-4-sporata. Cystidia et pseudocystidia frequens. Trama hymenialis homomera. Hyphae laticiferae abundantes. Contextus heteromerus. Peridiopellis: cutis, ixocutis aut trichoderma. Species typus: *Gastrolactarius densus* (R. Heim) J.M. Vidal (= *Elasmomyces densus* R. Heim).*

Basidioma hemiangiocarpic, lactarioid, secotioid, with a well developed stipe. Pileus 1-8 cm in diam., initially angiocarpic, globose, on expanding convex, applanate or depressed, rarely becoming fully expanded; margin initially attached to stipe, often exposing the underlying gleba at maturity. Peridium smooth, sometimes viscid. Gleba sublamelliform, radiate to loculate-labyrinthoid; cavities empty to partially filled with spores. Stipe-columella percurrent. Context white. Latex always present. Spores globose to broadly ovoid, 8-15 µm long, hyaline or yellowish, heterotropic to suborthotropic, statismosporic, ballistospory rarely active; with an eusporial ornamentation of partial to complete reticulum or echinate, covered with an amyloid myxosporium, usually with a suprahilar plage; hilar appendix conic. Basidia clavate, 2-4 spored. Cystidia and macrocystidia present or not, pseudocystidia often present. Subhymenial layer pseudoparenchymatous. Hymenial trama homoiomerous, sometimes with few sphaerocytes; clamp-connections absent; laticiferous hyphae abundant in all tissues. Context heteromerous. Peridiopellis a cutis, an ixocutis or a trichoderm. Habitat & distribution.- Epigeous or subhypogeous, ectomycorrhizal with trees, known from North America, Africa and Australasia. Phylogenetical relationship: *Lactarius* Pers. Type species.- *Gastrolactarius densus* (R. Heim) J.M. Vidal (= *Elasmomyces densus* R. Heim).

The genus *Gastrolactarius* has been resurrected and validated to accommodate the *Lactarius*-related sequestrate secotioid fungi. *Gastrolactarius* is in accordance with the *Arcangeliella* concept sensu SINGER & SMITH (1960), PEGLER & YOUNG (1979), THIERS (1984) and others.

#### SPECIES WITH ECHINATED SPORES:

***Gastrolactarius densus*** (R. Heim) J.M. Vidal, *comb. nov.*

Basionym.- *Elasmomyces densus* R. Heim, *Rev. Mycol.* 24: 93 (1959).

=*Arcangeliella densa* R. Heim, *Compt. rend. Acad. Sci.* 246: 3564 (1958). (*nom. inval.*)

=*Arcangeliella densa* (R. Heim) Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 71 (1960).

***Gastrolactarius textus*** (J.W. Cribb) J.M. Vidal, *comb. et stat. nov.*

Basionym.- *Secotium sessile* var. *textum* J.W. Cribb, *Univ. Queensland Dept. Bot. Pap.* 3: 108 (1956).

=*Elasmomyces textus* (J.W. Cribb) A.H. Sm., *Mycologia* 54: 638 (1962).

=*Arcangeliella texta* (J.W. Cribb) Pegler et T.W.K. Young, *Trans. Br. Mycol. Soc.* 72(3): 365 (1979).

#### SPECIES WITH RETICULATED SPORES:

***Gastrolactarius camphoratus*** (Singer et A.H. Sm.) J.M. Vidal, *comb. nov.*

Basionym.- *Elasmomyces camphoratus* Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 62 (1960).

=*Arcangeliella camphorata* (Singer et A.H. Sm.) Pegler et T.W.K. Young, *Trans. Br. Mycol. Soc.* 72(3): 365 (1979).

***Gastrolactarius crassus*** (Singer et A.H. Sm.) J.M. Vidal, *comb. nov.*

Basionym.- *Arcangeliella crassa* Singer et A.H. Sm., *Mem. Torrey Bot. Cl.* 21(3): 74 (1960).

=*Arcangeliella tenax* A.H. Sm. et Wiebe, in Smith, *Mycologia* 55: 422 (1963). (sec. THIERS, 1984)

***Gastrolactarius crichtonii*** (G.W. Beaton, Pegler et T.W.K. Young) J.M. Vidal, *comb. nov.*

Basionym.- *Cystangium crichtonii* G.W. Beaton, Pegler et T.W.K. Young, *Trans. Br. Mycol. Soc.* 86(1): 181 (1986).

=*Arcangeliella crichtonii* (G.W. Beaton, Pegler et T.W.K. Young) T. Lebel et Castellano, *Mycologia* 94(2): 329 (2002).

***Gastrolactarius desjardinii*** (Thiers) J.M. Vidal, *comb. nov.*

Basionym.- *Arcangeliella desjardinii* Thiers, *Sydowia* 37: 300 (1984).

***Gastrolactarius dolichocaulis*** (Pegler) J.M. Vidal, *comb. nov.*

Basionym.- *Arcangeliella dolichocaulis* Pegler, *Kew Bull.* 37: 267 (1982).

***Gastrolactarius hepaticus*** (G.W. Beaton, Pegler et T.W.K. Young) J.M. Vidal, *comb. nov.*

Basionym.- *Elasmomyces hepaticus* G.W. Beaton, Pegler et T.W.K. Young, *Kew Bull.* 39(4): 676 (1984).

=*Arcangeliella hepatica* (G.W. Beaton, Pegler et T.W.K. Young) T. Lebel et Castellano, *Mycologia* 94(2): 332 (2002).

***Gastrolactarius lactarioides*** (Zeller) J.M. Vidal, *comb. nov.*

Basionym.- *Arcangeliella lactarioides* Zeller, *Mycologia* 39: 282 (1947).

***Gastrolactarius parvus*** (Thiers) J.M. Vidal, *comb. nov.*

Basionym.- *Arcangeliella parva* Thiers, *Sydowia* 37: 301 (1984).

***Gastrolactarius saylori*** (Thiers) J.M. Vidal, *comb. nov.*

Basionym.- *Arcangeliella saylori* Thiers, *Sydowia* 37: 302 (1984).

***Gastrolactarius variegatus*** (Thiers) J.M. Vidal, *comb. nov.*

Basionym.- *Arcangeliella variegata* Thiers, *Sydowia, Beih.* 8: 383 (1979).

#### EXCLUDED SPECIES OF *ARCANGELIELLA* AND NEW COMBINATION IN *RUSSULA*-RELATED SEQUESTRATE FUNGI

***Arcangeliella ellipsoidea*** Zeller et C.W. Dodge, *Ann. Mo. Bot. Gard.* 22: 367 (1935).

According to the description of ZELLER & DODGE (1936) and SINGER & SMITH (1963), *A. ellipsoidea* Zeller et C.W. Dodge is probably a synonym of *Protoglossum violaceum* (Massee et Rodway) T.W. May.

***Gymnomyces meridionalis*** (Calonge, Moreno-Arroyo et J. Gómez) J.M. Vidal, *comb. nov.*

Basionym.- *Zelleromyces meridionalis* Calonge, Moreno-Arroyo et J. Gómez, in Moreno-Arroyo *et al.*, *Mycotaxon* 69: 468 (1998).

COLLECTIONS EXAMINED.- SPAIN: Córdoba, Cabra, under *Quercus ilex* ssp. *rotundifolia*, 21-6-1997, leg. B. Moreno and J. Gómez (MA-Fungi 38502, holotypus); *Ibid.*, Priego, Dehesilla, under *Quercus ilex* ssp. *rotundifolia*, 18-5-1993, leg. J. Gómez, det. F.D. Calonge as *Gymnomyces ferruginascens* (MA-Fungi 32069, paratypus).

This species shows an heteromerous hymenial trama, with plenty of sphaerocytes, which give it a pseudoparenchymatic look. No laticiferous hyphae has been seen. In consequence, it must be placed in the genus *Gymnomyces* Massee et Rodway.

***Arcangeliella mitsucae*** Imai, *Sci. Rep. Yokohama Nat. Univ.*, Sec. II, 6: 5 (1957).

According to the description of IMAI (1957), it is probably an *Octaviania* Vittad. species.

#### ACKNOWLEDGEMENTS

My gratitude to the directors and curators of the herbaria consulted: E.W. Wood (FH), E. Woodgyes (K), D. Triebel (M), F. Pando (MA), V. La Valva (NAP), B.M. Thiers (NY), J. Holec (PRM), R. Moberg (UPS) and W. Till (WU). To A. Sánchez-Cuxart, curator of BCN Herbarium, for the help in the request of loans. To A. Montecchi (AM), M. Sarasini, Z. Lukács, I. Király, G. Meyer, E. Rubio, P. Juste, F. García for the exsiccata loan, and specially to P.A. Moreau (PAM) for his generous collaboration in the loan of material, collection data and photographic images, all of *A. borziana*. To R. Walley and colleagues, for their kind communication of their results about *A. borziana* and *Z. stephensii*. To J. Llistosella and F.D. Calonge for their bibliographical assistance. To F. Rodríguez and M.A. Pérez-De-Gregorio for they collaboration and friendship. A special mention is indebted to X. Llimona, for the translation to English and Latin, and for this revision. This work has received support from the Institut d'Estudis Catalans.

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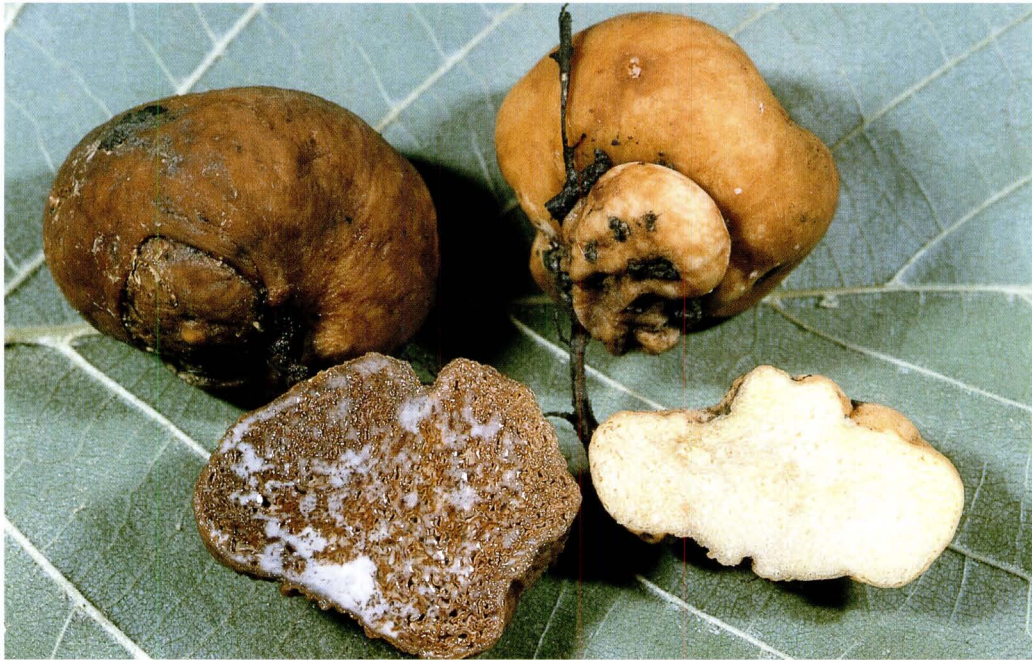
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*Arcangeliella borziana* Cavara, phot. P.A. Moreau (PAM02081306)



*Arcangeliella stephensii* (Berk.) Zeller et C.W. Dodge, phot. J.M. Vidal (JMV970830-1)