

The lichen genus *Dimelaena* (*Physciaceae*, *Lecanorales*) in the Iberian Peninsula

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Abstract – A taxonomic revision of the species of the genus *Dimelaena* in the Iberian Peninsula is presented. The morphology, anatomy, ascospore ontogeny, chemistry, ecology and distribution of the two recognized species, *Dimelaena oreina* and *Dimelaena radiata*, are discussed and several new data are afforded. *Buellia tesserata*, a closely related species to *Dimelaena radiata*, is also included for comparison. Distribution maps, a original illustration and a diagnostic key to the species treated and their chemotypes are also provided.

***Dimelaena oreina* / *Dimelaena radiata* / *Buellia fimbriata* / *Physciaceae* / Andorra / Portugal / Spain**

Résumé – Une révision taxonomique des espèces du genre *Dimelaena* dans la Péninsule Ibérique est présentée. La morphologie, l'anatomie, l'ontogenie des ascospores, la chimie, l'écologie et la répartition géographique de deux espèces du genre, reconnues dans la Péninsule Ibérique, *Dimelaena oreina* et *Dimelaena radiata*, sont discutées et de nouveaux éléments apportés. Pour comparaison, l'espèce *Buellia tesserata*, très voisine de *Dimelaena radiata*, est aussi incluse. Des cartes de distribution, une illustration originale et une clef des espèces étudiées et de leurs races chimiques sont également présentées.

***Dimelaena oreina* / *Dimelaena radiata* / *Buellia fimbriata* / *Physciaceae* / Andorra / Espagne / Portugal**

Resumen – Se presenta una revisión taxonómica de las especies del género *Dimelaena* en la Península Ibérica. Se discuten y aportan nuevos datos sobre la morfología, anatomía, tipo ontogenético de las ascósporas, química, ecología y distribución de las dos especies del género reconocidas en el área, *Dimelaena oreina* y *Dimelaena radiata*. A efectos de comparación, se incluye también en el estudio a *Buellia tesserata*, una especie estrechamente relacionada con *Dimelaena radiata*. Además, se aporta cartografía e iconografía originales y una clave diagnóstica de las especies tratadas y sus razas químicas.

***Dimelaena oreina* / *Dimelaena radiata* / *Buellia fimbriata* / *Physciaceae* / Andorra / España / Portugal**

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INTRODUCTION

The lichen genus *Dimelaena* Norman (Norman, 1852) in the Iberian Peninsula has been revised in order to study the family *Physciaceae* for the Iberian Lichen Flora.

The genus *Dimelaena* currently comprises 8 species in the world, namely *Dimelaena australiensis* H. Mayrhofer & Sheard, *D. californica* (H. Magn.) Sheard, *D. elevata* Elix, Kalb & Wippel, *D. oreina* (Ach.) Norman, *D. radiata* (Tuck.) Müll. Arg., *D. tenuis* (Müll. Arg.) H. Mayrhofer & Wippel, *D. thysanota* (Tuck.) Hale & W. L. Culb. and *D. weberi* Sheard. These species are characterized by its unthickened spore wall, radiate-plicate (placodioid) thallus margin, apothecia initially cryptolecanorine but finally lecanorine or lecideine, and are all saxicolous and occur exclusively on siliceous rocks (cf. Sheard, 1974; Sheard & Mayrhofer, 1984; Mayrhofer *et al.*, 1996; Matzer *et al.*, 1996). The more widespread is *Dimelaena oreina*, known from the holarctic and also from South Africa and South America, following by *D. tenuis*, known from the Southern Hemisphere, in Australia, Tasmania, New Caledonia, Papua New Guinea, Columbia, Venezuela, Brazil, Somalia and South Africa, and *D. australiensis*, currently known from South America, South Africa, Australia and Tasmania (cf. Mayrhofer *et al.*, 1996). *Dimelaena radiata* is a species with disjunct distribution, occurring in western North America, Macaronesia, Mediterranean Europe and north-western Africa (cf. Matzer *et al.*, 1996). In contrast, *Dimelaena californica*, *D. thysanota* and *D. weberi* are restricted to western North America (cf. Sheard & Mayrhofer, 1984), and *D. elevata* to Australia (cf. Mayrhofer *et al.*, 1996).

Two species of *Dimelaena* are hitherto known to occur in the study area, *Dimelaena oreina*, represented by four chemotypes (cf. Calatayud & Rico, 1999), and *D. radiata*, represented by one chemotype (cf. Rico *et al.*, 2003).

Buellia tesserata Körb. (= *Buellia fimbriata* (Tuck.) Sheard) is also included in the present contribution due to the close morphological, chemical and ecological affinities with *Dimelaena radiata*. *Buellia tesserata* and *B. fimbriata* were considered conspecific in a previous study (Rico *et al.*, 2003).

MATERIALS AND METHODS

The study is based on fresh and herbarium material from the following herbaria: ASU, BCC, L, LEB, LISU, MA, MAF, MUB, VAB and the private herbarium of J. Etayo (Pamplona, herb. Etayo). More than 228 samples were studied. For each species, the accepted name, author citation and reference to the protologue are provided. A full reference to the basionyms and types are also given. Listed synonyms of each species are based on those cited in the Iberian literature (Andorra, Portugal, Spain and the Balearic Islands). A complementary list with bibliographic reports of the studied species from the Iberian Peninsula is provided by Llimona & Hladun (2001: 52, 56, 131). References to selected illustrations and descriptions (with more complete synonym lists) and general distribution maps appear under the section '**Iconography** (icon.), **descriptions** (desc.) **and maps**'. The description of the species are based on the Iberian studied material.

All specimens were analyzed by standard techniques with stereoscopic and compound microscopes. Current mycological terminology is used and generally follows Kirk *et al.* (2001), and phytoclimatic terminology is used in accordance with Rivas-Martínez (1987). Extreme values have been placed between brackets where they represented no more than 10% of the measured character. The terminology used for the asci follows Rambold *et al.* (1994), for the ascospore ornamentation-types Scheidegger (1993), for the ascospore-types and ascospore-ontogenetic-types Mayrhofer (1982), Scheidegger (1993) and Giralt (2001), while for the conidiomata and conidia the terminology of Sutton (1980) and Vobis (1980) is followed.

The standard methods of thin layer chromatography (TLC) (*e.g.* Culberson & Ammann, 1979; Culberson *et al.*, 1981; Culberson & Johnson, 1982) and high performance liquid chromatography (HPLC) (Rico *et al.*, 1992; Feige *et al.*, 1993) were used for the identification of lichen substances.

The distribution maps are based on a UTM grid projection and include all the Iberian material studied here, in Calatayud & Rico (1999) and in Rico *et al.* (2003), and also unverified selected bibliographic data.

KEY TO THE IBERIAN *DIMELAENA* SPECIES, CHEMOTYPES AND *BUELLIA TESSERATA*

1. Thallus yellow to yellowish-green or pale green to whitish-green, very rarely with few pruina, areolate at centre, lobulate at margins; hypothecium colourless; 3-chlorodivaricatic acid absent, usnic acid always present; medulla I+ blue *Dimelaena oreina* (for chemotypes see 3)
1. Thallus whitish-grey to grey, rarely greyish-brown, occasionally pruinose, areolate at centre, lobulate or fimbriate at margins; hypothecium brown; 3-chlorodivaricatic acid present, usnic acid absent; medulla I⁻ 2
2. Prothallus black, fimbriate; thallus fimbriate at margins (rarely sublobulate); apothecia at first cryptolecanorine, becoming lecideine, with convex to hemispherical discs; ascospores 8-15 × 5-7 μm *Buellia tesserata*
2. Prothallus absent; thallus distinctly lobulate at margins; apothecia cryptolecanorine to rarely lecideine, with plane to subconvex discs; ascospores 8-12 × 5-8 μm *Dimelaena radiata*
3. Medulla C+ rose; gyrophoric acid present 4
3. Medulla C-; gyrophoric acid absent 5
4. Medulla K+ yellow, P+ orange; stictic acid present
..... *Dimelaena oreina* - Chemotype VII
4. Medulla K-, P-; stictic acid absent *Dimelaena oreina* - Chemotype II
5. Medulla K+ yellow, P+ orange; stictic acid present
..... *Dimelaena oreina* - Chemotype V
5. Medulla K+ yellow-brown, P+ yellow than red; fumarprotocetraric acid present
..... *Dimelaena oreina* - Chemotype I

THE STUDIED SPECIES

***Dimelaena oreina* (Ach.) Norman** (Figs. 1, 4)
Nyt Mag. Naturvidensk. 7: 231-232. 1852; *Conat. praem. gen. lich.*: 19-20. 1852. = *Lecanora straminea* β (var.) *oreina* Ach., *Lichenogr. universalis*: 433. 1810 (basionym). = *Lecanora oreina* (Ach.) Ach., *Syn. meth. lich.*: 181. 1814. = *Parmelia oreina* (Ach.) Fr., *Lichenogr. eur. reform.*: 113. 1831. = *Rinodina oreina* (Ach.) A. Massal., *Ric. auton. lich. crost.*: 16. 1852. = *Squamaria oreina* auct. hisp. Type: Switzerland, 'in alpebus Helvetiae', *Schleicher* (H-ACH 1018A—lectotype, BM-ACH 538—isolectotype; cf. Sheard & Ahti, 1975: 89 and also Moberg, 2002: 25).

= *Rinodina hueana* Vain., *Hedwigia* 37: 38. 1898 (basionym). = *Lecanora hueana* (Vain.) Hue, *J. Bot. (Morot), sér. 2*, 2: 80. 1909. Type: Erythraea, 'in rupe prope Asmara', 1895, *Levander* (not designated; cf. Sheard & Ahti, 1975: 89, 91).

= *Lecanora mougeotioides* Nyl., *Flora* 55: 364. 1872 (basionym). = *Rinodina oreina* var. *mougeotioides* (Nyl.) Zahlbr., *Cat. lich. univ.* 7: 564. 1931. = *Squamaria mougeotioides* auct. hisp. Type: France, 'in montibus Europae mediae et meridionalis occurrens', *Nylander* (H-NYL 29069—lectotype, BM—isolectotypes; cf. Sheard & Ahti, 1975: 89, 91).

Iconography, descriptions and maps. Norman (1852: tab. I, 10.b icon.); Hue (1909: 78-82 desc., sub *Lecanora oreina* and *L. hueana*); Harmand (1913: 878 desc., sub *L. oreina*); Hale (1952: 253-254 desc., 255 map, sub *Rinodina oreina*); Sheard (1974: 132-135 desc., 137 icon.); Leuckert & Poelt (1978: 66-70 maps); Leuckert *et al.* (1987: 376-377 maps); Moberg & Holmåsén (1992: 197 desc.); Mayrhofer *et al.* (1996: 294-295 icon., 302 desc.); Calatayud & Rico (1999: 41-42 desc., 41-42 maps); Brodo *et al.* (2001: 300 desc., 300 map, 301 icon.); Moberg (2002: 25 desc., 78 map, 95 icon.); Obermayer *et al.* (2004: 334-337 desc., 334 map, 336 icon.).

Thallus crustose, placodioid, forming irregular to circular rosettes, thin (200 μm) to thick (550-790 μm), yellow to yellowish-green, green or whitish-green, rarely whitish, rarely with few pruina; surface often rugose and dull, areolate to rarely bullate at centre, lobulate at margins; areolae 0.2-1.9 mm wide, plane to convex, subangular; margin radiate-plicate to irregularly lobulate, lobules up to 3 mm long, often plane to convex or irregular. **Photobiont** trebouxiioid. **Prothallus** poorly developed and narrow, dark brown to black, when visible restricted to the undersurface and edges of lobes and areolae.

Apothecia cryptolecanorine to lecanorine, innate to adnate, up to 1.1 mm diam., frequent, one or more per areolae. **Disc** dark brown to black, sometimes pruinose, plane or slightly convex. **Thalline margin** concolorous with thallus, sometimes pruinose, usually persistent; cortex \pm pigmented and paraplectenchimatous; proper exciple poorly differentiated. **Epiphymenium** reddish-brown to dark brown. **Hymenium** colourless, (50-)60-120 μm high, without oil droplets; paraphyses up to 2 μm wide, simple or branched at the end, apices clavate, up to 6 μm diam., brown pigmented and with a dark brown cap. **Hypothecium** colourless, 80-200 μm deep. **Asci** of *Bacidia*-type, with broad axial body with converging flanks, with an evident or thin amyloid zone above it, 8-spored. **Ascospores** 1-septate, olivaceous to brown, of *Buellia*-type, ontogeny of A-type (Fig. 4), 9-14(-15) \times 5-7(-8) μm , with rather thickened walls when young, constricted at septum or rarely not, torus well developed, wall ornamentation smooth when young to microrugulate when mature.



Fig. 1. Distribution of *Dimelaena oreina* in the Iberian Peninsula. Solid figures = localities of the studied specimens; open figures = selected bibliographic data. Modified from Calatayud & Rico (1999).

Conidiomata pycnidia, immersed, irregularly distributed in the thallus.
Conidia bacilliform, $3-7(-10) \times 1 \mu\text{m}$.

Chemistry and spot tests. **Chemotype I:** usnic and fumarprotocetraric acids (usually with the related protocetraric acid as minor); medulla K+ yellow-brown, C-, KC+ yellow-dark orange, Pd+ yellow than red, I+ blue. **Chemotype II** (including subtypes IIa and IIb in the sense of Obermayer *et al.*, 2004): usnic and gyrophoric acids (usually with several satellite substances of the gyrophoric chemosyndrome: lecanoric and ovoic acids); medulla K-, C+ rose, KC+ rose, P-, I+ blue. **Chemotype V** (including subtypes Va and Vb in the sense of Obermayer *et al.*, 2004): usnic and stictic acids (usually with several satellite substances of the stictic chemosyndrome: norstictic, cryptostictic, menegazziaic, constictic and hypoconstictic acids); medulla K+ yellow to sometimes dirty brown, C-, KC+ yellow to dirty brown-rose, P+ orange, I+ blue. **Chemotype VII:** usnic, stictic and gyrophoric acids (usually with several satellite substances of the stictic and gyrophoric acid chemosyndromes); medulla K+ yellow to sometimes dirty brown, C+ rose, KC+ yellow to dirty brown-rose, P+ orange, I+ blue.

The spot test reactions C+ rose and KC+ rose, sometimes are very brief and faint and change in different parts of the thallus. The intensity of the I+ blue reaction is variable, even within different parts of a single thalli. Further information is provided by Calatayud & Rico (1999).



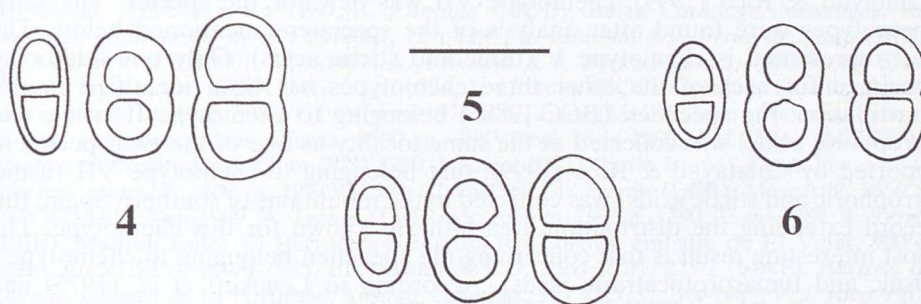
Fig. 2. Distribution of *Dimelaena radiata* in the Iberian Peninsula. Solid figures = localities of the studied specimens; open figures = selected bibliographic data.

Habitat and distribution (see also Calatayud & Rico, 1999). *Dimelaena oreina* is a widespread species on acid rocks in the northern hemisphere and is also known from South Africa and South America (Mayrhofer *et al.*, 1996). Among the seven chemotypes currently known, chemotype II (with usnic and gyrophoric acids as major substances) is the most widely distributed (Mayrhofer *et al.*, 1996; Calatayud & Rico, 1999).

In the Iberian Peninsula, *Dimelaena oreina* is a very frequent lichen extending from the highest mountains (2700 m) to the coast, and four chemotypes were reported (I, II, V and VII). Currently, chemotype V is the most frequent and chemotype VII is known from Spain (Calatayud & Rico, 1999), Afganistan, Kyrgyztan, Nepal (Obermayer *et al.*, 2004) and from one locality in Tyrol (Italy), not regarded by Leuckert *et al.* (1981) as a different chemotype. According to the specimens studied (see also Calatayud & Rico, 1999), the species occurs in Andorra; Beira Alta, Beira Baixa, Tras-os-Montes e Alto Douro provinces, in Portugal; and Albacete, Almería, Barcelona, Castelló, Ciudad Real, Cuenca, Girona, Granada, Huesca, Jaén, León, Lleida, Madrid, Murcia, Navarra, Palencia, Soria, Tarragona, Teruel, València, Zamora and Zaragoza provinces, in Spain. It was impossible for us to check the material reported from: Alto Alentexo (Leuckert *et al.*, 1975; Sheard, 1977), in Portugal; Ávila (Sancho, 1985, 1986, 1988), Guadalajara, Logroño (Crespo *et al.*, 1976) and Toledo (Valladares & Sancho, 1993) provinces in Spain. Probably, the species is more widespread in the Central and South-western territories of the Iberian Peninsula than show the studied specimens.



Fig. 3. Distribution of *Buellia tessarata* in the Iberian Peninsula. Solid figures = localities of the studied specimens; open figures = selected bibliographic data.



Figs. 4-6. Ascospore ontogenies: from left to right, young to mature spores. 4: *Dimelaena oreina* (BCC 5554). 5: *Dimelaena radiata* (BCC s. n.). 6: *Buellia tessarata* (MUB 6908). Scale = 10 μ m.

Dimelaena oreina is a mountainous species which shows a wide ecological amplitude in the Iberian Peninsula. However, it prefers open habitats and acid rocks, highly exposed to the sun, especially those hard or crystalline such as quartzite, quartz, slate, granite, etc., where it can cover large areas in any orientation and situation and may act as a pioneer species. Territories where those hard rocks (and *D. oreina*) are common have a dry to humid ombroclimate and

support high temperatures and radiation in summer. *Dimelaena oreina* is also frequent in nutrient-rich exposed bird-perches, where the thallus is usually thicker.

Taking into account the known distribution of *Dimelaena oreina* (see Fig. 1 and Sheard, 1974, 1977; Leuckert *et al.*, 1975; Leuckert & Poelt, 1978; Matzer *et al.*, 1996), the taxon is related to the Eurosiberian and Mediterranean regions of the Iberian Peninsula. Chemotype VII is mainly restricted to dry to subhumid situations, in continental mountainous areas up to 1300 m, from the thermomediterranean to the supramediterranean belts of the Mediterranean Region. The material of this chemotype from Andorra (*cf.* Calatayud & Rico, 1999) is an exception. Chemotype V occurs on diverse bioclimatic belts of both Eurosiberian and Mediterranean Regions. In contrast, chemotypes I and II are not common: chemotype II always occurs at altitudes above 1400 m, in middle to high mountains; and chemotype I is restricted to some localities of northern Spain.

Material studied from chemotype V from Morocco and the Canary Islands is also listed below.

Remarks. *Dimelaena oreina* cannot be mistaken for any of the other species of *Dimelaena* known as it is unique in sharing the following combination of characters: placodioid and yellowish thallus due to the presence of usnic acid in the cortex; cryptolecanorine to lecanorine apothecia, innate at first and becoming adnate; colourless hypothecium; and *Buellia*-type ascospores.

According to our observations, the ascospores of *Dimelaena oreina* follow an ascospore ontogeny of A-type (*cf.* Giralt, 2001), measure 9-14(-15) × 5-7(-8) µm, belong to the *Buellia*-type but have rather thickened walls when young, are usually constricted at septum and possess a well developed torus. Concerning the spore-wall ornamentation, it is smooth when young and microrugulate when mature, as noted by some authors (*e.g.* Scheidegger *et al.*, 2001) but in contrast to that stated by *e.g.* Nordin & Mattsson (2001).

Chemotypes I, II, V and VII were reported in the Iberian Peninsula by Calatayud & Rico (1999), chemotype VII was new for the species. The same chemotypes were found after analysis of the specimens mentioned below. The best-represented is chemotype V (usnic and stictic acids). Only one additional specimen for each of the other three chemotypes has been identified in this contribution: the specimen (BCC-12885) belonging to chemotype II (usnic and gyrophoric acids) was collected at the same locality as one of the two specimens reported by Calatayud & Rico (1999); that belonging to chemotype VII (usnic, gyrophoric and stictic acids) was collected in the mountains of southern Spain, this record extending the distribution area hitherto known for this chemotype. The most interesting result is that concerning the specimen belonging to chemotype I (usnic and fumarprotocetraric acids). According to Leuckert *et al.* (1975) and Calatayud & Rico (1999), this chemotype is restricted to the mountains of northern Spain and the Pyrenees, in elevations greater than 1000 m. In contrast, the specimen reported here was collected at low altitude (*c.* 300 m), close to the Mediterranean coast. In agreement with Calatayud & Rico (1999), no significant correlation have been found between morphology and chemistry.

Specimens examined which were not listed by Calatayud & Rico (1999).

Chemotype I. — **SPAIN: Girona:** Alt Empordà, La Selva de Mar, Puig Dijous, ca. 300 m, 31TEG1586, 19-v-1984 (BCC). **León:** Peña de la Serna, cuarcita, 1350 m, 29TQG1594, 24-vi-1989, A. Terrón (LEB). Pozas de las Frechas, arenisca, 1400 m, 29TQG1394, 21-vii-1987, A. Terrón (LEB). **Chemotype II.** — **SPAIN: Lleida:** Baixa

Cerdanya, Belver de Cerdanya: Grèixer, prop del poble, esquistos, 1400 m, 31TDG08, 20-xi-1990, *X. Llimona* (BCC 12885); id.: Serra de la Ginebrada, esquistos, 1500 m, 31TDG0097, 17-iv-1992, *J. Pérez-Redondo* (BCC). **Chemotype V. — MOROCCO: Nador:** Cabo tres Forcas, rocas volcánicas: 100 m, 12-iv-1985, *J.M. Egea* (MUB); id.: 80-100 m, 25-iv-1984, *J.M. Egea* (MUB). **PORTUGAL: Beira Baixa:** Serra da Estrêla, acima das Penhas da Saude, sôbre o granito, > 1650 m, 29TPE26, 7-vii-1941, *Palhinha* (LISU). **SPAIN: Almería:** Gergal, Sierra de los Filabres, El Cura Morales, 1300 m, roca silícea, 30SWG3316, 2-iv-1979, *J.M. Egea* (MUB). Los Lobos, Collado de la Casa Nueva, rocas silíceas, 370 m, 30SXG1128, 6-iv-1977, *J.M. Egea* (MUB). Mojacar, Sierra de Cabrera: Adelfa, rocas silíceas, 500 m, 30SWG90, 3-iv-1979, *J.M. Egea* (MUB); id.: rocas silíceas, 43-70 m, 30SXG00, 15-vi-1979, *J.M. Egea* (MUB). Uleila del Campo, Monteagudo, rocas silíceas, 1300 m, 30SWG71, 10-viii-1978, *J.M. Egea* (MUB). Bacaes: Barranco Barrancón, rocas silíceas, 1700 m, 30SWG4520, 1-iv-1979, *J.M. Egea* (MUB); id.: Merendera, rocas silíceas, 1984 m, 30SWG4219, *J.M. Egea* (MUB). **Barcelona:** Maresme, Cabrils, Castell de Burriac, 31TDF4898, 18-vii-1975, *X. Llimona* (BCC). Montseny, Les Agudes, pizarras metamórficas con incrustaciones de mármol, orientadas al E, 1600 m, 31TDG52: 25-x-1975, *N.L. Hladun* (BCC); id.: 22-xi-1975, *N.L. Hladun* (BCC). **Castelló:** Alfondeguilla, Pico Nevera, arenisca ortocuarcítica, 830 m, 30SYK2115, 10-vi-1989, *V. Calatayud* (VAB). Almonacid, cerca del Pico Espadán, arenisca ortocuarcítica, 920 m, 30SYK2420, 14-iii-1992, *V. Calatayud* (VAB). Azuebar, barranco Mosquera: arenisca ortocuarcítica, 620 m, 30SYK2517, 15-iv-1989, *V. Calatayud* (VAB); id.: arenisca, 620 m, 30SYK2517, 18-ii-1989, *V. Calatayud* (VAB). Benicàssim: Parreta Alta, arenisca ortocuarcítica, 300 m, 31TBE4639, 7-vii-1990, *V. Calatayud* (VAB); id.: Villa Comba, arenisca, 300 m, 31SBE03, 7-vii-1990, *V. Calatayud* (VAB); id.: Mas Salandó, 31TBE4839, 23-iii-1975 (BCC). Ahin, Pico Batalla, arenisca, 860 m, 30SYK2717, 20-i-1990, *V. Calatayud* (VAB). Pina de Montalgrao, Sta. Bárbara, arenisca, 1300 m, 30TYK0233, 12-x-1989, *V. Calatayud*, *V. Aienza* & *F. Puche* (VAB). Serra de L'Espadà, Pantà de Benitandús, 30TYK22, 4-v-1973, (BCC). **Ciudad Real:** Puebla de Don Rodrigo, Sierra de Enmedio, carretera hacia Arroba de los Montes, roquedos cercanos a la Garganta de Retama, cuarcitas muy soleadas, 775 m, 30SUJ6532, 28-ix-1996, *M.A. Florido* & *V. J. Rico* 3221/2 (MAF). **Girona:** Alt Empordà: Colera, Cap Lladró, 31TEG19, 26-viii-1975, *X. Llimona* (BCC 5554); id.: Cadaqués, Canyelles Grosses, 80 m, 31TEG27, 31-iii-1972, *X. Llimona* (BCC); id.: Pic Jordana, Barbes del Boc, sobre quarç, 31TEG0696, 9-viii-1979, *X. Llimona* (BCC); id.: Port de la Selva: Puig Vaquer, 380-400 m, 31TEG18, 27-viii-1974, *X. Llimona* (BCC); id.: sobre el club Nàutic, 50 m, 31TEG18, 8-vi-1975, *X. Llimona* (BCC); id.: 31TEG18, 8-v-1980, *X. Llimona* (MUB). Baixa Cerdanya, Meranges, Roc Cardena: granit, 1900 m, 31TDH0001, 12-x-1991, *X. Llimona* & *J. Pérez-Redondo* (BCC); id.: 1400 m, 31TDH0001, 12-x-1991, *X. Llimona* & *J. Pérez-Redondo* (BCC). La Selva, Tossa, Puig Ventós, 31TDG9413, 23-vi-1974, *X. Llimona* (BCC). **Granada:** Guadix, Padilla, rocas silíceas, 2000 m, 30SWG1924, 1-xi-1978, *J.M. Egea* (MUB). Sierra Nevada, Peñones de San Francisco: rocas silíceas, 2500 m, 30SVG60, 28-ix-1980, *J.M. Egea* (MUB); id.: pizarras carbonatadas, 2500 m, 30SVG60, *J. Etayo* 10723 (herb. Etayo). **León:** Pozas de las Frechas, arenisca, 1400 m, 29TQG1394, 21-vii-1987, *A. Terrón* (LEB). Mascariel, 1650 m, 29TQG1390, 23-vii-1989, *A. Terrón* (LEB); id.: 1650 m, 29TQG1290, 23-vii-1989, *A. Terrón* (LEB). **Madrid:** Entre El Berrueco y Berzosa del Lozoya, embalse de El Villar, 900 m, gneis, 30TVL5233, 16-vii-1985, *E. Barreno* & *V. J. Rico* 267/1, 275/2 (MAF). Berzosa del Lozoya, collado de El Portillejo, 1300 m, cuarcitas, 30TVL5737, 3-x-1986, *V. J. Rico* 991/1, 995/3, 997/2, 998/2, 999/3, 1044/3, 1045/2, 1046/4 & *E. Manrique* (MAF). Collado-Mediano, Cerro del Castillo, 1300 m, granito, 30TVL1406, 7-ix-1986, *V. J. Rico* 874/2, 884/2 (MAF). La Cabrera, Sierra de La Cabrera, pico de El Mojón, 1240 m, granito, 30TVL4623, 27-x-1985, *V. J. Rico* 426/2 & *M. A. Florido* (MAF). Lozoya, El Chaparral, 1300 m, gneis, 30TVL3634, 24-vii-1986, *V. J. Rico* 791 & *E. Manrique* (MAF). Manzanares el Real, La Pedriza: Collado de Valdealcones, 1240 m, granito, 30TVL2311, 29-v-1986, *V. J. Rico* 631, 632/1, 632/2 & *E. Barreno* (MAF); id.: arroyo del Chivato, 1480 m, granito, 30TVL2415, 2-vi-1986, *V. J. Rico* 478, 498, 503, 505/2 & *E. Barreno* (MAF); id.: umbría de El Yelmo, espolón ornitocoprófilo, 1575 m, 30TVL2612, 21-ii-1987, *F. Valladares* FV81 (MAF). Robledillo de la Jara, Collado de Fragüela, 1100 m, pizarra, 30TVL5733, 3-x-1986, *V. J. Rico* 1083/2, 1083/3, 1104/2 & *E. Manrique* (MAF). Robledo de Chavela, pico de El

Almojón, 1175 m, granito, 30TUK9581, 23-xi-1986, *V. J. Rico* 804/1 (MAF). Hoyo del Manzanares, espolón ornitocoprófilo, 1060 m, 30TVK29, 10-ii-1988, *F. Valladares* FV88 (MAF). Galapagar, espolón ornitocoprófilo, 860 m, 30TVK165923, 16-xii-1988, *F. Valladares* FV96 (MAF). Sierra de Abantos, espolón ornitocoprófilo: 1580 m, 30TVK012995, 31-x-1988, *F. Valladares* FV87 & *C. Ramírez* (MAF); id.: 1680 m, 30TVK021969, 31-x-1988, *C. Ramírez & F. Valladares* FV89 (MAF); id.: 1600 m, 30TVK09, 31-x-1988, *C. Ramírez & F. Valladares* FV90 (MAF). Peña de El Aguila, espolón ornitocoprófilo, 1920 m, 30TVL082140, 17-xii-1988, *C. Ramírez & F. Valladares* FV94 (MAF). San Martín de Valdeiglesias, embalse de San Juan, cerro Almodón, 650 m, granito, 30TUK8273, 2-i-1984, *E. Barreno & V. J. Rico* 184/1, 190/2 (MAF). **Murcia:** Águilas, Cabo Cope: Cerro de Cope, rocas silíceas, 65-100 m, 30SXG3343, 15-iv-1976, *J. M. Egea* (MUB); id.: La Rambla, rocas silíceas, 10-100 m, 30SXG3143, 15-iv-1976, *J. M. Egea* (MUB). Cabo de Palos: Atalayón, 180 m, 30SYG0165, 11-ii-1978, *J. M. Egea* (MUB); id.: El Carmolí, andesitas ortopiroxénicas, 30SYG06, 12-iv-1973, *X. Llimona & J. M. Egea* (MUB); id.: Monte de las Cenizas, micaesquistos, 337 m, 30SXG9261, 6-iii-1978 (MUB); id.: Perdiguera, andesitas ortopiroxénicas, 30SXG97, 23-i-1981, *X. Llimona & J. M. Egea* (MUB). Mar menor: Isla Grossa, andesitas ortopiroxénicas, 30SYG07, 3-ii-1978, *X. Llimona & J. M. Egea* (MUB); id.: Isla Mayor, andesitas ortopiroxénicas, 30SXG97, 25-iii-1975, *X. Llimona* (MUB). Cartagena: Cabezo del Pericón, cuarcitas, 372 m, 30SXG6671, 1-iii-1973, *J. M. Egea* (MUB); id.: Sierra del Algarrobo, Cabezo Negro de Tallante, cuarcitas, 285 m, 30SXG6369, 13-iv-1976, *J. M. Egea* (MUB). Mazarrón, Los Huertos, rocas volcánica básicas, 100 m, 30SXG46, 26-iii-1975: *J. M. Egea* (MUB); id.: *X. Llimona* (MUB). **València:** Sagunt, Monte Picayo, 30SYJ3091, 30-iii-1975, *X. Llimona* (BCC). Benifairó de la Valls, arenisca, 250 m, 30SYK3201, 16-iv-1993, *V. Calatayud* (VAB). Serra: Font del Berro, arenisca, 550 m, 30SYJ1699, 14-xii-1990, *V. Calatayud* (VAB); id.: El Garbí, arenisca, 575 m, 30SYJ2597: 10-viii-1992, *V. Calatayud* (VAB); id.: 16-ii-1993, *V. Calatayud & V. J. Rico* (VAB). **CANARY ISLANDS: Tenerife:** Malpaís de Güimar, rocas silíceas, 0-25 m, 10-i-1984, *J. M. Egea, X. Llimona & C. Sánchez-Padrón* (MUB). Montaña de Guajara im südlichen Cañadaszirkel, 2200-2300 m, iii-1980, *G. Follmann* (BCC, Follmann: Lich. Exs. Sel. Mus. Hist. Nat. Casselensi ed. nr. 330). **Chemotype VII. — SPAIN: Jaén:** Sierra Morena, Puerto de Despeñaperros, 30SVH54, 19-iv-1973, *X. Llimona* (BCC). **Madrid:** San Lorenzo de El Escorial, Silla de Felipe II, 1080 m, granito, 30TVK0291, 4-vii-1986, *M. A. Florido & V. J. Rico* 1142 (MAF). Lozoya, El Chaparral, 1300 m, gneis, 30TVL3634, 24-vii-1986, *V. J. Rico* 753/1 & *E. Manrique* (MAF). Manzanares el Real, La Pedriza: collado de Valdealcones, 1240 m, granito, 30TVL2311, 29-v-1986, *V. J. Rico* 589/2, 593/2, 634/2, 644/2 & *E. Barreno* (MAF); id.: umbría de El Yelmo, gneis, espolón ornitocoprófilo, 1400 m, 30TVL2612, 21-ii-1987, *F. Valladares* FV84 & *Gil* (MAF); id.: Sierra de Los Porrones, espolón ornitocoprófilo, 1580 m, 30TVL218114, 13-ii-1988, *F. Valladares* FV83 (MAF). Robledo de Chavela, pico de El Almojón, 1175 m, granito, 30TUK9581, 23-xi-1986, *V. J. Rico* 807/2 (MAF). La Cabrera, Sierra de La Cabrera: pico de El Mojón, 1240 m, granito, 30TVL4623: 27-x-1985, *V. J. Rico* 425/3, 435/2 & *M. A. Florido* (MAF); id.: espolón ornitocoprófilo, 1140 m, 30TVL507269, 14-ii-1987, *F. Valladares* FV86 (MAF). Entre El Berrueco y Berzosa del Lozoya, embalse de El Villar, 900 m, gneis, 30TVL5233, 16-vii-1985, *E. Barreno & V. J. Rico* 275/2, 276/1, 277/3 (MAF). Collado-Mediano, cerro del Castillo, 1300 m, granito, 30TVL1406, 7-ix-1986, *V. J. Rico* 885/2, 895/1 (MAF). Zarzalejo, espolón ornitocoprófilo, 1180 m, 30TVK016888, 26-xii-1988, *F. Valladares* FV95 (MAF). Puerto de La Morcuera, Sta. Ana, espolón ornitocoprófilo, 1320 m, 30TVL296257, 15-ii-1987, *F. Valladares* FV91, FV92 (MAF). Torreledones, espolón ornitocoprófilo, 860 m, 30TVK211919, 19-xii-1987, *F. Valladares* FV82 (MAF). Sierra de Hoyo de Manzanares, espolón ornitocoprófilo, 1040 m, 30TVK225978, 19-xii-1987, *F. Valladares* FV85 & *Gil* (MAF). Galapagar, espolón ornitocoprófilo, 880 m, 30TVK172897, 18-xii-1988, *F. Valladares* FV97 (MAF). San Martín de Valdeiglesias, embalse de San Juan, cerro Almodón, 650 m, granito, 30TUK8273, 2-i-1984, *E. Barreno & V. J. Rico* 163/1, 189/1, 200 (MAF). **TLC not carried out. — ANDORRA: Ordino:** Sota l'Estany primer de Tristaina, estret per on passa la carretera, 2200 m, 31TCH72, 28-viii-1978, *X. Llimona* (BCC). **SPAIN: Huesca:** Sallent de Gállego, Valle de Tena, Arista de Campo de Troya, 2240 m, 30TYN1238, 8-ix-1994, *L. G. Sancho & al.* (MAF). **Madrid:** Guadarrama, 30TVL1000, *B. Vicioso* (MA, sub *Squamaria*

mougeotioides). Sierra de Guadarrama, roca cerca de La Golondrina, 30TVL1000, verano de 1913, B. Vicioso (MA, sub *Squamaria mougeotioides*). **Zamora**: arroyo del Zape, 30TTL19, 7-ix-1998, A. Crespo & O. Blanco (MAF). **Zaragoza**: Calatayud, Campiel, ad rupes frequens, 30TXL18, B. Vicioso (MA, sub *Lecanora mougeotioides*).

***Dimelaena radiata* (Tuck.) Müll. Arg.**

(Figs. 2, 5)

Flora 67: 466. 1884. ≡ *Buellia radiata* Tuck., *Lich. Calif.*: 25. 1866 (basionym). ≡ *Dimelaena radiata* (Tuck.) Hale & W.L. Culb., *Bryologist* 73: 513. 1970 (superfl. comb.). Type: U.S.A., California, 'San Bruno, Rocks on the coast, Mr. Bolander' (FH-TUCK—lectotype; cf. Sheard, 1974: 135).

Iconography, descriptions and maps. See references in Rico *et al.* (2003).

Thallus crustose, placodioid, often forming orbicular rosettes, thin to thick, whitish-grey and pruinose to grey and epruinose or with pruina located only at margins, rarely greyish-brown, surface often rugose and dull, rimose to usually areolate at centre, lobulate at margins; areolae 0.1-1.4(-2.5) mm wide, plane to convex, angular to subangular; margin radiate-plicate, lobules up to 3 mm long, plane to slightly convex, edges sometimes dirty brown. **Photobiont** trebouxoid. **Prothallus** absent.

Apothecia cryptolecanorine to lecideine, innate to adnate, up to 0.9 mm diam., frequent when present, one or rarely more per areolae; young apothecia sometimes surrounded by a pruinose irregularly dentate thalline crown. **Disc** black, often with a whitish-grey pruina, plane to convex. **Proper margin** black to blackish-grey or pruinose and then ± concolorous with thallus, persistent or not; outer part of proper exciple brown to black, inner part pallid. **Epihyemium** yellowish-brown to brown, interspersed with crystals solving in K. **Hymenium** colourless, (55-)65-90 µm high, without oil droplets; paraphyses (1.5-)2-3 µm wide, simple or branched at the end, apices clavate, up to 5 µm diam., brownish pigmented, usually without distinct brownish cap. **Hypothecium** brown, 105-225 µm deep. **Asci** 8-spored, of *Bacidia*-type, with a broad axial body with converging flanks, with a very thin amyloid zone above it. **Ascospores** 1-septate, olivaceous to brown, of *Buellia*-type, ontogeny of A-type (Fig. 5), 8-12 × 5-8 µm, with rather thickened walls when young, septum constricted or not, torus developed, wall ornamentation rugulate.

Conidiomata pycnidia, immersed, frequent, isolated or highly grouped, often causing a convex deformation of areolae. **Conidia** bacilliform, (6-)7-11 × 1 µm.

Chemistry and spot tests. Following Matzer *et al.* (1996), our specimens belong to **chemotype I** and contain: 3-chlorodivaricatic acid (major), unknown depside Y (submajor), nordivaricatic and divaricatic acids (in traces or absent). In some of the specimens analyzed traces of atranorin, norstictic acid, 5-chlorodivaricatic acid and of several additional unknown substances, were also detected by TLC and HPLC. Medulla K+ sordid yellow-brown, C-, KC+ sordid brownish-orange or KC+ briefly rose, P-, I-

Habitat and distribution. *Dimelaena radiata* is a species with a disjunct distribution, currently reported from the USA (California and Californian Islands), Mexico (Baja California and the coastal areas of the gulf of California), Morocco, the Canary, Madeira and Selvages Islands, Corsica and SE Spain (Sheard, 1974; Llimona & Werner, 1975; Matzer *et al.*, 1996). This kind of distribution pattern is not rare in lichens (cf. Kärnefelt, 1980; Matzer *et al.*, 1996; Sheard, 1995), especially

among Mediterranean climate species. *Dimelaena radiata* prefers semiarid to arid situations on siliceous rocks, mostly near the coasts.

In the Iberian Peninsula, *Dimelaena radiata* is restricted to Almería and Murcia provinces (Spain), where it is not rare near the coast (Fig. 2). It has a very restricted ecology, growing in the thermomediterranean belt of the Mediterranean Region, with semiarid ombroclimate. It prefers open acid substrata, particularly hard lava, very exposed to sun, and up to 500 m (exceptionally 700 m) about sea level. It can cover large areas of these rocks, forming dense crusts of several thalli in the coastal hills or more rarely in localities situated a few km off the coast, unprotected and directly influenced by marine winds.

Material studied from chemotype I from Morocco and the Canary Islands is also listed below.

Remarks. *Dimelaena radiata* is characterized by its placodioid and whitish-grey to grey thallus, containing as major secondary lichen metabolites substances of the divaricatic acid chemosyndrome (chemotypes I, II and III) or psoromic acid (chemotype IV) (cf. Matzer *et al.*, 1996), its innate cryptolecanorine apothecia, becoming adnate and lecideine, with plane to convex discs, its brown hypothecium and its *Buellia*-type ascospores with a rugulate ornamentation.

According to Sheard (1974) and Matzer *et al.* (1996) two morphotypes of *Dimelaena radiata* can be distinguished on the basis of the coloration of the thallus: a pale grey and pruinose and a darker grey more or less epruinose type. Both morphotypes occur in the Iberian Peninsula. In contrast, only chemotype I has been recognized in the study area.

Dimelaena radiata is easily separated from other *Dimelaena* species known, as it is unique in containing 3-chlorodivaricatic acid, but might easily be mistaken for *Buellia tesserata*. In fact, both taxa are nearly identical chemically, ecologically and biogeographically, since they contain 3-chlorodivaricatic acid as major; grow side by side on siliceous rocks in Mediterranean xerothermic habitats and show a disjunct distribution, occurring in western North America (California) and in south-western Europe and North Africa. Morphologically, *Dimelaena radiata* and *Buellia tesserata* are mainly separated by thallus and apothecia characters. Whereas the thallus is radiate-plicate with lobulate margins and lacks prothallus and the apothecia are up to 0.9 mm diam. in *D. radiata*, the thallus is crustose with black fimbriate margins and the apothecia are up to 1.8 mm diam. in *B. tesserata*. An additional distinguishing feature between both taxa is found in adult lecideine apothecia, which remain adnate and convex in *D. radiata* whereas they become sessile and hemispherical in *B. tesserata*. The different generic position of these closely related taxa is questioned and discussed in Rico *et al.* (2003).

Specimens examined, all of chemotype I, which were not listed by Rico *et al.* (2003).

MOROCCO: Nador: Cabo tres Forcas, rocas volcánicas, 100 m, 12-iv-1985, *J. M. Egea* (MUB). **SPAIN: Almería:** San José, Playa de Monsul, sobre roca volcánica, 15 m, 30SWF7565, 15-iii-1993, *E. Barreno, V. Calatayud & M. J. Sanz* (VAB). Cabo de Gata: El Monsul, 20 m, 30SWF76, 30-xii-1970 (BCC); id.: El Fraile, 30SWF87, iii-1972, *X. Llimona* (BCC); id.: Cierro de las Cuevas, 90 m, 30SWF77, 19-iii-1972, *X. Llimona* (BCC s. n.); id.: La Cruceta, 270 m, 30SWF76, 21-iii-1972, *X. Llimona* (BCC); id.: Las Madriguericas, SW de Carboneras, 110 m, 30SWF99, 1-i-1973, *X. Llimona* (BCC); id.: Vela Blanca: sobre roca volcánica, 30 m, 30SWF7365, 15-iii-1993, *E. Barreno, V. Calatayud & M. J. Sanz* (VAB); id.: 23-iii-1972, *X. Llimona* (BCC). Sierra Almagrera, Los Lobos, Collado de la Casa Nueva, rocas silíceas, 370 m, 30SXG1128, 6-iv-1977, *J. M. Egea & X. Llimona* (MUB).

Mojacar, Sierra de Cabrera: La Adelfa, rocas silíceas, 500 m, 30SWG9702, 3-iv-1979, *J. M. Egea* (MUB); id.: rocas silíceas, 43-70 m, 30SXG00, 15-vi-1979, *J. M. Egea* (MUB). **MURCIA:** Cabo Cope, Águilas: La Rambla, rocas silíceas, 10-100 m, 30SXG3143, 15-iv-1976, *J. M. Egea* (MUB); id.: Sierra del Cantal, Tinajeros, rocas silíceas, 700 m, 30SXG2652, 19-iii-1979, *J. M. Egea* (MUB). Cabo de Palos: Atalayón, micaesquistos y cuarcitas, 180 m, 30SYG0165, 11-ii-1978, *J. M. Egea* (MUB); id.: El Carmolí, andesitas ortopiroxénicas, 30SXG97, 12-iv-1973, *X. Llimona & J. M. Egea* (MUB); id.: Monte de las Cenizas, micaesquistos y cuarcitas, 337 m, 30SXG9261, 6-iii-1978, *J. M. Egea* (MUB). Mar menor: Isla Grossa, andesitas ortopiroxénicas, 30SYG07, 3-ii-1978, *X. Llimona & J. M. Egea* (MUB); id.: Isla Mayor, andesitas ortopiroxénicas, 30SXG97, 25-iii-1975, *X. Llimona* (MUB). Cartagena, Sierra del Algarrobo: Cabezo del Pericón, cuarcitas, 372 m, 30SXG6671, 1-iii-1973, *J. M. Egea* (MUB); id.: Cabezo negro de Tallante, micaesquistos y cuarcitas, 285 m, 30SXG6369, 13-iv-1976, *J. M. Egea* (MUB). Mazarrón, Los Huertos, rocas volcánica básicas, 100 m, 30SXG46, 26-iii-1975, *X. Llimona* (MUB-8383, 8386). **CANARY ISLANDS: Tenerife:** Malpaís de Güimar, 0-25 m, 10-i-1984, *J. M. Egea, X. Llimona & C. Sánchez-Padrón* (MUB, BCC). Los Cristianos, sobre rocas muy soleadas, lejos del mar, 50 m, 1-iv-1971, *X. Llimona* (BCC).

***Buellia tesserata* Körb.**

(Figs. 3, 6)

Parerga lichenol.: 189. 1860. Type: Norway, 'An Schieferfelsen Norwegens von Hübener und Kurr gesammelt' (L 56579—lectotype!, UPS—isolectotype; cf. Foucard *et al.*, 2002: 71).

= *Buellia cerussata* Llimona & Werner, *Acta Phytotax. Barcinon.* 16: 18. 1985. Type: Spain, 'Crescit ad saxa vulcanio-andesitica in Hispaniae Gata montibus (Sierra de Gata dictis), prope Almeria urbem, loco El Monsul, ad alt. 20 m, *X. Llimona*, 30-xi-1970' (BCC 618—holotype!, BCC—isoetypes!).

= *Rinodina radiata* b. (var.) *fimbriata* Tuck., *Syn. N. Amer. lich.* 1: 205. 1882 (basionym). ≡ *Buellia fimbriata* (Tuck.) Sheard, *Bryologist* 72: 221. 1969. Type: USA, 'Rocks on the coast of California', *Bolander* (FH-TUCK—lectotype; cf. Sheard, 1969: 221).

Iconography, descriptions and maps. See references in Rico *et al.* (2003).

Thallus crustose, fimbriate, ± orbicular forming rosettes or irregular, thin to thick, whitish-grey, whitish-ochraceous or pale greyish-brown and pruinose to grey and epruinose, surface smooth to rugose and dull, rimose to areolate at centre, fimbriate and sometimes sublobulate at margins; areolae 0.1-1.5(-2) mm wide, plane to convex, angular to subangular. **Photobiont** trebouxoid. **Prothallus** clearly distinct at margins, black, fimbriate, often with young verrucose areolae arranged in radiating rows differentiating on it.

Apothecia cryptolecanorine to lecideine, innate to adnate or sessile but widely attached, up to 1.8 mm diam., frequent when present, one or rarely more per areolae; young apothecia sometimes surrounded by a pruinose lacinate thalline crown. **Disc** black, often with a whitish pruina, plane to hemispherical. **Proper margin** persistent or not, when present distinct as a pruinose ring, especially when the apothecia are young and more or less plane, rarely black; outer part of proper exciple brown to black, inner part pallid. **Epihyemium** yellowish-brown to brown, interspersed with crystals dissolving in K. **Hymenium** colourless, 60-90 µm high, without oil droplets; paraphyses 2-3 µm wide, simple or branched at the end, apices clavate, 4-5(-6) µm diam., brownish pigmented, with or without distinct brownish cap. **Hypothecium** brown, 100-180 µm deep. **Asci** 8-spored, of *Bacidia*-type, with a broad axial body with converging flanks, usually with a very thin amyloid zone above it. **Ascospores** 1-septate (some non-septate

spores observed), olivaceous to brown, of *Buellia*-type, ontogeny of A-type (Fig. 6), $8\text{--}15 \times 5\text{--}7 \mu\text{m}$, with rather thickened walls when young, septum constricted or not, torus developed, wall ornamentation rugulate.

Conidiomata pycnidia, immersed, frequent, isolated or highly grouped, often causing a convex deformation of areolae. Conidia bacilliform, $(7\text{--})8\text{--}11 \times 1 \mu\text{m}$.

Chemistry and spot tests. Contain: 3-chlorodivaricatic acid (major), unknown depside X (submajor), nordivaricatic and divaricatic acids (traces or absent). Traces of the unknown substances present in *Dimelaena radiata*, atranorin and norstictic acid have also been sometimes detected by TLC and HPLC (see *D. radiata* for details). Medulla K+ sordid yellow-brown, C-, KC+ sordid brownish-orange or KC+ briefly rose, P-, I-.

Habitat and distribution. *Buellia tesserata* is a species with a similar and disjunct distribution and habitat to *Dimelaena radiata* (cf. Egea & Alonso, 1996). It occurs preferentially in Mediterranean thermic climates, where it grows on sunny acid rocks situated near the coasts. Putting the type material aside, *B. tesserata* is known from California (USA) (Sheard, 1969, sub *Buellia fimbriata*), Turkey (Mediterranean coast), Greece (Aegean Islands), Italy (continent and Sardinia), Portugal (W), Cape Verde Islands (Llimona & Werner, 1975, sub *Buellia cerussata*), Spain (SE and the Canary Islands), France (SE) (Scheidegger, 1991, 1993, sub *B. fimbriata*), Morocco (Egea & Rowe, 1987a, sub *B. fimbriata*) and Algeria (Egea & Llimona, 1991, sub *B. cerussata*).

Buellia tesserata is not rare in the Iberian Peninsula (Fig. 3). According to the material studied (see below and Rico *et al.*, 2003), it occurs in Estremadura province (Portugal) and in Almería, Castelló, Girona, Murcia and the Balearic Islands provinces (Cabrera and Menorca, Spain). The record from Lugo (NW Spain) mentioned by Valcárcel *et al.* (1995, sub *Buellia cf. tesserata*), does not refer to this species. Several additional records, such as those in Rowe & Egea (1986) and Egea & Rowe (1987b, sub *Buellia cerussata*) from Cádiz (S Spain), could not be verified.

In the studied area, *Buellia tesserata* occurs in subhumid to semiarid ombroclimate of the mesomediterranean to thermomediterranean belts of the Mediterranean Region. It grows on hard or porous acid rocks (including acid lava), in horizontal surfaces very exposed to the sun, or in more or less vertical surfaces sometimes protected from the sun by overhanging rocks. In xerothermic Mediterranean coastal habitats of SE Spain, *Dimelaena radiata* and *Buellia tesserata* grow side by side. However, *B. tesserata* does not seem to be as restricted to these habitats as *D. radiata* is and it appears also several km from the coast (in localities not directly influenced by marine winds), up to 450 m altitude (exceptionally 700 m), on the top of boulders and at different exposures. *Buellia tesserata* clearly shows a wider ecological behaviour than *D. radiata*, being found in more humid habitats, such as the Atlantic coast of Portugal or protected rocks with higher humidity.

Material studied from Morocco and the USA is also listed below.

Remarks. *Buellia tesserata* is characterized by its greyish-white to grey crustose thallus, very well delimited by a dark, fimbriate prothallus and which contains as major lichen substance 3-chlorodivaricatic acid, its cryptolecanorine apothecia becoming lecideine with hemispherical discs, its brown hypothecium and its *Buellia*-type ascospores with a rugulate ornamentation. As in *Dimelaena radiata*, two morphotypes can be distinguished in *Buellia tesserata*, a greyish-white,

pruinose and a grey epruinose type. No chemical differences have been observed between the morphotypes.

The recent approval of *Buellia disciformis* (Fr.) Mudd (= *Lecidea parasema* var. *disciformis* Fr.) as the type species of the genus *Buellia* (Greuter *et al.*, 2000) implies that *Buellia* s. str. has to be used only for what was until now *Hafellia* and that the remaining *Buellia* have to be combined in a new genus or more probably several, since *Buellia* was not monophyletic (Grube & Arup, 2001). Pending further studies to determine the correct taxonomic position of all those *Buellia* species which as *Buellia tesserata* were not *Hafellia*, this taxon is here retained into *Buellia* (*cf.* also Rico *et al.*, 2003).

As mentioned above, *Buellia tesserata* is only separated from *Dimelaena radiata* by its thallus growth, being crustose with fimbriate margins instead of placodioid with lobulate margins (see under *D. radiata*).

Additional specimens examined which were not listed by Rico *et al.* (2003).

MOROCCO: Tanger: Cabo Spartel, sobre esquistos, 30-100 m, 14-IV-1984, *J. M. Egea & J. G. Rowe* (MUB). **SPAIN: Almería:** Cabo de Gata: Vela Blanca, 215 m, 30SWF7365, 22-iii-1972, *X. Llimona* (BCC); *id.*: Las Negras, Gallineras, 30SWF88, 4-iv-1980, *A. Crespo & L. G. Sancho* (MAF, sub *Buellia cerussata*); *id.*: San José, El Berrocal, 30SWF76, *A. Crespo & X. Llimona* (MAF, sub *B. cerussata*); *id.*: Sierra del Cabo de Gata, entre San José y Cabo de Gata, cerca del faro, lavas ácidas, 140 m, 30SWF7465, 27-i-1988, *V. J. Rico* 1928, 1931 (MAF); *id.*: El Monsul, sobre lavas, 20 m, 30SWF76: 30-xii-1970, *X. Llimona* (BCC—locotypus); *id.*: 23-iii-1972, *X. Llimona* (BCC—locotypus); *id.*: El Fraile, colada de lava reciente, 90-450 m, 30SWF87: 23-iii-1972, *X. Llimona* (BCC); *id.*: 29-xii-1972, *X. Llimona* (BCC); *id.*: Cierro de las Cuevas, 80 m, 30SWF77, 19-iii-1972, *X. Llimona* (BCC); *id.*: La Cruceta, 270 m, 30SWF76: 28-vii-1966, *X. Llimona* (BCC); *id.*: 11-vii-1968, *X. Llimona* (BCC); *id.*: 21-iii-1972, *X. Llimona* (BCC). **Girona:** Alt Empordà: Cap de Creus, 31TEG2685, 23-v-1971, *X. Llimona* (BCC); *id.*: Cala Gorguell, cerca del mar, gneiss, 31TEG1888, 21-viii-1969, *X. Llimona* (BCC); *id.*: Cadaqués, 31TEG2282, 29-xii-1974, *X. Llimona* (BCC); *id.*: Puig Gros, cara W, 150 m, 31TEG1988, 23-viii-1974, *X. Llimona* (BCC); *id.*: Port de la Selva: 31TEG1687, 8-iv-1980, *X. Llimona* (MUB); *id.*: sobre Cala Tamarina, de cara al mar, exposició N, silíceo, 31TEG18, 12-viii-1969, *X. Llimona* (BCC); *id.*: vora carretera, sobre lloses planes que limiten amb la cuneta, 60 m, 31TEG18, 9-vi-1970, *X. Llimona* (BCC); *id.*: riuet sobre Tamarina, 31TEG18, 17-v-1987, *X. Llimona* (BCC). **Murcia:** Águilas, Sierra del Cantal, Tinajeros, 700 m, 30SXG2652, 19-iii-1979, *J. M. Egea* (MUB). Cabo de Palos: El Carmolí, rocas volcánicas, 30SYG06, 17-v-1979, *J. M. Egea* (MUB); *id.*: Monte de las Cenizas, micaesquistos y cuarcitas, 337 m, 30SXG9261, 24-xii-1976, *J. M. Egea* (MUB); *id.*: Cabezo de la Punta del Lobo, micaesquistos y cuarcitas, 20-120 m, 30SYG0165, 5-iv-1977, *J. M. Egea* (MUB). Mar menor: Isla del Ciervo, andesitas ortopiroxénicas, 30SXG97, 29-i-1982, *X. Llimona & J. M. Egea* (MUB); *id.*: Isla Mayor, 30SXG97: 25-iii-1975, *X. Llimona* (BCC); *id.*: 15-xii-1975, *X. Llimona* (BCC); *id.*: Isla Grossa, andesitas ortopiroxénicas, 30SYG07: 3-ii-1978, *X. Llimona & J. M. Egea* (MUB 6908); *id.*, 25-iii-1975, *X. Llimona* (BCC). **BALEARIC ISLANDS: Menorca:** Cabo Fabarix, Sescala, pizarras, 5 m, 31SFE0929, 17-viii-1988, *V. J. Rico* 2251/1 (MAF). **USA: Baja California:** Punta Banda, coastal rocky cliffs, 6-xi-1972, *T. H. Nash* 4965 (ASU). San Luis Obispo, San Simeón, along route 1, on rock near ocean, 20', 13-viii-1973, *T. H. Nash* 8030 (ASU).

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