

## Mountainous and nivicolous myxomycetes described by CHARLES MEYLAN. A SEM-study

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**Abstract:** The type material of the following species and varieties described by MEYLAN has been studied: *Chondrioderma montanum*, *Diderma asteroides* var. *luteum*, *D. montanum* var. *roseum*, *D. trevelyanii* var. *nivale*, *Didymium decipiens*, *D. niviculum*, *D. wilczekii*, *Lamprodermopsis nivalis*, *Lepidoderma carestianum* var. *flavescens*. Furthermore, material of the following forms proposed by MEYLAN has been examined: *Badhamia foliicola* f. *flavescens*, *Diderma niveum* f. *pulverulentum*, *Physarum alpinum* f. *albescens*, *P. alpinum* f. *badhamioides*. A new lectotype for *Diderma montanum* and lectotypes for *Badhamia foliicola* f. *flavescens* and *Diderma niveum* f. *pulverulentum* are proposed. *Diderma niveum* f. *pulverulentum* is synonymized with *Diderma meyerae* and *Lepidoderma carestianum* var. *flavescens* with *L. chailletii*. The varieties *Diderma asteroides* var. *luteum*, *D. montanum* var. *roseum* and the forms *Badhamia foliicola* f. *flavescens*, *Physarum alpinum* f. *albescens*, and *P. alpinum* f. *badhamioides* are considered variations of the respective species without taxonomic value. Spore ornamentation by SEM is used as an important character for the validity of the studied taxa.

**Zusammenfassung:** Das Typusmaterial der folgenden von MEYLAN beschriebenen Arten und Varietäten wurde studiert: *Chondrioderma montanum*, *Diderma asteroides* var. *luteum*, *D. montanum* var. *roseum*, *D. trevelyanii* var. *nivale*, *Didymium decipiens*, *D. niviculum*, *D. wilczekii*, *Lamprodermopsis nivalis*, *Lepidoderma carestianum* var. *flavescens*. Weiters wurde Material der folgenden von MEYLAN vorgeschlagenen Formen untersucht: *Badhamia foliicola* f. *flavescens*, *Diderma niveum* f. *pulverulentum*, *Physarum alpinum* f. *albescens*, *P. alpinum* f. *badhamioides*. Ein neuer Lectotyp für *Diderma montanum* und Lectotypen für *Badhamia foliicola* f. *flavescens* und *Diderma niveum* f. *pulverulentum* werden vorgeschlagen. *Diderma niveum* f. *pulverulentum* wird mit *Diderma meyerae* und *Lepidoderma carestianum* var. *flavescens* mit *L. chailletii* synonymisiert. Die Varietäten *Diderma asteroides* var. *luteum*, *D. montanum* var. *roseum* und die Formen *Badhamia foliicola* f. *flavescens*, *Physarum alpinum* f. *albescens* und *P. alpinum* f. *badhamioides* werden als Variationen der entsprechenden Arten ohne taxonomischen Wert angesehen. Die Sporenornamentation im REM wird als wichtiges Merkmal für die Gültigkeit der studierten Taxa verwendet.

Many species of the myxomycetes show preferences for the type of substrate on which they fruit. There are species that fructify on leaves (foliicolous), bark of trees and shrubs (corticolous), wood (lignicolous), dung (fimicolous) and on decomposing succulent plants (succulenticolous). However, there is a group of myxomycetes that does not show such preferences for a determined substrate, but on precise ecological conditions. These organisms are able to fructify on any type of substrate (e.g., leaves, wood, living vegeta-

tion, stones), as long as they have been covered by snow over a long period. This is the case of the nivicolous myxomycetes that we can find only in high mountain areas or with northern latitudes. SCHINNER (1982) pointed out that some basic conditions have to be fulfilled for the germination of the spores of the nivicolous myxomycetes, formation of the plasmodia and eventual fructification, such as: a permanent snow-layer of at least three months and a series of factors that cause stress such as changes of temperature and a high grade of humidity and low temperatures.

Sometimes we can find nivicolous myxomycetes sharing their habitat with non-nivicolous species, mainly foliicolous and lignicolous ones, who consequently do not require the above mentioned ecological conditions in order to complete their life cycle. Among these non-nivicolous species, two groups can be distinguished: There are species such as *Badhamia foliicola* LISTER and *Didymium dubium* ROSTAF. that fructify frequently in the habitat of the nivicolous myxomycetes, but are also common at low altitudes; and there are some non-nivicolous species that prefer the mountainous habitat and usually cannot be found at lower altitudes, such as *Diderma montanum* (MEYL.) MEYL. and *Hemitrichia montana* MORGAN. In the present paper we revise nivicolous as well as non-nivicolous taxa described by the Swiss investigator CHARLES MEYLAN from the mountainous habitat.

MEYLAN was the first investigator to study this type of organisms, and he published numerous papers dealing with the slime moulds between the years 1908 and 1931. He made abundant collections of myxomycetes in the Jura Mountains. Being a habitat not explored previously, MEYLAN soon published new taxa. Later, KOWALSKI (1975) critically studied all the new myxomycete taxa that MEYLAN had described, accepting some of them but synonymizing others.

The present knowledge of the mountainous, especially the nivicolous species of myxomycetes is much larger, as several investigators have continued studying them. Apart from D. T. KOWALSKI in the United States, in Europe there are two groups that have contributed most: In France there is the group of M. MEYER, J. BOZONNET, and M. POULAIN, and in Germany and Austria the one of H. NEUBERT and W. NOWOTNY.

In the University of Alcalá we have been involved in revising type material of different nivicolous taxa for some years. In our current work we are studying the types of some of these taxa described by MEYLAN.

MEYLAN did not designate type specimens for his taxa as this was not obligatory at that time. When KOWALSKI (1975) revised the collections deposited in the Swiss herbarium LAU he designated only a nomenclatural type for the species and varieties published by MEYLAN but he did not do so for MEYLAN's numerous forms, as he considered them taxonomically unimportant. We have been able to locate in the herbarium LAU most of the type material proposed by KOWALSKI, and also material of various forms described by MEYLAN. Some types were not found and, according to the curator of the herbarium, might be lost: *Chondrioderma montanum* MEYL. (today *Diderma montanum*), *Diacheopsis metallica* MEYL., *Diderma umbilicatum* var. *flavogenitum* MEYL. (today a synonym of *D. montanum*). Collections of the forms *Diderma niveum* f. *endoleuca* MEYL. and *Didymium wilczekii* f. *pulverulenta* MEYL. likewise could not be located. KOWALSKI (1975) had already indicated that he was unable to find collections of *Diacheopsis metallica* in the herbarium, though he studied a microscope slide, that unfortunately could not be found by us. We have selected as a new lectotype for *Diderma montanum* (= *Chondrioderma montanum*) a typical and abundant collection

made by MEYLAN. From the other taxa mentioned we have not been able to find any specimen.

The nivicolous species, varieties and forms of the genus *Lamproderma* will be the subject of a later paper.

### Materials and methods

The collections studied come from the herbaria AH, B, BPI, BR, LAU, MICH, UC, and WRSI. In the case of LAU the material was studied in situ, in the herbarium itself.

The specimens were studied with a binocular microscope and after mounting in Hoyer's medium, with a Nikon (Optiphot) microscope (LM). Spore measurements were made under the oil immersion objective and include surface structures such as spines or warts.

Scanning electron microscopy (SEM) micrographs were taken in the University of Alcalá de Henares using a Zeiss DSM-950. In order to examine the spore ornamentation the critical point drying technique was applied to the specimens: sporocarps were rehydrated in concentrated ammonium hydroxide (28-30 %) for 30 min, dehydrated in aqueous ethanol (70 %) for 30 min, fixed for 2 h in pure ethylene glycol dimethyl ether (= 1,2-dimethoxymethane) and finally immersed in pure acetone for at least 2 h followed by critical point drying and sputtering with gold-palladium.

### List of taxa

*Badhamia foliicola* f. *flavescens* MEYL., Bull. Soc. Vaud. Sci. Nat. **57**: 301. 1931. (Figs. 1, 2)

**Specimen examined: Switzerland:** Granges de Sainte Croix, Canton Vaud, 1900 m s. m., leg. C. MEYLAN, 192? [sic], proposed as lectotype.

**Original description:** Aspect de *Badhamia nitens*, soit: sporanges jaunâtres. Les spores, par contre, sont bien celles de *B. foliicola*. Sur des branches entassées dans la tourbière de la Sagne, près Ste-Croix, 1020 m.

The material studied is scarce and consists of a twig stored in a transparent plastic tube, closed with a cork. The twig is stuck on a card and bears crowded sporocarps.

Sporocarps crowded, sessile. Sporotheca globose, up to 1 mm in diam. Hypothallus hyaline, inconspicuous. Peridium double, persistent, with irregular dehiscence; exoperidium calcareous, thin, rugous, yellowish white, closely united with the endoperidium and not separable of it; endoperidium membranous, hyaline. Columella absent. Capillitium yellowish white by magnifying glass, yellowish by LM; formed by a network of calcareous tubes, branched and anastomosed. Spores black in mass, violaceous brown by LM, 10-12 µm in diam., globose, verrucose, by SEM spore ornamentation consisting of baculae that can fuse forming short crests.

**Observations:** This form presents the same characteristics as *Badhamia foliicola* regarding to morphology of the sporocarps and spore diameters (10-12 µm), differing in the colour of the calcareous deposits of peridium and capillitium that are slightly yellowish. We observed a small difference in the spore ornamentation viewed by SEM, which in the form *flavescens* is composed of baculae that can fuse to form short crests, whereas *Badhamia foliicola* also has baculae, but more scarcely crests (LIZÁRRAGA & al. 1999, SINGER & al. 2001).

We do not dare to taxonomically appropriate *Badhamia foliicola* f. *flavescens* to any

other similar taxon due to the paucity of the type material. However, the only nivicolous species it is similar to is *B. alpina* G. LISTER, which differs from *B. foliicola* by "the pale colour of the plasmodium, the more hemispherical sporangia and the paler smoother spores" (LISTER 1925). In SINGER & al. (2001) it was considered that the differences between *B. alpina* and *B. foliicola* are so small that the separation of the two species could not be justified. For this reason we consider them synonyms, *B. foliicola* having priority, which considering its habitat is an abundant species at low altitudes, but can also be found in high mountain areas.

***Chondrioderma montanum* MEYL., Bull. Soc. Bot. Genève 2: 262. 1910 (Figs. 3, 4)**

**Specimen examined: Switzerland:** St. Oliver, Côte-aux-Fées, Canton Neuchâtel, 1100 m s. m., 11. 1907, on mosses growing over decayed wood, leg. C. MEYLAN, proposed as new lectotype.

**Original description:** Plasmodium? Sporangia stipitata, raro sessilia, alba vel rosea, 1 mm lata. Peridium duplex; cutis externa fragilis, calcarea; cuticula interna membranacea, ab externa separabilis. Stipes flavo-brunneus, 1/2 mm altus; columella sphaerica, magna vel parva, brunnea nonnumquam rufo-brunnea, raro pallida. Tubuli capillitii pauci ramificati, non flexuosi, brunneo-violacei. Sporae 7-9  $\mu\text{m}$  brunneo-purpureae, valde leviter spinulosae.

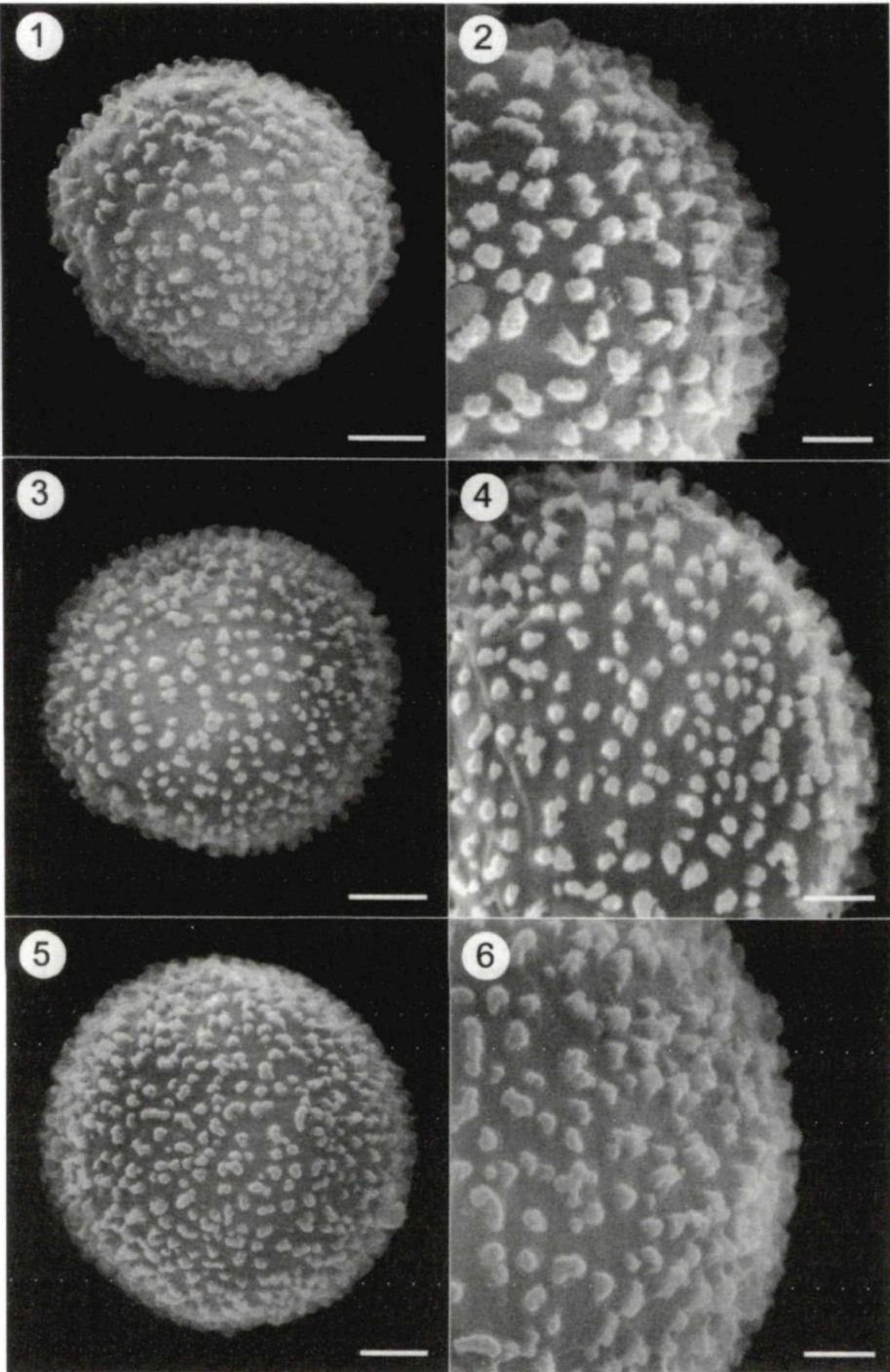
The material examined has fructified on bryophytes growing over pieces of decayed wood and is kept in an envelope.

Sporocarps gregarious to crowded, shortly stalked, up to 1.2 mm in total height. Sporotheca lenticular to subglobose, 0.8-1 mm in diam. Hypothallus hyaline, inconspicuous. Stalk very short or almost absent, up to 0.2 mm high, longitudinally striate, tapering towards the apex, brownish white to brown. Peridium double, with irregular dehiscence; exoperidium calcareous, cartilaginous, thick, smooth, beige-white, strongly united with the endoperidium; endoperidium thin, membranous, dark reddish brown, sometimes persisting in the base of the sporotheca where it is darker. Columella distinct, slender, cylindrical, with an obtuse apex, dark reddish brown. Capillitium blackish violaceous by magnifying glass, violaceous brown by LM, with clearer tips; filaments thin, about 1  $\mu\text{m}$  in diam., sinuous, with protuberances in the form of small nodes, sparsely branched and anastomosed. Spores black in mass, violaceous brown by LM, 8-9(10)  $\mu\text{m}$  in diam., globose, verrucose, by SEM spore ornamentation thick baculae.

**Observations:** As we have not been able to find the lectotype proposed by KOWALSKI (1975) for this species in LAU, we have chosen another specimen with abundant and well developed sporocarps, which was determined by MEYLAN as *Chondrioderma montanum*. We propose this specimen as new lectotype.

*Diderma montanum* is a species that can be characterized by shortly stalked sporocarps, double peridial layer, distinct, cylindrical columella, sinuous capillitium and spores 8-9(-10)  $\mu\text{m}$  in diam.

A close species is *Diderma umbilicatum* PERS., which has sporocarps 1-1.5 mm in diam., shortly stalked to almost sessile, globose to hemispherical, in groups and sometimes deformed due to mutual pressure; beige to light brown columella, rarely dark brown, globose to subglobose, 0.3-0.8 mm in diam., straight capillitium threads, hardly branched and spores 9-12  $\mu\text{m}$  in diam.



Figs. 1-6. Spores by SEM. - Figs. 1, 2. *Badhamia foliicola* f. *flavescens*. 1. Spore, bar: 2  $\mu$ m. 2. Detail of spore ornamentation, bar: 1  $\mu$ m. - Figs. 3, 4. *Chondrioderma montanum*. 3. Spore, bar: 2  $\mu$ m. 4. Detail of spore ornamentation, bar: 1  $\mu$ m. - Figs. 5, 6. *Diderma asteroides* var. *luteum*. 5. Spore, bar: 2  $\mu$ m. 6. Detail of spore ornamentation, bar: 1  $\mu$ m.

*Chondrioderma montanum* was combined by MEYLAN himself to *Diderma montanum* (MEYLAN 1913). HAGELSTEIN (1936) considered *D. montanum* as a phase of *D. radiatum* var. *umbilicatum* (PERS.) G. LISTER, today considered a synonym of *D. umbilicatum*. LISTER (1925), NANNENGA-BREMEKAMP (1974) and BUYCK (1982) observed intermediate forms between the two species. However, at this time, we prefer to maintain *Diderma montanum* as an independent species.

Although *Diderma montanum* fructifies in mountainous areas, it is not a strictly nivicolous species.

***Diderma asteroides* var. *luteum* MEYL., Bull. Soc. Vaud. Sci. Nat. 53: 454. 1921 (Figs. 5, 6)**

**Specimen examined: Switzerland:** Granges de Sainte Croix, Canton Vaud, 1100 m s. m., 10. 1920, on moss growing over decayed wood, leg. C. MEYLAN, holotype.

**Original description:** Diffère du type par la couleur jaune de la couche interne du peridium. Cette couleur est visible sur les cassures aussi bien que sur la face interne du peridium.

The type material is stuck on a card kept in a matchbox and consists of abundant sporocarps that have fructified on a bryophyte growing over decayed wood.

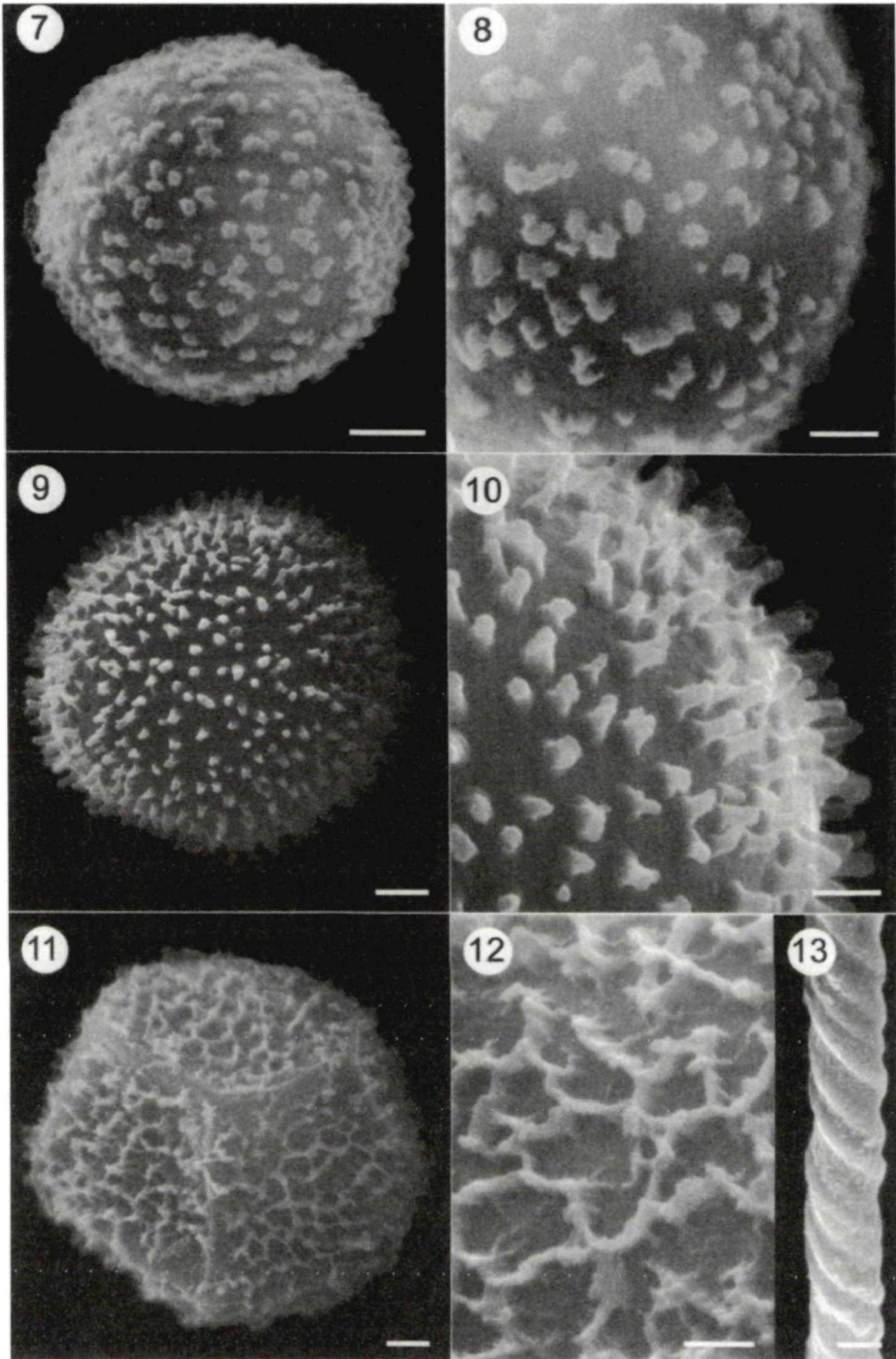
Sporocarps scattered, sessile. Sporotheca globose, up to 1 mm in diam. Hypothallus brownish, inconspicuous. Stalk absent. Peridium triple, with stellate dehiscence; exoperidium calcareous, cartilaginous, thin, reddish brown to dark brown, closely united with the intermediate layer; intermediate layer calcareous, thick, straw-white to yellowish-white, again very united with the endoperidium; endoperidium thin, membranous, hyaline. Columella reduced to an elevation of the base of the sporotheca. Capillitium dark brown by magnifying glass, dark violaceous brown by LM, with hyaline tips; filaments approximately 1 µm in diam., flexuous, branched and anastomosed. Spores dark brown in mass, violaceous brown by LM, 11-12 µm in diam., globose, verrucose, by SEM spore ornamentation thick baculae that can fuse forming short crests.

**Observations:** MEYLAN differentiated *Diderma asteroides* var. *luteum* by its yellowish colour of the intermediate peridial layer, which in *D. asteroides* (LISTER & G. LISTER) G. LISTER is white. We agree with the treatment of KOWALSKI (1975), who was of the opinion that this small difference in colour did not justify the separation of this variety, found by MEYLAN only once. We confirmed that the other macro- and microscopic characters coincide with those of *D. asteroides* var. *asteroides*, a species we have studied recently and synonymized with the nivicolous species *D. nigrum* KOWALSKI (MORENO & al. 2003 c).

*Diderma asteroides* is a facultative nivicolous species that can fructify with and without snow and at different altitudes.

***Diderma montanum* var. *roseum* MEYL., Bull. Soc. Vaud. Sci. Nat. 52: 450. 1919**

**Specimen examined: Switzerland:** La Chaux, near Sainte Croix, Canton Vaud, 1100 m s. m., 10. 1918, on leaf of liverworts growing over decayed wood, leg. C. MEYLAN, holotype.



Figs. 7-13. Spores and capillitium by SEM. - Figs. 7, 8. *Didymium niveum* f. *pulverulentum*. 7. Spore, bar: 2  $\mu$ m. 8. Detail of spore ornamentation, bar: 1  $\mu$ m. - Figs. 9, 10. *Didymium trevelyanii* var. *nivale*. 9. Spore, bar: 2  $\mu$ m. 10. Detail of spore ornamentation, bar: 1  $\mu$ m. - Figs. 11-13. *Didymium decipiens*. 11. Spore, bar: 2  $\mu$ m. 12. Detail of spore ornamentation, bar: 1  $\mu$ m. 13. Capillitium with spiral bands, bar: 1  $\mu$ m.

**Original description:** Plasmodium rouge. Sporangies d'un rose pâle.

The type specimen is conserved in a matchbox and consists of two pieces of wood bearing bryophytes on which a few sporocarps are conserved, stuck on a card. The sporocarps appear solitary or in groups of two to three.

In the material examined by us, sclerotized closed sporocarps containing a collapsed spore mass can be observed by magnifying glass what does not allow us to describe with details this variety. However, we point out that the only outstanding difference from *Diderma montanum* var. *montanum* is the pinkish white colour of the exoperidium, the other characters seem to agree with this species. Our study by light microscope and SEM confirms that we are dealing it with a bad fructification, as we could measure spores 8-14 µm in diam., collapsed, opened and with a poorly developed spore ornamentation.

**Observations:** We agree with MARTIN & ALEXOPOULOS (1969) and consider *Diderma montanum* var. *roseum* without taxonomic value, being this variety only a colour variation of *D. montanum*.

***Diderma niveum* f. *pulverulentum* MEYL. in SCHINZ, Ber. Schweiz. Bot. Ges. 13: 3. 1922 (Figs. 7, 8)**

**Specimen examined: Switzerland:** La Chaux, Vallon de Nant, Canton Vaud, 1800 m s. m., 5. 1920, leg. C. MEYLAN. Proposed as lectotype.

**Original description:** The description of this new form is limited to the commentary: "*f. pulveratum f. nova*, Chasseron und La Chaux sur Nant (Alp. vaud.) (3)". The reference (3) points to MEYLAN (1921). In this paper, on page 454, discussing *Diderma niveum* MEYLAN indicates: "J'ai rencontré au Chasseron et près des chalets de La Chaux sur Nant (Alpes vaudoises) une forme de cette espèce dont la couche calcaire externe du peridium était pulvérulente (forma pulverulenta) et non dure et lisse. Le *Didymium wilczekii* présente une forme semblable".

The type material is conserved in a matchbox, stuck on a card, and consists of two pieces of two herbaceous stems, each bearing an abundant group of sporocarps.

Sporocarps crowded, sessile. Sporotheca globose to subglobose, 1-2 mm in diam., snow white to slight creamy white. Hypothallus inconspicuous. Stalk absent. Peridium double, with irregular dehiscence; exoperidium thick, calcareous, powdery by magnifying glass; endoperidium membranous, hyaline to greyish hyaline. Columella globose to subglobose, light ochraceous to creamy white. Capillitium slightly greyish by magnifying glass, violaceous by LM, with hyaline ends; filaments 1-2 µm in diam., with nodes, sparsely branched and anastomosed. Spores black in mass, violaceous by LM, 10-12 µm in diam., globose, with small warts, by SEM spore ornamentation composed of fusing warts forming small crests.

**Observations:** *Diderma niveum* f. *pulverulentum* has a nivicolous habitat, white sporocarps and verrucous spores by LM, more obvious and with small crests by SEM. These characters correspond to *Diderma meyeræ* H. SINGER, G. MORENO, ILLANA & A. SÁNCHEZ described by MORENO & al. (2003 d). Thus we consider it a synonym of this



species.

Other nivicolous species macroscopically close to *Diderma meyeræ* are *D. alpinum* (MEYL.) MEYL. and *D. niveum* (ROSTAF.) T. MACBR., which differ clearly by spiny spore ornamentation by LM, with baculae by SEM. The *Diderma niveum* complex including this group of *Diderma* with sessile, white sporocarps and coriaceous peridium was studied recently by MORENO & al. (2003 d).

***Diderma trevelyanii* var. *nivale* MEYL.**, Bull. Soc. Vaud. Sci. Nat. **50**: 8. 1914 (Figs. 9, 10)

**Specimen examined: Switzerland:** Le Chasseron, Canton Vaud, 1580 m s. m., 6. 1913, on decaying conifer needles, leg. C. MEYLAN, lectotype.

**Latin diagnosis:** A typo differt sporangiis griseo-brunneis aerolato rugosis, irregulariter dehiscentibus; cutícula internaue iridescens vulgo libera; columella longa, lanceolata ut in *Diderma lyallii*.

The type is conserved in a matchbox and consists of six herbaceous stems stuck on a card, on which abundant and well-developed sporocarps can be found.

Sporocarps crowded to heaped, sessile. Sporotheca globose, 1.5-2 mm in diam., ochraceous. Hypothallus membranous, brownish. Stalk absent. Peridium triple, with apical and irregular dehiscence into large plates; exoperidium thin, ochre to ochraceous brown, covered by aggregated whitish calcareous scales forming lines united in a more or less lax reticulum and marking the areas of dehiscence, closely united with the intermediate layer; intermediate layer calcareous, thick, white, usually united with the endoperidium; endoperidium membranous, hyaline and iridescent. Columella globose to claviform, well developed. Capillitium dark brown by magnifying glass and LM, with hyaline extremities; filaments 2-3 µm in diam., straight, branched and anastomosed, with fusiform nodes. Spores dark brown in mass and by LM, with a clearer zone, 12-13 µm in diam., globose, very spiny, by SEM spore ornamentation large and slender baculae.

**Observations:** KOWALSKI (1975), after studying MEYLAN's collections, distinguishes *Diderma trevelyanii* var. *trevelyanii* (GREV.) FR. from *D. trevelyanii* var. *nivale* by stalked sporocarps, a stellate dehiscence of the peridium that bears few white lines on its surface, a small or absent columella and lowland habitat. *Diderma trevelyanii* var. *nivale* has sessile fructifications, an irregular dehiscing peridium with typical white lines on its surface, a well developed columella and an alpine habitat.

Later, NEUBERT & al. (1991) considered the differences indicated by KOWALSKI (1975) enough to consider *Diderma trevelyanii* var. *nivale* as a separate species, that they nominated as *D. nivale* (MEYL.) G. LISTER. But this new combination is invalid because on the species level there is an older, priority species called *Lepidoderma peyerimhoffii* MAIRE & PINOY that already was considered a synonym of *Diderma trevelyanii* var. *nivale* by MEYLAN (1931). The same authors subsequently rectified this realizing the correct combination of *Diderma nivale* to *D. peyerimhoffii* (NEUBERT & al. 2000). However, today this species has been reinstated in *Lepidoderma* as it was initially described (POULAIN & al. 2002).

*Lepidoderma peyerimhoffii* is cited from Europe (Austria, France, Germany and

Spain) and from Argentina.

***Didymium decipiens* MEYL., Bull. Soc. Vaud. Sci. Nat. 58: 319. 1935 (Figs. 11-13)**

**Specimen examined: Switzerland:** Petites Roaches, Le Chasseron, Canton Vaud, 1500 m s. m., 4. 1934, on decorticated, coniferous twigs, leg. C. MEYLAN, lectotype.

**Latin diagnosis:** *Didymio dubio* similiter. Peridii interna parte pelluciditate rufa. Capillitii filamentis incoloribus, rigidioribus, minus divisis, hic illic 1-3 spireis ornatis. Sporis 14-16  $\mu\text{m}$  latis, valde coloris papillosisque.

The type is conserved in a matchbox on which is indicated "*Didymium wilczekii*". The epithet "*wilczekii*" is crossed out and "*decipiens*" written below. The material consists of three decorticate twigs stuck on a card, with four well-developed plasmodiocarps.

Plasmodiocarps flat, effuse, greyish white, black when the lime deposits are missing. Hypothallus inconspicuous. Peridium membranous, dark greyish brown to blackish grey, iridescent, covered by lime crystals of different sizes. Capillitium brownish by magnifying glass, yellowish hyaline by LM, with hyaline ends; filaments 2-3  $\mu\text{m}$  in diam., with tightly wound spiral bands, straight and parallel, sparsely branched and anastomosed, with funnel-shaped ends. Spores black in mass, dark brown by LM, 16-20  $\mu\text{m}$  in diam., polyhedral to globose, subreticulate to reticulate, by SEM spores polyhedral with well-defined sides and the ornamentation formed by a reticulum of irregular meshes, sometimes incomplete, with non-perforated walls and more or less dented projections.

**Observations:** *Didymium decipiens* is characterized by plasmodiocarpous fructifications with a dark peridium that turns white to grey due to the lime deposits, uniformly coloured capillitium formed by filaments ornamented with tightly wound spiral bands (that remind us of some species of the order *Trichiales*) and large, subreticulate to reticulate spores, 16-20  $\mu\text{m}$  in diam., polyhedral with well-defined walls by SEM.

*Didymium dubium* and *D. nivicolum* are two close nivicolous species. The former can sometimes also bear spiral bands in its capillitium, but these are never present in the entire capillitium, are loosely wound and dark brown. *Didymium dubium* further can be differentiated by smaller, globose (and not polyhedral) spores, 10-15  $\mu\text{m}$  in diam., ornamented with baculae that are united by low walls forming an incomplete reticulum by SEM. *Didymium nivicolum* completely lacks spiral bands in its capillitium and has smaller spores 12-15  $\mu\text{m}$  in diam., globose to slightly polyhedral and with an ornamentation composed of baculae with claviform and flat apices by SEM.

***Didymium nivicolum* MEYL., Bull. Soc. Vaud. Sci. Nat. 57: 40. 1929. (Figs. 14, 15)**

**Specimen examined: Switzerland:** Salanfe, Canton Valais, 2000 m s. m., 10. 6. 1917, on decaying plant debris, leg. C. MEYLAN, lectotype.

**Original description:** Plasmodium? Sporangies 1 à 1.5 mm de diamètre, sessiles, subglobuleux ou plasmodiocarpes, blancs. Paroi interne du péridium très mince,

transparente, couverte d'étoiles de calcite formant une couche plus ou moins pulvérulente, soit comme chez les *Didymium melanosporum* et *D. crustaceum*. Ces étoiles varient comme diamètre. Capillitium assez semblable à celui de *D. dubium*, à branches non onduleuses, plutôt rigides, anastomosées; noduleuses ici et là ou présentant les renflements brunâtres ou pourprés, oblongs, allongés. Columelle peu élevée, jaunâtre. Spores de 12 à 15 µm, d'un pourpre noir, très sombres, presque opaques; nettement et assez fortement papilleuses.

The type material is conserved in a matchbox and is composed of five pieces of herbaceous stems, stuck on a card, bearing independent sporocarps that occasionally are fused to form plasmodiocarps of different dimensions.

Fructifications sporocarpic or plasmodiocarpic, white. Sporocarps pulvinate, up to 2 mm in diam., that can fuse in order to form short plasmodiocarps. Plasmodiocarps effuse to vermiform. Hypothallus inconspicuous. Peridium double; exoperidium calcareous, breaking up in more or less concave flakes, white; endoperidium hyaline to brownish hyaline, iridescent. Capillitium dark brown by magnifying glass, brownish by LM, with hyaline ends; filaments about 1 µm in diam., with nodes up to 2 µm in diam., sinuous, with scarce ramifications and anastomosis. Spores black in mass, dark brown by LM, globose to polyhedral, 12-15 µm in diam., spiny, by SEM spores more or less polyhedral and ornamentation consisting of baculae with claviform and flat apices fusing to form short crests.

**Observations:** *Didymium nivicolium* is a species that can be well differentiated by sporocarpic to plasmodiocarpic fructifications, with a discontinuous exoperidium that breaks up into more or less concave flakes, and spores 12-15 µm in diam., globose to slightly polyhedral and ornamented by baculae with claviform and flat apices fusing to form short crests when viewed by SEM.

Recently we have collected this species in Austria and Spain (SINGER & al. 2001, MORENO & al. 2003 a) and the macro- and microscopic characters coincide with the type material.

This species has scarcely been cited from Europe from France, Italy, Scotland, Spain, and Switzerland, and in the United States from Colorado.

*Didymium wilczekii* MEYL., Bull. Soc. Vaud. Sci. Nat. 44: 290. 1908 (Figs. 16, 17)

**Specimen examined: Switzerland:** La Chaux, near Sainte Croix, Canton Vaud, 1100 m s. m., 5. 1908, on herbaceous plant debris, leg. C. MEYLAN, lectotype.

**Original description:** Plasmodium grisâtre, puis gris-foncé. Sporangies blanc grisâtre ou pur, toujours plasmodiocarpes, atteignant 1 à 8 cm de longueur sur 2 à 8 mm de largeur et 0,3 à 0,5 mm d'épaisseur. Paroi mince, incolore ou grisâtre, visible sur le bord du sporange (où manque parfois la couche de calcite), couverte de calcite en étoiles grandes et petites en aiguilles, en bâtonnets, en grains, sphériques ne formant pas de couche continue et séparable. Lorsque cette couche de calcite est très mince, les grandes étoiles manquent fréquemment. Capillitium brun pourpre, très abondant, à filaments perpendiculaires au support, très divisés et reliés ou anastomosés entre eux par de nombreux rameaux se séparant à angle droit ou sous un angle très ouvert comme chez *Didymium dubium*, et formant parfois comme un réseau. Ces filaments toujours de

même grosseur, présentent toujours la même teinte. Leurs extrémités décolorées sur une faible longueur ne s'amincissent pas et s'épatent même parfois. En somme le capillitium est constant et ne présente guère de variations. Columelle nulle. Spores 9 à 12  $\mu\text{m}$  finement spinuleuses, brun pourpre foncé.

The type material is conserved in an envelope containing three herbaceous stems and four pieces of twigs with abundant plasmodiocarps.

Plasmodiocarps flat, effuse, white to greyish white. Hypothallus inconspicuous. Peridium simple, membranous, hyaline, iridescent, covered by a layer of lime crystals, white to greyish white, dehiscence irregular. Capillitium abundant, brownish by magnifying glass, violaceous brown by LM, with hyaline ends; filaments 1-2  $\mu\text{m}$  in diam., smooth, with scarce nodes, straight to sinuous, with pointed ends, branched and anastomosed. Spores brown in mass, light violaceous brown by LM, globose, 10-12  $\mu\text{m}$  in diam., with spinules of irregular distribution, by SEM spore ornamentation composed of baculae united by low walls without perforations forming an incomplete reticulum.

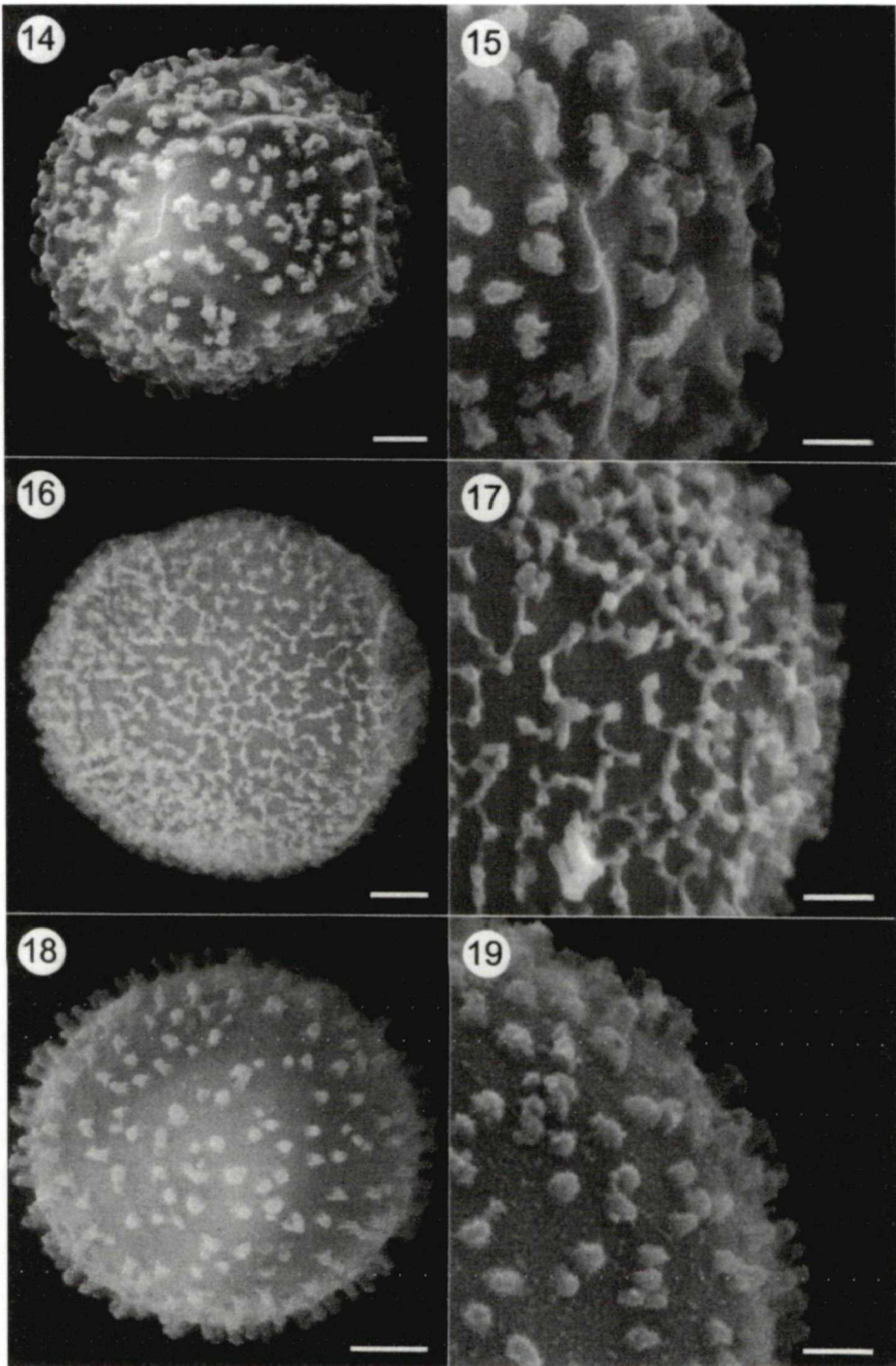
**Observations:** We consider that *Didymium wilczekii* is the same species as *D. dubium* and should be synonymized with it, as the variable macro- and microscopic characters coincide, as well as the spore ornamentation by SEM. The type studied coincides with the nivicolous collections of *Didymium dubium* from Austria and Spain (SINGER & al. 2001, MORENO & al. 2003 a).

KOWALSKI (1975) already indicated the synonymy of these two taxa. NEUBERT & al. (1995) did not recognize *Didymium wilczekii* as an independent species and placed it within the concept of *D. dubium*, which they considered to be a very broad and variable taxon. These authors distinguished between lowland forms of *D. dubium* and nivicolous forms, in which they differentiated new groups. However, after studying numerous specimens gathered at different altitudes, we conclude that it is impossible to establish constant differences of taxonomic value. All the collections represent one very variable species.

***Lamprodermopsis nivalis* MEYL.,** Bull. Soc. Vaud. Sci. Nat. **46:** 56. 1910 (Figs. 18, 19)

**Specimen examined: Switzerland:** La Col de l'Aigullon, Canton Vaud, 1280 m s. m., 5. 1909, on dead grass stems, leg. C. MEYLAN, lectotype.

**Original description:** Plasmodium? Sporangies isolés, sessiles ou pédicellés de 1 à 1,5 mm de diamètre, globuleux, blonds avec reflets métalliques. Stipe de même couleur, de 0 à 1 mm de hauteur. Peridium membraneux, lisse, persistant longtemps à la base du sporange. Columelle nulle. Capillitium naissant du sommet du stipe et du 1/4 inférieur du périidium; formé de filaments, d'abord dressés et simples puis divisés sous des angles de plus en plus ouverts à mesure que l'on s'approche de la surface du sporange. Les dernières divisions sont anastomosées avec de nombreuses extrémités libres, donnant ainsi au sporange dépouillé de son peridium l'aspect d'une minuscule éponge, d'autant plus que la couleur est la même. Ces filaments sont lisses, raides ou ondulés. Spores d'un blond très pâle, presque transparentes sous le microscope, très finement papilleuses, de 10 à 12  $\mu\text{m}$ .



Figs. 14-19. Spores by SEM. - Figs. 14, 15. *Didymium nivicolum*. 14. Spore, bar: 2  $\mu\text{m}$ . 15. Detail of spore ornamentation, bar: 1  $\mu\text{m}$ . - Figs. 16, 17. *Didymium wilczekii*. 16. Spore, bar: 2  $\mu\text{m}$ . 17. Detail of spore ornamentation, bar: 1  $\mu\text{m}$ . - Figs. 18, 19. *Lamprodermopsis nivalis*. 18. Spore, bar: 2  $\mu\text{m}$ . 19. Detail of spore ornamentation, bar: 1  $\mu\text{m}$ .

The lectotype is kept in an envelope on which is written and crossed out "*Lamproderma violaceum* var. *brunnescens*", beside the note "sp. 11 à 14 µm, columelle 0". The material is very scarce and consists of two loose fragments of herbaceous stems, a small one and a larger one. The bigger piece bears only the remains of the bases of sporocarps, and on the smaller stem three sporocarps and remains of fructifications are conserved.

Sporocarps solitary, sessile. Sporotheca globose to subglobose, up to 1.5 mm in diam., ochraceous brown. Hypothallus hyaline, inconspicuous. Peridium simple, persistent, membranous, iridescent, light brown by LM, irregular dehiscence. Columella absent. Capillitium abundant, pale ochraceous by magnifying glass, pale yellow by LM; filaments up to 4 µm in diam., narrower towards the apex where it branches abundantly. Applying phase contrast, pores can be seen on the surface of the capillitium. Spores pale ochraceous in mass, pale yellowish by LM, 10-12 µm in diam., globose, spinulose, by SEM spore ornamentation formed by dense baculae.

**Observations:** The genus *Lamprodermopsis* was proposed by MEYLAN (1910), who characterized it by globose, sessile or stalked sporocarps with persistent membranous peridium, shiny with metallic reflections, without columella, with a capillitium originating in the lower part of the peridium forming filaments similar to the ones of a *Lamproderma*. One year later, LISTER (1911) accepted the validity of the species, but did not recognize the genus. He transferred the species to the genus *Dianema*, basing himself on the slender capillitial filaments and its blond-coloured spores and capillitium, placing it in *Dianema nivale*. KOWALSKI (1975) considered it a true species, but also within the genus *Dianema*.

The capillitium of the type material having pores on its surface when viewed with phase contrast has caught our attention, but we have not been able to confirm this detail by SEM due to the scarce material. In order to precise this character, more collections are necessary. As KOWALSKI (1975) had already indicated, the sporocarps are sessile, and not stalked, in the lectotype studied.

*Dianema nivale* is a rarely cited nivicolous species, known from Germany, France, Ireland, Scotland, and also the United States and Japan.

*Lepidoderma carestianum* var. *flavescens* MEYL., Bull. Soc. Vaud. Sci. Nat. **44**: 292. 1908 (Figs. 20, 21)

**Specimen examined: Switzerland:** near La Vraconnaz, Canton Vaud, 1100 m s. m., 5. 1908, on living twigs, leg. C. MEYLAN, lectotype.

**Original description:** Calcite gris jaunâtre, columelle et face interne de la paroi d'un jaune foncé; spores 9 à 11 µm. C'est surtout sur les tiges de framboisier que j'ai rencontré cette nouvelle variété.

The type material is conserved in an envelope and consists of four twigs with abundant sporocarps and plasmodiocarps.

Fructifications in the form of sporocarps that can fuse and form short plasmodiocarps, crowded and cramped. Sporocarps hemispherical to subglobose, frequently angular due to mutual pressure, up to 1.5 mm in diam., mixed with slender and generally straight plasmodiocarps. Hypothallus brownish, membranous. Columella hemispherical

to elongate in the plasmodiocarps, pale ochraceous. Peridium simple, thin, membranous, brownish, covered with abundant and densely crowded calcareous scales; scales greyish, with the borders more or less rounded. Capillitium dark brown by magnifying glass, violaceous brown by LM, extremities hyaline; threads 1-2  $\mu\text{m}$  in diam., little branched and anastomosed, with nodes. Spores dark brown in mass, violaceous brown with a distinct clearer zone by LM, 10-12  $\mu\text{m}$  in diam., globose, spiny, by SEM irregularly distributed baculae with more or less coralloid apices observable.

**Observations:** MEYLAN (1908) differentiated *Lepidoderma carestianum* var. *flavescens* from *Lepidoderma carestianum* var. *carestianum* by yellowish grey calcareous scales, the deep yellow columella and inner face of the peridium, and small spores 9-11  $\mu\text{m}$  in diam. KOWALSKI (1975) had already observed greyish calcareous scales without yellowish coloration, a pale brown inner surface of the peridium, a pale ochraceous columella and spores 10-12  $\mu\text{m}$  in diam., characters we can confirm by the revision of the material. KOWALSKI (1975) thought that part of MEYLAN's observations are due to the slight yellow tint of the calcareous scales when observed under a stereoscopic microscope and the yellowish colour of the inner surface of the peridium when the yellow colour of the underlying hypothallus shows through.

MORENO & al. (2003 b, 2004) examined the type material of *Reticularia carestiana* RABENH., from the herbaria B, BPI, BR and WRSL, and the types of the species of *L. aggregatum* KOWALSKI (from UC), *L. crustaceum* KOWALSKI (from BPI and MICH), and *L. didermoides* KOWALSKI (from UC). We conclude that *L. carestianum* (RABENH.) ROSTAF. differs from the other species of the genus by extensive plasmodiocarpous fructifications and spiny spore ornamentation with pointed and not coralloid apices by SEM.

*Lepidoderma aggregatum* and *L. didermoides* form sessile sporocarps and present similar capillitia and spore ornamentations. We have considered both *L. aggregatum* and *L. didermoides* to be synonyms of *L. chailletii*, the type of which we have not been able to localize (MORENO & al. 2004). However, we have followed the concept of LISTER (1925), based on the type material of *L. chailletii*, who gave a brief description of it: "clustered sessile sporangia, hemispherical on broad brown bases, with columella ridge-like or hardly developed".

On the other hand, we have considered *Lepidoderma crustaceum* to be a good species that also forms sporocarps, being very close to *L. chailletii*. But the first differs by cream ivory to straw white, didermoid fructifications, the absence of a columella, a scarce, stout, sinuous capillitium, and mainly by spores with an ornamentation formed by baculae not having coralloid apices by SEM.

POULAIN & al. (2002) recognize *Lepidoderma carestianum*, after studying type material of this species, as a species different from *L. chailletii*, and also accept as different the species *L. aggregatum* and *L. didermoides*, the types of which, however, they have not studied. They separate *Lepidoderma carestianum* from *L. chailletii* because the first has a double peridium and forms large, flat plasmodiocarps, whereas *L. chailletii* has a single peridium and forms sporocarps and sometimes small plasmodiocarps.

The material of *Lamproderma carestianum* var. *flavescens* forms preferably sporocarpic fructifications, with columella and a spore ornamentation formed by baculae with more or less coralloid apices. For these reasons we consider it to be a synonym of *L. chailletii*. The different colorations indicated by MEYLAN do not justify the crea-

tion of this variety.

***Physarum alpinum* f. *albescens* MEYL.,** Bull. Soc. Vaud. Sci. Nat. **57**: 303. 1931, forma inv. (Figs. 22, 23)

**Specimen examined: Switzerland:** Le Chasseron, Canton Vaud, 1580 m s. m., 6. 1930, leg. C. MEYLAN.

**Original description:** Il se présente assez fréquemment sous une forme *albescens* a sporanges blancs ou d'un jaune très pâle, mais à nœuds jaunes comme ceux du type.

The studied material is conserved in a small cardboard box and consists of three twigs with short, crowded plasmodiocarps. On the box is indicated "*Physarum alpinum* var. *albescens*", although MEYLAN described this taxon as a form.

Fructifications in the form of short crowded plasmodiocarps. Hypothallus colourless, membranous, inconspicuous. Stalk absent. Peridium double, persistent; exoperidium calcareous, thick, rough, scaly, pale yellowish white by magnifying glass; endoperidium membranous. Columella absent. Capillitium composed of large yellowish lime nodes connected by hyaline filaments; filaments 1-2  $\mu\text{m}$  in diam. Spores blackish brown in mass, medium brown by LM, 10-12  $\mu\text{m}$  in diam., globose, spiny, by SEM dense baculae observable.

**Observations:** As MEYLAN (1931) does not indicate this taxon as a new form, it was not validly published.

*Physarum alpinum* is a species close to *P. alpestre*. The latter was initially included within *P. alpinum* and subsequently separated by MITCHEL & al. (1986). *Physarum alpestre* is characterized by slender and large plasmodiocarps, smooth, yellow to ochraceous peridium, the capillitium being badhamioid in the lower part of the plasmodiocarp and physaroid above, the presence of a distinct columella, spores 11-13(-14)  $\mu\text{m}$  in diam., and the habitat, preferably herbaceous stems. On the other hand, *Physarum alpinum* forms sporocarps or short plasmodiocarps, with a rough, scaly peridium, bright cadmium yellow to dull yellow or yellow-brown, has no columella, capillitium that is badhamioid in the upper part of the fructification and physaroid below, spores (9-)10-11(-12)  $\mu\text{m}$  in diam., and the habitat is primarily decayed coniferous wood.

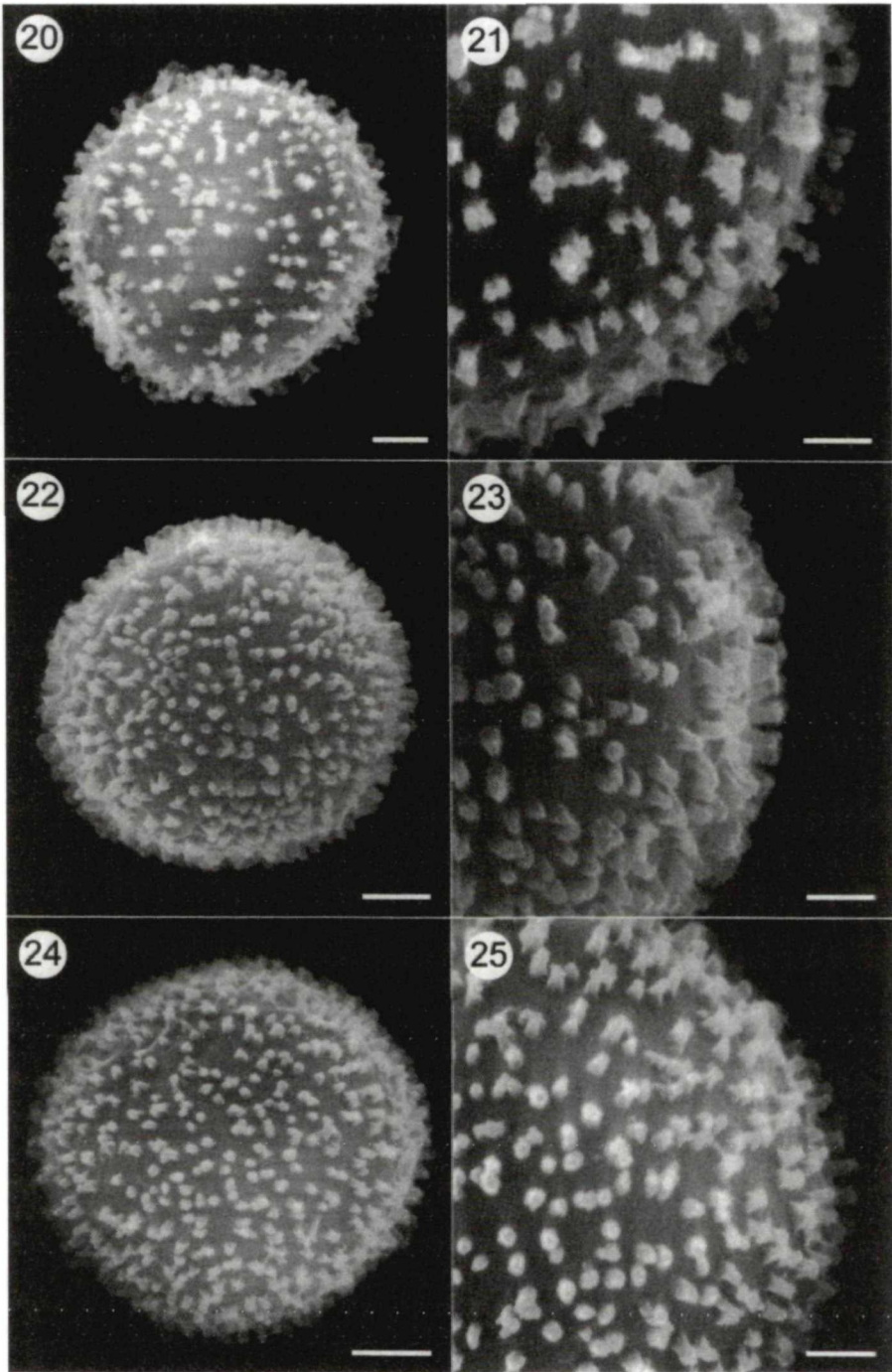
*Physarum alpinum* f. *albescens* coincides both macro- and microscopically with the actual concept of *P. alpinum*.

***Physarum alpinum* f. *badhamioides* MEYL.,** Bull. Soc. Vaud. Sci. Nat. **50**: 6. 1914, forma inv. (Figs. 24, 25)

**Specimen examined: Switzerland:** Bois de la Natron, between Sainte Croix and Jougne, Canton Vaud, 1200 m s. m., 5. 1913; leg. C. MEYLAN.

**Original description:** Le *Physarum alpinum* présente des variations parallèles à celles de *P. vernum*, mais la forma *badhamioides* est moins bien caractérisée. Les sporanges sans calcite extérieure restent toujours jaunâtres.





Figs. 20-25. Spores by SEM. - Figs. 20, 21. *Lepidoderma carestianum* var. *flavescens*. 20. Spore, bar: 2  $\mu$ m. 21. Detail of spore ornamentation, bar: 1  $\mu$ m. - Figs. 22, 23. *Physarum alpinum* f. *albescens*. 22. Spore, bar: 2  $\mu$ m. 23. Detail of spore ornamentation, bar: 1  $\mu$ m. - Figs. 24, 25. *Physarum alpinum* f. *badhamioides*. 24. Spore, bar: 2  $\mu$ m. 25. Detail of spore ornamentation, bar: 1  $\mu$ m.

The material is kept in a small cardboard box, is sparse and consists of a fragment of a herbaceous stem with five scattered fruiting bodies: three sporocarps and two small plasmodiocarps (formed by fusion of three or four sporocarps). As has happened with the form *albescens* mentioned above, on the box is written "*Physarum alpinum* var. *badhamioides*", although MEYLAN regarded it as a form.

**Observations:** MEYLAN (1914) briefly described *Physarum alpinum* f. *badhamioides* without indicating it as a new form. Consequently this form was not validly published.

The differences indicated by MEYLAN in his description which separate it from *Physarum alpinum* are insignificant. The badhamioid capillitium is often present in *P. alpinum* and the spore ornamentation formed by dense baculae under SEM is the same.

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