

## On two new tropical *Vararia* (Russulales, Basidiomycota) with extremely small, racemose dichohyphidia

Bernard DUHEM<sup>a</sup> & Bart BUYCK<sup>b</sup>

<sup>a</sup> Muséum national d'histoire naturelle, Direction des collections,  
Herbier Mycologie (PC), Case Postale n° 39, 57, rue de Cuvier,  
F-75231 Paris cedex 05, email : duhem@mnhn.fr

<sup>b</sup> Muséum national d'histoire naturelle, Département de Systématique et Evolution  
Case Postale n° 39, UMR 7205, 57, rue de Cuvier, F-75231 Paris cedex 05,  
email : buyck@mnhn.fr

**Abstract** – *Vararia V. lanquetiniana* and *Vararia V. boidiniana* (Basidiomycota, Russulales), two new species respectively collected in New-Caledonia (France, South Pacific) and Mayotte (France, Comoros archipelago, Indian Ocean), are described and illustrated in this paper. Both species form resupinate, pellicular and closely adnate, greyish to ochre-argillaceous fruit bodies, and produce smooth, thin-walled, non-amyloid basidiospores, without a distinct amyloid suprahilar spot (in *V. lanquetiniana* sometimes with a very subtle grayish patch). Both are in particular characterized by unusually small, racemose dichohyphidia, not dichotomically branching, but with very short, tortuous or finely botryophysoid terminal branches, very weakly dextrinoid, only partially so after AMA treatment. *V. lanquetiniana* is the second species of *Vararia* described from New-Caledonia, whereas *Vararia V. boidiniana* is the first representative of this genus on the Island of Mayotte.

**Mayotte / New Caledonia / Peniophoraceae / taxonomy**

**Résumé** – *Vararia V. lanquetiniana* et *Vararia V. boidiniana* (Basidiomycota, Russulales), respectivement nouvelles espèces néo-calédonienne (France, Pacifique Sud) et de l'île de Mayotte (France, Archipel des Comores, Océan Indien), sont décrites et illustrées dans cet article. Ces 2 espèces assez similaires par l'apparence de leur basidiome étalé, pelliculaire à crustacé mince, très adhérent et intimement lié au support, grisâtre à argillacé-ocracé, sont des *Vararia* à spores lisses, à paroi mince non amyloïdes, sans plage amyloïde supra-apiculaire ou bavette (sauf chez *V. lanquetiniana* chez laquelle les spores peuvent avoir une très subtile plage grisâtre) et possèdent toutes deux de très petites dichophyses non dichotomiques, mais racémeuses aux rameaux ultimes courts, frisottés, tortueux ou très finement botryophysoïdes en texture dense aux ramifications peu discernables, peu ou très partiellement dextrinoïdes, même après le traitement AMA. *V. lanquetiniana* est la deuxième espèce de *Vararia* décrite de Nouvelle-Calédonie et *Vararia V. boidiniana* la première pour l'île de Mayotte.

**Mayotte / Nouvelle Calédonie / Peniophoraceae / taxinomie**

## INTRODUCTION

Reid (1965) introduces family Lachnocladiaceae for the genera *Dichopleuropus* Reid 1965, *Lachnocladium* Lév. 1849 emend. Corner 1950, *Asterostroma* Masee 1889, *Vararia* P. Karst. 1898 and *Scytinostroma* Donk 1956, to which Boidin et Lanquetin (1977) add *Dichostereum* Pilát 1926, previously interpreted as a subgenus of *Vararia* (Boidin 1967).

Together with Dichostereaceae Jülich 1981 and Dichantharellaceae Jülich 1981, this family constitutes the order Lachnocladiales Jülich 1981, accepted by Boidin *et al.* (1998) on the basis of their shared possession of fibres, dendrodicho- or asterohyphidia with thickened, dextrinoid and cyanophilous walls, considered diagnostically more important than the amyloidity of spores. Since then, and confirming the views of Oberwinkler (1977), more recent phylogenetic studies (Binder *et al.*, 2005; Larsson & Larsson, 2003; Larsson, 2007) have placed these resupinate species in the russuloid clade, a group of morphologically very different fungi, all sharing the possession of so-called gloeocystidia or sulfocystidia, which may or may not react positively with sulfoaldehydes.

The type-species of *Vararia*, *V. investiens* (Schw.) P. Karst., and a number of closely related species belonging to some satellite genera have been shown to be part of the Peniophoraceae (Larsson & Larsson, 2003; Larsson, 2007), a clade comprising cantharelloid, clavarioid, corticioid or stereoid species, all sharing predominantly smooth basidiospores and a tendency towards non amyloid spore-walls. The possession of differentiated skeletal hyphae, simple or branched fibers, dico-, dendro- or asterohyphidia are interpreted as features of secondary importance (Larsson & Larsson, 2003).

*Vararia* accounts today for some 66 different species. The many valuable contributions of J. Boidin and P. Lanquetin (both were mycologists in Lyon, France) demonstrated the wide distribution of the genus *Vararia* as well as its high diversity in the tropics, in particular in Africa and the Lesser Antilles (Boidin 1967, 1980, 1989; Boidin & Lanquetin 1975, 1977, 1984; Boidin *et al.*, 1976, 1980, 1986, 1987a; Boidin & Michel 1998; Boidin & Gilles 1999). Both Frenchmen also contributed to our knowledge of some of its satellite genera, such as *Dichostereum* (Boidin & Lanquetin 1973, 1977, 1980; Lanquetin & Boidin 1984; Boidin *et al.* 1987b; Boidin & Michel 1998; Lanquetin 1973b) and also *Scytinostroma* (Boidin et Lanquetin 1976, 1987; Boidin *et al.*, 1987a, 1988; Lanquetin 1973a), a genus that is extremely close to *Vararia*, even molecularly (Boidin *et al.*, 1998; Larsson, 2007).

Fruit bodies of *Vararia* are uncommon to quite rare in the temperate climates of the northern hemisphere, but become quickly much more frequent when approaching the tropics, especially when focusing certain types of substrates: dead wood, lianas, suspended dead wood, especially from family Araceae (Boidin *et al.*, 1980, based on experiences in Gabon and the Central African Republic).

The purpose of this paper is to dedicate two new and unusual and interesting species from French overseas departments to these two French mycologists who have contributed so much to the taxonomy of this genus: *Vararia lanquetiniana* sp. nov. and *V. boidiniana* sp. nov. Whereas the former species is the second representative of *Vararia* for New Caledonia (after *V. rosulenta* Boidin, Lanquetin & H.S. Mc Kee 1986), the latter is the first report of the genus from Mayotte.

## MATERIAL AND METHODS

The specimens were collected by the second author and photographed in the field before drying. Both specimens are deposited in the mycological herbarium of the National natural history museum, Paris (PC).

Macro- and microscopical observations are based on the herbarium specimens. The Munsell Soil-Color Charts (2010) are used for precision of the fruit body color.

Detailed microscopic observations and illustrations are based on thin, freehand sections or surface scrapings that were observed in Congo red and a mixture of a 2-3% (w/v) Potassium hydroxyde solution and a 1% (w/v) aqueous Phloxine B solution. Melzer's reagent was used to check for the presence of amyloid or dextrinoid reactions, whereas Cotton blue was used to check for cyanophilic reactions. All measurements are based on 30 spores. For the location and study of the unusually small dichohyphidia, as well as for the demonstration of weak dextrinoid reactions, AMA treatment (Boidin *et al.*, 1980b) was used: small portions of tissue were kept in pure ammonium (NH<sub>4</sub>OH) solution at 60°C for approximately 15 to 20 hours, then mounted in acetic Melzer (Melzer with addition of 10% acetic acid solution).

## TAXONOMY

*Vararia lanquetiniana* Duhem & Buyck sp. nov.

Figs 1-9

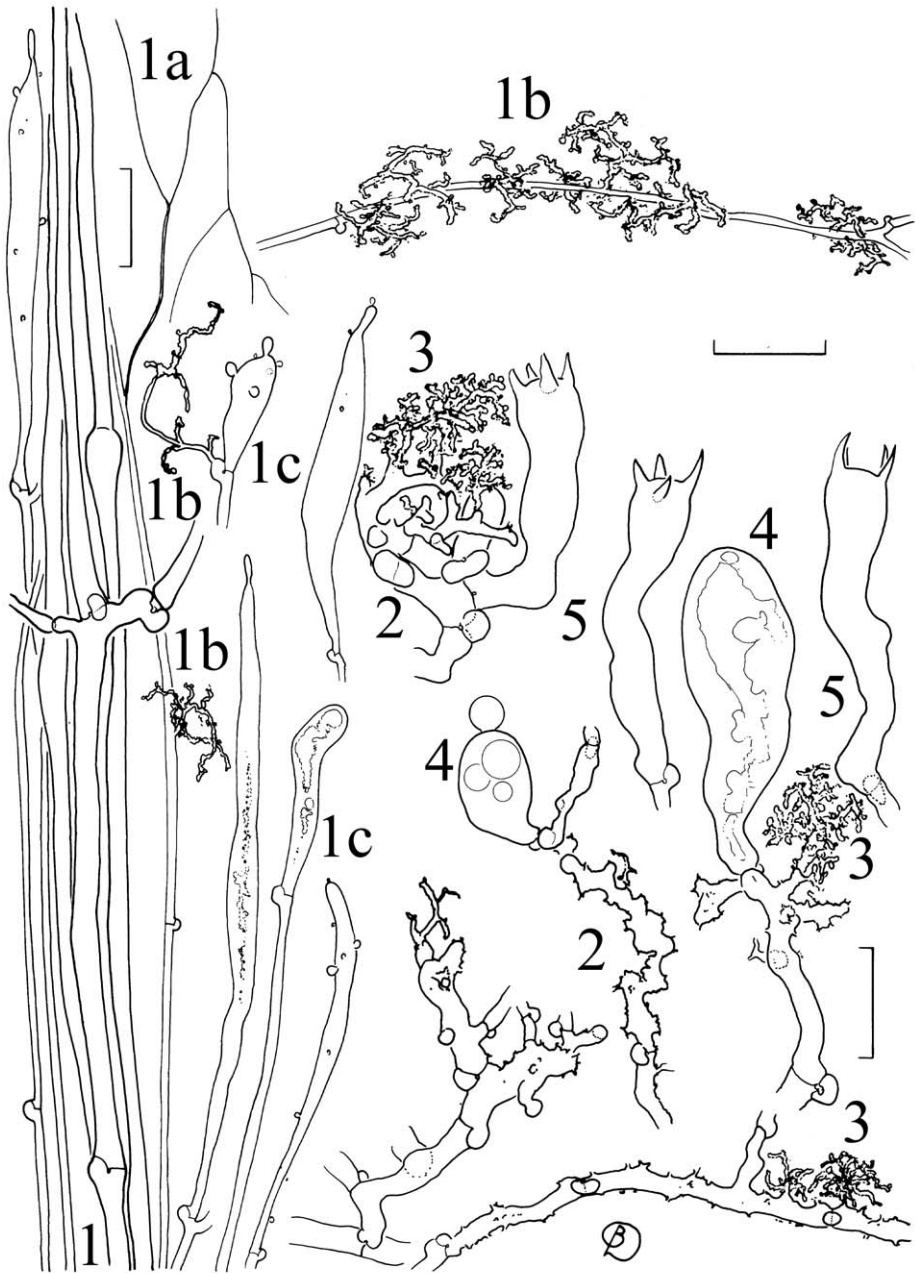
*Mycobank*: MB 802421

*Diagnosis*: Apart from its distribution, *V. lanquetiniana* can be distinguished from other close *Vararia* species and from *V. boidiniana* by its less fusiform spores, 5.5-8 (9.5) × 2.2-3 (4.4) μm, and its shorter, more rounded gloeocystidia having more differentiated, refringent and slightly yellowish contents.

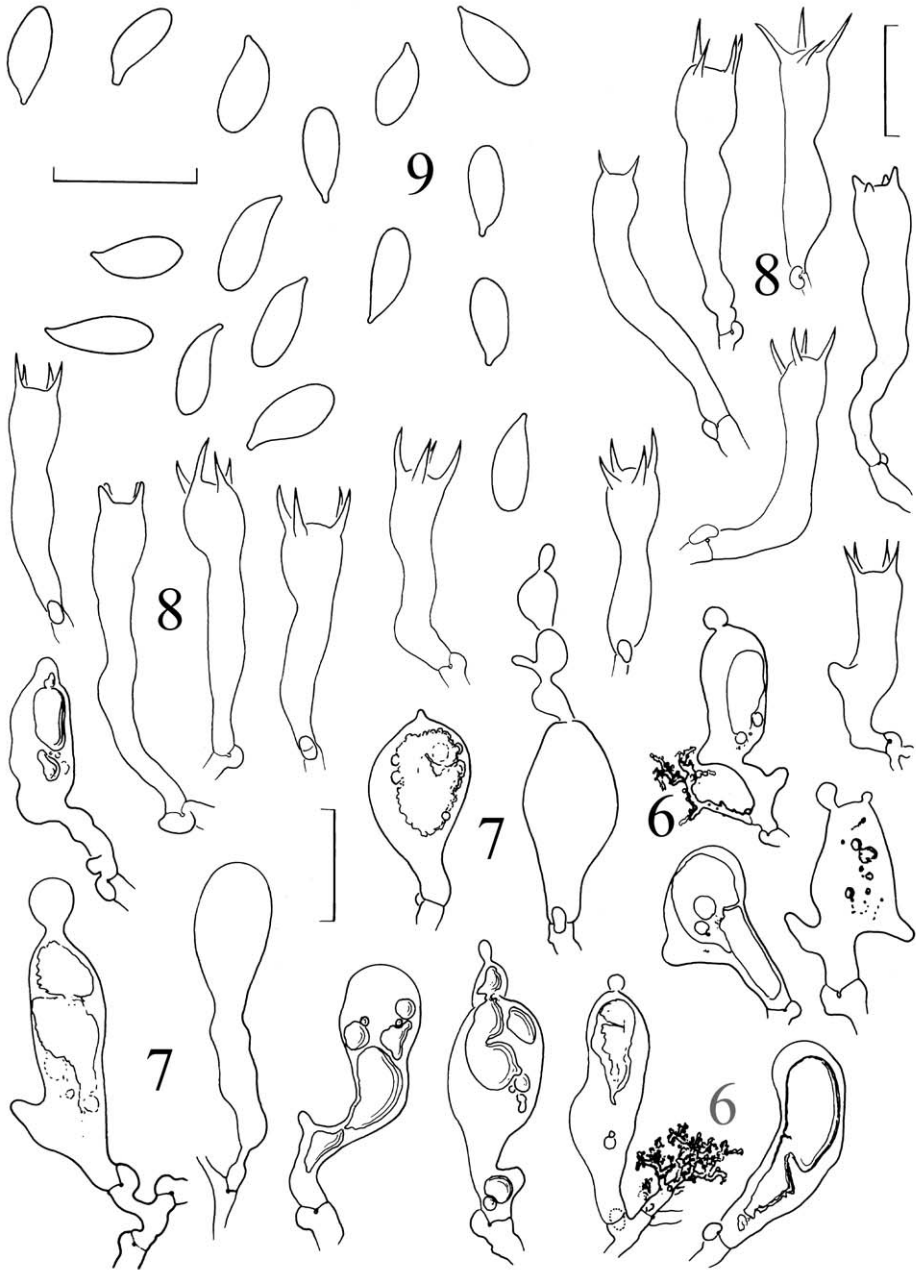
*Holotypus*: FRANCE (French Overseas Dept.). New Caledonia (Indian Ocean), "Ile des Pins", near beach close to "la piscine d'Oro" along a trail from the lodge "Chez Regis", on rotten wood, 1 April 2009, B. Buyck 09.254, in herbario PC conservatur sub nr. PC0086036.

*Etymology*: Dedicated to Paule Lanquetin, research engineer in mycology at l'Université de Lyon 1 and collaborator of Jacques Boidin, in appreciation of his considerable contributions to worldwide *Vararia*.

**Basidiome** resupinate, effused, pruinose, pellicular and adhering to its support, often enclosing small debris, continuous, then somewhat thicker and minutely tuberculate-granulate under the hand lens. At first grayish or gray (Gley 1:7-8/N), then with a very pale greenish tint (10 Y 8/1 à 6/1-6/2 up to 5GY 7/1-6/1) or olive (5YR 7/2-6/2-6/3), finally turning more ochraceous (5Y 7/3-7/4), or even brownish (2,5Y 7/4 à 7/3), becoming more dull once dried. Margin well-delimited, pruinose, pellicular, off-white to gray, developing some cottony or cob web-like filaments and some extremely thin, whitish rhizomorph-like strands. The **subjacent mycelium** is composed of narrow, generative hyphae of very regular diam., 0.8-2.5 μm diam. (up to 5.5 μm inside the rhizomorph-like strands - Fig. 1), more or



Figs 1-5. *Vararia lanquetiniana* sp. nov. (holotype). **1a-c**. Elements from the subjacent mycelium and fine rhizomorphic strands. **1a**. Capillary fibers. **1b**. Racemose dichohyphidia. **1c**. Terminal sulfocystidia on generative hyphae. **2**. Dendroid subhymenial hyphae giving rise to dichohyphidia. **3**. Small racemose dichohyphidia from the context and hymenium. **4**. Hymenial sulfocystidia. **5**. Basidia. Scale 1 a-c = 20  $\mu$ m, 2 to 5 = 10  $\mu$ m.



Figs 6-9. *Vararia lanquetiniana* sp. nov. (holotype). 6. Small subhymenial dichohyphidia. 7. Sulfocystidia. 8. Basidia. 9. Spores. Scale = 10  $\mu$ m.

less thin-walled and resembling skeletal hyphae because of the widely separated septa giving rise to abundant but extremely narrow (ca. 0.1-0.25  $\mu\text{m}$ !), capillary fibres of dichohyphidia-like nature (Fig. 1a) and also to short, lateral, strongly tortuous to cauliflower-like ramifications (Fig. 1b). These small fascicles of dichohyphidia, generally not dextrinoid, grow laterally or from a clamp connection, either very dispersed along the hyphal walls or in crowded, inextricable clusters. These same generative hyphae may end in the formation of very slender, usually optically empty, appendiculate gloeocystidia (Fig. 1c). In transversal section, the **context of fruit bodies** is almost inexistant and sections show merely a dense mixture of gloeocystidia, basidiola and basidia mingled with racemose to cauliflower-like dichohyphidia with extremely short ramifications. The latter are only very locally or partially dextrinoid, even after AMA-treatment (Fig. 3 & 6). Also in between basidia, very small and slender dendroid hyphae or deformed endings of generative hyphae can be observed giving rise to dense clusters of dichohyphidia (Fig. 2). **Gloeocystidia** abundant, 13-34  $\times$  4.5-8.6  $\mu\text{m}$ , morphologically variable, subglobose, clavate to subcylindrical, sometimes pedicellate, flexuous to compressed, with multiple lateral appendices, obtuse, moniliform, capitulate or with several schizopapillae (Fig. 4 & 7), filled with refringent yellowish, SV-negative inclusions. **Basidia and pleurobasidia** claviform to utriform, often deformed because of irregularly flexuous walls or local inflations or constrictions, mostly four-spored, clamped at the base, 15-25  $\times$  4-4.5  $\mu\text{m}$  (Fig. 5 & 8). **Spores** 5.5-6.50-8 (9.5)  $\times$  2.2-2.80-3 (4.4)  $\mu\text{m}$ . Q = 2.06-2.38-2.96, ellipsoid-fusoid, obtuse or somewhat narrowing at the tip, sometimes more angular and almost narrowly rhomboidal, thin-walled, not amyloid but sometimes with a weakly grayish suprahilar spot (Fig. 9).

*Material examined:* FRANCE. New Caledonia (Indian Ocean), Ile des Pins, on wood, 1 April 2009, B. Buyck 09.254, in herbario PC conservatur sub nr. PC0086036, Holotype).

***Vararia boidiniana* Duhem & Buyck sp. nov.**

**Figs 10-15**

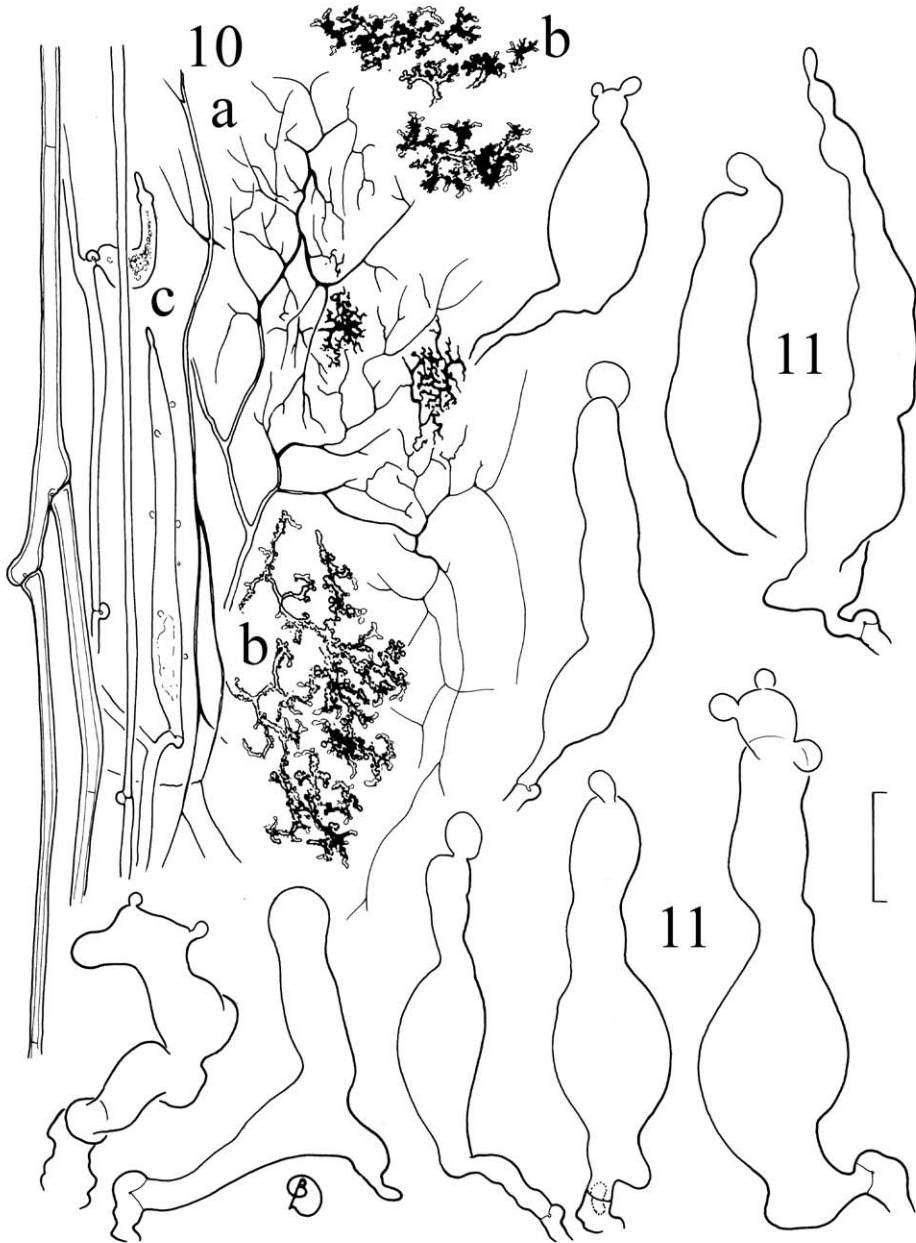
*Mycobank:* MB 802422

*Diagnosis:* Differs from the closely related *Vararia boidiniana* (Mayotte, France, Comoros archipelago, Indian Ocean) by its more slender basidiospores and longer gloeocystidia; from *Vararia calami* Boidin & Lanquetin 1975 by its smaller, non-amyloid basidiospores, 5.5-8.5  $\times$  1.8-2.2  $\mu\text{m}$ , lacking an amyloid suprahilar spot and by its unusually small, racemose dichohyphidia, that do not branch dichotomically, but develop dense, minute and hardly dextrinoid, botryophysoid, terminal branches.

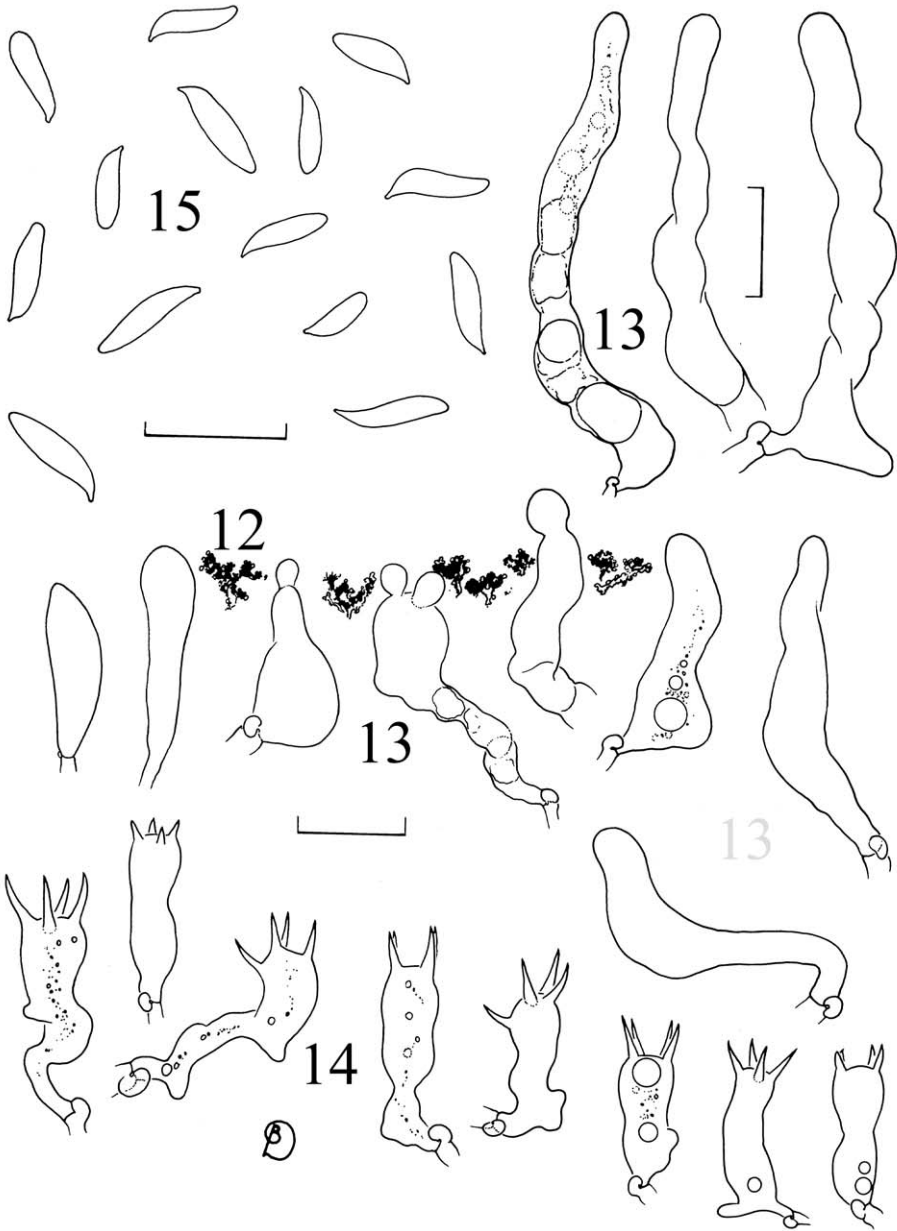
*Holotypus:* FRANCE (French Overseas Dept). Mayotte (Archipelago of the Comoros, Indian Ocean), near the "Gite du Mont Combani", 363 m alt., on wood, S 12.80454, E 45.15489, 14 January 2010, B. Buyck & V. Hofstetter legunt sub nr. 10.405, in herbario PC conservatur sub nr. PC0001218.

*Etymology:* Dedicated to Jacques Boidin, Prof. Emeritus at the laboratory of mycology and microbiology of the "Université de Lyon 1" and worldwide expert on *Vararia*, for his invaluable contributions to the taxonomy of this genus.

**Basidioma** crust-like, pellicular and strongly adhering, whitish, ochraceous-alutaceous (2,5Y 8/2 à 7/4) to dull brownish (10YR 6/3-6/4); margin abrupt, very thin and bluish gray (2,5Y 7/0). **Subiculum** in the subjacent woody substrate composed of narrow, sparsely septate, clamped hyphae, with dispersed secondary



Figs 10 et 11. *Vararia boidiniana* sp. nov. (holotype). **10a-c.** Elements from the subiculum; **10a.** Capillary fibers. **10b.** Tufts of racemose dichohyphidia. **10c.** Sulfocystidia. **11.** Sulfocystidia from context and hymenium. Scale = 10 μm.



Figs 12-15. *Vararia boidiniana* sp. nov. (holotype). **12.** Very small racemose dichohyphidia near the surface. **13.** Sulfocystidia. **14.** Basidia. **15.** Spores. Scale = 10 µm.



septa; sometimes wider and with slightly thickened wall, developing ampullaceous clamps (Fig. 10) or having sometimes identical contents as sulfocystidia. **Sulfocystidia** terminal, narrow, long, often with several lateral or terminal schizopapillae (Fig. 10c). Subiculum hyphae also developing very narrow fibres, less than 1  $\mu\text{m}$  diam. and clusters of tortuous hyphae that are clamped at the base of the fruit body and develop botryoid, more or less dense, minute ramifications (probably the subiculum equivalent of the racemose dichohyphidia in the fruit body) with partly and weak dextrinoid reactions after AMA treatment (Fig. 10b). **Gloeo-cystidia** numerous, up to  $60 \times 14 \mu\text{m}$ , fusoid, clavate, cylindrical or irregularly constricted, flexuous to moniliform at the apex, often appendiculate with 1-3 globose appendices; contents hyaline, SA-negative (Figs 11 & 13). **Dichohyphidia** locally abundant to nearly absent or difficult to observe because of their extremely small size, bearing very short racemose, cauliflower-like ramifications (Fig. 12), hardly dextrinoid unless after AMA treatment, inserted directly, without almost any basal stipe-like development, on the walls of the clamped, generative hyphae. **Basidia and pleurobasidia**  $11-20 \times 4-5.5 \mu\text{m}$ , cylindrical, clavate, often centrally constricted and subutriform, tortuous or flexuous, four-spored, and with a clamp connection at the base (Fig. 14). **Spores**  $5.5-6.75-8.5 \times 1.8-1.94-2.2 \mu\text{m}$ .  $Q = 2.86-3.47-4.72$ , narrowly fusiform, often curved and narrowing upward, thin-walled, smooth, not amyloid, without amyloid, suprahilar spot (Fig. 15).

*Examined material:* FRANCE (French Overseas Dept). Mayotte (Archipelago of the Comoros, Indian Ocean), near the "Gite du Mont Combani", 363 m alt., on wood, S 12.80454, E 45.15489, 14 January 2010, B. Buyck & V. Hofstetter 10.405 (PC0001218).

## DISCUSSION

Both new species are very similar, yet widely separated geographically. Apart from the presence of abundant clamp connections and non-amyloid spores that lack a suprahilar spot (although in *V. lanquetiniana* certain spores show a subtle graying above the apiculus), both also share the unusually small and highly ramified, cauliflower-like dichohyphidia. These dichohyphidia are very difficult to find, partly because they are unequally distributed throughout the fungal tissue, and partly because of their extremely small size. In addition, these botryophyoid or cauliflower-like, minute appendages are only very weakly and usually also partially dextrinoid, unless when treated with AMA (Boidin *et al.*, 1980b), which renders a clear dextrinoid reaction to the large majority of these minute dichohyphidia.

As far as *V. boidiniana* is concerned, the only other known *Vararia* with similar features (Boidin et Gilles, 1999) is *V. calami* Boid. & Lanq. 1975, a species with larger spores,  $12-19 \times 3.5-5 \mu\text{m}$ , bearing a distinctly amyloid suprahilar spot. The latter species is found on climbing, spiny palms in inundated areas of the Central African Republic and Gabon (Boidin *et al.*, 1980), a different habitat from the secondary vegetation at higher elevation in Mayotte where *V. Boidiniana* was found. The spores of *V. boidiniana* are also reminiscent of some other *Vararia* which, however, all lack clamp connections: *V. cremea* Boid., Lanq. & Gilles 1980, *V. trinidadensis* Welden 1965 and *V. phyllophila* (Masse) Rogers & Jackson 1943. *V. mediospora* Boid., Lanq. & Gilles 1980, has spores of identical length ( $5.5-8 \mu\text{m}$ ), but slightly larger ( $2-3.2 \mu\text{m}$ ), more ellipsoid or ovoid and not fusiform.

**Acknowledgements.** The collecting in Mayotte was financed by the French Mycological Society through its convention N°099/DAF/2009 of 16/11/2009 with the Direction of Agriculture and Forestry (DAF, Mayotte). We also would like to thank the “Agroscope Changins-Wädenswil” (Nyon, Suisse) for offered facilities. Finally, field work would not have been possible without the support from Danny Laybourne (DAF, Mayotte) and the efficiency of Valérie Guiot, Guillaume Viscardi, Abdou Andhume and Ali Bacar Sifari from the “Conservatoire botanique national de Mascarin” (CBNM), Coconi, Mayotte. Collecting in New Caledonia was funding by two ANR (BIONEOCAL ANR-07-BDIV-006 et ULTRABIO ANR-07-BDIV-010) and with the support of Denis Poignonec of Koniambo Nickel SAS for access to the forests near Koniambo, and the logistical support from the Mycological Society of New Caledonia ([www.smmc.nc](http://www.smmc.nc)). Collecting permits were obtained from the Environmental Direction of the Southern Province of New Caledonia.

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