A CONTRIBUTION TO THE STUDY OF THE BOLETACEAE—SUILLOIDEAE

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ABSTRACT. *Suillus bellinii*, *S. boudieri*, *S. cembrae*, *S. fluryi*, *S. granulatus* and *S. plorans*, and a possible form of the latter, are recorded from Greece; full descriptions are given and in most cases cultural characters. *S. abietinus*, *S. alboflocculosus*, *S. alkaliaurantians*, *S. obscurus* & *S. roseovelatus* all from the same region are described as new. Cultural characters are described for all new species excepting *S. alkaliaurantians*. Four unnamed series of collections grouped on cultural characters are described, as are two of uncertain position. The relationships of these fungi with their conifer hosts and reasons for their distribution are discussed.

INTRODUCTION

Little work has been carried out on the boletes of the Eastern Mediterranean region. Reichert (1940) has discussed the taxonomy and nomenclature of *Suillus bellinii* and *S. boudieri* (under the names *Rostkovites bellinii* and *R. boudieri* respectively) and has given details of their distribution in SW Asia. Few records of boletes exist for Greece although members of the Boletaceae are far from rare, particularly during the month of October, continuing to appear until early December. The opportunity is therefore taken here to describe as fully as possible some of the species belonging to the subfamily Suilloideae.

We believe that the boleti included in this study are all mycorrhizal and dependent for their presence and distribution on species of Coniferae. The pines found in Greece come into the eastern margin of Mirov's (1967) Mediterranean pine region; the distribution of the conifers in Greece shows an interesting pattern. Thus, forests of *Pinus halepensis*† are found pure, or often mixed with *P. brutia* from sea level to 1000 m and are generally confined to southern Greece reaching the northern part of Evvoia; it also occurs in Chalkidiki and the island of Zakinthos. *Pinus nigra* is found scattered almost all over Greece and in certain localities it is accompanied or replaced by its subspecies *pallasiana*. *Pinus sylvestris* is confined to the area north of Mount Olimbos and *P. peuce* to the northern mountains of Rodopi and Peristeri; *P. heldreichii* occurs in central and northern Greece around Mount Olimbos and Pindos and *P. mugo* is confined to the mountains of Western Thrace.

Abies cephalonica grows from 400–1800 m, rarely to 2000 m and mostly between 800 and 1600 m; it is almost confined to the southern part of Greece and the island of Kefallinia. *Abies alba* occupies much of northern Greece whereas *A. borisii-regis* extends from central to northern Greece. A map of the distribution of the main conifers under which our collections were made, i.e. *Pinus halepensis*, *P. nigra* and *Abies cephalonica* accompanies this account (fig. 1).

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† All conifer names follow Flora Europaea, Vol 1. (1964) and Flora of Turkey, Vol 1. (1965).

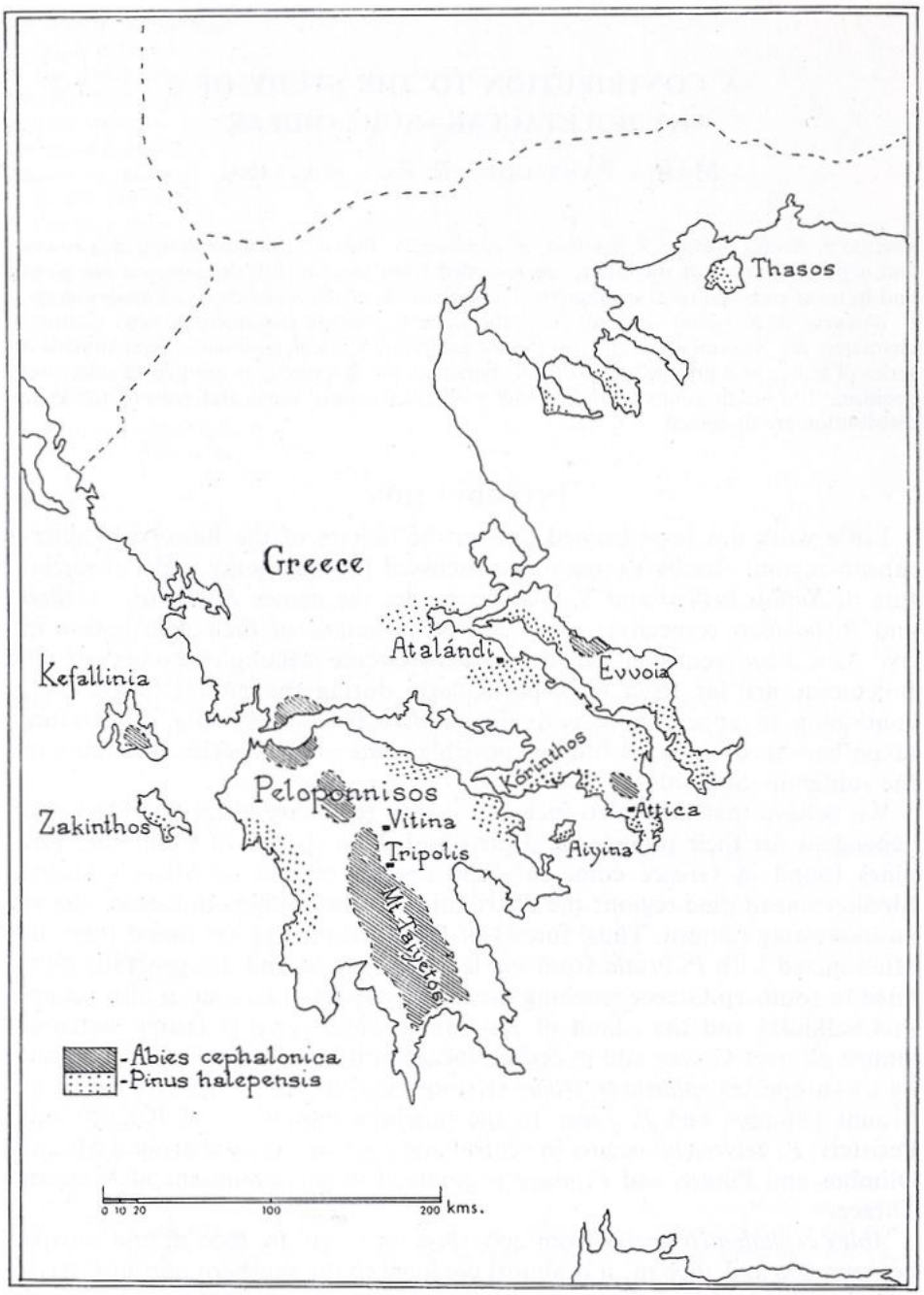

FIG. 1. Map of Greece and neighbouring islands including Thasos showing regions in which specimens were collected and the distribution of *Abies cephalonica* and *Pinus halepensis*. *Pinus nigra* is spread throughout the area.

There is a vast area of conifer forest yet to be explored mycologically and the taxa encountered there, although posing some problems, may have in store the answer to several questions which have arisen in the study of the boletes of northern and south-western areas of Europe.

Some of our collections were made in mountainous forests composed of pure stands of *Abies cephalonica* with a few low-lying junipers, mainly *Juniperus oxycedrus*. In such forests the boletes most frequently encountered were: *Boletus edulis* Fries, *B. erythropus* (Fries) Secretan, *B. queletii* Schulzer, *B. piperatus* Fries and one xerocomoid species, *B. chrysenteron* Fries. A bolete with some of the characters of *B. regius* Krombholz is also frequently found; it grows to enormous sizes and has often been found in very great quantity. Members of the genus *Suillus*, in these same woods, are rather rare but nevertheless all have been found to be of great interest, as will be shown below.

In contrast, in the lower-lying pine forests, mainly of *Pinus halepensis*, we found members of the genus *Suillus* predominating. They grow not only in great quantity but the material exhibits a wide range of morphological characters. In fact, the variability encountered in our collections proved at first very confusing and the component specimens difficult, not only to separate into specific entities, but to tie-up satisfactorily with published data. This was true for specimens not only from different localities but also for collections made within a square mile or so of the same wood.

Fennoscandia and neighbouring countries to the south were scoured clean during the Ice Age whilst, although changing in content, the flora of the Mediterranean region exhibited a continuum. Thus in northern Europe during this period of ice, snow and cold the flora became depauperate or static, and even during the period of colonization thereafter many species of plant did not migrate back to their former localities; throughout this same period the components of the flora of the Mediterranean differentiated to a finer or coarser degree. This is particularly important to appreciate for mycorrhizal fungi like species of *Suillus* are very closely tied to their host plants, indeed may well have evolved in some instances along with their respective associates. It has been rare for agaricologists to think in terms of the phytogeographic aspects of their study and it remained for a plant pathologist to suggest possible explanations for bolete distribution in southern Europe and SW Asia (Reichert, 1940); even since 1940 little emphasis has been placed on the host-fungus distribution in Europe.

One of us (Watling, 1967a) has already expressed the view that the taxonomy of the agaric and bolete components of the Mediterranean flora may well prove to be one of great complexity, paralleling that of many of the phanerogamic groups of the same region. The results of the present study tend to support this view.

The present study is the first attempt to examine critically a group of the Agaricales as it occurs in Greece. As has been suggested by the work of Smith & Thiers (1964) in the United States both the identification and classification of members of the genus *Suillus* are very complex. Their observations showed that many more species exist in North America than was formally supposed. In Europe, simply judging from the literature it would appear at first sight that little or no such difficulty should be encountered for only a few taxa are described; even the recent treatment by Singer (1965) appears

to be fairly straightforward but now we feel it does not really express the complexity of this group of fungi in Europe. In the last decade it has been found necessary, in order to obtain a better understanding of the Agaricales, to describe several new taxa and re-describe in modern terms collections which could be considered to agree as closely as possible with the concepts attached to the old names (Blum, 1965, 1967; Huijsman, 1969; Watling, 1967b etc.). The species concept in the higher fungi is now quite narrow, or, if large species units are retained, a number of entities are identified within them (Blum 1965, 1967). The species concept here accepted is parallel to that already indicated by Orton (1960), Hesler & Smith (1963, 1965), Smith & Singer (1964), Smith & Hesler (1968), Watling (1967a, b) etc. in various groups in the Agaricales; A. H. Smith (1968) has recently reviewed the reasons for recognising a narrow species concept.

Methods

To ease the initial stages of the study, separation was made of those collections showing, in the field, small differences in fruit-body morphology; they were labelled and numbered as though they were quite different and cultured separately. It was not only interesting but extremely gratifying to find that in most cases the separation was justified for, as will be shown below, the cultures were often very strikingly different. It was thus possible to marry information from modern laboratory methods with those from a more classical approach. Such a marriage has in our study shown firstly how exceedingly close the results from these two entirely different paths can be and secondly that our suspicions of a whole spectrum of species existing in Greece were confirmed. We have independently worked on the project and although using the same material, have used quite different techniques; only when we were about to write the present paper were our respective notes brought together for the first time and then we found an amazing degree of agreement. Thus we are able for the first time to support the narrow species concept in *Suillus* with cultural studies.

The important criteria for identification used in our study were: a), presence or absence of velar remains either as a ring, ring-zone, or roll of velar tissue at the pileus margin; b), viscidity of the pileus, measured either directly in the field or in the laboratory by the use of sections mounted in ammoniacal or alkali solutions; c), colour of the pileus and stipe; d), colour and distribution of the stipe glandules and e), presence and colour of the mycelium at the stipe base.

The presence of a veil, as already suggested by one of us (Watling, 1965), is of prime importance in the taxonomy of the group and although closely related species-pairs, e.g. *Suillus luteus* and *S. fluryi; S. albovelatus* and *S. brevipes* can be found with and without veil tissue respectively we believe that these taxa are separate entities and should not be simply considered varieties of a single species.

All cultures were established by the tissue culture method (Pantidou, 1961, 1966). It was found that the tissue from young fruit-bodies gave the same type of culture as those obtained from older fruit-bodies. Similar cultures were obtained using tissue taken from the stipe and the pileus and so indicated the consistency and reproducibility of our methods. The medium

utilised was that used in previous studies, i.e. Modess' modification of Hagem's medium, as outlined by one of us (Pantidou 1961, 1966).

The criteria used in the cultural studies were: a), the amount of growth in a Petri dish after one month, from a central inoculum; b), texture and colour of the mycelium including reference to differences at the margin of the colony; c), colour of the reverse; d), hyphal ornamentation; e), type of branching exhibited by hyphae and f), presence of clamp-connections and any associated branching. Melin's term *paarige* branching has been adopted for that type of branching illustrated earlier by one of us (Pantidou, 1961).

Chemical reactions of the colony were also recorded but we have restricted the published information to the colour changes induced by gum guaiac (a saturated alcoholic solution), formol (40% aqueous solution) and alkali (10% aqueous solution of KOH). The colour changes of the dried tubes when mounted in ammoniacal solutions and the reaction of the fresh flesh with KOH are also recorded.

The dried material has been deposited at Edinburgh and at Benaki; some material has been deposited at the Plant Research Institute, Ottawa, Canada. The cultures described below are kept under mineral oil in a 10°C refrigerator at the Benaki Institute of Phytopathology in Athens. The abbreviations for Royal Botanic Garden, Edinburgh and Plant Research Institute, Ottawa follow Lanjouw & Stafleu (1964); the abbreviation for the Benaki Institute, Athens does not appear in the same publication and we propose here to designate it as MPIH.

A map is appended to indicate the regions in which the specimens were collected (fig. 1); localities follow The Times, 'World Atlas—South Europe & Africa' (1956).

Taxonomic treatment

We believe that the majority of the taxa discussed in this paper belong to *Suillus* section *Suillus* subsection *Angustiporini* Singer (type *S. granulatus*); there is only one collection which may have affinities with subsection *Hirtellini* Singer or section *Bovini* Singer. In Smith & Thiers' scheme (1964) all these species would be placed in *Suillus* sect. *Suillus*.

The following is a synopsis of the species to be discussed:

A. Previously described species

1. *Suillus bellinii* (Inzenga) Watling
2. ,, *boudieri* (Quélet) Watling
3. ,, *cembrae* (Studer) Singer
4. ,, *fluryi* Huijsman
5. *Suillus granulatus* (Fries) O. Kuntze
6. ,, *plorans* (Rolland) O. Kuntze
7. ,, aff. *plorans* cf. *Ixocomus cembrae* f. *obscuratus* Singer

B. New species described in this paper

1. *Suillus abietinus* sp. nov.
2. ,, *alboflocculosus* sp. nov.
3. ,, *alkaliaurantians* sp. nov.
4. *Suillus obscurus* sp. nov.
5. ,, *roseovelatus* sp. nov.

C. Notes on un-named collections

1. Cultural Group I
2. Cultural Group VI
3. Cultural Group VII
4. Cultural Group IV (remainder)

D. Collections of uncertain position

1. MPIH–959: the status of the clamp-connection as a taxonomic character
2. MPIH–698: the significance of the orange reaction with alkali

A. Previously described species

1. Suillus bellinii (Inzenga) Watling in Notes R.B.G. Edinb. 28: 59 (1967).

Pileus whitish to chamois becoming distinctly ochraceous or pale rust-colour, the latter retained on drying. *Pores* greenish yellow then dirty yellow at maturity becoming flushed with olivaceous brown, particularly where roughly handled; when dry faintly purplish brown with NH_4OH. *Stipe* yellow in a small apical zone, dirty white to buff below, short, conical and matted with mycelium at base, covered with small, reddish brown glands which darken considerably on drying to become vinaceous brown.

Basidiospores 7·5–10 × 3·3–3·8 μm, subfusoid in side view, ellipsoid in face view, smooth, pale straw-colour in both Melzer's reagent and NH_4OH, some reddish brown when in proximity to cystidia. *Basidia* 4-spored, hyaline or slightly coloured in NH_4OH, 12–14 × 4·5–6 μm, faintly yellow in Melzer's reagent. *Pleurocystidia* in clusters, dark brown in NH_4OH, rich red-brown in Melzer's reagent, cylindric to subclavate, 22–25 × 4·5–6 μm, covered in brown, amorphous material, with red-brown pigment globules in Melzer's reagent; *cheilocystidia* similar, soon obliterated by deposition of brown, amorphous material. *Hymenophoral trama* of gelatinised, hyaline or faintly yellowish hyphae, divergent from a slightly more coloured, central strand. *Pileal surface* of repent, hyaline or pale, gelatinised, smooth to faintly asperulate hyphae, 4–6 μm broad, not associated with pigment globules in Melzer's reagent; *caulocystidia* subclavate to fusiform, rounded at apices, less frequently drawn out, frequently septate, dark brown, variable in length, 40–60 × 8–12 μm, broad, numerous, in obvious clusters, associated with some development of pigment globules in Melzer's reagent. *Clamp-connections* not seen.

In forest of *Pinus halepensis*, Dionisos, Attica, 23 xi 1966, *Pantidou* MPIH–756 (no culture).

The description of this material is taken from a transparency and dried material and is therefore rather sketchy. However, it agrees closely with Inzenga's coloured plate and the microscopic details are parallel to the material described recently from Majorca by one of us (Watling, 1967a) Unfortunately, we failed to obtain cultures.

2. Suillus boudieri (Quélet) Watling in Notes R.B.G. Edinb. 28: 61 (1967).

Pileus up to 80 mm, pallid at first, then vinaceous to cinnamon, viscid. *Tubes* decurrent with fine wings of hymenial tissue running down stipe apex. *Stipe* 40–80 × 10–20 mm, equal or tapering to a point at base, covered in pinkish to vinaceous glandules. *Flesh* soft, pale yellow, unchangeable, with KOH vinaceous-red then black.

Basidiospores 7·5–10(11) × 3·8–4·5(5) μm, broadly subfusoid in side view, more ellipsoid in face view, smooth, pale straw-colour in NH_4OH, only slightly darker and more ochreous in Melzer's reagent. *Basidia* 4-spored, 17–25·5 × 5–6 μm, clavate to cylindrical, hyaline in NH_4OH, yellowish in

Melzer's reagent. *Pleurocystidia* in clusters, dull brown in NH_4OH, infrequent, cylindric-clavate to fusiform-elongate c. 45 μm × 4·5–6·5 μm with some encrusting material, associated with red-brown and colourless globules in Melzer's reagent; *cheilocystidia* up to 60 μm × 4·5–6·5 μm, dark ochreous to dark brown; *caulocystidia* numerous, soon covered in dark brown amorphous material, frequently up to 40 × 8 μm, forming tight bundles, numerous small groups between main groups, interconnected one to the other by brown material. *Hymenophoral trama* of colourless, gelatinised hyphae, divergent from slightly more coloured, narrow, central strand which is pale brown in Melzer's reagent. *Pileal surface* of repent, slightly gelatinised, smooth hyphae, 4·5–7·5 μm broad, colourless to pale brown in NH_4OH, overlying open pileus trama which is red-brown in Melzer's reagent; this zone passes into more compact, dull brown layer overlying subhymenium at base of tubes, unassociated with large development of pigment-globules. *Clamp-connections* not seen.

In forest of *Pinus halepensis*, Varibombi, Attica, 30 x 1966, *Pantidou* MPIH–702 (no culture); part collection in E and DAOM.

Only one collection has been made to date; it appears to be a rare species. It is unfortunate that the material was not suitable for culturing. At the moment, therefore, it is impossible to compare in culture *S. bellinii* and the present species, something which will be of prime importance in assessing the species of *Suillus* in the Mediterranean.

3. Suillus cembrae (Studer) Singer in Farlowia 2: 277 (1945).

Pileus up to 100 mm, dark reddish brown, smooth, glabrous, viscid, resembling *Russula adusta* in colouring, slightly inturned at margin. *Tubes* 6 mm long in mature areas; *pores* slightly brownish with NH_4OH when dry. *Stipe* 25–40 × 18 mm, yellow at apex, dirty whitish elsewhere, covered with brown glandules. *Flesh* watery, lemon-yellow; with KOH instantly orange and remaining so for a few minutes but finally grey.

Basidiospores 7·5–9 × 3·3–3·8 μm, subfusoid in side view, elongate-ellipsoid in face view, smooth, pale straw-colour in NH_4OH, slightly ochreous in Melzer's reagent. *Basidia* 27 × 6·5–7·5 μm, clavate-cylindric, hyaline in NH_4OH. *Pleurocystidia* in clusters, more numerous towards tube orifice, 40–50 × 5·5–11 μm, hyaline to red-brown, with sparse, amorphous encrustation; *cheilocystidia* clavate-fusiform or distinctly swollen at middle, hyaline or dull brown in NH_4OH, with dull brown amorphous material, associated with red-brown pigment globules in Melzer's reagent; *caulocystidia* in discrete clusters, red-brown, clavate or variable as cheilocystidia, up to 12 μm broad or some only 4·5 μm broad, some associated with large areas of dark brown, amorphous material. *Hymenophoral trama* of colourless, slightly gelatinised hyphae, divergent from a darker, central strand which is slightly red-brown in Melzer's reagent. *Pileal surface* a mixture of repent, brown, finely granulate hyphae, 2·5–6 μm broad and smooth, flexuous, thinner, highly gelatinised units with pale yellow or hyaline contents. *Clamp-connections* not seen.

Only one collection has come to our attention to date; the Greek material was not growing under *Pinus cembra*, the usual host. When we compared colour transparencies of our specimen with the original paintings by Studer it left us with no doubt that the two collections are conspecific.

In forest of *Pinus halepensis*, Mount Parnis, Attica, 2 xii 1966, *Pantidou* MPIH–701 (no culture); part collection in E and as DAOM 117942.

4. Suillus fluryi Huijsman in Schw. Zeitschr. für Pilz. 3: 70 (1969). Plate 12 a–d.

Pileus 70–200 mm, convex to irregularly convex, then expanding or upturned with irregular margin, pale yellowish to chamois or orange ochreous, sometimes tinted vinaceous, cracked imperceptibly into small scales, viscid, blackening with KOH. *Tubes* yellow to dark yellow then flushed golden, finally dirty brown, adnate to slightly decurrent; *pores* yellow to brownish yellow or golden yellow, ± boletinoid, when dry immediately vinaceous buff or no reaction with NH_4OH, slightly olivaceous in Melzer's reagent. *Stipe* very variable, 40–120 × 10–40 mm, bright yellow to chrome-lemon at apex with small, cinnamon glandules frequently increasing in size to become smears, dirty brownish or with reddish or vinaceous areas below and there eglandulate or infrequently with distinct cinnamon glandules. *Flesh* thick under the disc, pale yellow to yellow, whitish especially near the pileus cuticle, more yellow above tubes and bright yellow in stipe, with KOH instantly vinaceous then grey-black. *Mycelium* abundant at stipe base, pink and strand-like giving base a rooting appearance; taste mild, smell none.

Basidiospores (8·75)9–10·5(11) × 3·75–4·5(5) μm, subfusoid in side view, ellipsoid in face view, pale straw-colour in NH_4OH, hardly darker in Melzer's reagent. *Basidia* 4-spored, clavate to cylindric, 22–25 × 4·5–6 μm, hyaline in NH_4OH, only slightly more coloured in Melzer's reagent. *Pleurocystidia* narrowly cylindric to distinctly clavate, 25–55 × 4·5–7 μm, in discrete clusters, colourless or filled with frothy contents, or distinctly coloured and then also associated with some amorphous material, pinkish brown in NH_4OH, some red-brown in Melzer's reagent; *cheilocystidia* similar to pleurocystidia very variable, many obovate with long foot, up to 12 μm broad, colourless or distinctly coloured. *Hymenophoral trama* of gelatinised to slightly gelatinised, colourless hyphae, divergent from slightly more coloured, floccose, thin, central strand. *Pileal surface* of repent, gelatinised, asperulate, hyaline hyphae, 4·5–7·5–9(11) μm broad, with large amount of brownish debris in Melzer's reagent, some brown material within cells, overlying a paler less compacted pileus trama. *Stipe surface* with groups of elongate cells similar to those at tube orifice, the clusters associated with brownish material. *Clamp-connections* not seen.

In forest of *Pinus halepensis*, Roviais, Evvoia, 11 xi 1968, *Pantidou* MPIH–950 (culture B–39–68); Varibombi, Attica, 25 xi 1968, *Pantidou* MPIH–954 (culture B–45–68); Lower Parnis, Attica, 4 xii 1968, *Pantidou* MPIH–957 (culture B–48–68); Lower Parnis, Attica, 12 xii 1968, *Pantidou* MPIH–958 (culture B–50–68).

Very large and voluminous fruit-bodies, very variable in their stipe length, in some very long and then up to 120 mm or some, even in mature fruit-bodies, very short and then only 40 mm; very variable also in stipe thickness, some thin, 10–25 mm and some long and 35–40 mm thick. MPIH–957 differs slightly in having larger glandules and more yellow colours to the stipe.

MPIH–948 (in forest of *Pinus halepensis*, Aiyina, Attica, 25 x 1968, Plate 12 e (B–36–68) resembles *S. fluryi* closely but differs in the greater extent of

vinaceous on the pileus and lower part of stipe, and to the flesh near the pileus 'cuticle' and mycelium at the stipe base; this vinaceous flush is intensified with the application of KOH becoming instantly vinaceous orange and then bluish grey or greyish black; when immature remaining grey with KOH. The tubes and 'cuticle' of the pileus with KOH become respectively dark vinaceous and vinaceous then black. The tubes at maturity are more copper-coloured than in *S. fluryi* and the pileus is dry with an inturned margin. Anatomically this collection is close to *S. fluryi* although the spores are slightly larger 9·5–11 μm, and distinctly narrower 3·25–4 μm. The pileal surface is of repent, slightly gelatinised hyphae, 6–12 μm broad and full of brown material in Melzer's reagent.

MPIH–951 (in forest of *Pinus halepensis*, Atalandi, Fthiotis, 15 xi 1968 —no culture) was found accompanying MPIH–952 and was at first thought to be referable to *S. fluryi*; it differs in the very striking flesh colour i.e. bright mustard yellow which instantly turns vinaceous with KOH. Further work is required on specimens which parallel this collection i.e. yellow flesh, smaller pileus, few stipe glandules and rose flush to the pileus. The spores of MPIH–951 agree with those of *S. fluryi* as here understood; the pileal surface is composed of rather narrow, gelatinised hyphae, 4·5–5·5 μm broad, with slightly tapered end-cells.

Cultural characteristics

Macroscopic characters: Mycelial mat of medium to slow growth rate, 30–50 mm diameter in one month; presence of aerial hyphae variable, in some isolates, woolly, whitish and buff and in others aerial hyphae scarce, immersed mycelium more or less grooved, margin uneven; reverse pale buff mixed with different degrees of olive to olive-brown.
Microscopic characters: Hyphal system simple; sap hyphae few; immersed hyphae mostly papillated and dendritic; *paarige* branching present but rare; clamp-connections rarely seen and then only on main hyphae.
Chemical reactions: Gum guaiac, formol and KOH all negative.
Cultures studied: B–36–68 (MPIH–948); B–39–68 (MPIH–950); B–45–68 (MPIH–954); B–48–68 (MPIH–957) and B–50–68 (MPIH–958).

The isolates of this species are rather variable in culture. The isolates B–45–68, B–48–68 and B–50–68 produce a rather woolly culture whereas the isolates B–39–68 and B–36–68 are more or less grooved. They all however, have olive to olive brown reverse; B–36–68 has a darker olive-brown reverse and discolours the medium yellow. However, the collection agrees with the discussion on morphological characters above.

5. Suillus granulatus (Fries) O. Kuntze in Rev. Gen. Pl. 3: 535 (1898).

Pileus up to 90 mm, orange to orange-brown, very viscid, margin inturned. *Pores* minute, cream then dirty yellow-brown with copious development of whitish milk, slightly vinaceous in NH_4OH when dry. *Stipe* up to 80 × 20 mm, apex in some yellow, dirty whitish or cream, elsewhere with small, cinnamon glandules. *Flesh* pale yellow, with KOH instantly, but only slightly, vinaceous then grey-black. *Mycelium* whitish.

Basidiospores 6·5–8·5 × 3–3·5 μm, elongate-subfusoid in side view, more elongate-ellipsoid in face view, pale straw-colour in NH_4OH, slightly more

coloured in Melzer's reagent. *Basidia* 4-spored, cylindric-clavate, 18–22 × 4–5 μm, hyaline in NH_4OH. *Pleurocystidia* 30–60 × 4·5–7μm, in discrete bundles, pale yellow to dark brown, cylindrical to narrowly clavate with blunt, rounded apices; *cheilocystidia* similar in general shape to pleurocystidia, up to 75 × 12 μm, colourless or filled with brown material or globules, many obliterated by brown amorphous material which produces red-brown pigment globules in Melzer's reagent. *Hymenophoral trama* of pale coloured, gelatinised hyphae, slightly divergent from a similarly coloured central strand. *Pileal surface* of repent, gelatinised, asperulate, slightly coloured hyphae, 4·5–11 μm broad. *Stipe surface* with clusters of cells similar to those at tube orifice, cells associated with brownish material. *Clamp-connections* not seen.

In forest of *Pinus nigra* and *Abies*, Sarandapiho, Korinthia, 9 vi 1968, *Pantidou* MPIH–956 (no culture).

The material was in bad condition and most of it had to be rejected; the transparencies of the collection agreed in all ways with published plates of *S. granulatus*. In fact, the copious development of milk and the anatomical details would agree with what Smith and Thiers have recently (1968) described as *Suillus lactifluus* (Withering ex S. F. Gray) Smith & Thiers.

A collection of MPIH–706 (under *Pinus nigra* subsp.? *pallasiana*), Mount Taiyetos at 1300 m, Peloponnisos, 30 vi 1966, agrees in many respects with the collection above except the pileus was very dry and like that of a *Xerocomus*:—pileus glabrous, tan colour and umbonate, particularly in one specimen; stipe heavily dotted with cinnamon glands; pores non-weeping, orange-yellow; flesh pale whitish pink in pileus, slightly orange near tubes and turning brownish in stipe when exposed to air; pileal surface of narrow hyphae, 3–4·5 μm broad. However, the material was collected under dry conditions which may explain the discrepancies observed between this material and more normal material from other European areas. The less obviously "weepy" pores would refer this to the more typical variant. The spores (6–8·5 × 2·3–3·3 μm) were similar in size to MPIH–956 and the pleurocystidia, c. 25–30 × 3·7–5·5 μm, although smaller were similar in shape; the pileal surface has much narrower hyphae. It is interesting that both collections of *S. granulatus* were made in June.

6. Suillus plorans (Rolland) O. Kuntze in Rev. Gen. Pl. 3: 536 (1898). Plate 12, f.

Pileus 40–60 mm, convex, thick, smooth, glabrous, mustard-yellow later turning pale ochraceous and the cuticle cracking and showing the yellow flesh. *Pores* dull yellow to yellow and pinkish buff with NH_4OH when dry. *Flesh* thick in pileus, lemon-yellow in both pileus and stipe, with KOH first vinaceous then grey-brown. *Stipe* 45 × 18 mm, pale yellow with few cinnamon glandules. *Mycelium* pinkish.

Basidiospores 7·5–10 × 3·5–4·5 μm, ellipsoid in face view, broadly subfusoid in side view, pale straw-colour in NH_4OH, smooth, many distinctly red-brown in Melzer's reagent. *Basidia* 4-spored, clavate to cylindric, 20–22 × 4·5–5·5 μm, hyaline in NH_4OH, slightly yellowish in Melzer's reagent. *Pleurocystidia* in scattered bundles, hyaline or slightly coloured, associated with brownish material, cylindric-clavate, 15–25 × 4–5 μm; *cheilocystidia*

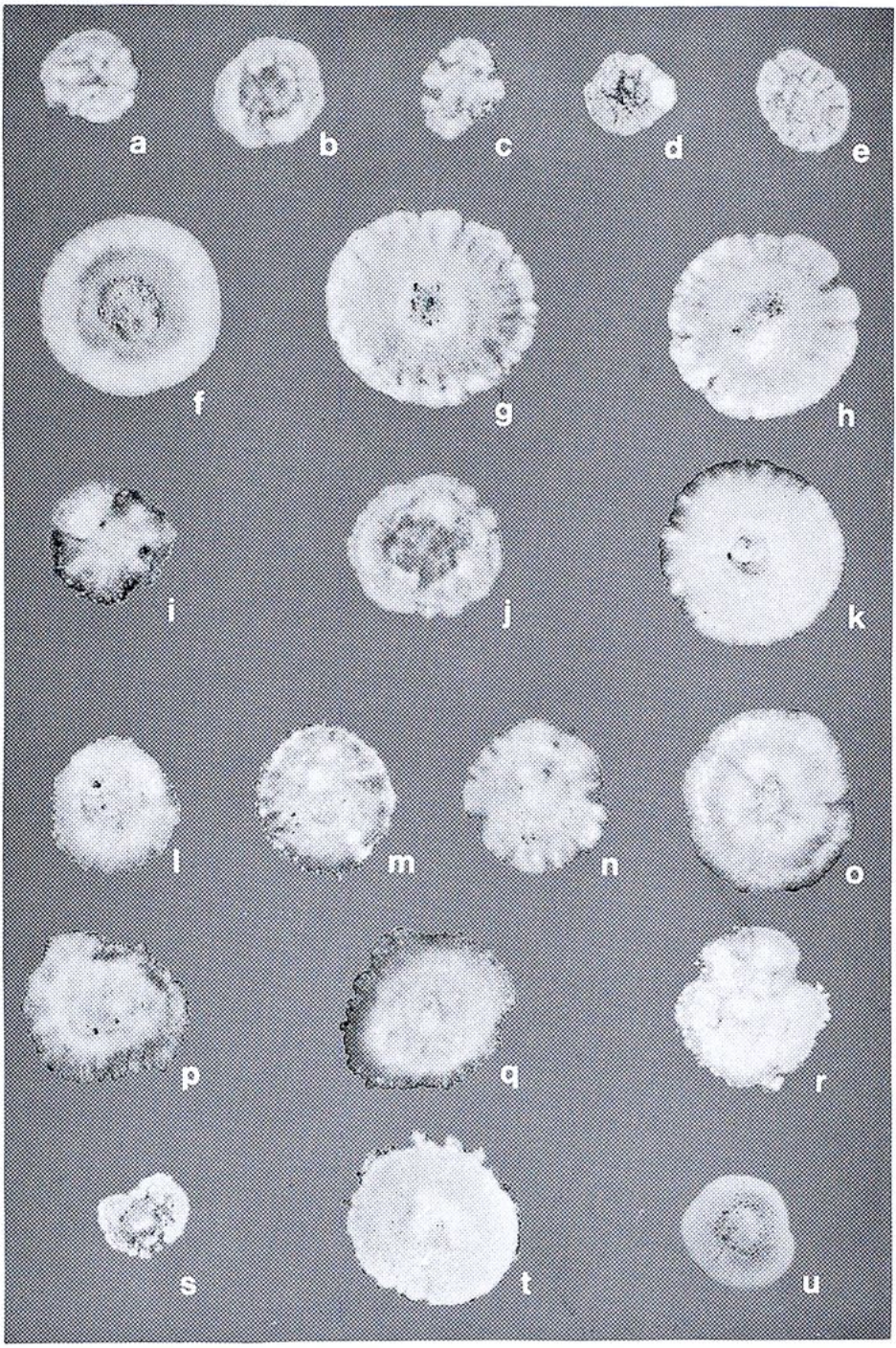

PLATE 12. One month-old cultures on malt agar: a–d, *Suillus fluryi*, isolates B–45–68, B–48–68, B–50–68 & B–39–68 respectively; e, *S.* aff. *fluryi*, isolate B–36–68; f, *S. plorans*, isolate B–17–66; g & h, *S.* aff. *plorans*, isolates B–31–67 & B–33–67 respectively; i, *S. abietinus* type isolate; j & k, *Suillus* spp., isolates B–15–66 & B–16–66 respectively; l–q, *S. obscurus*, isolates B–20–66, B–29–67, B–30–67, B–32–67, B–42–68 & B–44–68 respectively; r, *S.* aff. *obscurus*, isolate B–26–67; s & t, *S. alboflocculosus* & *S. roseovelatus* type isolates respectively; u, *Suillus* sp. isolate B–2–64: all x 2/3rd.

distinctly clavate, apex up to 8 μm broad, hyaline or ochreous, obscured by encrusting brownish material, more brownish and with dark red-brown globules in Melzer's reagent. *Pileal surface* of repent ± radially arranged, gelatinised hyphae, 3–5(8) μm broad, soon tangled, brownish or colourless and then appearing as "ghosts" in a gelatinous matrix, associated with colourless globules in Melzer's reagent; immediately overlying similar, although more compacted, darker layer with numerous associated globules. *Hymenophoral trama* of hyaline, gelatinised hyphae, divergent from slightly more coloured central strand. *Stipe surface* with large, dark aggregates of hyaline or brownish, clavate cystidia, up to 10 μm broad, obscured by brownish, amorphous material. *Clamp-connections* not seen.

In forest of *Pinus halepensis*, Ekali, Attica, 8 xi 1966, *Pantidou* MPIH–704 (culture B–17–66): part collection in E & DAOM 117940.

Characterized by the pale colours of both pileus and stipe and with indistinct, cinnamon glandules on the stipe.

Two other collections found in the area of Dionisos, Attica are similar except for the slightly darker pilei and the fruit-bodies being more voluminous. Because of these minor differences the Dionisos material is described separately below, immediately before discussing the cultural characters of *S. plorans*.

7. Suillus aff. **plorans** (Rolland) O. Kuntze cf. *Ixocomus cembrae* f. *obscuratus* Singer in Rév. de Myc. 3: 49 (1938). Plate 12, g–h.

Pileus up to 150 mm, voluminous, convex, viscid, pale to dark ochraceous, sometimes streaked with yellow, particularly near the margin, or background yellow streaked with ochreous to orange ochraceous fibrils, vinaceous then black with KOH. *Tubes* 10 mm long, deep yellow, adnate, when dry pinkish buff to vinaceous ochre with NH_4OH; *pores* olive-yellow becoming golden yellow, minute when young, up to 1 mm when mature. *Stipe* 100 × 20–25 mm, long and robust, curving towards the base, bright yellow at apex, the rest pale yellow to lemon-yellow with cinnamon to brown glands which are denser in the upper half. *Flesh* lemon-yellow throughout except for very bright orange zone at stipe base; with KOH instantly vinaceous and turning grey very slowly and with gum guaiac pink. *Mycelium* lemon-yellow.

Basidiospores (7·5)8–9(10) × 3·3–4·5 μm, ellipsoid in face view, subfusoid in side view, pale straw-colour in NH_4OH, many slightly red-brown in Melzer's reagent. *Basidia* 4-spored, 18–22 × 4·5–5·5 μm, hyaline or slightly yellowish in NH_4OH and Melzer's reagent. *Pleurocystidia* in scattered bundles, cylindric to slightly clavate, up to 25 × 5·5–6·5 μm, hyaline to red-brown in Melzer's reagent; *cheilocystidia* more variable than pleurocystidia, heavily encrusted with brownish, amorphous material, associated with red-brown globules in Melzer's reagent. *Hymenophoral trama* of hyaline, slightly gelatinised hyphae divergent from distinctly darker, more compacted, central strand, with dark brown to red-brown pigment globules in Melzer's reagent. *Pileal surface* of repent, smooth to faintly ornamented, gelatinised hyphae, 3–5 μm broad overlying tangled hyphae, up to 10 μm broad which form in Melzer's reagent a red-brown layer passing into a compacted layer containing numerous, pigment globules. *Stipe surface* with numerous, large, dark brown clusters of elongate cells 3·5–5 μm broad. *Clamp-connections* not seen.

In forest of *Pinus halepensis*, Dionisos, Attica 26 xi 1967, legit *Hidjanidou & Pantidou* MPIH–752 (culture B–31-67); same area 7 xii 1967, *Pantidou* MPIH–754 (culture B–33–67).

Cultural characteristics

Macroscopic characters: mycelial mat of medium growth rate, 50–70 mm diameter in one month, smooth, furry, white, margin even, aerial hyphae in centre growing up to Petri-dish lid, becoming with age white at margin and at centre bright buff; reverse cream-coloured then somewhat zoned with wide, hyaline marginal zone passing into purple brown to blackish brown and into dark cream or pale purple central zone; medium not discoloured. *Microscopic characters:* hyphal system with frequent *paarige* branching; clamp-connections rarely seen; sap hyphae yellow; papillated hyphae rare. *Chemical reactions:* gum guaic, vinaceous spot, soon disappearing; formol, negative; KOH spot slowly vinaceous brown.
Cultures studied: B–17–66 (MPIH–704); B–31–67 (MPIH–752); B–33–67 (MPIH–754).

The isolate B–17–66 from Ekali differs slightly from the two isolates collected at Dionisos in having somewhat slower growth rate and reverse colours, although the same, not forming definite zones. This conclusion agrees with the morphological and anatomical studies.

MPIH–753 was found in the same locality as both MPIH–752 and MPIH–754 but it is quite different both culturally and morphologically, possibly agreeing more with *S. obscurus* (see below).

It is relevant here to mention the taxon *S. cembrae* f. *cyanescens* Singer for, although the two collections we assigned to *S.* aff. *plorans* did not blue, the likeness between Singer's plate, accompanying the original description and our own colour transparencies is very great. Singer (1965) considers *S. plorans* and *S. cembrae* simply variants of the same species as does Moser (1967), although both authors have treated them as separate entities on various occasions.

B. New species

1. Suillus abietinus Pantidou & Watling, **sp. nov.**; Fig. 2, A–E; Plate 12, i.

Pileus usque 100 mm latus, glaber, siccus, flavo-brunneus vel erythro-brunneus, convexus demum planus; tubuli decurrentes, flavi vel aureo-flavi; stipes 40–70 mm longus, 10–25 mm crassus, basis frequenter attenuatus vel leviter bulbosus, ad apicem fulvus, ad basin roseo-vinaceus, glandulosus; sporae 7·5–9·9 × 3·3–4·5 μm, ellipsoideae; pleurocystidia in fasciculis, clavata vel cylindracea, 25–35 × 5·5–7·5 μm.
Typus: *Pantidou* MPIH–730(E), Vitina, Arkadhia, Greece, 19 xi 1967.

Pileus up to 100 mm broad, smooth, glabrous, dry, yellow-brown to reddish-brown, streaked with darker, almost blackish, fibrils towards the margin, convex then expanding, margin slightly incurved. *Tubes* 8 mm in mature areas narrowing towards the stipe and pileus margin, yellow to golden yellow, decurrent, when dry dirty ochraceous with NH_4OH; *pores* yellow even in the very young fruit-bodies, deepening to golden with age, minute when young, enlarging to 2 mm broad and becoming boletinoid. *Stipe* 40–70 × 10–25 mm thick, tapering at the base to somewhat bulbous,

apex bright yellow, the lower half pink-vinaceous or pale yellow with slight pinkish flush at very base, covered with small and poorly developed brown glandules which become large and smear-like. *Flesh* pale yellow except for pink near pileus cuticle; with KOH instantly vinaceous and then grey. *Mycelium* pink.

Basidiospores 7·5–9·5 × 3·3–4·5 μm, ellipsoid in face view, subfusoid in side view, smooth, straw-coloured in NH_4OH, slightly ochreous in Melzer's reagent. *Basidia* 4-spored, cylindric-clavate, 25–28 × 4·5–5·5 μm, hyaline or slightly yellowish in NH_4OH, yellowish in Melzer's reagent, seated on a subhymenium becoming red-brown in Melzer's reagent. *Pleurocystidia* clavate to elongate cylindric with rounded apices, 25–35 × 5·5–7·5 μm, in numerous pairs or small clusters of a few cells, ochreous or brownish, sheathed with encrusting material, not associated with heavy deposits of amorphous material; *cheilocystidia* in loose fringe to tubes, utriform, elongate-pyriform or clavate, hyaline or slightly coloured, or brownish, associated with some amorphous brown material, some filamentous, 4·5–5·5 μm broad. *Hymenophoral trama* of slightly gelatinised hyphae, slightly divergent from a floccose, slightly darker, central strand which contains orange-brown elements in Melzer's reagent. *Pileal surface* of repent, gelatinised, irregularly swollen hyphae, 7–10 μm broad, intermixed with a few more flexuous hyphae, hyaline in NH_4OH although browner towards their base and terminating in a dark brown layer; pileal surface overlying tangled, open, brownish zone of pileus trama which is bright orange-brown in Melzer's reagent and similarly coloured to hyphae connecting up with some cells of hymenophoral trama. *Stipe surface* with numerous clusters of dark brown cells, similar to those at tube orifice; some hyaline cells also present and intermixed with large deposits of brown material. *Clamp-connections* not seen.

In pure forest of *Abies cephalonica*, Vitina, Arkadhia, 19 xi 1967, *Hidjanidou & Pantidou*, *Pantidou* MPIH–730 (culture B–27–67); part collection in E and as DAOM 124635.

Cultural characteristics

Macroscopic characters: mycelial mat when first isolated of fast growth rate, 70–80 mm diameter in one month, fluffy, cottony, white, later developing bright yellow areas; in 10-day-old cultures abundant primordia formed.
Microscopic characters: aerial hyphae with frequent *paarige* branching and clamp-connections infrequent but present at the point of branching; hyphal bridges frequent; sap hyphae yellow; appressed hyphae mostly papillated, often forming strands and then clamp-connections rare.
Chemical reactions: gum guaiac brown spot; formol negative; KOH instant vinaceous spot.
Culture studied: B–27–67 (MPIH–730), Vitina, Arkadhia.
The primordia in MPIH–730 (culture B–27–67) consisted of stipes 2–3 mm in height, at first white, then bright yellow, turning brown when older; pilei never developed. In the stipe primordia the context was differentiated into a tissue of closely packed hyphae which lost their identity and did not stain in KOH-Phloxine, while the cuticular hyphae were cylindrical with the rounded ends directed outwards, some with *paarige* branching and clamp-connections;

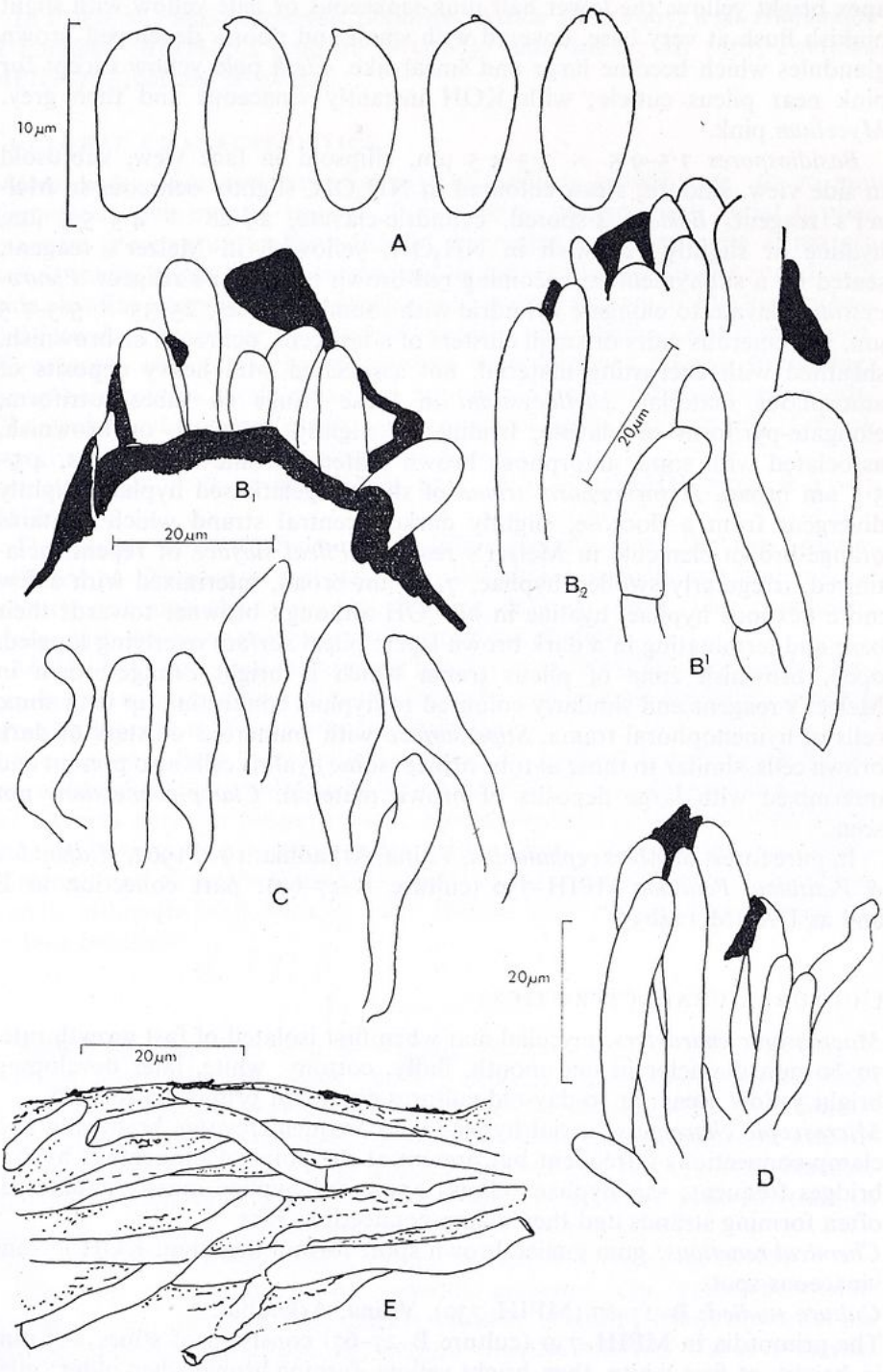

FIG. 2. Holotype of *Suillus abietinus*: A, basidiospores; B_1 & B_2, two groups of cheilocystidia with amorphous encrusting material; B^1, individual cheilocystidia; C, individual caulocystidia from stipe glandule; D, group of pleurocystidia; E, hyphae of pileal surface. Magnification as indicated.

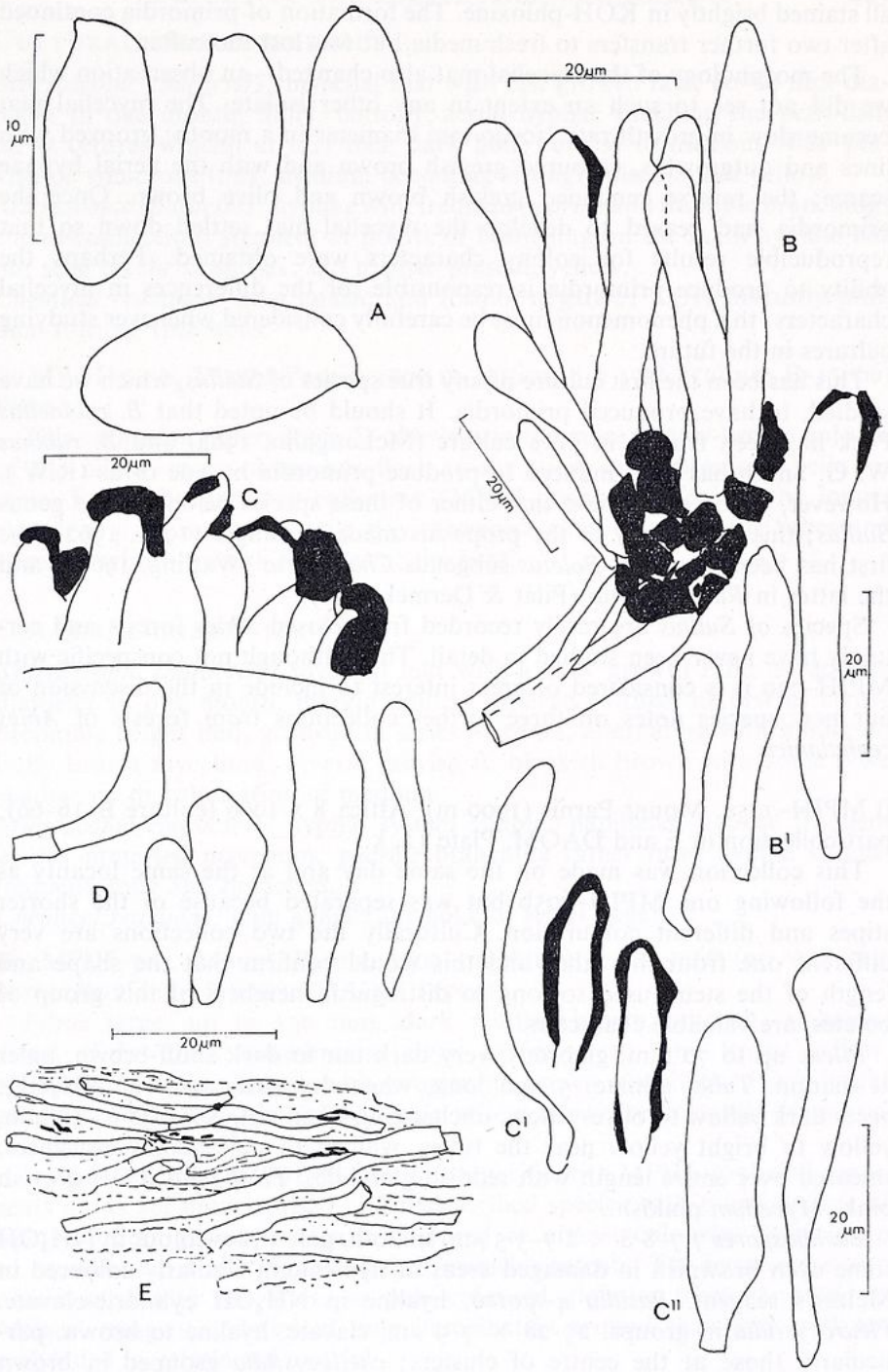

FIG. 3. Holotype of *Suillus alboflocculosus*: A, basidiospores; B, group of caulocystidia with small amorphous particles at their base; B¹, individual caulocystidia; C, group of encrusted cheilocystidia; C¹ & C¹¹, individual cheilocystidia showing encrustation; D, individual pleurocystidia; E, hyphae of pileal surface. Magnification as indicated.

all stained brightly in KOH-phloxine. The formation of primordia continued after two further transfers to fresh media but was lost thereafter.

The morphology of the mycelial mat also changed—an observation which we did not see to such an extent in any other isolate. The mycelial mat became slow in growth rate, 30–40 mm diameter in a month; grooved with lines and outgrowths, coloured greyish brown and with the aerial hyphae scarce; the reverse remained greyish brown and olive brown. Once the primordia had ceased to develop the mycelial mat settled down so that reproducible results for colony characters were obtained. Perhaps the ability to produce primordia is responsible for the differences in mycelial characters; this phenomenon must be carefully considered whenever studying cultures in the future.

This has been the first culture of any true species of *Suillus*, which we have studied, to have produced primordia. It should be noted that *B. rubinellus* Peck has been fruited in pure culture (McLaughlin, 1964) and *B. rubinus* W. G. Smith has been induced to produce primordia by one of us (R.W.). However, we do not believe that either of these species belong to the genus *Suillus*; this is contrary to the proposals made by Singer (1951, 1962); the first has been placed in *Boletus* subgenus *Chalciporus* (Watling, 1967b) and the latter in *Rubinoboletus* (Pilát & Dermek, 1969).

Species of *Suillus* are rarely recorded from closed *Abies* forests and certainly have never been studied in detail. Thus although not conspecific with MPIH–730 it is considered of great interest to include in the discussion of our new species notes on three further collections from forests of *Abies cephalonica*.

i) MPIH–705a, Mount Parnis (1000 m), Attica 8 x 1966 (culture B–16–66); part collection in E and DAOM, Plate 12, k.

This collection was made on the same day and at the same locality as the following one MPIH–705b but was separated because of the shorter stipes and different colouration. Culturally the two collections are very different one from the other and this would confirm that the shape and length of the stem, used so long to distinguish members of this group of boletes, are valuable characters.

Pileus up to 70 mm, glabrous, very dark tan to dark snuff-brown, paler at margin. *Tubes* adnate, 5 mm long, when dry rusty pink in NH_4OH; *pores* dark yellow to olive-yellow, unchanging when cut. *Stipe* 30 × 15 mm, yellow to bright yellow near the tubes, whitish to pale yellow elsewhere, smeared over entire length with reddish glandules. *Flesh* with KOH greyish pink. *Mycelium* pinkish.

Basidiospores 7·7–8·8 × 2·7–3·5 μm, smooth, pale straw-colour in NH_4OH some even brownish in damaged areas of hymenium, similarly coloured in Melzer's reagent. *Basidia* 4-spored, hyaline in NH_4OH cylindric-clavate. *Pleurocystidia* in groups, 25–28 × 7–9 μm, clavate, hyaline to brown, particularly those at the centre of clusters; *cheilocystidia* grouped in brown fringes at tube orifices, individual cells elongate-clavate, hyaline or filled with red-brown material, encrusted at the base with brown, amorphous material. *Pileal surface* of repent, hyaline or pale coloured hyphae, embedded in gelatinised matrix, 3–6 μm broad, intermixed with reddish globules in Melzer's reagent particularly in zone overlying the pileus trama.

CULTURAL CHARACTERISTICS

Macroscopic characters: mycelial mat with fast growth rate, 60–80 mm diameter in one month, fluffy, cottony, aerial hyphae touching the petri-dish lid at centre, whitish at first then dark buff; reverse ochraceous with pinkish or vinaceous tints; medium becoming strongly discoloured yellow.
Microscopic characters: hyphae with frequent *paarige* and multiple branching; clamp-connections frequent at points of branching on the main hyphae but not seen on the branches; sap hyphae present, yellow.
Chemical reactions: gum guaiac and formol negative; KOH instantly pink then turning vinaceous.

ii) MPIH–705b, Mount Parnis, 1000 m, Attica, 8 x 1966 (culture B–15–66) Plate 12, j.

This collection differs from *S. abietinus* in the more yellow-brown colours of the pileus, more olivaceous flush to the tubes and pores and yellower stipe. From the previous collection (MPIH–705a) it differs in the longer stipe, 60 × 15 mm, with only tiny, brownish glandules near the tubes and streaked with brownish fibrils near the base.

CULTURAL CHARACTERISTICS

Macroscopic characters: mycelial mat with a slow growth rate, 20–40 mm diameter in one month, margin whitish, uneven, whitish at first at centre becoming bright buff, grooved in series of zones, alternating with immersed buffy brown mycelium; reverse greyish to blackish brown with some olive shades; no discolouration of medium.
Microscopic characters: hyphal system simple; papillated hyphae frequent in the immersed mycelium; *paarige* branching rather rare; hyphal strands frequent, long and branched.
Chemical reactions: gum guaiac, formol and KOH negative.

iii) MPIH–700, Mount Parnis, 1000 m, Attica, 14 x 1966 (no culture); part collection in E and as DAOM 117941.

Pileus large, up to 130 mm, dark reddish brown, smooth, glabrous, viscid. *Tubes* dark olive-brown. *Stipe* 40–60 × 20 mm, bright yellow, smeared for entire length with prominent brown glandules. *Flesh* bright yellow near the tubes, whitish to pale yellow elsewhere, instantly vinaceous then grey with KOH.

It would appear that MPIH–700 is conspecific with MPIH–705b and represents an as yet unrecognised and undescribed species with pileal surface of tightly adhering groups of pale coloured or almost colourless hyphae up to 10μm broad and with colloidal, brownish contents. The hyphae are also ornamented with colourless or pale coloured globules when mounted in Melzer's reagent, gelatinised only immediately around their wall and not embedded in gelatinised matrix.

2. Suillus alboflocculosus Watling & Pantidou, **sp. nov.**; Fig. 3, A–E; Plate 12, s.

Pileus usque 120 mm latus, subluteus vel fuscus aurantio-luteus, glaber, viscidus, marginis incurvis, cum vestigium leuco velum; tubulis adnati, sordidi flavi; stipes 40 mm longus, 20–25 mm crassus, ad basim roseus vel

purpureus ad apicem luteo-aurantius, glandulosus; sporae 11–13·5 × 4·5–5·5 μm, ellipsoideae.

Typus: *Pantidou* MPIH–703b (E) and DAOM 117938, Roviais, North Evvoia, 15 xii 1965.

Pileus up to 120 mm broad, pale buff to dark orange buff, glabrous, viscid, margin incurved in young fruit-bodies with traces of white veil which disappear at maturity. *Tubes* 6 mm long, adnate, dirty yellow, with KOH grey-black, little or no change with NH_4OH when dry; *pores* whitish then yellow-brown, less than 1 mm broad. *Flesh* pale yellow to yellow, pinkish near the tubes, unchanging, grey-black with KOH. *Stipe* 40 × 20–25 mm (15 mm at base), pink to reddish at base, bright yellow-orange near the tubes, smeared throughout with large, reddish brown glandules. *Mycelium* pinkish buff.

Basidiospores 10–12·5 × 4–5·5 μm, ellipsoid in face view, elongate-subfusiform in side view, straw-yellow in NH_4OH, red-brown in Melzer's reagent. *Basidia* 4-spored, c. 22 × 6·5–7 μm, hyaline in NH_4OH, seated on orange-brown cells of subhymenium, yellowish in Melzer's reagent. *Pleurocystidia* 25–35 × 5·5–9 μm, in numerous clusters, dark brown and frequently obscured in NH_4OH, red-brown in Melzer's reagent, associated with red-brown globules which collapse to form an amorphous deposit; *cheilocystidia* similar to pleurocystidia in shape and colour with numerous pigment globules in Melzer's reagent. *Hymenophoral trama* of hyaline, slightly gelatinised hyphae divergent from a central, floccose strand, hyaline in NH_4OH, slightly darker in Melzer's reagent. *Pileal surface* mixture of repent, thin, colourless hyphae and broader, gelatinised, hyaline to yellowish units up to 12 μm broad, with frothy contents towards their base, overlying compacted dark brown zone separating surface layer from open, paler, tangled pileus trama; trama darkening towards base of the tubes. *Stipe surface* covered with numerous clusters of brownish cells similar to those at tube orifice and in mature fruit-bodies coalescing at apex to form an almost complete palisade. *Clamp-connections* not seen.

In forest of *Pinus halepensis*, Roviais, North Evvoia, 15 xii 1965, *Pantidou* MPIH–703b (culture B–14–65); part collections in E and DAOM 117938.

Characterized especially by white, marginal veil and stipe covered with large reddish brown glandules. In veil characters it approaches the North American *Suillus albidipes* (Peck) Singer.

Cultural characteristics

Macroscopic characters: mycelial mat with a slow growth rate, 30–40 mm diameter in one month, mostly immersed, grooved with lines and outgrowths, margin uneven, pale buff and buffy brown; reverse cream-colour with some olive tints or dark olive patches; medium slightly discoloured.
Microscopic characters: hyphal system simple; sap hyphae few; aerial hyphae pale yellow or hyaline, frequently papillated; *paarige* branching rare; clamp-connections very rare; strands frequent.
Chemical reactions: gum guaiac, formol, KOH negative.
Cultures studied: B–14–65 (MPIH–703b).

This species was collected intermixed with MPIH–703a (B–12–65), but was separated in the field by the shorter, thicker stipe (30 × 30 mm). Cul-

turally and microscopically the two collections also proved to be quite different.

CULTURAL CHARACTERISTICS OF B–12–65 (MPIH–703a)

Macroscopic characters: mycelial mat with fast growth rate, 80–90 mm diameter in one month, cottony to woolly, raised, often touching the petri-dish lid in the centre, margin even, white, then buff with yellow tints, when old developing fan-like, hyaline sectors, centre pale buff becoming vinaceous buff on ageing; reverse with narrow, pale yellow to lemon-yellow margin, centre ochreous at first becoming dark yellow-brown; medium discoloured yellow.

Microscopic characters: hyphae with *paarige* branching frequent, mostly one clamp-connection at the point of branching; sap hyphae bright yellow, frequent.

Chemical reactions: gum guaiac, formol negative; KOH vinaceous spot.

3. Suillus alkaliaurantians Pantidou & Watling, **sp. nov.**; Fig. 4, A–E.

Pileus usque 100 mm latus, convexus demum planus, flavidus, vel ochraceus, glutinosus; tubuli fulvi, vel fulvi-olivacei; stipes 60 mm longus, 13 mm crassus, fulvus vel citreus, ochraceus, glandulosus; sporae (7·5)8–9·5 × 3·3–3·8 μm.

Typus: *Pantidou* MPIH–747 (E), Varibombi, Attica, Greece, 13 xi 1967.

Pileus up to 100 mm, convex then plane, pale yellow to ochreous or pale yellow with ochreous patches, becoming dark ochreous at centre, smooth, glabrous, viscid. *Tubes* yellowish brown to brownish olive, vinaceous with NH_4OH when dry; *pores* concolorous with tubes. *Stipe* 60 × 13 mm, some curved at base, yellow to almost chrome yellow, smeared with cinnamon glands, also some brown staining at base. *Flesh* bright chrome-yellow, soft, watery, with KOH bright orange and later brown-black. *Mycelium* white.

Basidiospores (7·5)8–9·5 × 3·3–3·8 μm, ellipsoid in face view, smooth, straw-colour in NH_4OH, slightly more yellowish in Melzer's reagent. *Basidia* 4-spored, up to 25 μm long × 4·5–5 μm wide, only slightly coloured in NH_4OH, slightly yellowish in Melzer's reagent. *Pleurocystidia* in numerous clusters, brownish in NH_4OH (pale or dark), clavate to cylindric c. 25 × 4·5–8 μm, red-brown in Melzer's reagent and associated with some red-brown pigment globules; *cheilocystidia* filled with brownish material, associated with pigment globules in Melzer's reagent and almost obliterated by coloured excresence, shape and size similar to pleurocystidia. *Hymenophoral trama* of slightly gelatinised hyphae divergent from a similar or slightly more coloured, central, floccose strand. *Pileal surface* of radially arranged or repent, finely to coarsely granulate hyphae, 5–9 μm broad, only slightly gelatinised, associated with small globules in NH_4OH, red-brown globules in Melzer's reagent absent. *Stipe surface* with large numbers of dark brown cell clusters similar to those at the tube orifices. *Clamp-connections* not seen.

In forest of *Pinus halepensis*, Varibombi, Attica, 13 xi 1967, *Pantidou* MPIH–747 (E), (no culture).

Characterized by the pale yellow to ochreous pileus, chrome-yellow stipe with cinnamon glandules and the reaction of the flesh with KOH; the specific name is taken from this rather distinctive and uncommon colour

reaction. Unfortunately, isolation in culture was unsuccessful and so we have been unable to compare culturally *S. alkaliaurantians* with other species examined during the study. In some ways our fungus resembles illustrations of *S. sibiricus* Singer, especially the subspecies *helveticus* Singer, which appears to lose its veil characters very rapidly. However, our specimens possessed neither a marginal veil nor a ring.

4. Suillus obscurus Pantidou & Watling, **sp. nov.**; Fig. 5, A–E; Plate 12, l–q.

Pileus usque 130 mm latus, irregularis, glaber, viscidus, flavo-brunneus vel erythro-brunneus vel aurantio-brunneus; tubuli cremea vel cremea-fulvi; stipes 20–50 mm longus, 17–40 mm crassus, ad apicem luteus, ad basim bidus vel flavidus; sporae (6·5)7·5–9(10·5) × 3·25–4(4·5) μm, ellipsoideae.

Typus: *Pantidou*, MPIH–751 (E), Tripolis, Arkadhia, Greece, 21 xi 1967.

Pileus up to 130 mm broad, voluminous and irregular, smooth, glabrous, viscid, yellow-brown to reddish brown or orange-brown, darker in the centre, sometimes with a persistent white, inrolled margin, always devoid of velar tissue. *Tubes* pale cream to cream-yellow then yellow-brown, 5–10 mm long in mature fruit-bodies, vinaceous to reddish in NH_4OH when dry; *pores* minute, pale cream, dull yellowish then brownish yellow. *Stipe* 20–50 × 17–40 mm, bright yellow at apex, whitish to dirty yellow below with reddish to cinnamon glandules over entire length, equal or rounded at base, lacking obvious mycelial system. *Flesh* hard, firm, thick in pileus, vinaceous under the cuticle, then whitish to yellowish, yellower near the tubes and stipe base; in mature fruit-bodies often bright yellow throughout, with KOH instantly vinaceous then grey-black, with gum guaiac instantly red and then rapidly fading; taste pleasant, smell slightly phenolic. *Mycelium* whitish to pale buff.

Basidiospores (6·5)7·5–9(10·5) × 3·25–4(4·5) μm, elongate-ellipsoid in face view, subfusiform in side view, tapered slightly at apex, smooth, pale straw-colour, slightly darker in Melzer's reagent. *Basidia* 4-spored, hyaline in NH_4OH, very pale ochreous in Melzer's reagent, clavate-cylindric, 5–6·5 μm. *Pleurocystidia* in numerous clusters, dull brown in NH_4OH, brighter red-brown and associated with numerous red-brown pigment globules in Melzer's reagent, clavate-cylindric, hyaline or with brown inclusions, 25–30 × 5·5–7·5 μm; *cheilocystidia* similar, cells intermixed with more clavate, fusiform cells, up to 10μm broad, forming an obscure dark fringe to the tube orifice, dark red-brown with amorphous and red-brown pigment globules in Melzer's reagent. *Hymenophoral trama* of slightly gelatinised hyphae divergent from a similarly coloured central, floccose strand. *Pileal surface* of tangled, repent, asperulate, hyaline to slightly coloured or brownish gelatinised hyphae, (3·5)5–10(12) μm broad, usually associated either with few or no pigment globules in Melzer's reagent, or globules only forming in over mature specimens; surface hyphae overlying a browner, more compacted, non-gelatinised zone, passing into hyaline units and then into very open-textured pileus trama. *Stipe surface* with clusters of similar cells to those at the tube margin, umber-brown in mass due to excresence, many individuals thinner than cheilocystidia, c. 4 μm broad, and filled with amorphous material. *Clamp-connections* not seen.

In forest of *Pinus halepensis*, Mount Parnis, Attica, 2 xi 1966, *Pantidou* MPIH–697 and as DAOM 117939 (culture B–20–66); Tripolis, Arkadhia, 21 xi 1967, *Hidjanidou & Pantidou, Pantidou* MPIH–751 (culture B–30–67–

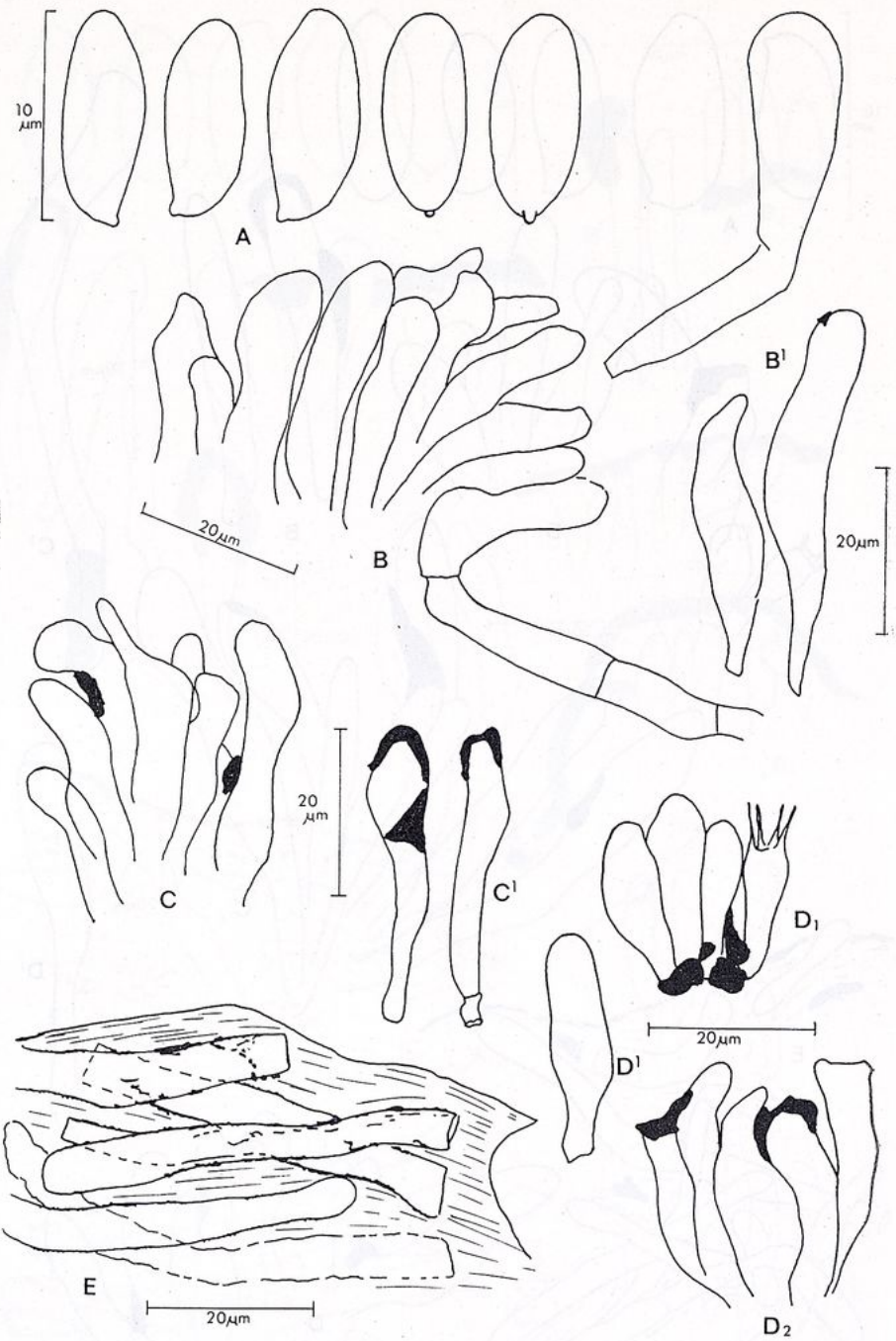

FIG. 4. Holotype of *Suillus alkaliaurantians*: A, basidiospores; B, group of caulocystidia—part of glandule; B^1, individual caulocystidia; C, group of cheilocystidia; C^1, individual cheilocystidia; D_1 & D_2, two groups of pleurocystidia, the latter close to tube-mouth; D^1, individual pleurocystidium; E, hyphae of pileal surface. Magnification as indicated.

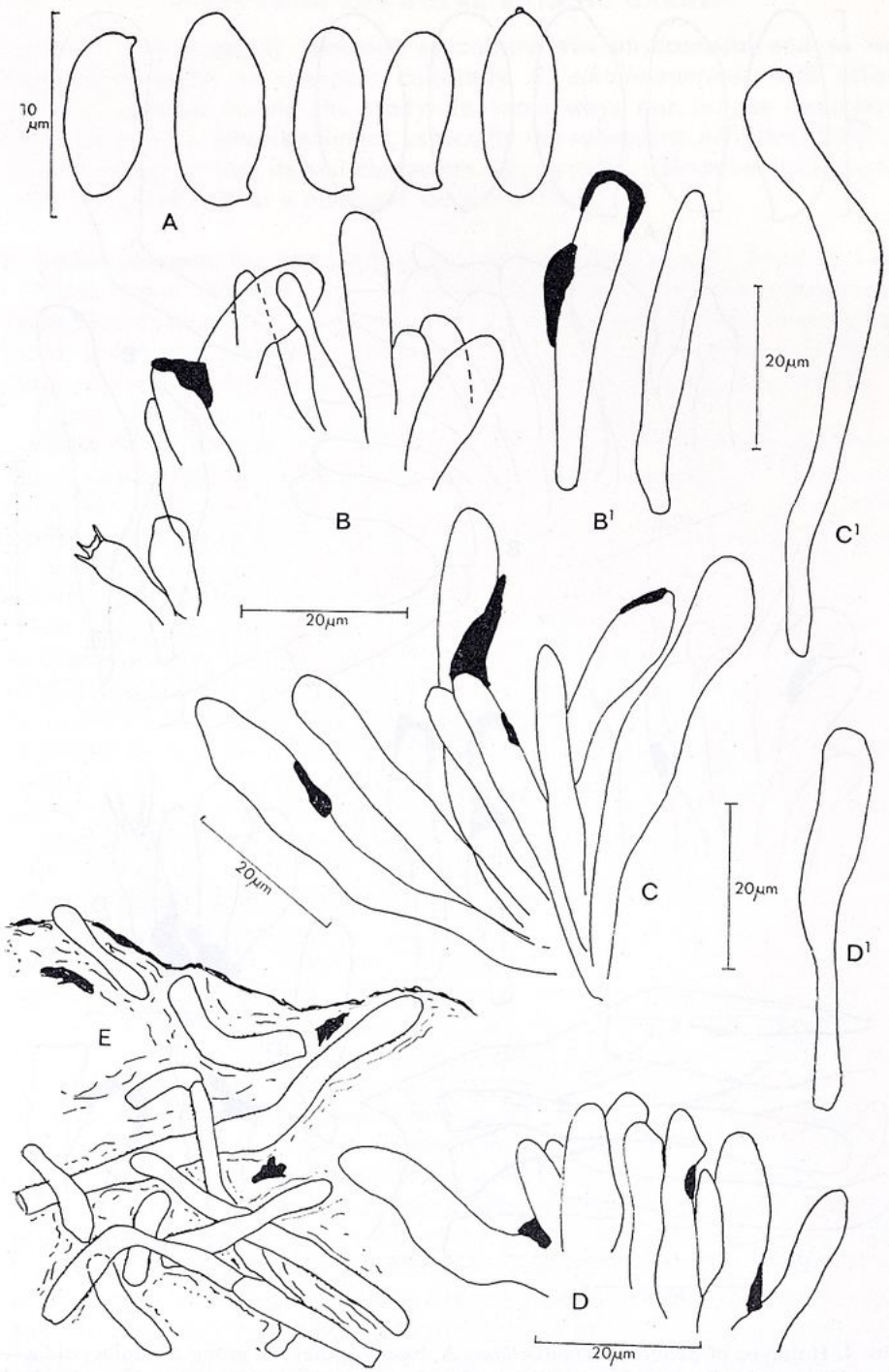

FIG. 5. Holotype of *Suillus obscurus*: A, basidiospores; B, group of pleurocystidia; B^1, individual pleurocystidia; C, group of caulocystidia; C^1, individual caulocystidium; D, group of pleurocystidia; D^1, individual pleurocystidium; E, hyphae of pileal surface. Magnification as indicated.

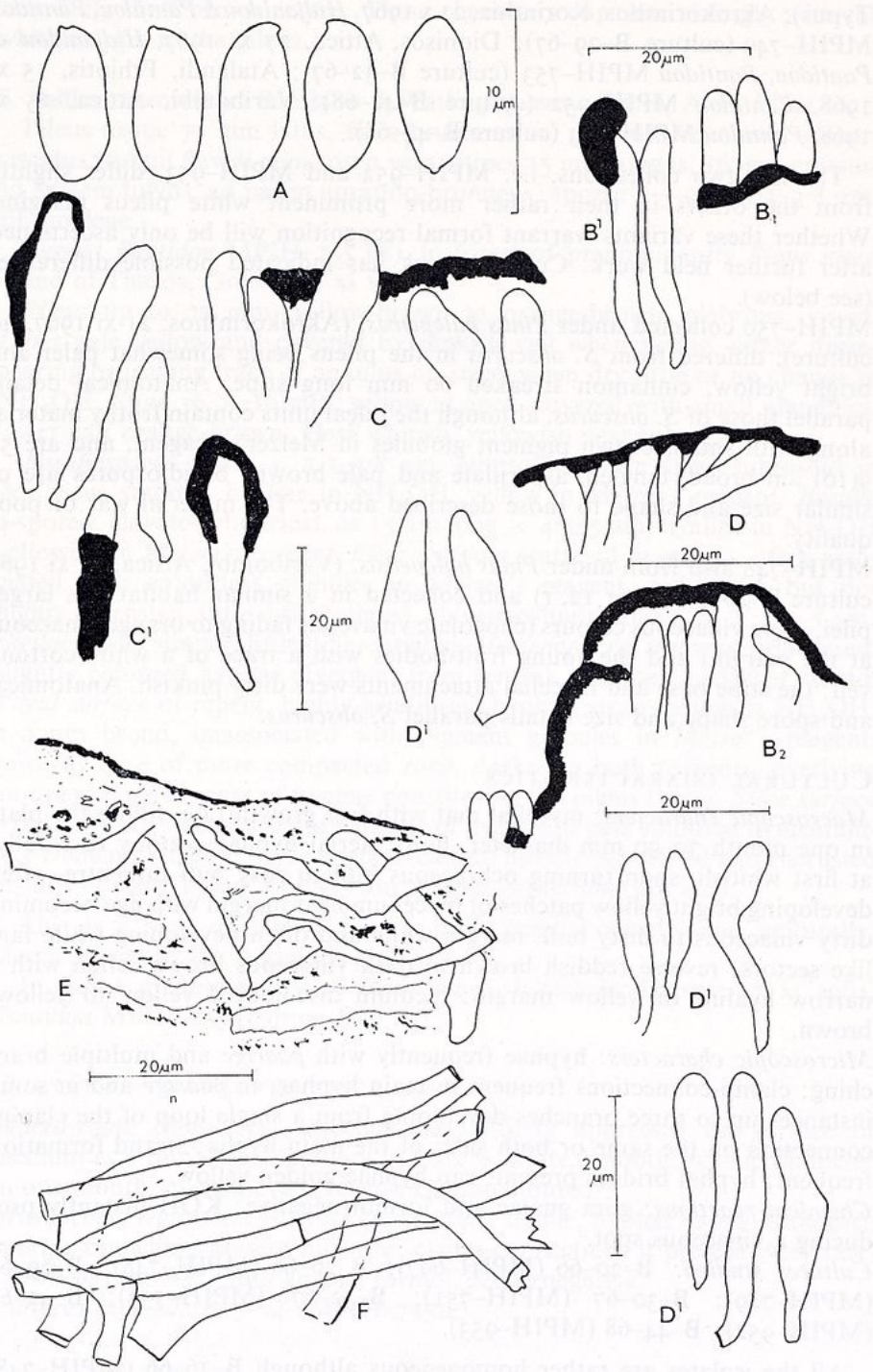

FIG. 6. Holotype of *Suillus roseovelatus*: A, basidiospores; B_1 & B_2, pleurocystidia, B_2 from near tube-mouth, B^1, individual pleurocystidia; C, heavily encrusted caulocystidia; C^1, individual caulocystidia; D, group of cheilocystidia embedded in amorphous deposit; D^1, individual cheilocystidia; E, hyphae of pileal surface; F, hyphae of velar fragments. Magnification as indicated.

Typus); Akrokorinthos, Korinthia, 21 x 1967, *Hidjanidou & Pantidou, Pantidou* MPIH–749 (culture B–29–67); Dionisos, Attica, 27 xi 1967, *Hidjanidou & Pantidou, Pantidou* MPIH–753 (culture B–32–67); Atalandi, Fthiotis, 15 xi 1968, *Pantidou* MPIH–952 (culture B–42–68); Varibombi, Attica, 25 xi 1968, *Pantidou* MPIH–953 (culture B–44–68).

The last two collections, i.e. MPIH–952 and MPIH–953, differ slightly from the others in their rather more prominent white pileus margins. Whether these variants warrant formal recognition will be only ascertained after further field work. Cultural work has indicated possible differences (see below).

MPIH–750 collected under *Pinus halepensis*, (Akrokorinthos, 21 xi 1967, no culture), differed from *S. obscurus* in the pileus being somewhat paler and bright yellow, cinnamon streaked 60 mm long stipe. Anatomical details parallel those of *S. obscurus*, although the pileal units contain frothy material along with small, brown pigment globules in Melzer's reagent, and are 5–9(10) μm broad, tangled, asperulate and pale brown; basidiospores are of similar size and shape to those described above. The material was of poor quality.

MPIH–748 also from under *Pinus halepensis*, (Varibombi, Attica, 13 xi 1967 culture B–26–67; Plate 12, r) and collected in a similar habitat has larger pilei, more vinaceous colours (chocolate vinaceous fading to orange vinaceous at the margin) and the young fruit-bodies with a trace of a white cottony veil; the stipe base and mycelial attachments were dirty pinkish. Anatomical and spore shape and size details parallel *S. obscurus*.

Cultural characteristics

Macroscopic characters: mycelial mat with fast growth rate, filling the plate in one month 70–90 mm diameter, fluffy, aerial hyphae cottony to woolly, at first whitish, soon turning ochraceous buff to rosy buff in centre, often developing bright yellow patches of mycelium near margin with age becoming dirty vinaceous to dirty buff, margin white and often developing white fan-like sectors; reverse reddish brown to dark vinaceous brown, often with a narrow hyaline or yellow margin; medium discoloured yellow to yellow-brown.

Microscopic characters: hyphae frequently with *paarige* and multiple branching; clamp-connections frequent in main hyphae, in *paarige* and in some instances up to three branches developing from a single loop of the clamp-connection on the same or both sides of the main hypha; strand formation frequent; hyphal bridges present; sap hyphae golden yellow.

Chemical reactions: gum guaiac and formol negative; KOH instantly producing a vinaceous spot.

Cultures studied: B–20–66 (MPIH–697); B–26–66 (MPIH–748); B–29–67 (MPIH–749); B–30–67 (MPIH–751); B–32–67 (MPIH–753); B–42–68 (MPIH–952); B–44–68 (MPIH–953).

All the isolates are rather homogeneous although B–26–66 (MPIH–748) deviates somewhat in having a darker and somewhat metallic reverse and also strongly discolouring the medium. B–42–68 (MPIH–952) and B–44–68 (MPIH–953) also deviate slightly having a faster growth rate and a more striking differentiation of the mat into two zones i.e. a white margin and a

very fluffy, buff brown centre. These characters correlate strongly with the white margin to the pileus.

5. Suillus roseovelatus Pantidou & Watling **sp. nov.**; Fig. 6, A–F; Plate 12, t.

Pileus usque 70 mm latus, flavo-brunneus vel aurantio-brunneus, glaber, viscidus; tubuli flavidi cum roseo velo; stipes 35 mm longus, 16 mm crassus, ad apicem fulvus, ad basim aurantio-brunneus; sporae 7·5–9 × 3·3–3·8 μm, ellipsoideae.

Typus: *Pantidou* MPIH–755 (E), in forest of predominantly *Pinus nigra* island of Thasos, Greece, 17 xi 1964.

Pileus up to 70 mm, yellow-brown to orange-brown, glabrous, viscid. *Tubes* pale yellow and covered by pinkish veil when young, either disappearing or leaving trace of annulus on stipe, when dry little or no change in NH_4OH. *Stipe* 36 × 16 mm, yellow at apex, covered with small glandules, lower half orange-brown. *Flesh* whitish, yellowish near tubes.

Basidiospores 7·5–9 × 3·3–3·8 μm, ellipsoid in face view, subfusoid in side view, smooth, hyaline in NH_4OH, yellow in Melzer's reagent. *Basidia* 4-spored, clavate-cylindrical, ca 15 μm long × 4·5–5 μm, hyaline in NH_4OH yellowish in Melzer's reagent. *Pleurocystidia* scattered in groups, often associated with colourless globules in Melzer's reagent, red-brown but not highly encrusted, little differentiated, clavate-cylindrical, 15–20 × 4·5–5 μm; *cheilocystidia* similar, little differentiated. *Hymenophoral trama* of gelatinised, slightly coloured hyphae divergent from central, floccose, ± darker strand. *Pileal surface* of repent, highly gelatinised hyphae, straw-yellow in NH_4OH, 2–4 μm broad, unassociated with pigment globules in Melzer's reagent, towards base of more compacted zone, darker in both reagents, overlying an open, tangled mass of hyphae constituting the pileus trama. *Stipe surface* irregularly covered at apex in palisade of hyaline to pale coloured hymenium-like elements which become aggregated into heavily pigmented and encrusted groups of cells, 15–20 × 4·5–5 μm. *Clamp-connections* not seen.

This is a very distinctive fungus both macroscopically and culturally, characterized by the fugacious pink veil.

In forest predominantly of *Pinus nigra*, Island of Thasos, 17 xi 1964, *Pantidou* MPIH–755 (culture B–5–64).

Cultural characteristics

Macroscopic characters: mycelial mat entirely appressed on surface of medium as a thin sheet, powdery in texture, white, smooth, 50 mm diameter in one month, margin even; reverse cream-coloured.
Microscopic characters: hyphal system very simple, hyphae rarely branched; *paarige* branching present but rare; clamp-connections if present, very rare.
Chemical reactions: gum guaiac, formol, KOH negative.
Cultures studied: B–5–64 (MPIH–755).

C. Notes on unnamed collections

Several collections from Greece which have been examined have not been assigned taxonomically. Many, we feel, are autonomous species but we have not described them formally, not because we are unconvinced of their

distinctness, but because the material is not suitable for type descriptions. Nevertheless, we feel that the inclusion of these collections in this account, simply as notes, will act as a permanent reference point for future workers. One of us (M.P.) originally arranged the cultures of all the material of *Suillus* collected into seven different groups. Of these Group II agreed with *S. roseovelatus*, Group III with *S. plorans* and Group IV with *S. obscurus* although two cultures, MPIH–699 & 705a, did not have all the typical characteristics. Group V was subdivided into six subgroups of which (a) agreed with *S. alboflocculosus* (b), (c) & (d) agreed with *S. fluryi* or *S.* aff. *fluryi*, (e) with 705b and is not placed and (f) with *S. abietinus*. Thus groups I, VI, VII and MPIH–699 from group IV were not placed and are discussed below. MPIH–705a & 705b are discussed immediately after *S. abietinus* as both were found growing with *Abies*.

1. Cultural group I

In forest of *Pinus nigra*, Kaloneri, Island of Thasos, 17 xi 1964, *Pantidou* MPIH–746 (culture B–2–64); Plate 12, u.

The field notes are scanty and have been supplemented with notes taken from colour transparencies.

Pileus pale buff or pale straw-colour, darker towards centre and there flushed fulvous or buff, cuticle broken into scales in both young and old fruit-bodies (colours resemble *Russula delica*, or not as strongly spotted with rust-colour), margin slightly incurved when young, paler than disc. *Tubes* brown, when dry ochraceous buff in NH_4OH; *pores* very pale lemon-yellow, then flushed slightly sulphur-yellow. *Stipe* almost white or cream with slight vinaceous flush. *Flesh* orange in young specimens, unchangeable, in older fruit-bodies yellow, watery and turning intensely blue.

Basidiospores 6·5–8 × 2·2–2·5 μm. *Pileal surface* of thin-walled, hyaline hyphae 6–9 μm broad, outline accentuated in gelatinised matrix by small asperulations, otherwise of similar refractive index.

Cultural characteristics

Macroscopic characters: mycelial mat with medium growth rate, 40–60 mm diameter in one month, at first white, compact, furry, margin even and thinner, then becoming dirty pinkish vinaceous; appressed mycelium dark brown; reverse dark cream then dirty vinaceous; slight yellow discoloration of medium.

Microscopic characters: hyphae frequently branched with both *paarige* and multiple branching; clamp-connections frequent on main hyphae, not seen on branches; sap hyphae few, pale yellow.

Chemical reactions: gum guaiac, formol and KOH negative.

When collected the fruit-bodies somewhat resembled the North American *Suillus tomentosus* (Kauffman) Singer, Snell & Dick. In the microscopic characters of the culture the collection has some similarities to this species but the macroscopic and chemical characters of the fresh fruit-body are different. The structure of the pileus and the colours of the flesh resemble more members of *Suillus* sect. *Fungosi* than members of sect. *Angustiporini*.

2. CULTURAL GROUP VI

In forest of *Pinus halepensis*, Varibombi, Attica, 6 xi 1968, *Pantidou* MPIH–949 (culture B–38–68).

Pileus 70 mm, convex, firm, pale brown to pale yellow-brown, viscid, margin slightly inturned. *Tubes* adnate, slightly cinnamon in NH_4OH when dry; *pores* pale yellow, minute. *Stipe* robust as in *Boletus edulis*, 100 × 25 mm (35–40 mm at base), yellow at apex, whitish below with cinnamon glandules only at apex. *Flesh* white, hard and firm, KOH negative; on cuticle greenish black. *Mycelium* snow-white.

Basidiospores 7·5–9 × 3·5–4·5 μm, ellipsoid in face view, fairly broadly subfusoid in side view, smooth, pale straw-colour in NH_4OH, yellow-brown in Melzer's reagent. *Basidia* 4-spored, 30–35 × 4·5–6 μm, elongate, clavate to cylindrical, hyaline in NH_4OH and Melzer's reagent. *Pleurocystidia* in scattered groups hyaline at base of tubes with little or no pigmentation or faintly asperulate, darker and more encrusted towards tube orifice, distinctly clavate, 7·5–10 × 30–35 μm; *cheilocystidia* in discrete bundles intermixed with brown and hyaline cells, strongly encrusted at base. *Pileal surface* of repent, gelatinised, hyaline, asperulate hyphae, 6·5–8 μm broad, terminating in dull brown layer overlying red-brown, compacted zone with some amorphous material scattered between constituent cells, then passing into open pileus trama. *Stipe surface* covered in small bundles of brown cells with brown encrustation, similar in shape to those at tube orifice, up to 12·5 μm broad.

This material when seen in the field resembled a true *Boletus* and was collected as such until the glands on the stipe indicated otherwise. Macroscopically this collection agrees with nothing in the literature and is probably an autonomous species, but as the material is probably not fully mature we decline to describe it as such. The colour transparency would suggest a taxon in the *S. granulatus-lactifluus* group.

CULTURAL CHARACTERISTICS

Macroscopic characters: mycelial mat with medium growth rate, 40–60 mm diameter in one month, furry, whitish, faintly zonate; reverse with distinct orange shades.
Microscopic characters: hyphae mostly with simple branching; *paarige* not frequent; clamp-connections not frequent.
Chemical reactions: gum guaiac, formol and KOH negative.

3. CULTURAL GROUP VII

In forest of *Abies cephalonica* mixed with some *Pinus nigra* ssp. ? *pallasiana*. Mount Taiyetos, Peloponnisos, 28 xi 1968, MPIH–955 (culture B–46–68).

Pileus 120 mm, convex, dark reddish brown, glabrous, viscid. *Tubes* 12 mm long in mature parts of fruit-body, yellow, reddish in NH_4OH when dry. *Stipe* 40 × 25 mm, yellow at apex, reddish brown elsewhere, covered in glands. *Flesh* whitish to pale yellow near tubes, taste rather sweet, with KOH directly greenish grey. *Mycelium* whitish.

Basidiospores 8·5–10 × 3·5–3·75 μm, ellipsoid in face view, subfusoid in side view, smooth, pale straw-colour in NH_4OH, only slightly more yellowish

in Melzer's reagent. *Basidia* 4-spored, clavate-cylindric, hyaline in NH_4OH, hardly coloured in Melzer's reagent, 17·5–20 × 4·5–5 μm broad. *Pleurocystidia* clavate, distinctly cinnamon-brown in NH_4OH, associated with red-brown to dull brown pigment globules in Melzer's reagent, *cheilocystidia* and *caulocystidia* similar. *Pileal surface* of repent, gelatinised, hyaline or faintly coloured, asperulate hyphae, 6–11 μm broad, darkening, more compacted towards base, passing into similar hyphae of pileus trama. *Hymenophoral trama* of distinctly gelatinised, hyaline hyphae, divergent from a darker, central strand with some areas of hymenium distinctly vinaceous-cinnamon in NH_4OH and red-brown in Melzer's reagent.

Cultural characteristics

Macroscopic characters: mycelial mat 60–70 mm diameter in one month, pale cream or whitish with buff tints mainly at centre, furry, margin uneven; reverse distinct, pinkish ochraceous becoming purplish brown when old; medium not discoloured.
Microscopic characters: hyphae mostly simple; *paarige* present, not frequent; clamp-connections rather rare, only on the main hyphae.
Chemical reactions: gum guaiac, formol, KOH negative.

Although the material was rather old when collected, the culture is quite distinct and places this collection in a group of its own.

4. Remainder of cultural group IV

MPIH–699, in forest of *Pinus halepensis*, Ekali, Attica, 8 xi 1966 (culture B–18–66).

Pileus up to 70 mm, plane, smooth, glabrous, viscid, dark yellow-brown, margin in some wavy, in others upturned. *Tubes* 6 mm long in mature areas, pinkish or ochraceous brown in NH_4OH when dry; *pores* pale ochraceous. *Stipe* 50 × 15–20 mm, yellowish at apex, reddish vinaceous at very base, between these zones whitish, smeared all over with large reddish glandules. *Flesh* thick in pileus, pale yellow, darker near tubes, with KOH instantly vinaceous, then grey-black.

Basidiospores 7·5–9·5 × 3–4·5 μm ellipsoid in face view, subfusoid in side view, smooth, pale straw-colour in NH_4OH, ochreous brown in Melzer's reagent. *Basidia* 4-spored, 20–22·5 × 4·5–5 μm, hyaline in NH_4OH, covered with ochreous brown globules in Melzer's reagent. *Pleurocystidia* 18–22·5 × 5·5–7·5 μm, clavate or fusiform, hyaline or filled entirely or in part with brownish material, darker brownish material around base particularly in clusters closest to tube orifice; *cheilocystidia* heavily encrusted with dark brown, amorphous material, forming dark groups about the tube orifices, so heavily pigmented as to obscure individual cells; *caulocystidia* similar in shape and pigmentation to cheilocystidia. *Hymenophoral trama* of gelatinised, hyaline, hyphae divergent from floccose, central similarly coloured strand. *Pileal surface* of hyaline or pale coloured, granulate to asperulate or coarsely roughened, not heavily gelatinised hyphae 5–9 μm broad, darkening towards base of zone, intermixed with pigment globules in Melzer's reagent, becoming compacted at base to form a distinct zone immediately above pileus trama.

This isolate is culturally close to *S. obscurus* but there are certain distinct differences (see below).

CULTURAL CHARACTERISTICS

Macroscopic characters: mycelial mat with fast growth rate, 60–80 mm diameter in one month, fluffy, cottony to woolly, whitish at first, soon turning ochraceous or dark buff, margin white, producing fan-like sectors in age; reverse pale ochraceous, with age becoming vinaceous brown; medium discoloured yellow.
Microscopic characters: hyphae frequently branched in *paarige*, multiple branching common; clamp-connections frequent only on main hyphae and point of branching; sap hyphae few.
Chemical reactions: gum guaiac instantly vinaceous spot; formol and KOH negative.

D. COLLECTIONS OF UNCERTAIN POSITION

1. MPIH–959, in forest of *Pinus halepensis*, Lower Mount Parnis, Attica, 4 xii 1968 (no culture).

Pileus up to 70 mm, plane, orange-brown, smooth, glabrous, glutinous. *Tubes* dirty yellow to dirty brown, pinkish brown in NH_4OH when dry. *Stipe* 30 × 10 mm, pale yellow at apex, dirty brownish or dirty whitish elsewhere, covered throughout with small, cinnamon glandules. *Flesh* yellowish, pinkish near the pileus cuticle; with KOH instantly vinaceous then grey.

Basidiospores 8·5–10 × 3·8–4 μm, ellipsoid in face view, slightly subfusoid in side view smooth, straw-yellow in NH_4OH, slightly darker in Melzer's reagent. *Basidia* 4-spored, c. 18–20 × 10 μm, hyaline in NH_4OH and Melzer's reagent. *Pleurocystidia* and *cheilocystidia* in clusters, surrounded or encrusted with varying amounts of dark brown, amorphous material, clavate, associated with red-brown pigment globules in Melzer's reagent. *Hymenophoral trama* of gelatinised, hyaline or slightly coloured hyphae, divergent from a possibly darker, central strand. *Pileal surface* of highly gelatinised, repent, hyaline hyphae, 3–4·5 μm broad, associated with little amorphous material. *Clamp-connections* present in hyphal elements of pileal surface.

This collection was separated from all the other specimens by virtue of its possessing numerous clamp-connections. Macroscopically the collection approaches *S. obscurus* in many of its features. The pileus and stipe characters are typical of those in the genus *Suillus* and there is little doubt in our mind that this is in fact closely related to some of the fungi recorded in this paper. Singer (1962) distinguishes the genus *Boletinus* from *Suillus* by the character of the cap (for *Suillus* viscid and if fibrils present easily lost); presence or absence of clamp-connections (absent in *Suillus*) and the character of the stipe medulla (hollow in several species of *Boletinus*). Thus in one of these characters i.e. clamp-connections, our material might be considered a species of *Boletinus*. This therefore confirms our views that the circumscription of *Suillus* and *Boletinus* must be closely examined in the future. Smith & Thiers's (1964) proposals might be the way to deal with the problem although it may be even better to recognise further splitting of the group.

2. MPIH–698, in forest of *Pinus halepensis*, Lower Mount Parnis, Attica, 2 xi 1966 (no culture); part collection in E and as DAOM 117934.

Pileus 40–55 mm, smooth, glabrous, slightly viscid, pale ochraceous, margin inturned, without velar remnants. *Tubes* adnate to decurrent, 6 mm long, pale yellow to golden yellow, bright orange with KOH little or no colour change in NH_4OH, when dry. *Stipe* 25–35 × 13 mm, bright yellow, with tiny brown glandules throughout. *Mycelium* pinkish.

Basidiospores 8·5–10 × 3·3–4·5 μm. *Pileal surface* of repent, slightly gelatinised, smooth hyphae, 6–10 μm broad, associated with only few pigment globules in Melzer's reagent.

Distinguished from all the other species described in the literature and in this paper (excepting *S. alkaliaurantians*) by the orange colour produced by KOH when placed on the flesh of the fresh fruit-body. The typical colour change with this reagent is vinaceous, lilaceous or pinkish which more or less rapidly turns grey, steel blue or black. The orange reaction is unusual indeed and it is only found in a few other members of the Agaricales e.g. the rust-orange to sienna produced with KOH on the fruit-body of *Hygrophorus chrysaspis* Metrod.

The position of MPIH–698 remains uncertain. It differs from *S. alkaliaurantians* in colour of flesh, pileus and stipe characters. Unfortunately isolation in culture was not successful.

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