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TAXONOMIC STUDIES IN THE PHACIDIALES: THE GENUS COCCOMYCES (RHYTISMATACEAE)

MARTHA A. SHERWOOD

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TAXONOMIC STUDIES IN THE PHACIDIALES: THE GENUS COCCOMYCES (RHYTISMATACEAE)

by

MARTHA A. SHERWOOD[1]

SUMMARY

This paper reviews the history, nomenclature, morphology, and relationships of *Coccomyces* (Phacidiales: Rhytismataceae) and provides keys to and detailed descriptions of the fifty species accepted in the genus. Also included are descriptions of *Biostictis tjibodensis*, four species of *Karstenia*, *Cerion leucophaeum*, *Myriophacidium corticola* and *M. tridentatum*. Of the fifty accepted species of *Coccomyces*, 29 were previously accepted in the genus, five (*C. bipartitus*, *C. castanopsidis*, *C. foliicola*, *C. petersii*, and *C. philippinus*) are new combinations, and 16 (*C. annulatus*, *C. antillarum*, *C. arbutifolius*, *C. concolor*, *C. crystalligerus*, *C. duplicarioides*, *C. farlowii*, *C. irretitus*, *C. monticola*, *C. palmicola*, *C. parvulus*, *C. radiatus*, *C. tesselatus*, *C. tympanidiosporus*, *C. urceolus*, and *C. venezuelae* are described as new.

INTRODUCTION

The Rhytismataceae (Ascomycetes: Phacidiales) (= Hypodermataceae of most authors) constitute a well-defined family of immersed discomycetes characterized by reduced apothecia imbedded in an intramatrical stroma which opens at maturity to expose the hymenium; thin-walled, inoperculate, J− asci without an obvious apical pore; abundant paraphyses; and colorless, sheathed ascospores.[2] The history and nomenclature of the group have been adequately reviewed by Darker (1932, 1967), Terrier (1942), Nannfeldt (1932), and Tehon (1935); only those aspects of the history relevant to *Coccomyces* will be reviewed here.

Most of the twenty-two genera accepted by Darker (1967) in the Rhytismataceae occur either primarily or exclusively on conifer needles. These conifericolous species, many of which are parasitic, were ably revised by Darker (1932, 1967); recent additions to the group are summarized by Hunt and Ziller (1978). In contrast, the non-conifericolous species are poorly known, and generic concepts are based on studies of a few, not necessarily representative, taxa. Tehon's (1935) monograph of *Lophodermium*, for example, emphasizes conifericolous taxa, completely ignoring several common and distinctive tropical species on broad-leaved angiosperms. *Hypoderma* was revised by Powell (1974) in an unfortunately as yet unpublished thesis. There is no modern treatment of *Colpoma*, *Rhytisma* or their segregates.

Of the remaining genera of the Rhytismataceae, the most serious taxonomic problems involve *Coccomyces*, a large assemblage of species

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[2]The status of the alleged brown-spored species of the group, (*Criella* (Sacc.) P. Henn., *Phaeorhytisma* P. Henn., and *Nymanomyces* P. Henn.) deserves reinvestigation).

which occur on leaves, herbaceous stems, bark, and wood, and which have circular ascocarps opening by teeth, cylindrical or clavate asci, and cylindric-clavate to filiform ascospores. This assemblage is the subject of the present revision.

HISTORY

De Notaris (1847) erected *Coccomyces* as a monotypic genus of the Hysteriaceae, typified by *Hysterium tumidum* Fr. (≡ *Coccomyces tumidus* (Fr.) de Not.). At the same time he explicitly excluded three species now considered to belong in *Coccomyces, C. coronatus* (as *Lophodermium phacidium*), *C. dentatus,* and *C. delta,* placing them in *Lophodermium* ρ *Phacidioides.* Darker (1967), who considered *C. coronatus* and *C. tumidus* to be synonyms, regarded this arrangement as "curious." In fact, *C. tumidus* and *C. coronatus* are at least as different from each other as *Hypoderma rubi* (Pers. ex Chev.) de Not., type of *Hypoderma,* and *Lophodermium arundinaceum* (Schrad. ex St. Amans: Fr.) Chev., type of *Lophodermium,* two genera which have been considered distinct since 1826. In addition to the differences in asci and ascospores (*Hypoderma* and *C. tumidus* have long-stalked, clavate asci and short-cylindrical ascospores; *C. coronatus* and *Lophodermium arundinaceum* have nearly sessile, cylindrical asci and filiform ascospores), *C. tumidus* lacks the preformed, regular ascocarp dehiscence mechanism found in *C. dentatus* and *C. delta.* Hence, under a modern arrangement of these fungi, paralleling Darker's (1967) treatment of the hysterothecial Rhytismataceae, de Notaris's arrangement (with *Lophodermium* ρ *Phacidioides* raised to generic rank) might well be preferable to the arrangements of Nannfeldt (1932) and Terrier (1942).

Such an arrangement, however, results in a number of unfortunate nomenclatural difficulties. The most familiar species of *Coccomyces* are relegated to *Coccomycella* Höhnel, a name not accepted by any author other than its originator. *Coccomyces tumidus,* on the other hand, appears to have no close relatives among the leaf and bark-inhabiting *Coccomyces* species.

Coccomyces, in the sense of modern authors, developed by gradual accretion of taxa, many of them well-known but assigned to other genera. Until the general acceptance of ascospore characteristics as a means of classifying discomycetes, together with the use of microscopes capable of resolving the small, colorless ascospores of the Rhytismataceae, the orbicular, discoid species continued to be separated from the hysterothecial type of the genus. *Coccomyces coronatus* and its allies were considered (e.g., Fries, 1849; Fuckel, 1870) to be typical members of the genus *Phacidium*, now generally considered

to have been typified by von Höhnel (1917) with *P. lacerum*. However, when Fries (1822–23) validated *Phacidium*, he explicitly excluded one of the two species on which the genus was founded, leaving only *P. coronatum* in *Phacidium*. If this constitutes valid typification of *Phacidium*, the generic name should be proposed for conservation in von Höhnel's sense.

De Notaris (Ardissone et al., 1859) subsequently recognized the similarities between *Coccomyces tumidus* and *Phacidium coronatum*, and transferred the latter species to *Coccomyces*. Karsten (1871) made the first systematic attempt to bring together under *Coccomyces* all of the filiform- and fusiform-spored *Phacidium* species, including *C. pini* (now *Therrya*), *C. juniperi*, *C. quadratus*, *C. macer* (a *Karstenia*), *C. coronatus*, with *Phacidium trigonum* (= *C. tumidus*) reduced to infraspecific rank, and *C. rubi* (= *Coleroa*). He also transferred the genus from the Hysteriaceae to the Phacidiaceae.

Rehm (1887–96) added a number of additional species, again considering *Phacidium trigonum* as a subspecies of *Coccomyces coronatus*, while recognizing *C. tumidus* as a species of *Lophodermium*. At the same time he errected the Hypodermataceae (a later, more familiar name for the Rhytismataceae), but included *Coccomyces* in the Phacidiaceae. Saccardo (1889) recognized *C. coronatus*, *C. trigonus*, and *C. tumidus* as distinct species, accepted other species included by Karsten and Rehm, and added a number of extralimital species of *Phacidium* not included by those authors in their regional floras. Minor contributions by other authors, consisting of descriptions of additional species, are discussed under the species concerned.

After Duby (1861), whose treatment of *Coccomyces* was identical to that of De Notaris, the first major attempt to reorganize the fungi now included in the Rhytismataceae was that of von Höhnel (1917), who divided the Phacidiales into six families on the basis of orientation with respect to the host. The Schizothyrieen consisted entirely of loculoascomycetous leaf parasites. The Leptopelteen were of a mixture of subcuticular fungi including *Coccomyces*, with its correct type species *C. tumidus*, *Rhytisma*, *Bifusella*, *Duplicaria*, *Lophodermina*, and a variety of Loculoascomycetes. The intraepidermal Dermatopelteen included *Coccomycella* (= *Coccomyces* s.l. pro parte) and the majority of Rhytismataceae. The subepidermal Phacidiaceae were a mixture including *Phacidium*, *Lophodermium*, and *Coccomycetella*, a genus not now considered (Nannfeldt, 1932) to be related to *Coccomyces*. The Phacidiostromaceen were characterized by deeply sunken leaf-inhabiting stromata. The Cryptomyceteen, with deeply sunken bark-inhabiting stromata, included *Sporomega*, *Colpoma*, and *Therrya*. This arrangement is untenable by modern systems of classification, since it juxtaposes within the same family genera now

considered to belong to separate subclasses.

Nannfeldt (1932) rejected this classification of the Phacidiales, removed the most discordant elements included by von Höhnel in the group, and recognized a single family, Phacidiaceae, including hysterothecial forms as well as *Phacidium* and *Coccomyces*. Darker's (1932) treatment of the Hypodermataceae of conifers included only hysterothecial forms traditionally included in that family.

Terrier (1942) examined the genera of Phacidiaceae sensu Nannfeldt and separated them into three families. The Hypodermataceae were characterized by a complex covering layer of radiating, often carbonized hyphae, solitary ascocarps, and J− asci. The Rhytismataceae possessed ascocarps like those of the Hypodermataceae immersed in a complex, compound stroma. The Phacidiaceae were characterized by a covering layer of vertically-oriented, prismatic cells, and J+ asci. Although the orientation of cells in the covering layer of *Coccomyces* is often vertical, and Terrier's suggestion that the Phacidiaceae are ascolocular is evidently incorrect, the distinction between the Hypodermataceae and the Phacidiaceae on the basis of ascus characters appears to be a valid one. More recent authors (Darker, 1967; Dennis, 1977; Korf, 1973) have united the Rhytismataceae and Hypodermataceae. Terrier briefly redescribed several species of *Coccomyces*, including *C. coronatus* and *C. dentatus* but not *C. tumidus*.

Since 1942 no further revisions of *Coccomyces* have appeared. Darker (1967) discussed the genus briefly, with *Coccomyces coronatus* incorrectly considered as its type and *C. tumidus* as a synonym. Dennis (1977) used the name *C. coronatus* for *C. tumidus*. B. Eriksson (1970) provided a useful account of the species on Ericaceae in Fennoscandia.

RELATIONSHIP OF COCCOMYCES TO OTHER GENERA

According to the most current system for delimiting the genera of the Rhytismataceae (Darker, 1967), genera having ascocarps which open by teeth are set aside definitively from those genera with hysterothecial ascocarps. Hence, it should be possible to consider the generic limits in one group without reference to the other. It is questionable, however, whether this is an appropriate model for evolutionary relationships in the group. The majority of wood-inhabiting species of *Coccomyces*, as well as *Sporomega*, *Duplicaria*, some taxa assigned to *Colpoma*, and a few species of *Lophodermium*, lack any preformed dehiscence apparatus and split open irregularly, usually by a longitudinal slit if the substrate has a strong longitudinal grain, otherwise by teeth. According to D. C. Minter (personal communication) two species of *Lophodermium* which occur on both needles and cones of *Pinus* may exhibit stellate dehiscence when on cones.

In contrast, the majority of the hysterothecial Rhytismataceae and a large proportion of the foliicolous *Coccomyces* species have distinct, differentiated, often rather elaborate dehiscence mechanisms. In the former undifferentiated group the mode (linear or stellate) of ascocarp dehiscence is probably of less significance taxonomically than in the latter group.

The species of Rhytismataceae which have a well-defined preformed dehiscence mechanism have a number of other common characters, including a foliicolous or acicolous, intraepidermal habit, production of pycnidia, bleaching of the substrate to form discrete lesions bounded by a black line, and a tendency toward parasitism. If these characters are accorded equal weight with the ascocarp shape in determining the relationships of the genera of Rhytismataceae the effect is to group the foliicolous species of *Coccomyces* with the foliicolous species of *Lophodermium* and not with the wood-inhabiting Rhytismataceae which open by teeth. More information is needed on taxa which occur on Angiosperms, particularly in the tropics, before this question can satisfactorily resolved.

If the rhytismataceous fungi which open by teeth are considered in isolation, there remain a number of problems in the delimitation of genera and their relationship to one another.

The characters used by Darker (1967) for defining genera of hysterothecial Rhytismataceae included ascus shape (whether cylindrical, cylindric-clavate, or clavate), ascospore morphology, the shape of the apothecia (whether elliptic of nervisequious), the number of apothecia in a stroma and the orientation of the ascocarps with respect to the surface of the substrate. Ascospore characters considered of generic importance included shape (rod-shaped, clavate, filiform, bifusiform) and septation. Other authors have regarded paraphyses characters to be of generic importance. For example, Reid and Cain (1961) considered the knobbed paraphyses immersed in a brown gel to be diagnostic of *Therrya*, and Dennis (1958) separated *Cerion* from *Colpoma* on the grounds that the former lacked the circinate paraphyses of the latter.

With the exception of ascus and ascospore shape, these characters appear to be independent of each other. Therefore, if each is considered by itself to be diagnostic at the generic level, as shown in Table 1, the potential number of genera in the group is high, being the product of septation level (2 states), spore shape (4 states), paraphyses type (4 states), ascocarp shape (4 states), and orientation with respect to the surface of the substrate (4 states), or 512 genera if all the slots are filled, a figure exceeding the number of species now known in the Rhytismataceae.

Rather than carry such a scheme to its absurd logical conclusion

TABLE 1. CHARACTERS OF GENERIC IMPORTANCE IN THE RHYTISMATACEAE (AFTER DARKER, 1967).

Spores	Spore Shape	Paraphyses	Ascocarp Shape	Orientation
septate	rod-shaped	simple	nervisequious	subcuticular
nonseptate	clavate	branched	linear-elliptic	intraepidermal
	filiform	circinate	compound	subepidermal
	bifusiform	inflated, in a gel	circular	intracortical

and distribute the species of *Coccomyces* among a myriad of segregate genera, a system which shows little potential for being natural or elucidating evolutionary relationships, I have adopted a conservative approach in which all of the species of Rhytismataceae having ascocarps which open by teeth have been retained in *Coccomyces* except those which belong in genera already accepted in the literature. This approach is admittedly conservative. In order to avoid creating large numbers of new combinations in a group where future research may well again suggest altering generic limits, I have sacrificed a degree of uniformity in generic definition. The distinctions between the accepted segregate genera (*Cerion, Duplicaria, Duplicariella, Lasiostictis, Moutoniella, Myriophacidium, Naemacyclus, Sporomega, Therrya,* and *Tryblidiopsis*) and *Coccomyces* are discussed briefly below, as are the reasons for transferring those genera in the above list, which are traditionally considered to belong to other groups, to the Rhytismataceae.

KEY TO THE GENERA OF RHYTISMATACEAE WITH ORBICULAR ASCOCARPS WHICH OPEN BY TEETH

The key also includes selected non-rhytismataceous genera of similar growth habit; their names appear in parentheses. For a more complete key to immersed, stromatic discomycetes, see also Sherwood (1977a).

1. On wood, bark, or coniferous cone scales . . . . . 2.
1′. On leaves, rarely on herbaceous stems . . . . . 9.

2(1). Stroma fleshy, thick, well-developed, noncarbonized or with a carbonized crust and gelatinous interior, without a preformed dehiscence mechanism . . 3.
2′(1). Stroma heavily carbonized or much reduced . . . . . 5.

3(2). Covering stroma colorless or nearly so, of small, vertically oriented cubical cells; asci saccate to clavate; spores closely septate; hymenial gel sometimes blueing in iodine . . . . . (*Karstenia*).
3′(2). Stroma pigmented. Spores usually nonseptate and sheathed; asci clavate or cylindrical, often pointed at the apex . . . . . 4.

4(3′). Ascospores long-clavate to filiform. Ascocarps immersed, not erumpent, tending to be elongate. On Ericaceous twigs . . . . . *Sporomega.*
4′(3′). Ascospores oblong to clavate. Ascocarps erumpent, pseudostipitate. On twigs of various hosts, typically conifers . . . . . *Tryblidiopsis.*

5(2′). Covering stroma heavily carbonized, fringed internally with a conspicuous layer of hyphal hairs visible to the naked eye. On cone scales of *Pinus* . . . . . *Lasiostictis.*
5′(2′). Covering stroma without a prominent internal fringe of hairs, sometimes with gelatinous periphysoids . . . . . 6.
6(5′). Covering layer essentially absent, reduced to a layer of crystals . . . . . *Naemacyclus.*
6′(5′). Covering layer well-developed . . . . . 7.
7(6′). Apothecia erumpent, eventually nearly superficial, large, with a bright red hymenium and black rugose border. Ascospores long-filiform. Australia, tropical America . . . . . *Cerion.*
7′(6′). Apothecia remaining immersed, or, if erumpent, covered by stroma when dry; hymenium variously pigmented but not bright red . . . . . 8.
8(7′). Epithecium of inflated paraphyses cemented in a brown gel; ascospores septate. On confiers . . . . . *Therrya.*
8′(7′). Epithecium colorless or yellowish. Ascospores generally nonseptate. On various hosts . . . . . *Coccomyces.*
9(1′). Covering stroma reduced or absent, often crystalline . . . . . 10.
9′(1′). Covering stroma well-developed . . . . . 12.
10(9). Paraphyses cemented apically in a brown gel; ascospores filiform. Java . . . . . *Moutoniella.*
10′(9). Paraphyses not cemented in a brown epithecial gel . . . . . 11.
11(10′). Asci cylindrical, with a prominent apical cap. Ascospores closely septate. Parasitic on living leaves . . . . . (*Biostictis*).
11′(10′). Asci without a prominent apical cap; spores nonseptate or distantly septate . . . . . *Naemacyclus.*
12(9′). Ascospores bifusiform . . . . . *Duplicaria.*
12′(9′). Ascospores some other shape . . . . . 13.
13(12′). Ascospores ovoid . . . . . 14.
13′(12′). Ascospores long-cylindrical, clavate, or filiform . . . . . *Coccomyces.*
14(13). Ascocarps subcuticular. Stroma fleshy, without a preformed dehiscence mechanism . . . . . *Duplicariella.*
14′(13). Ascocarps intraepidermal. Stroma carbonized, with a preformed dehiscence mechanism . . . . . *Myriophacidium.*

Of the above genera, *Biostictis* Petr., discussed because it includes a species described as a *Coccomyces*, is evidently Ostropalean. The affinities of *Karstenia* are obscure, but do not appear to lie with the Rhytismataceae.

Sporomega has, in the past, been synonymized with *Colpoma* Wallr. and included among the hysterothecial Rhytismataceae. Eriksson (1970) considered it distinct from *Colpoma* on the grounds that it lacked a distinct dehiscence apparatus and lip cells. The ascocarps are elongate but occasionally open by teeth. The rather fleshy stroma separates *Sporomega* from the majority of the wood-inhabiting species of *Coccomyces*. Microanatomically it is rather similar to *Coccomyces tumidus*, which is, however, totally dissimilar ecologically.

Tryblidiopsis Karst., and the closely related, possibly synonymous genus *Discocainia* J. Reid and Funk, have usually been assigned to the Helotiales by modern authors (Korf, 1973; Reid & Funk, 1966). Both genera, however, share several characters which suggest that they are related to the corticolous species of *Coccomyces*. Stalked clavate asci with no demonstrable apical pore apparatus, sheathed,

colorless spores, and fruit bodies which open by splitting a partially carbonized covering layer radially, all suggest rhytismataceous affinities. The taxonomy of this group of fungi will be discussed in greater detail in a separate paper.

Lasiostictis, formerly included in the Stictidaceae, was considered by Sherwood (1974) and Dennis (1977) to belong to the Phacidiaceae, a position based on the vertical orientation of the covering layer and an alleged J+ reaction of the ascus tip. Since many indubitable species of *Coccomyces* have vertically oriented cells in the covering layer, this character cannot be used by itself to determine to which family an immersed phacidealean fungus belongs. As for the asci, their structure more closely resembles the asci of the Rhytismataceae and the observations on the ascus pore are open to question since the alleged pore region is minute and a diffraction pattern might well be mistaken for a blueing reaction. Di Cosmo (1979) considers the genus to be rhytismataceous.

Naemacyclus species whose ascocarps open by teeth are closely related to *Coccomyces*, differing in having a much reduced covering layer and an invariably subepidermal habit. This group was partially revised by Sherwood (1977b) under the name *Propolis*. *Cerion* is discussed under a separate heading, below.

Both Nannfeldt (1932) and Reid and Cain (1962) doubted that *Therrya* belonged in the Rhytismataceae. Neither, however, was able to place it satisfactorily in another family of discomycetes. The two known species are quite isolated and share a combination of many distinctive characters, but most of these characters (somewhat truncate asci, septate, sheathed spores, inflated paraphyses imbedded in a brown epithecial gel, and a massive corticolous stroma) can be found elsewhere in the family. The appendages on the spores of *T. fuckelii* are the only character unique to *Therrya*. Surely the genus is better accomodated near the wood-inhabiting species of *Coccomyces* than with the foliicolous needle pathogens with amyloid asci of the Phacidiaceae s. str.

Moutoniella is essentially a *Propolis* with a brown agglutinated epithecium, therefore differing from that genus no more than *Coccomyces clusiae* differs from the other foliicolous species of *Coccomyces*. *Duplicaria* and *Duplicariella* differ from most species of *Coccomyces* (but not from its type, *C. tumidus*) in having fleshy, subcuticular stromata lacking preformed lines of dehiscence; additionally, *Duplicaria* has bifusiform ascospores and *Duplicariella* ovoid ascospores. *Myriophacidium* is discussed under a separate heading, below.

Mention should be made here of *Godronia* (Leotiaceae: Scleroderridoideae). The species accepted by Groves (1965) in the genus are all easily distinguished from *Coccomyces* by their substipitate asco-

carps with a well-developed exipulum (which may be toothed) and typical helotialean short-stalked asci with an obvious J+ pore, but there remains a residue of species formerly assigned to the genus for which Groves could locate no satisfactory alternative placement. Of these, only *G. castanopsidis, G. treleasei, G. splendida, G. jamaicensis* and *G. juniperi* appear from their descriptions and/or examination of specimens to be rhytismataceous. Groves's list of excluded species, however, should be consulted for erumpent filiform-spored discomycetes which cannot be identified here.

MATERIALS AND METHODS

The observations in this paper are based primarily on dried herbarium specimens. *Coccomyces* ascocarps, adapted to alternate wetting and drying in nature, preserve well and retain most of their diagnostic characters.

Ascocarps were rehydrated in water, sectioned at 15 or 20 μm on a freezing microtome, and mounted in Melzer's reagent or lactophenol-cotton blue for microscopic observation. Additional crush mounts were used for observation of asci and spores. For more routine identification gross morphology, ascospore dimensions, paraphyses characters, and host are usually adequate for determining a *Coccomyces* to species; sections provide additional characters of stroma and exciple.

The only species cultured during the study was *Coccomyces strobi*. Mass ascospore isolates of this species produced compact, slow-growing mycelial colonies, initially colorless but darkening with age, on potato dextrose agar. No conidia were produced.

Because they are inconspicuous and occupy a specialized habitat, *Coccomyces* and its allies often escape the attention of the general mycological collector. They are, however, worthy of attention, since they are diverse, preserve well by drying, and can be found fruiting in areas and at times of the year when few other fungi are available.

Leaf inhabiting species are easily recognized in the field because of the distinctive bleached lesions they cause. Fruitbodies are generally found only on the upper surface of leaves in the topmost layer of litter. Host species should be recorded if possible, and collections from different hosts kept separate. To avoid collecting effete material the collector should select leaves which are not in an advanced state of decay. If the hymenium is exposed it will normally be a color other than black; specimens which appear entirely black in wet weather are probably not sporulating.

Twig-inhabiting species are less conspicuous. Small twigs of trees whose lower branches are dying are a favored habitat. The majority

of species occur on conifers, a few on Fagaceae. The species parasitic on ericaceous twigs should be taken from living stems; ascocarps on dead twigs are usually overmature. Again, the host should be recorded. Even if the same fungus appears to be attacking several different hosts, collections should be made from all host species.

If present, rhytismataceous fungi usually occur in quantity. Since it is normally impossible to determine collections to species on field characters alone, it is always advisable to make large collections, both to ensure that fertile material is obtained and to provide adequate herbarium specimens for future workers in the event that the species is uncommon.

MORPHOLOGY

Vegetative morphology. The vegetative thallus of a *Coccomyces* consists of intramatrical, colorless or pigmented hyphae of narrow diameter, often accompanied by extruded crystals, presumably of calcium oxalate. Most leaf-inhabiting species form discrete lesions, often bounded by a thin, black line of carbonized fungal cells and disintegrating host tissue. The entire structure is roughly analogous to the 'substratal stroma' (Whetzel, 1945) of the Sclerotiniaceae. Microsclerotia of unknown function may accompany the line.

Imperfect stage. A few species of *Coccomyces* produce small, flattened, lenticular brown subcuticular or intraepidermal pycnidia with simple, colorless, subulate phialides in a single basal layer producing minute, unicellular, bacilliform colorless conidia. These pycnidial stages are usually assigned to the form genus *Leptothyrium*, although Darker (1967) expresses doubt that they really belong there. Their morphology is so uniform as to be scarcely diagnostic in differentiating between species of *Coccomyces*, but their presence or absence is an important factor in the classification of species. Since conidia are usually produced before the apothecia are developed (perhaps they function as spermatia) the presence or absence of a pycnidial stage could not be verified in some infrequently collected species.

In addition to the *Leptothyrium* stages, also ascribed to *Coccomyces* by Tulasne and Tulasne (1865), Nannfeldt (1932) and others, Lind (1907), von Höhnel (1925) and Nannfeldt (1932) suggested that *Ceuthospora* imperfect stages were associated with *Coccomyces coronatus* aggr. The material I examined gave no evidence of an association between *Coccomyces* and *Ceuthospora*. Since *Coccomyces* species often grow in association with obviously unconnected fungi (e.g., *Mycosphaerella*) great care is needed in interpreting perfect-imperfect stage connections. *Ceuthospora* is generally considered to be the

imperfect stage of *Phacidium*. The fungus which Grove (1928) interpreted as *Schizothyriella quercina* Thüm. and claimed to be the imperfect stage of *Henriquesia quercina* (= *Coccomyces tumidus*) is simply immature *Coccomyces tumidus*. *Schizothyriella quercina* (FH-Thüm. Mycotheca Universalis #1864, isotype) is an entirely unrelated coelomycete.

Perfect stage. Following the interpretation of most recent authors (Nannfeldt, 1932; Terrier, 1942; Powell, 1974) of a rhytismataceous ascocarp, the fruitbody of *Coccomyces* is viewed as an apothecium immersed in a stroma. The entire structure is shown diagrammatically in Figure 1-I. A young apothecial stroma is initially intramatrical, either subcuticular, intraepidermal, or subepidermal (on leaves), intracortical (on bark) or immersed in decorticated decaying wood. The position of the developing apothecium in relation to the substrate has been used as a criterion for delimiting genera in the group (von Höhnel, 1917; Tehon, 1935), but is used here only at the specific level, where it appears to be a constant character.

The stroma consists of a covering layer (b) composed of one or more layers of thick-walled, dark, globose, radiating, or epidermoid cells, a basal layer (h) constructed like the covering layer, and (at least in most species) an internal differentiated layer of tissue (here

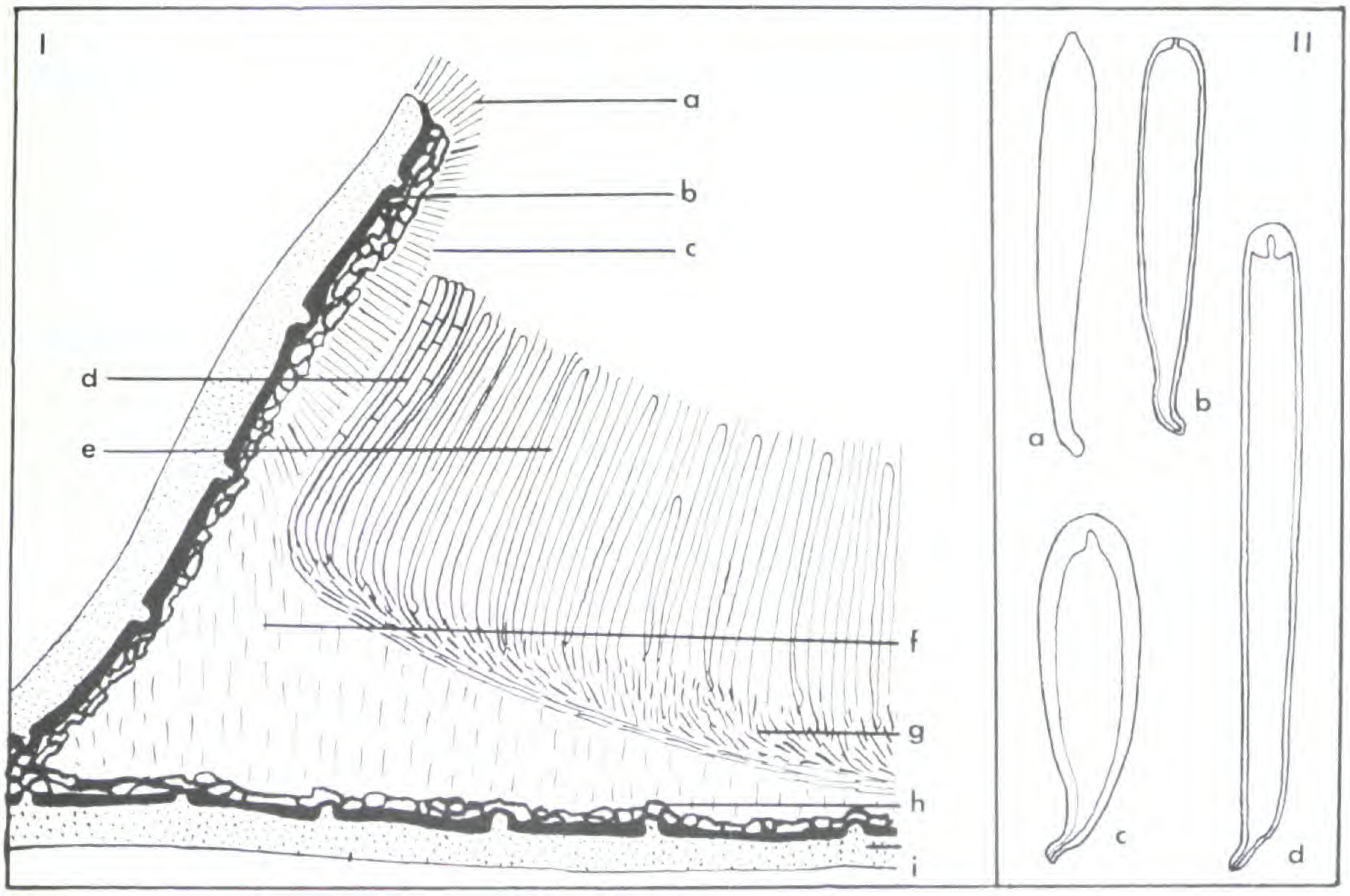

FIG. 1-I. Cross section of a rhytismataceous ascocarp (diagrammatic):—a. lip cells.—b. covering stroma.—c. periphysoids.—d. proper exipulum.—e. hymenium.—f. internal matrix of stroma.—g. subhymenium.—h. basal stroma.—i. host tissue. FIG. 1-II. Asci of immersed discocarpous Ascomycetes:—a. Rhytismataceae.—b. Phacidiaceae or Dermateaceae.—c. bitunicate ascus.—d. Stictidaceae.

termed the intra-stromal matrix) which breaks down as the developing apothecium enlarges and ruptures the overlying covering layer. This layer may be absent in the mature apothecium. Its structure may be hyphal or pseudoparenchymatous and appears to be a useful feature in defining species.

In a mature apothecium the covering layer may consist only of stromatic, heavily carbonized cells, or may be differentiated, with a layer of colorless, fleshy pseudoparenchymatous tissue or periphysoidal hairs (c) on its inner face. These structures, often gelatinous, swell when rehydrated and appear to aid in opening and closing the stroma.

In hysterothecial Rhytismataceae (e.g., *Lophodermium* spp.) the apothecia open by splitting the overlying covering layer longitudinally along a preformed line of thin-walled, noncarbonized cells which may later give rise to a compact layer of differentiated hyphae termed periphyses (Tehon, 1935) or lip cells (a). The opening mechanism of *Coccomyces* is rarely so elaborate. Most wood and bark inhabiting species appear to open irregularly, without any distinct dehiscence apparatus. *Coccomyces delta* and allied species have an opening mechanism consisting of a stellate figure of thin-walled, noncarbonized cells flanked by thick carbonized ribs, as in *Lophodermium*; however, there is no subsequent elaboration of the marginal cells. Some species also appear to have a flexible "hinge" of colorless cells near the junction of the covering and basal layers which probably aids opening and closing of the stroma.

A final form of dehiscence mechanism involves either a central thickening in the covering layer which appears as a papilla in the immature apothecium, or a system of thickened stellate ribs. The covering layer tends to tear along the junction between thicker and thinner portions of the stroma, but more irregularly than in the preceding group.

Coccomyces apothecia may be orbicular, polygonal, or irregular and elongate in face view. Shape was much emphasized as a taxonomic criterion in the early literature, but appears to be variable in most species. The color of the fresh hymenium ranges from pale grey to yellow, orange, olive green, dark grey, or brown, and appears to be sufficiently useful as a taxonomic character to warrant taking accurate field notes.

The apothecium consists of a usually colorless, small-celled and nondescript subhymenium (g), asci, paraphyses, and, in some cases, a rudimentary proper exciple (d) consisting of a few layers of agglutinated septate hyphae. The paraphyses, which are usually nonseptate, provide some of the most valuable diagnostic characters for differentiating species. The apices may be simple, inflated and knoblike,

cemented in a colorless or pigmented gel, branched, or circinate. The asci (Figure 1–IIa) range from cylindrical and nearly sessile to long-stalked and clavate, are uniformly thin-walled, J−, somewhat pointed at the apex, and lack an obvious apical pore. This characteristic rhytismataceous ascus is quite different from the asci of *Phacidium* and immersed Dermateaceae (b), which have a distinct apical apparatus and usually J+ pores, microthyriaceous leaf parasites (c), which have thick-walled, bitunicate asci, and the Stictidaceae (d) which have long-cylindrical asci with a distinct apical cap. Members of these unrelated groups are occasionally confused with *Coccomyces*.

Ascospores of *Coccomyces* range from short-fusiform to long-filiform, are colorless, usually nonseptate, and frequently conspicuously sheathed. As Darker (1932) and Tehon (1935) have pointed out, both asci and ascospores of the Rhytismataceae are variable in their dimensions even in apparently mature apothecia. Evidently the asci continue to elongate after spores have been delimited. All measurements of asci and spores in this study were made from rehydrated herbarium specimens mounted in Melzer's reagent. Darker (1932) mentions that ascospores are narrower in diameter after drying. Differences in methods of treating material probably account for differences in measurements in recently published accounts and those reported here. Small differences in measurements of asci and spores have not, alone, been used to delimit species in the present treatment. A second source of variability in recorded ascospore dimensions can be accounted for by the presence of many species which normally produce both 4- and 8-spored asci. This feature is often overlooked in species with filiform spores. Ascospores in 4-spored asci are invariably larger than those in 8-spored asci of the same species.

HABITAT AND RANGE

Knowledge of the ecology of *Coccomyces* is limited, since no detailed studies exist of the life cycles of any of the species now considered to belong in the genus. A few inferences can be drawn from the morphology and collection data, however, and by analogy with other members of the Rhytismataceae.

Coccomyces species are often found in rather dry climates or in microhabitats such as standing dead twigs which are too dry to support many groups of fungi. Situations exposed to alternate wetting and drying pose problems which fungi have overcome by a number of adaptive strategies. It is reasonable to suppose that the covering stroma of *Coccomyces*, which opens when wet and closes upon drying in response to changes in rehydration of the periphysoidal layer or pseudoparenchymatous matrix on its inner face, is an adaptation

protecting the persistent hymenium during periods of drought.

The majority of species of *Coccomyces* fruit on recently dead plant material. It would be worth investigating whether the mycelium could be recovered from living plant parts. *Naemacyclus niveus* (Pers. ex Fr.) Sacc. and *Lophodermium pinastri* (Schrad. ex Fr.) Chev., two other members of the Rhytismataceae, occur as asymptomatic infections on living conifer needles, fruiting only on dead material (F. Carroll et al., 1977; G. Carroll & F. Carroll, 1978).

Data from frequently collected species of *Coccomyces* suggest that most species in the genus exhibit some degree of host specificity, but that host preference is determined more by the texture of the invaded substrate and the ecology of the host than by taxonomic affinity. Many authors have interpreted this apparent inability to discriminate between unrelated hosts as evidence that the species are plurivorous, and have consequently reduced distinct species to synonymy. For example, Nannfeldt (1932), observing that *Coccomyces* could be found growing on leaves of various trees in the same natural collection, concluded that there were neither morphological nor biological factors that would separate *C. coronatus*, *C. dentatus*, *C. quercinus* (= *C. delta*) and *C. coronatus* var. *trigonus* (= *C. tumidus*). In addition to being distinct morphologically the four species exhibit subtle differences in host and geographical range. *Coccomyces coronatus*, which fruits in August and September, occurs on thin-textured, rather well-rotted deciduous leaves, chiefly in northern parts of Europe and eastern North America, on *Fagus*, *Betula*, *Castanea*, *Quercus* (chiefly red oaks), *Populus*, and *Acer*. *Coccomyces dentatus* occurs on sound, often evergreen leaves of *Quercus* (red, white, and live oaks), *Castanea*, *Rhododendron*, *Lithocarpus*, *Berberis*, *Arbutus*, *Fagus*, *Gaultheria*, *Myrica*, and Lauraceae. It is a warm-temperate species, common in southern Europe and the western U.S., fruiting in late summer in northern areas but nearly year-round in California. *Coccomyces delta* is apparently confined to evergreen hosts (*Quercus* and Lauraceae) in southern Europe and Macaronesia, and fruits throughout the winter rainy season. *Coccomyces tumidus* occurs in late fall on thin deciduous leaves of *Fagus*, *Quercus* (red and white), *Betula*, and *Populus* (rarely on canes of *Rubus*) in Europe and northeastern North America, and is often collected with *C. coronatus*.

Common species with restricted host ranges include: *Coccomyces strobi*, which apparently occurs only on bark of *Pinus strobus* and introduced white pines and never on other conifers; *C. triangularis*, on twigs of *Quercus alba*; *C. arctostaphyli*, on leaves of *Arctostaphylos uva-ursi*; *C. quadratus*, on twigs of *Vaccinium* spp.; and *C. ledi* on twigs of *Ledum* spp. Although the hosts of most tropical collections are unfortunately unidentified, some of the leaf fragments are suffi-

ciently distinctive to suggest that the tropical species also exhibit host specificity.

None of the species investigated appeared to be capable of colonizing both bark and leaves. Rather, bark-inhabiting and leaf-inhabiting species tend to fall into two distinct taxonomic groups. Those on bark are characterized by small spores, irregular dehiscence of the ascocarp, lack of imperfect stages, and a strictly saprophytic habit. Those on leaves are characterized by long-filiform spores, regular dehiscence along preformed lines of specialized cells, pycnidial stages, and parasitism in a few species. Emphasis on host species, but not substrate, has led in the past to lumping of unrelated species, such as *Coccomyces quadratus* on stems and *C. quadratus* var. *arctostaphyli* (= *C. arctostaphyli*) on leaves of Ericaceae, and *C. boydii* on bark and *C. boydii* var. *foliicola* (= *C. foliicola*) on leaves of *Myrica*.

Coccomyces is unusual among rhytismataceous fungi in being rare on monocotyledonous hosts and unknown on conifer needles. This may reflect the strong linear grain of these substrates, which encourages a hysterothecial growth habit.

Coccomyces is worldwide in its distribution, and probably abundant in most areas with woody, broad-leaved vegetation, although specimens are unavailable from some poorly collected areas. Several species occur on Ericaceae in arctic and alpine environments, others in temperate deciduous forest and others on the sclerophyllous leaves of the Mediterranean chaparral. It is one of the few genera of saprophytic discomycetes commonly encountered in tropical lowland rain forests.

Individual species tend to have restricted distributions related to their preference for a single host or group of hosts (not necessarily taxonomically related) which tend to co-occur. The effect of climate on distributions is difficult to assess, since climate affects the phenology and morphological adaptations of host as well as fungus. Foliicolous species of *Coccomyces* in the eastern deciduous forest fruit on year-old fallen leaves at the onset of leaf senescence in the autumn. This ensures that ascospores are discharged into the air and may enable the fungus to colonize leaves before they reach the litter layer. This phenological adaptation would be less advantageous in an evergreen forest, which may account for the absence of *C. coronatus* from warm climates.

Coccomyces de Notaris

Coccomyces de Notaris, Giorn. Bot. Ital. **2**(7–8): 14 & 38(1847).

= *Lophodermium* Chev. ρ *Phacidioides* de Not., l.c. p. 42.

= *Coccomycella* Höhnel, Ann. Mycol. **15:** 323 (1917).

Holotype species: *Coccomyces tumidus* (Fr.) de Not.

Apothecia imersed in an intramatrical stroma. Stromata orbicular

to angular or somewhat elongate, never linear, at least partially carbonized, usually consisting of a layer of carbonized hyphae running parallel to the surface of the substrate, a basal carbonized layer, and an internal matrix of fleshy pseudoparenchymatous cells, opening either irregularly or along preformed lines of dehiscence composed of thin-walled cells, the covering layer usually split into three or more teeth, rarely opening by a longitudinal slit, the torn edges of the teeth typically not lined with a well-defined layer of lip cells. Apothecia ascohymenial, consisting of a subhymenium, asci, and true paraphyses, sometimes with a rudimentary proper excipulum in addition to the stromatic margin. Asci uniformly thin-walled, J−, usually pointed, without an obvious apical dehiscence apparatus, cylindrical and nearly sessile to clavate and long-stalked, 4- or 8-spored. Ascospores colorless, cylindrical, fusiform, or filiform, usually sheathed, simple or septate. Paraphyses simple, inflated, branched, or circinate, free or cemented in a gelatinous epithecium.

On leaves, twigs, bark, and old wood, rarely on *Rubus* canes, saprophytic or less commonly parasitic, throughout the vegetated parts of the world.

KEY TO ACCEPTED SPECIES

1. Ascocarps on leaves, fern rachides, or *Rubus* canes . . . . . 21.
1′. Ascocarps not on leaves; on wood or bark . . . . . 2.
2(1′). Parasitic, fruiting on living twigs of Ericaceae . . . . . 3.
2′(1′). Saprobic, or in any case not fruiting on living twigs of Ericaceae . . . 4.
3(2). On *Ledum*. Spores less than 50 µm long, broadly sheathed . . . . . *C. ledi.*
3′(2). On *Vaccinium, Gaultheria,* and *Rhododendron*. Spores more than 50 µm long . . . . . *C. leptideus.*
4(2′). Ascospores all less than 50 µm long . . . . . 5.
4′(2′). Ascospores all or almost all over 50 µm long . . . . . 13.
5(4). Ascocarps developing beneath a common black stromatic crust . . . . . 6.
5′(4). Ascocarps not developing beneath a common black stromatic crust . . . . . 7.
6(5). Ascospores fusiform, 3–4 µm broad . . . . . *C. atactus.*
6′(5). Ascospores cylindric-fusiform, 1–1.5 µm broad . . . . . *C. parvulus.*
7(5′). Ascocarp with lip cells. On cactus pads, sometimes opening by a longitudinal slit . . . . . *C. wagnerianus.*
7′(5′). Ascocarps without lip cells . . . . . 8.
8(7′). On recently dead, corticate twigs of white (5-needle) pines . . . . . 9.
8′(7′). On other hosts . . . . . 10.
9(8). Occurring in North America, chiefly on *Pinus strobus*. Basal stroma and accompanying matrix not well-developed . . . . . *C. strobi.*
9′(8). Occurring in Pakistan on *P. wallichiana*. Basal stroma massive, subtending a matrix of thick-walled hyphae . . . . . *C. papillatus.*
10(8′). Ascospores more than 2 µm broad . . . . . 11.
10′(8′). Ascospores 2 µm broad or less . . . . . 12.
11(10). Paraphyses nodose. On *Pseudotsuga* and *Abies*, western North America . . . . . *C. pseudotsugae.*
11′(10). Paraphyses circinate. On *Tsuga* spp., western North America . . . . . cfr. *C. heterophyllae.*
12(10′). On *Juniperus*, Europe (if from North America see *C. petersii*) . . . . . *C. juniperi.*
12′(10′). On *Tsuga heterophylla*, western north America . . . *C. heterophyllae.*

13(4′). Paraphyses circinate . . . . . 14.
13′(4′). Paraphyses noncircinate . . . . . 18.
14(13). Periphysoids present . . . . . 15.
14′(13). Periphysoids absent . . . . . 17.
15(14). Periphysoids netlike. On conifers, eastern North America . . . . . *C. irretitus.*
15′(14′). On Fagaceae. Periphysoids not netlike . . . . . 16.
16(15′). Outer surface of covering layer pruinose. On *Quercus alba*, eastern North America . . . . . *C. triangularis.*
16′(15′). Outer surface of covering layer not pruinose. On *Quercus* and *Castanopsis*, western North America . . . . . *C. castanopsidis.*
17(14′). Basal stroma prominent, heavily carbonized. On *Pinus cembra*, Europe . . . . . *C. cembrae.*
17′(14′). Basal stroma reduced to a subiculum. On *Juniperus virginiana*, eastern North America . . . . . *C. petersii.*
18(3′). Ascospores septate, eventually budding to form ascoconidia . . . . . *C. tympanidiosporus.*
18′(3′). Ascospores nonseptate, not forming ascoconidia . . . . . 19.
19(18′). Paraphyses branched apically. Apothecia in swarms beneath a common black stromatic crust . . . . . *C. bipartitus.*
19′(18′). Paraphyses unbranched, apothecia solitary . . . . . 20.
20(19′). Spores 60–100 × 2.0 μm. On *Erica*, Azores . . . . . *C. ericae.*
20′(19′). Spores 50–55 × 1.0 μm. On *Myrica*, British Isles . . . . . *C. myricae.*
21(1′). Apothecia subcuticular . . . . . 22.
21′(1′). Apothecia intraepidermal or subepidermal . . . . . 24.
22(21). Ascospores cylindrical, 3–4 μm broad . . . . . *C. tumidus.*
22′(21). Ascospores filiform . . . . . 23.
23(22′). Ascospores under 100 μm long. On *Andromeda polifolia*, Siberia . . . . . *C. duplicarioides.*
23′(22′). Ascospores over 100 μm long. On *Carex*, Scandinavia . . . . . *C. insignis.*
24(21′). Apothecia intraepidermal . . . . . 25.
24′(21′). Apothecia subepidermal . . . . . 45.
25(24). Paraphyses inflated at the apex, firmly immersed in a gel, forming an epithecium . . . . . 26.
25′(24). Paraphyses apices not immersed in a gel, although sometimes inflated . . 28.
26(25). Epithecial gel brown . . . . . *C. clusiae.*
26′(25). Epithecial gel hyaline or yellow . . . . . 27.
27(26′). Apothecia with a distinct dark brown proper exciple, tropical America . . . . . *C. leptosporus.*
27′(26′). Apothecia without a proper exiple, Azores . . . . . *C. foliicola.*
28(25′). Apothecia on bleached spots bounded by a black line or reddish discolored area . . . . . 29.
28′(25′). Apothecia not on bleached spots, or bleached spots not bounded by a black line or discolored area . . . . . 41.
29(28). Ascospores more than 2 μm broad . . . . . 30.
29′(28). Ascospores 2 μm broad or less . . . . . 31.
30(29). Apothecia irregular in form, without a preformed dehiscence mechanism; pycnidia absent, strictly temperate . . . . . *C. coronatus.*
30′(29). Apothecia regular in form, with a preformed stellate dehiscence mechanism, accompanied by pycnidia, temperate or tropical . . . . . *C. dentatus.*
31(29′). Spores 1.0 μm broad or less . . . . . 32.
31′(29′). Spores 1–2 μm broad . . . . . 38.
32(31). Parasitic. Lesions bounded by reddish discolored leaf tissue, without a black line, Asia . . . . . *C. vilis.*
32′(31). Not parasitic; spots bounded by a black line . . . . . 33.
33(32′). Hymenium bright yellow-orange when dry, diffusing a yellow pigment in water, tropical America . . . . . *C. tesselatus.*
33′(32′). Epithecium not diffusing a yellow pigment in water . . . . . 34.
34(33′). Paraphyses broader than 3 μm at the apex . . . . . 35.
34′(33′). Paraphyses less than 3 μm broad at the apex . . . . . 36.

35(34). Pycnidia produced, Philippines . . . . . *C. philippinus.*
35′(34). Pycnidia not produced, tropical America . . . . . *C. limitatus.*
36(34′). Apothecia very regular in outline, with a preformed dehiscence mechanism . . . . . 37.
36′(34′). Apothecia without a preformed dehiscence mechanism, more irregular in outline . . . . . 38.
37(36). On Lauraceae and *Quercus,* Europe, North Africa, Atlantic Islands . . *C. delta.*
37′(36). On various hosts, tropical America . . . . . *C. spegazzinii.*
38(36′). With a proper exciple, remaining open when dry . . . . . 40.
38′(36′). Without a proper exciple, closing when dry . . . . . 39.
39(38′). On palm fronds, tropical America . . . . . *C. palmicola.*
39′(38′). On *Canarium,* Philippines . . . . . *C. canarii.*
40(38). On *Quercus,* eastern North America . . . . . *C. farlowii.*
40′(38). On evergreen hosts, South America . . . . . *C. monticola.*
41(28′). Ascospores more than 2 μm broad . . . . . 42.
41′(28′). Ascospores 2 μm broad or less . . . . . 43.
42(41). Parasitic on *Arbutus menziesii,* pycnidia present . . . . *C. arbutifolius.*
42′(41). Saprobic, on *Eryngium* and monocots, tropical America. Pycnidia absent . . . . . *C. pampeanus.*
43(41′). Paraphyses branched apically . . . . . *C. venezuelae.*
43′(41′). Paraphyses not branched, more or less inflated . . . . . 44.
44(43′). Proper exciple present . . . . . *C. antillarum.*
44′(43′). Proper exciple absent, on *Musa* . . . . . *C. annulatus.*
45(24′). Ascospores more than 2 μm broad . . . . . 46.
45′(24′). Ascospores 2 μm broad or less . . . . . 48.
46(45). Paraphyses circinate . . . . . *C. arctostaphyli.*
46′(45). Paraphyses not circinate . . . . . 47.
47(46′). In bleached spots bounded by a reddish discolored line . . . . . *C. puiggarii.*
47′(46′). Not in bleached spots . . . . . *C. consociatus.*
48(45′). Ascospores 1 μm broad or less . . . . . 49.
48′(45′). Ascospores 1–2 μm broad . . . . . 51.
49(48). Paraphyses with a solid refractive tip . . . . . *C. urceolus.*
49′(48). Paraphyses apices not solid and refractive . . . . . 50.
50(49′). Asci 85–120 × 5.5 μm, on Palmae, tropical Africa . . . . . *C. cocoes.*
50′(49′). Asci 180 × 7 μm. On dicotyledonous leaves, tropical America . . . . . *C. concolor.*
51(48′). Paraphyses simple, inflated at the apex, on *Rhododendron,* eastern North America . . . . . *C. radiatus.*
51′(48′). Paraphyses branched apically, on ferns, South America . . *C. crystalligerus.*

INCLUDED AND EXCLUDED SPECIES

All of the published combinations and species included in *Coccomyces* traced, together with new species and new combinations of species here transferred to *Coccomyces,* are listed below in alphabetical order. Descriptions are provided for fifty accepted or provisionally accepted species as well as for a few excluded taxa. Abbreviated collection data are provided for all specimens examined during the study, except that, in order to avoid unnecessary repetition, only selected specimens of common species are cited. If more than one specimen from a state or other subdivision is cited, the subdivision is given only for the first specimen listed. Herbarium abbreviations are taken from Holmgren and Keuken (1974). Exsiccati specimens are indicated by title of the set and specimen number.

The following two species, described in 1979, appeared in print too late to be included in this paper: *Coccomyces araucariae* Butin & Speer, Sydowia 31: 23 (1978 [1979]), on leaves of *Araucaria angustifolia*, Brazil; *Coccomyces aurei* L. Vasilyeava, Mykol. Fitopatol. 13: 280 (1979) on *Rhododendron aureum* Siberia.

1. *Coccomyces acerinus* (Kunze & Schm.) Quélet, Enchirid. Fung. 337 (1886).
   ≡ *Pilidium acerinum* Kunze & Schm., Myc. Hefte **2:** 92 (1823).
   ≡ *Leptothyrium acerinum* (Kunze & Schm.) Corda, Icon. Fung. **2:** 25 (1838).

According to the original description and illustrations, the name *Pilidium acerinum* applies to a fungus with the external appearance of a *Phacidium*, but with small fusiform spores not contained in asci. Quélet (l.c.) did not provide a redescription of the species as an ascigerous fungus or justify transferring it to *Coccomyces*. This is the type species of *Pilidium* Kunze, a genus of Coelomycetes (Sutton, 1977).

2. *Coccomyces albidus* (Phill. & Harkn.) Sacc., Syll. Fung. **8:** 746 (1889).
   ≡ *Phacidium albidum* Phill. & Harkn., Grevillea **12:** 83 (1884).
   = *Naemacyclus phacidioides* (Fr.) B. Erikss., Symb. Bot. Upsal. **19**(4): 49 (1970).

For a redescription and additional synonyms of this species, see Eriksson (1970) and Sherwood (1977b). Those *Naemacyclus* spp. which open by teeth appear to be rather closely related to *Coccomyces*, differing principally in their more deeply immersed, subepidermal fruitbodies, crystalline margins, and lack of a stromatized covering layer.

Specimen examined: NORTH AMERICA. USA: On dead leaves of *Vaccinium ovatum*, California, Dr. H. W. Harkness, 1884, holotype of *Phacidium albidum* (K).

3. **Coccomyces annulatus** Sherwood, spec. nov. Figure 2

Ascocarpi primo immersi, dein aperientes, tetragoni vel hexagoni, 0.8–1.2 mm diam, per lacinias aperientes, in macula pallida stromate non obvallato insidentes. Margo superior stromatica 50–60 µm crassa, ex hyphis intertextis carbonaceis constata. Periphysoidei nulli. Margo inferior stromatica 5 µm crassa, ex hyphis carbonaceis constata. Excipulum nullum. Paraphyses filiformes, apice ad 4.0–4.5 µm incrassatae, achromae. Asci 140–160 × 8.5–10 µm, haud pedicellati, cylindrici, 8-spori, in iodo non caerulescentes; sporis filiformibus, continuis, in tunica gelatinosa inclusis, 120 × 2.0 µm. In foliis dejectis *Musae paradisicae*, Colombia, Amer. Austral.

Holotypus: NY, Fungi of Colombia 5228, on banana leaves, ca. 20 km from Aguazul on the Aguazul-Sogamoso road, Dpto. Boyacá, elev. ca. 2500 ft, leg. K. P. Dumont, S. E. Carpenter, M. A. Sherwood

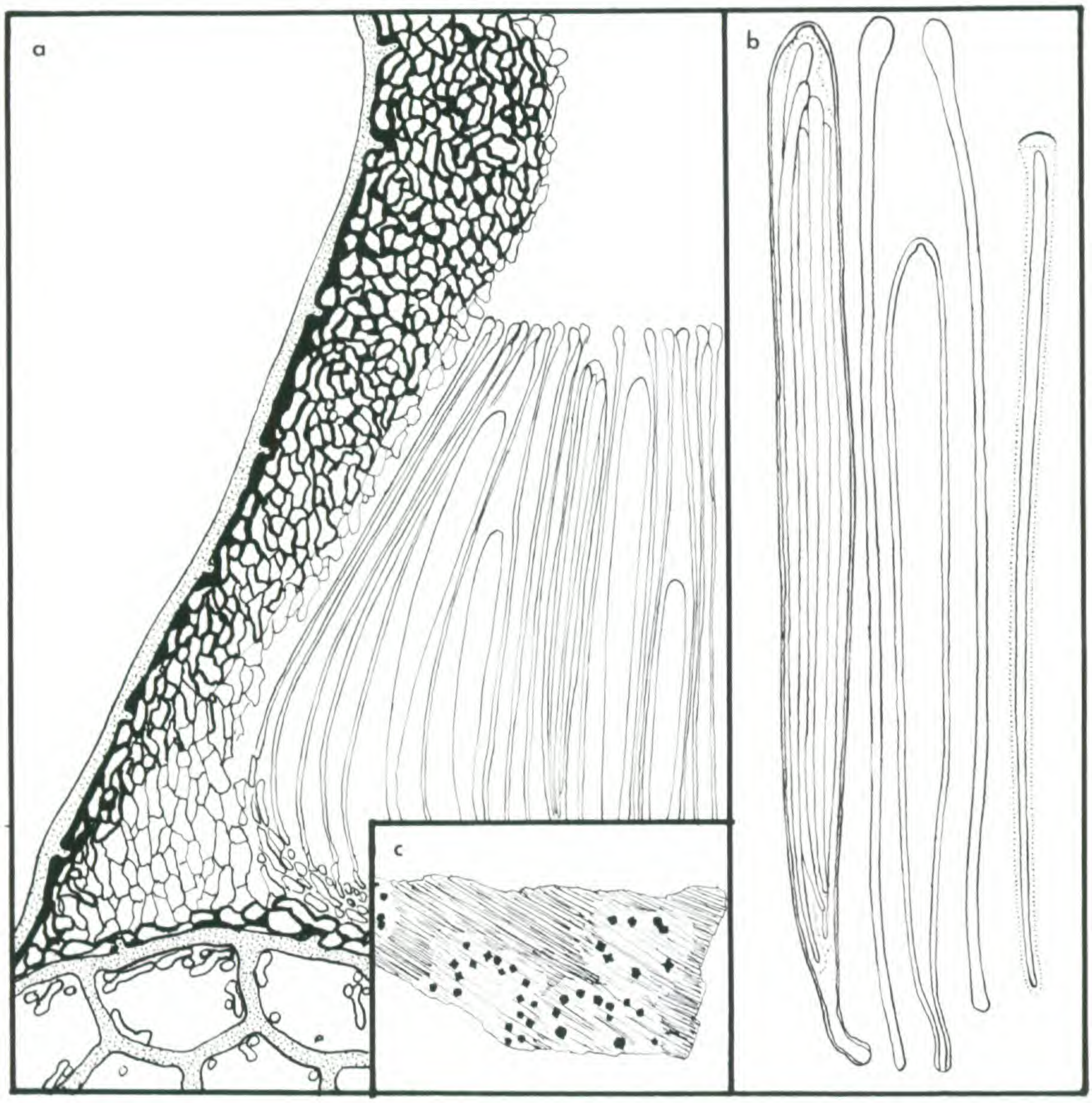

FIG. 2. *Coccomyces annulatus*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

& L. A. Molina, 14 June 1976. Isotypi: COL, FH.

Etymology: annulatus (L), annulate, referring to the arrangement of the ascocarps in a ring.

Ascocarps intraepidermal, arranged in a rough circle near the margin of bleached spots not bounded by a black line, predominantly quadrate, sometimes pentagonal or hexagonal, 0.8–1.2 mm diam, black, shining, with a distinct, light-colored preformed dehiscence mechanism, opening regularly by teeth. Covering stroma 50–60 μm thick, of heavily carbonized cells 5 μm diam, lined on the inner face with colorless pseudoparenchyma, lacking periphysoids. Excipulum absent. Basal stroma carbonized, 5 μm thick. Subhymenium 10–15 μm thick, colorless, without imbedded crystals. Asci 140–160 × 8.5–10 μm, cylindrical, short-stalked, J−, 8-spored. Ascospores 120 × 2.0 μm, distinctly

sheathed. Paraphyses filiform, enlarged to 4–4.5 μm at the knoblike apex, not imbedded in a gel.

On banana leaves, Colombia. The species is similar to *Coccomyces dentatus*, but differs in having longer ascospores, no imperfect stage, and no black line bounding the lesions. Other tropical species of *Coccomyces* having inflated paraphyses have narrower ascospores lacking a prominent gelatinous sheath. As indicated below under *Coccomyces clusiae*, the name *C. musae* applies to a different species.

4. **Coccomyces antillarum** Sherwood, spec. nov. Figure 3

Ascocarpi primo immersi, dein erumpentes, trigoni vel tetragoni, 0.2–0.5 mm diam, per lacinias aperientes, in macula pallida stromate non obvallato insidentes. Margo superior stromatica 20–25 μm crassa, ex hyphis intertextis brunneis constata. Periphysoi-

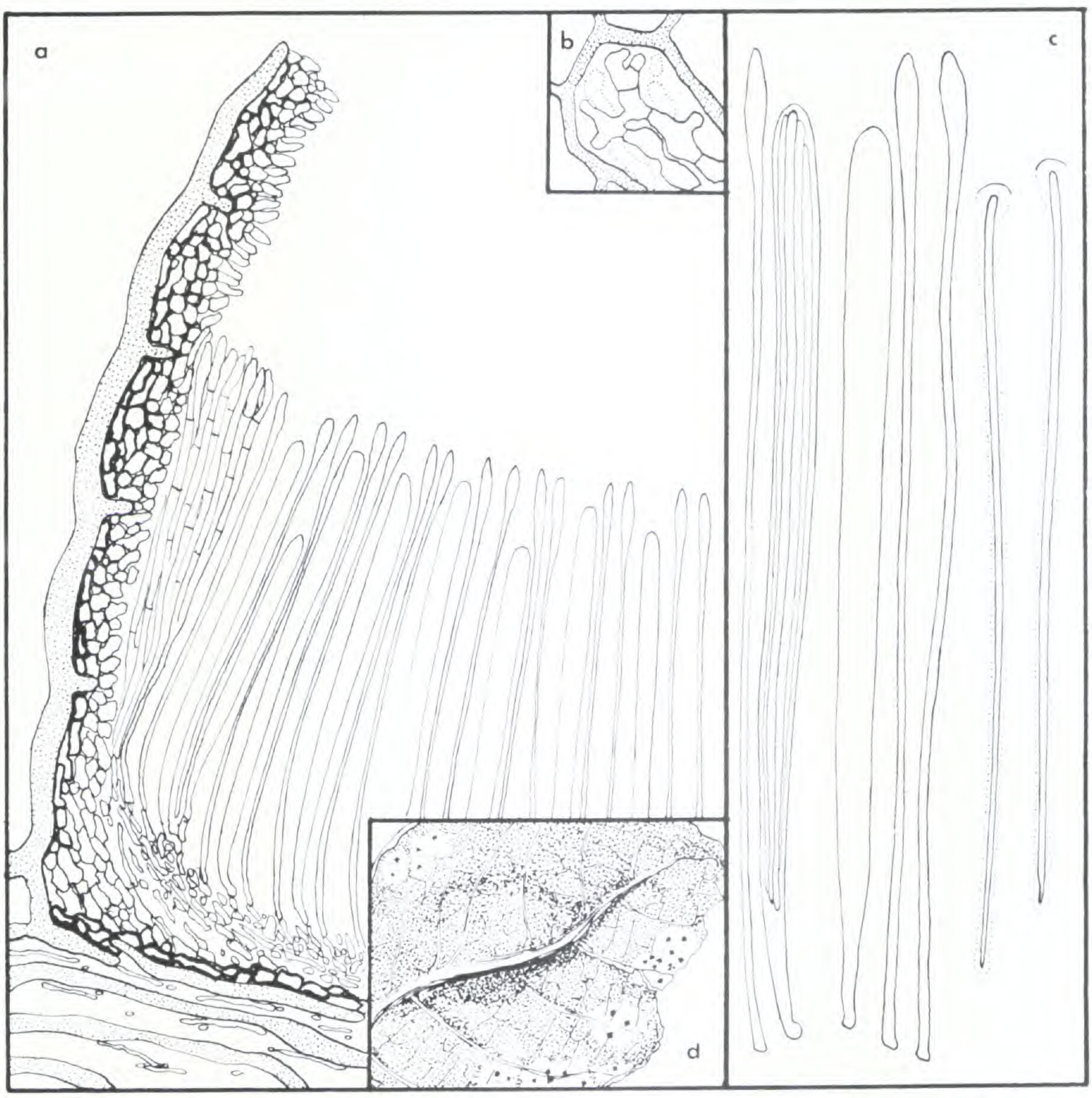

FIG. 3. *Coccomyces antillarum*:—a. cross section of apothecium, ×375.—b. covering layer in face view, ×1000. Dotted lines represent hyphae below plane of focus.—c. asci, paraphyses, and spores, ×750.—d. habit sketch, ×7.5. Drawn from the holotype.

dei hyalini, 7 μm longi. Margo inferior stromatica 5 μm crassa, ex hyphis intertextis brunneis constata. Excipulum hyalinum. Paraphyses filiformes, apice ad 3–5 μm incrassatae, in epithecio gelatinoso non inclusae. Asci cylindrici, haud pedicellati, 115–140 × 6–6.5 μm, in iodo non caerulescentes; sporis filiformibus, continuis, in tunica gelatinosa inclusis, 90–110 × 1.0 μm. In foliis dejectis ignotis, Antilles infer.

Holotypus: On undetermined leaves, Grand Etang, Grenada, British West Indies, 1912–13, leg. R. Thaxter (FH). Isotypi: UC, CUP, NY.

Etymology: antillarum (L), referring to the Antilles, where the species occurs.

Apothecia intraepidermal, epiphyllous or hypophyllous, in diffuse bleached spots not bounded by a line, triangular or quadrate, 0.2–0.5 mm diam, opening by teeth along indistinct preformed lines of dehiscence, the lobes black, shining, the disc yellowish. Covering layer 20–25 μm thick, of dark brown cells 3–6 μm diam, not heavily carbonized, lined on the inner face with short hyaline periphysoids 7 × 5 μm. Lower stroma 1 cell layer thick, of dark carbonized cells 5 μm diam. Subhymenium colorless, 15 μm thick. Proper exciple colorless, ca. 20 μm thick above, of septate hyphae 2.5–3.5 μm diam, with pointed ends like those of the paraphyses. Asci 115–140 × 6.0–6.5 μm, cylindrical, short-stalked, 8-spored. Paraphyses filiform, inflated to 3–5 μm at the lanceolate apex, not firmly cemented in a gel. Ascospores nearly as long as the asci, 1.0 μm broad, nonseptate, the sheath apparent as a distinct refractive cap at the apex of the spore.

On coriaceous leaves, Caribbean islands, frequent. The host seems to be identical in all of the collections cited, but I am unable to identify it from leaf fragments. Slightly broader spores with a distinct sheath, lanceolate paraphyses, and the absence of a line stroma distinguish *Coccomyces antillarum* from other members of the *C. leptosporus* complex.

Specimens examined (see also holotype, above): WEST INDIES. GUADELOUPE: Grand Etang, 6.I.1974, Pfister 1006 (FH, CUP); Transverse Road, 4.I.1974, Pfister 844 (FH, CUP). DOMINICA: St. Paul's Parish, 29.VI.1970, Korf et al. (CUP-DO 295).

5. **Coccomyces arbutifolius** Sherwood, spec. nov. Figure 4

Ascocarpi primo immersi, dein erumpentes, irregulariter orbiculati, 0.2–1.0 mm diam, per lacinias irregulariter aperientes. Margo superior stromatica 25–30 μm crassa, ex hyphis brunneis constata. Periphysoidea nulla. Margo inferior stromatica nulla. Excipulum nullum. Paraphyses filiformes, apice ad 2.5 μm incrassatae, achromae. Asci 125–150 × 15–20 μm, clavati, pedicellati, in iodo non caerulescentes; sporis filiformibus, continuis, in tunica gelatinosa inclusis, 75–100 × 2.5 μm. Pycnidia subepidermalia, brunnea; conidia hyalina, continua, 3.5–5 × 1.0 μm.

In foliis vivis *Arbuti menziesii,* Vancouver, British Columbia.

Holotypus: FH, on *Arbutus menziesii,* 1938, leg. I. Mounce, distributed by DAOM as *Coccomyces quadratus,* ex DAOM 5347. Isotypi: BPI, DAOM.

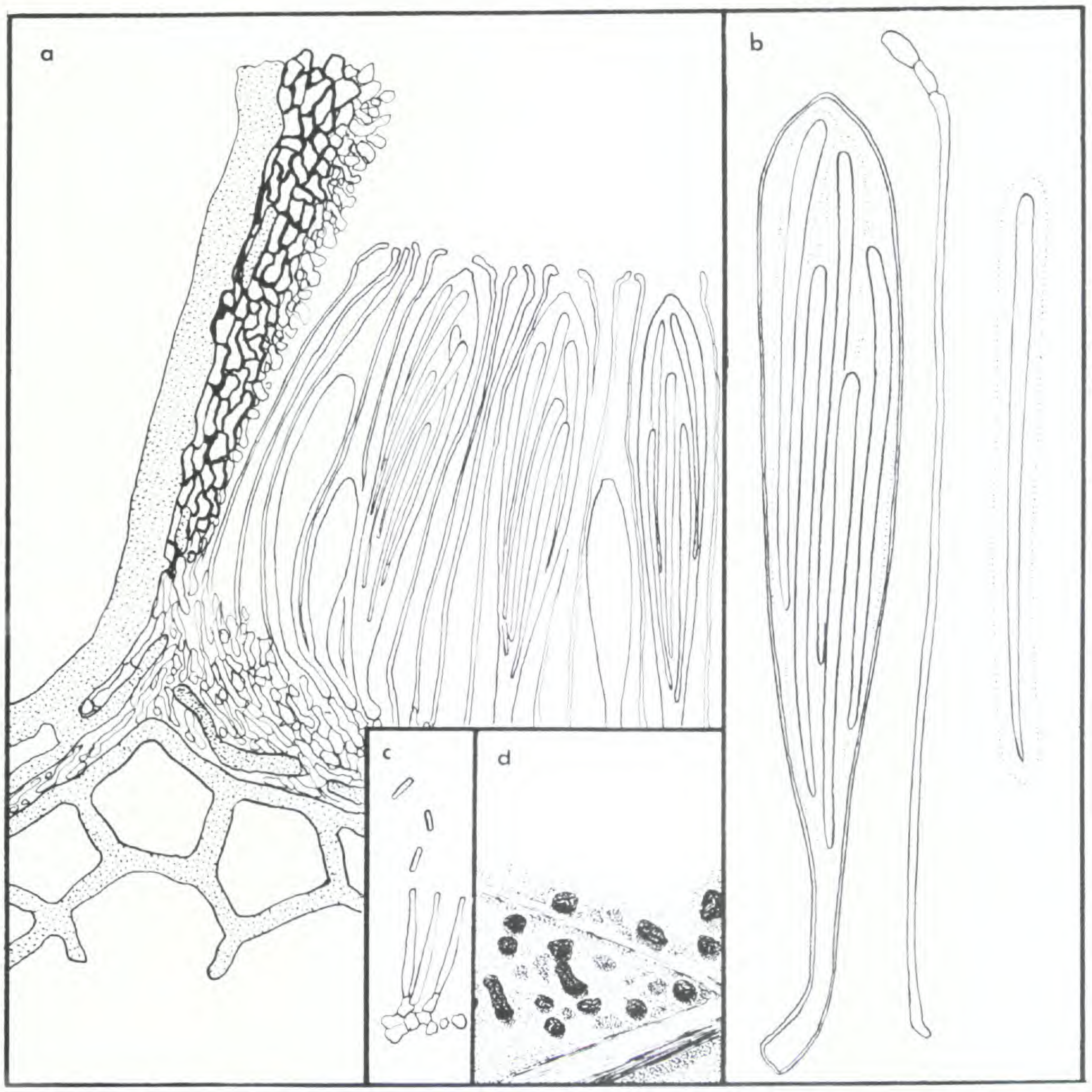

FIG. 4. *Coccomyces arbutifolius*:—a. cross section of margin, ×375.—b. ascus, paraphysis, and spores, ×750.—c. conidiophores and conidia, ×750.—d. habit sketch, ×7.5. Drawn from FH-ex DAOM 5347.

Apothecia subepidermal, dark brown, densely gregarious, on discolored spots not bleached or bounded by a line stroma, but marked by a faint, whitish, superficial bloom, 0.2–1.0 mm diam, irregular and often somewhat elongate in outline, without a preformed dehiscence mechanism, opening irregularly by teeth (sometimes by a longitudinal slit). Covering layer 25–30 μm thick at the center, becoming nearly obsolete at the edges, of dark brown, slightly carbonized cells 3–5 μm diam, lined on the inner face with a layer of globose colorless cells; periphysoids lacking. Subhymenium colorless, 20 μm thick, the cells 3–5 μm diam, resting directly on disintegrating host tissue; basal stroma absent. Asci 120–150 × 15–20 μm, clavate, long-stalked, 8-spored. Ascospores 75–100 × 2.5 μm, nonseptate,

prominently sheathed. Paraphyses filiform, simple or occasionally once-branched, enlarged to 2.5 μm at the apex.

Pycnidia hypophyllous, subepidermal, scattered among the apothecia, flattened, irregular in outline, dark brown, consisting of a covering layer of dark brown isodiametric cells 2.5 μm diam and a basal palisade of colorless, simple conidiophores 15 × 1.5 μm, with a narrow neck and no collarette; conidia simple, colorless, bacilliform, 3.5–5 × 1.0 μm.

On leaves of *Arbutus menziesii,* Vancouver Island, British Columbia. DAOM 5162, cited below, appears to have been collected on living leaves.

Specimens examined (see also holotype, above): NORTH AMERICA. CANADA: Vancouver Island, British Columbia, leg. F. L. Drayton, 7.IV.1938, distributed as *C. quadratus,* ex DAOM 5162 (MICH).

6. *Coccomyces arctostaphyli* (Rehm) B. Erikss., Symb. Bot. Upsal. **19**(4): 11 (1970). Figure 5
   ≡ *Coccomyces quadratus* [Schm. & Kunze] Sacc. var. *arctostaphyli* Rehm, Ber. Bayer. Bot. Ges. **13:** 130 (1912).

Apothecia epiphyllous or hypophyllous on dead (exceptionally living) leaves, the spots not bounded by a black line, subepidermal, 0.3–0.7 mm diam, black, shining, triangular to quadrate or circular, opening by 3–5 teeth, without an obvious preformed dehiscence mechanism. Covering stroma 30 μm thick, black, carbonized, the hyphae 3–5 μm diam, fringed below with sparse hyaline periphysoids 5 × 2 μm. Lower stroma ca. 5 μm thick, discontinuous in the center. Subhymenium colorless, ca. 30 μm thick. Asci 90–110 × 10–12 μm, cylindric-clavate, stalked, slightly thick-walled when young, 4- (rarely 8-) spored. Paraphyses filiform, 1–1.5 μm diam, simple, weakly circinate. Ascospores 45–55 × 2–2.5 μm, unicellular, multiguttulate, prominently sheathed.

On leaves of *Arctostaphylos uva-ursi,* northern and central Europe and western North America, late summer and fall. A relatively inconspicuous fungus, it is probably more common and widespread than the few records indicate. Eriksson (1970) discusses this species and the question of synonymy with *Coccomyces ursinus* (q.v.).

Specimens examined: EUROPE. SWEDEN: Härjedalen, Mt. Funäsdalsberget, I. Nordin 3399, 10.X.1965 (UPS). SWITZERLAND: auf *Arctostaphylos uva-ursi,* Schynige Platte, 15.7.1905, leg. O. Jaap, holotype of *C. quadratus* var. *arctostaphyli* (S); Zermatt, Ct. Valais, Terrier, 23.X.1938 (ZT); Ct. Wallis, Aletschwaldreservat, Müller, 9.9.1962 (ZT); Ct. Graubünden, H. Hess, 10.X.1958 (ZT). NORTH AMERICA. CANADA. Alberta: Kananaskis, E. Müller, 6.9.1977 (ZT, FH). USA. Oregon: Sahalie Falls, Sherwood & Pike, 5.VIII.1978 (FH).

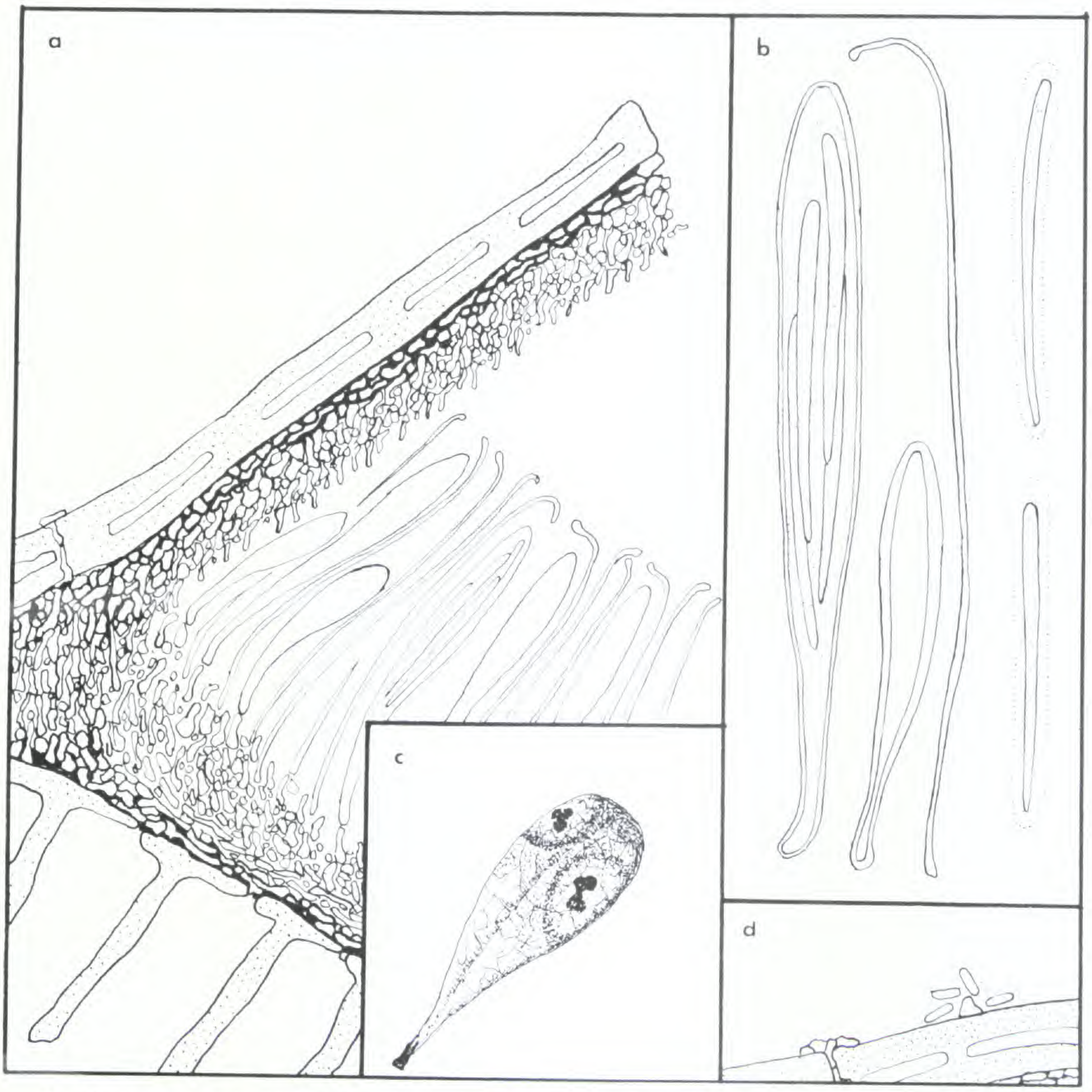

FIG. 5. *Coccomyces arctostaphyli*:—a. cross section of margin, ×375.—b. asci, paraphysis, and spores, ×750.—c. habit sketch, ×1.5.—d. conidia found associated with lesions. Drawn from FH-Müller 6.9.1977.

7. *Coccomyces atactus* Rehm, Rabenh. Krypt.-Fl. ed. 2, **1**(3): 81 (1888). Figure 6

Apothecia at first immersed in blackened decorticated wood, gregarious, becoming confluent, 0.5–1.5 (–2.5 fide Rehm) mm diam, generally somewhat elongate, black, shining, opening irregularly by 4–6 teeth to expose the greyish-yellow disc. Covering layer and basal stroma heavily carbonized. Covering layer ca. 50 μm thick, the cells 5 μm diam, vertically arranged, carbonized above, paler beneath. Periphysoids absent. Excipulum absent. Subhymenium colorless, 15 μm thick, separated from the basal stroma by ca. 50 μm of colorless subiculum. Asci clavate, long-stalked, 90–100 × 10–14 μm, 8-spored. Ascospores fusiform, unicellular, prominently sheathed, 20–25 × 3–4

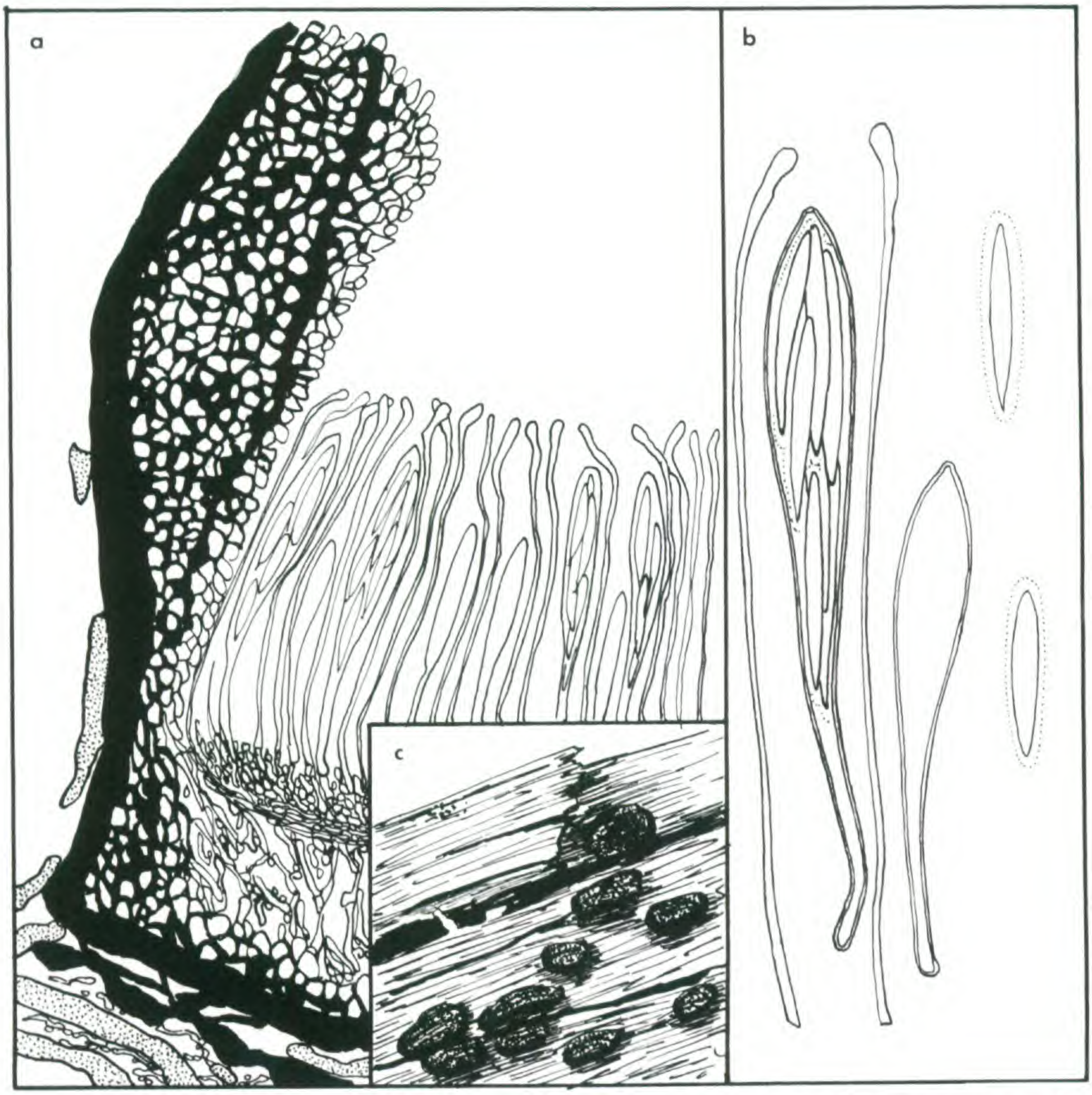

FIG. 6. *Coccomyces atactus*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

μm. Paraphyses filiform, simple, enlarged to 3 μm at the apex.

On spruce wood, Tyrol, known only from the type specimen. The unusual fusiform ascospores will immediately separate *Coccomyces atactus* from other species of Rhytismataceae which occur on wood. Like allied species (*C. bipartitus, C. parvulus*) it differs considerably from typical leaf-inhabiting species of *Coccomyces*, and might with equal justification be referred to *Colpoma*. The type of *Colpoma*, however, has elongate hysterothecia with a well-defined opening mechanism consisting of a longitudinal slit flanked with prominent lip cells.

Specimen examined: EUROPE. AUSTRIA: auf Fichtenstock in Langenthal bei Keihter, c. 5000 ft. in Tyrol oetz. 8/1872, Dr. Rehm, holotype of *C. atactus* (s).

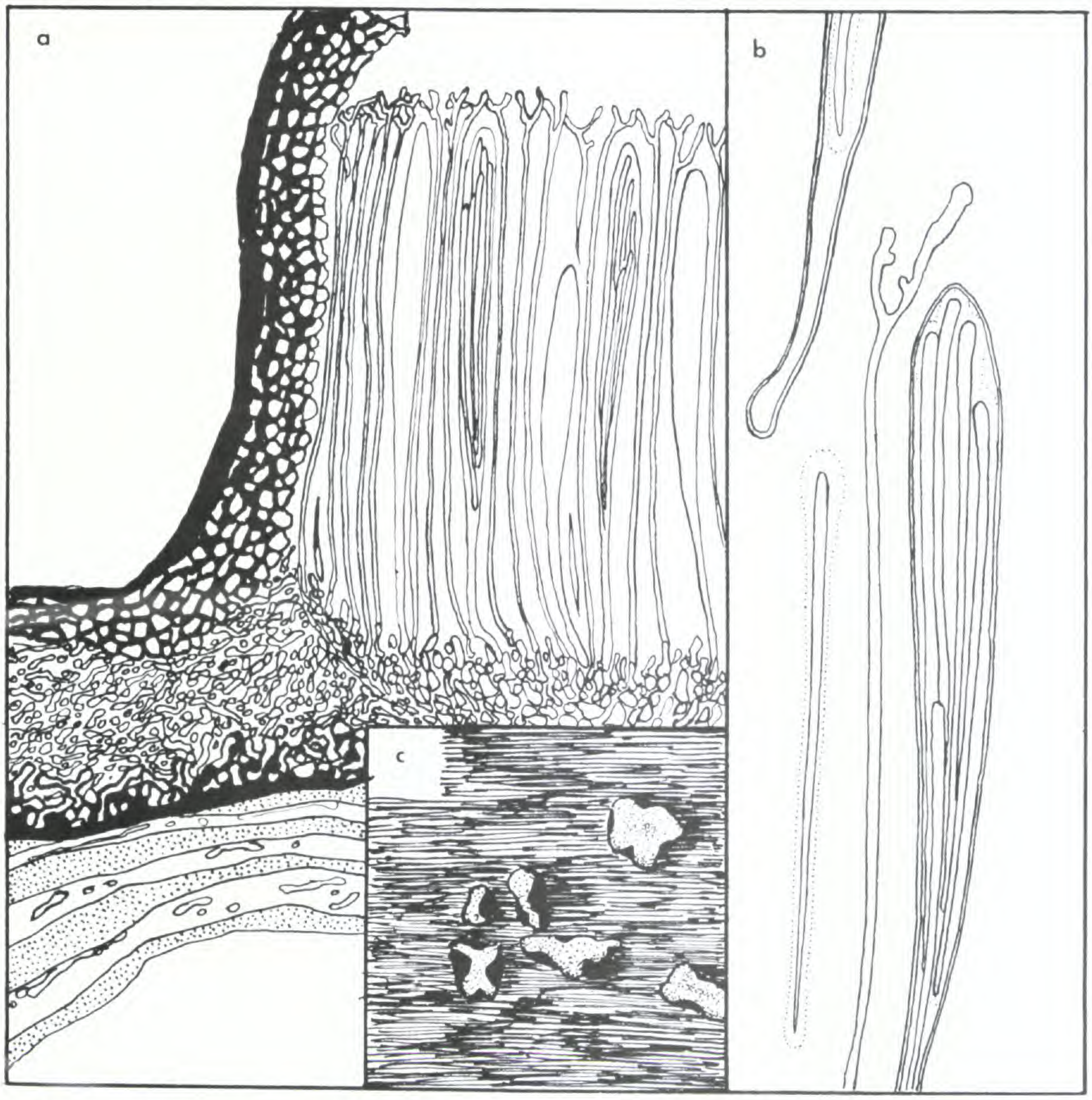

FIG. 7. *Coccomyces bipartitus*:—a. cross section of apothecium, ×300.—b. detail of an ascus, paraphysis, and spores, ×750.—c. habit sketch of rehydrated material, ×7.5. Drawn from the holotype.

8. **Coccomyces bipartitus** (Kauffm.) Sherwood, comb. nov.
Figure 7

≡ *Schizoxylon bipartitum* Kauffm., Pap. Mich. Acad. Sci. **9:** 184 (1929).

Apothecia gregarious beneath a common black stromatic crust, 1–2 mm diam, often somewhat elongate with the grain of the wood, opening irregularly by teeth or by a longitudinal slit to expose the grey hymenium, without a preformed dehiscence mechanism. Covering stroma ca. 30 μm thick, heavily carbonized, the cellular structure obscured in mature specimens. Lower stroma black, carbonized, of loosely consolidated hyphae 3–4 μm diam, with a few crystalline inclusions. At the margin of the apothecia the space between the covering layer and basal stroma is filled with colorless, somewhat

gelatinous hyphae 2.0 μm diam. Subhymenium colorless, ca. 75 μm thick. Asci clavate, stalked, uniformly thin-walled, 170–200 × 12–14 μm, 8-spored. Ascospores 60–80 × 1.5–2.0 μm, nonseptate, distinctly sheathed, in two irregular series. Paraphyses filiform, colorless, branched and enlarged to 3.0 μm at the apex, forming an epithecium.

On decorticated conifer wood, Michigan and New York, common, according to Kauffman (l.c.). According to the original description the ascospores disarticulated in the middle, but this is not evident in any of the material I examined. The ascus structure alone definitively excludes this species from *Schizoxylon.* It is somewhat intermediate between *Coccomyces* and *Colpoma.*

Specimens examined: NORTH AMERICA. USA. New York: Warrensburg, 11.X.1934, A. H. Smith 888, 898; Warrensburg, J. Lowe (MICH). Michigan: on *Picea nigra*?, Rock River, C. H. Kauffman, Sept. 6, 1927, holotype of *Schizoxylon bipartitum* (MICH).

9. *Coccomyces boydii* A. L. Smith, Trans. Brit. Mycol. Soc. **3:** 39 (1907). Figure 8

Apothecia intracortical, immersed, raising the bark into small pustules and opening by cracking irregularly to expose the pale yellow hymenium, 0.8–1.5 (−3 fide Smith, l.c.) mm diam, orbicular to irregular in outline, sometimes becoming confluent, without a preformed dehiscence mechanism. Covering stroma up to 40 μm thick, slightly carbonized, the cells 5–10 μm diam. Periphysoids and excipulum absent. Lower stroma incomplete, replaced by an almost colorless pseudoparenchyma 50 μm thick, the cells 3–5 μm diam. Subhymenium ca. 50 μm thick, colorless. Asci 90–115 × 8 μm, clavate, stalked, 8-spored. Ascospores 50–55 × 1.0 μm, obscurely sheathed. Paraphyses filiform, enlarged to 2.0 μm at the apex, bent but not circinate.

On bark of *Myrica gale,* Great Britain, apparently known only from the type specimen. The species is similar in apothecial morphology to *C. strobi,* but the spores are larger.

Specimens examined: EUROPE. GREAT BRITAIN: ad corticem *Myrica gale,* Killin, Perthshire, D. A. Boyd, July, 1907, Holotype of *C. boydii* (K).

10. *Coccomyces boydii* f. *foliicola* Dennis & Spooner. See *C. foliicola.*

11. *Coccomyces brasiliensis* Karst. See *Cerion leucophaeum.*

12. *Coccomyces brasiliensis* Speg. See *Coccomyces spegazzinii.*

13. *Coccomyces bromeliacearum* Theiss. See *C. dentatus.*

14. *Coccomyces canarii* Rehm, Phillip. J. Sci. **8:**403 (1913). Figure 9

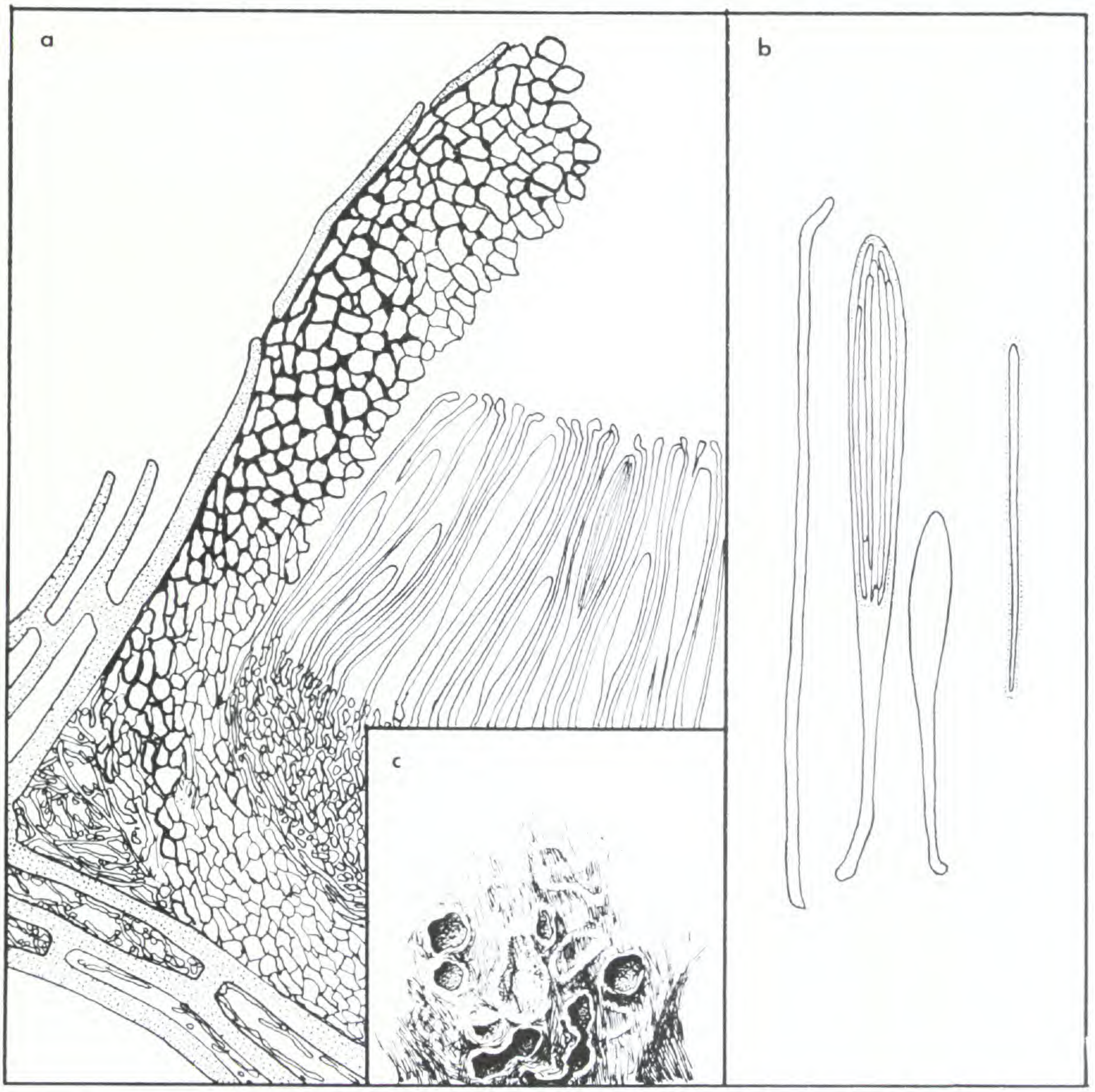

FIG. 8. *Coccomyces boydii*:—a. cross section of apothecium, ×375.—b. asci, paraphysis, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

Apothecia intraepidermal, scattered in prominent bleached spots bounded by a delicate black line, on dead coriaceous leaves, triangular to quadrate, 0.3–0.5 mm diam, black, shining, without an obvious preformed dehiscence mechanism, opening by 3–4 teeth (rarely by a longtitudinal slit). Covering layer 25–30 μm thick, consisting of a heavily carbonized outer layer 15–20 μm thick and an inner layer of vertically oriented hyphae ca. 3 μm diam. Lower stroma 10 μm thick, carbonized only on its lower surface. Subhymenium 10 μm thick. Proper excipulum absent. Asci cylindrical, short-stalked, J−, 8-spored. Ascospores nearly as long as the asci, 0.5–0.8 μm diam, not obviously sheathed. Paraphyses filiform, 1.5 μm broad, simple, not inflated.

On dead leaves of *Canarium*, Philippine Islands, apparently known

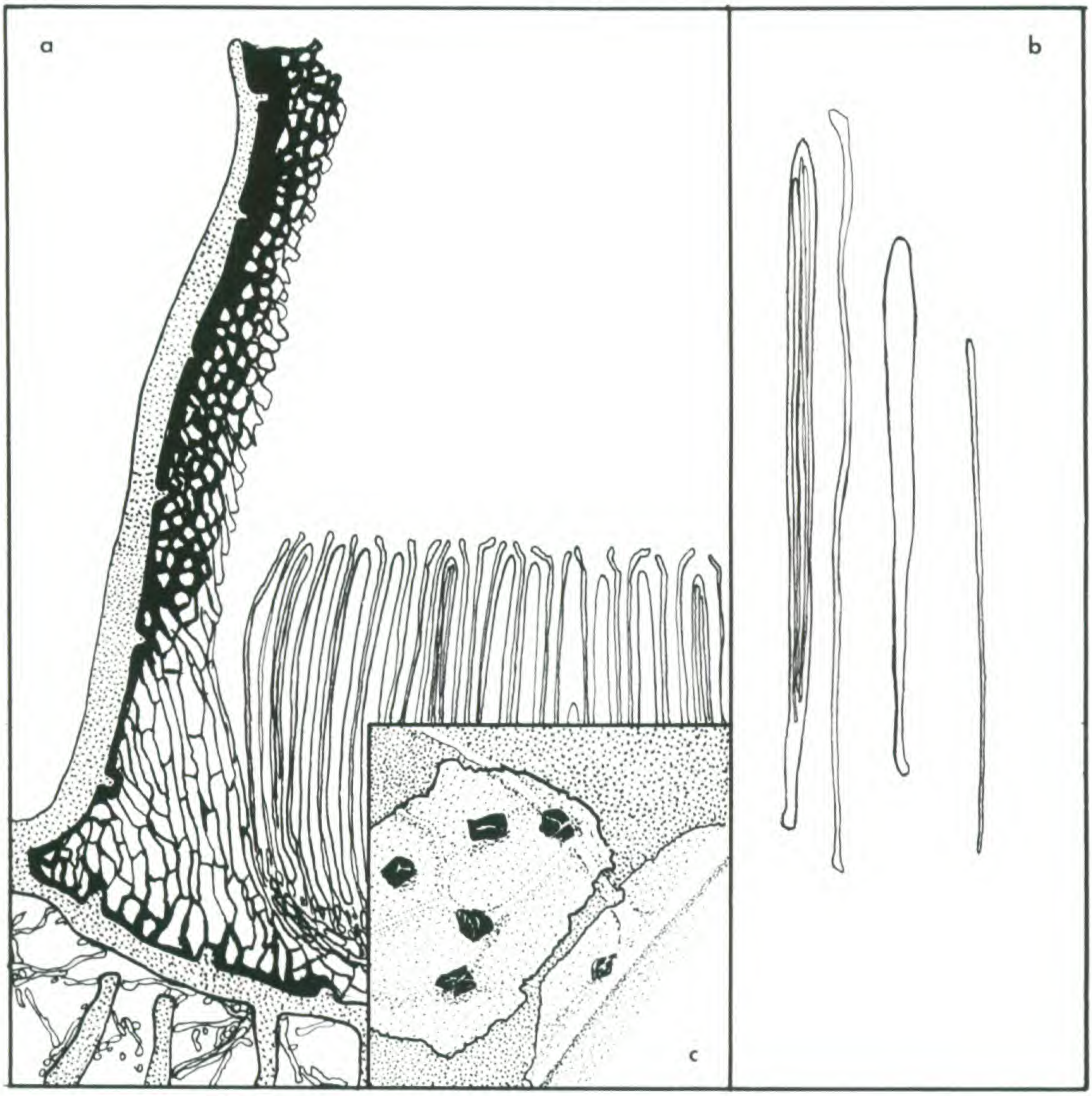

FIG. 9. *Coccomyces canarii*:—a. cross section of apothecium, ×375.—b. asci, paraphysis, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

only from the type collection. It is rather similar to some members of the *C. leptosporus* complex in South America, but does not agree in all characters with any one of them. Rehm (l.c.) stated that the spores were 0.05 μm broad, surely an inadvertent error.

Specimen examined: ASIA. PHILIPPINES: Luzón, Prov. Laguna, Los Baños, Baker 703 in herb. Rehm, holotype of *Coccomyces canarii* (s).

15. *Coccomyces carbonaceus* ([Fr.] ex Fr.) Quélet, Enchirid. Fung. 337 (1886).
    ≡ *Phacidium carbonaceum* [Fr.] ex Fr., Sclerom. Sueciae 210 (1821); Syst. Mycol. **2**(2): 574 (1823).
    ≡ [*Xyloma carbonacea* Fr., Obs. Mycol. **2**: 359 (1818)].

≡ *Discella carbonacea* ([Fr.] ex Fr.) Berk. & Br., Ann. and Mag. Nat. Hist. ser. 2, **5:** 377 (1850).

The specimen of Scleromycetes Sueciae I examined was sterile. Barkeley and Broome (l.c.) and Saccardo (1884) used the name for conidial *Cryptodiaporthe salicella* (Fr.) Petr., but according to Sutton (1977), Fries's type is a *Rhabdospora.*

Specimen examined: EUROPE. SWEDEN: Fries, Sclerom. Sueciae 210, isotype of *Xyloma carbonacea* (FH).

16. **Coccomyces castanopsidis** (Seaver) Sherwood, comb. nov. Figure 10

≡ *Godronia castanopsidis* Seaver, Mycologia **37:** 351 (1945).
= *Colpoma californicum* Cash, Mycologia **50:** 645 (1958).

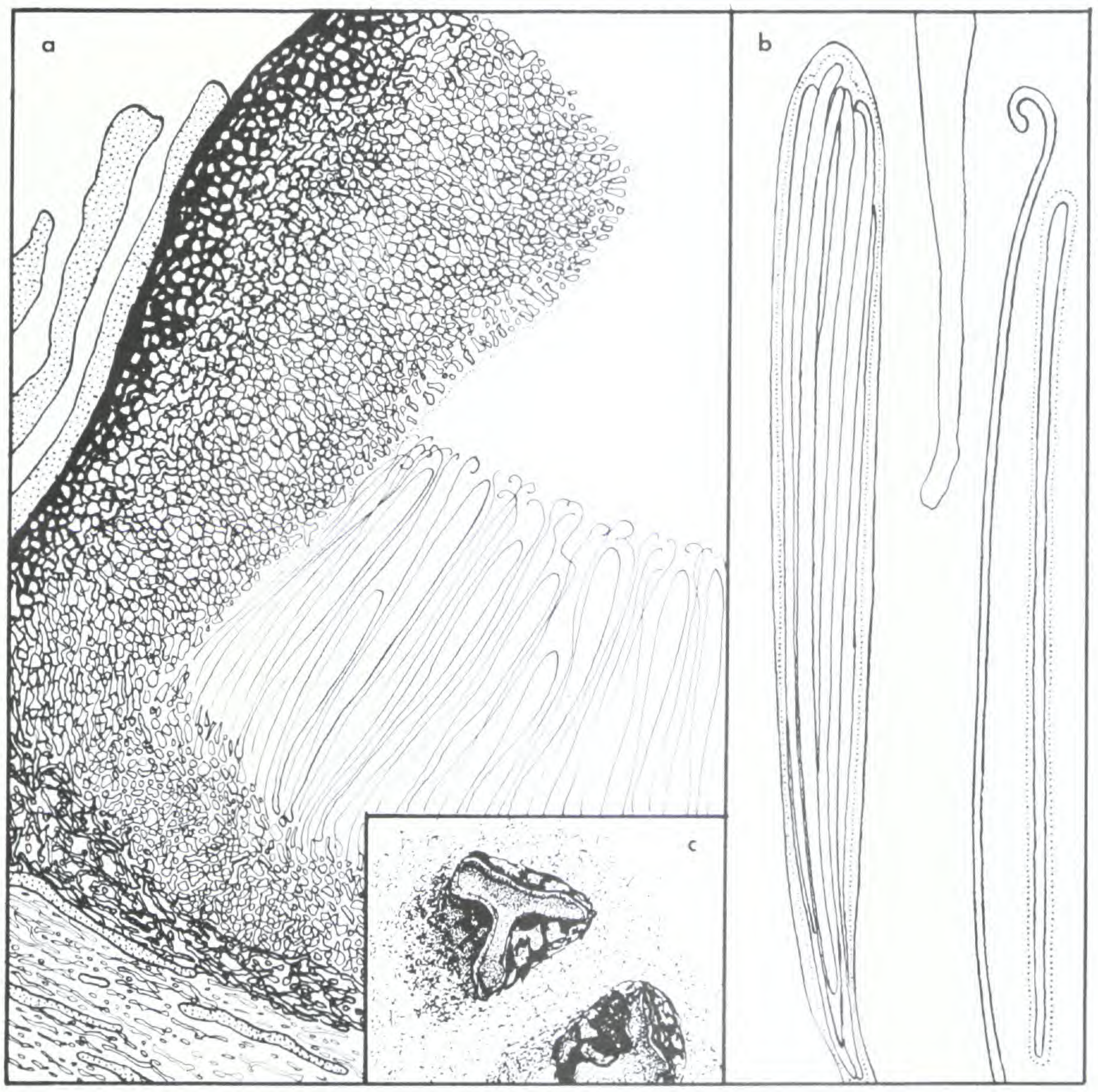

FIG. 10. *Coccomyces castanopsidis:*—a. cross section of apothecium, ×150.—b. detail of ascus, paraphysis, and spores, ×750.—c. habit sketch, ×7.5. Drawn from FH-Suttle L. VIII.1978.

Apothecia intracortical, rarely imbedded in stromatized wood, long enclosed by the orbicular, black, carbonized stroma, finally opening by 3–6 irregular teeth, sometimes by a longitudinal slit, without preformed lines of dehiscence, 1.5–4.0 mm diam, the disc bright yellow when fresh. Covering stroma 250 μm thick, the cells 5–8 μm diam, the outermost 40 μm heavily carbonized, the inner face fringed with gelatinous periphysoids 25 × 4.0 μm, agglutinated and appearing pseudoparenchymatous. Basal stroma reduced to a subiculum of coarse brown hyphae intermingled with pieces of disintegrating wood. Subhymenium colorless, 100 μm thick. Asci 200–250 × 12–15 μm (300 × 16–18 fide Seaver, l.c.), stalked, clavate, uniformly thin-walled. Paraphyses filiform, circinate, 1.5–2 μm diam at the apex, mostly unbranched, with yellowish granular contents. Ascospores 8, 100–150 × 2.0 μm, eventually becoming multiseptate, the cells 6–10 μm long, with a prominent sheath.

On dead bark and wood of *Castanopsis* and *Quercus chrysolepis*, western North America. A conspicuous species when fresh because of its large size and bright yellow hymenium, it is probably uncommon, but the limited distribution records suggest a preference for dry areas which have not been extensively sampled by mycologists. Apparently saprophytic.

Specimens examined: NORTH AMERICA. USA. California: W. B. Cooke, Mycobiota North America 157, on *Castanopsis chrysophylla*, Mt. Shasta, Siskiyou Co., elev. 6000 ft, WBC 15725, 8-18-41, isotype of *G. castanopsidis* (FH); California Fungi 1132, on *Q. chrysolepis*, Butte Co., May–June 1936, Copeland, isotype of *Colpoma californicum* (FH). Oregon: Jefferson Co., Suttle Lake, on *Castanopsis*, Sherwood & Pike, 15.XIII.1978 (FH); Government Camp, 29. V.1932 (OSC 27,497).

17. *Coccomyces cembrae* Rehm, Hedwigia **24:** 232 (1885).
Figure 11

Apothecia densely gregarious, developing beneath a common black stromatic crust on decorticated wood, irregular in outline, opening irregularly, without a defined preformed dehiscence mechanism, 0.5–1.0 mm diam, the disc dark yellowish ochraceous when dry. Covering layer up to 60 μm thick, of uniform, isodiametric, thick-walled brown cells 4 μm diam, carbonized above, the lowermost cells faintly pigmented and vertically oriented but not definitely periphysoidal; lower stroma 5–10 μm thick, the cellular structure obscure in mature specimens, heavily carbonized. Subhymenium 50 μm thick, brown below, hyaline above. Paraphyses filiform, simple, weakly circinate, enlarged to 2–3 μm above. Asci clavate, long-stalked, 75–120 × 9–10 μm, uniformly thin-walled, J−, 8-spored. Ascospores 40–55 × 1.5–2.0 (−2.5 fide Rehm) μm, prominently sheathed, nonseptate (becoming septate according to Rehm, l.c.).

On pine wood, Tyrol, apparently rare. The name has been misapplied

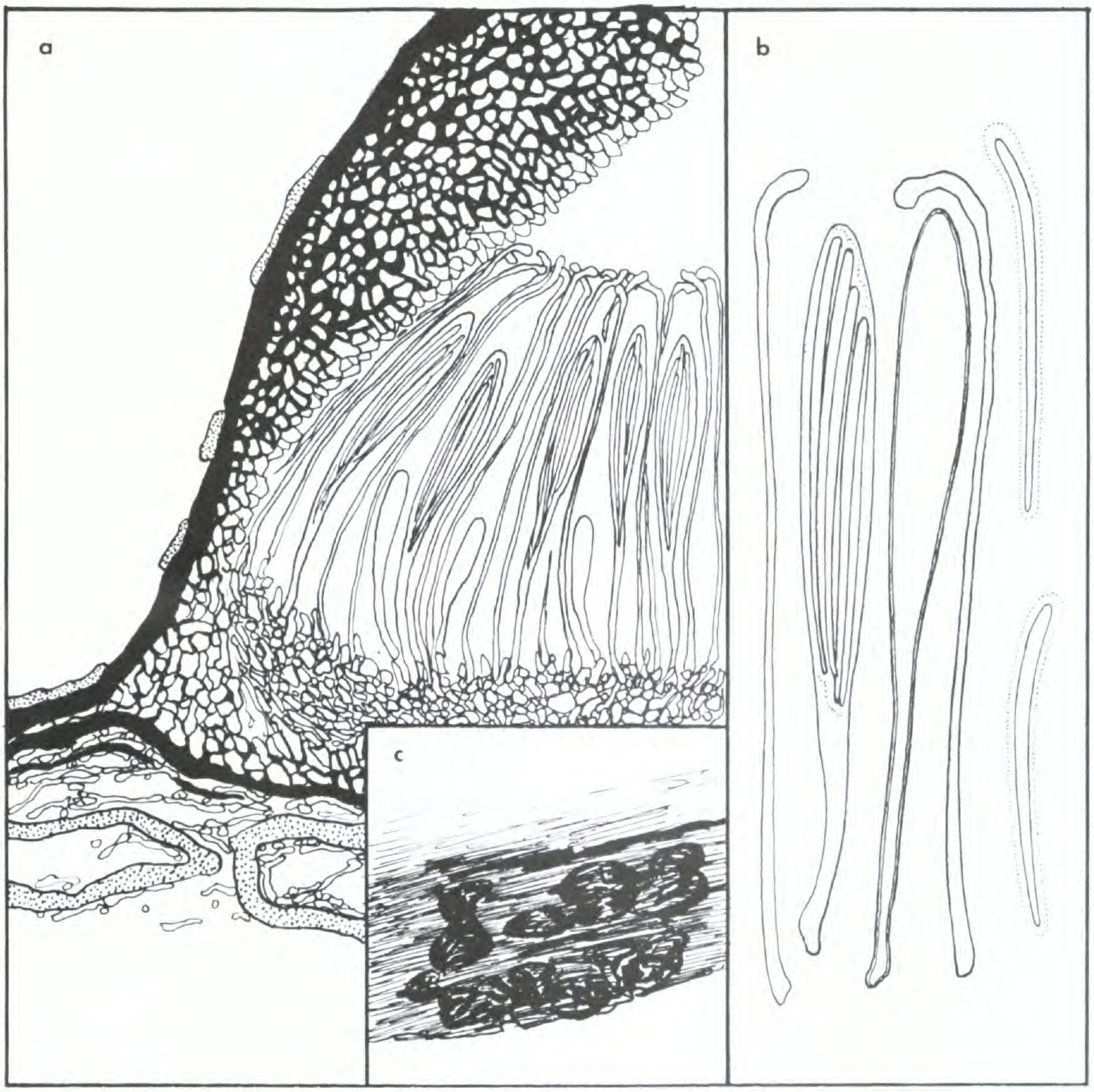

FIG. 11. *Coccomyces cembrae*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from s, Rehm Ascomyceten 801.

in herbaria to a number of other species of *Coccomyces* on decorticated wood, all of them readily separable on ascospore and paraphysis characters.

Specimen examined: EUROPE. AUSTRIA: Rehm, Ascomyceten 820, an faulenden entrindeten Aesten von *Pinus cembra*, oberhalb der Gamperhofe bei Sulden am Ortler (Tyrol), ca. 1900 m. 7/1884, Dr. Rehm, isotypes of *C. cembrae* (S, FH).

18. *Coccomyces clematidis* (Phill.) Sacc. See *Karstenia clematidis*.

19. *Coccomyces clusiae* (Lév.) Sacc., Syll. Fung. **8:** 747 (1889). Figure 12

≡ *Phacidium clusiae* Lév., Ann. Sci. Nat. Bot. sér. 4, **20:** 291 (1863).

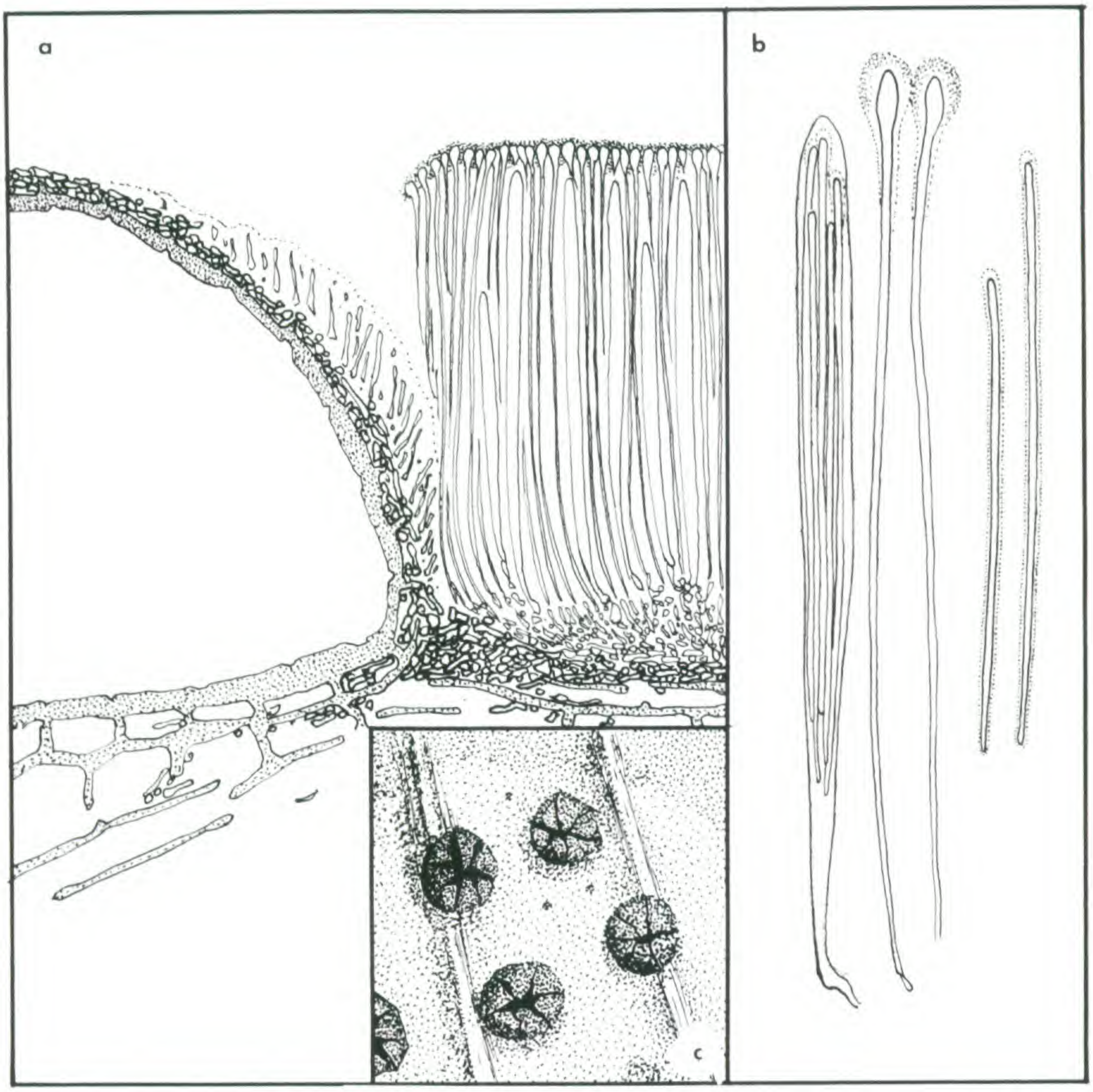

FIG. 12. *Coccomyces clusiae*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from FH-Lindig 2821.

= *Phacidium musae* Lév., Ann. Sci. Nat. Bot. sér. 3, **5:** 303 (1846), nom. rej. prop. (Art. 69).
≡ *Coccomyces musae* (Lév.) Sacc., Syll. Fung. **8:** 752 (1889).
= *Phacidium pluridens* Berk. & Curt., J. Linn. Soc. (London) **10:** 371 (1868).
≡ *Coccomyces pluridens* (Berk. & Curt.) Sacc., Syll. Fung. **8:** 747 (1889).

Apothecia epiphyllous or hypophyllous, intraepidermal, on dead leaves, in bleached spots not bounded by a black line, black, shining, 0.7–1.5 mm diam, orbicular or polygonal, the covering layer with a distinct preformed stellate dehiscence mechanism of light-colored thin-walled cells, opening by 4–10 (usually more than 5) teeth to expose the dark brown hymenium. Covering layer ca. 30 μm thick,

consisting of an upper layer 10 μm thick of carbonized cells 2–3 μm diam, fringed below with a layer of hyaline periphysoids 20 × 3–5 μm, unbranched, widely spaced in a gel. Basal stroma carbonized, 10–20 μm thick. Excipulum absent. Subhymenium colorless, ca. 20 μm thick. Paraphyses filiform, enlarged to 5–6 μm at the knobbed apex, imbedded in a dark brown gel, forming an epithecium. Asci cylindrical, short-stalked, 75–120 × 7–8 μm, J−, 8-spored. Ascospores 50–60 × 1.0 μm, nonseptate, obscurely sheathed.

On dead, fairly sound leaves of *Clusia* spp. and unidentified Ericaceae, in humid forests at middle elevations, throughout tropical America, common, conspicuous, and unmistakable on account of the inflated paraphyses imbedded in a brown gel, a character found in no other leaf-inhabiting species of *Coccomyces*.

The earliest validly published name for the species is *Phacidium musae*, based on a specimen collected by Bonpland in tropical America. The specimen deposited under this name in PC is annotated in Léveillé's handwriting and appears to be the holotype. The host, however, is not *Musa*, but *Clusia*. To the best of my knowledge this species never occurs on *Musa*. Léveillé described the species as having "disco nigricante," a character fitting the species on *Clusia* but none of the species known to occur on *Musa*. The evidence, then, suggests that this is the correct application of the name *Coccomyces musae*.

According to the revised wording of Article 69 of the International Code of Botanical Nomenclature, "A name must be rejected if it has been widely and persistently used for a taxon not including its type" (Stafleu et al., 1978). Where the name *Coccomyces musae* has been used in the literature, it has been used for species on *Musa* rather than species on *Clusia* (see, for example, Seymour, 1929; Stevenson, 1926; Wardlaw, 1935). I would argue that among parasitic fungi, or fungi which for other reasons are considered to be host specific and are routinely identified through the use of a host index, an initial misdetermination of the host may lead to persistent use of a name in a sense that excludes its type, and that this is the case here. I therefore propose that the name *C. musae* be rejected under the revised wording of Article 69 of the International Code of Botanical Nomenclature.

Specimens examined: CENTRAL AMERICA. COSTA RICA. Prov. Cartago: Gomez 6897 (CR). Prov. Heridia: Gomez 6898 (CR). CARIBBEAN ISLANDS. PUERTO RICO: Maricao, 16.VI.1970, Korf et al. (CUP-PR 4151). CUBA: Fungi Cubensis Wrightiani 581, 873, 713, 724, C. Wright (FH-CURTIS); Fungi Cubensis Wrightiani 533, isotype of *Phacidium pluridens* (FH-CURTIS). GUADELOUPE: La Soufrière, Pfister et al., Jan, 1974 (FH-GUADELOUPE 764, 774). SANTO DOMINGO: Cifferi, Mycoflora Domingensis 2241, Moca, on *Clusia rosea* (BPI); San José de las Natas, Skuen, 11.4.1930 (BPI); Mao near Santiago, V.1929, Cifferi (ZT); San José de las Natas, Ekman 4–1930 (IMI 21430); Santiago, Cifferi, 1924 (IMI

101418). HAITI: Departement du Nort, Leonard 7020a, on *C. rosea* (ZT). COUNTRY UNKNOWN: Herbier de la Amerique equatorial donné par M. Bonpland, presumed holotype of *Phacidium musae* (PC). SOUTH AMERICA. COLOMBIA: Villeta, Lindig 2280, 1400 m (FH); Villeta, Lindig 2821, 1861, alt. 1400 m, lectotype, designated here, of *Phacidium clusiae* (PC); Antioquia, Dumont et al., 1976 (NY-CO 6240, 6561, 6265, 6245); Cauca, Dumont et al. (NY-CO 1272). VENEZUELA: Sydow, Fungi Exotici 862, Puerto de la Cruz, on *C. rosea* (PC, FH, BPI); Sydow, Fungi Venezuelani 36a, Catuche, on *C. rosea* (BPI, FH); Eralia, Dpto. Federal, Dennis 4.7.1958 (ZT); Dpto. Federal, Dumont et al. (NY-VE 562, 832, 90).

20. *Coccomyces cocoes* Dennis, Kew Bulletin **1953:** 50 (1953). Figure 13

Apothecia immersed in obscurely bleached spots not bounded by a line (type) or bounded by a delicate black line, on long-dead leaves, quadrate to hexagonal, subepidermal, dark brown when closed, 0.2–1.0 mm diam, without an obvious preformed dehiscence mechanism,

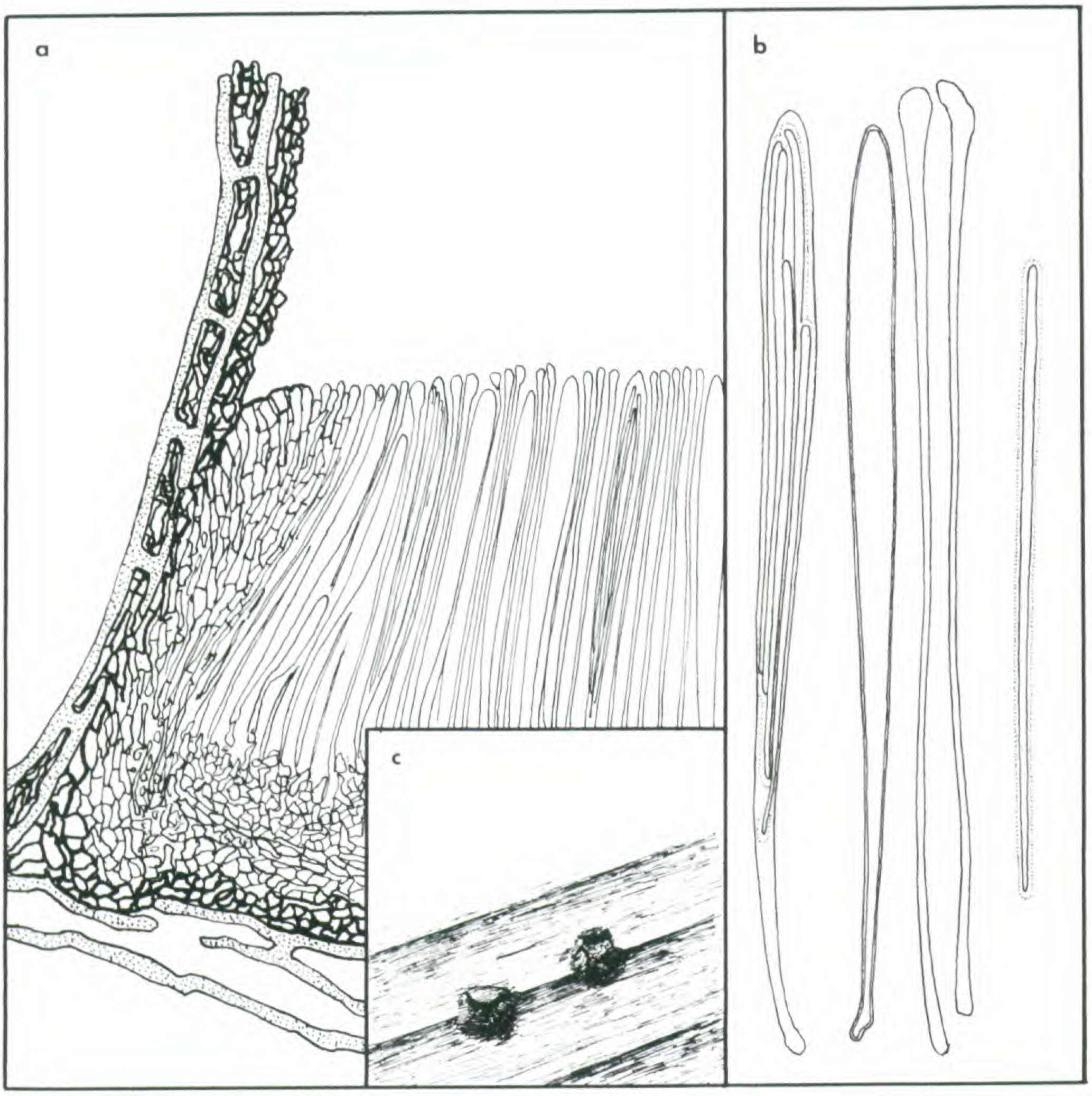

FIG. 13. *Coccomyces cocoes*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

opening irregularly by 4–6 teeth. Covering layer devoid of differentiation, consisting of 10–15 μm of carbonized hyphae 3 μm diam. Excipulum rudimentary, consisting of a few layers of colorless closely-septate hyphae. Basal stroma complete, carbonized, 10–15 μm thick, the cells 5 μm diam; subhymenium 30 μm thick, colorless. Asci cylindrical, short-stalked, 18 × 7 μm, 8-spored. Paraphyses filiform, enlarged to 3–5 μm at the apex, not cemented in a gel. Ascospores 70–90 × 1.0 μm, nonseptate, obscurely sheathed.

On leaves of Palmae, west Africa. Similar morphologically to *C. spegazzinii* and *C. limitatus*, differing from both principally in its host and geographical range, and its subepidermal habit.

Specimens examined: AFRICA. GOLD COAST: Asanta, on *Cocos nucifera*, S. J. Hughes 687, 14.5.1949, holotype of *Coccomyces cocoes* (K). GABON: Libreville, on *Eremospatha macrocarpa*, G. Gilles 29.4.1979 (FH).

21. *Coccomyces comitialis* (Batsch) Dearn. & House. See *C. tumidus*.

22. **Coccomyces concolor** Sherwood, spec. nov. Figure 14

Ascocarpi primo immersi, orbiculati, 0.5–0.8 mm diam, per lacinias 4–6 irregulariter aperientes, in macula pallida inconspicua stromate obvallato insidentes. Margo superior stromatica ex hyphis intertextis brunneis constata, inconspicua. Periphysoidei nulli. Margo inferior stromatica 5 μm crassa, ex hyphis carbonaceis constata. Excipulum brunneum. Paraphyses filiformes, apice ad 5–6 μm incrassatae, achromae, in epithecio gelatinoso non inclusae. Asci 85–120 × 5.5 μm, cylindrici, haud pedicellati, 8-spori, in iodo non caerulescentes; sporis filiformibus, continuis, in tunica gelatinosa inclusis, 70–100 × 0.8–1.0 μm. In foliis dejectis ignotis, Venezuela.

Holotypus: CUP-Fungi of Venezuela 4266, on a leaf blade, Rancho Grande, Aragua, K. P. Dumont, June 12, 1968.

Etymology: concolor (L), concolorous, since the apothecia appear nearly the color of the leaf they are growing on rather than appearing black against a bleached background as in allied species.

Apothecia immersed, hypophyllous, subepidermal, brown, in inconspicuous bleached spots bounded by a delicate black line, orbicular, 0.5–0.8 mm diam, without a definite preformed dehiscence mechanism, opening by 4–6 irregular teeth to expose the pale yellowish-grey hymenium. Covering layer nearly obsolete, consisting of 1–2 layers of loosely interwoven brown noncarbonized hyphae 2–3 μm diam, not accompanied by crystals. Lower stroma 5 μm thick, black, carbonized, separated from the subhymenium by a subiculum of hyaline hyphae 2 μm diam. Proper excipulum 40–50 μm thick, of septate hyphae 3–4 μm diam, brown above. Subhymenium 20 μm thick, colorless. Asci 80–120 × 5.5 μm, cylindrical, very short-stalked, J−, 8-spored. Paraphyses filiform, colorless, inflated to 5–6 μm at the apex, not imbedded in a gel. Ascospores 70–100 × 0.8–1.0 μm, obscurely sheathed, nonseptate.

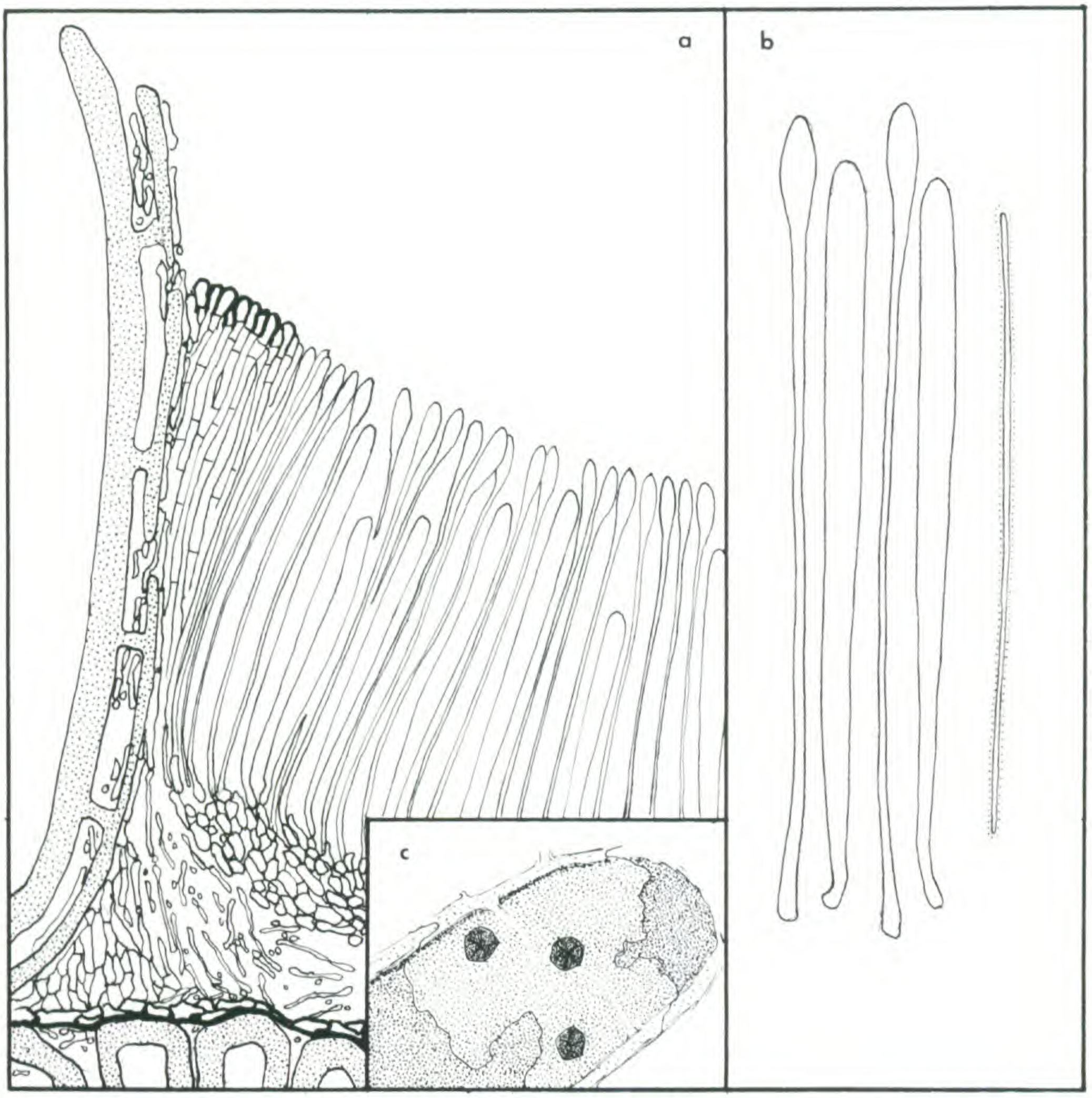

FIG. 14. *Coccomyces concolor:*—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×10. Drawn from the holotype.

On undetermined leaves, Venezuela. The almost complete absence of a covering layer, subepidermal habit, and absence of epithecial gel distinguish this species from *Coccomyces leptosporus*.

Specimen examined: see holotype, above.

23. *Coccomyces consociatus* Petrak, Sydowia **2:** 66 (1948).
Figure 15

Apothecia scattered on discolored spots on living leaves (the spots said to be caused by *Ophiodothella sydowii*), not accompanied by stromatic structures or pycnidia, 0.5–0.8 mm diam, without a preformed dehiscence mechanism, subepidermal, irregularly polygonal, raising the substrate into small pustules and at length becoming erumpent, the overlying epidermis colorless, splitting irregularly by 3–5 teeth

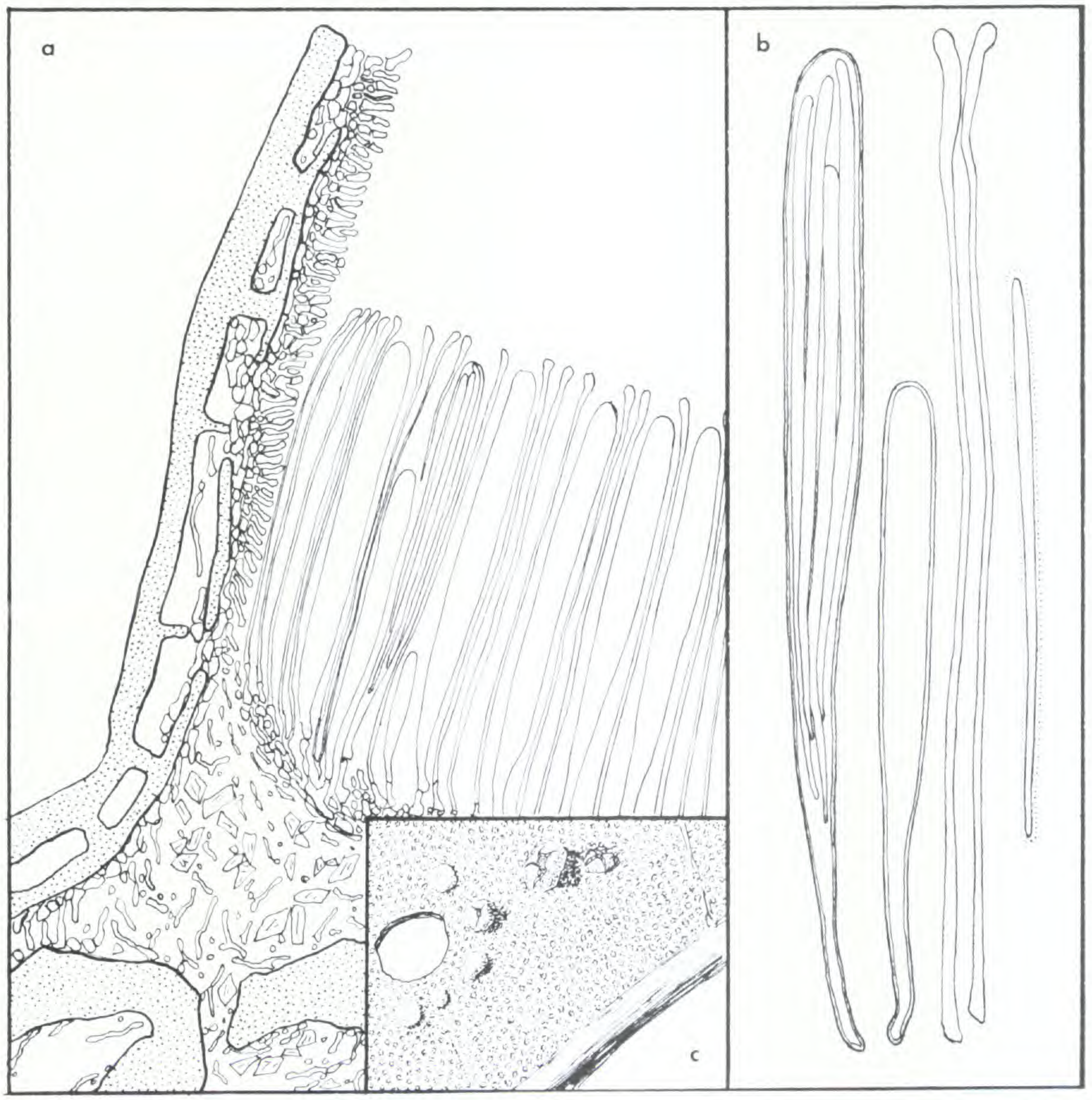

FIG. 15. *Coccomyces consociatus*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from Sydow 815a (ZT).

to expose the pale yellow hymenium. Covering layer consisting of 1–2 layers of hyaline pseudoparenchyma, the cells 3–4 μm diam, lined on the inner face with a compact layer of periphysoids 10 × 2.5–3.5 μm. Subhymenium colorless, 15 μm thick, resting on a subiculum of colorless hyphae 1.5–2 μm diam intermingled with crystals, becoming increasingly crystalline with age. Basal stroma absent. Asci 90–130 × 8–10.5 μm, cylindrical, short-stalked, 8-spored. Paraphyses filiform, slightly enlarged to 2.5 μm at the apex, not cemented in a gel. Ascospores 60–90 × 1.5–2.3 μm, nonseptate, obscurely sheathed.

On dead leaves of *Cavendishia*, Ecuador. The isotype specimen examined is only in fair condition, and the above is taken in part from Petrak's original description. The species is intermediate between *Coccomyces* and *Naemacyclus;* it lacks the prominent pigmented

stroma of most *Coccomyces* species but has a more differentiated covering layer and lacks the branched paraphyses of a typical *Naemacyclus*.

Specimen examined: SOUTH AMERICA. ECUADOR: in dem durch *Ophiodothella sydowii* verursachten Blattflecken auf *Cavendishia* sp., Ekuador, Prov. Tungurahua, Hacienda San Antonio bei Baños, leg. H. Sydow nr. 615 a, 28.XII.1937, isotype of *Coccomyces consociatus* (FH).

24. *Coccomyces coronatus* ([Schum.] ex Fr.) de Not., Erbar. Critt. Ital. ser. 1, 236 (1859).[3] Figure 16

≡ [*Ascobolus coronatus* Schum., Fl. Saell. pars post. 437 (1803)].

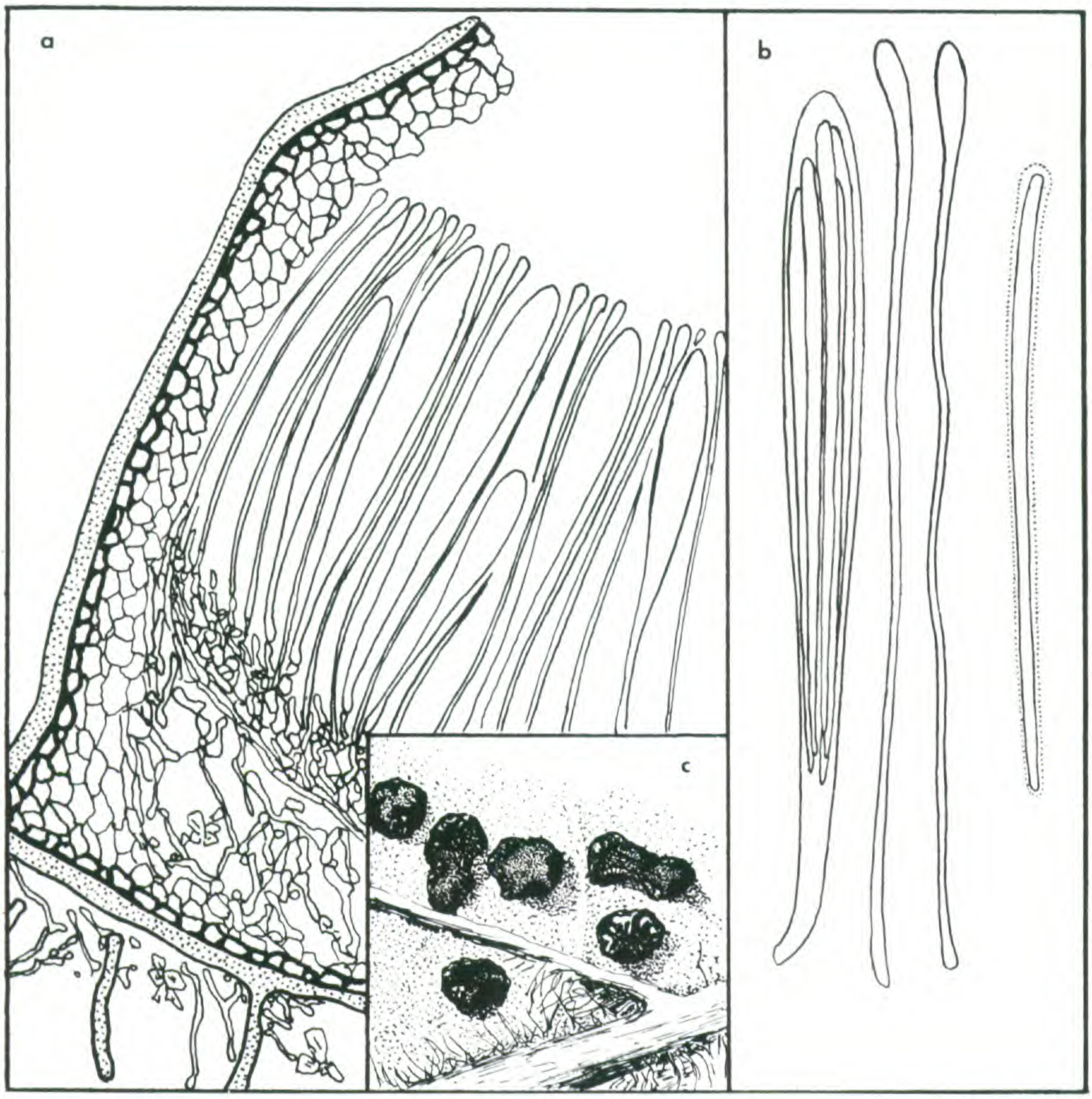

FIG. 16. *Coccomyces coronatus*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×10. Drawn from FH, Thaxter, Intervale VIII.1901.

[3]For other names not listed above, see discussion of dubious synonyms and misapplied names following the species description.

≡ [*Phacidium coronatum* (Schum.) Fr., Obs. Myc. **1:** 167 (1817)]; ex Fr., Scleromycetes Sueciae 165 (1821); Syst. Mycol. **2**(2): 577 (1823).

≡ [*Peziza connivens* Martius, Fl. Erlang. 463 (1817)].

= *Lophodermium phacidium* de Not., Giorn. Bot. Ital. **2**(7–8): 42 (1847).

= *Coccomyces epiphyllus* Velenovský, Monogr. Discom. Bohem. 43 (1934).

Apothecia in bleached spots bounded by a delicate line stroma and accompanied by microsclerotia, on long-dead, well-rotted leaves, orbicular or polygonal in outline, black, shining, without an obvious preformed dehiscence mechanism, 0.6–1.2 mm diam, splitting open by 4–6 irregular teeth to expose the pale orange (when dry) hymenium, intraepidermal. Covering layer ca. 20 μm thick, of brown, carbonized cells 5–10 μm diam; periphysoids absent. Basal stroma 10 μm thick, carbonized, the cells 5 μm diam. Subhymenium colorless, 25 μm thick, separated from the basal stroma by a hyaline subiculum with a few crystalline inclusions. Proper exciple absent. Paraphyses filiform, with a pronounced apical swelling 4–5 μm diam, somewhat agglutinated, forming an epithecium. Asci cylindric-clavate, short-stalked, 100–130 × 11–13 μm, J−, 8-spored. Ascospores 60–80 × 2.0–2.5 μm, nonseptate, narrowly sheathed.

On well-rotted leaves of many species of deciduous trees, particularly *Betula* and *Quercus*, mid-autumn. Very common. Collection records from Europe and North America suggest that it prefers more northern and less maritime areas than *Coccomyces dentatus*, with which it is often confused.

Considerable confusion exists in the literature regarding the identity of *Coccomyces coronatus*, although the above interpretation has been included by most authors in their concept of the species. The specimen which Fries distributed as *Phacidium coronatum* in Scleromycetes Sueciae 165 is this species. I designate the specimen of Scleromycetes Sueciae 165 in UPS to be the lectotype of *Phacidium coronatum*. If one interprets Article 9 of the International Code of Botanical Nomenclature as implying that all of the material included by Fries in his concept of a species, including descriptions and specimens of pre-starting point authors, form an integral part of the protologue and are eligible for selection as lecotypes, then Scleromycetes Sueciae 165 must be considered a lectotype and not (collectively) the holotype of the species.

Schumacher's published description of the species is at best ambiguous. His unpublished illustration, deposited in the library of the University of Copenhagen, which shows strongly erumpent apothecia with a tan disc and irregular dehiscence, may represent *Coccomyces*

tumidus. In view of the International Code of Botanical Nomenclature's recommendation not to typify species with pre-starting point descriptions, and the absence of a type specimen, the Friesian type has been chosen for *C. coronatus*.

Several pre-starting point names listed by Fries in his synonymy of *Phacidium coronatum* appear, as well as can be determined from illustrations of macroscopic characters, to belong to species other than *Coccomyces coronatus*. These are omitted from the synonymy above. *Peziza comitialis* Batsch may be *C. tumidus;* this is the interpretation of Dearness and House (1925). *Xyloma pezizoides* Pers. opens by a longitudinal slit, a character rarely found in *C. coronatus*. *Peziza laciniata* Alb. & Schw., cited as a synonym by Karsten (1871, as *C. coronatus* var. *laciniatus*) and Rehm (1887–96) is a stalked superficial fungus now referred to *Discocainia*. *Phacidium trigonum* Kunze & Schm., also included by Karsten in his concept of *C. coronatus* (as var. *trigonus*) is *C. tumidus*. *Coccomyces dentatus, C. tumidus,* and *C. quercinus* (= *C. delta*), considered to be synonyms by Nannfeldt (1932), are distinct species readily separable on morphological grounds.

Imperfect stages have been ascribed to *Coccomyces coronatus* (cfr. Nannfeldt, 1932). None of the specimens I examined had a pycnidial stage co-occuring with ascocarps in the same lesion. Reports of *Leptothyrium* stages may have resulted from confusion with *C. dentatus*.

Specimens examined:[4] EUROPE. SWEDEN: Fries, Sclerom. Sueciae 165 (FH, UPS, lectotype of *Phacidium coronatum* Fr.); on *Quercus,* Uppsala, O. Eriksson (UME). FINLAND: Messkuby, Sept., 1860, on *Betula,* Karsten, Fungi Fenniae 340 (FH). DENMARK: On *Quercus,* Sorø, 19.XI.1978, Pfister (FH). GERMANY: Sydow, Mycotheca Germanica 2713, on *Quercus,* Brandenberg (BPI, FH); Allesch. & Schnabl., Fungi Bavarici 457, on *Quercus,* pp (FH). AUSTRIA: on *Fagus,* Sonntagberg, 1885 (BPI). POLAND: Biólowieza, Müller, 5.IX.1966 (ZT); Miklájka, Müller, 2.IX.1966 (ZT). CZECHOSLOVAKIA: Bohemia, Jevany, in foliis *Fagi sylvaticae,* IX. 1922, leg. Velenovský, holotype of *Coccomyces epiphyllus* (PRM 148699); Bohemia, on *Quercus,* leg. M. Svrček (PRM 756276, 756274, 620800, 714315, 714316, 625807); Bohemia, on *Fagus,* leg. Svrček (PRM 612637, 756282); Bohemia, on *Betula* (PRM 756284, 149921); Moravia (PRM 150513). ITALY: Herb. Crittog. Ital. 256, Riva di Valsesia, on *Fagus,* Cesati, Carestia (FH). FRANCE: Herb. Barb. Boiss. 1010b, Normandy (FH). GREAT BRITAIN: Phillips, Elvellacei Britanici 201, on *Quercus,* Herfordshire (BPI, FH); Hockfall, Yorkshire, Hughes & Webster, 25.IX.1948 (BPI). NORTH AMERICA. CANADA. Nova Scotia: on *Fagus,* Wehmeyer 1467 (MICH). Ontario: on *Quercus,* Lake Timagami, Thompson & Pady, 25.VIII.1930 (MICH, BPI). USA. Maine: on *Quercus,* Shear 23.VIII.1940 (BPI); on *Betula, ibid.* (BPI); Mt. Katahdin, Shear, 1940 (BPI); Whetzel & Sprosten, 1940 (CUP 29190). New Hampshire: White Mts., O. F. Cook, VIII, 1889 (BPI); Intervale, on *Fagus,* Thaxter, 1901 (FH); Chocorua, on *Sarracenia,* Farlow (FH); on *Betula,* Thaxter, 1885 (FH); on *Betula,* Farlow, 1885 (FH). Massachusetts: Newton, Farlow, VIII.1878, on *Quercus* (FH). New York: on *Acer,* Warrensburg, Rogerson, 3.X.1959 (NY); Lake Placid, on *Fagus,* Kauffman & Mains, 15.IX.1917 (MICH); Saranac L., Mains, 25.XII.1914 (MICH); Ithaca, Whetzel, 6.X.1903 (CUP 1838). Iowa: G. W. Martin, 22.VIII.1936 (BPI). Michigan: Marquette, on *Populus,* Mains 1935 (MICH); Ann Arbor, 15.IX.1938, Smith

[4]For exsiccati specimens distributed as *C. coronatus* see also *C. tumidus* and *C. dentatus*. 'pp' indicates a mixed collection of two or more *Coccomyces* spp.

(MICH). Wisconsin: Lake Geneva, VII.1903, Harper (F). SOUTH AMERICA. BRASIL: Rio Grande do Sul, Rick, VII.1906 doubtfully referred here (S, HERB. REHM).

25. *Coccomyces coronatus* f. *rubi* Rehm, Ber. Bayer. Bot. Ges. **13:** 129 (1912).

Rehm based this form on a specimen collected by Morthier in Schweizer-Jura in 1864 and distributed in Herbier Barbey-Boissier as *Phacidium coronatum.* No specimen answering this description could be found in S or FH. The name may apply to *Coccomyces tumidus,* which occasionally occurs on *Rubus* canes, has ascospores of the dimensions given by Rehm, and was included by Rehm in his concept of *C. coronatus.*

26. *Coccomyces crustaceum* Curt. *in* Reid & Cain. See *C. strobi.*

27. **Coccomyces crystalligerus** Sherwood, spec. nov. Figure 17

Ascocarpi primo immersi, irregulariter orbiculati, 0.7–1.2 mm diam, per lacinias irregulariter aperientes, in macula pallida non insidentes. Margo superior stromatica 20 μm crassa, ex hyphis intertextis carbonaceis constata. Excipulum brunneum. Periphysoidei nulli. Margo inferior stromatica 20 μm crassa, ex hyphis intertextis carbonaceis constata. Paraphyses filiformes, ramosae, achromae, in epithecio gelatinoso non inclusae. Asci 180–225 × 10–11 μm, cylindrici, haud pedicellati, 8-spori, in iodo non caerulescentes. Sporis filiformibus, continuis, in tunica gelatinosa inclusis. In laminae et petiolis filicis ignotis, Colombia, Amer. Austral.

Holotypus: NY-CO 6111, on indet. fern leaf (Polypodiaceae) ca. 82 km from Medellín-Pto. Valdivia rd., Dpto. Antioquia, elev. ca. 9400 ft, leg. Dumont, Carpenter & Sherwood, 12 August 1976. *Isotypi:* COL, FH.

Etymology: crystalligerus (L), forming crystals, referring to the epithecium.

Apothecia subepidermal, deeply immersed in leaves and rachides of an unidentified polypodiaceous fern, 0.7–1.2 mm diam, dark brown when closed, opening irregularly by teeth, without a preformed dehiscence mechanism. Hymenium pale translucent yellow when wet, drying white-pruinose, dotted with discrete clumps of colorless crystals. Covering stroma ca. 20 μm thick, of carbonized cells 3–5 μm diam, without periphysoids. Basal stroma complete, ca. 20 μm thick, of carbonized cells 3–5 μm diam. Subhymenium colorless, 25 μm thick. Proper excipulum well-developed, 50 μm thick, of closely septate hyphae 2.5 μm diam, the cells 8–10 μm long, brown above. Paraphyses filiform, 1.0 μm broad below, barely enlarged above, richly branched above, colorless, crystalliferous, forming an epithecium. Asci cylindrical, short-stalked, J−, 180–225 × 10–11 μm, 8-spored. Ascospores 150–180 × 1.5–2.0 μm, narrowly but distinctly sheathed.

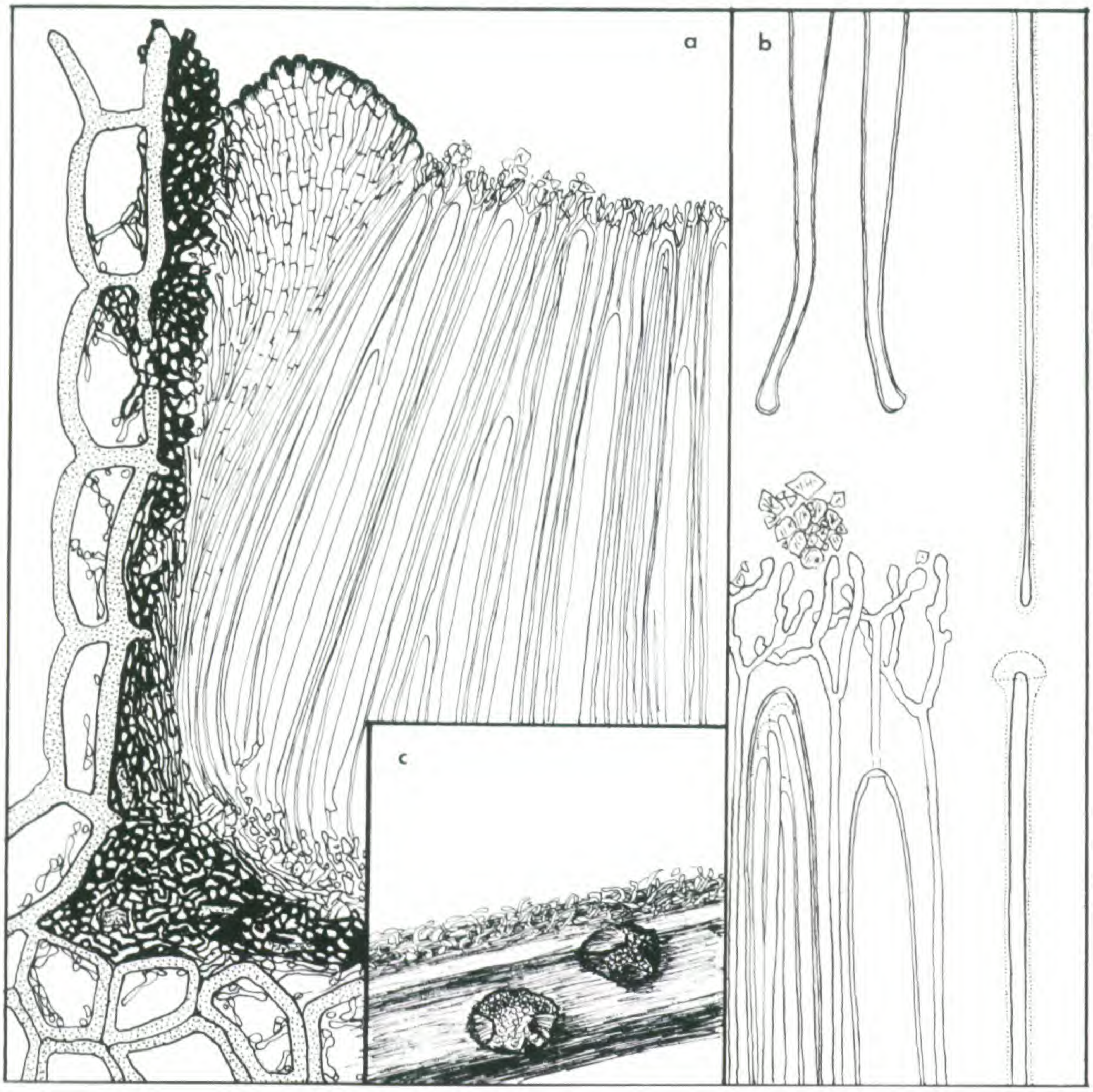

FIG. 17. *Coccomyces crystalligerus*:—a. cross section of margin, ×300.—b. detail of asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

On fern leaves and rachides, known only from a single collection from the Colombian highlands. A very distinctive species because of its unusual host, very long asci, and crystalline epithecium.

Specimen examined: see holotype, above.

28. *Coccomyces delta* (Kunze) Sacc., Flor. Myc. Lusit. 13 (1893). Figure 18

≡ *Phacidium delta* Kunze, Linnaea **5:** 551 (1830).

= *Phacidium quercinum* Desm., Pl. Crypt. France 1644 (1847).

≡ *Coccomycella quercina* (Desm.) Höhnel, Ber. Deutscher Bot. Gesell. **35:** 419 (1917).

≡ *Coccomyces quercinus* (Desm.) Terrier, Essai Syst. Phacid. 39 (1942).

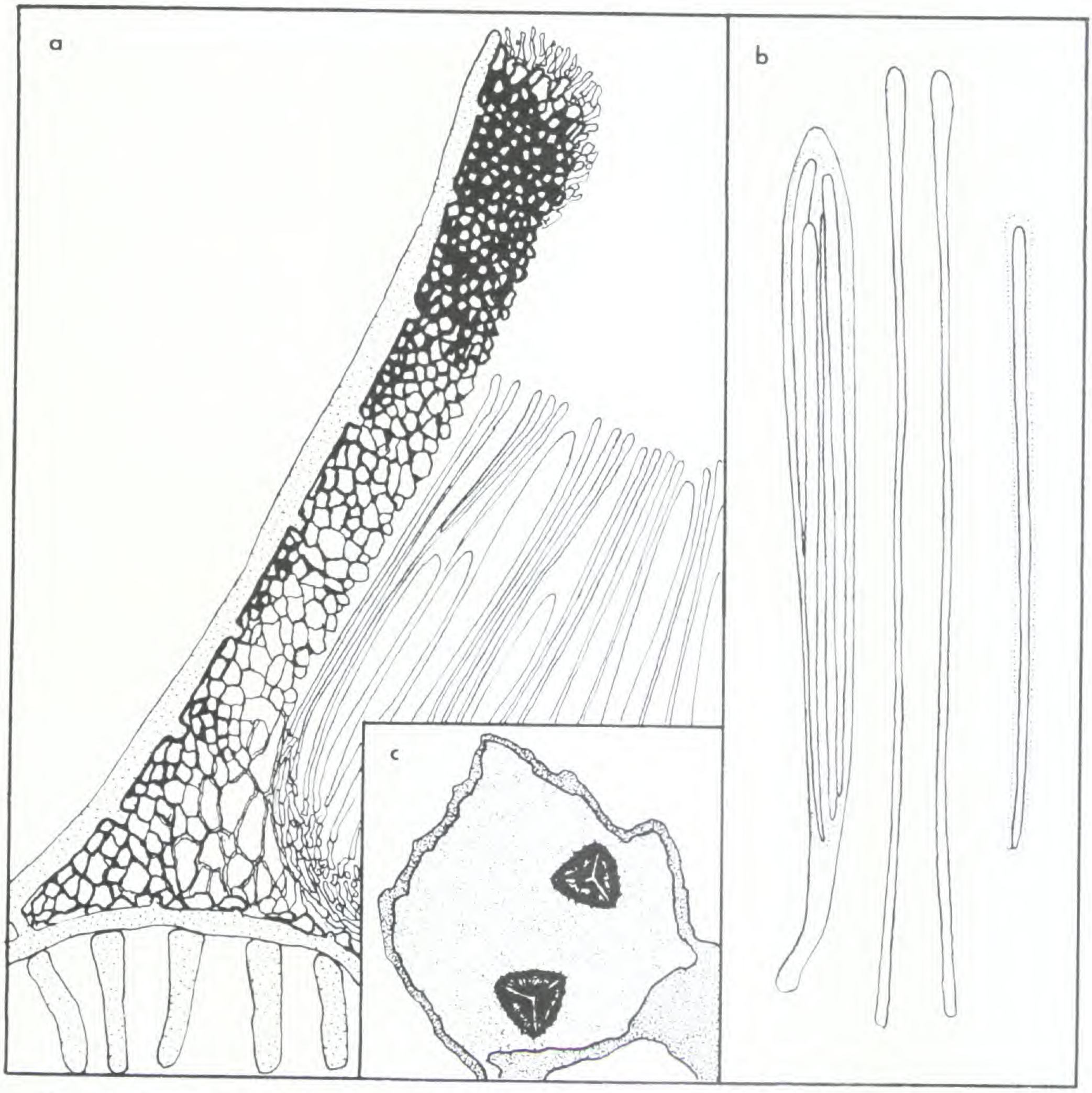

FIG. 18. *Coccomyces delta*:—a. cross section of apothecium, ×375.—b. ascus, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from CUP-MM 654.

Apothecia intraepidermal, on distinct bleached spots bounded by and intersected by a delicate line, black, shining, triangular or quadrate (triradiate or cruciate when immature), with an obvious preformed dehiscence mechanism of light colored cells, opening by 3–4 teeth. Covering layer 30 μm thick, of isodiametric cells 4–10 μm diam, heavily carbonized at the center, less so at the periphery. Periphysoids absent. Edges of teeth bordered by a fringe of periphysis-like lip cells 1.5–2.5 μm diam, immersed in a gel (as in *Lophodermium*). Lower stroma 5 μm thick, heavily carbonized, separated from the upper stroma by a large-celled pseudoparenchymatous matrix. Subhymenium 25 μm thick, colorless. Paraphyses filiform, slightly enlarged to 2.5–3 μm at the apex, simple, not immersed in a gel. Asci 100–150 × 8–10 μm, cylindrical, short-stalked, thin-walled, J−, 8-spored. Asco-

spores 80–100 × 2.0 μm, nonseptate, narrowly sheathed. Pycnidia absent.

On dead coriaceous leaves of Lauraceae and evergreen *Quercus*, throughout the winter rainy season, Mediterranean area and Atlantic Islands, common. *Coccomyces dentatus* is similar, but differs in having shorter asci and ascospores, lacks lip cells, and usually has associated pycnidia. The species was originally described from Madeira. I could locate no type material, but have little doubt that this is the correct application of the name. De Thuemen, Mycotheca Universalis 1367, Fl. Lusit. Exs. 1208, and Rabenhorst, Fungi Europaei 1208, cited below, were distributed as *Phacidium trigonum*, all misidentifications. California fungi 430, distributed as *C. delta*, is *Stictis emarginata* Cke. & Massee.

Specimens examined: EUROPE. ITALY: on *Laurus nobilis*, July, 1906 (PAD). FRANCE: Desm., Pl. Crypt. France sér. 1: 1694, in fol. sicc. *Querc. coccif.*, autun, isotype of *Phacidium quercinum* (FH). PORTUGAL: de Thuemen, Mycoth. Univ. 1367, Coimbra, 1879, on *L. nobilis* (FH, ZT); Rabenh., F. Eur. 3363, Coimbra, 1885 (FH, ZT); Flor. Lusit. Exs. 1208, Coimbra, 1893 (FH, ZT). ATLANTIC ISLANDS. MADEIRA: Ribeiro Frio, Korf et al., 13.I.1977 (CUP-MM 1486); Faja da Noguera, 21.III.1978, Korf et al. (CUP-MM-2291); Chão dos Louros, 26.III.1978, Korf et al. (CUP-MM 2455). CANARY ISLANDS: Tenerife, Korf et al., January, 1976 (CUP-MM 1, 217, 11, 76, 207); La Palma, Korf et al., January, 1976 (CUP-MM 817, 647, 654). AZORES: São Miguel, 5.III.1978, Korf et al. (CUP-MM-1845; Phacid. Exs. #16).

29. *Coccomyces dentatus* ([Schm. & Kunze] ex Fr.) Sacc., Michelia **1:** 59 (1882). Figure 19
    ≡ [*Phacidium dentatum* Schm. & Kunze, Deutschlands Schwämme 2 (1816)] ex Fr., Syst. Mycol. **2**(2)**:** 577 (1823).
    ?= *Coccomyces bromeliacearum* Theiss., Bot. Centralbl. **27**(2)**:** 406 (1910).
    = *Coccomyces dentatus* var. *lauri* Rehm in Theiss., Bot. Centralbl. **27**(2)**:** 406 (1910).
    ?= *Coccomyces filicicola* Speg., Bol. Acad. Nac. Ci. **23:** 152 (1919).
    = *Coccomyces pentagonus* Kirschst., Ann. Mycol. **34:** 208 (1936).

Apothecia scattered in prominent bleached spots bounded by a black line, intraepidermal, usually accompanied by pycnidia, 0.5–1.0 mm diam, quadrate to hexagonal, black, shining, with a distinct stellate preformed dehiscence mechanism of lighter colored cells, opening by teeth to expose the dull yellow hymenium. Covering layer ca. 30 μm thick, of carbonized cells 5–6 μm diam; periphysoids and lip cells absent. Basal stroma ca. 5 μm thick, carbonized. Excipulum absent. Paraphyses simple, filiform, gradually enlarged to 2.0 μm at the apex, the contents rather granular. Asci cylindric-clavate, short-stalked, 70–105 × 8–10 μm, thin-walled, J−, 8-spored. Ascospores

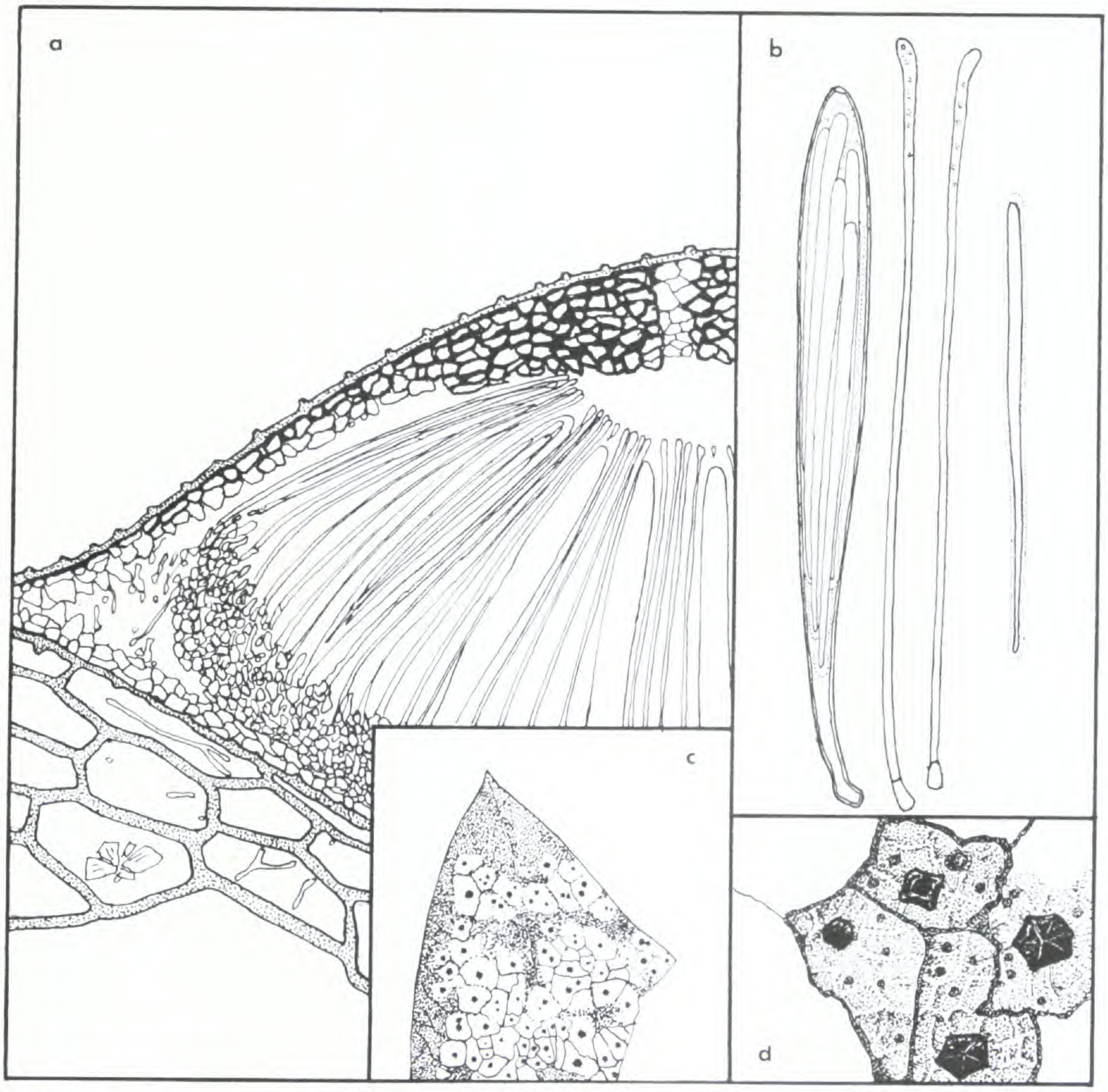

FIG. 19. *Coccomyces dentatus*:—a. cross section of apothecium (slightly immature), ×375.—b. ascus, paraphyses, and spores, ×750.—c. habit sketch, approximately natural size.—d. habit sketch, ×7.5. Drawn from FH-Parks 4084.

45–65 × 2.0 μm, narrowly but distinctly sheathed, nonseptate. Pycnidia appearing before the apothecia mature, intraepidermal, lenticular in cross section, 0.1–0.3 mm diam, with a dark brown covering layer; phialides in a basal layer, borne on short conidiophores, subulate, without a collarette, 5–10 × 2–2.5 μm; conidia bacilliform, nonseptate, colorless, 4–5 × 1.0 μm.

On dead (rarely living) leaves of a wide variety of angiosperms, notably on Fagaceae and Ericaceae, widespread and common, chiefly in warm temperate areas, summer and fall in the northern part of its range, throughout the year in subtropical areas. Owing to its abundance, wide geographical distribution, and conspicuousness, this is the most frequently collected species of *Coccomyces*. *Coccomyces*

coronatus, with which it is frequently confused, has inflated paraphyses, longer asci and ascospores, less regular apothecia, and rarely occurs on leaves of evergreens.

Coccomyces bromeliacearum and *C. filicicola*, cited as tentative synonyms above, cannot be completely characterized from their respective type specimens. The type of the former is old, and the type of the latter completely immature. The specimens and original descriptions suggest that they are very close to, if not identical with, *C. dentatus*. *Coccomyces dentatus* var. *lauri* does not differ in any recognizable morphological detail from typical *C. dentatus*. *Coccomyces pentagonus* likewise appears to be typical *C. dentatus;* infections on *Berberis aquifolium* in the western U.S. agree exactly with infections which appeared when the host was introduced into Europe.

Specimens examined:[5] EUROPE. GERMANY: auf *Mahonia aquifolium*, Brandenberg, Tamsler Baumhüln, V.1936, leg. P. Vogel, isotype? of *C. pentagonus* (ZT); on *M. aquifolium*, Brandenberg, Sydow Mycoth. 3136 (FH); Schmidt & Kunze, Deutschlands Schwämme 106, on *Quercus robur*, isotype of *Phacidium dentatum* (FH, BPI); Cassel, on *Quercus*, C. Grabe 1872 (BPI); Sydow, Mycoth. Germ. 1249, on *Q. pedunculata*, Lothringen (FH); Sydow, Mycoth. Germ. 2367, on *Mahonia*, (as *C. coronatus*) (FH); Herb. Barb. Boiss. 1011 & F. Rhen. 1090, Nassau, auf *Castanea* & *Quercus*, Fuckel (FH, BPI); Bayreuth, 4.1875, on *Q. rubra* (FH). CZECHOSLOVAKIA: De Thuem., F. Austriaci 973, Bohemia, on *Fagus* (FH). FRANCE: Contremoulins, Nov. 1872, on *Castanea vesca* (FH-Patouillard). CORSICA: on *Quercus*, Terrier, 13.4.1938 (ZT); on *Q. ilex*, Terrier, 13.4.38 (ZT). BELGIUM: Libert, Pl. Crypt. Ard. IV 368, on *Quercus* (ZT); Liège, Kinkempois, on *Quercus*, leg. E. Morren (LG). ITALY: Saccardo, Mycoth. Ital. 682, on *Quercus*, Novarra, III.1899 (FH); on *Castanea*, Montignoso, Arx, 25.5.48 (ZT). AFRICA. TUNISIA: El Feidja, on *Q. morbeckii*, I. 1893 (FH-Patouillard). ATLANTIC ISLANDS. CANARY ISLANDS: La Palma, on *Myrica faya*, Korf et al., 18.I.1976 (CUP-MM 888). NORTH AMERICA. CANADA. British Columbia: Vancouver, on *Berberis*, Bandoni, 30.III.1960 (BPI). USA. Pennsylvania: Ell. & Ev., N. Am. F. 2057, on *Quercus*, IX.1884 (FH). Virginia: Mansanutten, 26.IX.1932, Davidson (BPI); Airmont, 18.VII.1903, on *Quercus alba*, Shear (BPI). North Carolina: on *Quercus*, Whitewater falls, Shear, 19.VIII.1923 (BPI); on *Q. nigra*, new Bern, Hedgecock, 23.VI.1938 (BPI); on *Q. virens*, Smith Island, 23.VIII.1931, Cash (BPI). Tennessee: on *Q. michauxii*, La Follette, Sharp & Hessler, 7–11–1934 (BPI). Louisiana: on *Quercus*, Langlois, 27.V.1895 & 30.VII.1889 (FH). Florida: Highlands Hammock, on *Quercus*, Shear 118 & 132, 1937 (BPI). Arizona: on *Q. reticulata*, Pima Co., Lindsey 153 (ARIZ). Washington: on *Berberis*, Marysville, Grant, XII.1927 (BPI); on *B. aquifolium*, 1895, Ell. & Ev., N. Am. F. 3336 (BPI, FH); on *Gaultheria shallon*, Orcas Isl., VII.1906 (F). Oregon: on *B. nervosa*, Siskiyou Mts., Haines, 20.X.1968 (NYS); on *Q. vaccinifolia*, Curry Co., Sherwood (FH); on *B. nervosa*, Umatilla Co., Cooke, Mycob. N. Am. 310 (BPI, FH); on *Castanopsis chrysophylla*, Lane Co., Sherwood, 1978 (FH); on *Rhododendron macrophyllum*, Lane Co., Sherwood, 13.VIII.1975 (FH, CUP). Idaho: on *Mahonia repens*, Moscow, IX.1955 (FH). California: on *Lithocarpus densiflora*, Santa Cruz, Bonar, 24.VI.1955 (BPI); on *Q. agrifolia*, Solano Co. Bonar, 7.II.1964 (BPI); on *Q. kelloggii*, Lake Co., Bonar, 15.V.1943 (FH); on *Arbutus menziesii*, Marin Co. (BPI, CUP 47382); on *R. californicum*, Parks, II.1943, Calif. F. 1011 (FH); on *Gaultheria shallon*, Trinidad, Shear, 7.VI.1939 (BPI). CENTRAL AMERICA. PANAMA: Prov. Chiriqui, Dumont & Carpenter, 2.VII.1978 (NY-Pa 1729). SOUTH AMERICA. VENEZUELA: Edo. Merida, on *Clusia*? Dumont et al., 23.VII.1971 (NY-Ve 2792); Edo. Merida, Dumont et al., 20.VII.1971 (NY-Ve 2563). COLOMBIA: Putumayo, Dumont et al., 26.I.1976 (NY-Co 3646); on *Macleania*,

[5] When more than one specimen on the same host from the same general locality was examined, only one has been cited.

Cundinamarca, Dumont et al. (NY-Co 283). BRASIL: São Leopoldo, Rio Grande do Sul, Theiss., Dec. Fung. Brasil. 135, Rick, 1908, presumed isotype of *Coccomyces bromeliacearum* (FH); Apiahy, s/*Pteridium*?, 1890 leg. J. Puiggari no. 2107, holotype of *C. filicicola* (LPS 28187).

30. *Coccomyces dentatus* (Kunze & Schm. ex Fr.) Sacc. var. *hexagonus* Penz. & Sacc., Malphigia **15:** 222 (1901).

No specimen of this variety is deposited in Saccardo's herbarium (PAD), and Penzig's herbarium was destroyed during World War II. The disposition of the taxon cannot be determined from the original description. The name has been applied to large specimens of *Coccomyces dentatus* with regular, hexagonal apothecia from the western U.S.

31. *Coccomyces dentatus* var. *lauri* Rehm. See *C. dentatus*.

32. *Coccomyces dianthi* (Fuckel) Rehm, Rabenh., Krypt.-Fl. ed. 2, **1**(3): 79 (1888).
≡ *Phacidium dianthi* Fuckel, Jahrb. Nassauischen Veriens Naturk. **23-24:** 262 (1870).

This species is not a *Coccomyces* and appears to be dermateaceous rather than rhytismataceous. It is characterized by short broad asci 65 × 14 μm, with a pronounced J+ apical ring, and 8 unicellular or 1-septate inequilateral ascospores 15 × 5 μm. It may be a member of the Naevioideae, but does not correspond to any of the taxa discussed by Hein (1976). The specimen of this species in the Farlow Herbarium contains no asci, but rather fruitbodies similar in external appearance but containing long falcate conidia, possibly the imperfect stage of the species.

Specimens examined: EUROPE. GERMANY: Herbier Barbey-Boissier 1012 (= Fungi Rhenani 1091), an dürren Stengeln von *Dianthus carthusiana*, selten, in Frühling, Budenbremenwalk, Oestrich (Nassau) leg. Fuckel, isotype of *Phacidium dianthi* (FH, BPI); P. Vogel, Tamsel, 24.9.1937 (FH).

33. *Coccomyces dubius* Rehm, Leafl. Philipp. Bot. **8:** 2926 (1916). Figure 20
= *Schizochora elmeri* Sydow, Ann. Mycol. **11:** 265 (1913).

The type specimen of *Coccomyces dubius* consists of flattened, subcuticular stromata containing a few small perithecia. The asci are clavate, stalked, J−, uniformly thin-walled, 8-spored, and occur intermingled with paraphyses. The ascospores are hyaline, ca. 30 × 3 μm, nonseptate, and bear a filiform appendage at each end.

This is surely not a *Coccomyces* and seems to be a synonym of *Schizochora elmeri* (Polystigmataceae) which also occurs on leaves of *Ficus* in the Philippines, and was redescribed by von Arx and Müller (1954).

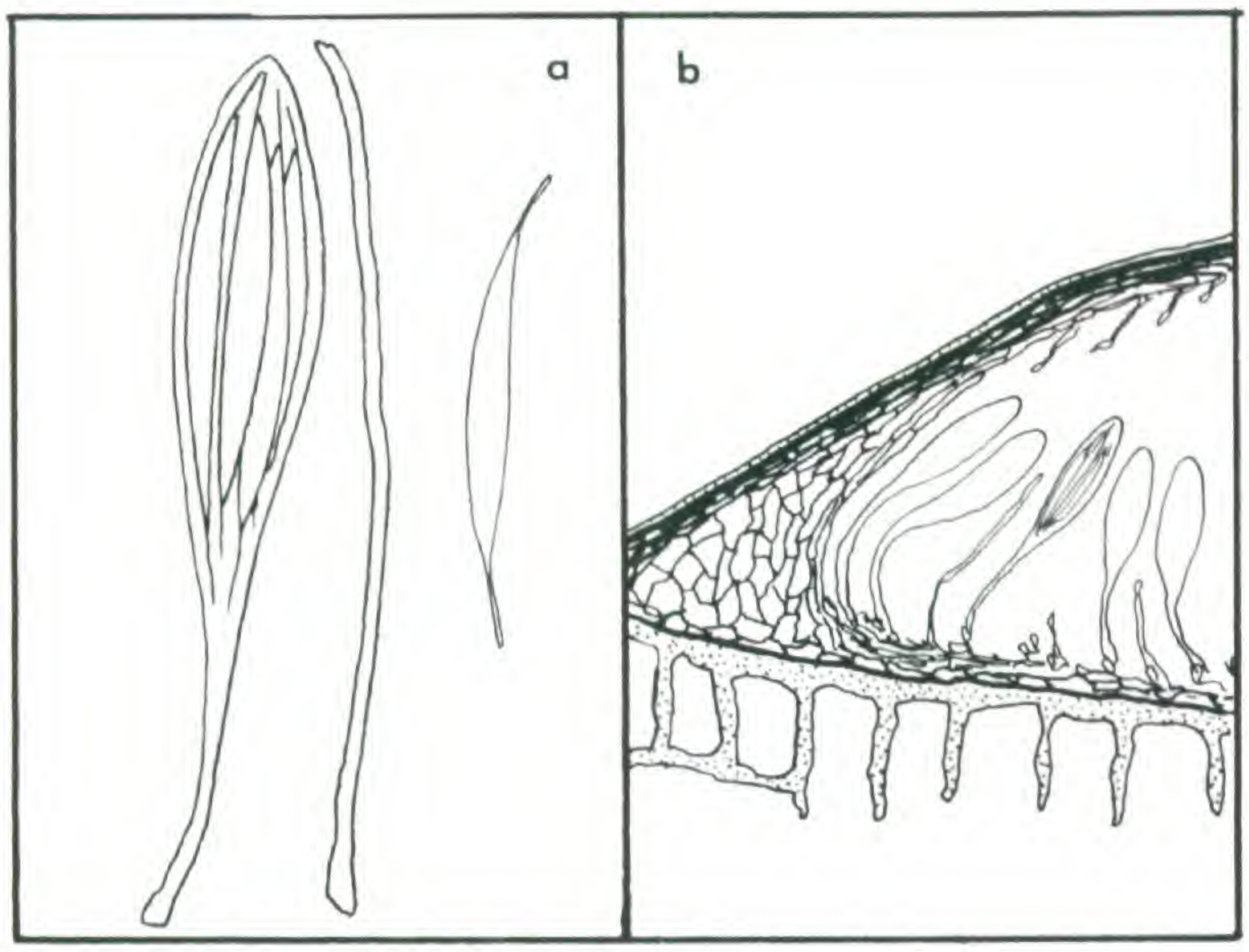

FIG. 20. *Schizochora elmeri (Coccomyces dubius):*—a. ascus, paraphyses, and spores, ×750.—b. cross section of ascocarp, ×225. Drawn from Baker, Fungi Malayani 128 (S).

Specimen examined: ASIA. PHILIPPINES: Baker, Fungi Malayana 128, on *Ficus minahassae,* Mt. Maquiling, Los Baños, May, 1914 (S, herb. Rehm, holotype; PC, FH).

34. **Coccomyces duplicarioides** Sherwood, spec. nov. Figure 21

Ascocarpi primo immersi, orbiculati, 0.2–0.3 mm diam, per lacinias irregulariter aperientes, in macula pallida stromate non obvallato insidentes. Margo superior stromatica 40 μm crassa, ex hyphis intertextis brunneis constata. Periphysoidei nulli. Margo inferior stromatica 10–15 μm crassa, ex hyphis carbonaceis constata. Excipulum nullum. Paraphyses filiformes, circinatae, apice non incrassatae, in epithecio gelatinoso non inclusae. Asci 150–200 × 12–15 μm, clavati, pedicellati, 8-spori, in iodo non caerulescentes; sporis filiformibus, continuis, in tunica gelatinosa inclusis, 45–63 × 1.5 μm. In foliis emortuis *Andromedae polifoliae,* Magadan region, USSR.

Holotypus: TAA, on *Andromeda polifolia,* Magadan Region, distr. Tenkinski, Kontakt Field Station, USSR, 5.IV.1975, leg. Lar. Vasiljeva. Isotypus: FH.

Etymology: from *Duplicaria,* a genus which this species resembles in its external appearance and apothecial structure.

Apothecia subcuticular in bleached spots not surrounded by a line on dead leaves, orbicular, black, shining, 0.2–0.3 mm diam, without a preformed dehiscence mechanism, opening irregularly by teeth. Covering layer 40 μm thick, the outer surface consisting of interwoven brown noncarbonized hyphae 5 μm diam, lined on the inner face by a matrix of interwoven, nearly colorless hyphae with a cell lumen 1.5 μm diam and very thick gelatinizing walls. Basal stroma 10–15 μm thick, of nongelatinous carbonized hyphae 3–5 μm diam, separated from the subhymenium by 75 μm of colorless, vertically oriented hyphae widely spaced in a gel. Excipulum absent. Subhymenium colorless, 15 μm thick. Asci 150–200 × 12–15 μm, long-stalked, clavate,

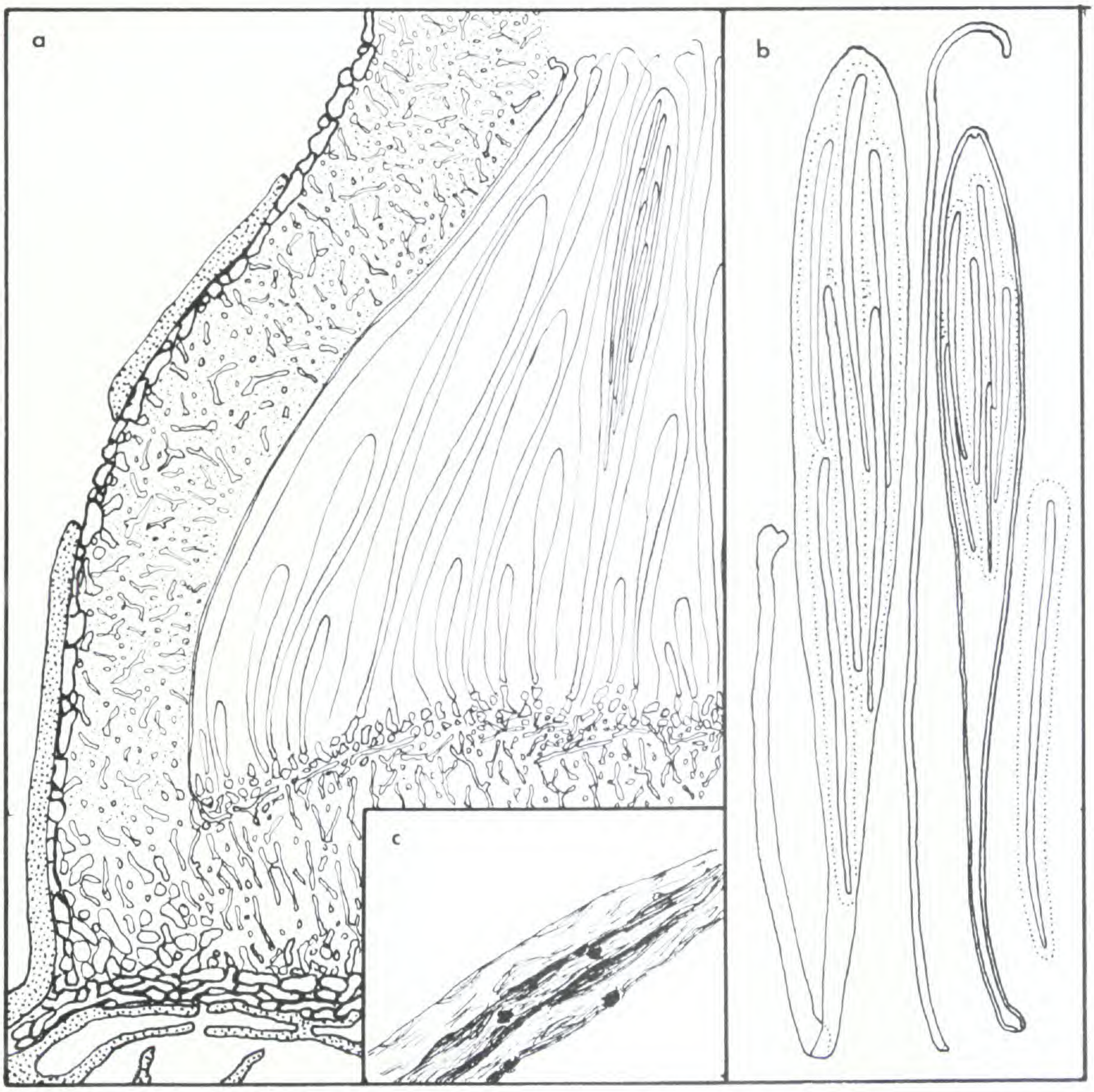

FIG. 21. *Coccomyces duplicarioides:*—a. cross section of margin, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

J−, 8-spored. Paraphyses colorless, 1–1.5 μm broad, circinate, not enlarged above or immersed in a gel. Ascospores 52–63 × 1.5 μm, filiform, nonseptate, tapering slightly below, prominently sheathed. Pycnidia not seen.

On dead leaves of *Andromeda polifolia*, Magadan Region, eastern USSR. The distribution of this inconspicuous species is unknown; it should be sought elsewhere on its widely distributed host. *Duplicaria empetri* (Fr.) Fuckel is similar in external appearance and ascocarp structure, but has bifusiform ascospores.

35. *Coccomyces epiphyllus* Velen. See *C. coronatus*.

36. *Coccomyces ericae* Dennis & Spooner, Kew Bull. **32:** 113 (1977).
Figure 22

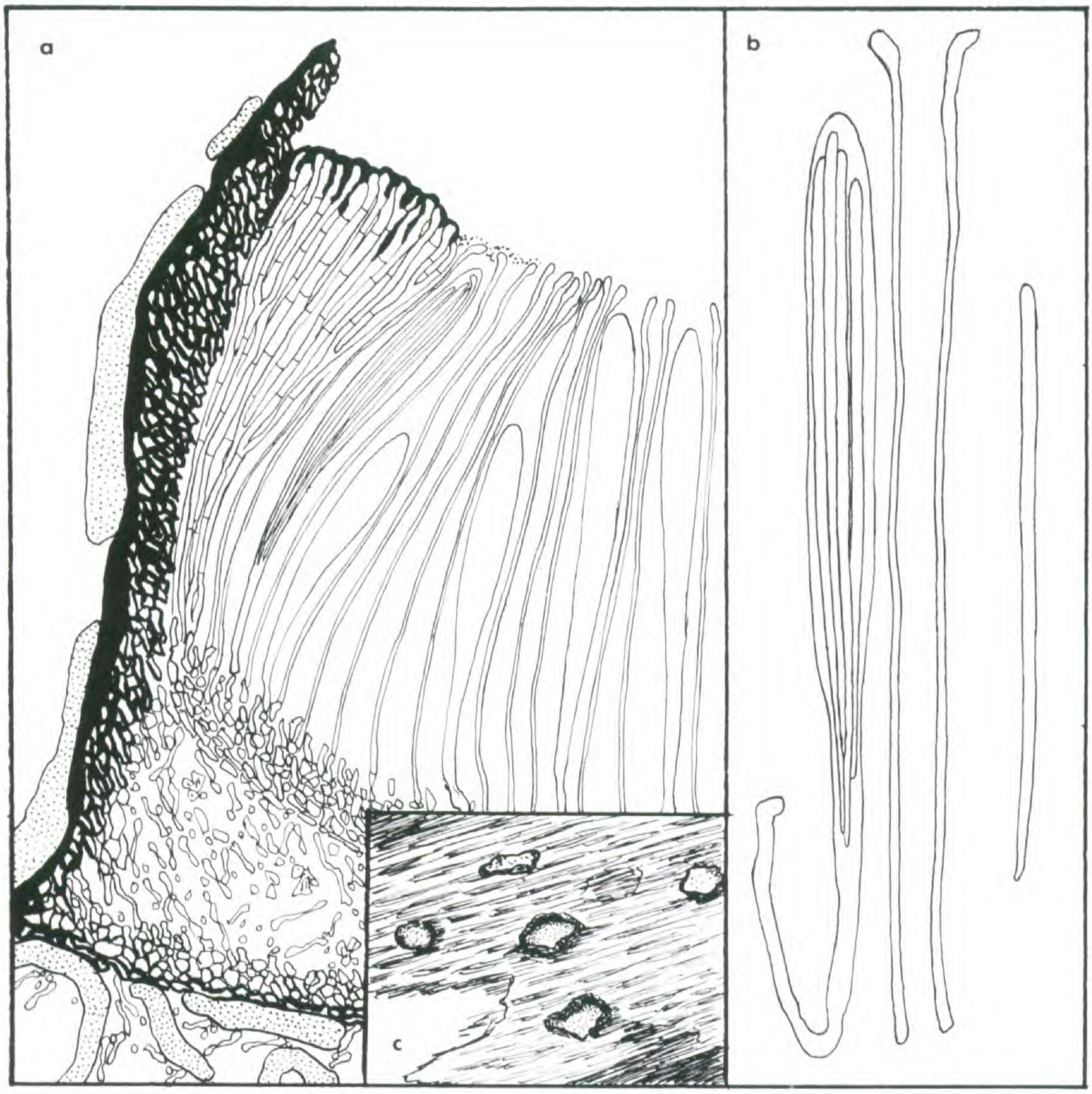

FIG. 22. *Coccomyces ericae:*—a. cross section of apothecium, ×375.—b. ascus, paraphysis, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

Apothecia scattered on decorticated wood, not forming confluent crusts, black, orbicular or somewhat elongate, 0.5–1.0 mm diam, without a preformed dehiscence mechanism, splitting open irregularly to expose the yellowish-orange disc. Covering stroma ca. 20 μm thick, heavily carbonized, of vertically oriented hyphae. Lower stroma 10–15 μm thick, heavily carbonized, of globose cells 4–6 μm diam, separated from the hymenium by a hyaline subiculum interspersed with a few crystals. Subhymenium colorless, 25 μm thick. Proper exciple well-developed, ca. 40 μm thick, the hyphae 2.5 μm diam, closely septate, carbonized above. Asci clavate, rather long-stalked, 125–150 × 8–10 μm, J−, 8-spored. Paraphyses filiform, enlarged to 2.5 μm at the apex, interspersed with brownish amorphous material. Ascospores 60–100 × 2.0 μm, nonseptate, not prominently sheathed.

On decorticated wood of *Erica azorica*, Azores, known only from the type specimen.

Specimen examined: ATLANTIC ISLANDS, AZORES: on *Erica azorica*, Caldesia road, above Flamengos, Faial, 23.3.1975, leg. R. W. G. Dennis, holotype of *Coccomyces ericae* (K).

37. **Coccomyces farlowii** Sherwood, spec. nov. Figure 23

Ascocarpi primo immersi, dein erumpentes, tetragoni vel hexagoni vel irregulariter orbiculati, 0.5–1.0 mm diam, per lacinias 4–6 aperientes, in macula pallida stromate obvallato insidentes. Margo superior stromatica 5–10 µm crassa, ex hyphis carbonaceis constata. Periphysoidaei nulli. Margo inferior stromatica 30 µm crassa, ex hyphis intertextis carbonaceis constata. Excipulum brunneum. Paraphyses filiformes, apice ad 3–5 µm incrassatae, achromae, in epithecio gelatinoso non inclusae. Asci 115–130 × 10–12.5 µm, cylindrici-clavati, haud pedicellati, 8-spori, in iodo non caerulescentes; sporis filiformibus, continuis, in tunica gelatinosa inclusis, 60–75 × 2.0 µm. In foliis dejectis *Quercus rubrae*, Massachusetts, USA.

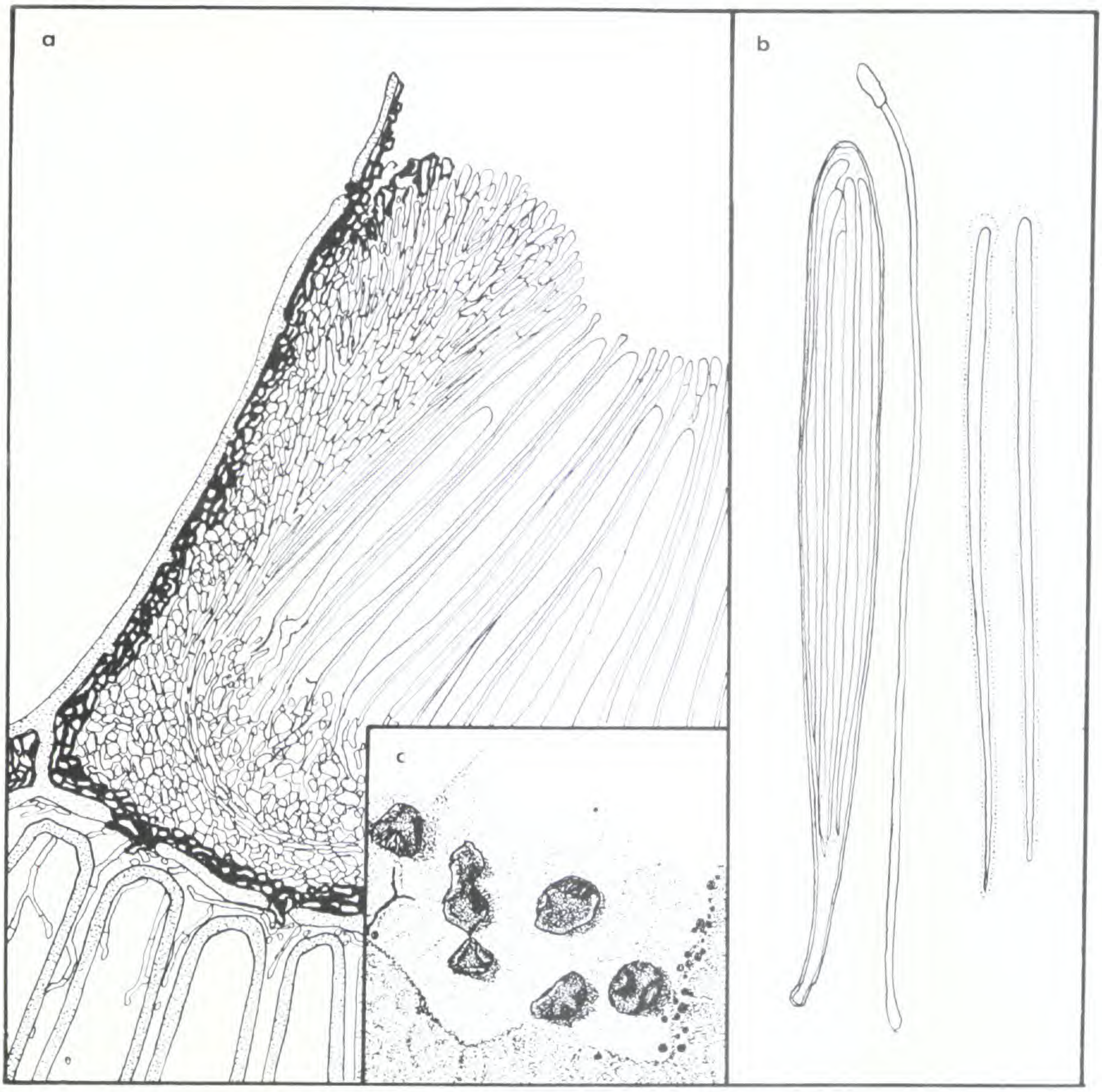

FIG. 23. *Coccomyces farlowii*:—a. cross section of apothecium, ×375.—b. ascus, paraphysis, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

Holotypus: FH, on fallen leaves of *Quercus*, Estabrook Woods, Concord, Mass., M. A. Sherwood 9/25/1977.

Etymology: farlowii, after W. G. Farlow, cryptogamic botanist at Harvard University.

Apothecia intraepidermal, at first immersed, dark brown, shining, orbicular to polygonal or irregular in outline, in bleached spots bounded by a line stroma on dead leaves, 0.5–1.0 mm diam, without a preformed dehiscence mechanism, opening by 3–6 teeth to expose the olivaceous hymenium, the teeth becoming reflexed, the hymenium remaining exposed when dry. Covering stroma 5–10 µm thick, heavily carbonized, devoid of internal differentiation; periphysoids absent. Lower stroma 30 µm thick, the basal part heavily carbonized, merging above into a layer of lighter brown cells 3–5 µm diam. Excipulum well-developed, up to 75 µm thick, of closely septate hyphae 3–4 µm diam, faintly brownish above. Subhymenium colorless, 40 µm thick. Paraphyses filiform, gradually expanded to 3–5 µm at the apex, not agglutinated at the apex. Asci cylindric-clavate, short-stalked, J−, 8-spored. Ascospores 60–75 × 2.0 µm, nonseptate, narrowly sheathed.

On fallen leaves of *Quercus rubra*, autumn, on leaves of the previous year, Concord, Massachusetts, USA. The dimensions of the hymenial elements match *Coccomyces coronatus*, but the external aspect of the two species is quite different. *Coccomyces coronatus* has larger apothecia which open very irregularly, an orange disc, somewhat longer asci and spores, and characteristic agglutinated paraphyses which form an epithecium. *Coccomyces farlowii* can further be distinguished from *C. coronatus* and *C. dentatus* by the presence of an excipulum and a hymenium which remains exposed when dry.

Specimen examined (see also holotype, above): North America. USA: Concord, Mass., on *Quercus rubra*, D. Pfister, 17.IX.1978.

38. *Coccomyces filicicola* Speg. See *C. dentatus*.

39. *Coccomyces fimbriatus* (Schm. ex Fr.) Quélet, Euchirid. Fung. 338 (1886).
≡ [*Phacidium fimbriatum* Schm., Myc. Heft **1:** 39 (1817)] ex Fr., Syst. Mycol. **2**(2)**:** 578 (1823).

According to the original description the species occurred on leaves of *Populus* and resembled *C. coronatus*, but with smaller fruitbodies and a white (turning grey) hymenium. I am unable to locate any original material of this species, and cannot characterize it from the original description. It may be a synonym of *C. tumidus*, which occurs on this host.

40. **Coccomyces foliicola** (Dennis & Spooner) Sherwood, comb. nov. Figure 24

≡ *Coccomyces boydii* A. L. Smith f. *foliicola* Dennis & Spooner, Kew Bull. **32:** 111 (1977).

Apothecia intraepidermal in bleached spots bounded by a line stroma on dead leaves, circular or quadrangular, 0.7–1.0 mm diam, opening along indistinct, paler preformed lines of dehiscence to expose the yellowish hymenium. Covering stroma 25 μm thick, of slightly carbonized cells 3–5 μm diam, paler toward the periphery of the stroma, without periphysoids. Basal stroma 10–15 μm thick, the cells 5–8 μm diam, slightly carbonized. Excipulum absent. Subhymenium colorless, 15 μm thick. Paraphyses filiform, enlarged to 4.0 μm at

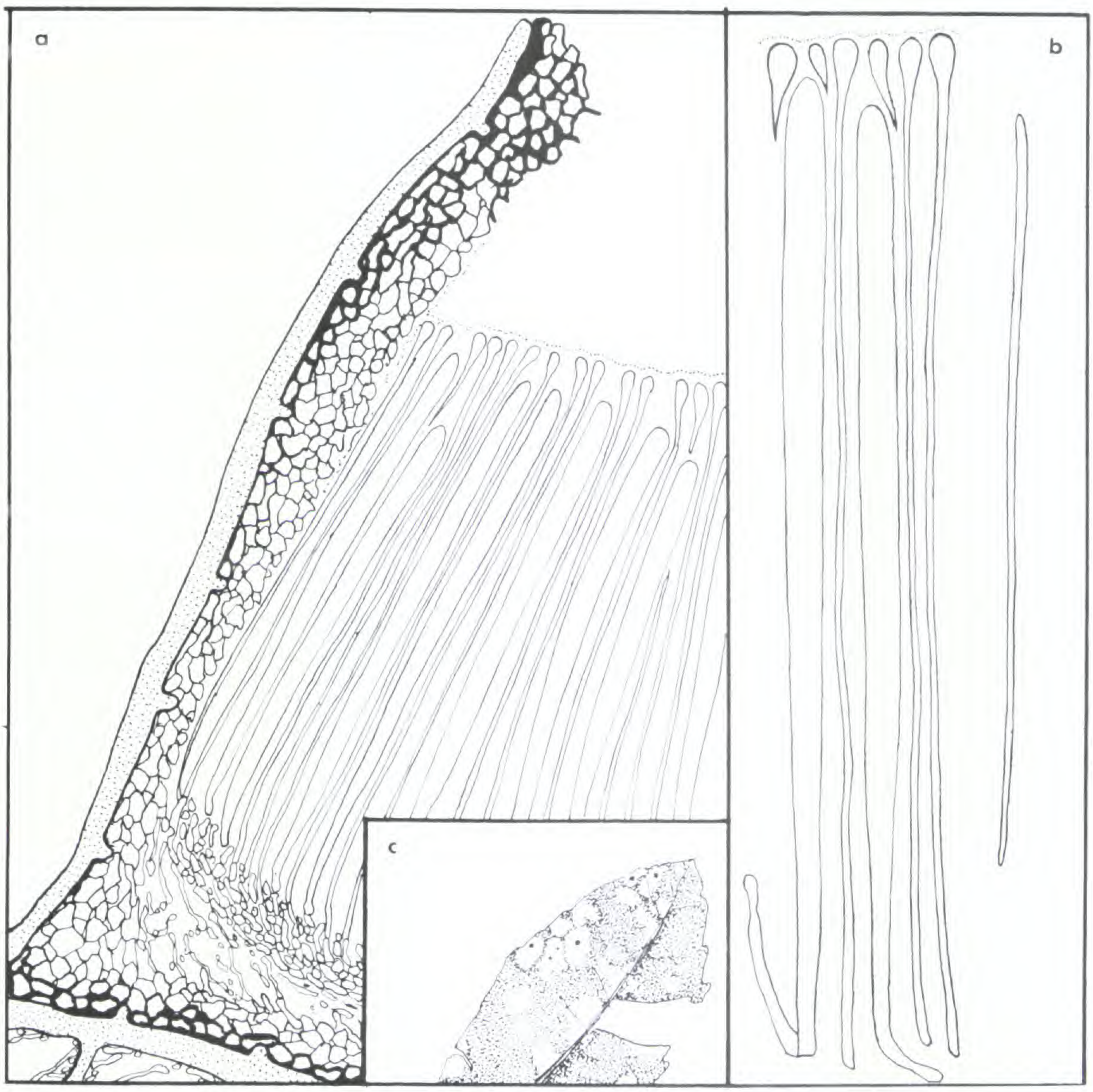

FIG. 24. *Coccomyces foliicola:*—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, approximately natural size. Drawn from the holotype.

the apex, cemented in a gel, forming an epithecium. Asci cylindrical, short-stalked, 135–170 × 6.5 μm, J−, 8-spored. Ascospores 90–120 × 1.0 μm, nonseptate, not obviously sheathed.

On fallen leaves of *Myrica faya,* Azores. Dennis and Spooner (l.c.) give somewhat shorter dimensions for the asci. The material which I examined appeared mostly immature. In their comments they remark "*Coccomyces boydii* was described on bark and twigs of *Myrica gale* in Perthshire, with rather shorter ascospores. Until there is a critical revision of *Coccomyces* it seems best to treat the Azores collection as a foliicolous form of this." *Coccomyces foliicola* differs from *C. boydii* not only in ascospore dimensions, but also in the preformed dehiscence mechanism of the stroma and the inflated paraphyses forming an epithecium. It is close to *C. leptosporus,* but lacks an excipulum. In general, a species of *Coccomyces* is less likely to grow on leaves and twigs of the same host than it is to grow on leaves of ecologically similar but taxonomically unrelated hosts.

Specimen Examined: ATLANTIC ISLANDS. AZORES: on *Myrica faya,* Terceira de Macela, Terceira, 26.3.1975, holotype of *C. boydii* f. *foliicola* (K).

41. *Coccomyces heterophyllae* Funk, Canad. J. Bot. **45:** 2263 (1967) [1968]. Figure 25

Apothecia intracortical, becoming erumpent, orbicular, polyhedral, or slightly elongate, 0.5–1.1 mm diam, black, pulvinate, without an obvious preformed dehiscence mechanism, splitting open irregularly to expose the pale yellow hymenium, solitary or becoming confluent but not immersed in swarms under a common black stromatic crust. Covering layer 40–50 μm thick, of globose dark brown cells 3 μm diam, barely carbonized on the exterior, without a defined periphysoidal layer. Excipulum absent. Basal stroma poorly developed. Subhymenium 75–120 μm thick, of loosely consolidated somewhat gelatinous, nodulose hyphae. Paraphyses filiform, 1.0 μm broad, circinate, sometimes branched. Asci clavate, long-stalked, 75–140 × 8–10 μm, 8-spored; ascospores 19–27 × 1.5–2 μm (but see comments, below). Pycnidia not produced.

On twigs of *Tsuga heterophylla* in the coastal forests of British Columbia and Washington, spring and summer, possibly weakly parasitic but more common as a secondary invader on branches killed by other fungi, according to Funk (1967).

Funk (1967) reported that he was unable to find the species in central British Columbia. I have collected two specimens in the Cascade Mountains in Oregon which may represent this species but differ significantly in their ascospore characters. One, on *Tsuga heterophylla* from Wildcat Mt. (elev. 4000 ft) has ascospores 17.5–22 × 4.5–5.5 μm. The other, on *Tsuga mertensiana* from the same area

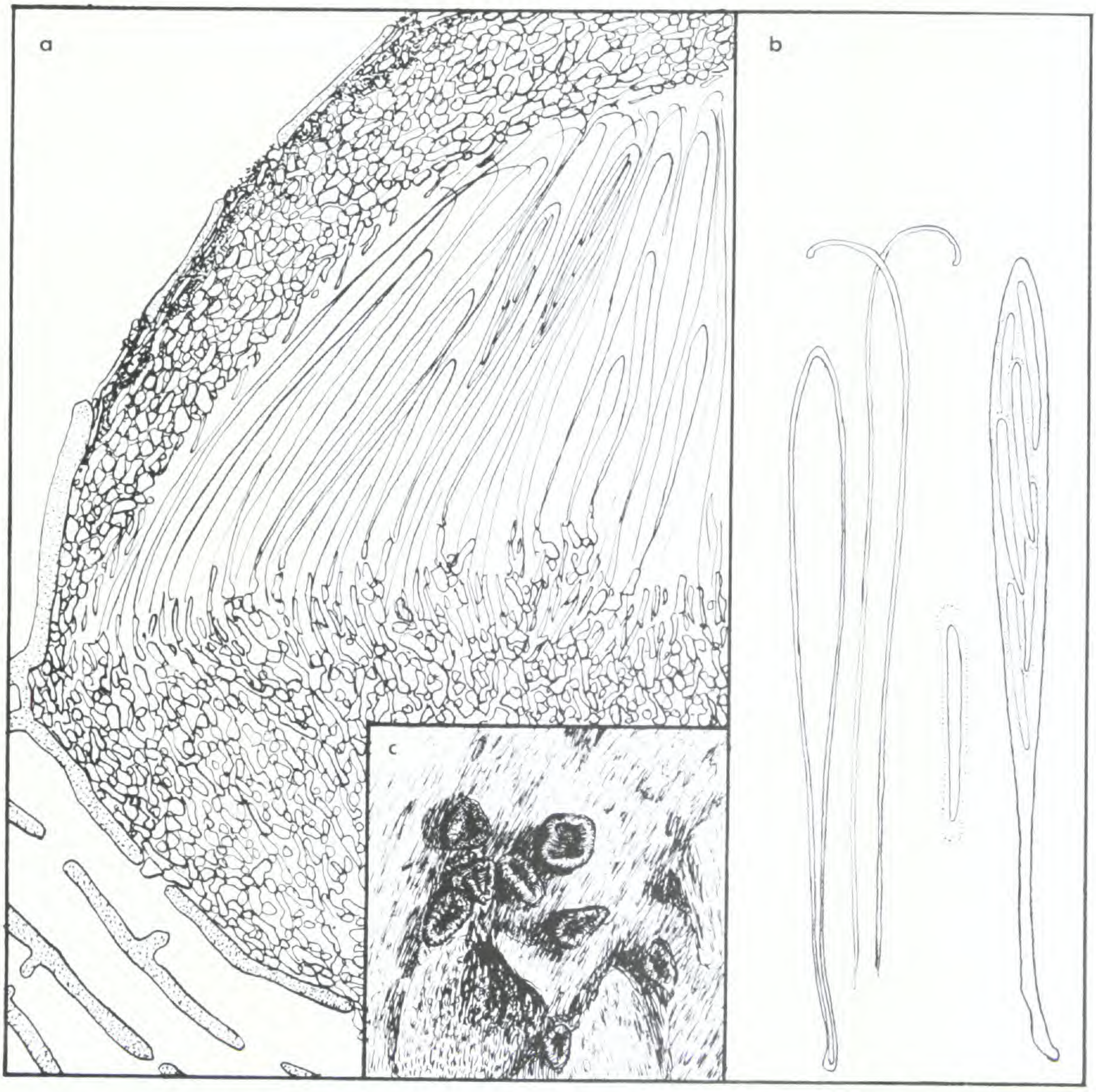

FIG. 25. *Coccomyces heterophyllae:*—a. cross section of margin, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

(elev. 5200 ft) has ascospores 25–35 × 2.5–3 μm. Additional collections and cultural studies would be desirable to determine whether or not these represent distinct species, infraspecific taxa, or ecological variants.

Specimens examined: NORTH AMERICA. CANADA. British Columbia: on *Tsuga heterophylla*, Courtenay, Victoria Island, A. T. Foster, May 1, 1962, holotype of *C. heterophyllae* (DAVFP 17300). USA. Oregon: Linn Co., Wildcat Mt., on *Tsuga heterophylla*, Sherwood & Pike, 18.VIII.1978 (FH); on *T. mertensiana*, *ibid.* (FH).

42. *Coccomyces hiemalis* Higgins, Science n.s. **37**: 637–638 (1913).
≡ *Higginsia hiemalis* (Higgins) Nannf., Nova Acta Regiae Soc. Sci. Upsal. IV, **8**(2): 175 (1932).
= *Blumeriella jaapii* (Rehm) Arx, Phytopathol. Z. **42**: 164 (1961).

According to Nannfeldt (1932), Arx (1961) and Korf (1973), this is a member of the Dermateaceae unrelated to *Coccomyces*.

Specimen examined: EUROPE. GERMANY: Rehm, Ascomyceten 1727, auf Blättern von *Prunus padus*, Oldesloe, Schleswig-Holstein, V/1907, leg. O. Jaap, isotype of *Pseudopeziza jaapii* (FH).

43. *Coccomyces insignis* Karst., Meddel. Soc. Flora Fauna Fennica **16:** 16 (1888).

Apothecia scattered, oblong-ellipsoid, at first closed, subcuticular, black, fleshy, opening by a longitudinal slit, 1 mm diam, the disc pallid. Asci 215–240 × 21–30 μm, clavate, long-stalked, uniformly thin-walled; ascospores 8, 180 × 1.5–2.0 (–3.0 fide Karsten) μm, colorless, very prominently sheathed, nonseptate. Paraphyses filiform, branched, noncircinate, 1.5–2.0 μm diam.

On leaves of *Carex pauciflora*, Mustiala, Finland. As the species is known only from a fragmentary collection containing a single apothecium I am unable to supply microanatomical details of the construction of the apothecial stroma. The species is clearly rhytismataceous, but its generic placement is unclear. The subcuticular, fleshy ascocarps opening by a longitudinal slit are reminiscent of certain forms of *Coccomyces tumidus*. It would be desirable to recollect *C. insignis*.

Specimen examined: EUROPE. FINLAND: Tavastia australis, Tammela, Salois (= Mustiala N.) in *Caric. paucifl.*, IX.1887, leg. & det. P. A. Karsten, authentic (H, herb. Karsten).

44. **Coccomyces irretitus** Sherwood, spec. nov. Figure 26

Ascocarpi primo immersi, dein erumpentes, orbiculati vel irregulariter elongati, 1–1.8 μm diam, per lacinias irregulariter aperientes, in macula pallida non insidentes. Margo superior stromatica 50 μm crassa, ex hyphis intertextis carbonaceis constata. Periphysoidei hyalini, reticulati, 200 μm longi. Margo inferior stromatica 20 μm crassa, ex hyphis brunneis constata. Excipulum nullum. Paraphyses filiformes, haud circinatae, apice non incrassatae. Asci 130–140 × 11 μm, clavati, pedicellati, 8-spori, in iodo non caerulescentes; sporis filliformibus, continuis, in tunica gelatinosa inclusis, 45–55 × 1.0 μm. In ramis emortuis *Pini, Abietis, Piceae* et *Laricis*, Amer. Bor.

Holotypus: FH-Phacidiales Exsiccati 29, on bark of *Picea* sp., Seal Cove Road, Acadia National Park, Mt. Desert Island, Maine, 16.VI.1979, leg. M. A. Sherwood.

Etymology: irretitus (L), surrounded by a net, referring to the distinctive reticulate periphysoids.

Apothecia at first immersed, intracortical, becoming erumpent and at length nearly superficial, orbicular to irregularly elongate, 1–1.8 mm diam, black, pulvinate, without a preformed dehiscence mechanism, splitting open irregularly by teeth, not surrounded by a bleached area of bark or developing beneath a common stromatic crust. Covering layer 50 μm thick, of heavily carbonized, disintegrating cells mixed

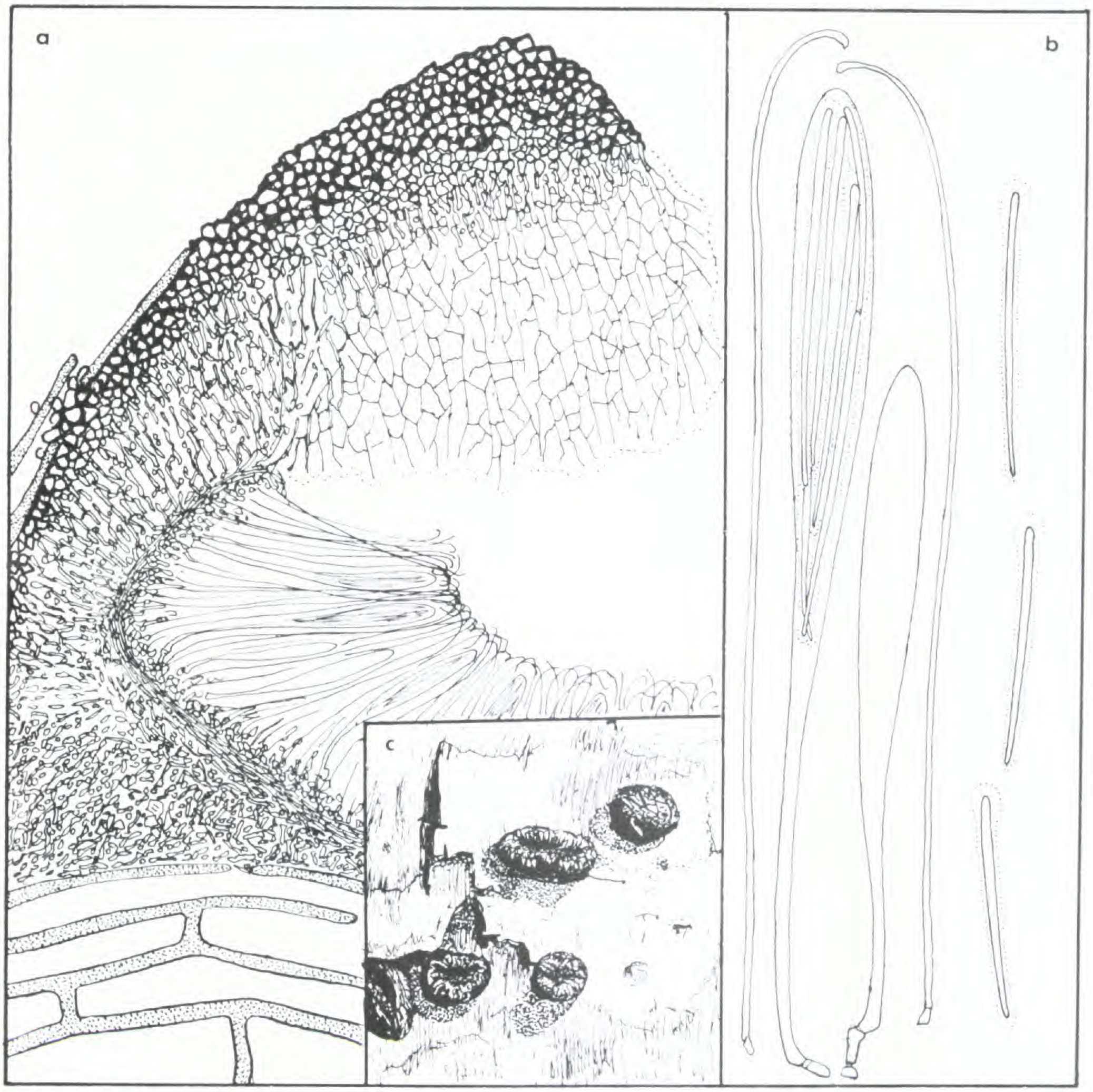

FIG. 26. *Coccomyces irretitus*:—a. cross section of apothecium, ×225.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from FH-Thaxter 252.

with host tissue, lined on the inside with 200 μm of branched and netlike interwoven colorless periphysoids immersed in a gel, merging at the periphery of the stroma with vertically oriented, nodulose hyphae 2–3 μm diam, intermingled with a few scattered crystals. Lower stroma 20 μm thick, of brown, noncarbonized cells 2–3 μm diam. Subhymenium colorless, 20 μm thick. Asci clavate, long-stalked, 130–140 × 11 μm, thin-walled, J−, 8-spored. Paraphyses filiform, weakly circinate, not enlarged above, colorless, not forming an epithecium. Ascospores 45–55 × 1.0 μm, distinctly sheathed.

On corticate branches of a variety of conifers, eastern North America, frequent. Not to be confused with *Therrya fuckelii*, which occurs on the same hosts, but has septate ascospores and a brown epithecium. The hymenial elements of *Coccomyces pseudotsugae* are similar, but the structure of the margin is entirely different. This is almost certainly

the same fungus to which Reid and Cain (1961) refer when they mention a specimen (#2082) collected by Wehmeyer in Colchester Co., Nova Scotia, identified as *C. cembrae* but representing a distinct, undescribed species of *Coccomyces* which they declined to describe from the scanty material they had on hand.

Specimens examined (see also holotype, above): NORTH AMERICA. CANADA. Nova Scotia: Wehmeyer 1004, on *Larix laricina*, upper Brookside, Colchester Co., 13.VII. 1931 (MICH). USA. New Hampshire: on *Pinus resinosa*?, Shelburne, VI.1894, Thaxter (FH); *ibid.*, VI.1899. R.T. #252 (FH); on *Abies nigra*, Lake Pennigewasset, VII.1895, Farlow (FH); on *Picea negra* vel *Pinus resinosa*, Shelburne, VI.1894 (FH); on *Picea*, Tuckerman's ravine, Sherwood & Kneiper, VII.1978 (FH). North Carolina: Indian Gap, 10.VI.1927, on *Picea mariana* (OSC 12012).

45. *Coccomyces javanicus* Sacc. & Sydow, Syll. Fung. **16:** 789 (1902).
= *Coccomyces rhododendri* Rac., Paras. Algen Pilze Javas **3:** 19 (1900), non *C. rhododendri* (Schw.) Sacc. nec *C. rhododendri* Rehm.

I could locate no type or authentic material of this species, which occurred on leaves of *Rhododendron javanicum* in Java, causing bleached lesions bordered by a reddish discolored zone, and having asci 125–140 × 6–7 μm, with spores 1 μm broad. It may be an older name for *C. vilis*. The question of the synonymy and host range of parasitic Asian species of *Coccomyces* needs further investigation.

46. *Coccomyces juniperi* [Karst.] Karst., Bidrag Kännedom Finlands Natur Folk **19:** 254 (1871). Figure 27
[≡ *Phacidium pini* (Alb. & Schw. ex Fr.) Fr. f. *juniperi* Karst., Fungi Fenniae 339 (1866), nom. nud.]
[≡ *Phacidium juniperi* [Karst.] Karst., Not. Soc. Fauna Flora Fenn. **11:** 257 (1870), nom. nud.].
≡ *Clithris juniperi* ([Karst.] ex Karst.) Rehm in Rabenh., Krypt.-Fl. ed. 2, **1**(3): 102 (1888).
≡ *Colpoma juniperi* ([Karst.] ex Karst.) Dennis, Kew Bull. **1957:** 401 (1957).
= *Godronia juniperi* Rostr., Meddel. Grønland **3:** 611 (1891).[6]

Apothecia intracortical, becoming erumpent, 1–3 mm broad, orbicular to irregular in outline, never linear, at most 1.5 times as long as broad, brownish-black, without a preformed dehiscence mechanism, splitting open irregularly to expose the hymenium. Covering layer 90–100 μm thick, with a heavy, black, carbonized crust and internal layer of loosely interwoven brown hyphae 5 μm diam, oriented perpendicular to the surface. Lower stroma absent, replaced by a subiculum of dark hyphae 3 μm diam, merging above into a compact

[6] For other synonyms reported in the literature, see discussion below.

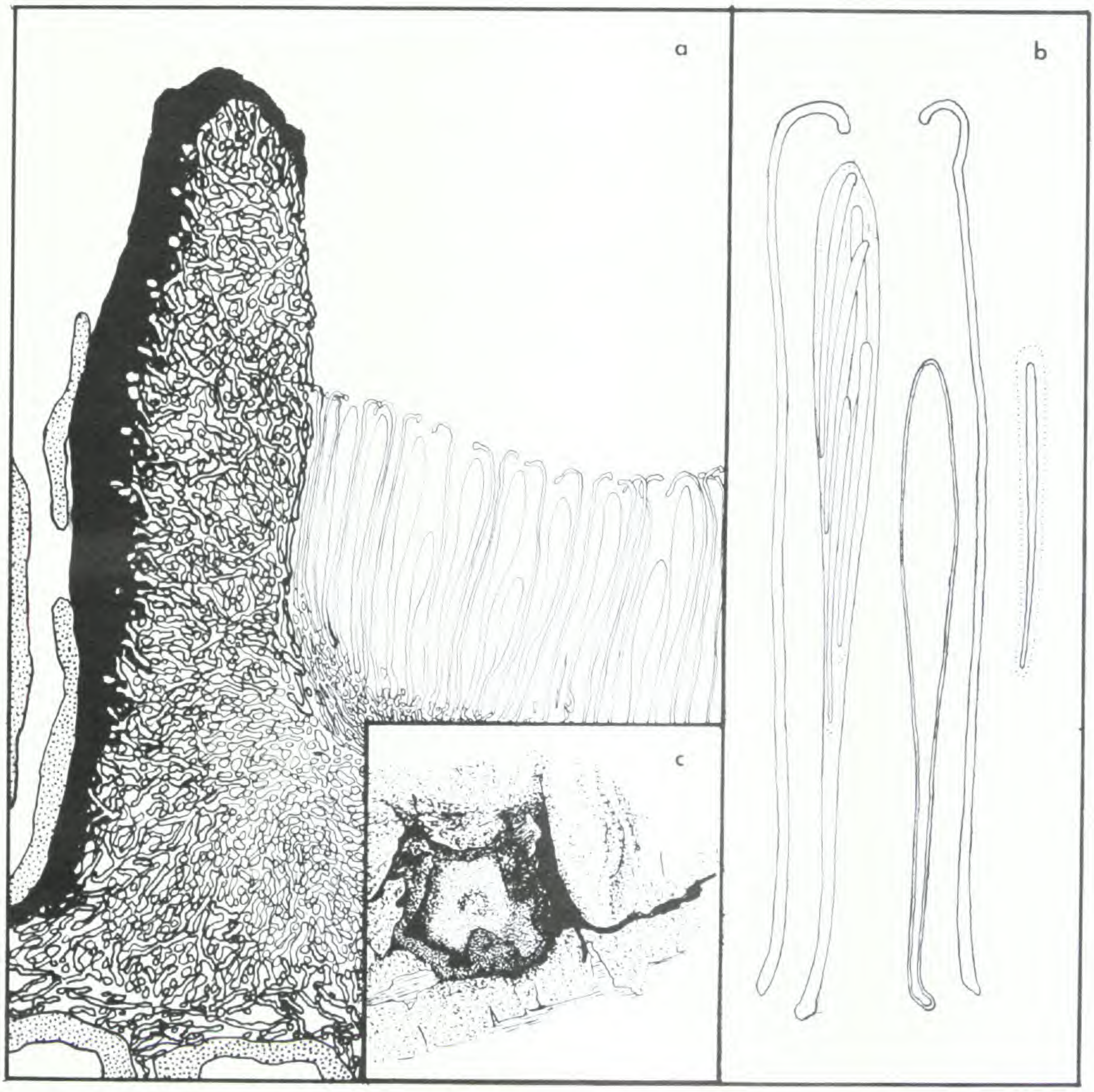

FIG. 27. *Coccomyces juniperi*:—a. cross section of apothecium, ×225.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. (a) and (b) drawn from Rehm, Ascomyceten 272b (MICH); (c) drawn from Poelt specimen (GRZ).

matrix of colorless hyphae 3–5 μm diam. Subhymenium colorless, 40–70 μm thick. Paraphyses filiform, colorless, circinate, often branched, 1.5 μm diam. Asci stalked, clavate, 75–120 × 7.5–9 μm, uniformly thin-walled, J−, 8-spored. Ascospores 40–50 × 1–1.5 (−2) μm, tapering slightly below, nonseptate, distinctly sheathed.

On corticate twigs of *Juniperus communis* subsp. *nana*, Europe. Dennis (1958) noted that the American material to which this name had been applied had larger ascospores than the European material, and questioned the synonymy, widely accepted in the literature, of *Colpoma juniperinum* Cke. and Pk. with *Coccomyces juniperi*. Reports of *C. juniperi* from North America (Ellis & Everhart, 1892; U.S.D.A. Host Index, 1960) appear to be based either on *C. petersii* (q.v.) or *Colpoma* species. *Coccomyces juniperi* is distinguished from *C.*

petersii by its consistently larger apothecia, thicker covering layer, and smaller ascospores, and from *Colpoma* spp., which occur on *Juniperus* (probably *Colpoma crispum* (Pers. ex Fr.) Sacc.), by the lack of a preformed longitudinal slit bordered by distinct lip cells. Notwithstanding that the asci, ascospores, and paraphyses of *Colpoma crispum* and *Coccomyces juniperi* are similar, there is ample evidence against synonymizing the two species, as was done by Holm and Holm (1977). The synonymy with *Godronia juniperi*, also suggested by Holm and Holm is more plausible. I have not examined the type of that species.

Specimens examined: EUROPE. FINLAND: Karsten, Fungi Fenniae 339, Merimasku, a på enbarr, isotype of *Phacidium pini* forma *juniperi* (FH); Inari-Lappland, Kevo, 196–, leg. J. Poelt, (GRZ). COUNTRY UNCERTAIN: Petrak, Mycotheca Carpatica 211, Wetin, VIII.1923 (FH). AUSTRIA: Rehm, Ascomyceten 272, on *Juniperus nana*, Tyrol, 8/1874 (FH, MICH). ITALY: Mycotheca Italica 880, Riva-Valdobbia (Novara), Carestia, 1901 (FH).

47. *Coccomyces kerriae* Stewart, Phytopathology **7:** 405 (1917).
    ≡ *Higginsia kerriae* (Stewart) Nannf., Nova Acta Regiae Soc. Sci. Upsal. ser. 4, **8**(2)**:** 175 (1932).
    ≡ *Blumeriella kerriae* (Stewart) Korf, Phytologia **21:** 202 (1971).

This is a dermateaceous fungus unrelated to *Coccomyces*.

48. *Coccomyces laciniatus* (Alb. & Schw. ex Fr.) Quélet, Enchirid. Fung. 337 (1886).
    ≡ [*Peziza laciniata* Alb. & Schw., Consp. Fung. Nisk. 333 (1805)] ex Fr., Syst. Myc. **2**(1)**:** 113 (1822).
    ≡ *Heterosphaeria laciniata* (Alb. & Schw. ex Fr.) Fr., Summa Veg. Scand. pars post. 365 (1849).
    ≡ *Phacidium laciniatum* (Alb. & Schw. ex Fr.) Fr., Elench. Fung. **2:** 132 (1832).
    ≡ *Coccomyces coronatus* (Schum. ex Fr.) de Not.° *laciniatus* (Alb. & Schw. ex Fr.) Karst., Bidrag Kännedom Finlands Natur Folk **19:** 257 (1871).
    ≡ *Discocainia laciniata* (Alb. & Schw. ex Fr.) Torkels. & Eckbl., Norw. J. Bot. **24:** 137 (1977).

This species has been widely cited as a synonym of *Coccomyces coronatus*. The original illustration, however, shows a stalked apothecium, a character not found in *Coccomyces*. Recently Torkelsen and Eckblad (1977) have suggested a different interpretation based on specimens collected in Norway. Their specimens are a substipitate discomycete on leaves and herbaceous debris, initially entirely enclosed in a black carbonaceous matrix, opening at maturity by irregular teeth, correctly referred to *Discocainia* J. Reid and Funk. This inter-

pretation appears to be in accord with all the available information about the original authors' concept of the species, and should be adopted.

The genus *Discocainia* has generally been considered (J. Reid & Funk, 1966; Korf, 1973; Torkelsen and Eckblad, 1977) to be a member of the Helotiales. Anatomically, however, both the type species, *D. treleasei* (Sacc.) J. Reid and Funk, and *D. laciniata* resemble some of the wood-inhabiting species of *Coccomyces*. Points of similarity include the carbonized, stromatic covering layer splitting radially by means of teeth to expose the hymenium, stalked, clavate, pointed, J− asci of the type characteristic of the Rhytismataceae, and filiform-clavate, sheathed, colorless spores. *Tryblidiopsis* Karst. is similar and probably congeneric. A paper dealing with these fungi is in preparation.

Specimens examined: EUROPE. NORWAY: Rana, Lien N. for Rundfjell, Dissing & Sivertsen, 7/9/1973; Rana, Lasken, Rundfjell, 7/9/1973, Dissing & Sivertsen (TRH).

49. *Coccomyces ledi* Rehm, Ann. Mycol. **11**: 153 (1913). Figure 28

Apothecia intraepidermal, scattered on bleached areas not bounded by a line, on living twigs, 0.4–0.6 mm diam, quadrate to hexagonal, black, shining, opening along light-colored preformed lines of dehiscence. Cover layer 40 μm thick, carbonized above, lined with nearly colorless pseudoparenchyma, with a layer of colorless cells flanking the torn margin of the teeth. Basal stroma 10 μm thick, dark brown, not heavily carbonized, the cells 5 μm diam. Subhymenium colorless, 10–20 μm thick. Paraphyses filiform, enlarged to 2 μm at the apex, slightly bent, colorless. Asci 100–130 × 13–17 μm, clavate, short-stalked, J−, 8-spored. Ascospores 30–38 × 2–2.5 μm, tapered below, with a broad, conspicuous sheath.

On living twigs of *Ledum groenlandicum* and *L. palustre*, late summer and early fall, common in arctic and alpine localities. B. Eriksson (1970) reports it from Finland, Norway, Sweden, and the USSR. Judging from the material in GH it is commoner in the northern part of its range.

Specimens examined: EUROPE. SWEDEN: Västerbotten, leg. Sylvén, isotype of *C. ledi* (S); Micromycetes Rariores selecti, Västerbotten, Kuhlbachsliden, Aug. 1909, leg. Sylvén, isotype of *C. ledi* (S); Västerbotten, Vindeln, B. Eriksson, 24.X.1970 (UME). NORTH AMERICA. CANADA. Manitoba: Nueltin L., 19.VII.1951 (GH); Duck L., 10.VIII.1950 (GH). Northwest Territories: Hay River, Lewis 665 (GH); Athabaska R., Raup 1157 (GH). British Columbia: Ft. Nelson, Raup & Correll 10719 (FH). USA. New Hampshire: King's Ravine, White Mts., VIII.1882 (FH); Mt. Chocoru, 3.IX. 1909 (FH); Shelburne, Farlow, IX.1885 (FH); Tuckerman's Ravine, Sherwood, VII.1978 (FH). Oregon: Lane Co., III.14.1979, Sherwood (FH). ALASKA: Sitka, Bischoff 1865–66 (GH); Kuskowim R., Drury 2206, 22.VII.1949 (GH). ASIA. JAPAN: Mt. Hakkoda, Honda, 25.VI.1950 (GH).

50. *Coccomyces leptideus* ([Fr. ex Fr.]) B. Erikss., Symb. Bot. Upsal. **19**(4): 18 (1970). Figure 29

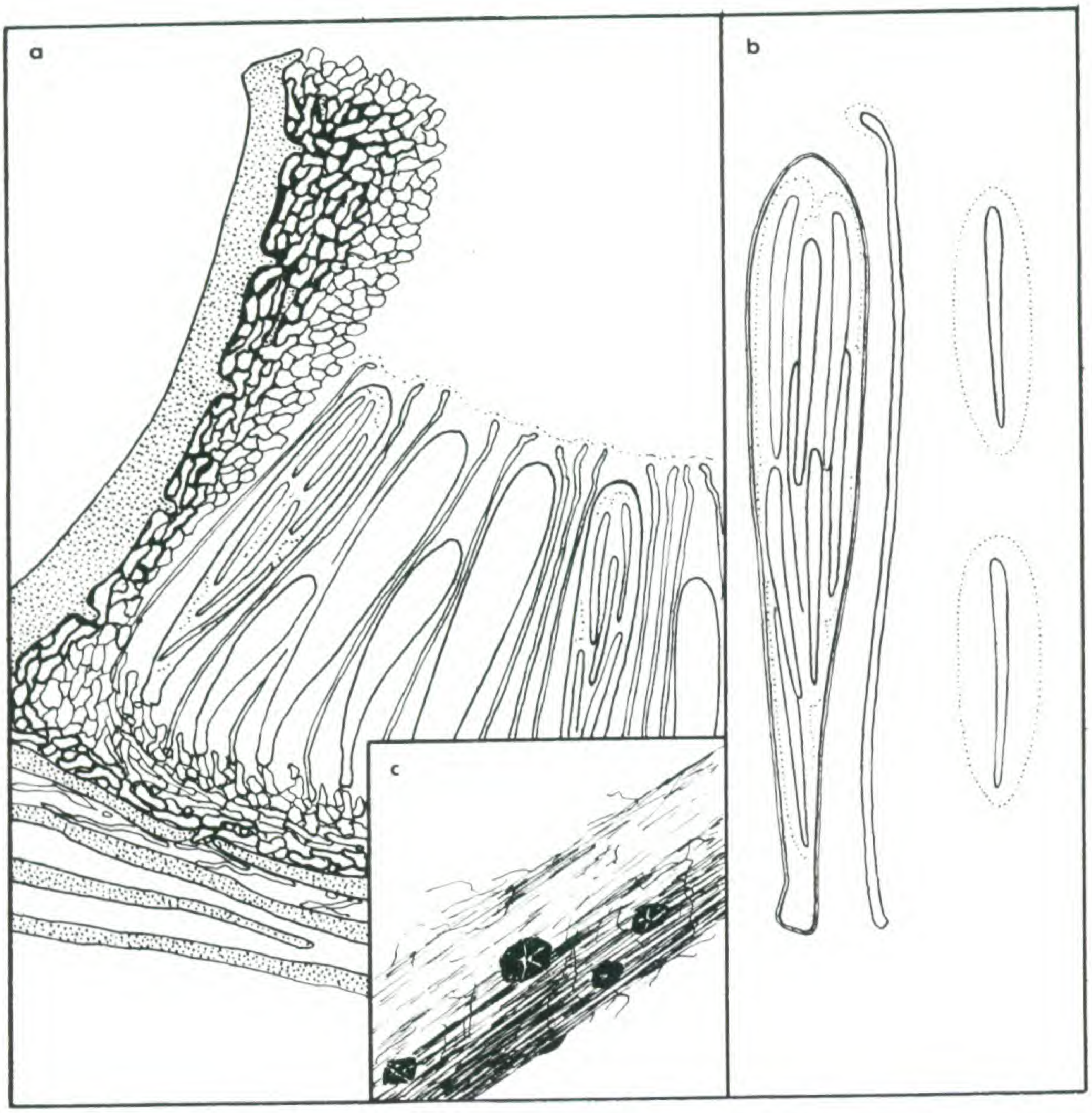

FIG. 28. *Coccomyces ledi*:—a. cross section of apothecium, ×375.—b. ascus, paraphysis, and spores, ×750.—c. habit sketch, ×10. Drawn from Thaxter, Shelburne, NH, specimen (FH).

≡ [*Phacidium leptideum* Fr., Obs. Mycol. 2: 312 (1818)] ex Fr., Syst. [Mycol. **2**(2): 576 (1823).

= [*Phacidium quadratum* Schm. & Kunze, Myc. Hefte **1:** 32 (1817)].

≡ *Coccomyces quadratus* [Schm. & Kunze] Karst., Bidrag Kännedom Finlands Natur Folk **19:** 255 (1871).

≡ *Lophodermium quadratum* [Schm. & Kunze] Ces., Erb. Crittogam. Ital. 885 (1862).

Apothecia scattered in bleached spots on living or recently killed twigs, quadrangular to hexagonal, black, shining, 0.5–1.0 mm diam, opening regularly by teeth along preformed lines of thin-walled, lightly pigmented cells. Covering layer 20–25 μm thick, heavily carbonized, the cells globose, 5–7 μm diam; lower stroma 20–25 μm thick,

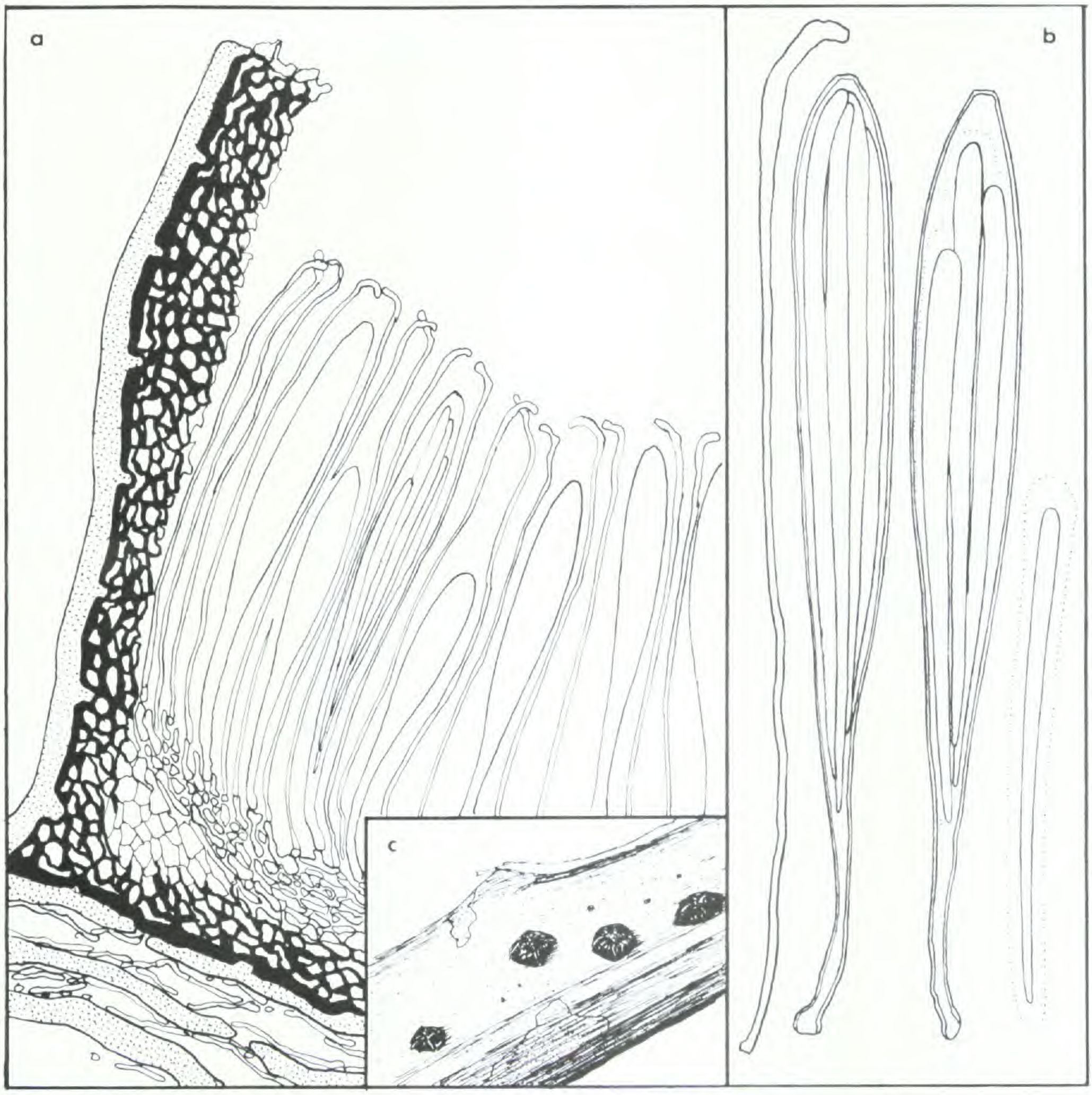

FIG. 29. *Coccomyces leptideus*:—a. cross section of apothecium, ×375.—b. asci, paraphysis, and spores, ×750.—c. habit sketch, ×7.5. Drawn from Müller 19.9.1973 (ZT).

constructed like the covering layer. Subhymenium colorless, 20 μm thick. Asci clavate, long-stalked, 115–140 × 12–15 μm, either 4-spored, with spores 60–90 × 4(−5) μm, or 8-spored, with spores 60–90 × 3.0–3.5 μm; spores prominently sheathed, nonseptate. Paraphyses filiform, enlarged gradually to 3.0–3.5 μm at the apex, curved but not circinate. Pycnidia absent.

On living and recently killed twigs of *Vaccinium myrtillus, V. vitisidaei, Rhododendron macrophyllum*, and *Gaultheria shallon*, summer and fall, Europe and western North America. Common. The ascocarps persist for a long time after sporulation has ceased and are often collected in an effete condition. Eriksson (1970) described the asci as being 4-spored; the material I examined had predominantly 8-spored asci. A collection on stems of *Oxalis* from Colombia (NY-Co

4190) agrees in all morphological particulars with typical *C. leptideus,* but may be distinct, as the species is normally quite host-specific. Specimens with the characters of *C. leptideus* on leaves from tropical highland areas (TNS-F-225572, Mt. Wilhelm, New Guinea; NY-Co 501, on petiole of Ericaceae, Colombia, Cundinamarca, Dumont et al.) may represent large-spored forms of *C. dentatus.*

There is another species of *Coccomyces, Phacidium gaultheriae* Dearn. which occurs on living twigs of *Gaultheria shallon* in North America. It is distinguished from *C. leptideus* by its shorter, broader ascospores 19–22 × 6–6.5 μm. Frank Di Cosmo, who called this taxon to my attention, is preparing to publish a rediscription of it.

Specimens examined: EUROPE. SWEDEN: Fries, Scleromycetes Sueciae 98, isotype of *Phacidium leptideum* (FH); Uppland, Vaksala, B. Eriksson 691 (UPS); on *V. myrtillus,* Västerbotten, 11.VII.1974, Eriksson 403c (UPS); Småland, Femsjö (UME 25386); Eriksson 2282 (UPS); Lycksele Lappmark, B. Eriksson 780 (UPS); Västerbotten, Umea, Laestadius, 11.VI.1901 (UME 25385); Västerbotten, Bygdeå (UME 25381); Dalarna, Avesta, Terrier 416 (ZT). SWITZERLAND: Ct. Valais, Terrier, 21.5.1944 (ZT); Ct. Wallis, Aletschreservat, Müller, 19.9.1973 (ZT); Ct. Wallis, Zermatt, Terrier, 31.VII.1938 (ZT); Ct. Graubünden, 18.9.1963, on *V. uliginosum* (ZT). ITALY: ? Val Marobia, Alp. Giumello, 15.VII.1937, Terrier (ZT); Erbar. Crittog. Ital. 885, Valdobbia, Valsesia, Carestia, 1861 (FH). NORTH AMERICA. USA. Oregon: Yachats, on *Gaultheria shallon,* Sherwood, 10.VIII.1978 (FH); Lane Co., on *R. macrophyllum,* Sherwood, III.1979 (FH); on *Rhododendron* sp., Rhododendron, 22.V.1930 (OSC 27,997). Washington: Langley, on *G. shallon,* I. 1923 (OSC 9962).

51. *Coccomyces leptosporus* Speg., Bol. Soc. Cien. Argentina **19:** 188 (1885). Figure 30

Apothecia intraepidermal, scattered in bleached spots bounded by a delicate black line on dead coriaceous leaves, immersed, becoming erumpent, orbicular, 0.3–0.5 mm diam, opening irregularly by 3–5 teeth, without a preformed dehiscence mechanism, the disc greyish-yellow when fresh, drying yellow, remaining exposed when dry. Covering layer 10 μm thick, devoid of internal differentiation, heavily carbonized. Lower stroma 10 μm thick, heavily carbonized. Proper exciple well-developed, 35 μm thick, of closely septate hyphae 3 μm diam, inflated and dark brown above, visible from above in dried material as a narrow black rim around the hymenium. Subhymenium colorless, 25 μm thick. Paraphyses filiform, abruptly enlarged to 2.5–4 μm at the apex, cemented in a gel and forming an obvious epithecium. Asci cylindrical, short-stalked, 90–105 × 5–6 μm, 8-spored; ascospores nearly as long as the asci, 0.8–1.0 μm broad, nonseptate, not obviously sheathed.

On dead coriaceous leaves at low and middle elevations, tropical America, common. The identity of the host is unfortunately unknown for most of the specimens but it appears that most of them are on the same host plant. A number of species of *Coccomyces* with cylindrical asci and ascospores less than 1 μm diam occur on leaves

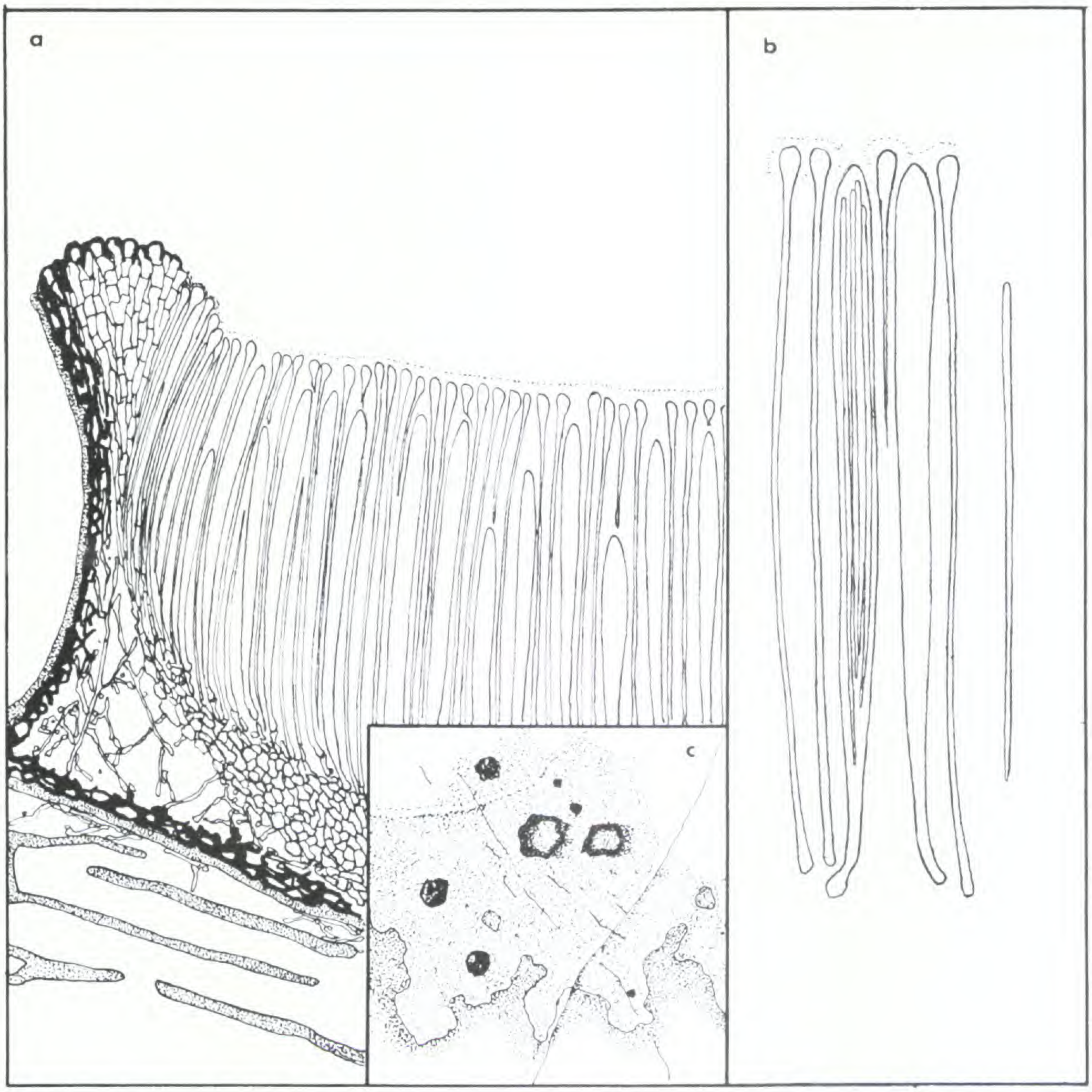

FIG. 30. *Coccomyces leptosporus*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from NY-Co 5246.

in tropical America, including *C. spegazzinii*, *C. tesselatus*, *C. antillarum*, *C. concolor*, *C. limitatus*, and *C. venezuelae*. I have chosen to separate them on rather fine morphological grounds partly because it appears that the morphological distinctions are correlated with host preference.

Specimens examined: CENTRAL AMERICA. PANAMA: Prov. Panamá, Dumont et al., 11.VI.1975 (NY-Pa 14); *ibid.*, 30.VI.1975 (NY-Pa 1582). CARIBBEAN. PUERTO RICO: Luquillo Exp. Forest, on *Dacryodes excelsa*, Haines & Korf, 6.VI.1970 (NYS). GUADELOUPE: Grand Etang, 18.VII.1973, Pfister 527 (FH). SOUTH AMERICA. VENEZUELA: Puerto Zamuro, Gaillard 26 (PC); Sydow, Fungi Venezuelani 295, El Limón, D.F. (ZT, FH); Petrak, Mycotheca Generalis 725, El Limón (ZT, FH); Edo. Aragua, Dumont et al. (NY-Ve 1208, 1186, 1145); Colonia Tovar, D.F., Dumont et al. (NY-Ve 6609); Edo. Merida, Dumont et al. (NY-Ve 2776); Edo. Sucre, *ibid.* (NY-Ve 4429); Edo. Bolivar, *ibid.* (NY-Ve 7085). COLOMBIA: Cundinamarca, Dumont et al. (NY-Co 4427, 5246, 2270); Antioquia, *ibid.* (NY-Co 6086, 1775, 6204, 1630); Boyacá, *ibid.* (NY-Co 7969). PERU: Dpto. Junín, Dumont et al. (NY-Pe 308); Dpto., Loreto, *ibid.* (NY-Pe 996). BOLIVIA: Prov. Nov. Jungos, Dpto. La Paz, R.

Singer B1431 (K). BRASIL: S Lauracea, Guarapí, leg. Balansa 3861, holotype of *C. leptosporus* (LPS 28182).

52. *Coccomyces limitatus* (Berk. & Curt.) Sacc., Syll. Fung. **8:** 747 (1889). Figure 31

≡ *Phacidium limitatum* Berk. & Curt., J. Linnean Soc. (London) **10:** 371 (1868).

Apothecia intraepidermal on bleached spots bounded by a black line on dead leaves, triangular or quadrangular, black, shining, with a preformed dehiscence mechanism consisting of faint lines of light colored, thin-walled cells, opening by 3–4 teeth to expose the yellow hymenium, 0.5–0.8 mm diam. Covering layer and basal stroma 10–15 µm thick, of heavily carbonized cells 5 µm diam. Periphysoids and excipulum absent. Subhymenium colorless, 30 µm thick, separated

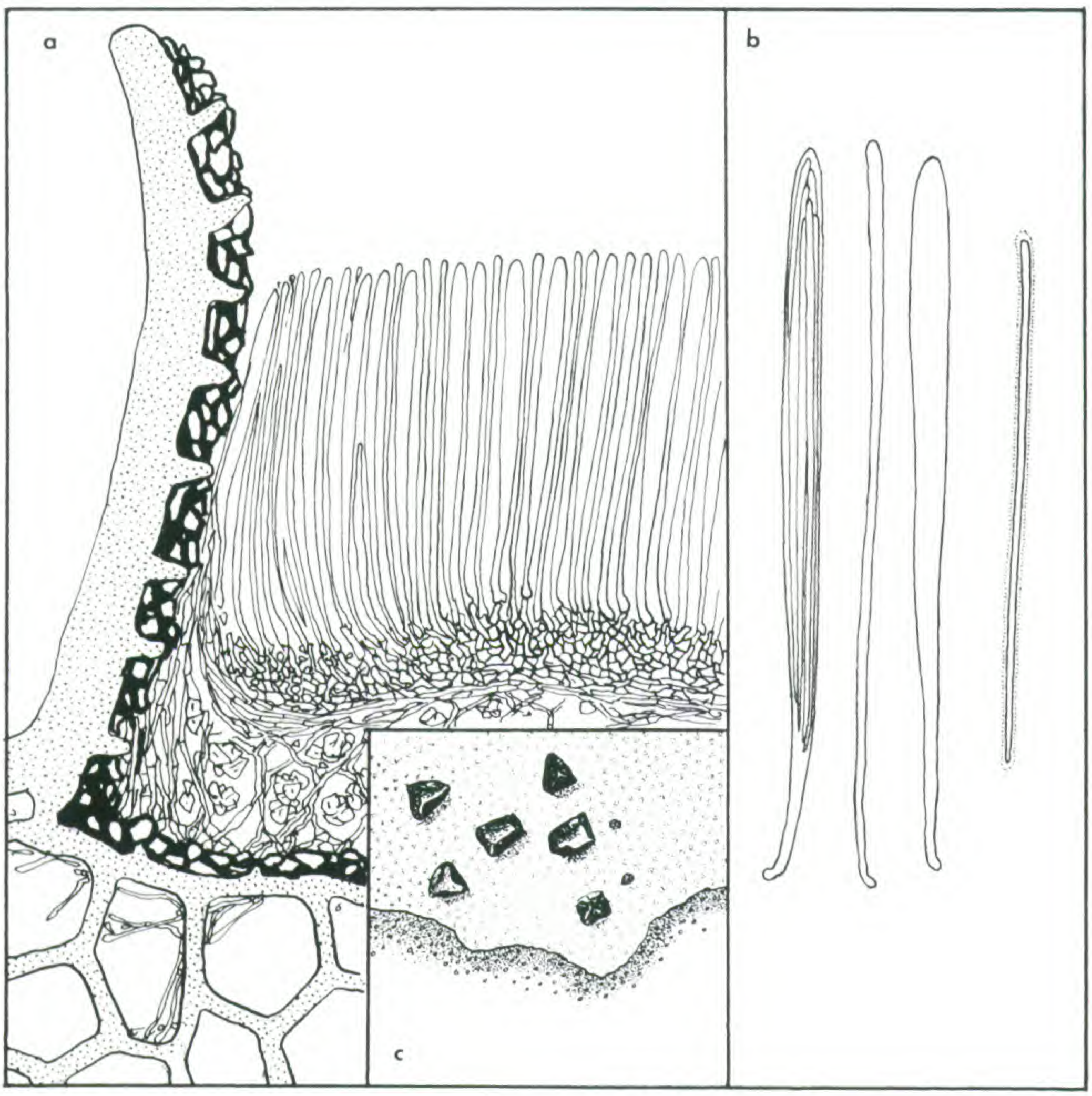

FIG. 31. *Coccomyces limitatus*:—a. cross section of apothecium, ×375.—b. asci, paraphysis, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

from the basal stroma by a loose subiculum of colorless hyphae intermingled with crystals. Asci cylindrical, short-stalked, 90–110 × 5.0–5.6 μm, 8-spored. Ascospores nearly as long as the asci, 0.8–1.0 μm diam, obscurely sheathed. Paraphyses 2–4 μm broad along their entire length, not agglutinated or forming an epithecium.

On dead leaves of *Clusia* and unidentified plants, at low and middle elevations, tropical America, generally on material in a more advanced state of decay than *Coccomyces clusiae* and *C. leptosporus*. A specimen collected on *Medinilla speciosa* in Java (CUP-Sa 344) appeared identical morphologically to the South American specimens.

Specimens examined: NORTH AMERICA, MEXICO: Oaxaca, Dumont, 25.VIII.1967 (CUP-Me 317). CENTRAL AMERICA, PANAMA: Altos de Pacora, Prov. Panama, Dumont et al., 30.VI.1975 (NY-Pa 1595). CARIBBEAN, CUBA: "Cuba, C. Wright" holotype of *Phacidium limitatum* (K); Fungi Cubensis Wrightiani 714, Cobre, Dec. (FH). SOUTH AMERICA, VENEZUELA: on *Clusia*, Rancho Grande, Aragua, Chardon & Whetzel (CUP-VZ 2798); Rancho Grande, Aragua, Dumont (CUP-VZ 4271, 4337); Maracay, Edo. Aragua, Dumont et al., 13.VII.1971 (NY-Ve 2112). COLOMBIA: Valle de Cauca, Dumont & Molina, 30.VIII.1976 (NY-Co 7552).

53. *Coccomyces lutescens* Higgins, Amer. J. Bot. **1:** 166 (1914).
= *Blumeriella jaapii* (Rehm) Arx.

For a discussion of this species see under *C. hiemalis*.

54. *Coccomyces macer* Karst. See *Karstenia macer*.

55. *Coccomyces maritimus* (Rolland) E. Müller, Rev. Mycol. N.S. **27:** 71 (1962).
≡ *Stictis maritima* Rolland, Bull. Soc. Mycol. France **14:** 84 (1898).
= *Lasiostictis fimbriata* (Schw.) Bäumler, Ann. K. K. Naturh. Hofmus. Wien **16:** 67 (1901).

The morphology and taxonomic position of this species are discussed by Sherwood (1974) and DiCosmo (1979).

56. *Coccomyces martinae* Hansf., Proc. Linn. Soc. N.S.W. **81:** 40 (1956).
= *Stictis emarginata* Cooke & Massee, Grevillea **18:** 7 (1889).
≡ *Propolis emarginata* (Cooke & Massee) Sherw., Mycotaxon **5:** 323 (1977).

This species, which is widespread and common on fallen leaves of *Eucalyptus*, is a member of the Rhytismataceae and closely allied to *Coccomyces*, differing principally in having subepidermal ascocarps with a very reduced covering layer. Sherwood (1977b), who provided a redescription and illustration of *S. emarginata*, referred the species to *Propolis* (Fr.) Cda for nomenclatural reasons; the majority of authors use *Naemacyclus* Fckl for subepidermal filiform-spored rhytismata-

ceous fungi without a dark stromatized covering layer. California Fungi 430 was distributed as *C. delta*, a misidentification.

Specimens examined: NORTH AMERICA. USA. California: California Fungi 430 (FH). SOUTH AMERICA. BRASIL: Minas Geraes, Hodges, 28.2.1974 (IMI 186648B). ASIA. INDIA: Thekkaty, on *Eucalyptus grandis*, Hodges, 17.4.1975 (IMI 194560C). PACIFIC ISLANDS. HAWAII: Maui, 10.11.1976, Hodges (IMI 209218C). AUSTRALASIA. AUSTRALIA: with *Phoma eucalyptidea*, Brisbane, n.d., leg. Martin, holotype of *Coccomyces martinae* (K).

57. *Coccomyces maydis* Rehm. See *Karstenia maydis*.

58. *Coccomyces memecycli* Sydow. See *C. vilis*.

59. *Coccomyces minutissimum* (Auersw.) Sacc. ex Gola, Atti Acad. Sci. Veneto Trent. Istriana 21, suppl. **1:** 129 (1930).
≡ *Naevia minutissima* (Auersw.) Rehm in Rabenh., Krypt.-Fl. ed. 2, **1**(3): 138 (1888).

The above combination was published, probably inadvertently, in the catalogue of the Saccardo Herbarium. The species is dermateaceous.

60. **Coccomyces monticola** Sherwood, spec. nov. Figure 32

Ascocarpi primo immersi, dein erumpentes, orbiculati, 0.5–0.8 mm diam, per lacinias 4–5 irregulariter aperientes, in macula pallida stromate obvallato insidentes. Margo superior stromatica 20 μm crassa, ex hyphis intertextis carbonaceis constata. Periphysoidei nulli. Margo inferior stromatica 20 μm crassa, ex hyphis intertextis carbonaceis constata. Excipulum brunneum. Paraphyses filiformes, apice ad 2.5 μm incrassatae, achromae, in epithecio gelatinoso non inclusae. Asci 150–175 × 8–9 μm, cylindrici, haud pedicellati, 8-spori, in iodo non caerulescentes; sporis filiformibus, continuis, in tunica gelatinosa inclusis, 90–100 × 1.5–2 μm. In foliis dejectis Ericaceae, Amer. Austral.

Holotypus: NY-Co 5065b, on Ericaceae leaves, along the Sogamoso-Aguazul road, at a point ca. 38 km from the intersection with the Sogamoso-Aquitania rd., Dpto. Boyacá, Colombia, elev. ca. 9000 ft, K. P. Dumont, S. E. Carpenter, M. A. Sherwood & L. A. Molina, 13.VI.1976. Isotypus: COL.

Etymology: *monticola* (L), inhabitor of mountains, as the species grows at high elevations.

Apothecia at first immersed, intraepidermal, orbicular, black, shining, 0.5–0.8 mm diam, opening by 4–5 irregular teeth to expose the orange disc, remaining open when dry, scattered in bleached spots bounded by a black line on dead leaves. Covering layer and lower stroma ca. 20 μm thick, black, carbonized, devoid of internal differentiation. Proper excipulum well-developed, consisting of 30 μm of closely agglutinated septate colorless hyphae 3–4 μm diam, short-celled, with brown apices. Subhymenium colorless, 30 μm thick, separated from the basal stroma by a subiculum of colorless hyphae

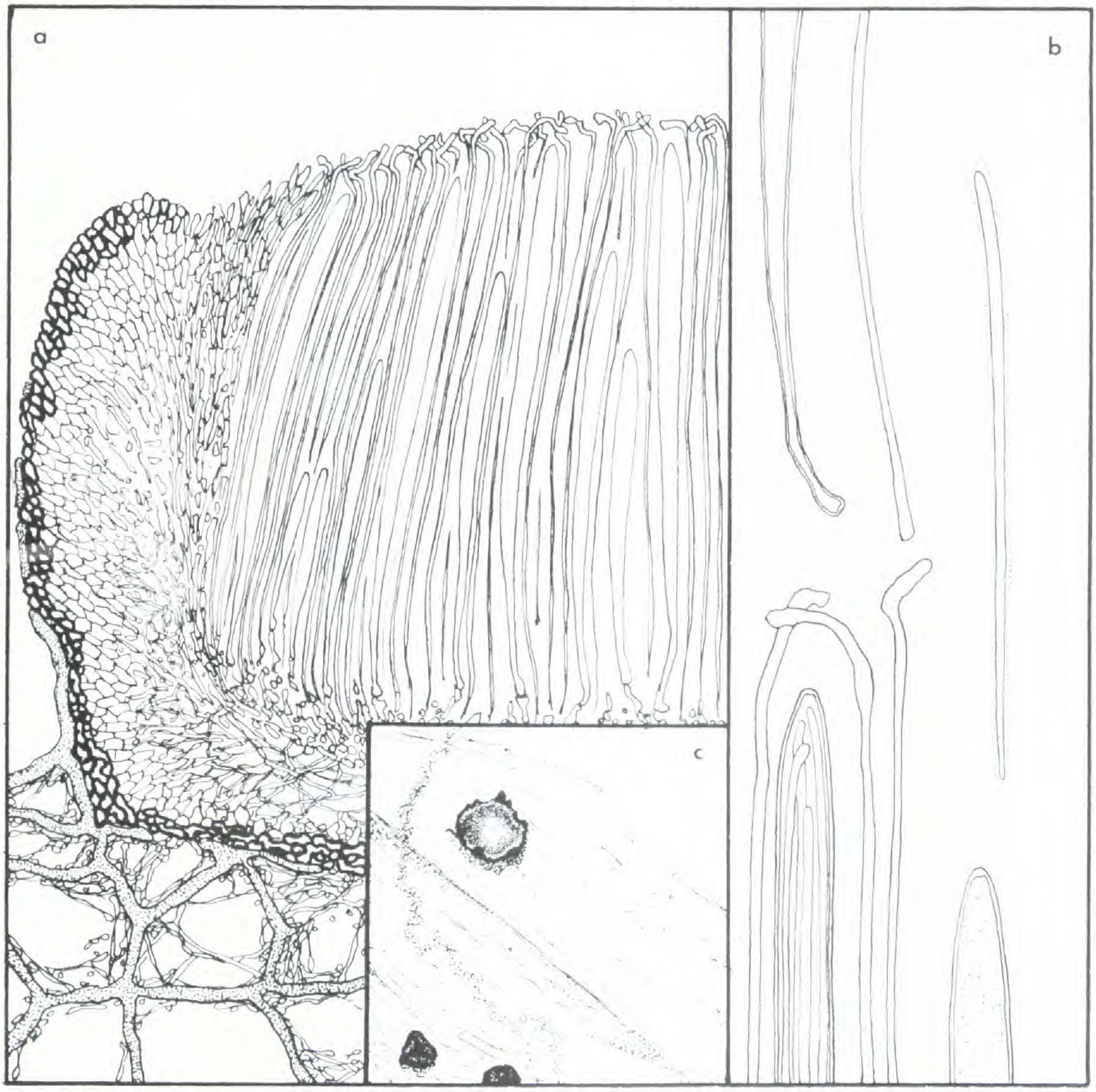

FIG. 32. *Coccomyces monticola*:—a. cross section of apothecium, ×375.—b. detail of asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from NY-Co 5065b.

2.0 μm diam. Paraphyses filiform, colorless, enlarged to 2.5 μm at the apex, bent but not circinate. Asci cylindrical, short-stalked, 150–175 × 8–9 μm, J−, 8-spored. Ascospores 90–100 × 1.5–2.0 μm, with a distinct, narrow gelatinous sheath.

On dead leaves at high elevations in Colombia. The host of the holotype is a species of *Vaccinium*; the hosts of the other specimens are unknown, but may well be ericaceous. The long asci and rather broader ascospores distinguish *Coccomyces monticola* from members of the *C. leptosporus* complex.

Specimens examined (see also holotype, above): SOUTH AMERICA. COLOMBIA: ca. 62 km from Ansermanuevo on the Ansermanuevo-San José de Palomar road, boundary Valle de Cauca and Chocó Dptos., elev. 2100 m, Dumont, Molina & Forrero, 25. VIII. 1976 (NY-Co 7297); km 16–17 from Mosquera on the Mosquera-La Mesa rd., Dpto. Cundinamarca, elev. 9300 ft, Dumont, Carpenter & Sherwood, 5.VI.1976 (NY-Co 4189);

km 112 from Pasto, Pasto-Mocoa rd., Intendencia Putumayo, elev. 8000 ft, Dumont, Buriticá, Molina & Luteyn, 28.I.1976 (NY-Co 3822, 3832).

61. *Coccomyces musae* (Lév.) Sacc. See *C. clusiae.*

62. *Coccomyces mussaendae* Sawada. See *Biostictis tjibodensis.*

63. **Coccomyces palmicola** Sherwood, spec. nov. Figure 33

Ascocarpi primo immersi, trigoni vel tetragoni, 0.3–0.6 mm diam, per lacinias 3–4 aperientes, in macula pallida stromate obvallato insidentes. Margo superior stromatica 50 μm crassa, ex hyphis intertextis carbonaceis constata. Margo inferior stromatica 15 μm crassa, ex hyphis intertextis carbonaceis constata. Excipulum nullum. Paraphyses filiformes, simplices vel ramosae, apice ad 2.0–2.5 μm incrassatae, circinatae, in epithecio gelatinoso non inclusae. Asci 110–130 × 7–9 μm, cylindrici, haud pedicellati, 8-spori, in iodo non caerulescentes; sporis filiformibus, continuis, in tunica gelatinosa inclusis, 75–100 × 1.5 μm. In foliis dejectis palmae, Panama.

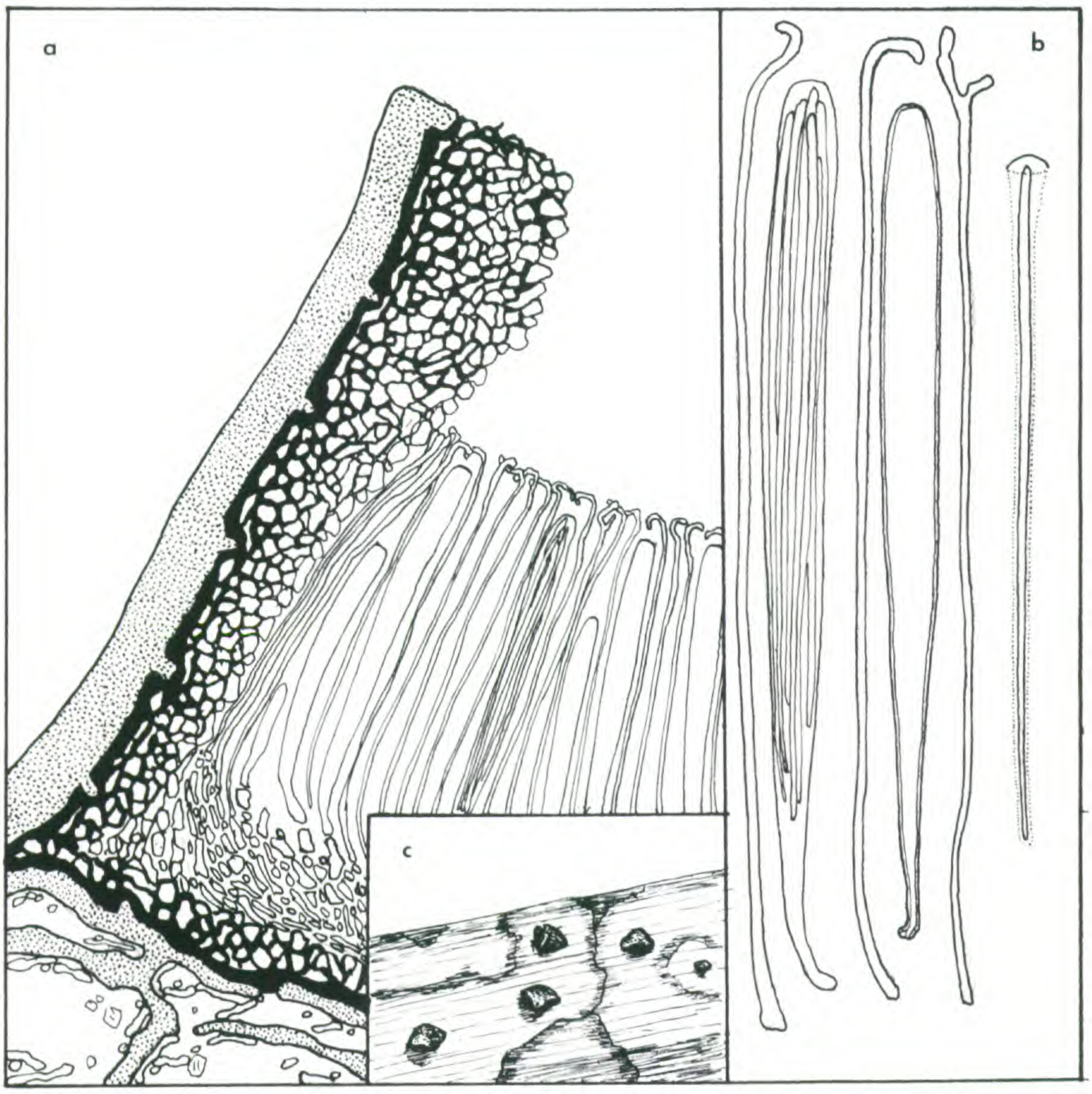

FIG. 33. *Coccomyces palmicola*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

Holotypus: NY, Fungi of Panama 49, on frond of indet. palm, summit of Cerro Jefe, ca. 23 km N. of Pan American Hwy., Prov. Panama. Elev. ca. 3000 ft, K. P. Dumont, S. E. & S. M. Carpenter, S. Mori, 11.VI.1975.

Etymology: *palmicola* (L), growing on palms, from the host.

Apothecia intraepidermal, at first immersed, black, shining, triangular or quadrate, 0.3–0.6 mm diam, without an obvious preformed dehiscence mechanism, opening by 3–4 teeth to expose the greyish (when dry) hymenium, scattered in prominent bleached spots on dead palm leaves. Covering stroma 50 μm thick, heavily carbonized. Basal stroma 15 μm thick, heavily carbonized, the cells 4–7 μm diam. Subhymenium colorless, 30 μm thick. Excipulum absent. Paraphyses colorless, enlarged to 2.0–2.5 μm at the apex, circinate, sometimes branched, not immersed in a gel. Asci cylindrical, short-stalked, 110–130 × 7–9 μm, somewhat truncate, J−, 8-spored. Ascospores 75–100 × 1.5 μm, distinctly sheathed, the sheath appearing as a refractive cap at the apex of the spore.

On palm fronds, Panama. *Coccomyces cocoes*, which occurs on palm fronds in Africa, differs in having a distinct excipulum and inflated, noncircinate paraphyses.

Specimens examined: see holotype, above.

64. *Coccomyces pampeanus* Speg., Contrib. Estud. Fl. Sierra Ventana 85 (1896). Figure 34
= *Coccomyces pampeanus* Speg. var. *chilensis* Speg., Fungi Chilensis 132 (1910).

Apothecia intraepidermal, immersed, triangular to quadrate, black, shining, 0.3–0.6 mm diam, without an obvious preformed dehiscence mechanism, opening by 3–4 teeth, scattered on inconspicuous bleached areas not bounded by a line on dead leaves. Covering layer 10–15 μm thick, undifferentiated, of carbonized cells 2.5 μm diam. Basal stroma consisting of 1 layer of carbonized cells 5 μm diam. Subhymenium colorless, 5 μm thick. Excipulum absent. Paraphyses filiform, enlarged to 2.5 μm at the apex, not imbedded in a gel. Asci clavate, short-stalked, 80–110 × 11–14 μm, 4- or 8-spored, J−. Ascospores 50–60 × 2–3 μm, tapered below, distinctly sheathed, becoming 1-septate.

On dead leaves of *Eryngium paniculatum*, Argentina and Chile, *Musa*, and an unidentified bromeliad. The type of *Coccomyces pampeanus* is immature. Spegazzini erected his var. *chilensis* on the grounds that the Chilean material had longer, broader spores. As the two types are on the same host and do not differ in any other respect I consider that the Chilean material represents the species in its fully mature state. The specimens on *Musa* from Guadeloupe agree in all morphological particulars with the specimens on *Eryngium* (Umbelli-

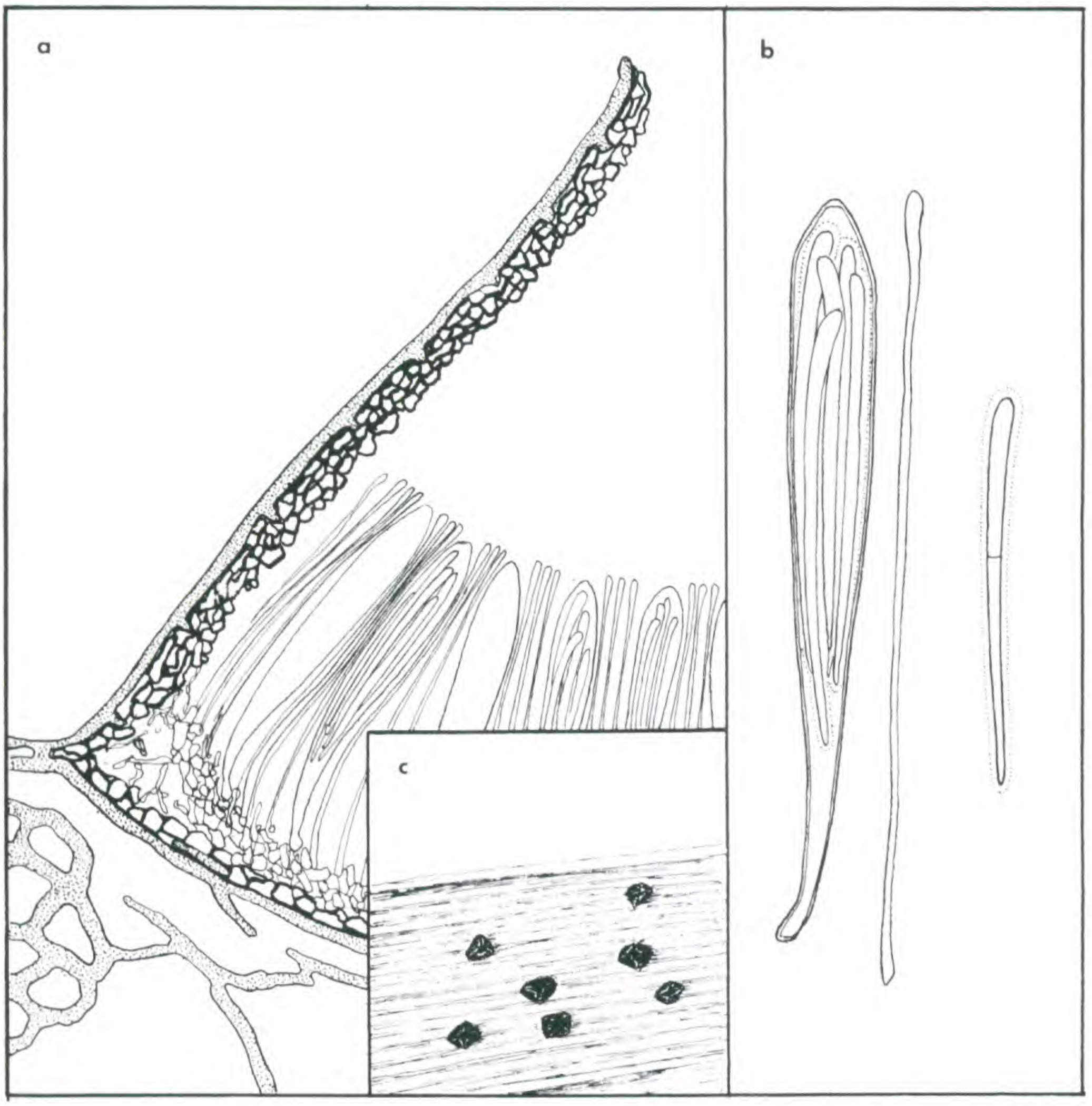

FIG. 34. *Coccomyces pampeanus*:—a. cross section of apothecium, ×375.—b. ascus, paraphysis, and spores, ×750.—c. habit sketch, ×7.5. Drawn from Gaudeloupe 956 (FH).

ferae). The specimen on Bromeliaceae from Colombia differs in having 4-spored asci. If these indeed all represent the same species, this is an interesting example of a *Coccomyces* occurring on ecologically similar but taxonomically unrelated hosts, *Eryngium* having the texture, growth form, and appearance of a terrestrial bromeliad.

Specimens examined: CARIBBEAN. GUADELOUPE: Morne a Louis des Mamelles, Pfister et al., 5.I.1974 (FH); Camp Jacob, Pfister et al., 7.I.1974 (FH). SOUTH AMERICA. VENEZUELA: on *Heliconia*, Edo. Sucre, Dumont et al., 13.VII.1972 (NY-Ve 4987). COLOMBIA: Mosquera-La Mesa rd., Dpto. Cundinamarca, Dumont et al., 5.VI.1976, on indet. bromeliad (NY-Co 4188). ARGENTINA: s/ *Eryngium paniculatum*, Buenos Aires, Sierra de la Ventana, XI.1895, leg. Spegazzini, holotype of *C. pampeanus* (LPS 12655). CHILE: Cerro Caracol de Concepción, I.1909, leg. C. Spegazzini, holotype of *C. pampeanus* var. *chilensis* (LPS 28178).

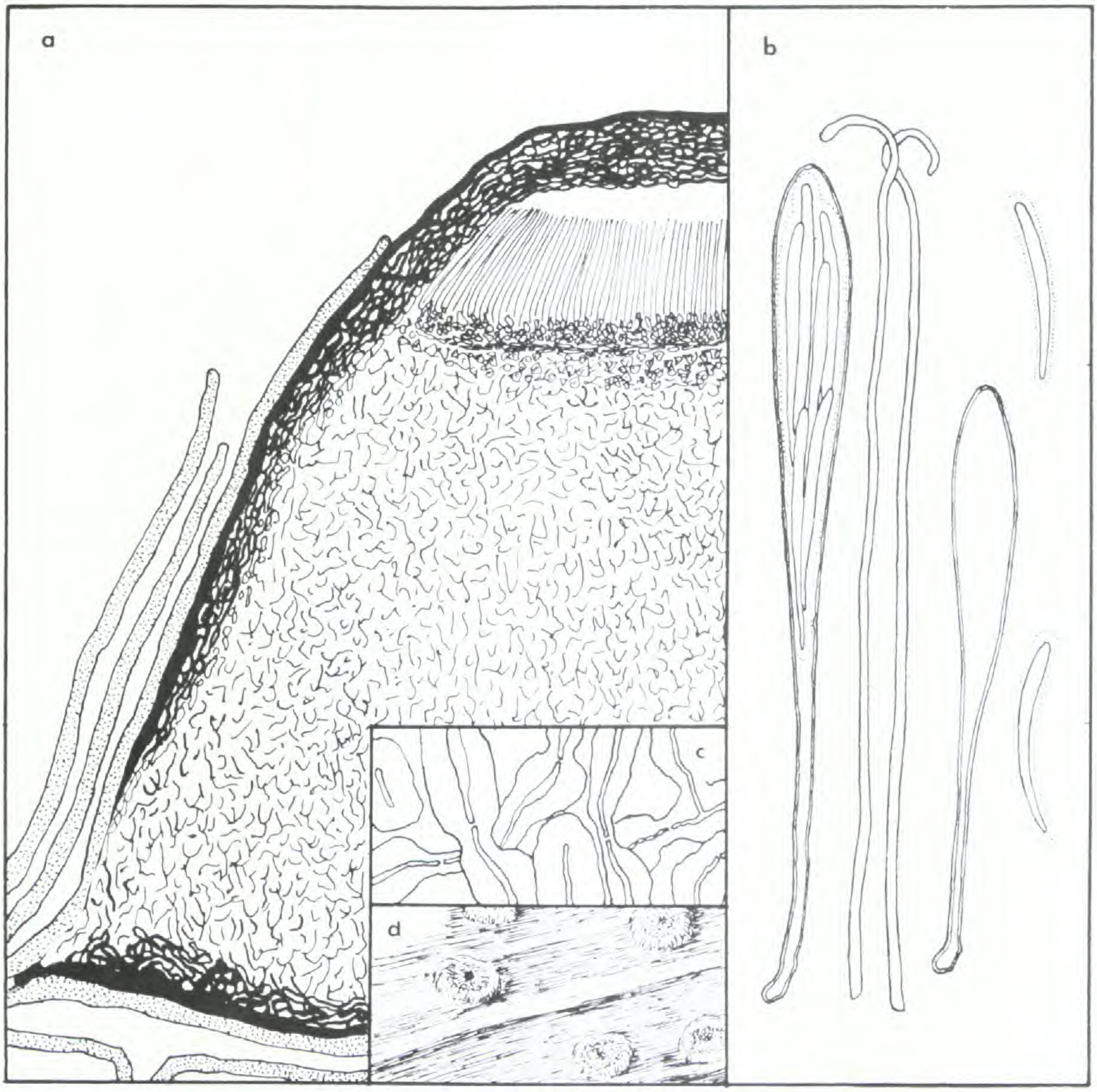

FIG. 35. *Coccomyces papillatus*:—a. cross section of apothecium, ×150.—b. asci, paraphyses, and spores, ×750.—c. detail of hyphae from interior matrix of stroma, ×750.—d. habit sketch, ×7.5. Drawn from the holotype.

65. *Coccomyces papillatus* Sherwood in Ahmad, Ascom. Pakistan 216 (1978). Figure 35

Ascocarps at first immersed, raising the overlying bark into prominent pustules with a depressed center and small central papilla, at length splitting open irregularly by teeth to expose the hymenium, without any preformed dehiscence mechanism, not accompanied by stromatic lines or bleached discoloration of the surrounding substrate. Covering layer 50 μm thick, of heavily carbonized cells 5–8 μm diam, devoid of internal differentiation. Lower stroma ca. 20 μm thick, heavily carbonized, separated from the subhymenium by a very thick (up to 500 μm) matrix of thick-walled, gelatinous hyphae 10 μm diam, which eventually break down, leaving a mass of crystals. Subhymenium

colorless, 30 μm thick. Paraphyses filiform, circinate, not cemented in a gel. Asci clavate, long-stalked, 95–120 × 9–11 μm, J−, 8-spored. Ascospores cylindrical, tapering slightly below, 29–41 × 2.0 μm, narrowly sheathed.

On smooth bark of twigs and small branches of *Pinus wallichiana* (= *P. excelsa*), Pakistan, common, according to S. Ahmad (personal communication). Very similar to *Coccomyces strobi* on *Pinus strobus* in eastern North America, differing principally in having larger apothecia with a much thicker matrix of hyphae beneath the subhymenium. I have collected *C. strobi* on cultivated *P. wallichiana* in Boston; the apothecia were of the same dimensions as those of this species on *P. strobus*. Since neither of these two species of *Coccomyces* is known to occur in Europe and their respective ranges are consequently quite isolated from one another, I have chosen to regard them as distinct species, although the morphological differences are slight.

Specimens examined: ASIA. PAKISTAN: Ahmad 19341, Loon Bagla, Muzaffarabad, 26.7.1963 (LAH); Ahmad 27504, Swat, Kalam, 20.8.1952 (LAH); Dunga Gali, 22.7.1965 (LAH); ex herb. S. Ahmad 4356, Kaghan Valley, Shogran, holotype of *C. papillatus* (BPI).

66. **Coccomyces parvulus** Sherwood, spec. nov. Figure 36

Ascocarpi primo immersi, orbiculati vel irregulariter elongati, 0.3–0.8 mm diam, per lacinias irregulariter aperientes, in macula pallida non insidentes. Margo superior stromatica 75–100 μm crassa, ex hyphis intertextis carbonacea constata. Periphysoidei nulli. Margo inferior stromatica nulla. Excipulum nullum. Paraphyses filiformes, ramosae, circinatae, in epithecio gelatinoso non insidentes. Asci 120–140 × 8–9 μm, clavati, pedicellati, in iodo non caerulescentes, 8-spori; sporis cylindricis, continuis, in tunica gelatinosa inclusis, 25–30 × 1.0–1.5 μm. In ligno coniferarum, Amer. Bor. Occident.

Holotypus: FH, Reliquiae Suksdorfiana II (unnumbered, sub *Clithris crispa*), on old conifer wood, Washington, Yakima Co., Mt. Adams, June 27, 1883, W. N. S. 55.

Etymology: parvulus (L), small, insignificant, referring to the size of the ascocarps (relative to other wood-inhabiting species of *Coccomyces*) and their inconspicuousness.

Ascocarps immersed in swarms beneath a common, coal black stromatic crust on decorticated conifer wood, orbicular to elongate but not linear, at most twice as long as broad, without a preformed dehiscence mechanism, splitting open irregularly by teeth. Covering stroma 75–100 μm thick, with a carbonized outer crust 20 μm diam, and an inner portion of fleshy brown globose cells 5–8 μm diam. Lower stroma absent, replaced by a layer 100 μm thick of loosely consolidated gelatinous hyphae 3–5 μm diam, resting directly on disintegrating wood. Subhymenium 15 μm thick, faintly brown.

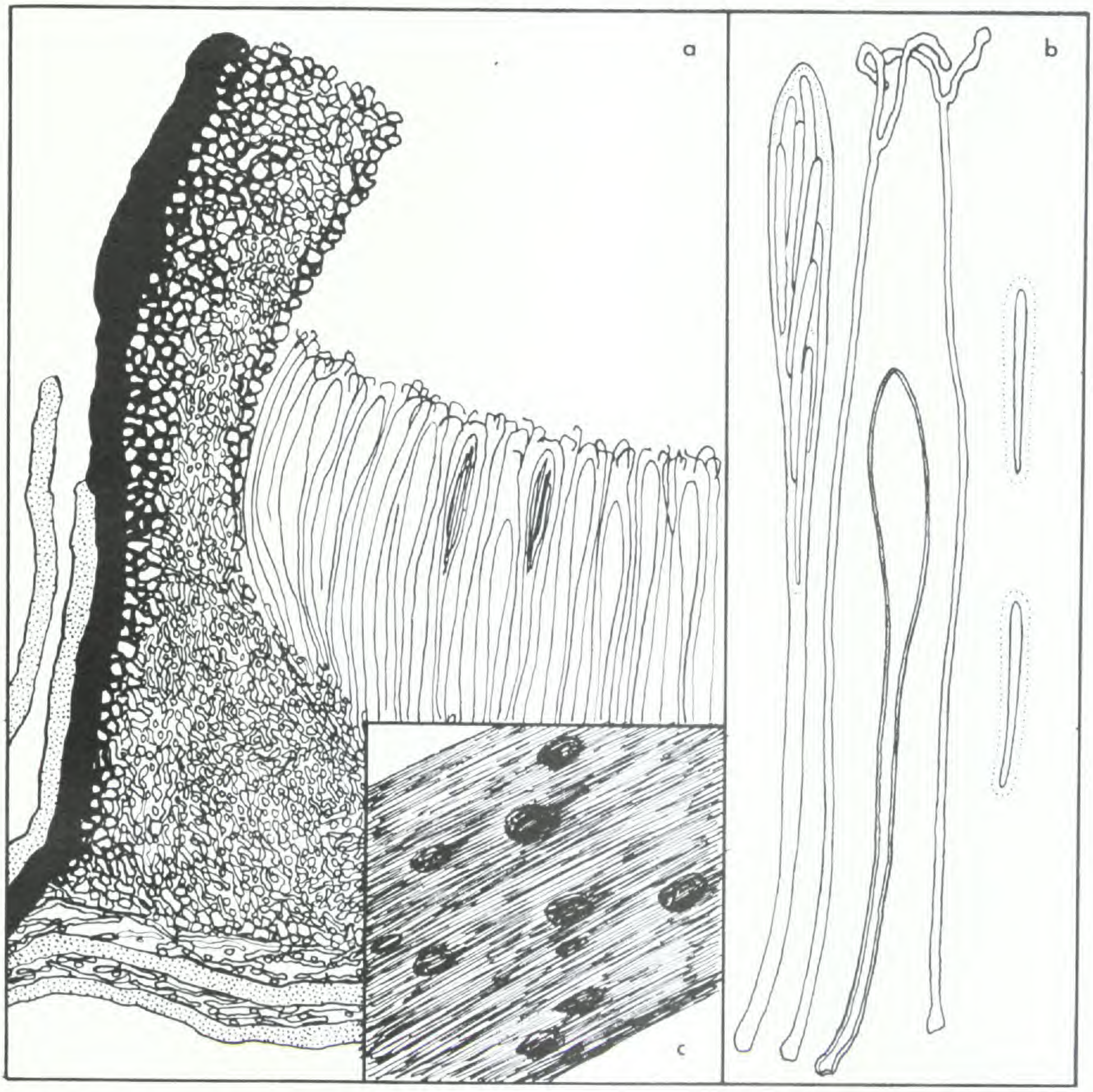

FIG. 36. *Coccomyces parvulus*:—a. cross section of margin, ×225.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

Excipulum absent. Paraphyses 1.5 μm diam, branched, circinate, forming an epithecium. Asci 120–140 × 8–9 μm, clavate, long-stalked, 8-spored; ascospores nonseptate, 25–30 × 1.0–1.5 μm, prominently sheathed.

On decorticated wood of various conifers, probably common. The fungus is easily overlooked in the field because the colonies resemble charred wood and the tiny apothecia are extremely inconspicuous. The specimens cited were found deposited in herbaria under the names *Clithris crispa*, *C. graphis*, and *C. morbida*, all species which have linear ascocarps opening by a definite longitudinal slit and usually occur on corticate twigs.

Coccomyces parvulus is closely related to *C. atactus*, *C. bipartitus*, and *C. cembrae*, differing from all of them in paraphysis and ascospore

characters. *Colpoma deusta* Sherw., also occurring on conifer wood in Oregon, is similar but has long-linear ascocarps.

Specimens examined (see also holotype, above): NORTH AMERICA. USA. Washington: on *Pinus* sp., Crystal Ridge, Olympic Mts., elev. 4800 ft, A. H. Smith 14422, 14423, 17.VI.1939 (MICH). Oregon: Takilma, on Douglas fir, C. H. Kauffman, Dec. 1925 (MICH); on *Abies*, Mary's Peak, 21.VIII.1975 (Herb. Sherwood 2020).

67. *Coccomyces peltiformis* (Preuss) Sacc. See *C. tumidus*.

68. *Coccomyces pentagonus* Kirschst. See *C. dentatus*.

69. **Coccomyces petersii** (Berk. & Curt.) Sherwood, comb. nov.
Figure 37

≡ *Hysterium petersii* Berk. & Curt., Grevillea **4:** 13 (1875).

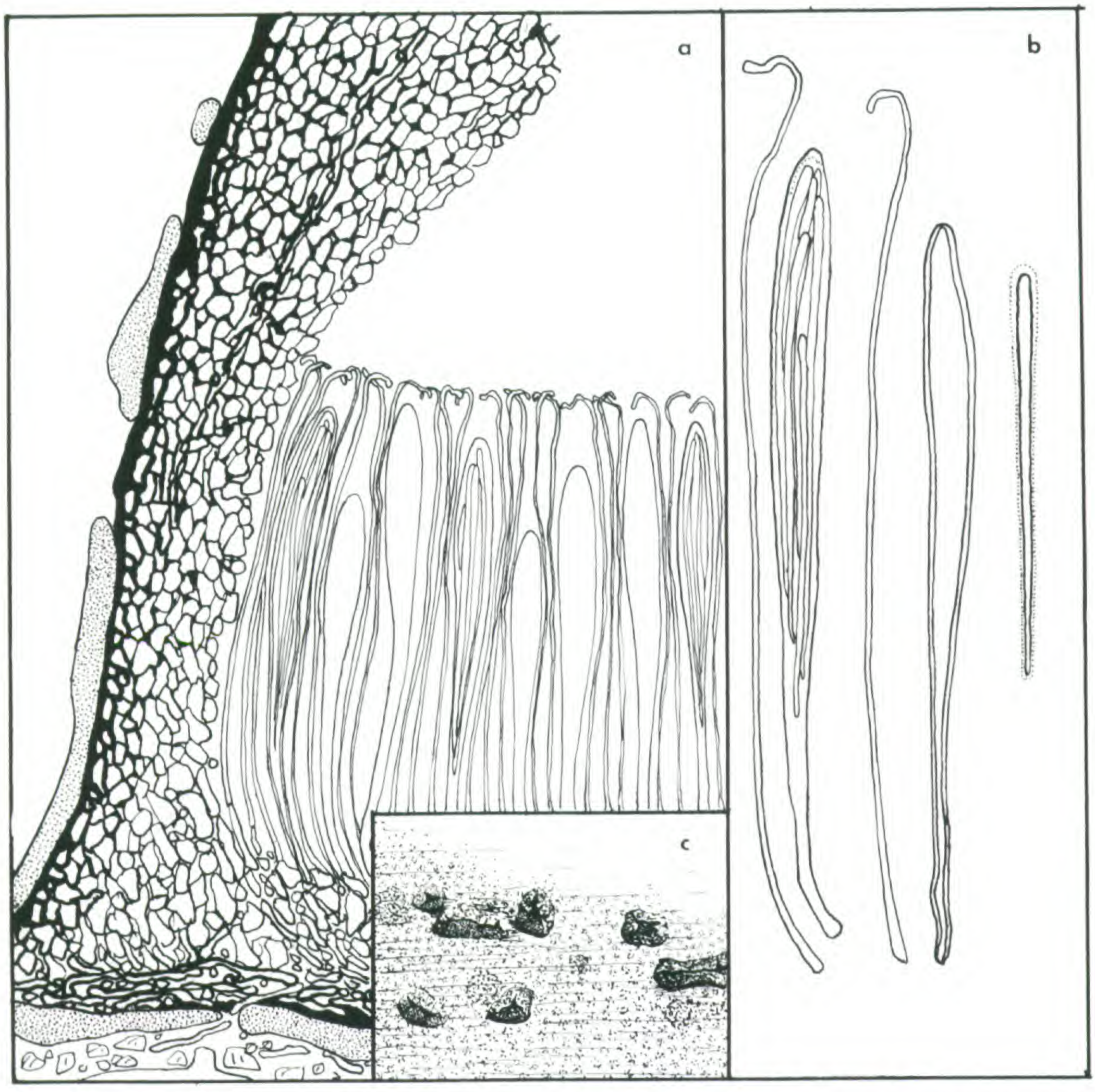

FIG. 37. *Coccomyces petersii*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from FH-Thaxter X.1902.

≡ *Lophodermium petersii* (Berk. & Curt.) Sacc., Syll. Fung. **2:** 795 (1883).

= *Colpoma juniperinum* Cke. & Pk., Bull. Buffalo Soc. Nat. Sci. **3**(2): 36 (1876).

Apothecia gregarious, at first immersed in nondiscolored bark, orbicular to oblong, 0.8–1.5 mm diam, black, shining, without a preformed dehiscence mechanism, splitting open irregularly by teeth to expose the yellowish hymenium. Covering layer 100 μm thick, without internal differentiation, of globose carbonized cells 3–7 μm diam. Basal stroma reduced to a subiculum of dark brown hyphae 2.5–3.5 μm diam. Subhymenium colorless, 30 μm thick. Excipulum absent. Paraphyses filiform, circinate, 1.5–2 μm broad. Asci clavate, long-stalked, 85–110 × 8–10 μm, J−, 8-spored. Ascospores 45–60 × 1.5–2 μm, narrowly sheathed, nonseptate.

On thin bark covering large limbs of *Juniperus virginiana*, eastern North America. This species has generally been considered in the literature to by synonymous with the European *Coccomyces juniperi* (Ellis and Everhart, 1892), although Dennis (1957) mentioned that the North American type of *Colpoma juniperinum* had larger spores than European specimens of *Coccomyces juniperi*. In addition to differences in spore dimensions, non-overlapping geographical ranges, and different host species, *C. juniperi* and *C. petersii* exhibit a number of small but consistent morphological differences which suggest that they are distinct taxa. *Coccomyces petersii* typically has smaller, flatter apothecia less deeply immersed in the substrate, is more gregarious, and occurs on trunks and large branches rather than on small twigs.

Specimens examined: NORTH AMERICA. USA: on *Juniperus virginiana*, F. A. Wolf, 1936 (FH); Waverley, Massachusetts, Oct. 1902, R. Thaxter (FH); Buffalo, New York, Clinton, on *J. virginiana* (FH); Curtis Herb. 4016, Alabama, Peters 376, isotype of *Hysterium petersii* (FH).

70. **Coccomyces philippinus** (Rehm) Sherwood, comb. nov.

Figure 38

≡ *Coccomyces quadratus* (Schm. & Kunze) Sacc. var. *philippinus* Rehm, Leafl. Philipp. Bot. **8:** 2926 (1916).

Apothecia immersed in bleached spots bounded by a black line on dead leaves, intraepidermal, 0.5–1.0 mm diam, triangular to hexagonal, black, shining, with a distinct preformed dehiscence mechanism of pale colored, thin-walled cells, opening by teeth. Covering stroma 20 μm thick, heavily carbonized, bearing a few short periphysoids on its inner face. Basal stroma 10 μm thick, heavily carbonized. Subhymenium 20 μm thick, colorless, the cells 5 μm diam. Excipulum absent. Paraphyses filiform, inflated to 5.0 μm at the apex, not cemented in a gel. Asci cylindrical, short-stalked, 100–125 × 5–6 μm, 8-spored;

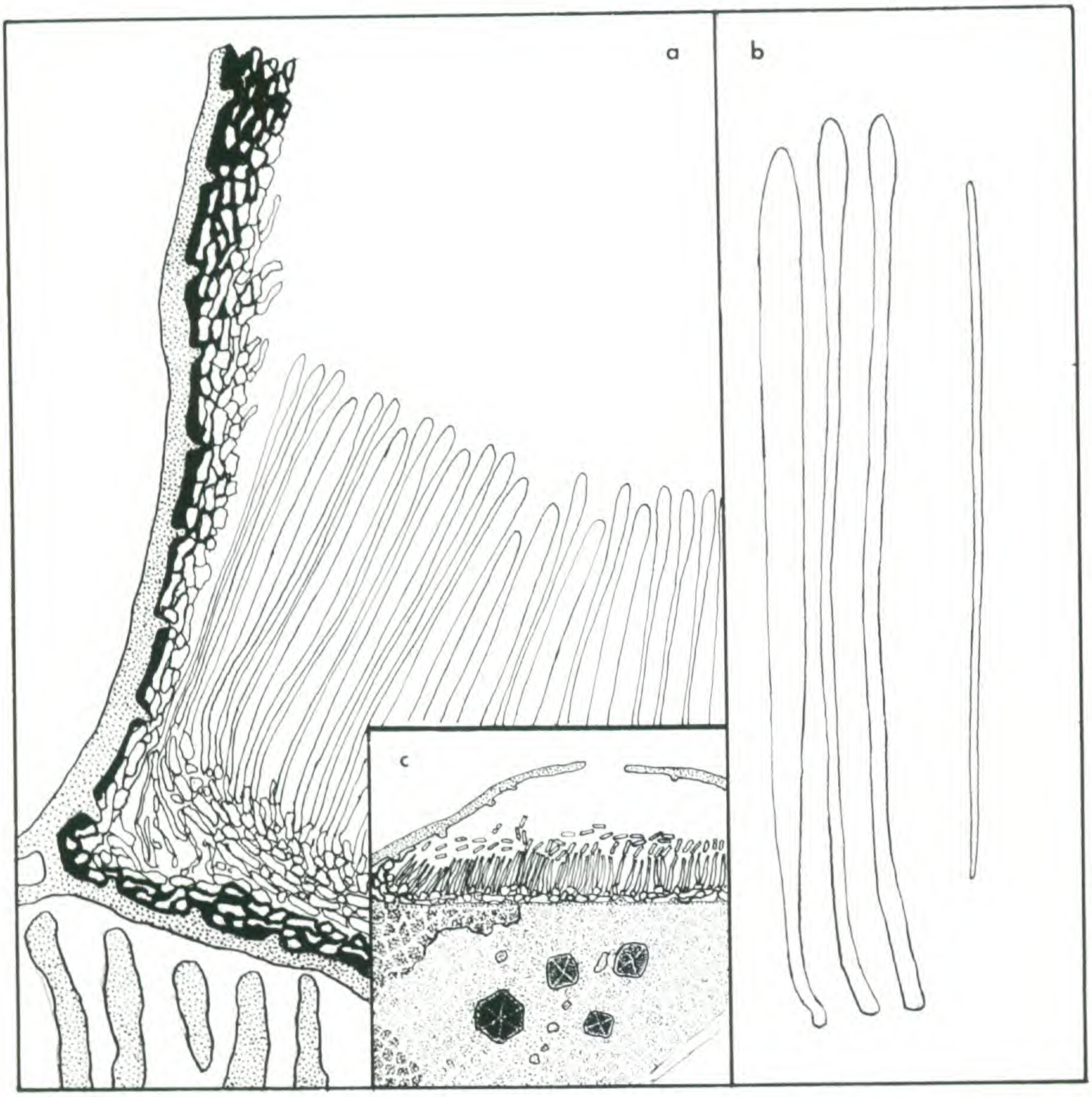

FIG. 38. *Coccomyces philippinus*:—a. cross section of apothecium, ×375.—b. ascus, paraphyses, and spores, ×750.—c. pycnidium, ×750.—d. habit sketch, ×7.5. Drawn from the holotype.

ascospores nearly as long as the asci, 1.0 μm diam, nonseptate, not obviously sheathed.

Pycnidia numerous, occurring with the apothecia, 0.1–0.2 mm diam, appearing as minute concolorous pustules bounded by a thin black line. Covering layer absent; basal stroma incomplete, forming a ring as seen from above. Conidiophores in a compact basal layer, 10–12 × 1.5 μm, simple. Conidia colorless, unicellular, 3–4 × 1.0 μm.

Ascospore dimensions, paraphyses type, and presence of pycnidia all separate *Coccomyces philippinus* from *C. quadratus* (= *C. leptideus*). It is rather close morphologically to *C. limitatus*, but that species also does not produce pycnidia.

Specimen examined: ASIA. PHILIPPINES: Baker, Fungi Malayani 129, on *Neolitsea*, Mt. Maquiling, near Los Baños, Prov. Laguna, June, 1914, isotype of *C. philippinus* (PC, FH).

71. *Coccomyces piceae* (Fuckel) Sacc., Syll. Fung. **8:** 746 (1889).
≡ *Phacidium piceae* Fuckel, Jahrb. Nassauischen Vereins Naturk. **28–29:** 51 (1875).
≡ *Lophodermium piceae* (Fuckel) Höhnel, Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl. Abt. 1, **126:** 296 (1917).

This is a species of *Lophodermium*, according to Darker (1967).

72. *Coccomyces pini* ([Alb. & Schw.] Schm. ex Fr.) Karst., Bidrag Kännedom Finlands Natur Folk **19:** 254 (1871).
≡ *Phacidium pini* [Alb. & Schw.] Schm. ex Fr., Syst. Mycol. **2**(2): 573 (1823).
≡ *Therrya pini* ([Alb. & Schw.] Schm. ex Fr.) Höhnel, Sitzungber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl. Abt. 1, **121:** 62 (1912).

For complete synonymy and a discussion of this and the following species, see Reid and Cain (1961).

73. *Coccomyces pini* ([Alb. & Schw.] Schm. ex Fr.) Karst. var. *fuckelii* Rehm in Rabenh., Krypt.-Fl. ed. 2, **1**(3): 99 (1888).
≡ *Therrya fuckelii* (Rehm) Kujala, Comm. Inst. Forestry Inst. **38:** 4 (1950).

74. *Coccomyces pluridens* (Berk. & Curt.) Sacc. See *C. clusiae*.

75. *Coccomyces prunophorae* Higgins, Amer. J. Bot. **1:** 165 (1914).
= *Blumeriella jaapii* (Rehm) Arx.

For a discussion and references, see *C. hiemalis*.

76. *Coccomyces pseudotsugae* Funk, Canad. J. Bot. **53:** 2297 (1975).
Figure 39

Apothecia intracortical, immersed, becoming erumpent, occurring on undiscolored host tissue, orbicular to polygonal, 0.6–1.2 mm diam, black, without a preformed dehiscence mechanism, splitting open irregularly. Covering stroma consisting of a crust of disintegrating carbonized hyphae 35–50 μm thick, lined on its inner face with 40–50 μm of brown noncarbonized pseudoparenchymatous cells 5 μm diam. Basal stroma black, carbonized, 20 μm thick, separated from the subhymenium by 50 μm of pale brown interwoven hyphae 2–4 μm diam. Subhymenium 40 μm thick, pale brown, the cells 2–4 μm diam. Asci (113–)125–168(–200) × 8–10 μm, clavate, long-stalked, 8-spored; ascospores nonseptate, 35–43 × 2–3 μm, rather narrowly sheathed. Paraphyses septate, partly recurved at the tips and nodose. Pycnidia absent.

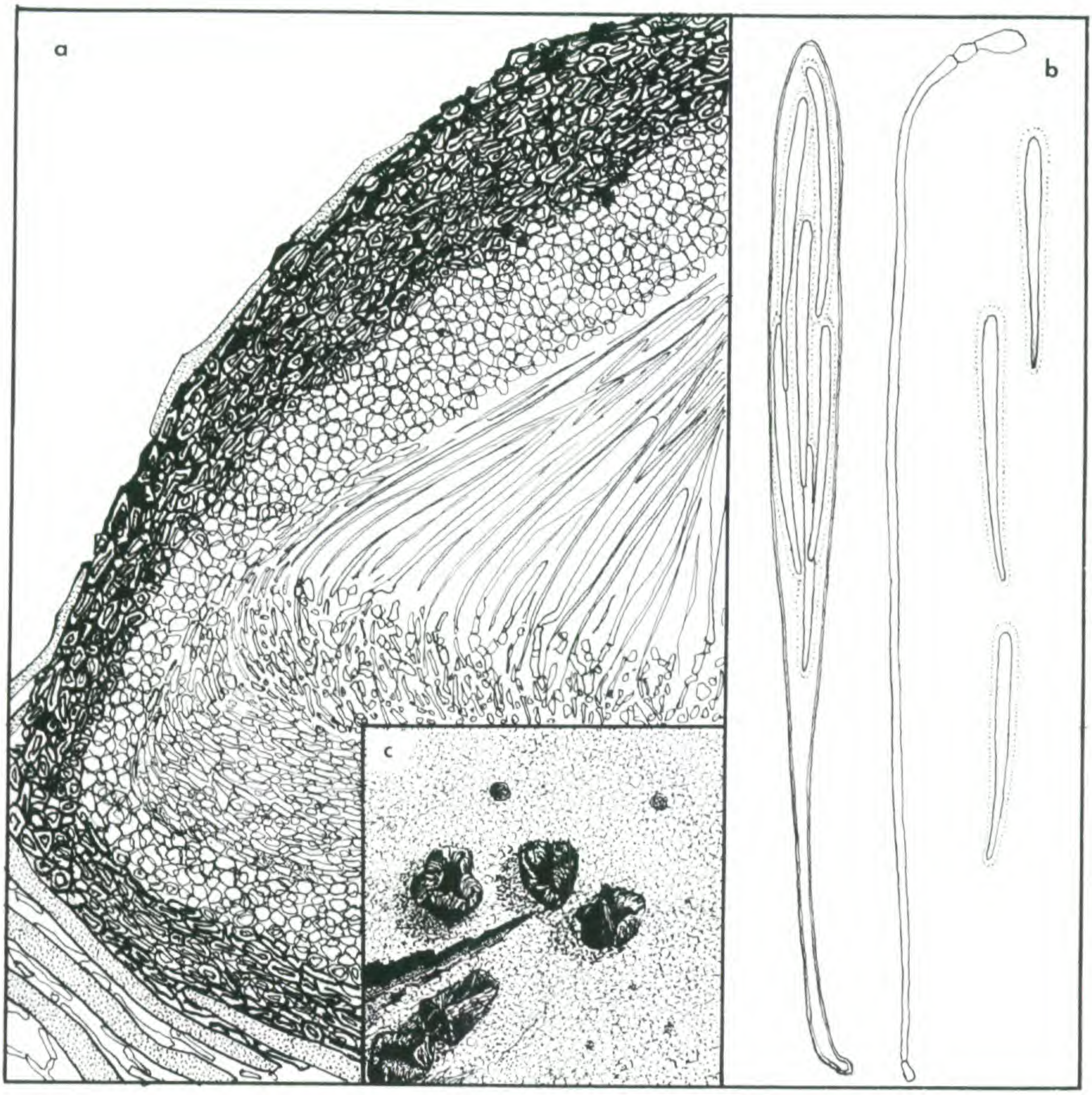

FIG. 39. *Coccomyces pseudotsugae*:—a. cross section of apothecium, ×375.—b. ascus, paraphysis, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

On bark of *Pseudotsuga menziesii* and *Abies grandis*, west coast of North America, summer and fall. Funk (1975) gives information on the cultural characteristics of the species.

Specimens examined: NORTH AMERICA. CANADA: on *Pseudotsuga menziesii*, Shawnigan Lake, Victoria Island, British Columbia, 8.XI.1974, holotype of *Coccomyces pseudotsugae* (DAVFP 20863). USA: On conifer twigs, Lake Crescent, Olympic National Park, Washington, 15.VI.1939, A. H. Smith (MICH); on *Abies grandis*, Trinidad, California, III.1935, Parks 5520, distributed as *Clithris juniperi* (MICH, FH, OSC 13452).

77. *Coccomyces puiggarii* Speg., Bol. Acad. Nac. Ci. Córdoba **23:** 517 (1919). Figure 40

Apothecia subepidermal in prominent bleached spots bounded by a raised, reddish discolored line, on dead leaves still attached to the host, 0.2–0.5 mm diam, dull brown with a darker rim when seen

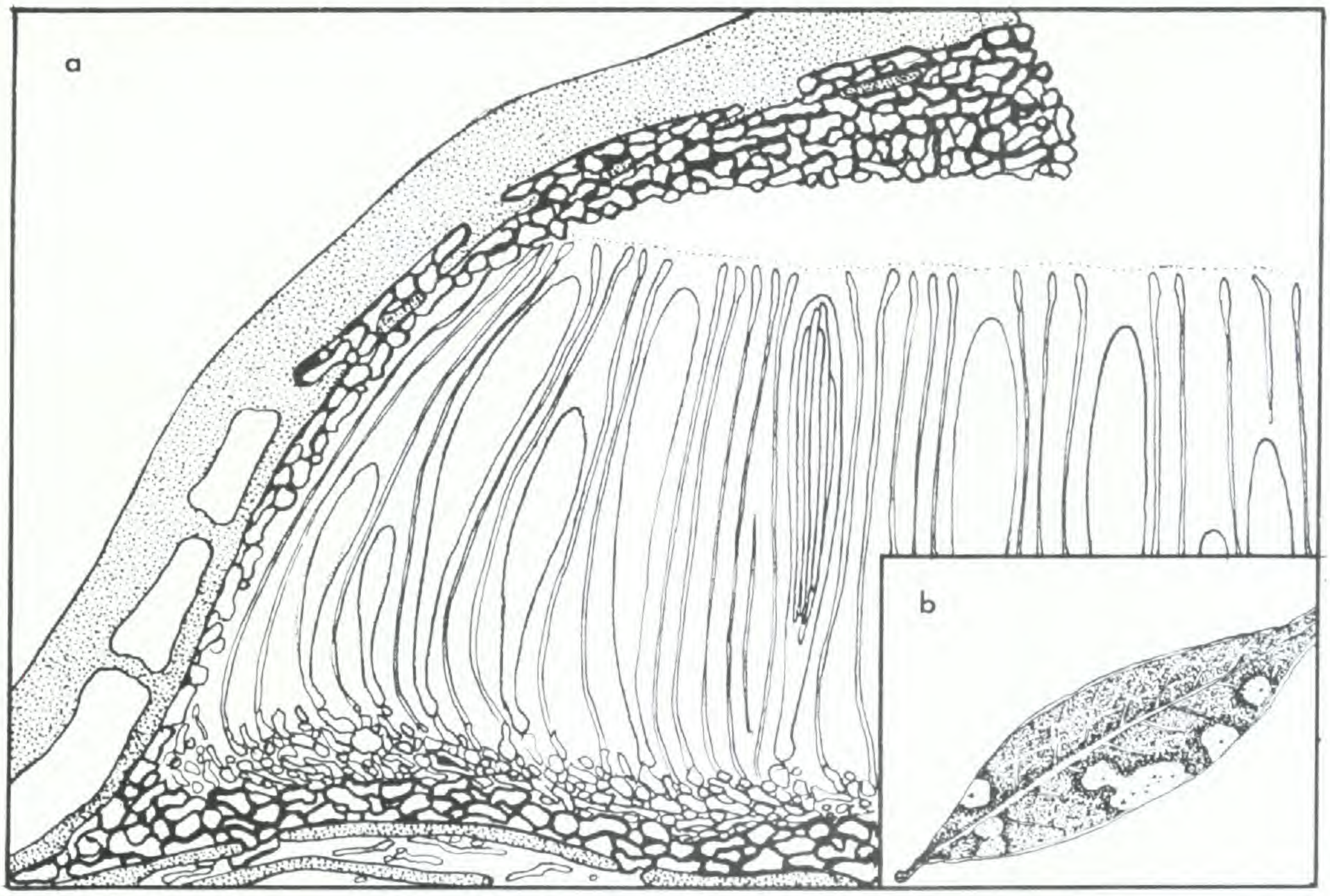

FIG. 40. *Coccomyces puiggarii*:—a. cross section of apothecium, ×375.—b. habit sketch, approximately natural size. Drawn from the holotype.

from above, opening irregularly by 3–5 teeth, without a preformed dehiscence mechanism. Covering layer 25–30 μm thick, dark colored, slightly carbonized; lower stroma 15 μm thick, composed of carbonized cells 5 μm diam. Subhymenium colorless, 15 μm thick. Excipulum absent. Paraphyses filiform, enlarged to 2.0–2.5 μm above, cemented in a gel. Asci 110–120 × 8–10 μm, 8-spored. Ascospores 60–75 × 2.5 μm.

On dead leaves of Myrtaceae, Brazil. All of the apothecia remaining in type collection are immature; dimensions of asci and ascospores are taken from Spegazzini's original description. The species appears very close to *Coccomyces vilis.* As well as can be determined from the scanty type specimen it lacks the inner periphysoidal layer of *C. consocians,* an otherwise similar subepidermal foliicolous species of *Coccomyces* known from South America. Both *C. vilis* and *C. puiggarii* are imperfectly known. In view of the parasitic habit of the former and widely separated geographical areas it would seem premature to synonymize them.

Specimen examined: SOUTH AMERICA, BRAZIL: Apiahy, 1879?, leg. J. Puiggari nro. 278, holotype of *Coccomyces puiggarii* (LPS 28188).

78. *Coccomyces quadratus* [Schm. & Kunze] Sacc. See *C. leptideus.*

79. *Coccomyces quadratus* [Schm. & Kunze] Sacc. var. *arctostaphyli* Rehm. See *Coccomyces arctostaphyli.*

80. *Coccomyces quadratus* [Schm. & Kunze] Sacc. var. *philippinus* Rehm. See *Coccomyces philippinus.*

81. *Coccomyces quercinus* (Desm.) Terrier. See *Coccomyces delta.*

82. **Coccomyces radiatus** Sherwood, spec. nov. Figure 41

Ascocarpi primo immersi, tetragoni vel hexagoni, 1.0–1.5 mm diam, per lacinias 4–6 aperientes, in macula pallida stromate non obvallato insidentes. Margo superior stromatica 30 μm crassa, ex hyphis intertextis brunneis constata. Periphysoidei nulli. Margo inferior stromatica 10 μm crassa, ex hyphis carbonaceis constata. Excipulum hyalinum. Paraphyses filiformes, apice ad 4–5 μm incrassatae, achromae, in epithecio

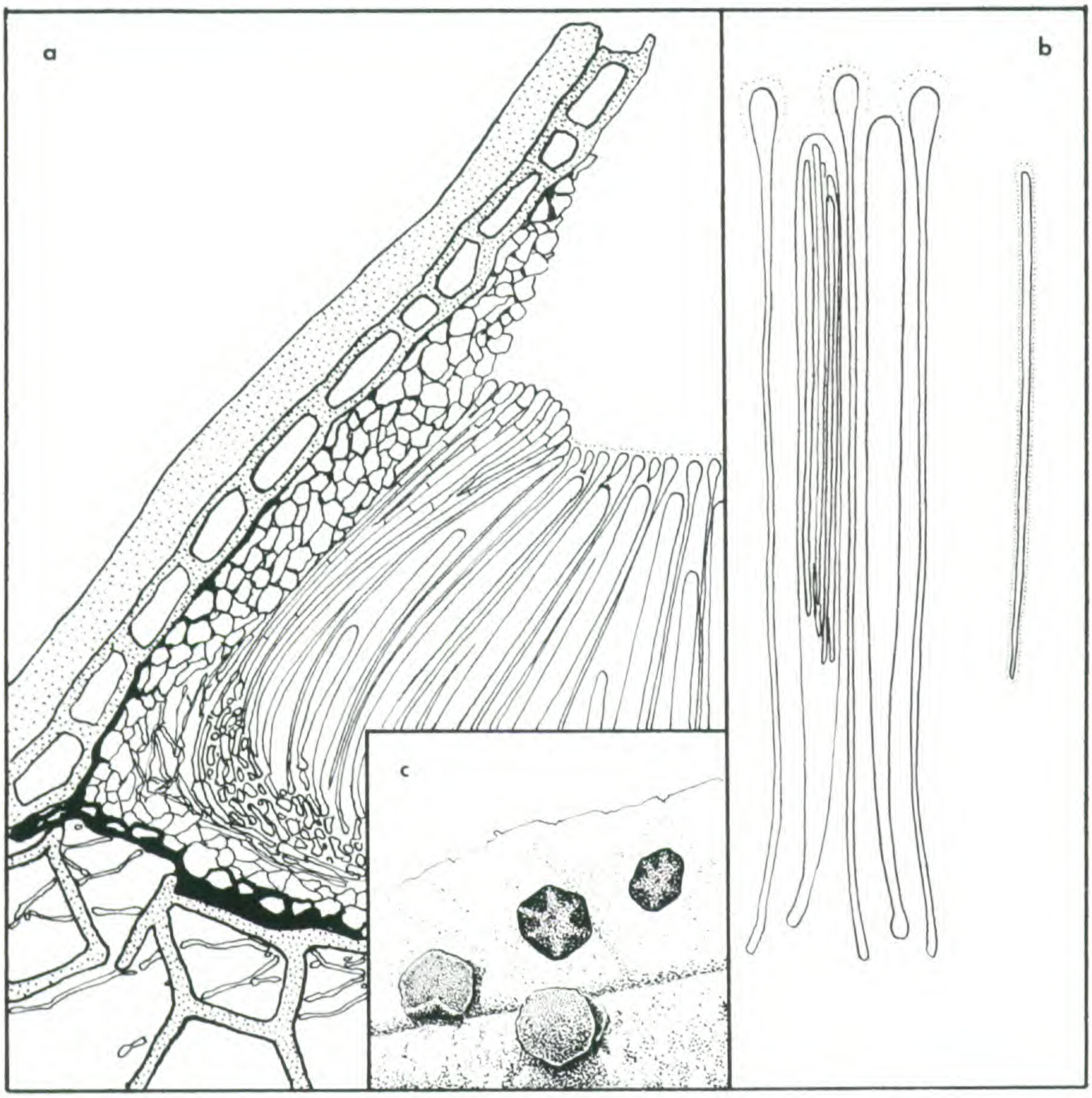

FIG. 41. *Coccomyces radiatus*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch of rehydrated material, ×7.5. Drawn from Shear 16.X.1925 (BPI).

gelatinoso inclusae. Asci 90–120 × 5–6 μm, cylindrici, haud pedicellati, in iodo non caerulescentes, 8-spori; sporis filiformibus, in tunica gelatinosa inclusis, continuis, 60–75 × 1.0 μm. In foliis emortuis *Rhododendri*, Amer. Bor.

Holotypus: BPI, on *Rhododendron* sp., Dismal Creek, Virginia, October 16, 1935, leg. C. L. Shear (sub. *C. rhododendri*)

Etymology: radiatus (L), radiata, referring to the stellate dehiscence mechanism.

Ascocarps at first immersed, subepidermal, epiphyllous and hypophyllous in bleached spots not bounded by a line stroma, 1.0–1.5 mm diam, mostly hexagonal, black, when closed exhibiting a distinct preformed pale stellate dehiscence mechanism, opening by 4–6 regular teeth to expose the clear pale orange disc. Covering stroma ca. 30 μm thick, consisting of globose brown noncarbonized cells 5–8 μm diam, without periphysoids; basal stroma 10 μm thick, carbonized, separated from the subhymenium by a layer 15 μm thick of pseudoparenchyma constructed like the covering layer. Subhymenium colorless, 15 μm thick. Proper exciple colorless, 20 μm thick, consisting of closely-septate agglutinated hyphae 2.0 μm diam. Asci cylindrical, short-stalked, 90–120 × 5–6 μm, J−, 8-spored. Paraphyses filiform, abruptly inflated to 4–5 μm at the apex, cemented in a gel and forming an epithecium. Ascospores 60–75 × 1.0 μm, nonseptate, obscurely sheathed.

On *Rhododendron*, Appalachian Mountains. There is an overmature specimen on *Epigaea repens* (White 2526) in FH which may be this species. The tropical American specimens are similar morphologically and have been tentatively referred here. The species differs from *C. coronatus* in having a well-defined dehiscence mechanism and paraphyses firmly cemented in an epithecial gel. Members of the tropical *C. leptosporus* complex differ in having narrower spores, smaller apothecia, and lacking the combination of a hyaline proper exciple and paraphyses cemented in a gel.

Specimens examined (see also holotype, above): NORTH AMERICA. USA: on *Rhododendron*, Rugby, Tennessee, 7.VIII.1949, Shear (BPI); on *Rhododendron*, Occoquan, Va., Shear, XI.1922 (BPI); Whitewater Falls, N.C., Shear, 19.VIII.1933 (BPI); on *Rhododendron maximum*, Mt. Lake, Virginia, 3.IX.1936 (BPI). SOUTH AMERICA. VENEZUELA: El Avila, Dpto. Federal, 24.VII.1972, leg. Dumont et al. (NY-Ve 5863). COLOMBIA: Medellin-Pto. Valdivia rd., Dpto. Antioquia, 12.VIII.1976, Dumont et al. (NY-Co 6230); Valle de Cauca-Chocó, Dumont et al., 25.VIII.1976 (NY-Co 7272).

83. *Coccomyces rehmii* Sacc. See *Coccomyces rhododendri*.

84. *Coccomyces repandus* ([Fr.] ex Fr.) Quélet, Enchirid. Fung. 338 (1886).
≡ [*Phacidium repandum* Fr., K. Vet. Akad. Handl. **40:** 108 (1819)] ex Fr., Syst. Mycol. **2**(2): 578 (1823).

≡ *Pseudopeziza repanda* ([Fr.] ex Fr.) Karst., Acta Soc. Flora Fauna Fennica **2:** 161 (1885).

85. *Coccomyces rhododendri* Rehm, Hedwigia **21:** 117 (1882).
≡ *Clithris rhododendri* (Rehm) Rehm in Rabenh., Krypt.-Fl. ed. 2, **1**(3): 104 (1888).
≡ *Coccomyces rehmii* Sacc., Syll. Fung. **8:** 751 (1889).

The staff of the Stockholm herbarium were unable to locate any type or authentic specimens of the above species in Rehm's Herbarium. The description suggests that it may be allied to *Coccomyces bipartitus* and related species, but it cannot be characterized completely from the description alone. Rehm's name, *C. rhododendri*, has priority over Saccardo's combination, *C. rhododendri* (Schw.) Sacc.; hence the name *C. rehmii* is superfluous.

86. *Coccomyces rhododendri* (Schw.) Sacc., Syll. Fung. **8:** 748 (1889).
≡ *Hysterium rhododendri* Schw., Trans. Amer. Philos. Soc. n.s. **4:** 246 (1832).
≡ *Lophodermium rhododendri* (Schw.) Ell. & Ev., N. Am. Pyrenomycet. 717 (1892), nom. inval.
≡ *Lophodermium schweinitzii* M. Wils. & Roberts, Trans. Brit. Mycol. Soc. **61:** 527 (1947), a name change.

Modern authors consider this to be a *Lophodermium* rather than a *Coccomyces*.

87. *Coccomyces rhododendri* Racib. See *Coccomyces javanicus*.

88. *Coccomyces rubi* (Fr.) Karst., Bidrag Kännedom Finlands Natur Folk **19:** 258 (1871).
≡ *Phacidium rubi* Fr., Syst. Mycol. **2**(2): 578 (1823).
= *Coleroa chaetomium* (Kunze ex Fr.) Rabenh., Herb. Mycol. **1456** (1850).

According to Müller and von Arx (1962), this is a Loculoascomycete in the Venturiaceae.

89. *Coccomyces rubicola* Ell. & Dearn. See *Karstenia rubicola*.

Specimens filed under this name in American herbaria may also be *C. tumidus*, which occasionally occurs on *Rubus* canes.

90. *Coccomyces salicinus* (Ell. & Ev.) Sacc., Syll. Fung. **11:** 432 (1895).
≡ *Coccophacidium salicinum* Ell. & Ev., Proc. Philadelphia Acad. Sci. **46:** 151 (1893) [1894].
= *Stictis schizoxyloides* Ell. & Ev., l.c. p. 150.

The two names for the taxon were published simultaneously. *Stictis schizoxyloides* is preferred, since it is more familiar and reflects the correct taxonomic position of the species. For a redescription, see Sherwood (1977a).

Specimen examined: NORTH AMERICA. USA: Helena, Montana, Kelsey #5, 13.I.1889, isotype of *Coccophacidium salicinum* (CUP-D 2008).

91. *Coccomyces spegazzinii* Sacc., Syll. Fung. **8:** 747 (1889). Figure 42

≡ *Coccomyces brasiliensis* Speg., Bol. Acad. Nac. Ci. Córdoba **11:** 593 (1889) non *C. brasiliensis* Karst.

Apothecia intraepidermal, scattered in bleached areas bounded by a black line stroma, 0.5-0.8 mm diam, triangular to hexagonal, with

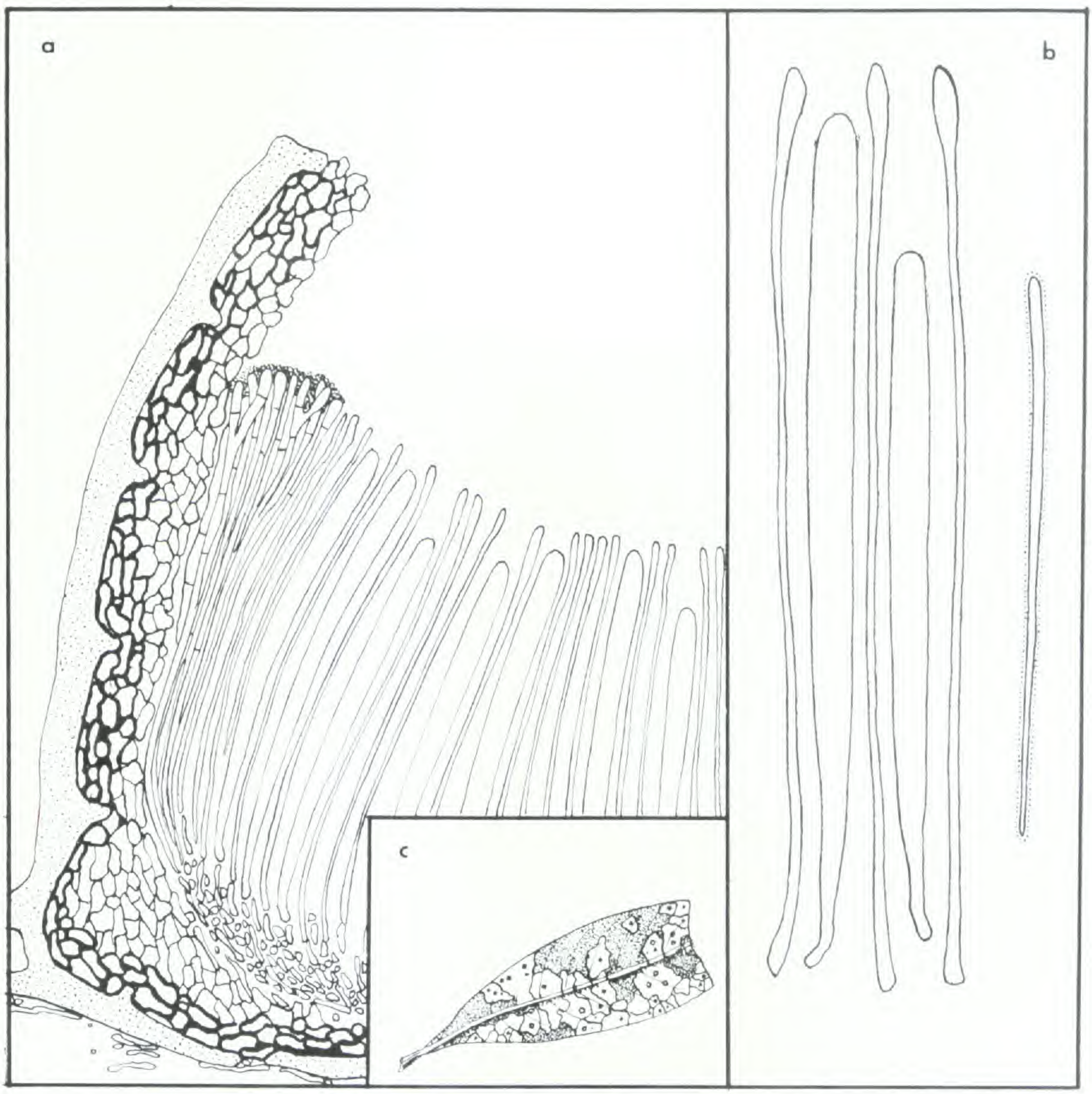

FIG. 42. *Coccomyces spegazzinii*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, approximately natural size. Drawn from Theissen 212 (FH).

a distinct preformed dehiscence mechanism consisting of thin-walled colorless cells, splitting open by teeth. Covering layer 20 μm thick, of dark, moderately carbonized cells 3–7 μm diam, without periphysoids; lower stroma complete, carbonized, 10 μm thick. Subhymenium 20 μm thick, colorless. Proper exciple well-developed, 30 μm thick, of closely septate hyphae 3 μm diam, brown above. Paraphyses filiform, enlarged above to 3–4 μm, not imbedded in a gel. Asci cylindrical, short-stalked, 100–120 × 6–6.5 μm, J−, 8-spored. Ascospores nearly as long as the asci, 1.5 μm broad, nonseptate, obscurely sheathed.

On coriaceous leaves, Brazil. Spegazzini's type no longer contains mature apothecia; the above description is taken from Theissen's exsiccata material. *Coccomyces spegazzinii* is similar to *C. leptosporus*, differing in having somewhat broader spores and no gelatinous epithecium. The well-developed exciple will distinguish it from the otherwise similar *C. dentatus*.

Specimens examined: SOUTH AMERICA. BRAZIL: Apiahy, VII.1882, leg. J. Puiggari 2928, holotype of *Coccomyces brasiliensis* Speg. (LPS 28183); Apiahy, 1889, leg. Puiggari (LPS 34990); Theissen, Decades Fungorum Brasiliensis 212, São Paulo, Rick, 1911 (FH). VENEZUELA: trail from Rincon E. along Rio Media, Edo. Sucre, Dumont et al., 15.VII.1972 (NY-Ve 5083).

91a. *Coccomyces striatus* (Phill. & Plowr.) Massee. See *Coccomyces tumidus*.

92. *Coccomyces strobi* Reid & Cain, Canad. J. Bot. **39:** 1127 (1961). Figure 43

≡ *Phacidium crustaceus* Curt. in Ellis, N. Am. Fungi 455 (1880) nom. nud.

≡ *Coccomyces crustaceum* Curt. in Reid & Cain, Canad. J. Bot. **39:** 1118 (1961) pro synon.

≡ *Coccophacidium crustaceum* (Curt.) Durand, in Seymour, Host Index **39** (1929) nom. nud.

Apothecia at first immersed, intracortical, raising the substrate into prominent, flattened pustules, without a preformed dehiscence mechanism, splitting open by numerous teeth to expose the dull yellow hymenium, 1–2 mm diam. Covering layer 50–75 μm thick, heavily carbonized, the cells 5–8 μm diam, with a distinct vertical orientation. Basal stroma reduced to a subiculum of interwoven brown hyphae 2–3 μm diam, separated from the hymenium by a matrix of hyaline thick-walled hyphae 100 μm thick which soon breaks down leaving a mass of colorless crystals. Subhymenium colorless, 25 μm thick. Asci clavate, rather long-stalked, 70–120(-125) × 6–9(-10.5) μm, J−, 8-spored. Paraphyses filiform, unbranched, circinate, 1.5–2 μm diam. Ascospores 27–40.5(-48) × 1–2 μm, nonseptate, narrowly sheathed.

On recently killed branches on *Pinus strobus* and introduced 5-needle

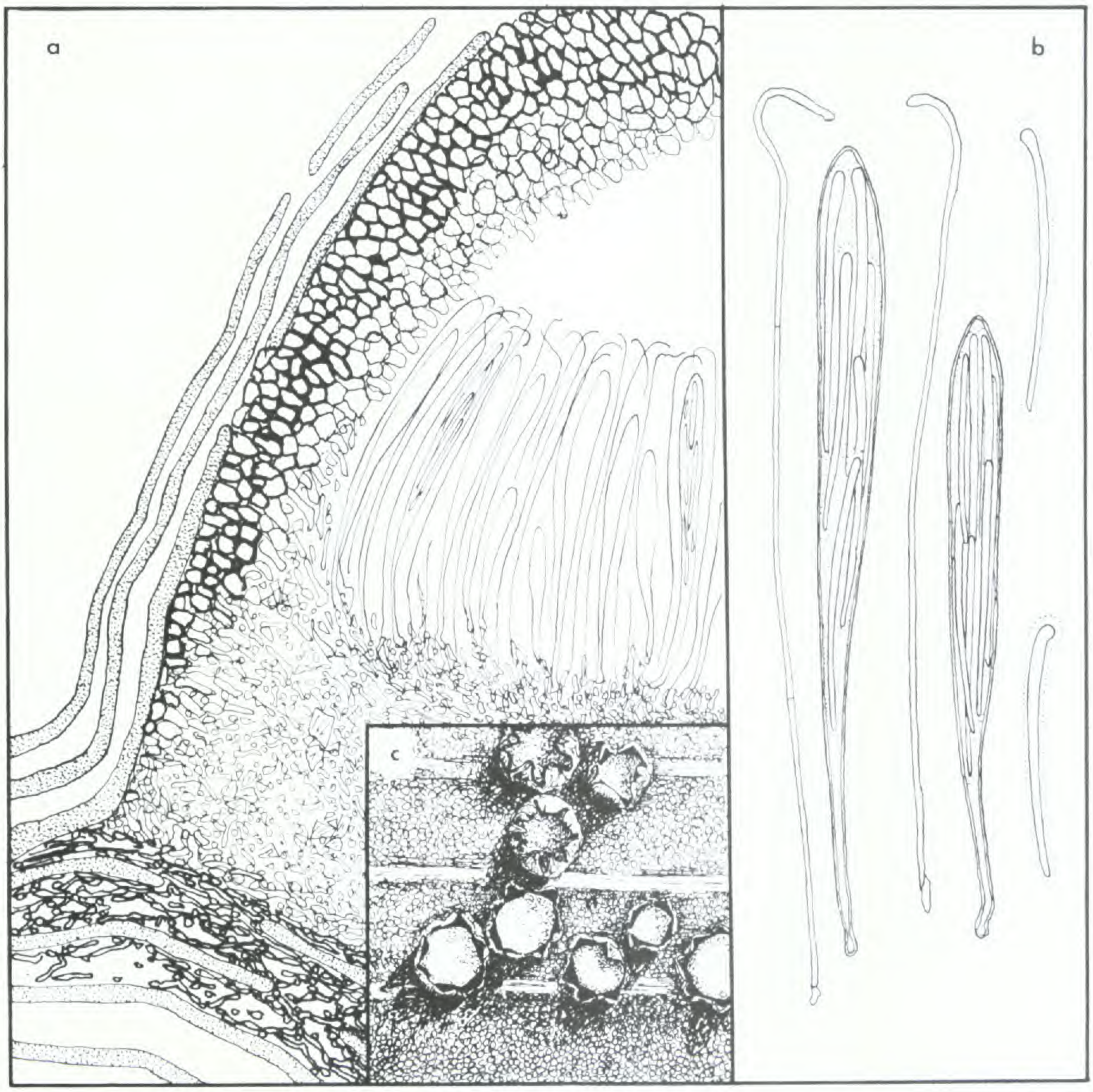

FIG. 43. *Coccomyces strobi*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch of rehydrated material, ×7.5.—c. habit sketch of rehydrated material, ×7.5. (a) and (b) from FH ex DAOM 20761; (c) from FH-Pfister 9.VI.1977.

pines, eastern North America, maturing in late spring, very common. Reid and Cain (1961) cite numerous specimens and discuss the name *Coccophacidium crustaceum*, which has been widely used for this species but was never validly published. Since the fungus is nearly ubiquitous and appears soon after the death of the portions of the host on which it occurs, it is tempting to brand it as parasitic and speculate on its importance, but nothing definite is known about the role of *C. strobi* in the ecology of its host.

Although introduced western North American pines planted in Boston are susceptible to *C. strobi*, no natural occurrences of this species west of the Rocky Mountains have been encountered either in the field or in herbaria.

Specimens examined:[7] NORTH AMERICA. CANADA: Midhurst, Simcoe County, Ontario, 4.VI.1953, Reid & Cain, isotype of *C. strobi* (BPI); New Brunswick, Marysville, Miller, VI.1916 (BPI). USA. Maine: Kittery Point, Thaxter, 1886 (FH). New Hampshire: Gorham, 14.VI.1915 (BPI). Massachusetts: Concord, Pfister, 9.VI.77 (FH); Boston, on *Pinus wallichiana*, 28.V.1977, Sherwood (FH); on *P. monticola*, *ibid.* (FH); on *P. avacahuite*, *ibid.* (FH). New York: Ithaca, Durand, 26.III.1904 (BPI). Ohio: Oxford, Fink, 2.VI.1912 (FH). Virginia: Arcadia, Hedgecock, 6.III.1928 (BPI). Illinois: 2.VI.1915, Dearness (BPI). Georgia: Talulah Falls, 12.IX.1910, Dearness (BPI). Pennsylvania: State College, 30.III.1933, White (FH). Minnesota: St. Louis Co., M. Palm, 6.VI.1978 (FH). Michigan: Ishpenning, 17.VI.1916, Hedgecock (BPI).

93. *Coccomyces strobilinus* Grelet, Rev. Mycol. (Paris) **24:** 88 (1959).

I was unable to locate type or other authentic or reliably identified specimens of this species. Grelet's description of elongate apothecia opening by a longitudinal slit rather than by teeth suggests a *Colpoma* rather than a *Coccomyces*.

94. **Coccomyces tesselatus** Sherwood, spec. nov. Figure 44

Ascocarpi primo immersi, tetragoni vel hexagoni, 0.5–0.8 mm diam, per lacinias aperientes, in macula pallida stromate obvallato insidentes. Margo superior stromatica 10 μm crassa, ex hyphis intertextis carbonaceis constata. Margo inferior stromatica 5 μm crassa, ex hyphis intertextis carbonaceis constata. Periphysoidei nulli. Excipulum hyalinum. Paraphyses filiformes, apice ad 4–5 μm incrassatae, achromae, in epithecio gelatinoso non inclusae. Asci cylindrici, haud pedicellati, 90–120 × 5.0–5.6 μm, 8-spori, in iodo non caerulescentes; sporis filiformibus, continuis, in tunica gelatinosa non inclusis, 80–90 × 0.8 μm. In foliis dejectis *Ingae*, tropical America.

Holotypus: CUP-PR 4050, along rte 105 at km 23.8, Maricao Forest Reserve, Puerto Rico, elev. 510 m, June 12, 1970, leg. R. P. Korf, J. Benson, D. H. Pfister, A. Y. Rossman & L. Skog. Isotypi: FH, MAPR, NYS.

Etymology: tesselatus (L), tiled, referring to the appearance of the much-dissected bleached spots on leaves.

Apothecia scattered in prominent bleached spots bounded by a black line stroma on dead coriaceous leaves, 4–6 sided, 0.5–0.8 mm diam, without a preformed dehiscence mechanism, black, shining, splitting open by irregular teeth to expose the bright yellow hymenium, drying orange, diffusing a soluble yellow pigment in water. Covering layer 10 μm thick, carbonized, the cells ca. 5 μm diam; periphysoids absent. Basal stroma 5 μm thick, carbonized. Proper exciple consisting of 3–4 rows of hyaline closely-septate hyphae 4–5 μm diam. Subhymenium colorless, 25 μm thick, separated from the basal stroma by a hyaline subiculum interspersed with a few colorless crystals. Paraphyses filiform, enlarged to 4–5 μm at the apex, colorless, not cemented in a gel. Asci cylindrical, short-stalked, J−, 90–120 × 5.5–6.0

[7] Only selected specimens of this common and frequently collected species are listed. Host is *Pinus strobus* unless otherwise indicated.

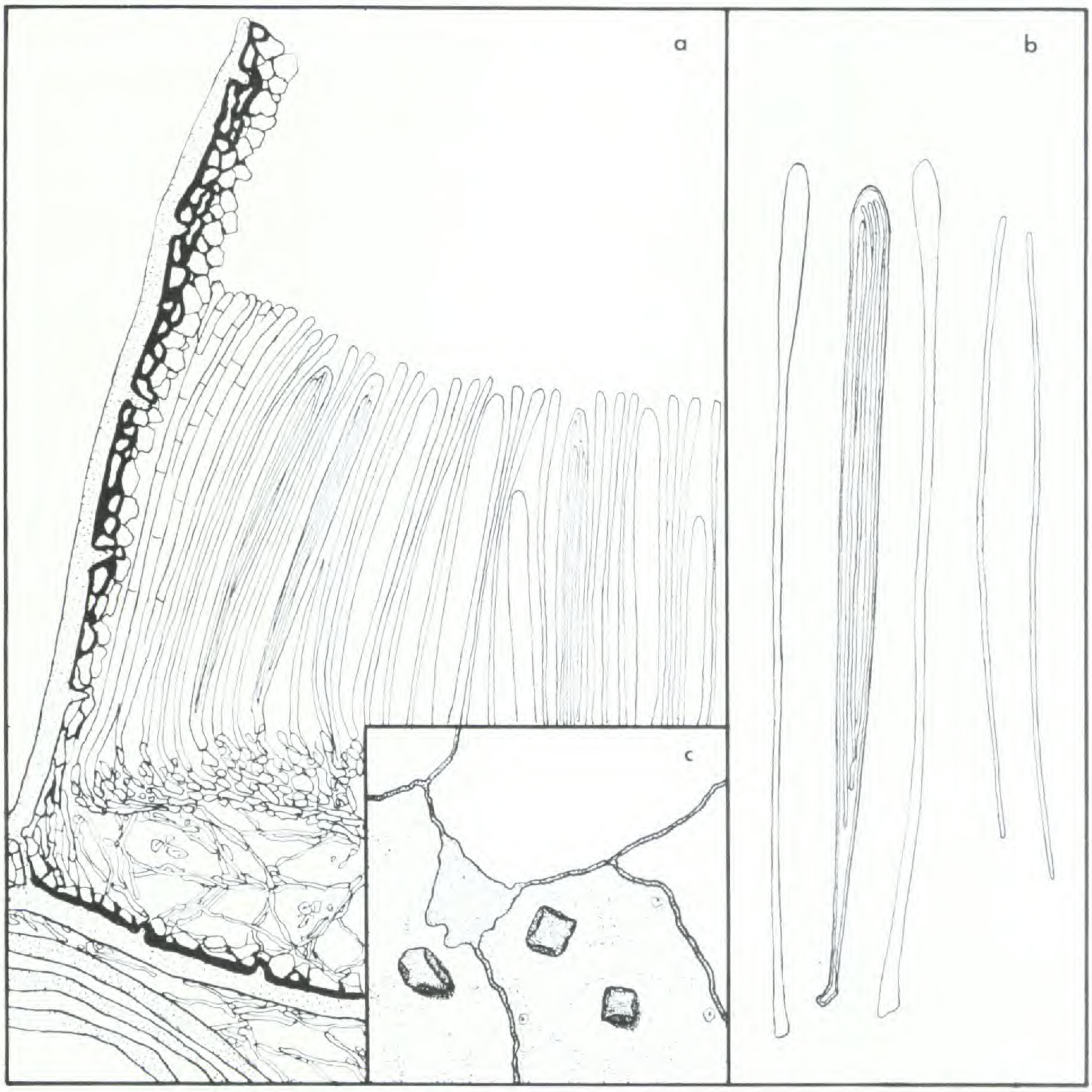

FIG. 44. *Coccomyces tesselatus*:—a. cross section of apothecium, ×375.—b. ascus, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from CUP PR 4050.

μm, 8-spored; ascospores 80–90 × 0.8 μm, not obviously sheathed.

On *Inga* and unidentified coriaceous leaves, tropical America, apparently fairly common. Basically *Coccomyces tesselatus* is distinguished from allied species by the intensely pigmented hymenium which diffuses a soluble yellow pigment in KOH.

Specimens examined (see also holotype, above): CARIBBEAN. PUERTO RICO: woods near Maricao Fish Hatchery, on *Inga laurina*, Korf et al., 15.VI.1970 (CUP-PR 4119); Mayagüez, Britton, 18-27.II.1914 (NY). GUADELOUPE: Transverse Road, Pfister et al., 4.I.1974 (FH-GUADELOUPE 844). GRENADA: Grand Etang, Thaxter 1912–13, 2612 (FH). DOMINICA: Roseau, Korf et al., 20.VI.1970 (CUP-DO 13, NY).

95. *Coccomyces tetracerae* (Rudolph in Fr.) Sacc., Sylloge Fungorum **8:** 748 (1889).
≡ *Phacidium tetracerae* Rudolph in Fr., Linnea **5:** 551 (1830).

≡ *Hysterostomella tetracerae* (Rudolph) Höhnel, (Sitzungsber. Acad. Wiss., Math.-Naturwiss. Kl. Abt. 1, **118:** 1541 (1909).

The type specimen in herb. Fries agrees well with the illustration and description provided by von Höhnel (l.c.) of a crustlike, multiloculate ascostroma which becomes apothecioid by cracking open irregularly, bitunicate asci, hyaline, 2-celled spores, and dark conidia with a hyaline equatorial band.

Specimen examined: CARIBBEAN. CUBA: on *Tetracera volubilis*, Poeppig, holotype of *Phacidium tetracerae* (UPS).

96. *Coccomyces tjibodensis* Racib. See *Biostictis tjibodensis*.

97. *Coccomyces triangularis* (Schw.) Sacc., Syll. Fung. **8:** 750 (1889). Figure 45

≡ *Peziza triangularis* Schw., Schriften Naturf. Gesell. Leipzig **1:** 122 (1822).

≡ *Cenangium triangularis* (Schw.) Fr., Syst. Mycol. **2**(1)**:** 182 (1822).

≡ *Colpoma triangularis* (Schw.) Petr., Sydowia **11:** 346 (1957) [1958].

Apothecia at first immersed, subcortical, becoming erumpent, remaining for a long time closed, covered by a thick, buff-colored, pruinose covering layer, triangular, square, or oblong in face view, never linear, without a preformed dehiscence mechanism, cracking open irregularly, usually by 3 teeth. Covering layer up to 400 μm thick, externally crystalliferous, with a thick, black, carbonized crust and an internal layer of thin-walled brown hyphae 2–4 μm diam running parallel to the surface, becoming thick-walled and carbonized on the interior face. Periphysoids abundant, 150 × 2–3 μm, branched but not netlike, imbedded in a gel. Basal stroma massive, up to 300 μm thick, the lower portion carbonized, separated from the subhymenium by a matrix of vertically oriented pale brown hyphae 5–8 μm diam, widely spaced in a gel. Subhymenium colorless, 40–50 μm thick. Asci clavate, long-stalked, 130–160 × 9–11 μm, 8-spored; ascospores 80–100 × 1.5 μm, nonseptate, narrowly sheathed. Paraphyses enlarged to 2.5 μm above, weakly circinate.

On dead twigs of *Quercus alba*, maturing in late summer and fall, eastern North America, common, apparently host specific. The generic position of the species is unclear. As Petrak (1958) indicated, it is scarcely a typical *Coccomyces*. The type of *Colpoma*, *C. quercinum* (Pers. ex Fr.) Wallr., is a hysterothecial fungus which invariably opens along a preformed longitudinal slit flanked by lip cells. I have chosen to exclude from *Colpoma* and include in *Coccomyces* those wood-inhabiting Rhytismataceae which lack a preformed longitudinal slit

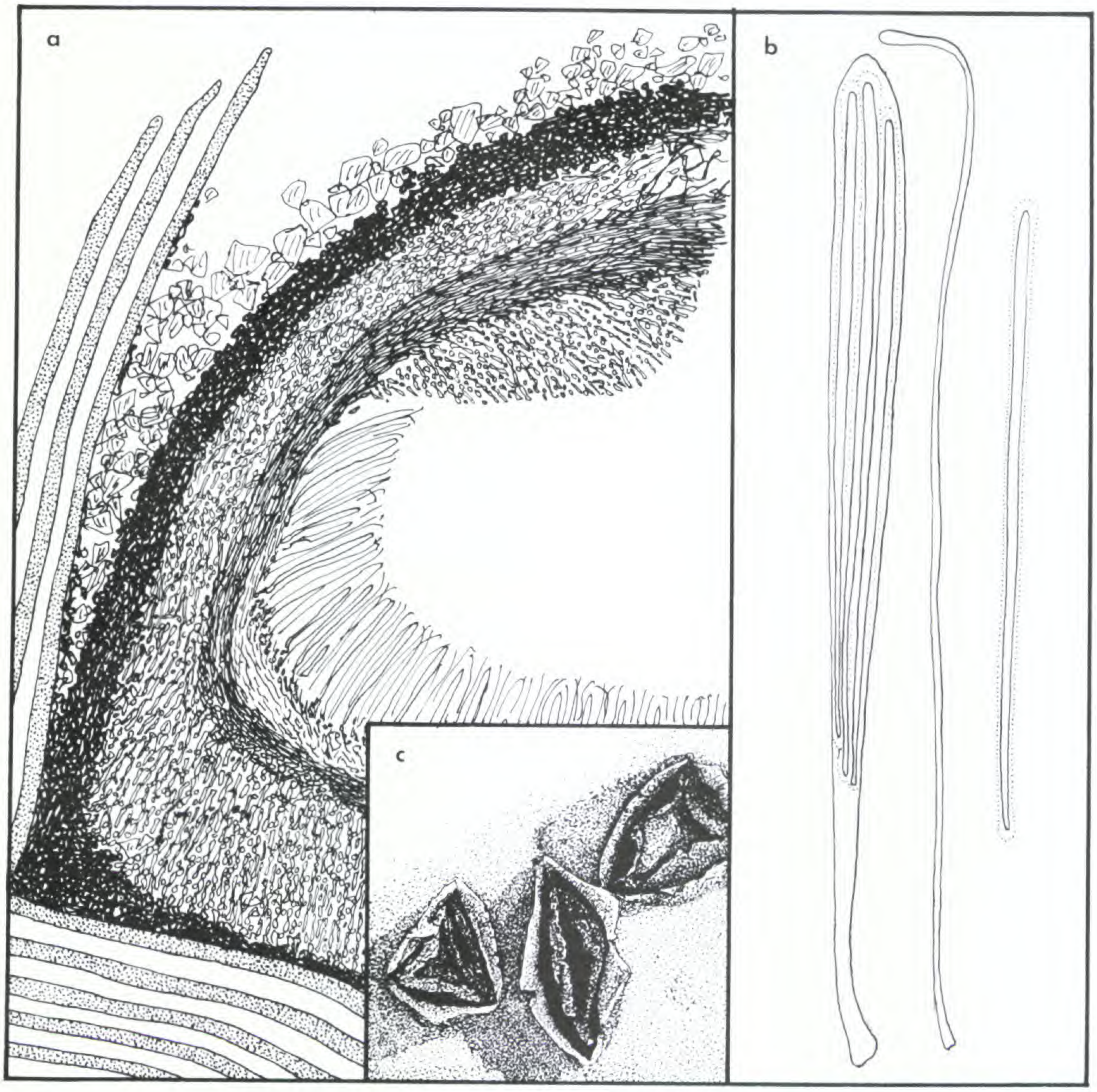

FIG. 45. *Coccomyces triangularis*:—a. cross section of apothecium, ×75.—b. ascus, paraphysis, and spores, ×750.—c. habit sketch, ×7.5. Drawn from Shear 5907 (FH).

and lip cells. *Coccomyces triangularis* is most closely related to *C. castanopsidis*, which occurs on Fagaceae in western North America. The morphological distinctions between these two species and typical leaf-inhabiting species of *Coccomyces* may well be sufficient to warrant erection of a separate genus to accomodate them; it would be premature, however, to propose generic segregates in *Coccomyces* without revising *Colpoma* as well.

Specimens examined:[8] NORTH AMERICA. CANADA: Komoka, Ontario, 8.V.1915, Dearness (BPI). USA. Massachusetts: Farlow, Newton, 4.VII.1891 (FH). Connecticut: Lakeville, Hansbrough, 7.VI.1933 (BPI). New York: Ithaca, 16.V.1933 (CUP 22, 561). New Jersey: Fungi Columbiani 410, Newfield, Ellis, VI.1894 (BPI, FH); Newfield, 1874, de Thuemen, Mycotheca Universalis 570 (FH). Pennsylvania?: Herb. Curtis, leg. Schweinitz, authentic

[8]Only selected specimens, indicating the geographical range, are cited.

(FH). Maryland: Takoma Park, Shear 5907, 1899 (FH). Washington, D.C.: 7.V.1899 (BPI). South Carolina: Ravenel, Fungi Caroliniani 2: 42 (FH). Georgia: Winterville, Miller, 26.IV.1926 (CUP 18266). Louisiana: Palmetto, Shear, 16.III.1932 (BPI). Ohio: Hocking Co., Fink, 6-4-1918 (BPI). Illinois: Kewaunee, Harper, V.1899 (FH).

98. *Coccomyces tridentatus* (Lév.) Sacc. See *Myriophacidium tridentatum*.

99. *Coccomyces trigonus* [Schm. & Kunze] Quél. See *Coccomyces tumidus*.

100. *Coccomyces tumidus* (Fr.) de Not., Giorn. Bot. Ital. **2** (7–8): 14, 38 (1847). Figure 46
≡ *Hysterium tumidum* Fr., Syst. Mycol. **2**(2): 591 (1823).

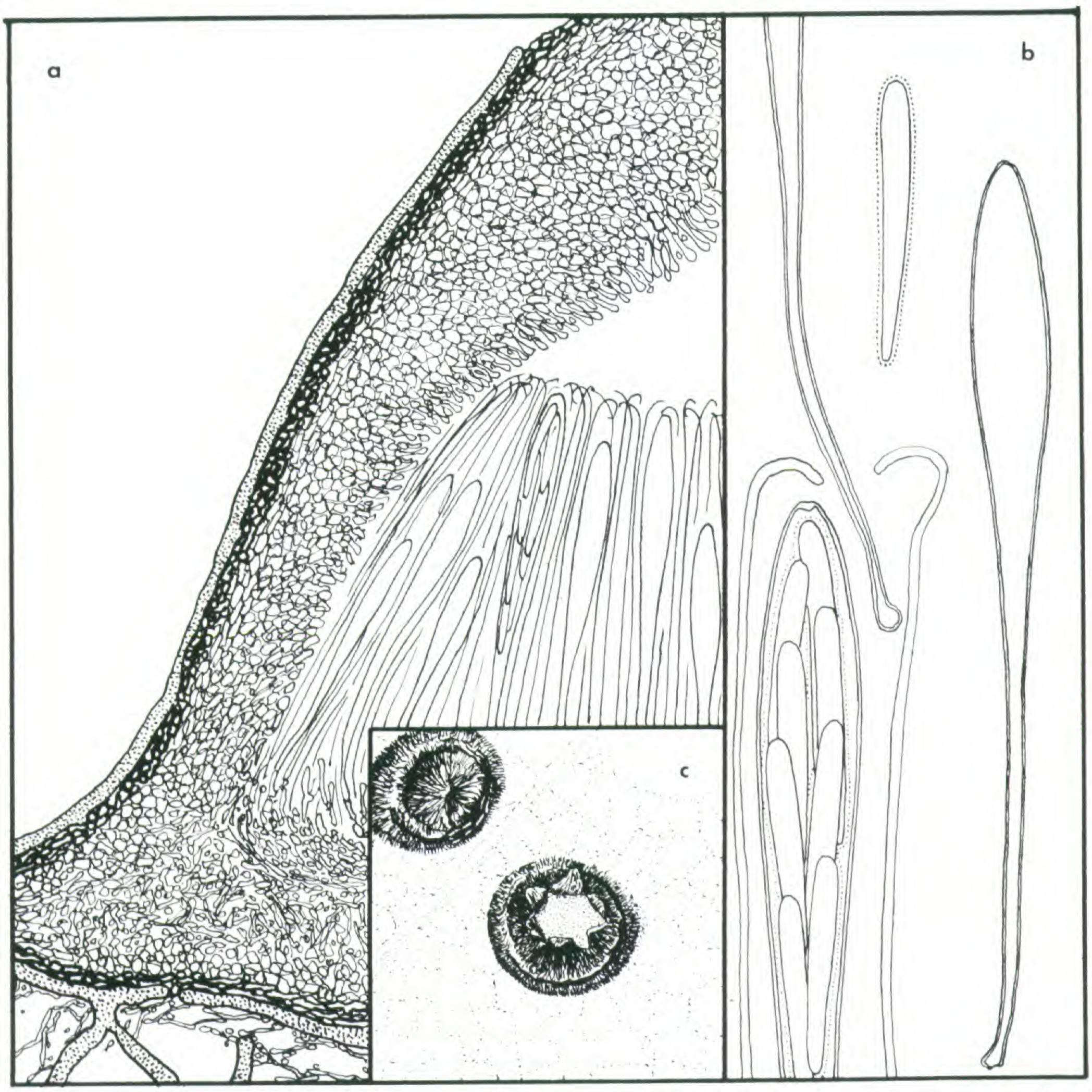

FIG. 46. *Coccomyces tumidus*:—a. cross section of apothecium, ×225.—b. detail of asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from Allerscher & Schnabl 548 (FH).

≡ *Lophodermium tumidum* (Fr.) Lamb., Fl. Myc. Belg. **2:** 452 (1880).

[= *Peziza comitialis* Batsch, Elench. Fung. cont. **1:** 217, t. 27 f. 152 (1786)].

≡ *Coccomyces comitialis* [Batsch] Dearn. & House, Bull. N.Y. State Mus. **266:** 65 (1925).

[= *Phacidium trigonum* Schm. & Kunze, Myc. Hefte **1:** 40 (1817)].

≡ *Coccomyces coronatus* ° ° ° *trigonus* [Schm. & Kunze] Karst., Bidrag Kännedom Finlands Natur Folk **19:** 257 (1871).

≡ *Coccomyces trigonus* [Schm. & Kunze] Quélet, Enchirid. Fung. 337 (1886).

= *Phacidium peltiforme* Preuss, Linnaea **26:** 724 (1853).

≡ *Coccomyces peltiformis* (Preuss) Sacc., Syll. Fung. **8:** 745 (1889).

= *Phacidium striatum* Phill. & Plowr., Grevillea 13: 75 (1885).

≡ *Coccomyces striatus* (Phill. & Plowr.) Massee, Brit. Fung. Fl. 4:51 (1895).

= *Henriquesia quercina* Grove, J. Bot. (London) **66:** 136 (1935).

Apothecia subcuticular, widely scattered on long-dead leaves, on bleached areas usually bounded by a black line, 1.0–2.0 mm diam, orbicular or elongate, dark brown, wrinkled, when immature appearing hat-shaped from above, with a flat brim, raised margin, and depressed center, fleshy when rehydrated, splitting open irregularly by teeth, or when hysterothecial by a longitudinal slit, to expose the dull yellow to yellowish-tan disc. Covering layer 120 μm thick, consisting of an outer layer of dark brown, but not heavily carbonized hyphae 3–5 μm diam, running parallel to the surface of the substrate, and a central matrix of fleshy brown globose pseudoparenchymatous cells 3–5 μm diam, separated from the subhymenium by a matrix of closely-packed, pale brown hyphae 2–5 μm diam. Subhymenium colorless, 45 μm thick. Asci clavate, long-stalked, 160–220 × 10–15 μm diam, J−, 8-spored. Paraphyses filiform, mostly unbranched, circinate, 1.5 μm broad. Ascospores 32–45 × 3.0–4.5 μm, nonseptate, but sometimes appearing pseudoseptate due to the presence of large guttules, narrowly sheathed.

On fallen leaves of a variety of plants, commonest on *Quercus* and *Fagus*, but reported on *Betula, Acer, Populus,* and *Gaultheria*, rarely on *Rubus* canes, late summer and fall, very common and widespread in Europe and North America. The hysterothecial form and orbicular form agree in all details of stroma construction and hymenial elements; I do not doubt that they are the same species. The two forms do not, however, commonly co-occur in the same lesion; hence, it is possible that there is some genetic distinction between them. One can learn to recognize this species on macroscopic

characters alone. The large, fleshy, rugose apothecia are unmistakable.

Considerable confusion exists in the literature concerning *Coccomyces tumidus*. The name *Lophodermium tumidum*, based on the hysterothecial form, was used by Rehm (1887–96) and others (for example, Romell in Fungi Scandinaviae Exs. 84 and Fuckel, Fungi Rhenani 746) for a bona fide and entirely distinct *Lophodermium* on *Sorbus aucuparia*. Nannfeldt (1932) realized that two taxa were involved, and used *L. tumidum* (ascribed to Rehm) for the *Lophodermium* on *Sorbus*, synonymizing Fries's species with *C. coronatus*. The epithet *tumidum* cannot legitimately be used in this sense, and now this species is known as *Lophodermium aucupariae* (Schleich. ex Schleich.) Darker.

The discocarpous form has widely been considered to be a synonym of *Coccomyces coronatus* and is distributed under that name in numerous exsiccatae. A partial list of such misidentifications is included in the list of specimens cited. Since the collections from which the exsiccatae specimens were drawn may well have been mixed, the presence of the species in the examples I examined does not guarantee that it was present in all sets of an exsiccata issued.

No type or authentic specimens of *Peziza comitialis*, *Phacidium trigonum*, or *Phacidium peltiforme* could be located; the synonymy is based on descriptions alone. The isotype specimen of *Hysterium tumidum* in FH is immature, but aggrees well in stromatal characters and appearance with better-developed specimens of the species.

Specimens examined:[9] EUROPE. SWEDEN: Fries, Scleromycetes Sueciae 166, on *Fagus*, isotype of *Hysterium tumidum* (FH). DENMARK: Sorø, on *Quercus*, Pfister, 9.X.1978 (FH). BELGIUM: Libert, Pl. Crypt. Ard. 175, on *Fagus*, sub *Phacidium coronatum* (BPI, LG, FH); Fungi Gallici 2279, on *Betula*, Brussels (FH). GERMANY: Sydow, Mycoth. Germ. 2714 p.p., Brandenberg, sub *C. coronatus* (BPI); Rehm, Ascomyceten 1803, on *Quercus*, sub *C. coronatus* (BPI, FH-Höhnel); Schmidt & Kunze, Deutschlands Schwämme 82 (BPI, *not* FH). CZECHOSLOVAKIA: Rudics, on *Populus tremula*, Svrček (PRM 149920); on *Betula*, Ulehle, Svrček (PRM 756277); on *Quercus*, Bohemia (PRM 620799); on *Fagus*, Brno (PRM 659122). POLAND: on *Quercus*, Kalmien, Kubicka, 2.IX.1966 (PRM 624897). ITALY: Erbar. Crittog. Ital. 780, on *Castanea*, Locarno, 1860 (FH). NORTH AMERICA. CANADA. Ontario: Dorset, on *Quercus rubra*, Cain, 11.IX.1963 (BPI). Nova Scotia: on *Populus tremuloides*, Wehmeyer 1198 (MICH); on *Fagus* and *Acer*, Wehmeyer 1297 (MICH). USA. Maine: Enfield, Shear, 23.VIII.1940 (BPI). New York: McClean, on *Rubus setosus* (CUP 14944); on *Betula*, Adirondack Mts., Kauffman & Mains (MICH). Massachusetts: Concord, Pfister, IX.1978 (FH). New Hamphire: Mt. Pacmonadnock, on *Quercus rubra*, Sherwood, IX.1978 (FH). Virginia: Mt. Lake on *Quercus*, 4.IX.1936, Cash (BPI). Washington: on *Gaultheria shallon*, Seattle, Piper, IX.1892 (BPI). Oregon: Woodburn, on *Quercus garryana*, Clemens (BPI); Blue River, on *Gaultheria*, Sherwood, VIII.1978 (FH).

101. **Coccomyces tympanidiosporus** Sherwood, spec. nov. Figure 47

Ascocarpi primo immersi, orbiculari vel irregulariter elongati, 0.5–1.0 mm diam, per lacinias irregulariter aperientes, in macula pallida insidentes. Margo superior

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[9]Only one specimen/host/locality has been included. "p.p." indicates that the collection involved included more than one species of *Coccomyces*.

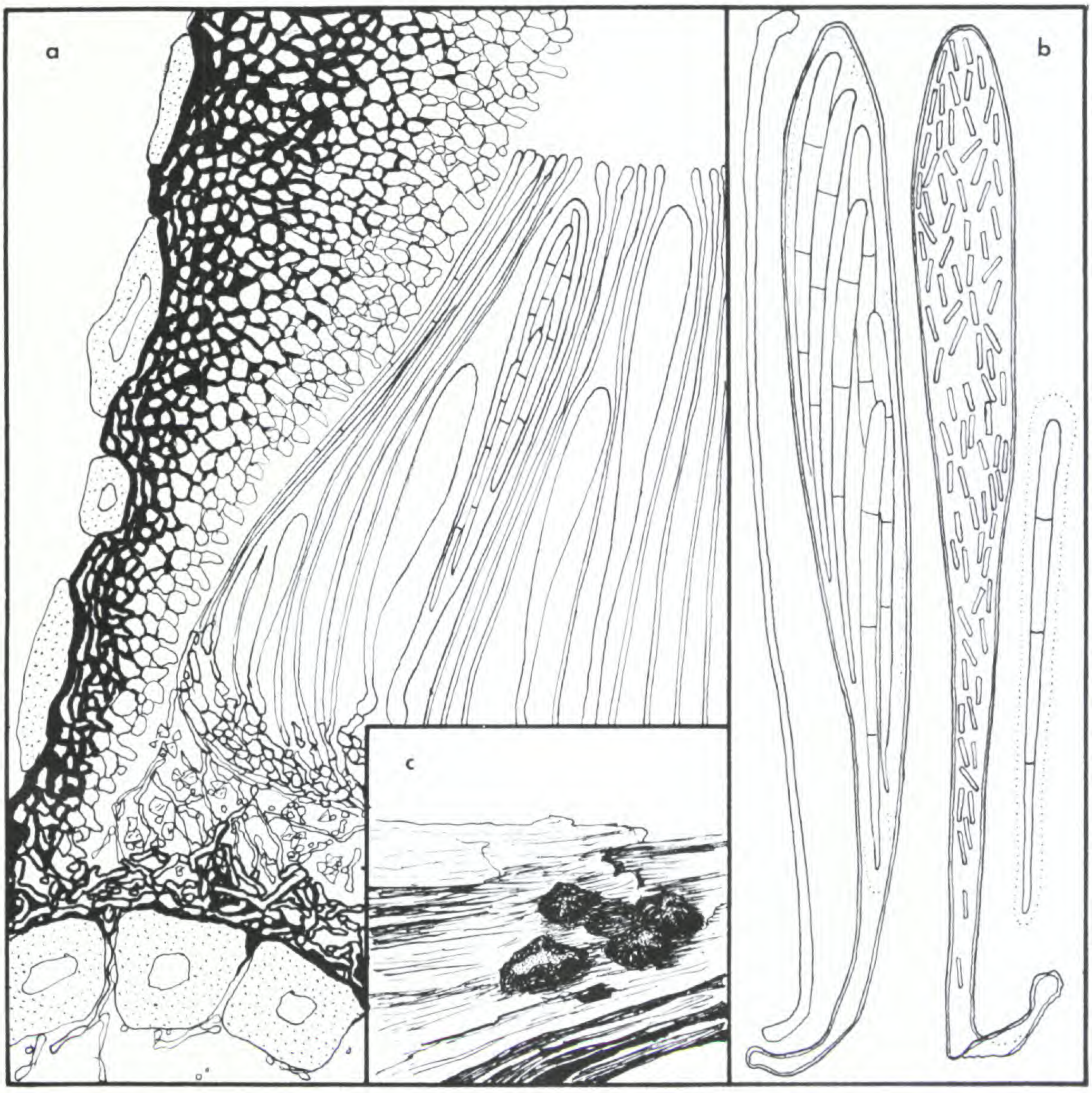

FIG. 47. *Coccomyces tympanidiosporus*:—a. cross section of apothecium, ×375.—b. asci, paraphysis, spores, and ascoconidia, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

stromatica 90 μm crassa, ex hyphis intertextis carbonaceis constata. Periphysoidei nulli. Margo inferior stromatica 20 μm crassa, ex hyphis carbonaceis constata. Excipulum nullum. Paraphyses filiformes, apice ad 3.0–3.5 μm incrassatae, in epithecio gelatinoso non inclusae. Asci 140–165 × 12.5–14.0 μm, clavati, pedicellati, 8-spori, in iodo non caerulescentes; sporis filiformibus, septatis, in tunica gelatinosa inclusis, 65–90 × 2.5 μm. In ligno decorticato, Ins. Canariensis.

Holotypus: CUP-Mycoflora Macaronesia 807, on pine? wood, La Palma, Canary Islands, along road in hills above la Giratte, Jan. 16, 1976, leg. W. C. Denison and M. A. Sherwood. Isotypus:FH.

Etymology: tympanidiosporus, (L), having spores like a *Tympanis*, i.e., producing ascoconidia by budding.

Apothecia at first immersed in old, bleached, decorticated wood, becoming more or less superficial by erosion of the overlying substrate,

gregarious and tending to form confluent crusts, 0.5–1.0 mm diam, orbicular to irregularly elongate but not linear, black, rugose, splitting open irregularly by 4–6 teeth to expose the clear orange hymenium. Covering layer 90 μm thick, heavily carbonized above, merging below into pale brown pseudoparenchyma of globose cells 8 μm diam, without periphysoids. Basal stroma carbonized, 20 μm thick, separated from the hymenium by a layer of small crystals and hyaline hyphae. Subhymenium colorless, 20 μm thick. Paraphyses filiform, unbranched, enlarged to 3.0–3.5 μm at the apex, not imbedded in a gelatinous epithecium, slightly agglutinated near the periphery of the ascocarp but not sufficiently differentiated to constitute a proper excipulum. Asci clavate, long-stalked, 140–165 × 12.5–14.0 μm, 8-spored; ascospores 65–90 × 2.5 μm, filiform, 3-septate, prominently sheathed, eventually budding off rod-shaped ascoconidia 5.0 × 1.0 μm.

Coccomyces ericae (q.v.) is similar, but the spores lack the conspicuous sheath, are not septate, and do not bud off ascoconidia. *Coccomyces ericae* also has a prominent proper exciple lacking in the present species.

Specimens examined (see also holotype, above): ATLANTIC ISLANDS. CANARY ISLANDS: on *Cistus monspeliensis* 17 km SW of San Sebastian de la Gomera, towards Tejiade, Gomera, 4.I.1977, Korf et al. (CUP-MM 1375).

102. *Coccomyces umbonatus* (Preuss) Sacc., Syll. Fung. **8:** 750 (1889).
≡ *Phacidium umbonatum* Preuss, Linnaea **26:** 724 (1853).

I was unable to locate any type or authentic material of this species, which was described from bark of *Pinus* in Europe. It may be a synonym of *Therrya pini*.

103. **Coccomyces urceolus** Sherwood, spec. nov. Figure 48

Ascocarpi primo immersi, tetragoni, 0.3–0.6 mm diam, per lacinias aperientes, en macula pallida stromate obvallati insidentes. Margo superior stromatica 30 μm crassa, ex hyphis intertextis brunneis constata. Periphysoidei nulli. Margo inferior stromatica 8–10 μm crassa, ex hyphis intertextis carbonaceis constata. Excipulum brunneum. Paraphyses filiformes, apice ad 3 μm incrassatae, in epithecio gelatinoso non inclusae. Asci 75–100 × 4.0 μm, cylindrici, haud pedicellati, 8-spori, in iodo non caerulescentes; sporis filiformibus, continuis, in tunica gelatinosa non inclusis, 50–75 × 0.8 μm. In foliis dejectis ignotis, Venezuela.

Holotypus: NY-Fungi of Venezuela 2053, on unidentified leaf ca. 14 km above Maracay, on the Maracay-Choroni road, Parq. Nac. Henry Pittier, Edo. Aragua, K. P. Dumont, J. H. Haines, & G. J. Samuels, 12 July 1971.

Etymology: urceolus (L), urceolate, referring to the deeply immersed fruitbodies.

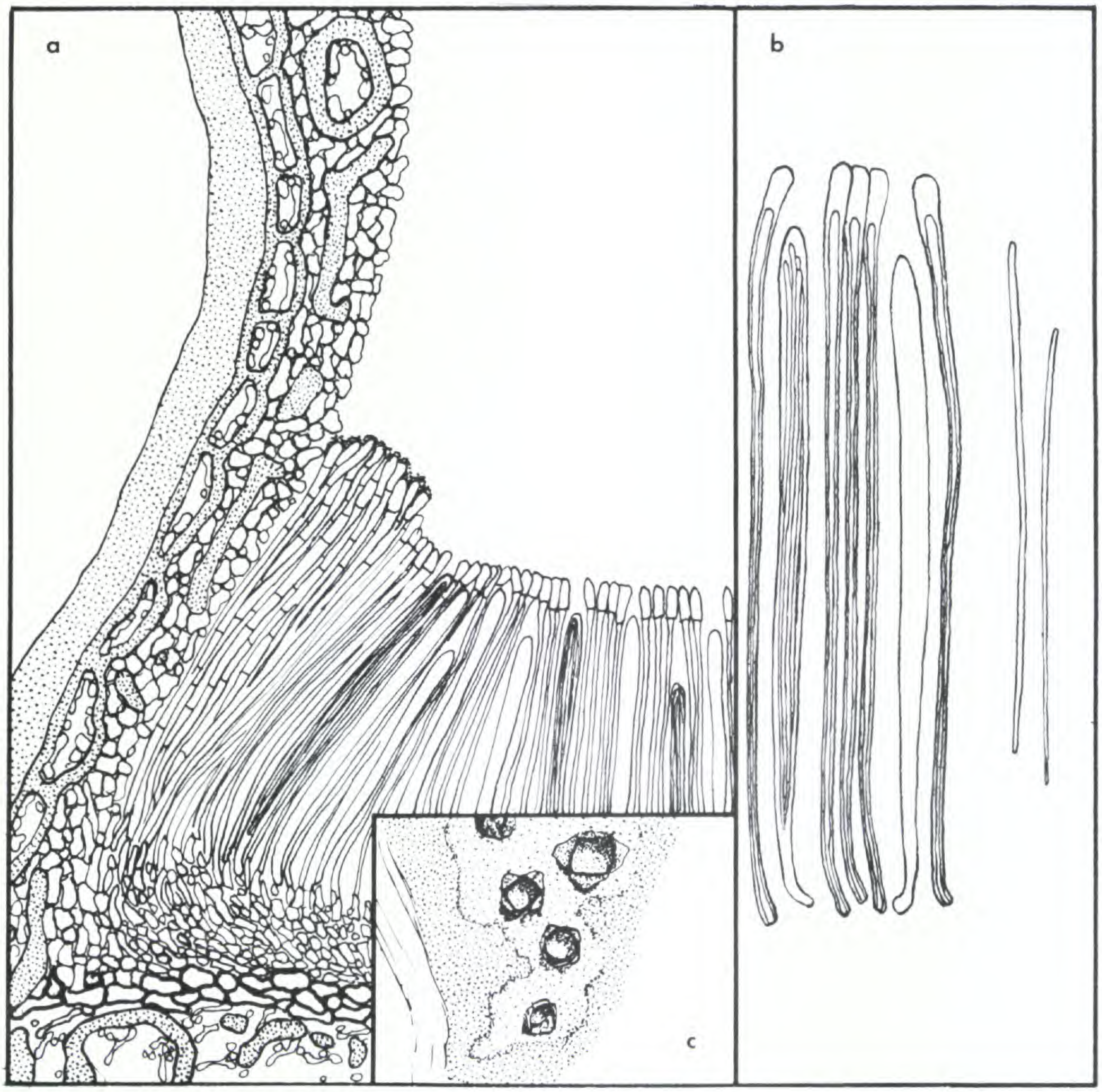

FIG. 48. *Coccomyces urceolus*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and ascospores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

Ascocarps subepidermal, scattered in slightly bleached areas bounded by a black line on decaying coriaceous leaves, at first appearing as concolorous pustules bounded by a black line, later opening by 4–5 irregular teeth, without a preformed dehiscence mechanism, 0.3–0.6 mm diam. Covering stroma 30 μm thick, of brown, noncarbonized hyphae, without periphysoids. Basal stroma 8–10 μm thick, carbonized, the cells 5–7 μm diam. Proper exciple 30 μm thick, well-developed, of closely septate hyphae 2–3 μm diam, brown above. Subhymenium colorless, 15 μm thick. Asci cylindrical, short-stalked, 75–100 × 4.0 μm, 8-spored, J−. Paraphyses filiform, enlarged to 3.0 μm at the apex, the apex solid and refractive. Ascospores 50–75 × 0.8 μm, nonseptate, not obviously sheathed.

On leaves, tropical America. The thickened, solid, refractive apices

of the paraphyses are distinctive and distinguish this taxon from *Coccomyces leptosporus*, which is also intraepidermal rather then subepidermal.

Specimens examined (see also holotype, above): CARIBBEAN. GUADELOUPE: Grand Etang, Pfister & Sarreira 527 (FH). SOUTH AMERICA. VENEZUELA: Rancho Grande, Parque Nac. Henry Pittier, Edo. Aragua, Dumont, Haines, & Samuels, 3.VII.1971 (NY-Ve 1213).

104. *Coccomyces ursinus* (Sacc. & Paol.) Petr., Ann. Mycol. **32:** 322 (1936).

≡ *Coccomyces quadratus* [Schm. & Kunze] Sacc. subsp. *ursinus* Sacc. & Paol., Bull. Soc. Bot. Belg. **28:** 96 (1889).

According to B. Eriksson (1970), no type specimen of this taxon remains, but it is probably a synonym of *Naemacyclus phacidioides*.

105. **Coccomyces venezuelae** Sherwood, spec. nov. Figure 49

Ascocarpi primo immersi, trigoni vel tetragoni, 0.2–0.4 mm diam, per lacinias aperientes, in macula pallida non insidentes. Margo superior stromatica 20 µm crassa, ex hyphis intertextis brunneis constata. Periphysoidei nulli. Margo stromatica inferior

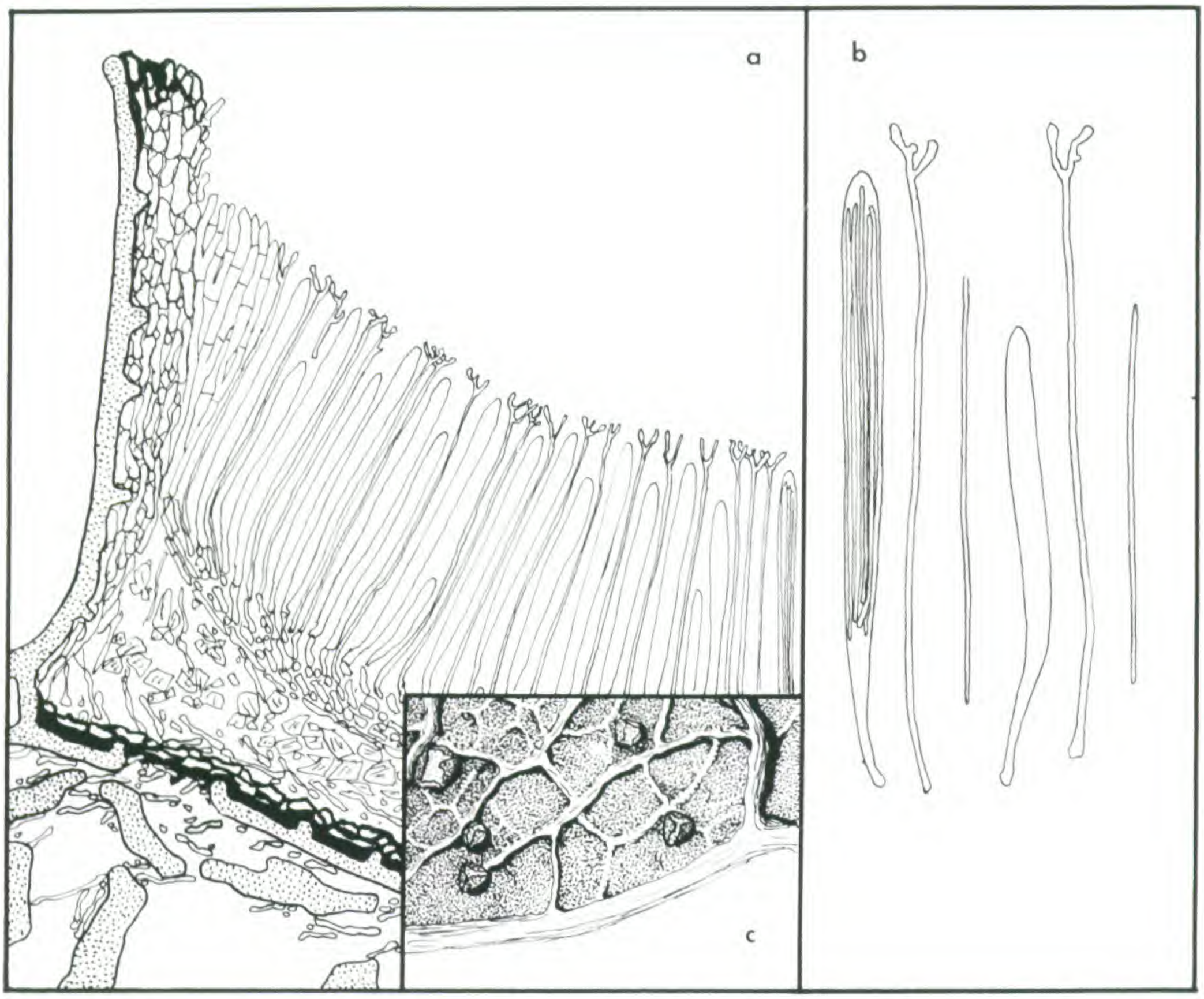

FIG. 49. *Coccomyces venezuelae*:—a. cross section of apothecium, ×375.—b. asci, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

10 μm crassa, ex hyphis intertextis carbonaceis constata. Excipulum hyalinum. Paraphyses filiformes, ramosae, apice non incrassatae, achromae, in epithecio gelatinoso non inclusae. Asci 75 × 4.5–5.5 μm, cylindrici, haud pedicellati, 8-spori, in iodo non caerulescentes; sporis filiformibus, continuis, in tunica gelatinosa non inclusis, 50–60 × 0.8 μm. In foliis dejectis ignotis, Venezuela, Amer. Austral.

Holotypus: NY-Fungi of Venezuela 221, on unidentified leaf, El Eden, Parq. Nac. El Avila, Edo. Miranda, K. P. Dumont, J. H. Haines & B. Manara, 19 June 1971.

Etymology: venezuelae (L), from the country where the species occurs.

Apothecia intraepidermal, not accompanied by obvious bleaching or a black line, on well-rotted leaves, 0.2–0.4 mm diam, when immature appearing as nearly concolorous pustules bounded by a faint black line, splitting open to expose the pale yellow disc, the reflexed lobes of the covering layer translucent. Covering layer 20 μm thick, of pale brown hyphae 3–5 μm diam, carbonized along the lines of dehiscence; basal stroma 10 μm thick, heavily carbonized. Subhymenium colorless, 15 μm thick, separated from the basal stroma by a matrix of colorless hyphae and crystals. Excipulum 20 μm thick, of closely-septate colorless hyphae 2.5–3.0 μm diam. Asci cylindrical, short-stalked, 75 × 4.5–5.5 μm, J−, 8-spored. Paraphyses filiform, colorless, not enlarged apically, branched. Ascospores 50–60 × 0.8 μm, nonseptate, not obviously sheathed.

On well-rotted leaves, Venezuela. Short asci, branched paraphyses, a reduced covering layer, and lack of bleached spots bounded by a black line distinguish this species from *Coccomyces leptosporus* and its allies.

Specimen examined (see also holotype, above): SOUTH AMERICA. VENEZUELA: Parq. Nac. El Avila, Edo. Miranda, Dumont et al., 30.VI.1972 (NY-Ve-3816).

106. *Coccomyces vilis* Sydow & Butler, Ann. Mycol. **9:** 377 (1911).
Figure 50

= *Coccomyces memecycli* Sydow, Ann. Mycol. **12:** 570 (1914).

?= *Naemacyclus korfii* Rao, Ullasa & Patil, J. Shivaji Univ. **5: 131 (1972).**

Apothecia imbedded in distinct bleached necrotic spots bounded by raised reddish discolored veins, 0.2–0.5 mm diam, orbicular or triangular, when closed with a dark rim and dark radiating lines marking the zones of dehiscence, otherwise scarcely darker than the surrounding leaf tissue. Apothecia intraepidermal, hypophyllous, the covering layer nearly obsolete, with 15 μm of dark carbonized cells surrounding the zone of dehiscence; basal stroma ca. 20 μm thick, carbonized, separated from the subhymenium by a colorless subiculum. Subhymenium colorless, 20 μm thick. Asci 70–90 × 5.0–6.5 (fide

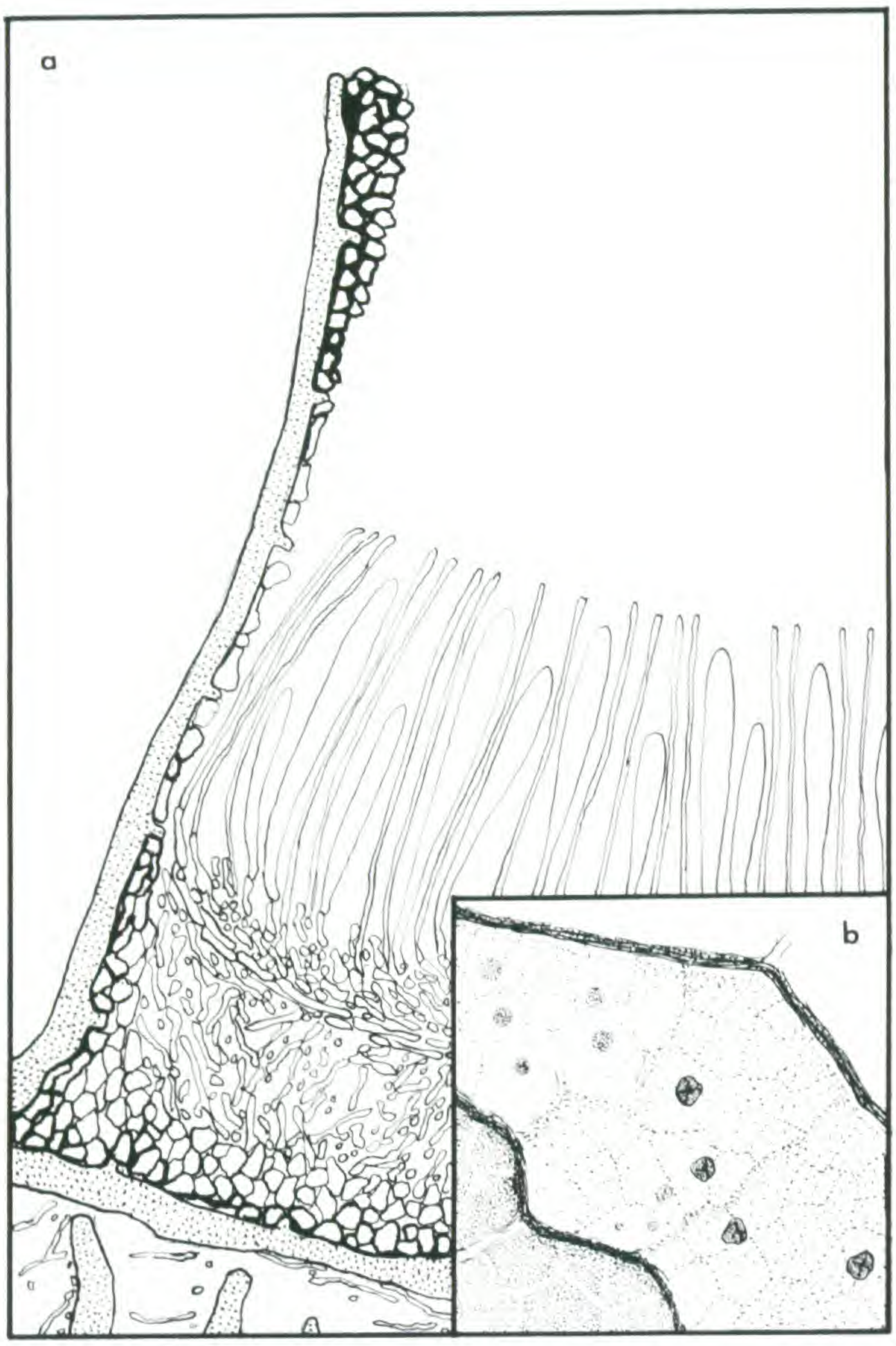

FIG. 50. *Coccomyces vilis:*—a. cross section of apothecium, ×375.—b. habit sketch, ×7.5. Drawn from the holotype.

Sydow) μm, 8-spored; ascospores filiform, colorless, nonseptate, nearly as long as the asci. Paraphyses colorless, unbranched, scarcely enlarged above.

On living leaves of *Mangifera indica*, Malda, India, and possibly on other hosts throughout tropical Asia. The holotype of the species, cited below, is extremely immature. The type specimen of *Coccomyces memecycli* is in poor condition but agrees externally with *C. vilis*; the asci of *C. memecycli* were, however, originally described as being 8.0–9.5 μm broad. *Coccomyces javanicus* (q.v.) may be an older name, but the synonymy is open to question. Another possible synonym, judging from the description, is *Naemacyclus korfii*, on *Carissa* from India. *Coccomyces puiggarii*, occurring in Brazil, is a very similar

species, known only from a depauperate type specimen. Insufficient information precludes either synonymizing these two species or separating them definitively on morphological grounds.

Specimens examined: ASIA. INDIA: Herb. Crypt. Orient 1372, on *Mangifera indica*, Malda, 5-8-1905, coll. E. Butler, holotype of *C. vilis* (S). PHILIPPINES: auf *Memecyclon lanceolatum*, Luzon, Antipolo, Prov. Rizal, leg. Ramos, 19.I.1914, holotype of *C. memecyli* (S); Elmer, Phillipine Island Plants 16236, Luzon, Mt. Bulusan, June, 1916 (FH).

107. *Coccomyces villae-vicosae* Torrend, Bull. Soc. Portugaise Sci. Nat. **3:** 7 (1919).

I was unable to locate any type or authentic material of this species, described on pine wood from Portugal. It is impossible to determine from the original description whether it is a species of *Coccomyces*, *Colpoma*, or *Therrya*.

108. *Coccomyces viridis* (Richon) Sacc., Syll. Fung. **10:** 51 (1892).
≡ *Phacidium viride* Richon, Cat. Champ. Marne 223 (1889).

I was unable to locate any material, type or otherwise, of this species. The original publication describes a fungus 1–2 mm diam, opening by teeth, with a brown epithecium and spores 40 μm long, occurring on bark of *Populus*. The description might possibly pertain to a fungus similar to *Propolidium fuscocinereum* Ell. & Ev., which occurs on *Populus* in North America; *P. fuscocinereum*, however, has spores only 20 μm long.

109. *Coccomyces wagnerianus* (Rehm) Rehm, Ber. Bayerische Bot. Gesellsch. **13:**131 (1912). Figure 51
≡ *Belonidium wagnerianum* Rehm in Rabenh., Krypt.-Fl. ed. 2, **1**(3): 1230 (1896).

Apothecia gregarious, at first immersed, 0.5–1.5 mm diam, often elongate, black, opening along preformed lines of dehiscence, either by teeth or by a longitudinal slit to expose the yellowish disc. Covering stroma 100 μm thick, carbonized without, fleshy within, of brown globose cells 5–8 μm diam, the margins provided with unbranched lip cells 30 × 3.0 μm diam. Lower stroma 20 μm thick, carbonized. Subhymenium colorless, 50 μm thick. Asci clavate, long-stalked, 100–120 × 12 μm, J−, 8-spored; ascospores 25–35 × 3.0–3.5 μm, nonseptate, narrowly sheathed. Paraphyses circinate.

On *Opuntia rafinesquii*, Germany. The species is undeniably rhytismataceous, but its correct generic placement is uncertain. It may be an unusual growth form of a *Hypoderma*.

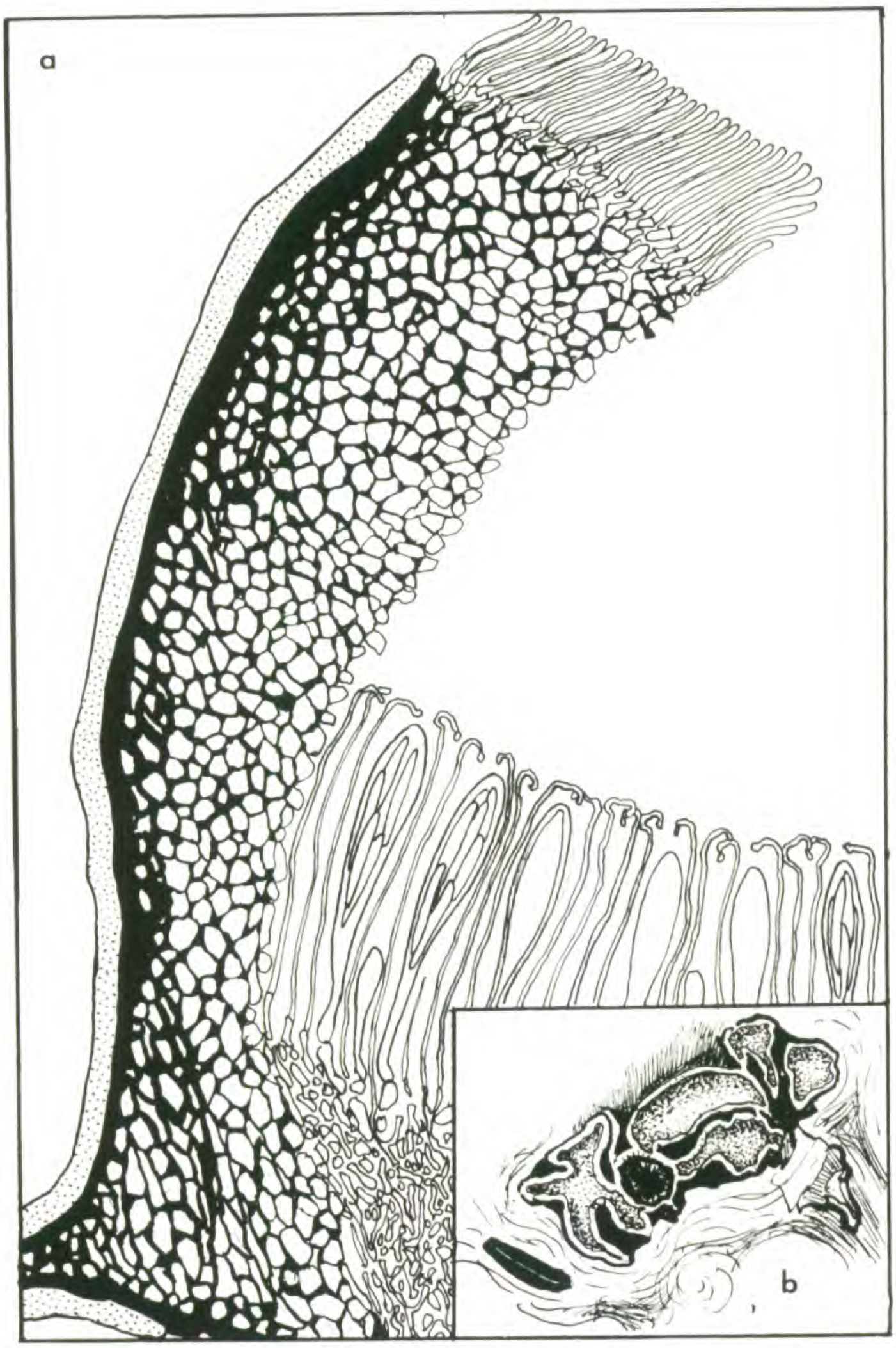

FIG. 51. *Coccomyces wagnerianus*:—a. cross section of apothecium, ×375.—b. habit sketch, ×7.5. Drawn from the holotype.

Specimen examined: EUROPE. GERMANY: a faul. *Opuntia rafinesquii* Engelm., 8.1893, in hort. meo leg. E. Wagner, holotype of *Belonidium wagnerianum* (S).

110. *Coccomyces yerbae* Speg., Ann. Mus. Nac. Buenos Aires **17:** 132 (1908).

The type specimen contains three minute apothecia of a *Coccomyces* occurring on bleached spots on dead leaves of *Ilex paraguayensis*. According to the original description the asci measured 50 × 5–6 μm and the ascospores were 1 μm broad. Without additional material on this host from South America the species cannot be characterized entirely; it appears to be closely related to *C. spegazzinii*.

Specimen examined: SOUTH AMERICA. ARGENTINA: S/*Ilex paraguayensis*, Misiones, San Pedro, II.1906, leg. C. Spegazzini, holotype of *C. yerbae* (LPS 28184).

ALLIED GENERA AND EXCLUDED SPECIES

Biostictis Petr., Sydowia **4:** 357 (1950).

Biostictis, a genus of the Stictidaceae, is characterized by a parasitic habit, immersed apothecia framed by a toothed, crystalline margin, cylindrical capitate asci, and cylindrical or filiform, septate ascospores. For further information and a formal description of the genus, see Sherwood (1977a, 1978). *Coccomyces tjibodensis* Racib. is a *Biostictis*. It may be distinguished from the other species in the genus as follows:

KEY TO BIOSTICTIS SPECIES

1. Ascospores filiform, multiseptate, nearly as long as the asci . . . . . 2.
1′. Ascospores cylindrical or cylindric-fusiform, much shorter than the asci, 3–5 septate . . . . . 3.
    2(1). Marginal hyphae in part pigmented. Ascospores 2.0 µm broad. On *Lasianthus*, Puerto Rico . . . . . *B. portoricensis* Sherw.
    2′(1). Marginal hyphae colorless. Ascospores 1.5 µm broad. On various Rubiaceae, South America. . . . . *B. psychotriae* (Mont.) Sherw.
3(1′). Ascospores 3-septate; paraphyses branched. On undetermined leaves, Trinidad. . . . . *B. chroodiscoides* Sherw.
3′(1′). Ascospores 5-septate; paraphyses unbranched. On *Lasianthus* spp., southeast Asia. . . . . *B. tjibodensis*.

Biostictis tjibodensis (Racib.) Sherw., comb. nov. Figure 52

≡ *Coccomyces tjibodensis* Racib., Paras. Alg. Pilze Javas **3:** 19 (1900).

= *Coccomyces mussaendae* Sawada, Rept. Gov. Res. Inst. Formosa **87:** 2 (1944) nom. inval.

Apothecia hypophyllous, gregarious in reddish discolored patches on living leaves, at first immersed, opening by splitting the overlying substrate irregularly, 0.3–0.6 mm diam, the margin brown, not crystalline, the disc moderately deeply immersed, dark brown. The reflexed epidermal lobes tend to break off. Margin consisting of disintegrating host tissue and hyphae, lined on the inner face with a compact layer of colorless, branched, periphysoids 15 × 1.0 µm. Subhymenium colorless. Asci cylindrical, thick-walled when young, with an indistinct apical thickening when mature, J−, 65–85 × 10–15 µm, 8-spored. Ascospores 24–30 × 2.5–3.0 µm, 5-septate, constricted at the septa, not sheathed. Paraphyses filiform, unbranched, colorless, 1.0 µm diam.

On *Lasianthus* and *Mussaenda* (Rubiaceae), Java, Philippine Islands, Taiwan, and China, common, according to Raciborski (l.c.). No conidial stage was found associated with any of the specimens examined, although conidial stages have been reported for other species of *Biostictis* (Petrak, 1950; Sherwood, 1978). Sawada (l.c.) described *Coccomyces mussaendae* as causing reddish-brown lesions, having ascocarps 0.3–0.8 mm diam, 8-spored asci 60–65 × 7–10 µm, and

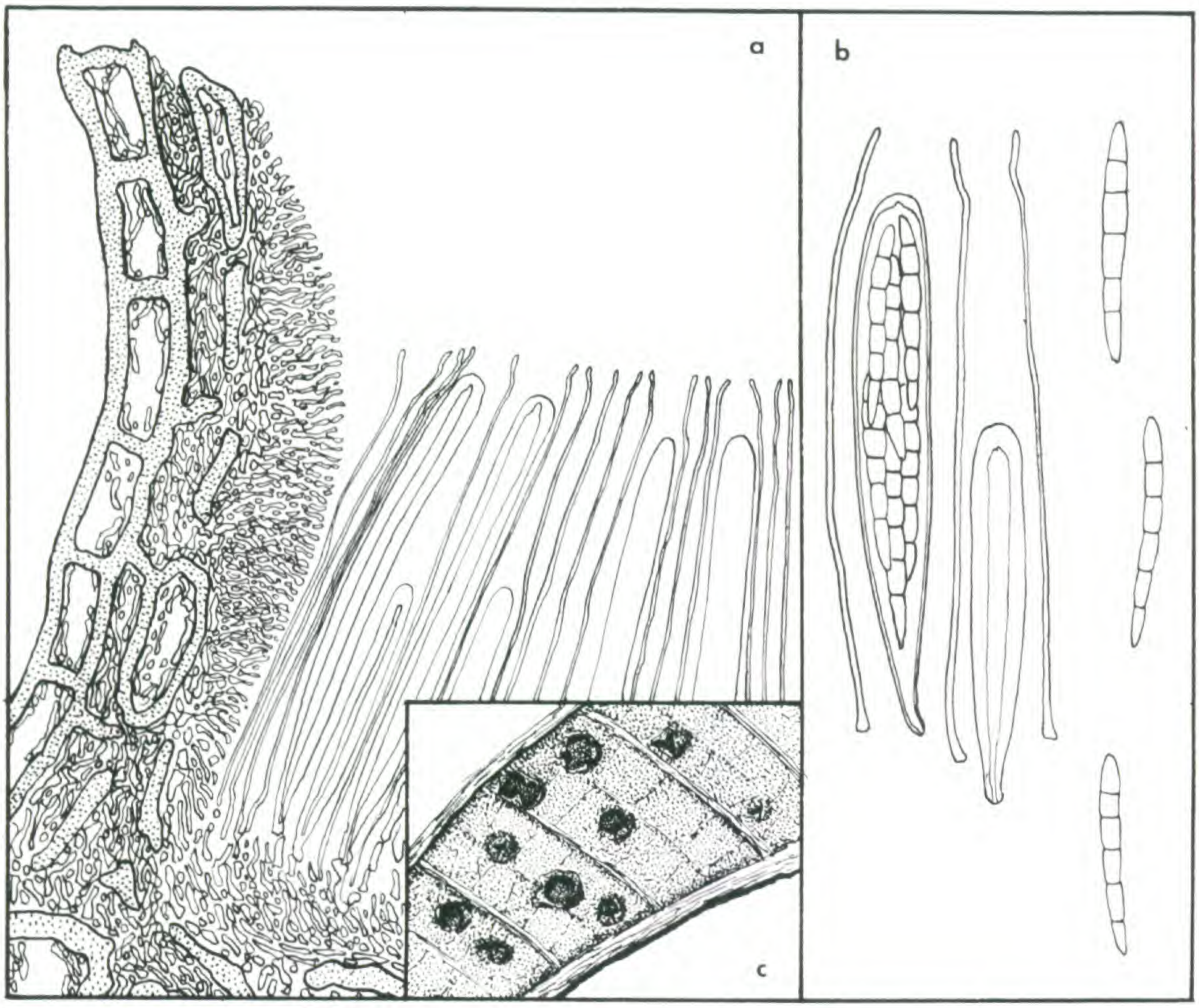

FIG. 52. *Biostictis tjibodensis*:—a. cross section of ascocarp, ×750.—b. asci, ascospores, and paraphyses, ×750.—c. habit sketch, ×7.5. Microanatomical details from ZT-Raciborski-Salak; habit sketch from ZT-Philippine Fungi 5200.

5-septate spores 31–38 × 2.0–2.5 μm. I have not seen type material, but suspect it is a synonym of *B. tjibodensis*. The name *C. mussaendae* is invalid since Sawada did not provide a Latin diagnosis for it.

Specimens examined: ASIA. JAVA: on *Lasianthus latifolius*, Gedeh, leg. Raciborski, isotype (?) of *Coccomyces tjibodensis* (FH-Höhnel 4526); on *Lasianthus* spec., Salak, leg. Raciborski, isotype? (ZT). PHILIPPINE ISLANDS: on *Lasianthus tashiroi*, Mindanao, M. S. Clemens 5200 (ZT). CHINA: on *Lasianthus*, Yunnan, Tsai 5267, 25.XII.1932 (FH).

Cerion Massee & Rodway, Bull. Misc. Inform. **1901:** 159 (1901).

Stromata erumpent from woody plant parts, eventually appearing nearly superficial, massive, heavily carbonized, when mature opening by splitting irregularly to expose the hymenium and remaining as a thick, rugose margin mimicking a true excipulum, internally composed of pseudoparenchymatous hyphae arranged nearly perpendicular to the surface. Asci cylindrical, short-stalked, uniformly thin-walled, J−. Paraphyses filiform, colorless, simple or branched. Ascospores long-filiform, obscurely sheathed, simple or 1-septate.

Cerion was formerly included in the Stictidaceae; its rhytismataceous affinities are discussed by Dennis (1958) and Sherwood (1977a). The genus includes two species, *C. coccineum* Massee & Rodway, from Australasia, and *C. leucophaeum* (Speg.) Dennis, from tropical America. The involved synonymy of the latter includes species of *Gorgoniceps, Coccomyces,* and *Godronia.*

Cerion leucophaeum (Speg.) Dennis, Kew Bull. **13:** 465 (1958).
Figure 53

≡ *Gorgoniceps leucophaeus* Speg., Bol. Acad. Nac. Ci. **11:** 589 (1889).

= *Godronia splendida* Speg., l.c.

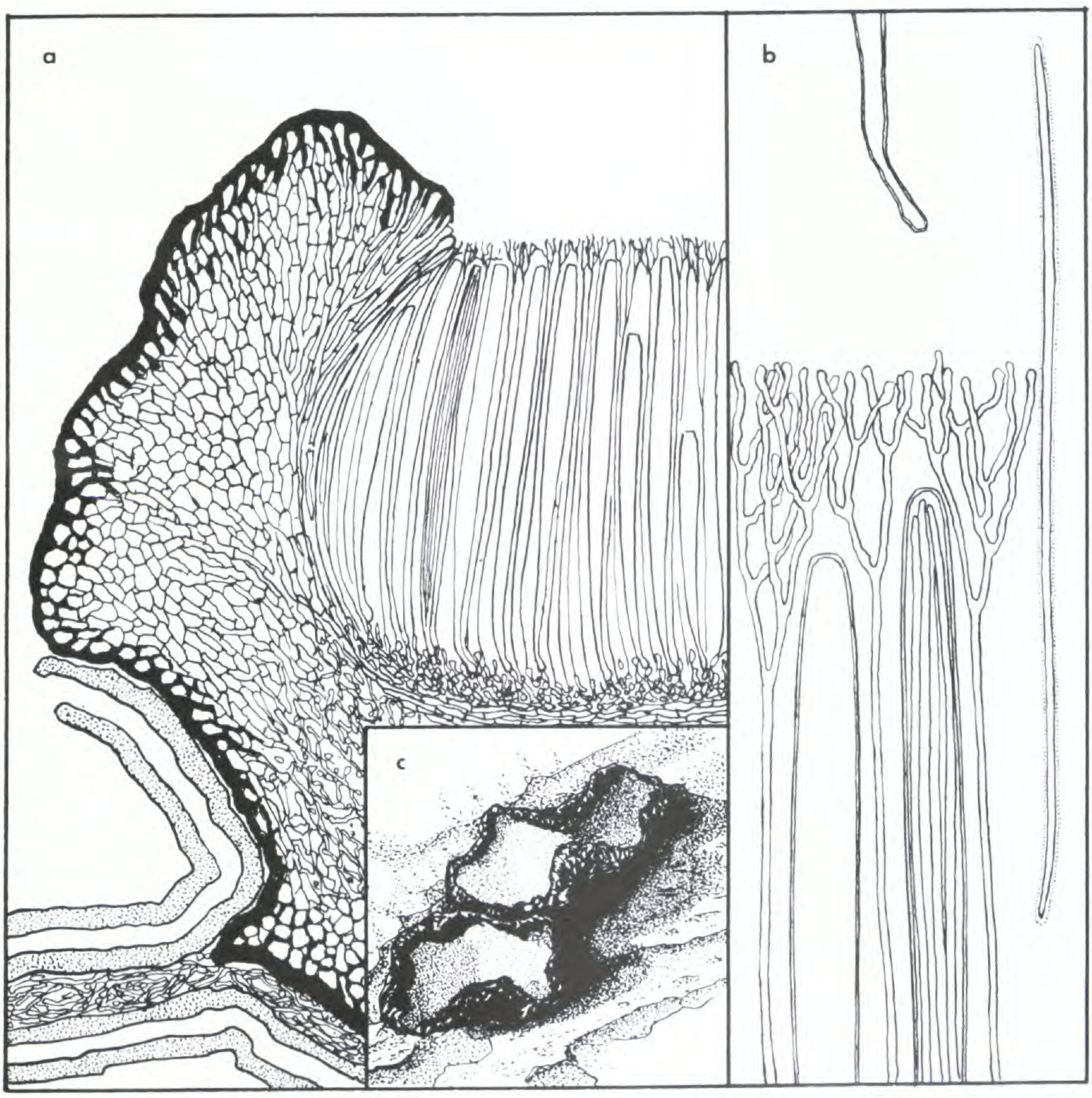

FIG. 53. *Cerion leucophaeum:*—a. cross section of apothecium, ×225.—b. detail of asci, paraphyses, and ascospores, ×750.—c. habit sketch, ×7.5. Drawn from FH-Thaxter, Grenada 1912–13.

= *Coccomyces brasiliensis* Karst., Hedwigia **28:** 193 (1889) non. Speg.
= *Godronia jamaicensis* Seaver, Mycologia **37:** 356 (1945).

Apothecia initially intracortical, becoming erumpent and appearing nearly superficial at maturity, 1–4 mm diam, orbicular to slightly elongate or irregular in outline, the margin black, shining, rugose, the disc barely immersed, pale pinkish buff to bright red, conspicuously pruinose. Margin in cross section ca. 100 μm thick, of radiating, tightly-packed, slightly thick-walled hyphae 4–8 μm diam (narrower near the hymenium) lying at a high angle to the surface, becoming pseudoparenchymatous and heavily carbonized near the surface. Subhymenium colorless, 30 μm thick, resting on ca. 100 μm of loosely interwoven colorless hyphae 2 μm diam, subtended by a thick, heavily carbonized basal stroma. Paraphyses filiform, 1.5 μm broad, repeatedly dichotomously branched near the apex (propoloid), J−, colorless, forming a distinct epithecium. Asci 200–230 × 8–10 μm, cylindrical, short-stalked, the apex blunt and slightly thickened, J−, 8-spored. Ascospores 100–150 × 1.5 μm, nonseptate, obscurely sheathed.

On decaying twigs and bark, plurivorous, at moderate elevations throughout tropical and subtropical America, common and conspicuous. *Cerion coccineum* is virtually identical but has unbranched or once-branched paraphyses and 1-septate spores.

The names *Coccomyces brasiliensis* Karst. and *C. brasiliensis* Speg. (q.v.) were both published in 1889. I can find no clear indication which has priority. Spegazzini (1919) stated that the publications appeared within a few days of each other and that he could not resolve which had priority. Saccardo (1892), providing a new name, *C. spegazzinii*, for *Coccomyces brasiliensis* Speg., considered Karsten's publication to be earlier.

Although I have been unable to locate a name in the pre-1889 literature, I suspect that one will eventually be found for this common and conspicuous species, and therefore have adopted Dennis's combination rather than introduce another combination into the literature.

A specimen from Colombia (NY-CO 5611), from bark of a living tree, differed from typical *Cerion leucophaeum* in having once-branched paraphyses 2.0–2.5 μm diam, small apothecia, and asci 175 μm long. It may be distinct, but does not differ from typical *C. leucophaeum* sufficiently to be described as new on the strength of a single specimen.

Specimens examined: NORTH AMERICA. MEXICO: Chiapas, Dumont, 19.VIII.1967 (CUP-ME 285). CARRIBBEAN. JAMAICA: Cincohona, Murrill 495, holotype of *Godronia jamaicensis* (NY). CENTRAL AMERICA. COSTA RICA: Prov. San Jose, 10.VII.1936, Dodge and Gregaer (NY). PANAMA: Prov. Chocle, Dumont et al., 14.VI.1975 (NY-Pa 277); Prov. Chiriqui, Dumont et al., 2.VII.1975 (NY-Pa 1632, 1689). SOUTH AMERICA. VENEZUELA: Edo. Merida, Dumont et al., 1971 (NY-Ve 3426, 2352); Edo. Yaracuy, Dumont et al., 7.VII.1971 (NY-Ve 1597);

Dto. Federal, Dumont et al., 22.VI.1976 (NY-Ve 456); Edo. Barinas, Dumont et al., 26.VII.1971 (NY-Ve 3151); Edo. Bolivar, Dumont et al., 4.VIII.1972 (NY-Ve 6820). COLOMBIA: Dpto. Cundinamarca, Dumont et al., 1974 & 1976 (NY-Co 8105, 4029, 4185, 2195, 959, 941, 439, 1869); Dpto. Boyacá, Dumont et al., 12.IX.1976 (NY-Co 7728); Dpto. Nariño (NY-Co 3343); Dpto. Antioquia (NY-Co 825, 6593); Dpto. Chocó, Dumont et al. (NY-Co 5611). ECUADOR: Prov. Pastaza, Dumont et al., 24.VII.1975 (NY-Ec 1446). BRASIL: Minas Geraes, E. Wainio 1885, holotype of *Coccomyces brasiliensis* (H, herb. Karst. 1740); Apiahy, 1888, leg. J. Puiggari, holotype of *Gorgoniceps leucophaeus* (LPS 24437); São Paulo, Apiahy, leg. J. Puiggari 2919, holotype of *Godronia splendida* (LPS 1003).

Karstenia Fr. *in* Karst., Acta Soc. Fauna Fl. Fenn. **2**(6): 166 (1885).

Four species previously included in *Coccomyces* appear rather to belong in *Karstenia*, a genus of immersed discomycetes characterized by a fleshy pseudoparenchymatous covering layer with vertically oriented cells, cylindrical or clavate, uniformly thin-walled asci without a J+ apical pore (the hymenial gel is sometimes J+ blue), true paraphyses, and cylindrical to filiform, multiseptate spores. The affinities of *Karstenia* at the family level are obscure (Sherwood, 1977a), but it does not appear to be closely related to *Coccomyces* either morphologically or ecologically, and would be quite out of place in the Rhytismataceae.

Karstenia clematidis (Phill.) Sherwood, comb. nov.

≡ *Phacidium clematidis* Phill., Grevillea **16:** 46 (1888).

≡ *Coccomyces clematidis* (Phill.) Sacc., Syll. Fung. **8:** 751 (1889).

Apothecia immersed, opening by a pore and eventually splitting the overlying substrate irregularly, 0.3–0.6 mm diam, colorless throughout. Covering layer 50 μm thick, of vertically arranged pseudoparenchymatous cells ca. 3 μm diam. Paraphyses filiform, simple, colorless, not enlarged above, J−. Asci cylindric-saccate, ca. 70 × 10 μm, 8-spored. Ascospores long-cylindrical, not sheathed, 35–45 × 3–4 μm, closely septate, the cells 3–4 μm long.

Similar to *Karstenia idaei* (Fckl.) Sherw., but the asci are shorter. Species concepts in this genus have yet to be defined; a brief redescription has been provided here since the species is not an obvious synonym.

Specimen examined: EUROPE. GREAT BRITAIN: Carlisle, Dr. Carlisle, on stems of *Clematis*, holotype of *Phacidium clematidis* (K).

Karstenia macer (Karst.) Sherwood, comb. nov. Figure 54

≡ *Phacidium macrum* Karst., Not. Sallsk. fauna flora fennica **11:** 218 (1871).

≡ *Coccomyces macer* (Karst.) Karst., Bidrag Kännedom Finlands Natur Folk **19:** 255 (1871).

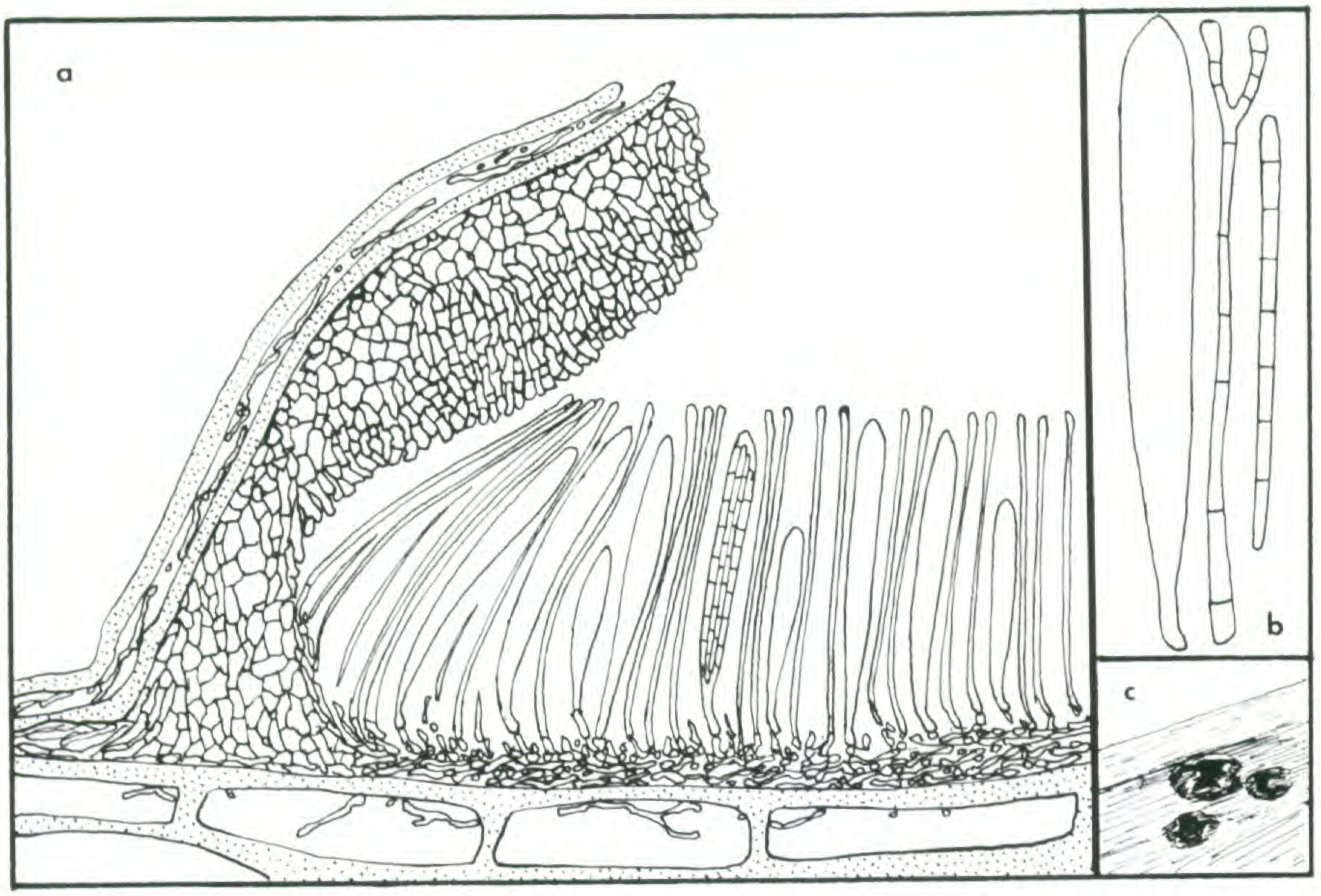

FIG. 54. *Karstenia macer*:—a. cross section of apothecium, ×375.—b. ascus, paraphysis, and spore, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

Apothecia immersed, becoming erumpent by splitting the overlying substrate irregularly, 1.0–1.5 mm diam, orbicular, externally dark grey, the surrounding host tissue slightly bleached but not exhibiting defined spots. Covering layer ca. 50 μm thick, of pale brown angular cells 3.5 μm diam, with a distinct vertical orientation, not ending in a fringe of hyphal filaments. Subhymenium pale brown, ca. 10 μm thick. Apothecia subepidermal. Asci 65–80 × 8–10 μm, thin-walled, pointed, J−. Ascospores 8, ca. 60 × 2.5 μm, 7-septate, not sheathed. Paraphyses filiform, 1.5–2.0 μm broad, a little enlarged at the apex, closely septate.

On umbelliferous (?) stems, Finland.

Specimen examined: EUROPE. FINLAND: Ad. caul. umbellif?, I.VI?.1866, Mustiala, leg. P. A. Karsten 1737, holotype of *Phacidium macrum* (H).

Karstenia maydis (Rehm) Sherwood, comb. nov. Figure 55

≡ *Phacidium maydis* Rehm, Ascom. Lojk. 23 (1883).

≡ *Coccomyces maydis* (Rehm) Sacc., Syll. Fung. **8:** 752 (1889).

Apothecia immersed, orbicular, inconspicuous, pale brownish, opening by splitting the overlying substrate irregularly. Covering layer ca. 50 μm thick, pale brown above, not carbonized, of angular, vertically oriented cells 3–4 μm diam, not ending in a fringe of hyphal filaments. Asci uniformly thin-walled, J−, 60–80 × 8–10 μm, 8-spored. Ascospores

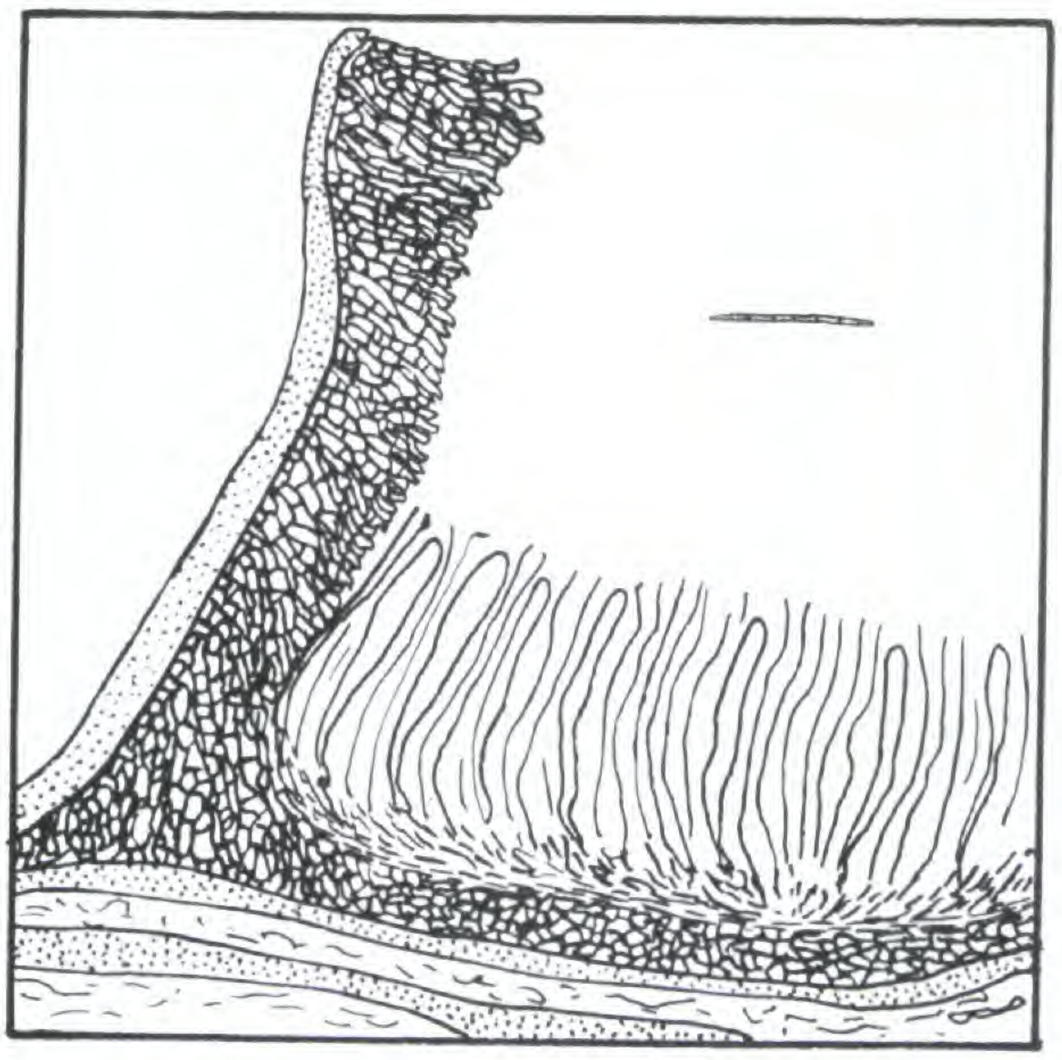

FIG. 55. *Karstenia maydis*:—cross section of apothecium, ×150. Drawn from the holotype.

30–55 × 2.5 μm (30–36 × 1.5 fide Rehm), not sheathed, usually 5-septate. Paraphyses filiform, enlarged to 2.0 μm at the apex.

On cornstalks, Hungary.

Specimen examined: EUROPE. HUNGARY: Herb. Rehm, Kaposvár, 1872, Lojka 112, holotype of *Phacidium maydis* (S).

Karstenia rubicola (Ell. & Dearn.) Sherwood, comb. nov. Figure 56

≡ *Coccomyces rubicola* Ell. & Dearn., Proc. Canad. Inst. **1:** 90 (1897).

Apothecia intraepidermal, becoming erumpent, scattered, orbicular, ca. 0.7 mm diam, splitting the overlying substrate irregularly, the margin dark, not toothed, the disc moderately deeply immersed, pale ochraceous. Covering layer pale brown, 50 μm thick, of thin-walled pseudoparenchymatous cells 5–8 μm diam with a vertical orientation, not ending in a fringe of hyphoid hairs. Subhymenium 20 μm thick, pseudoparenchymatous, colorless. Asci 50–60 × 7 μm, short-stalked, cylindric-clavate, J−, without an obvious apical dehiscence mechanism, 8-spored; paraphyses colorless, filiform, enlarged to 2.5 μm at the apex, septate. Ascospores 40–50 (50–60 fide Ellis & Dearness) × 2–2.5 μm, usually 5-septate, not sheathed. The hymenial gel turns faintly blue in iodine.

On *Rubus strigosus*, Canada, known only from a fragmentary type collection. A second specimen in DAOM (House 829) proved to be a *Pyrenopeziza*. The name has been applied in herbaria to *Coccomyces tumidus* (q.v.), which occasionally occurs on canes of *Rubus*.

Specimen examined: NORTH AMERICA. CANADA: on *Rubus strigosus*, Wm. Grants, Aug. 1895, holotype of *Coccomyces rubicola* (DAOM).

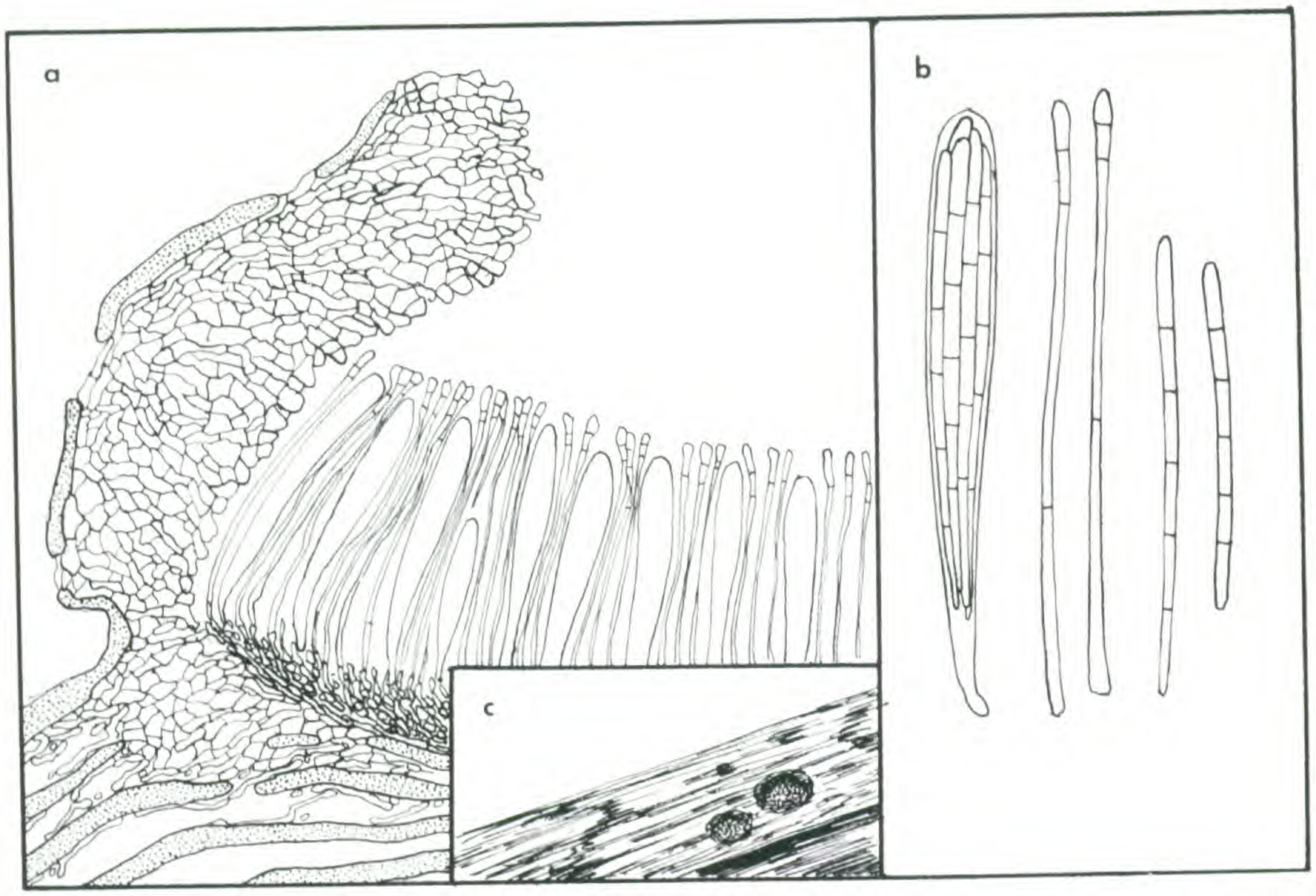

FIG. 56. *Karstenia rubicola*:—a. cross section of apothecium, ×375.—b. ascus, paraphyses, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the holotype.

Myriophacidium Sherwood, Mycologia **66:** 791 (1974).

One species formerly assigned to *Coccomyces*, *C. tridentatus*, belongs to the related genus *Myriophacidium*, distinguished from *Coccomyces* by the possession of oval spores. The type species, in addition, has an epithecium of paraphyses cemented in a brown gel. This is lacking in the two species discussed below. Although distinguishing a genus on the basis of spore characters alone is arbitrary and probably artificial, it has long been sanctioned in the Rhytismataceae.

Both the holotype and isotype specimens of *Phacidium tridentatum*, cited below, are mixtures of two different species of *Myriophacidium*, one on leaves of *Vaccinium*, the other on twigs of an unidentified host, possibly *Cavendishia*. Since Léveillé described the species as occurring on leaves, I have designated the portion on leaves as the type of *Phacidium tridentatum*, and described the portion on twigs as a distinct species. The three species of *Myriophacidium* are distinguished as follows:

KEY TO MYRIOPHACIDIUM SPECIES

1. Paraphyses cemented in a brown epithecial gel . . . . . *M. aphyophyllicum* Sherw.
1′. Paraphyses and epithecium colorless . . . . . 2.
2. Ascospores 17.5–22.5 × 5.0–7.5 μm. On stems of *Cavendishia*?, Colombia . . . . . *M. corticola*.
2′. Ascospores 16–30 × 3.0–5.0 μm. On leaves of *Vaccinium*, South America . . . . . *M. tridentatum*.

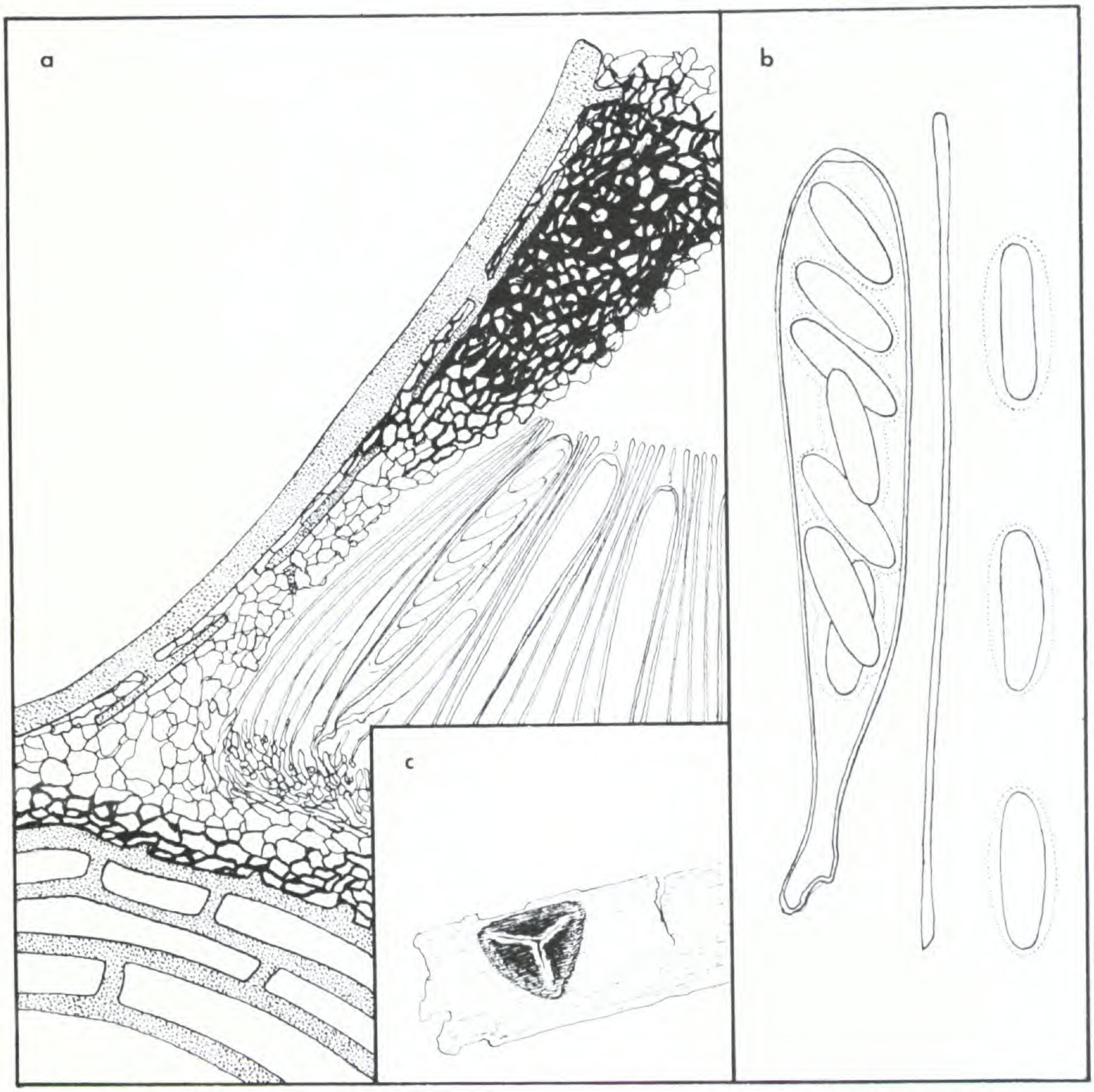

FIG. 57. *Myriophacidium corticola:*—a. cross section of margin, ×375.—b. ascus, paraphysis, and spores, ×750.—c. habit sketch, ×7.5. Drawn from the type in PC.

Myriophacidium corticola Sherwood, spec. nov. Figure 57

Ascocarpi primo immersi, dein erumpentes, trigoni vel tetragoni, 0.8–1.5 mm diam, per lacinias aperientes, in macula pallida stromate obvallato insidentes. Margo superior stromatica 60 μm crassa, ex hyphis intertextis carbonaceis constata. Periphysoidei nulli. Margo inferior stromatica 15–20 μm crassa, ex hyphis intertextis carbonaceis constata. Excipulum nullum. Paraphyses filiformes, apice ad 1.5 μm incrassatae. Asci 100–105 × 15–18 μm, cylindrici-clavati, pedicellati, in iodo non caerulescentes, 8-spori. Sporis ellipsoideis, continuis, in tunica gelatinosa inclusis, 17.5–22.5 × 5.0–7.5 μm. In corticem *Cavendishiae?*, Bogotá, Montserrat, Colombia.

Holotypus: PC, Herb. Lindig 2790, Bogotá, Nova Granata, Montserrat, p.p. Isotypus: FH.

Etymology: corticola (L), growing on bark, as opposed to the other two species, which occur on leaves.

Apothecia immersed in bleached spots bounded by a delicate black

line on the smooth cortex of dead twigs, triangular (less commonly quadrate), 0.8–1.5 mm diam, in face view with a distinct black rim, lighter colored 'hinge,' and black center marked by well-defined preformed dehiscence lines. Covering layer in cross section 60 μm thick, heavily carbonized toward the center, becoming colorless and fleshy toward the periphery, the cells 3–5 μm diam, oriented parallel to the surface of the substrate. Basal stroma 15–20 μm thick, of dark carbonized cells 5 μm diam. Subhymenium colorless, 20 μm thick. Asci ca. 100–105 × 15–18 μm, more or less cylindrical, short-stalked, blunt-ended, with an obscure nonrefractive apical thickening. Paraphyses filiform, simple, barely enlarged to 1.5 μm at the apex. Ascospores 8, 17.5–22.5 × 5.0–7.5 μm, prominently sheathed, nonseptate.

On dead twigs of an unidentified woody plant (probably ericaceous, possibly *Cavendishia*), Bogotá, Montserrat (elev. 9500 ft). The construction of the stroma is quite different from the construction of the stroma of *M. tridentatum*.

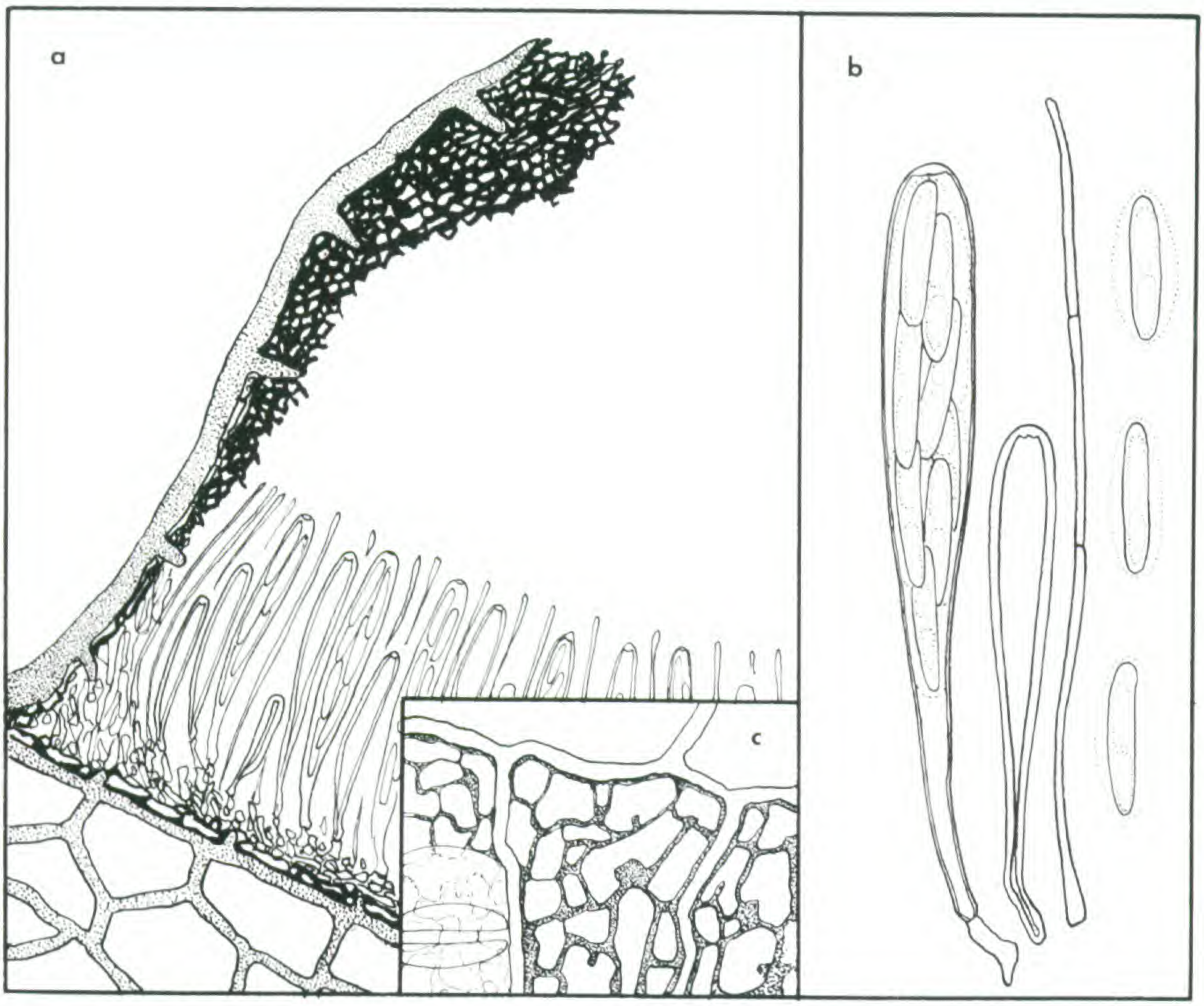

FIG. 58. *Myriophacidium tridentatum*:—a. cross section of apothecium, ×375.—b. detail of construction of covering layer, ×750.—c. asci, paraphysis, and spores, ×750. Drawn from NY-Co 5065a.

Myriophacidium tridentatum (Lév.) Sherwood, comb. nov. Figure 58

≡ *Phacidium tridentatum* Lév., Ann. Sci. Nat. Botanique sér. 4, **20:** 291 (1863).

≡ *Coccomyces tridentatus* (Lév.) Sacc., Syll. Fung. **8:** 748 (1889).

Apothecia intraepidermal, occurring on bleached spots bounded by a black line, triangular or quadrate, 0.3–1.0 mm diam, black, shining, opening by 3–4 regular teeth along preformed lines of dehiscence to expose the dull yellow hymenium. Covering layer 40–50 μm thick, heavily carbonized. Basal stroma 1 cell thick, heavily carbonized; subhymenium colorless, 5–10 μm thick. Asci 65–100 × 11.5–15.0 μm, cylindric-clavate, stalked, with a slightly thickened blunt apex, J−, 8-spored. Paraphyses colorless, filiform, simple, enlarged to 1.5(–2.5) μm at the apex; ascospores 16–30 × 3.0–5.0 μm, conspicuously sheathed.

On dead leaves of *Vaccinium* sp. at high elevations in the Andes, South America.

Specimens examined: SOUTH AMERICA. COLOMBIA: Hb. Lindig, Bogotá, Montserrat, nr. 2790 p.p. (PC, holotype of P. *tridentatum*, FH); Dpto. Boyacá, Sogamoso-Aguazul rd., 13.VI.1976, Dumont et al. (NY-Co 5065). PERU: Dpto. Junín, Carrizales, 9.VII.1976, Dumont et al. (NY-Pe 1087).

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HOST INDEX

The listing below includes the recorded hosts for all species of *Coccomyces* treated in the text, including those which are imperfectly known and those which have been transferred to other genera. The fungus name given is the one under which the species is listed in the text.

Host names conform to currently accepted nomenclature. Host names given in 'specimens examined' at the end of each description were copied directly from herbarium labels and may include synonyms and other obsolete names.

The symbols L(leaves), S(stems), B(bark), and W(wood) refer to the portions of the host on which the fungus usually occurs. *Coccomyces* species are quite specific in the portion of the host on which they grow.

Host indices should be used with caution in identifying members of the Rhytismataceae. Some species are quite host specific, but the host range of common pluriverous species is very broad.

ACERACEAE
Acer sp.
Coccomyces tumidus (L)
ANACARDIACEAE
Mangifera indica L.
Coccomyces vilis (L)
APOCYNACEAE
Carissa sp.
Coccomyces vilis (L)
AQUIFOLIACEAE
Ilex paraguayensis A. St. Hil.
Coccomyces yerbae (L)
BERBERIDACEAE
Berberis aquifolium Pursh
Coccomyces dentatus (L)
Berberis nervosa Pursh
Coccomyces dentatus (L)
Berberis repens Lindl.
Coccomyces dentatus (L)
BETULACEAE
Betula sp.
Coccomyces coronatus (L)
Coccomyces laciniatus (L)
Coccomyces tumidus (L)
BROMELIACEAE
Coccomyces dentatus (L)
Coccomyces pampeanus (L)
BURSERACEAE
Canarium sp.
Coccomyces canarii (L)
Dacryodes excelsa Vahl
Coccomyces leptosporus (L)
CACTACEAE
Opuntia rafinesquii Engelm.
Coccomyces wagnerianus (S)
CARYOPHYLLACEAE
Dianthus carthusianorum L.
Coccomyces dianthi (S)
CISTACEAE
Cistus monspeliensis L.
Coccomyces tympanidiosporus (W)
CUPRESSACEAE
Juniperus communis L. subsp. *nana* (Willd.)
Coccomyces juniperi (B)
Juniperus virginiana L.
Coccomyces petersii (B)
CYPERACEAE
Carex pauciflora Lightf.
Coccomyces insignis (L)
DILLENIACEAE
Tetracera volubilis H. B. K.
Coccomyces tetracerae (L)
ERICACEAE
Andromeda polifolia L.
Coccomyces duplicarioides (L)
Arbutus menziesii Pursh
Coccomyces arbutifolius (L)
Coccomyces dentatus (L)
Arctostaphylos uva-ursi (L) Spreng.
Coccomyces arctostaphyli (L)
Cavendishia sp.
Coccomyces consociatus (L)
Myriophacidium corticola (S)

Epigaea repens L.
Coccomyces radiatus (L)
Erica azorica Hochst.
Coccomyces ericae (W)
Gaultheria shallon Pursh
Coccomyces dentatus (L)
Coccomyces leptideus (S)
Coccomyces tumidus (L)
Ledum groenlandicum Oeder
Coccomyces ledi (S)
Ledum palustre L.
Coccomyces ledi (S)
Macleania sp.
Coccomyces dentatus (L)
Rhododendron macrophyllum G. Don.
Coccomyces dentatus (L)
Coccomyces leptideus (S)
Rhododendron maximum L.
Coccomyces radiatus (L)
Vaccinium sp.
Coccomyces monticola (L)
Myriophacidium tridentatum (L)
Vaccinium myrtillus L.
Coccomyces leptideus (S)
Vaccinium ovatum Pursh
Coccomyces albidus (L)
Vaccinium vitis-idaei L.
Coccomyces leptideus (S)

FAGACEAE

Castanea sativa L.
Coccomyces dentatus (L)
Coccomyces tumidus (L)
Castanopsis chrysophylla (Dougl. ex Hook.) DC
Coccomyces castanopsidis (B, W)
Coccomyces dentatus (L)
Fagus grandifolia Ehrh.
Coccomyces coronatus (L)
Coccomyces tumidus (L)
Fagus sylvatica L.
Coccomyces coronatus (L)
Coccomyces dentatus (L)
Coccomyces tumidus (L)
Lithocarpus densiflora (Hook. & Arn Rehd.
Coccomyces dentatus (L)
Quercus sp.
Coccomyces coronatus (L)
Coccomyces dentatus (L)
Coccomyces tumidus L)
Quercus alba L.
Coccomyces dentatus (L)
Coccomyces triangularis (B)
Quercus chrysolepis Liebm.
Coccomyces castanopsidis (B)
Quercus coccifera L.
Coccomyces delta (L)
Quercus garryana Dougl. ex Hook.
Coccomyces dentatus (L)
Quercus ilex L.
Coccomyces dentatus (L)
Quercus kelloggii Newb.
Coccomyces dentatus (L)
Quercus michauxii Nutt.
Coccomyces dentatus (L)
Quercus nigra L.
Coccomyces dentatus (L)
Quercus reticulata Humb. & Bonpl.
Coccomyces dentatus (L)
Quercus robur L.
Coccomyces dentatus (L)
Quercus rubra L.
Coccomyces farlowii (L)
Coccomyces tumidus (L)
Quercus vaccinifolia Kellogg
Coccomyces dentatus (L)
Quercus virginiana L.
Coccomyces dentatus (L)

GRAMINEAE

Zea mays L.
Karstenia maydis (S)

GUTTIFERAE

Clusia sp.
Coccomyces clusiae (L)
Coccomyces dentatus (L)
Coccomyces limitatus (L)
Clusia rosea Jacq.
Coccomyces clusiae (L)

LAURACEAE

Coccomyces leptosporus (L)
Laurus nobilis L.
Coccomyces delta (L)
Laurus canariensis W. B.
Coccomyces delta (L)
Neolitsea sp.
Coccomyces philippinus (L)
Ocotea foetens Benth. & Hooker
Coccomyces delta (L)

LEGUMINOSAE

Inga laurina (Sw.) Willd.
Coccomyces tesselatus (L)

MELASTOMATACEAE

Memecyclon lanceolatum Cogn.
Coccomyces vilis (L)

MORACEAE

Ficus minahassae Miq.
Coccomyces dubius (L)

MUSACEAE

Musa sp.
Coccomyces pampeanus (L)
Musa paradisica L.
Coccomyces annulatus (L)

MYRICACEAE

Myrica faya Ait.
Coccomyces dentatus (L)
Coccomyces foliicola (L)

Myrica gale L.
Coccomyces boydii (B)
MYRTACEAE
Eucalyptus sp.
Coccomyces martinae (L)
OXALIDACEAE
Oxalis sp.
Coccomyces cfr. *leptideus* (S)
PALMAE
Coccomyces palmicola (L)
Cocos nucifera L.
Coccomyces cocoes (L)
Eremospathus macrocarpa Mann & H. Wendl.
Coccomyces cocoes (L)
PINACEAE
Coccomyces atactus (W)
Coccomyces bipartitus (W)
Abies sp.
Coccomyces parvulus (W)
Abies grandis (Dougl.) Lindl.
Coccomyces pseudotsugae (B)
Larix laricina (DuRoi) K. Koch
Coccomyces irretitus (B)
Picea mariana (Mill.) B.S.P.
Coccomyces bipartitus (W)
Coccomyces irretitus (B)
Pinus sp.
Coccomyces parvulus (W)
Coccomyces pini (B)
Coccomyces villae-vicosae (B)
Pinus ayacahuite Ehrenb.
Coccomyces strobi (B)
Pinus cembra L.
Coccomyces cembrae (W)
Pinus monticola Dougl.
Coccomyces strobi (B)
Pinus resinosa Ait.
Coccomyces irretitus (B)
Pinus strobus L.
Coccomyces strobi (B)
Pinus wallichiana A. B. Jackson
Coccomyces papillatus (B)
Coccomyces strobi (B)
Pseudotsuga menziesii (Mirb.) Franco
Coccomyces parvulus (W)
Coccomyces pseudotsugae (B)
Tsuga heterophylla (Raf.) Sarg.
Coccomyces heterophyllae (B)
Tsuga mertensiana (Bong.) Carr.
Coccomyces cfr. *heterophyllae* (B)
POLYPODIACEAE
Coccomyces crystalligerus (L,S)
Pteridium sp.
Coccomyces dentatus (L)
RANUNCULACEAE
Clematis sp.
Karstenia clematidis (S)
ROSACEAE
Kerria japonica DC
Coccomyces kerriae (L,S)
Prunus spp.
Coccomyces hiemalis (L)
Coccomyces lutescens (L)
Coccomyces prunophorae (L)
Rubus hispidus L.
Coccomyces tumidus (S)
Rubus strigosus Michx.
Kartstenia rubicola (S)
RUBIACEAE
Lasianthus sp.
Biostictis tjibodensis (L)
Lasianthus latifolius Blume
Biostictis tjibodensis (L)
Lasianthus tashiroi Mats.
Biostictis tjibodensis (L)
Mussaenda sp.
Biostictis tjibodensis (L)
SALICACEAE
Populus sp.
Coccomyces coronatus (L)
Coccomyces viridis (B)
Populus tremuloides Michx.
Coccomyces tumidus (L)
Salix sp.
Coccomyces salicinus (W)
SARRACENIACEAE
Sarracenia purpurea L.
Coccomyces coronatus (L)
UMBELLIFERAE
Karstenia macer (S)
Eryngium paniculatum Cav. & Dombey
Coccomyces pampeanus (L)

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