

AN ABSTRACT OF THE THESIS OF

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Title: THE GENUS ANTHRACOBIA BOUDIER (PEZIZALES,  
ASCOMYCETES)

Abstract approved:

~~Redacted for privacy~~

~~William C. Denison~~

A taxonomic revision of the genus Anthracobia Boudier is presented. The genus and eight included taxa are described and figured. A discussion of the taxonomic criteria used to delimit the genus and the species is included, and a key to the recognized taxa is given. Four imperfect states for included species and the imperfect state for one excluded species are described and figured; of these, three have been previously reported, and two are new. Other previously included species and forms are either synonymized or excluded, with an indication of their affinities, on the basis of examination of the types involved. Anthracobia is again restricted to organisms having hyaline, smooth, biguttulate, elliptical spores and small, yellow-orange to dark brown, lenticular apothecia which are externally clothed with short, blunt, brown excipular hairs grouped in fascicles occurring at and below the margin. All but one species occur on burned soil and charcoal; the one exception occurs on cow dung. After revision, the seven accepted species and one accepted

variety include one provisional new combination and two new species which are fully characterized but not formally described. The included taxa are: A. macrocystis, A. melaloma, A. nitida, A. subatra, A. subatra var. fusca, A. tristis, A. taxonomic species "A," and A. taxonomic species "B."

The Genus Anthracobia Boudier (Pezizales, Ascomycetes)

by

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Typed by Mary Jo Stratton for Harold J. Larsen, Jr.

TO MY WIFE AND CHILDREN

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## TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION	1
II. MATERIALS AND METHODS	3
III. MORPHOLOGY AND TAXONOMIC CHARACTERS	7
Apothecial Morphology	7
Excipular Hairs	11
Excipular Tissue Microanatomy	15
Hymenial Elements	18
Imperfect States	21
Habit	24
Distribution	24
IV. THE GENUS <u>ANTHRACOBIA</u>	27
Historical Review	27
Generic Circumscription	31
Key to Included Species	34
<u>Anthracobia macrocystis</u>	36
<u>Anthracobia melaloma</u>	39
<u>Anthracobia nitida</u>	47
<u>Anthracobia tristis</u>	51
<u>Anthracobia subatra</u>	59
<u>Anthracobia subatra</u> var. <u>fusca</u>	62
<u>Anthracobia taxonomic species "A"</u>	64
<u>Anthracobia taxonomic species "B"</u>	66
V. DOUBTFUL AND EXCLUDED SPECIES	69
<u>Anthracobia humillima</u>	69
<u>Humaria flavoaurantiaca</u>	70
<u>Lachnea bruneola</u>	73
<u>Lachnea humana</u>	74
<u>Lachnea ramosa</u>	75
<u>Patella contradicta</u>	75
<u>Peziza subhirsuta</u>	76
<u>Pyronema aurantio-rubrum</u>	77
<u>Pyronema pallens</u>	77
VI. LITERATURE CITED	79

## LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1	Apothecium of <u>Anthracobia nitida</u> . (SEM)	9
2	Apothecium of <u>Anthracobia tristis</u> . (SEM)	9
3	Apothecia of the HOLOTYPE of <u>Humaria adusta</u> (= <u>A. melaloma</u> ).	14
4	Apothecia of the NEOTYPE of <u>Anthracobia melaloma</u> showing excipular hair distribution.	14
5	Excipular hairs of the HOLOTYPE of <u>Anthracobia subatra</u> showing the clavate hair apices.	14
6	Excipular hair fascicles of the NEOTYPE of <u>Anthracobia melaloma</u> .	14
7	Excipular hair fascicles of <u>Anthracobia</u> taxonomic species "B."	14
8	Excipular hairs of the NEOTYPE of <u>Anthracobia nitida</u> .	14
9	Cross-section of an apothecium of the HOLOTYPE of <u>Anthracobia tristis</u> .	17
10	Paraphyses from the HOLOTYPE of <u>Anthracobia subatra</u> showing the sub-sphaerical apices.	17
11	Cross-section of an apothecium of the NEOTYPE of <u>Anthracobia nitida</u> showing the two-zoned medullary excipulum.	17
12	Typical ascospore of <u>Anthracobia tristis</u> . (SEM)	17
13	Arthrosporic imperfect state of <u>Anthracobia melaloma</u> .	23

<u>Figure</u>		<u>Page</u>
14	Conidiophores and arthrospores of <u>Anthracobia</u> taxonomic species "B."	23
15	Young arthrosporic imperfect state of <u>Anthracobia</u> taxonomic species "B." (SEM)	23
16	Imperfect state of <u>Anthracobia nitida</u> . (SEM)	26
17	Imperfect state of <u>Anthracobia tristis</u> consisting of a dense sporodochia-like tuft of monilioid arthrospores. (SEM)	26
18	Apothecium of the ISOTYPE ? of <u>Peziza muelleri</u> .	57
19	Scutellinia-type rooting hair from the ISOTYPE ? of <u>Peziza muelleri</u> .	57
20	Apothecia of the PARATYPE of <u>Lachnea</u> <u>ampezzana</u> showing the pronounced fascicles of excipular hairs.	57
21	Excipular hairs of <u>Lachnea humana</u> .	57
22	<u>Dichobotrys</u> imperfect state of <u>Anthracobia</u> <u>humillima</u> . (SEM)	72
23	Acuminate hairs from apothecium of <u>Anthracobia humillima</u> . (SEM)	72

THE GENUS ANTHRACOBIA BOUDIER  
(PEZIZALES, ASCOMYCETES)

I. INTRODUCTION

The genus Anthracobia was erected by Boudier in 1885 to accommodate the type species, Peziza melaloma Alb. & Schw. ex Fr., and other, unspecified small orange firesite Ascomycetes with short, blunt, brown, fasciculate apothecial hairs and smooth, elliptical spores containing oil drops. Boudier's subsequent treatment (1907) provided an expanded description of the genus and included eight species and one subspecies. Later mycologists with differing generic concepts described or transferred five additional species and two forms to Anthracobia. At the start of this study, therefore, the genus contained 13 species, one subspecies, and two forms. No comparative treatment of all of these species has been published and the characters on which they are based have not been adequately evaluated (Rifai, 1968).

This thesis is a study of the species which have been referred to Anthracobia. The type collections of eight of the 13 species and the types of the subspecies and the two forms have been examined; the types of four species either no longer exist or could not be found, and the type of one species was too fragile to be sent. Neotypes for three of these four species are therefore designated. Specimens, including

authentic or type collections, of related species were also examined in order to provide an understanding of generic relationships between Anthracobia and allied genera.

After revision, the genus Anthracobia contains seven species and one variety, of which two are previously unrecognized species. Four of Boudier's eight species are recognized, and four species and the subspecies he included are either synonymized or reassigned to other genera or orders. Several species whose published descriptions fall within the limits of the genus but whose type collections were unavailable for examination and verification are included in the list of doubtful and excluded species. Finally, the genus Anthracobia Boudier is again restricted to small, yellow to dark brown, firesite or, rarely, dung-associated organisms having apothecia with short, blunt, brown, fasciculate, hyphoidal excipular hairs and smooth, elliptical spores containing two oil drops.

## II. MATERIALS AND METHODS

This study is based upon more than 100 dried herbarium specimens, and supplemented when possible with fresh collections and cultural studies. The most critical of these collections and cultures are cited in the text, and the descriptions and illustrations were made from type specimens wherever possible.

Herbarium specimens, particularly types of Anthracobia spp. and other morphologically similar species and genera, were requested from the following herbaria (abbreviations after Lanjouw and Stafleu, 1964): BR, C, CUP, G, H, K, L, LG, MEL, NY, NYS, PAD, PC, S, and UPS. Type specimens were obtained and examined for eight of the 13 described species and for the four varieties. One Anthracobia type was not sent due to its fragile condition, and the remaining four type collections could not be located.

Cultures were obtained in several manners. Germinating single ascospores on 2.5% water agar plates inverted over fresh apothecia were transferred to Corn Meal-Malt Extract-Yeast Extract (CMMY) agar plates and slants (Larsen, 1973). Alternatively, sections of fresh apothecia were sterilized in 10% clorox for 15 to 30 seconds and embedded in CMMY agar plates. Some dried herbarium specimens also yielded fruiting cultures after rehydration in 10%  $\text{NH}_4\text{OH}$  for 15 to 30 minutes, transfer to a sterile water agar plate for sectioning,

and subsequent embedment of small portions of the hymenial layer in CMMY agar plates or water agar plates. Other cultures were obtained from: the American Type Culture Collection (ATCC), Rockville, MD; Dr. R. P. Korf, Plant Pathology Herbarium, Cornell University, Ithaca, NY; Dr. Kerry L. O'Donnell, Michigan State University, East Lansing, MI; and Dr. C. T. Rogerson, New York Botanic Garden, Bronx, NY. Cultures were maintained in a 15°C incubator on CMMY agar slants and in triple-autoclaved soil tubes.

Cultural characteristics were determined on CMMY agar plates and by subsequent transfer of 1 cm diam. plugs from five-day old inoculated CMMY agar plates to 2.5% water agar plates. Apothecial and conidial production was induced by maintenance of these plates under room lighting and temperatures. Photoeffects on apothecial morphology were investigated previously for Anthracobia melaloma (Larsen, 1973) and only cursory observations were made of this aspect during the present study.

Herbarium specimens were examined initially using a stereomicroscope to determine their dry morphology. They were then rehydrated for 15 to 30 minutes in 10%  $\text{NH}_4\text{OH}$  to restore tissue and cell shape. The apothecia were reexamined with the stereomicroscope and annotations made on external morphology prior to subsequent microscopic examinations. Fresh specimens and specimens from cultures were treated similarly except for the rehydration step.

Two kinds of microscopic preparations were used. Isolated asci, ascospores, paraphyses, and apothecial hairs were examined in crush mounts stained with Melzer's reagent (Dennis, 1968) or with 0.2% cotton blue (aniline blue) in lactic acid after Le Gal (1947).

Apothecial anatomy was studied using freehand sections of fresh or rehydrated apothecia hardened in 50% ethanol for 15 to 30 minutes and supported in alcohol-saturated pith. Sections were floated out in a petri dish containing 50% alcohol, subsequently stained with aqueous 0.5% cotton blue or trypan blue, and mounted in either lactophenol or 50% glycerol. All slides were sealed with porcelain glaze or fingernail polish. Microscopic examinations were made using a Leitz Ortholux microscope with 10X, 40X, and 100X-oil fluorite objectives and 12.5X oculars fitted with a calibrated ocular micrometer.

Whole apothecia were photographed with a Zenza Bronica Model S camera using a 16 mm Zeiss Luminar lens with a diaphragm. The 6 x 6 cm H & W Control VTE film (ASA 80) was developed for 12 minutes in Microdol-X developer diluted 1:3 and fixed in Rapid Fix for two minutes at 21°C. Photomicrographs were made with the Bronica camera mounted on the Lietz Ortholux microscope. The film and development were as above.

Apothecia, conidiophores, and conidia for SEM study were fixed in FAA or with Osmium vapor followed by transfer to FAA, dehydrated via a graded acetone/Trifluorotrchloroethane (TFTCE) series, and

dried in a Bomar SPC-900 critical point drier using Freon 13 as the transition fluid. Conidiophores of Anthracobia humillima (Trichophaea abundans) were fixed with Osmium vapor and air dried. All specimens were shadowed with 60:40 Au:Pd in a Varian VE-10 vacuum evaporator and examined using an ISI Mini-SEM model MSM-2.

### III. MORPHOLOGY AND TAXONOMIC CHARACTERS

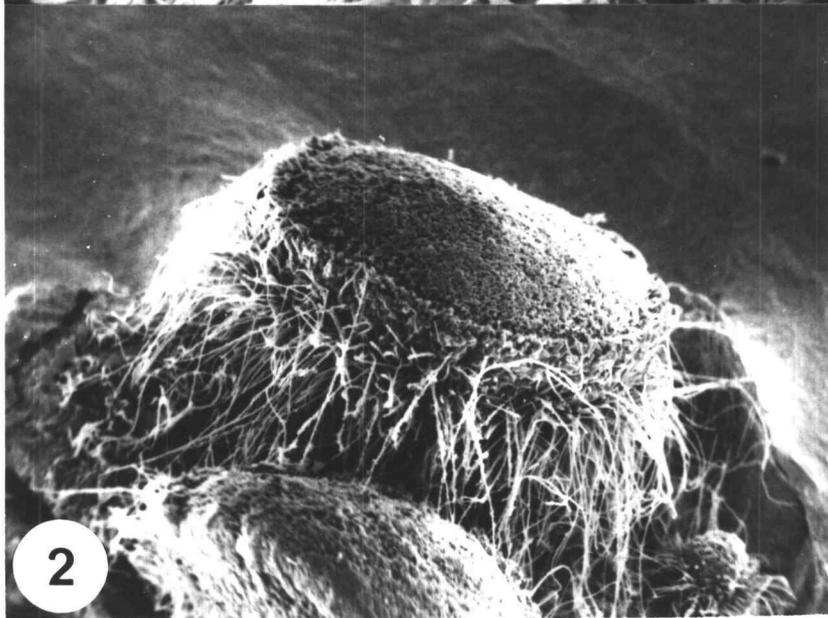
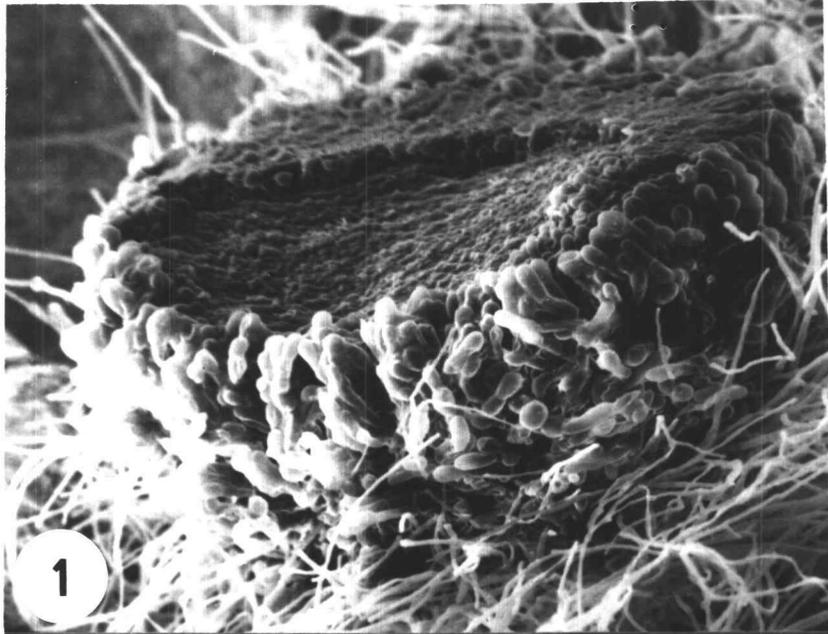
I have reviewed the criteria used to delimit genera and species within the Pezizales and used this information as a background in evaluating criteria for separating Anthracobia from similar genera and for separating species within the genus. Conventional criteria such as morphology and pigmentation of the apothecium, morphology and distribution of the excipular hairs, anatomy and morphology of the hymenial elements (asci, ascospores, and paraphyses), and substrate are treated in the following discussion, as are the more recent criteria of excipular (sterile) tissue microanatomy, staining characteristics of hymenial elements, and imperfect states.

#### Apothecial Morphology

Apothecial shape has historically been used to delimit genera within the Pezizales, but contemporary authors (Dissing, 1966; Harmaja, 1974a; Korf, 1973a) limit its use to the species or, at most, subgeneric level. Apothecial shape in Anthracobia and similar genera varies with the maturity of the specimen--slightly cupulate when young, variously flattened or even convex when old (Figs. 1, 2, 3)--rather than from genus to genus or from species to species. Thus it is not a useful criterion.

Figure 1. Apothecium of Anthracobia nitida. 200X. (SEM).

Figure 2. Apothecium of Anthracobia tristis. 50X. (SEM).



Apothecial coloration has been used primarily at the species level in Anthracobia and similar genera by previous workers (Boudier, 1907, 1905-1910; Dennis, 1968; Rifai, 1968). The yellow to red-orange to chestnut brown hymenial colors reported for Anthracobia species overlap those of yellow/orange/red hymenial hues known in Octospora, Pulvinula, and Pyronema (Dennis, 1968; Korf, 1972) and those of cream-grey to dark red-brown known in Trichophaea sensu Korf (1972). Hymenial coloration in one A. melaloma collection sent by Mme. Candoussau ranged from yellow through red to maroon; I found (Larsen, 1973) hymenial coloration in an isolate of A. melaloma to vary from light "Luteous"<sup>1</sup> through "Orange" and "Rosy Buff" to "Cinnamon" depending on the duration and sequence of exposure to light during apothecial development. The hymenial coloration of my A. nitida isolate varies from "Pale Luteous" to "Orange" in culture. The pigmentation of the excipular hairs and the outer cells of the ectal excipulum was less variable in my cultural studies and is similar to that found in Trichophaea. Excipular hair pigmentation is a good criterion for generic delimitation and is also usable for species delimitation, but hymenial coloration is usable only in broad values at only the species level.

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<sup>1</sup>Color notations in quotes are after Rayner (1970).

### Excipular Hairs

The absence or presence and type of apothecial hairs has traditionally been used as a generic character. Boudier (1885) originally separated his Trichophaea from his Anthracobia and Melastiza on the basis of the long, brown, acuminate hairs in Trichophaea vs. the short, brown, obtuse hairs in the latter two genera. Anthracobia and Melastiza were then differentiated on spore morphology. Eckblad (1968) recognized seven types of hairs found within the Pezizales:

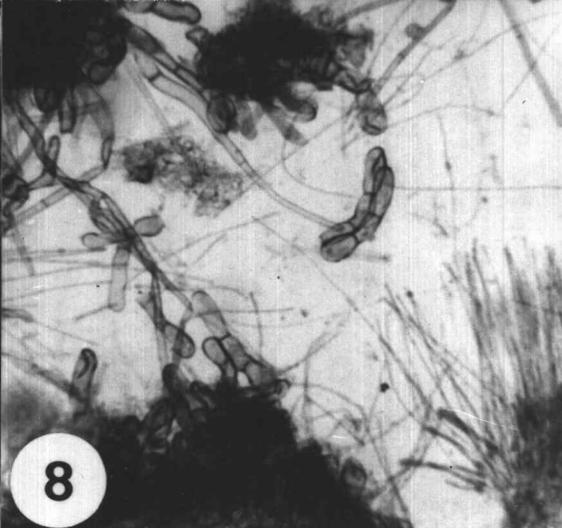
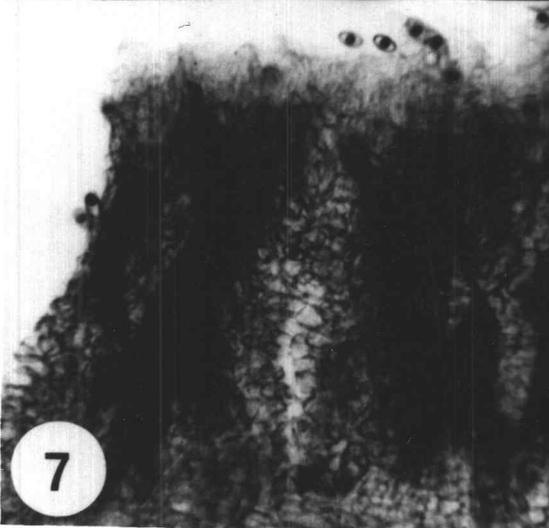
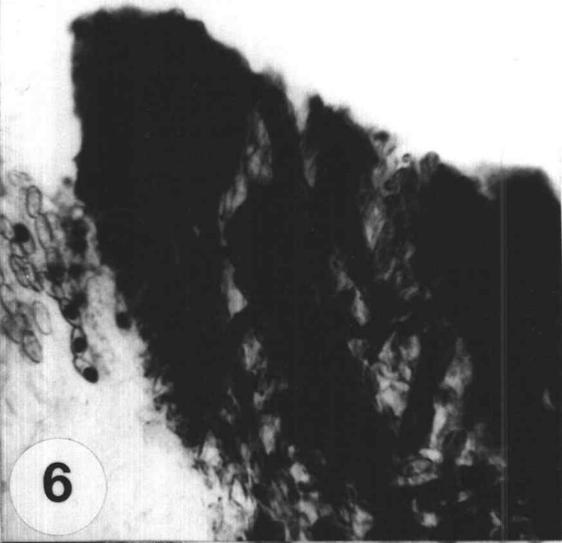
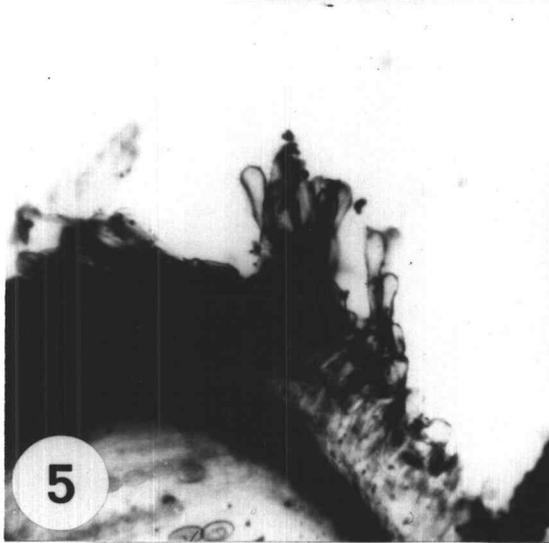
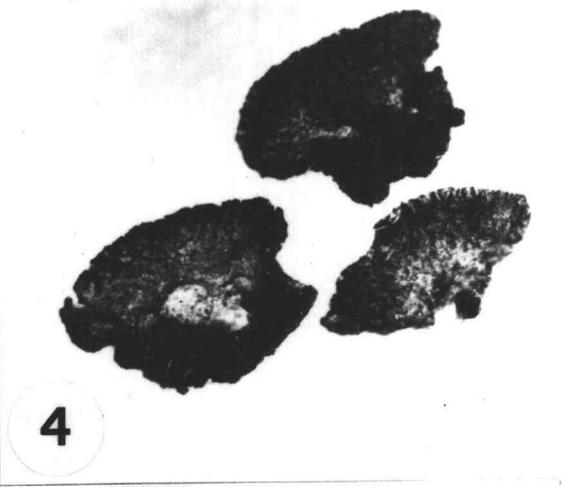
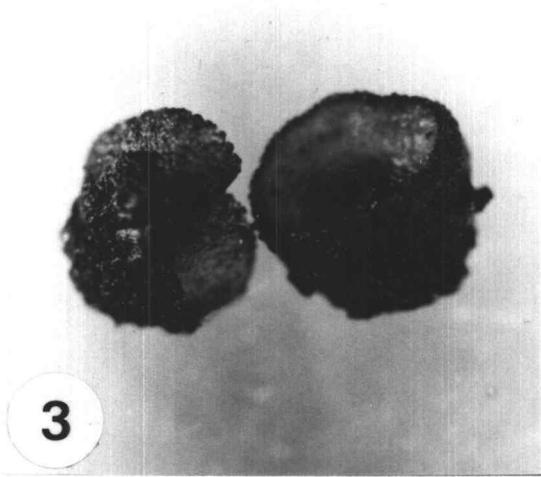
- 1) colored, short, blunt, hyphoidal, often fascicled hairs;
- 2) hyaline, flexuous, septate, hyphoidal hairs;
- 3) colored, flexuous, septate, hyphoidal hairs;
- 4) acuminate, straight, hyaline, non-septate hairs;
- 5) acuminate, straight, colored, septate hairs;
- 6) acuminate, straight, colored, septate hairs with a forked base, often originating within the internal parts of the excipulum;
- and 7) acuminate, stellate, colored, septate hairs.

Of the genera most likely to be confused with Anthracobia, only Melastiza has similar, fascicled, type 1 hairs, and it is easily differentiated by its conspicuously sculptured spores. Trichophaea has acuminate, brown, stiff, mostly separate excipular hairs, while Octospora has, at most, hyaline hyphoidal excipular hairs (Korf, 1972, 1973b). The presence or absence and type of excipular hairs is a good generic criterion.

Anthracobia species can be separated into two groups based upon hair septation, length and width morphology, and degree of brown pigmentation. A. melaloma, A. subatra, A. subatra var. fusca, and Anthracobia taxonomic species "B" have 2-4 septate, dark "Sepia" brown, long and slender excipular hairs, 60-110 x 3-10  $\mu\text{m}$ , with obtuse to clavate apices (Figs. 4, 5, 7, 7). A. macrocystis, A. tristis, and Anthracobia taxonomic species "A" have 0-2 septate, light "Ochraceous" to light "Umber" brown, short cylindrical excipular hairs, 20-60 x 10-15  $\mu\text{m}$ , with obtuse or, rarely, slightly enlarged apices. A. nitida has intermediate, 0-2 septate, "Umber" brown hairs, 30-80 x 5-15  $\mu\text{m}$ , with obtuse apices (Fig. 8). The light brown excipular hairs of the A. macrocystis group are very inconspicuous and easily overlooked, occasionally leading to their misidentification as Octospora (Dennis, 1968). One species, A. humillima Mal., was originally described as an Anthracobia but was synonymized with Trichophaea abundans (Binyamini, 1972) because, among other factors, it has long, stiff, acuminate, brown excipular hairs. Excipular hair morphology and degree of pigmentation is a good criterion at both the generic and the specific levels.

Excipular hair distribution in Anthracobia is always most dense at or immediately below the margin of the apothecium. The density of hair distribution between the margin and the base has been used, with other characters, to differentiate A. melaloma from A. maurilabra

- Figure 3. Apothecia of the HOLOTYPE of Humaria adusta (=A. melaloma). 15X.
- Figure 4. Apothecia of the NEOTYPE of Anthracobia melaloma showing excipular hair distribution. 15X.
- Figure 5. Excipular hairs of the HOLOTYPE of Anthracobia subatra showing the clavate hair apices. 220X.
- Figure 6. Excipular hair fascicles of the NEOTYPE of Anthracobia melaloma. 220X.
- Figure 7. Excipular hair fascicles of Anthracobia taxonomic species "B." 220X.
- Figure 8. Excipular hairs of the NEOTYPE of Anthracobia nitida. 220X.

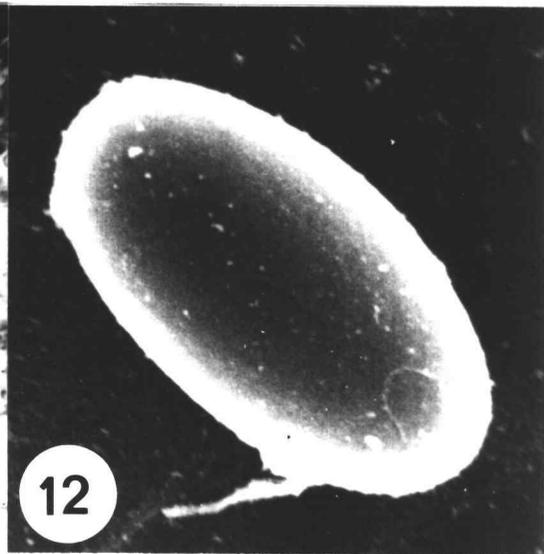
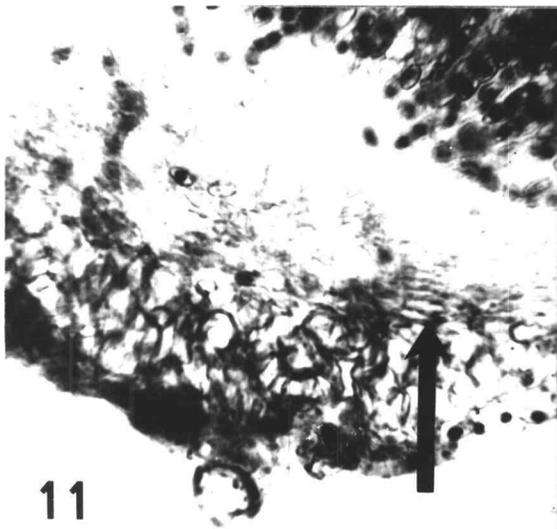
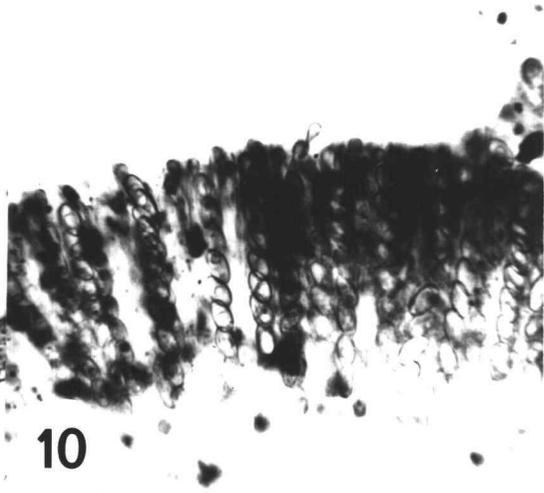


(Boudier, 1905-1910; Dennis, 1968). I commonly find that otherwise identical and immediately adjacent apothecia of A. melaloma differ greatly in the density of excipular hairs between the margin and the base. I do not view hair distribution below the margin as a useful criterion at the species level in Anthracobia.

#### Excipular Tissue Microanatomy

Excipulum structure and tissue types have been used as criteria at the family and subfamily level in the Helotiales (Nannfeldt, 1932) and at the generic level in the Pezizales (Dissing, 1966; Durand, 1900; Eckblad, 1968; Gamundi, 1960). The apothecia are composed of three anatomical regions: the outer or ectal excipulum, the inner or medullary excipulum, and the hymenium which is comprised of the paraphyses and asci to be discussed subsequently. Eckblad (1968) notes that excipular anatomy is usually of the same types throughout a genus, although some genera (such as Peziza) presently include species with greatly differing excipular anatomy (Dennis, 1968). Excipular structure in Anthracobia, Trichophaea, and Octospora consists of an ectal layer of textura angularis as defined by van Brummelen (1967) and a medullary layer consisting of textura intricata (Fig. 9). The lower portion of the medullary excipulum in A. nitida consists of a 5-8 cell deep zone of radially arranged hyphae or textura porrecta (Fig. 11). The outermost cells of the ectal excipulum in all

- Figure 9. Cross-section of an apothecium of the HOLOTYPE of Anthracobia tristis. 90X.
- Figure 10. Paraphyses from the HOLOTYPE of Anthracobia subatra showing the subsphaerical apices. 220X.
- Figure 11. Cross-section of an apothecium of the NEOTYPE of Anthracobia nitida showing the two-zoned medullary excipulum (arrow). 900X.
- Figure 12. Typical ascospore of Anthracobia tristis. 5,000X. (SEM).



Anthracobia species have pigmented walls of varying shades of brown. Cells in this layer vary from roughly isodiametric to polygonal and slightly to moderately elongated at right angles to the exterior. Excipular anatomy is of limited use in differentiation at the genus and species levels in Anthracobia.

### Hymenial Elements

Hymenial elements, i. e., asci, ascospores, and paraphyses, have historically been used as taxonomic criteria at various taxonomic levels (Eckblad, 1968; Kimbrough, 1970; Korf and Dumont, 1968). All of the members of the Pezizales, to which Anthracobia belongs, have operculate asci. Slight modifications in the apical structure have been used for differentiation at the subordinal level, for example the suboperculate asci in the Sarcoscyphineae (Rifai, 1968). Ascus staining characteristics are used at the family level in the Pezizales: asci of the families Pezizaceae (sensu Korf) and the Ascobolaceae turn blue in iodine, those of other families do not (Korf, 1972). Ascus shape is fairly uniform in the family Pyronemataceae, and ascus size varies more within a typical species than from species to species or genus to genus, with some exceptions. Thus, only ascus size is at all useful in delimiting species in Anthracobia.

Ascospore shape, color, surface structure, contents, staining characteristics, and nuclear number have been extremely important

in discomycete taxonomy (Eckblad, 1968; Kimbrough, 1970). The Pyronemataceae, including Anthracobia, all have hyaline, uninucleate ascospores. Spore staining characteristics in heated cotton blue/lactic acid have been used at the generic and suprageneric levels (Eckblad, 1968; Harmaja, 1974b). In Anthracobia, the spores are initially cyanophillic when young but become cyanophobic at maturity, i. e., exhibit Otideoid spore staining characteristics after Harmaja (1974b). Octospora and Trichophaea species with smooth spores exhibit the same staining characteristics, but those with sculptured spores have cyanophillic sculpturing at maturity. Anthracobia has only smooth spores (Fig. 12). Boudier (1885, 1907) used the presence and number of guttules (oil drops) as a generic character. Anthracobia includes only biguttulate species, while Octospora and Trichophaea include species with 1-3 guttules. Tricharia Boud. (Tricharina Eckbl.) is separated from Trichophaea on the basis of its nonguttulate spores. Svrcek (1948) was unconvinced of the validity of this character at the generic level and emended Anthracobia to include nonguttulate species also, but I am again restricting Anthracobia to species with biguttulate spores. Spore size and shape are now viewed by Kimbrough (1970) and Korf (1972, 1973b) as useful primarily at the species level, and Korf merges the spherical-spored Sphaerosporella Svr. & Kub. with Trichophaea Boud. My studies indicate, within the genus Anthracobia, that the presence or absence of guttules and spore

sculpturing are good criteria at the generic level. Spore shape is of limited use at the generic and at the specific levels, since they range from narrowly elliptical to broadly elliptical within most genera.

Paraphysis morphology has also been used as a taxonomic criterion in some Pezizales genera. For example, gracile, uncinata, branched paraphyses are diagnostic of Pulvinula, while Otidea has paraphyses with curved, hooked, or deformed, brown apices (Korf, 1972, 1973b). In Anthracobia sensu Boud., non sensu Svrcek, the paraphyses range from unbranched to variously branched and with apices scarcely enlarged to broadly clavate to subspherical; the apical cells typically contain minute yellow to dark orange granules or droplets and become green in iodine. The upper segments of the paraphyses in A. subatra are brown walled (Fig. 10). However, no Anthracobia species presently included has filiform, multibranched paraphyses such as those in the two species with non-guttulate spores for which Svrcek (1948) emended and expanded the generic concept of Anthracobia. Paraphysis morphology in Trichophaea and Octospora is very similar to that in Anthracobia sensu Boud., Trichophaea differing in lacking carotenoids and Octospora in the apex being, at most, only slightly enlarged (Eckblad, 1968). Paraphysis morphology thus can be used sparingly at both the genus and the species level in Anthracobia.

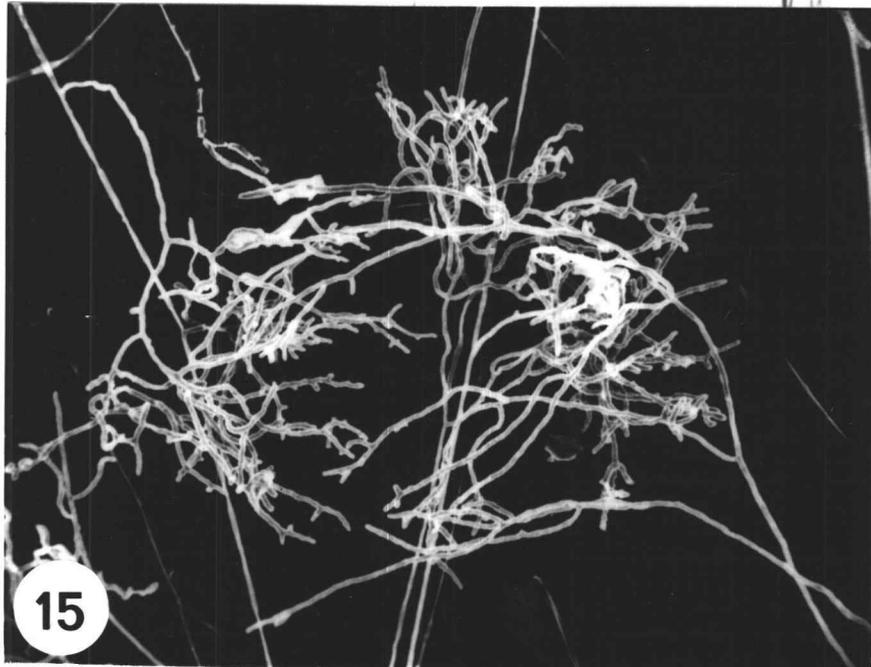
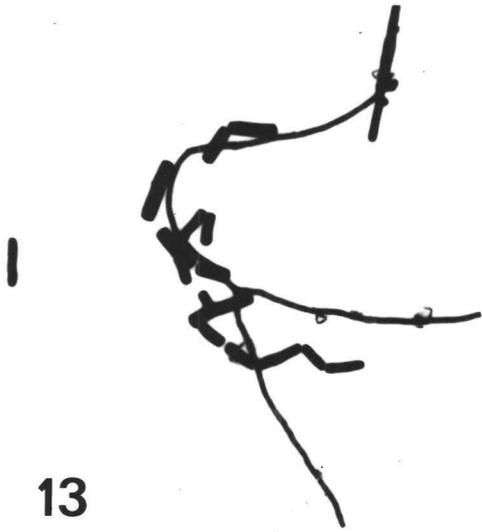
## Imperfect States

Imperfect states in the Pezizales have historically been ignored in taxonomic considerations because of the lack of data for the vast majority of the species included in the order (Eckblad, 1968). However, reports of imperfect states for this group are becoming available, and some correlations between perfect states and imperfect states can now be seen (Paden, 1972). Sympodulosporic Conoplea imperfect states are now known in the genera Urnula and Plectania, Costantinella imperfect states in Morchella, and Nodulisporium imperfect states in Geopyxis (Paden, 1972). Botryoblastosporic Chromelosporium and Oedocephalum imperfect states have been demonstrated in Peziza (Hennebert, 1973; Paden, 1972), and Dichobotrys imperfect states are connected thus far only to Trichophaea species (Hennebert, 1973). Imperfect states in Anthracobia include both arthrosporic and blastosporic types. A. melaloma has an arthrosporic "oidial" state consisting simply of mycelial fragmentation (Gwynne-Vaughn, 1937; Larsen, 1973; Olive, 1950) (Fig. 13). Anthracobia taxonomic species "B" produces a very distinctive arthrosporic state in which highly branched, upright, white, terminal or lateral hyphal tufts segment, collapse, and darken to yield tangled, ochraceous tufts of easily fragmenting arthrosporic hyphae (Figs. 14, 15). A. nitida produces both an arthrosporic

Figure 13. Arthrosporic imperfect state of Anthracobia melaloma. 220X.

Figure 14. Conidiophores and arthrospores of Anthracobia taxonomic species "B." 220X.

Figure 15. Young arthrosporic imperfect state of Anthracobia taxonomic species "B." 200X. (SEM).



"oidial" state with age similar to that of A. melaloma and a distinctive, monilioid, blastosporic state reminiscent of Hyalodendron (Fig. 16). Roxon and Batra (1973) report a "Rhizoctonia-like" imperfect state for A. "muelleri" (= A. tristis) consisting of sporodochia-like tufts of short, upright, occasionally branching chains of elongate doliform to subglobose cells in which the initially discrete tufts soon become confluent, velvety, brown, cushion-like masses (Fig. 17). Imperfect state data provide supplementary information for reinforcement of taxonomic decisions based primarily on perfect state characters.

#### Habit

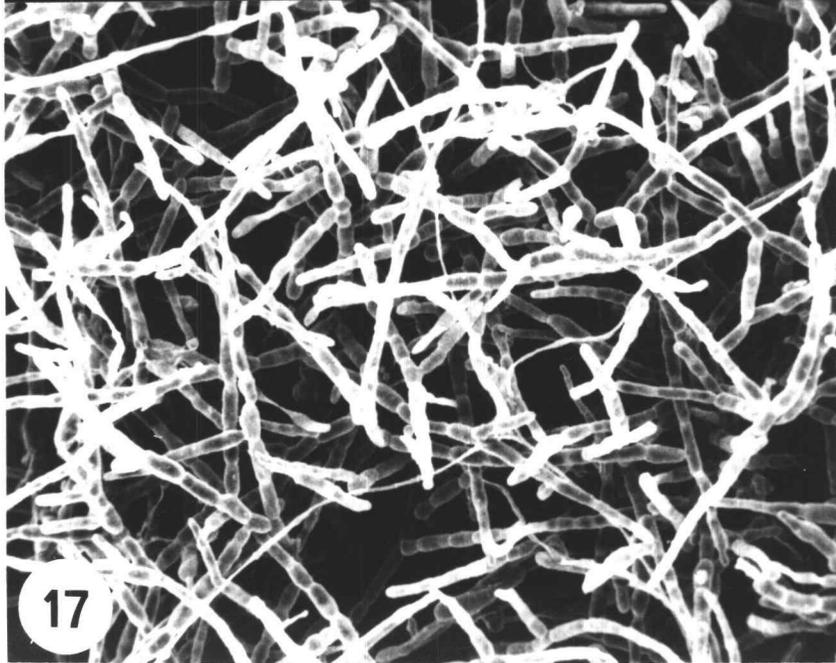
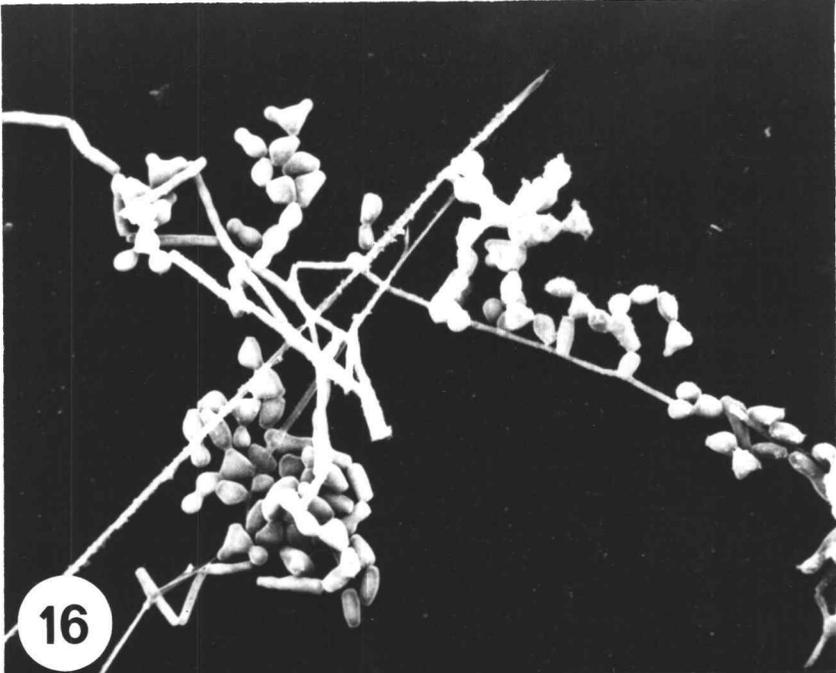
All Anthracobia species occur on soil and charcoal in fairly recent firesites with one exception; Anthracobia taxonomic species "B" was collected on cow dung.

#### Distribution

Anthracobia melaloma, A. macrocystis, and A. tristis occur in the temperate zones of both the Northern and Southern hemispheres. A. nitida is reported from Europe and the northwestern U. S. A., while A. subatra is known only from central and northern Europe. Anthracobia taxonomic species "A" occurs in Argentina and the West Indies, and Anthracobia taxonomic species "B" is only reported from Switzerland.

Figure 16. Imperfect state of Anthracobia nitida. 400X. (SEM).

Figure 17. Imperfect state of Anthracobia tristis consisting of a dense sporodochia-like tuft of monilioid arthrospores. 200X. (SEM).



IV. THE GENUS ANTHRACOBIAHistorical Review

Anthracobia was erected by Boudier in 1885 to accommodate the type species, Peziza melaloma Albertini & Schweinitz ex Fries, and "several other species quite closely related" (my translation). The genus was originally characterized by light-red to orange, sessile, lenticular apothecia exteriorly clothed with short, stiff, colored, obtuse hairs, by long, cylindrical, operculate asci not extending beyond the hymenium, by smooth, biguttulate ascospores, and by a carbonicolous habit. The "other species" were not listed at that time but were listed in his more complete treatment of the genus in 1907. The eight species and one subspecies included at that time were: A. melaloma, A. aurantio-zubra (sic!), A. aurantio-zubra ssp. pallens, A. intermixta, A. macrocystis, A. capituligera, A. maurilabra, A. tristis, and his new A. nitida. His more complete description of the genus included the following characteristics: apothecia small, sessile, orange, flattened-lenticular, clothed with fascicles of short, blunt brown hairs grouped mainly around the margin to give it a brown-punctate appearance; large, cylindrical, operculate asci not bluing in iodine; elliptical, smooth, biguttulate ascospores; paraphyses with enlarged apices whose contents become green in iodine.

Most Anthracobia spp., especially the type species Peziza melaloma, have been variously placed in different genera by other mycologists. Four of Boudier's eight Anthracobia species were originally described as species of Peziza [Dill.] St-Amans (P. melaloma, P. macrocystis Cooke, P. maurilabra Cooke, and P. intermixta Karsten), and one species later transferred to Anthracobia, was also originally described as a Peziza, P. muelleri Berkeley (Berkeley, 1872; Cooke, 1875, 1877; Karsten, 1869). Peziza is now restricted to species with asci whose opercula blue in iodine (Korf, 1973b). Fuckel (1870) transferred P. melaloma to Pyronema Carus and added Pyronema aurantio-rubrum Fuckel. However, the present conception of Pyronema includes only species with non-guttulate spores and small, orange apothecia seated on a cobwebby hyphal subiculum (Korf, 1973b). Gillet (1874) transferred Peziza melaloma to Aleuria Fuckel which has since been restricted to species with sculptured biguttulate spores and red, yellow, or orange apothecia with thin-walled blunt, poorly-developed hyphoidal hairs (Korf, 1973b). Saccardo (1889) transferred P. melaloma and P. macrocystis to Lachnea Gillet and P. maurilabra to Humaria Fuckel. Saccardo with Bommer and Rouseau (1891) described H. tristis, later transferred to Anthracobia by Boudier (1907). Saccardo also (1889) transferred P. intermixta to Humaria. Masee (1895), however, transferred P. melaloma to Humaria, while Rehm (1896) went the opposite

direction in transferring P. intermixta to Lachnea Gillet. In 1898, Starbäck described L. capituligera Starb., and Velenovsky (1934, 1939) added three varieties to P. melaloma as L. melaloma. Lachnea Gill. has now been abandoned as a later homonym of the higher plant genus Lachnaea L., and Humaria Fuck. is now restricted to species having deeply cupulate apothecia with thick-walled, rigid, brown excipular hairs (Korf, 1973b). Kuntze (1891) transferred P. melaloma to Scutellinia Lambotte, but Denison (1961), Le Gal (1966, 1968, 1972), and Korf (1973b) all now restrict that genus to species with guttulate spores and thick-walled, brown, acuminate excipular hairs which have their origin in the medullary excipulum. Schroeter (1893) placed P. melaloma in Humariella Schroeter which is not currently accepted as a genus. Snyder (1936) transferred P. macrocystis to Humarina Seaver, but Seaver (1928) had already synonymized P. macrocystis, P. intermixta, P. adusta Cooke & Peck (1875), Humaria melalomoides Rehm (1884), and H. flavoaurantiaca Rehm (1904) with P. melaloma when he transferred the latter to Patella Weber. That Seaver did not concur with Snyder's combination was made pointedly clear in 1942 when he listed Snyder's combination as a synonym of P. melaloma. Both Humarina and Patella contained many species now located in other genera, and neither genus is currently accepted (Korf, 1972).

One new species and new combinations by several authors since Boudier have increased the number of Anthracobia species to 13 and the number of varieties to four at the start of this study. Malençon (1927) described A. humillima Mal. which has subsequently been synonymized with Trichophaea abundans (Karsten) Boudier by Binyamini (1972). Moser (1963) transferred Lachnea subatra Rehm (1896) from Trichophaea, where Boudier placed it, to Anthracobia. Rifai (1968) transferred Peziza muelleri Berkeley (1872) to Anthracobia. Svrcek (1948), in the only revision of the genus, expanded the generic limits to include species with non-guttulate spores occurring on dung or rotting plants. He erected two subgenera, Pseudoanthracobia and Euanthracobia, in which the subgenus Pseudoanthracobia contained the two non-carbonicolous species with non-guttulate spores originally described as Lachnea spp., L. ramosa Velenovsky (1934) and L. humana Velenovsky (1939). The subgenus Euanthracobia contained the carbonicolous P. melaloma with which were synonymized several other species (following Seaver, 1928). Svrcek was dubious of A. humillima, A. maurilabra, and A. nitida and considered them possibly to be only forms of A. melaloma. He also downgraded two of Velenovsky's three varieties of L. melaloma to merely forms of the same as A. melaloma.

Contemporary discomycete authorities (Dennis, 1968; Korf, 1972; Moser, 1963; Rifai, 1968) recognize five or six Anthracobia

species. These include A. melaloma, A. macrocystis, A. maurilabra, A. muelleri, A. humillima, and A. subatra. Differentiation among them is based primarily on apothecial coloration and excipular hair morphology and distribution. After studying the type specimens of most of the species and those of the subspecies and the varieties, I am once again restricting the genus to the limits established by Boudier (1907) and am synonymizing or excluding all but five of the previously included species. They are A. melaloma, A. macrocystis, A. tristis, A. nitida, and A. subatra. I am additionally recognizing and characterizing two previously unknown species, taxonomic species "A" and "B."

ANTHRACOBIA Boudier, Bull. Soc. Myc. Fr. 1:106. 1885.

Apothecia small, 1-4 mm diam., rarely larger, crowded to scattered, sessile, broadly to narrowly attached, initially cupulate to slightly cupulate but becoming slightly cupulate to flattened or reflexed with age, externally clothed with fascicles of excipular hairs which usually give the margin a brown-punctate appearance and continue with variable density toward the base. Hymenial margin entire and elevated to crenulate or laciniate. Hymenium at maturity slightly concave to convex, yellow-orange to fawn, frequently fading on drying to buff. Excipular hairs superficial, hyphoidal, thin-walled, either cinnamon to light umber brown, 0-2

septate, stubby to short-cylindrical, 20-80 x 5-15  $\mu\text{m}$ , or dark sepia brown and 1-4 septate, longer, more slender, 60-150 x 4-8  $\mu\text{m}$ , apices obtuse to clavate, 6-17  $\mu\text{m}$  diam. Excipulum of two layers:

- 1) ectal excipulum of textura angularis, 2-4 cells deep, cells roughly isodiametric or polygonal and slightly to moderately elongated perpendicular to the exterior surface, all cells brown-walled or only outermost cells with light yellow-brown to brown pigmented walls;
- 2) medullary excipulum intergrading with the subhymenium and either two zoned with a 3-5 cell deep textura porrecta outer medullary excipulum and a more extensive inner medullary excipulum of large, loosely-packed textura intricata or composed entirely of large, loosely-packed textura intricata. Subhymenium consisting of smaller, more tightly compacted textura intricata. Asci cylindrical, 160-225 x 9-15  $\mu\text{m}$ , 8-spored, operculate, not bluing in iodine. Ascospores uniseriate, uninucleate, smooth, biguttulate, elliptical, 12-21 x 6-10  $\mu\text{m}$ , exhibiting Otidea-type cyanophillic staining characteristics, i. e., immature spores blue and mature spores hyaline in heated cotton blue/lactic acid. Paraphyses slender, frequently septate, variously branched or unbranched, apices scarcely enlarged to abruptly clavate or subsphaerical, frequently containing yellow-orange to orange-brown granules or droplets when fresh, becoming green in iodine.

Colonies on agar araneose, white, becoming some shade of tan with age, growing rapidly. Hyphae delicate, broad, mostly prostrate,

but some loose and interwoven aerial, hyaline to light ochraceous with age, collapsing easily. Imperfect states mycelia sterilia or one or more of the following: 1) hyaline, elongated, obtuse-cylindrical to bacilliform thallose arthrospores (oidia), 6-30 x 2-6  $\mu\text{m}$ , produced by segmentation of undifferentiated aerial and surface hyphae with age; 2) upright, white, highly branched, aerial tufts of hyphae with more or less determinate growth, tufts commonly 300-400 x 150-300  $\mu\text{m}$ , becoming light-tan with age and tuft hyphae soon segmenting to produce easily separated, hyaline to light-tan, elongated to obtuse-cylindrical arthrospores (oidia), 5-15 x 4-8  $\mu\text{m}$ ; 3) Hyalodendron-like branching chains of hyaline to buff, smooth, obtuse, doliform to branched oblong-cylindrical, monilioid blastospores, 9-15 x 4.5-9  $\mu\text{m}$ , borne terminally on hyaline, branched, aerial conidiophores, 200-700 x 7-15  $\mu\text{m}$ , or laterally and sessile on other undifferentiated hyphae; 4) short, upright, occasionally branching chains of hyaline to ochraceous brown, globose to elongate-doliform arthrospores, 20-40 x 10-16  $\mu\text{m}$ , aggregated in sporodochia-like tufts which become confluent with age. Mating types homothallic or heterothallic.

Habitat: Saprophytic on charcoal or burned soil throughout the growing season.

TYPE SPECIES: Peziza melaloma Alb. & Schw. ex Fr.

## KEY TO INCLUDED SPECIES

1. Excipular hairs medium to dark brown, 1-4 septate, long and slender, 60-150 x 4-17  $\mu\text{m}$ ; hymenium orange to fawn, rarely yellow-orange or chestnut brown . . . . . 2
- 1' Excipular hairs light to medium brown, 0-2 septate, short-cylindrical to stubby, 20-80 x 5-15  $\mu\text{m}$ , easily collapsing; hymenium yellow to ochraceous orange, rarely darker . . . . . 5
2. Hymenium orange to fawn, rarely yellow-orange; hair apices obtuse to only slightly enlarged . . . . . 3
- 2' Hymenium fuscous to chestnut brown; apices of hairs at margin obviously enlarged, 8-17  $\mu\text{m}$  diam., lower hair apices enlarged or not . . . . . 4
3. Asci 155-225 x 8-15  $\mu\text{m}$ ; spores large, 15-21 x 6.5-9.5  $\mu\text{m}$ ; on burned soil or charcoal . . . . . A. melaloma
- 3' Asci small, 120-130 x 10-12  $\mu\text{m}$ ; spores small, 13-16.5 x 7.5-9.0  $\mu\text{m}$ ; on cow dung . . . . . A. taxonomic species "B"
4. Excipular hairs 60-90 x 4-7  $\mu\text{m}$ , apices inflated, 8-17  $\mu\text{m}$  diam.; paraphyses apices abruptly inflated, broadly clavate to subsphaerical, 5-10  $\mu\text{m}$  diam. . . . . A. subatra
- 4' Excipular hairs at margin 60-110 x 3-5  $\mu\text{m}$ , apices to 9  $\mu\text{m}$  diam., lower hairs 80-150 x 5-7.5  $\mu\text{m}$ , apices to 9  $\mu\text{m}$  diam.; paraphyses

- apices only slightly enlarged to 3  $\mu\text{m}$   
diam. . . . . A. subatra var. fusca
5. Excipular hairs mostly 45-80 x 8-15  $\mu\text{m}$ ;  
paraphyses branched approximately one-fourth  
to one-third of the distance from the base, apices  
clavate to broadly clavate, 5.5-10  $\mu\text{m}$  diam. . . . A. nitida
- 5' Excipular hairs mostly 20-45 x 7.5-15  $\mu\text{m}$ ; para-  
physes not as above, either unbranched or branched  
at various levels including immediately below the  
apical septum . . . . . 6
6. Spores broadly elliptical to elliptical, 13-16 x  
7-9  $\mu\text{m}$ ; paraphyses branched below the apical  
septum, or occasionally  
elsewhere . . . . . A. taxonomic species "A"
- 6' Spores elliptical to narrowly elliptical, 17-21  
x 7-9.5  $\mu\text{m}$ ; paraphyses unbranched except,  
rarely, at their origin . . . . . 7
7. Ectal excipulum composed mostly of large, iso-  
diametric cells, 20-60  $\mu\text{m}$  diam.; excipular hairs  
very inconspicuous, light medium brown, up to  
8  $\mu\text{m}$  diam.; margin entire and elevated  
slightly . . . . . A. macrocystis
- 7' Ectal excipulum composed of polygonal cells, 20-40  
x 30-60  $\mu\text{m}$ , elongated perpendicular to the external  
surface; excipular hairs in more obvious fascicles,  
medium brown, usually greater than 15  $\mu\text{m}$  in diam.;

margin dentate to crenulate with "bars" of hair  
 fascicles which become discontinuous patches  
 toward the base . . . . . A. tristis

ANTHRACOBIA MACROCYSTIS (Cke.) Boudier

Peziza macrocystis Cooke, Mycograph. 1:36 (fig. 63). 1875.

≡ P. subhirsuta var. macrocystis Cke., Grevillea 1:129.  
 (March) 1873.

≡ Humaria macrocystis (Cke.) Saccardo, Syll. Fung.  
 8:122. 1889.

≡ Anthracobia macrocystis (Cke.) Boudier, Hist. Class.  
 Discom. Eur. 65. 1907.

≡ Humarina macrocystis (Cke.) Snyder, Mycologia 28:484.

Apothecia small, 2-4 mm diam., gregarious to scattered,  
 sessile, broadly attached, initially concave but becoming flattened  
 at maturity, exterior appearing glabrous to minutely granular macro-  
 scopically but actually clothed with fascicles of very inconspicuous,  
 light brown, excipular hairs; fascicles mostly grouped at the margin,  
 but some occasionally scattered down the exterior toward the base.  
 Margin entire and elevated 30-60  $\mu\text{m}$  above the hymenium. Hymenium  
 "Orange" to "Luteous," fading on drying, exterior concolorous to  
 slightly darker. Excipular hairs superficial, fasciculate, hyphoidal,  
 thin-walled and easily collapsing, light-medium brown, "Cinnamon" to  
 "Sienna" en masse, 0-2 septate, short-cylindrical, 15-45(60) x 4-8  
 $\mu\text{m}$ , apices obtuse to slightly enlarged, 5-9  $\mu\text{m}$  diam.; fascicles

mostly grouped at the margin but some occasionally scattered below toward the base. Ectal excipulum textura angularis, 2-3 cells deep, cells approximately isodiametric and only slightly elongated (if at all) perpendicular to the exterior surface, 20-60  $\mu\text{m}$  diam., outermost cells with light-brown pigmented cell walls. Medullary excipulum textura intricata, cells irregular in size and shape, 4-9  $\mu\text{m}$  diam., loosely packed, cylindrical to barrel-shaped, intergrading with the smaller (3-6  $\mu\text{m}$  diam.) and more densely packed cells comprising the textura intricata tissue of the subhymenium. Asci cylindrical, 165-190 x 11-15  $\mu\text{m}$ , 8-spored, operculate, not bluing in iodine. Ascospores uniseriate, smooth, biguttulate, elliptical to narrowly elliptical, (16)17-20 x 7.5-9.0  $\mu\text{m}$ , immature spores cyanophillic and mature spores cyanophobic in heated botton blue/lactic acid. Paraphyses slender, septate, unbranched, 1.5-3.5  $\mu\text{m}$  diam. below, apices clavate, 5-7.5  $\mu\text{m}$  diam., filled with small, orange granules which turn green in iodine.

Cultural characteristics: Only a mycelia sterilia imperfect state known thus far (Paden, 1972). Mating type reportedly heterothallic.

Habitat: On burned soil and charcoal.

Distribution: Europe, North America.

Holotype: W. Phillips, on the ground, Shrewsbury. (M. C. Cooke, Fungi Britannici Exsiccati, editio Secunda, no. 651) (K).

## Specimens examined:

Canada: British Columbia: H. J. Larsen, on burned soil and charcoal, forest fire site 9.3 mi. E. of Glacier Nat'l. Park along TransCanada No. 1, 26 June, 1971 (OSC 34,842; HJL F-200).

France: F. Candoussau no. 515, on burned soil, property of "La flourette" Loubersan, Mirande 32 300, 1 January, 1972 (OSC 34,845; HJL F-211).

Great Britain: W. Phillips, on the ground, Shrewsbury (no date) (K) (HOLOTYPE? of Peziza macrocystis Cke.); (no collector), Shrewsbury, 1873 (M. C. Cooke no. 59) (K).

Notes: Anthracobia macrocystis belongs to the group of Anthracobia species having 0-2 septate, light- to medium-brown, very short (usually less than 60  $\mu\text{m}$  long) excipular hairs and having a hymenium with yellow to orange hues. The other members of this group are A. tristis, A. nitida, and Anthracobia taxonomic species A. macrocystis appears to be most closely related to taxonomic species A., differing primarily in spore size and paraphyses branching. A. macrocystis has a few loosely-packed, large, radially arranged hyphae in the lower portion of the medullary excipulum, but there are not enough to give a two-zoned textura porrecta/textura intricata appearance to the medullary excipulum. The second British collection (M. C. Cooke no. 59) has a very pronounced sterile margin while the margin of the HOLOTYPE is not so evident, although it is elevated and entire.

My attempts to culture Anthracobia macrocystis have been unsuccessful. Paden (1972) found no imperfect sporulation in his isolate of A. macrocystis, but I have not yet examined his voucher specimens. The MSA mycology Guidebook (Mycological Society of America, Mycology Guidebook Committee, 1974) states A. macrocystis is heterothallic, but no reference is given. I presently have a homothallic isolate from C. T. Rogerson that produces apothecia in culture resembling those of A. macrocystis, but differing in the spores being broadly elliptical. It produces an imperfect state resembling that of A. tristis. Its relationship to A. macrocystis is not clear.

ANTHRACOBIA MELALOMA (Alb. & Schw. ex Fr.) Boudier

- Peziza melaloma Albertini & Schweinitz, Conspect. fung.  
Lusat. 336 (t. 1, f. 5). 1805.  
ex Fries, Syst. Myc. II:68. 1822.
- ≡ Aleuria melaloma (Alb. & Schw. ex Fr.) Gillet, Champ. Fr.  
Discom. 54. 1874.
- ≡ Lachnea melaloma (Alb. & Schw. ex Fr.) Saccardo, Syll.  
Fung. 8:181. 1889.
- ≡ Scutellinia melaloma (Alb. & Schw. ex Fr.) Kuntze, Rev.  
Gen. Pl. 2:869. 1891.
- ≡ Humariella melaloma (Alb. & Schw. ex Fr.) Schroeter,  
Krypt. -Fl. 3(2):37. 1893.
- ≡ Humaria melaloma (Alb. & Schw. ex Fr.) Masee, Brit.  
Fung. Fl. 4:411. 1895.
- ≡ Anthracobia melaloma (Alb. & Schw. ex Fr.) Boudier, Hist.  
Class. Discom. Eur. 65. 1907.

- ≡ Patella melaloma (Alb. & Schw. ex Fr.) Seaver, N. Am. Cup-fungi (Operc.) 167. 1928.
- = Lachnea melaloma (Alb. & Schw. ex Fr.) Sacc. var. combusta Velenovsky, Mon. Disc. 308. 1934.
- ≡ Anthracobia melaloma (Alb. & Schw. ex Fr.) Boud. forma combusta (Vel.) Svrcek, Acta Mus. nat. Prag. 4B, No. 6. (Bot. No. 1):78. 1948.
- = Lachnea melaloma (Alb. & Schw. ex Fr.) Sacc. var. dubia Velenovsky, Mon. Disc. 308. 1934.
- ≡ Anthracobia melaloma (Alb. & Schw. ex Fr.) Boud, forma dubia (Vel.) Svrcek, Acta Mus. nat. Prag. 4B, No. 6 (Bot. No. 1):78. 1948.
- = Peziza intermixta Karsten, Mon. Pez. 119. 1869.
- ≡ Humaria intermixta (Karst.) Saccardo, Syll. Fung. 8:134. 1889.
- ≡ Lachnea intermixta (Karst.) Rehm in Rabenhorst, Krypt. -Fl. Bd. I, Abh. III:1047. 1896.
- ≡ Anthracobia intermixta (Karst.) Boudier, Hist. Class. Discom. Eur. 65. 1907.
- = Peziza maurilabra Cooke, Grevillea 6:64. 1877.
- ≡ Humaria maurilabra (Cke.) Saccardo, Syll. Fung. 8:124. 1889.
- ≡ Anthracobia maurilabra (Cke.) Boudier, Hist. Class. Discom. Eur. 65. 1907.
- = Peziza adusta Cooke & Peck, Ann. Rep. N. Y. State Mus. 27:107. 1875.
- ≡ Humaria adusta (Cke. & Pk.) Saccardo, Syll. Fung. 8:141. 1889.
- = Humaria melalomoides Rehm in Sydow, Mycoth. March. exs. no. 778. 1884.

Apothecia small, 1-5 mm diam., gregarious and commonly crowded, sessile, larger apothecia narrowly attached, initially concave, remaining concave or becoming flattened at maturity, upper portion of exterior and particularly the margin clothed with fascicles of excipular hairs, scattered fascicles of hairs continuing to the base or not. Margin extending slightly beyond the hymenium, crenulate to lacinate, with a continuous to interrupted border of fascicles of dark brown hairs. Hymenium "Orange" to "Fawn," exterior concolorous to slightly darker. Excipular hairs superficial, fasciculate, thin-walled, hyphoidal, "Dark Brick" to "Chestnut" brown en masse, (1)2-4 septate, slender, (45)60-90(110) x 4-9  $\mu\text{m}$ , apices obtuse to slightly enlarged, 4-12  $\mu\text{m}$  diam.; fascicles mostly grouped at the margin but frequently continuing in scattered patches to the base. Ectal excipulum textura angularis, 2-4 cells deep, cells isodiametric to polygonal, 15-50  $\mu\text{m}$  diam., outermost cells with medium-brown pigmented cell walls. Medullary excipulum textura intricata, cells irregular in size and shape, narrowly cylindrical to doliform, 3-15  $\mu\text{m}$  diam., loosely packed, intergrading with the smaller (3-6  $\mu\text{m}$  diam.) and more densely packed cells comprising the textura intricata tissue of the subhymenium. Asci cylindrical, (155)170-200(225) x (8)10-13(15)  $\mu\text{m}$ , 8-spored, operculate, not bluing in iodine. Ascospores uniseriate, smooth, biguttulate, elliptical to narrowly elliptical, (15)17-20(21) x (6.5)7.5-9.5  $\mu\text{m}$ , immature spores

cyanophillic and mature spores cyanophobic in heated cotton blue/lactic acid. Paraphyses slender, septate, variously branched or unbranched, 1.5-3.0  $\mu\text{m}$  diam. below, apices slightly enlarged to clavate, 3-9  $\mu\text{m}$  diam., containing yellow to orange granules which turn green in iodine.

Colonies on agar araneose, white, commonly becoming ochraceous with age, growing rapidly. Hyphae delicate, broad, 5-18  $\mu\text{m}$  diam., mostly prostrate, but some aerial. Aerial hyphae may become ochraceous with age, collapsing easily or occasionally segmenting with age to produce hyaline, elongated obtuse-cylindrical to bacilliform, thallose, arthrosporic oidia, 6-30 x 2-6  $\mu\text{m}$ . Mating type heterothallic.

Habitat: On burned soil or charcoal throughout the growing season.

Distribution: World-wide (?).

Neotype: H. Rupprecht, auf Brandstellen, Westfalen: Kölnischer Wald bei Bottrop, 22 October, 1921/15 November, 1921 (Sydow, Mycotheca germanica no. 1937) (Lachnea) (K).

Partial list of specimens examined:

Australia: Drummond, Swan River (no date) (K).

Canada: British Columbia: H. J. Larsen, on burned soil and charcoal, forest fire site 9.3 mi. E. of Glacier Nat'l. Park along TransCanada No. 1, 26 June, 1971 (OSC 33, 349; HJL F-203).

Czechoslovakia: J. Velenovsky, Mnichovice: Kunice, October, 1928 (PR 147270) (HOLOTYPE or LECTOTYPE? of Lachnea melaloma var. combusta Vel.); J. Velenovsky, In carbonario, Vsenory, 19 November, 1926 (PR 147269) (HOLOTYPE of Lachnea melaloma var. dubia Vel.); M. Svrcek, In carbonario in piceto, ad pedem collis Kozeny Vrch, Mnichovice, Centr. Bohemia, 16 June, 1968 (PR 671806).

France: M.C. Cooke no. 77, on decaying chips and wood dust, Villers Cotterets (no date) (K) (HOLOTYPE of Peziza maurilabra Cke.); F. Candoussau no. 518, Vallee de Lesponne (Region de Tarbes), Hautes Pyrenees, 11 August, 1973 (OSC 34, 849; HJL F-214).

Germany: H. Rupprecht, Auf Brandstellen, Kölnischer Wald bei Bottrop, Westfalen, 22 October and 15 November, 1921 (Sydow, Mycotheca germanica 1937) (K) (NEOTYPE of Peziza melaloma Alb. & Schw. ex Fr.); F. Petrak, Lfg. 6 Nr. 265, Auf Brandstellen, M. Weisskirchen: Ohrensdorf, 19 August, 1912 (K); P. Sydow Mycotheca Marchica 778, Auf einer Brandstellung im Grunewald, Berlin, July 1885 (K) (PARATYPE ? of Humaria melalomoides Rehm).

Great Britain: (no collector), No. 5 Flanus (?), (no date) (K) (possible PARATYPE of Peziza maurilabra Cke.).

Northern Ireland: R.T. Moore, on a burnt-ground bonfire site, Coleraine, County Londonderry, 4 May, 1975 (OSC 34, 851; HJL 584).

Southern Rhodesia: A. Rothwell, on burned soil in tobacco seed bed, January, 1953 (Herbarium M. Le Gal).

Switzerland: W. Matheis 281, on burnt ground, Barchetsee TG, Kanton Thurgau, 15 September, 1973 (OSC 34,847; HJL F-218).

United States: New York: C.H. Peck, ground under pines, West Albany, (no date) (NYS) (HOLOTYPE of Humaria adusta Cke. & Pk.); M.A. Rosinski et al., on burned area, Lloyd-Cornell Preserve, Ringwood, 4 August, 1953 (CUP--DFNY 53-153). Oregon: H.J. Larsen, on soil in fire site, MacDonald State Forest, 1.2 mi. W. of Lewisburg on Sulfur Springs Road, 21 November, 1971 (OSC 34,848; HJL F-273).

Notes: Anthracobia melaloma, the most common species of Anthracobia, is also the most variable in its characteristics. Other authorities (Boudier, 1905-1910; Dennis, 1968; Eckblad, 1968; Gamundi, 1960; Moser, 1963) separate A. melaloma and A. maurilabra as distinct species on the basis of hymenial coloration, spore size and shape, and excipular hair coloration, morphology, and distribution. A. melaloma in their sense is restricted to organisms having a more orange-hued hymenium, broader spores (14-22 x 7-11  $\mu\text{m}$ ), and obtuse, medium-brown excipular hairs grouped in fascicles which are almost entirely restricted to the apothecial margin. A. maurilabra then contains organisms having a more red-hued hymenium, narrower spores (19-22 x 8-9  $\mu\text{m}$ ), and slightly clavate, dark-brown excipular hairs grouped in fascicles which are mostly distributed around the margin but also scattered with varied density toward

the base. I find these characters intergrade in herbarium collections and cultural apothecia and are far too variable and inconsistent to use as criteria on which to separate these two species.

Cooke (1877) differentiates his Peziza maurilabra from P. melaloma by stating "the external cells and margin are distinctly different." The HOLOTYPE of P. maurilabra has a crisp, irregularly splitting, lacinate margin and medium- to dark-brown exterior cells of the ectal excipulum. The fasciculate, dark "Sepia" brown excipular hairs are longer and obtuse below the margin, 60-90 x 6-8  $\mu\text{m}$ , and shorter at the margins, 45-60 x 6-7.5  $\mu\text{m}$ , with apices enlarged to 12  $\mu\text{m}$ . The collection is labeled with the unpublished name, P. (Hum.) atrocrenata Cke., which would have been very appropriate. The second P. maurilabra collection in Cooke's herbarium at K is similar to the HOLOTYPE but differs in having a much darker exterior, an even more crisp and lacinate margin, and much less obvious excipular hairs. I do not believe P. maurilabra should be recognized as a species distinct from P. melaloma; but, if the two species are to be separated, then the dark lacinate margin, dark-brown exterior cells, and the very dark-brown, clavate excipular hairs at the margin could provide the basis for doing so.

The HOLOTYPE of Peziza melaloma Alb. & Schw. ex Fr. could not be located, and the experience of other discomycete workers (Denison, 1964; Korf, pers. comm. 1972) indicates the species will

have to be neotypified. Rupprecht's collection, disseminated by Sydow as *Mycotheca germanica* no. 1937, agrees with both the original description and with the current European concept of the species. I therefore designate this collection at K the NEOTYPE of *Peziza melaloma* Alb. & Schw. ex Fr.

*Peziza adusta* Cke. & Pk. and *Humaria melalomoides* Rehm are synonymized with *P. melaloma* since I find their type specimens are virtually identical to the NEOTYPE of *P. melaloma*. The HOLOTYPE of *P. adusta* is slightly more cupulate and has a "Straw" to "Sulfur Yellow" hymenium upon rehydration. The PARATYPE of *H. melalomoides* differs only in having smaller spores, 16-18 x 7-9  $\mu\text{m}$  vs. 19-20 x 7.5-8.5  $\mu\text{m}$ . No type or authentic collections of *P. intermixta* Karsten could be located, but Rehm (1896) synonymized his *H. melalomoides* with that species. Assuming Rehm had access to the type material of *P. intermixta*, I am including it as a synonym of *P. melaloma*.

Velenovsky's varieties of *P. melaloma* deserve brief mention. The HOLOTYPE of his *Lachnea melaloma* var. *combusta* has spores measuring 17.5-19.5 x 8-9  $\mu\text{m}$  instead of the 24-28  $\mu\text{m}$  originally described. It does not deserve varietal status. The HOLOTYPE of his *Lachnea melaloma* var. *dubia* differs only in reportedly having a white hymenium when fresh. I am unconvinced it warrants recognition at the varietal or even form level as suggested by Svrcek (1948).

ANTHRACOBIA NITIDA Boudier

Anthracobia nitida Boudier, Hist. Class. Discom. Eur. 65.  
1907.

Apothecia small, 1-3 mm diam., gregarious, sessile, initially slightly cupulate but becoming flattened at maturity, externally clothed with light brown pustules of cells or patches of excipular hairs mostly grouped at or just below the margin and scattered below. Margin slightly elevated, crenate to crenulate, consisting of globose inflated cells. Hymenium "Orange" to "Pale Luteous" when fresh, rehydrated color "Pale Luteous" to dark "Buff," apothecium exterior concolorous to slightly darker. Excipular hairs superficial, fasciculate, hyphoidal, thin-walled, easily collapsing and easily overlooked, light "Umber" to "Honey" brown en masse, 0-2 septate, short-cylindrical to longer straight or somewhat contorted, (30)45-80 x (5)8-15  $\mu\text{m}$ , apices obtuse, fascicles mostly at or just below the margin but some scattered fascicles to the base. Ectal excipulum textura angularis, 2-4 cells deep, cells roughly isodiametric to somewhat polygonal, 10-50  $\mu\text{m}$  diam., with hyaline to light yellow-brown walls. Medullary excipulum composed of two layers; outer layer consisting of textura porrecta, 5-8 cells deep, cells 10-20  $\mu\text{m}$  diam.; inner layer consisting of textura intricata, cells loosely intertwined and irregular in size and shape, cells 10-20  $\mu\text{m}$  diam., intergrading with the smaller diam., 4-10  $\mu\text{m}$  diam., more densely packed

textura intricata of the subhymenium. Asci cylindrical, 170-210 x 9-12  $\mu\text{m}$ , 8-spored, operculate, not bluing in iodine. Ascospores uniseriate, uninucleate, smooth, biguttulate, elliptical, 16-19 x (6)7-9  $\mu\text{m}$ , immature spores cyanophillic and mature spores cyanophobic in heated cotton blue/lactic acid. Paraphyses slender, septate, commonly branched one-third of their length from the base, 1.5-3.0  $\mu\text{m}$  diam. below, apices clavate to broadly clavate, (5)7-10  $\mu\text{m}$  diam., filled with small to medium-sized hyaline vacuoles and minute orange granules which turn green in iodine.

Colonies on agar araneose, white, becoming light tan with age, growing rapidly. Hyphae delicate, broad, mostly prostrate but some aerial, loosely interwoven, hyaline to light "Ochraceous" with age, collapsing easily. Imperfect state sporulation initially producing branching acropetal chains of hyaline to buff, obtuse, smooth, doliform to branched oblong-cylindrical monilioid blastospores, 9-5 x 4.5-9  $\mu\text{m}$ , borne either laterally and sessile on other undifferentiated aerial hyphae or terminally on hyaline, branched or unbranched aerial conidiophores, 200-700 x 7-15  $\mu\text{m}$ ; subsequently, undifferentiated aerial hyphae segment with age to produce hyaline, elongated, obtuse-cylindrical to bacilliform thallose arthrospores (oidia), 6-30 x 2-6  $\mu\text{m}$ , virtually identical to those produced by A. melaloma. Mating type suspected to be heterothallic.

Habitat: On burned soil.

Distribution: Austria, France, Washington (USA).

Neotype: F. Candoussau, sur place à charbon, Vallée du Rieumajou /s Abies (Hautes Pyrenées), France, 19 October, 1973 (HJL no. F-216; to be deposited in a European herbarium).

Specimens examined:

Austria: M. Moser, Sur bruyères incendiées, près de Nederjoch, Tyrol, Tout l'été, surtout jussi-juillet, Reçu le 28 February, 1949 (Herb. Marcelle Le Gal).

France: F. Candoussau, sur place à charbon, Vallée du Rieumajou /s Abies (Hautes Pyrenées), 19 October, 1973 (HJL no. F-216; to be deposited in a European herbarium) (NEOTYPE); M. Courtillot, sur terre brûlée, Environs d'Auserre (Yonne) 6 May, 1953 (Herb. Marcelle Le Gal).

United States: Washington: J.M. Grant, on ground, Marysville, September, 1929 (sub Lachnea abundans) (UPS).

Notes: Dr. R.F. Korf (pers. comm., 1973) was unable to find at Paris any collection of Anthracobia nitida seen by Boudier. He indicated neotypification was probably necessary for this species. The two collections from Mme. Le Gal's herbarium were therefore obtained by Dr. Korf to provide an understanding of her concept of the species. The specimens from Mme. Le Gal's herbarium and those from Mme. Candoussau are identical in all respects except that those

from Mme. Le Gal have shorter excipular hairs (30-45 x 4-9  $\mu\text{m}$  for Moser's collection, and 30-60 x 10-12  $\mu\text{m}$  for Courtillot's collection) than those from Mme. Candoussau (45-75 x 9-15  $\mu\text{m}$ ). I am unable to determine the structure of the medullary excipulum from my copy of Boudier's illustrations in the Icones, and it is possible the specimens I have examined differ from those Boudier saw in this respect. The only ascertainable difference of these specimens from Boudier's illustrations and original description is that he termed the paraphyses "simplices," i. e., unbranched, and so illustrated them. The present specimens all have paraphyses which are regularly branched once in the lower third of their length. Their similarities in all other respects, however, convince me that this is their proper disposition. The holotype and other authentic material evidently no longer exist, and a neotype must be chosen. As the collection by Mme. Candoussau most closely agrees with the original description and with Boudier's illustrations in the Icones and a fruiting culture with apothecia has been derived from it, I am designating this collection the NEOTYPE.

No imperfect state sporulation has previously been reported for Anthracobia nitida. Durand (1968) describes apothecial ontogeny for an isolate of A. nitida, but she makes no mention of any imperfect state. Unfortunately, no voucher specimen is cited and insufficient data are included in her report to determine whether her organism was in fact A. nitida. None of the imperfect states of species in the

Pezizales reviewed by Paden (1972) are similar to the blastosporic state found in my studies. However, the arthrosporic oidial state is virtually identical to that previously reported for A. melaloma (Gwynne-Vaughn, 1937; Larsen, 1973; Olive, 1950).

Hymenial coloration of Anthracobia nitida apothecia produced by my isolate ranges from "Pale Luteous" in apothecia on the agar surface to bright "Orange" in apothecia submerged in the agar. Thus, hymenial coloration in fresh collections will most likely vary somewhat, depending on environmental conditions.

ANTHRACOBIA TRISTIS (Bomm., Rouss., & Sacc.) Boudier

Humaria tristis Bommer, Rousseau, & Saccardo in Bommer & Rousseau, Bull. Soc. Roy. Bot. Belg. 29:216. 1891.

≡ Anthracobia tristis (Bomm., Rouss., & Sacc.) Boudier, Hist. Class. Discom. Eur. 65. 1907.

= Peziza muelleri Berkeley, J. Linn. Soc. (Bot.) 13:176. 1872.  
sensu description & sensu Rifai (1968), non sensu typo.

≡ Humaria muelleri (Berk.) Saccardo, Syll. Fung. 8:119. 1889.

≡ Anthracobia muelleri (Berk.) Rifai, Austral. Pezizales 141-144. 1968.

Apothecia small, 1-3 mm diam., rarely 4 mm diam. [fide Rifai], gregarious to crowded, sessile, narrowly attached, initially slightly concave but becoming flattened to slightly convex at maturity, exterior appearing broadly striate or "barred" vertically toward the margin with fascicles of excipular hairs, the "bars" becoming broken

patches toward the base. Margin crenulate to dentate with the "bars" exceeding the hymenium only slightly. Hymenium "Luteous" yellow to "Ochraceous" orange-brown when fresh, exterior concolorous.

Excipular hairs superficial, fasciculate, hyphoidal, thin-walled, medium "Umber" brown en masse, 0-2 septate, short-cylindrical with obtuse apices, 20-40(60) x 7.5-15(18)  $\mu\text{m}$ ; fascicles grouped toward the margin to give a vertically "barred" appearance macroscopically but becoming discontinuous patches toward the base.

Ectal excipulum textura angularis, 2-4 cells deep, cells idodiametric to polygonal and slightly to moderately elongated perpendicular to the exterior surface, 20-40 x 30-60  $\mu\text{m}$ , outermost cells of the layer with light yellow-brown to light brown pigmented cell walls.

Medullary excipulum textura intricata, cells irregular in size and shape, 6-15  $\mu\text{m}$  diam., loosely packed, cylindrical to doliform, intergrading with the smaller (4-8  $\mu\text{m}$  diam.) and more densely packed cells comprising the textura intricata tissue of the subhymenium.

Asci cylindrical, 170-210 x 9-12  $\mu\text{m}$ , 8-spored, operculate, not bluing in iodine. Ascospores uniseriate, smooth, biguttulate, elliptical to elongate elliptical, (17)18-21 x 7.0-9.0(10)  $\mu\text{m}$ , immature spores cyanophillic and mature spores cyanophobic in heated cotton blue/lactic acid. Paraphyses slender, septate, unbranched or, rarely, branched toward the base, 1.5-2.5  $\mu\text{m}$  diam. below, apices clavate, 5-7  $\mu\text{m}$  diam., with orange-yellow granules and many

hyaline small to medium-sized vacuoles (to 2  $\mu\text{m}$  diam.) when fresh, granules turning green in iodine.

Colonies on agar araneose, white, becoming ochraceous brown with age, growing rapidly. Hyphae delicate, broad (to 17  $\mu\text{m}$  diam.), mostly prostrate, but some loose and interwoven aerial hyphae which are hyaline to ochraceous with age and collapse easily. Prostrate hyphae sporadically producing branched, upright tufts of monilioid, globose to doliform, subhyaline to ochraceous brown, arthrosporic cells, 20-40 x 10-16  $\mu\text{m}$ , tufts initially discrete, but soon becoming confluent, velvety, cushion-like masses. Mating types homothallic (and heterothallic ?).

Habitat: On burned soil and charcoal.

Distribution: Probably cosmopolitan: Australia, Europe, North America.

Holotype: Sur la terre brulee, Groenendael [Belgium] , October, 1884 (Humaria) (BR).

Specimens examined:

Australia: F. v. Mueller, Plenty Creek, no. 9, Victoria (no date) (MEL 58193) (ISOTYPE of Peziza muelleri Berk. ); F. v. Mueller, Sealers Cove, Victoria, May, 1853 (MEL 58194); no. 120, Peziza miniata, Sealers Cove (no collector, no date) (K); G. Beaton, Victorian Discomycetes 120, Moorhouses Bridge, Curdies River, Glenfyne-Timboon Road, 1 June, 1963 (K); P. H. B. Talbot no. 6, on

burned soil, Waterfall Gally near Adelaide, South Australia, 1962 (K); J. H. Warcup Em 315, near Glen Osmond, South Australia, approx. 20 September, 1972 (CUP-52752); J. H. Warcup Em 316, near Glen Osmond, South Australia, approx. 20 September, 1972 (CUP-52753).

Belgium: Sur la terre brulee, Goenendael, October, 1884 (Humaria) (BR--HOLOTYPE of Humaria tristis Bomm., Rouss., Sacc.) (PAD--ISOTYPE of the same); Sur la terre brulee, Groenendael, October, 1884 (BR).

Switzerland: W. Matheis 280, on burnt ground, Barchetsee TG, Kanton Thurgau, 15 September, 1973 (HJL F-217).

United States: Utah: C. T. Rogerson Utah soil 15-1, isolated from soil under Pseudotsuga menziesii, trail to Malans Peak, east of Ogden, Weber Co., 22 May, 1970 (CUP-52617, HJL-594); C. T. Rogerson Utah soil 38-1, isolated from soil under Acer glabrum, Indian Trail, Ogden Canyon, Weber Co., 10 June, 1971 (CUP-52618, HJL-595); C. T. Rogerson Utah soil 46-1, isolated from soil under Quercus gambelii, along Wolf Creek near Patio Springs, Eden, Weber Co., 13 June, 1971 (CUP-52619, OSC 34,843, HJL-596); C. T. Rogerson Utah soil 208-2, isolated from soil under Acer platanoides, Wasatch Springs Park, Salt Lake City, Salt Lake Co., 19 August, 1973 (OSC 34,844; HJL-589).

Venezuela: K. P. Dumont KPD VE-7800, isolated from soil collected between refugio "No Te Apures" and Quebrada Los Palos Grandes, South facing slope of La Silla, Parq. Nac. El Avila, Edo. Miranda, 1 July, 1972 (OSC 34, 852; HJL-591).

Notes: The name Anthracobia muelleri (Berk.) Rifai cannot be used for this species. Rifai (1968) noted that the type collection of Peziza muelleri Berkeley is a short-haired Scutellinia related to S. kerguelensis and in no way conforms to Berkeley's description or unpublished sketch of P. muelleri; additionally, it bears the evidently unpublished name, Peziza velutina Berk. & Müll. Rifai therefore rejected this specimen as the type specimen for P. muelleri and used a different collection ("on burnt ground, Sealers Cove, May 1853, von Müller s. n.") labeled P. muelleri in Berkeley's own hand as an "authentic--or probably type--specimen of Peziza muelleri Berk." I have been unable to examine these specimens from Kew, but I have examined the duplicate collections from Müller's herbarium at MEL. Müller's ISOTYPE collection of P. muelleri (MEL 58193) is also a short-haired Scutellinia (Fig. 18, 19), while his collection from Sealers Cove, May 1853 (MEL 58194) agrees entirely with Berkeley's description and Rifai's account. Thus Berkeley most probably erred in citing the type collection on which his description was based. However, according to the International Code of Botanical Nomenclature (1972), the species name is permanently attached to the

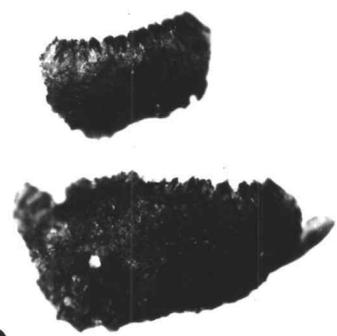
- Figure 18. Apothecium of the ISOTYPE ? of Peziza muelleri. 15X.
- Figure 19. Scutellinia-type rooting hair from the ISOTYPE ? of Peziza muelleri. 220X.
- Figure 20. Apothecia of the PARATYPE of Lachnea ampezzana showing the pronounced fascicles of excipular hairs. 15X.
- Figure 21. Excipular hairs of Lachnea humana. 220X.



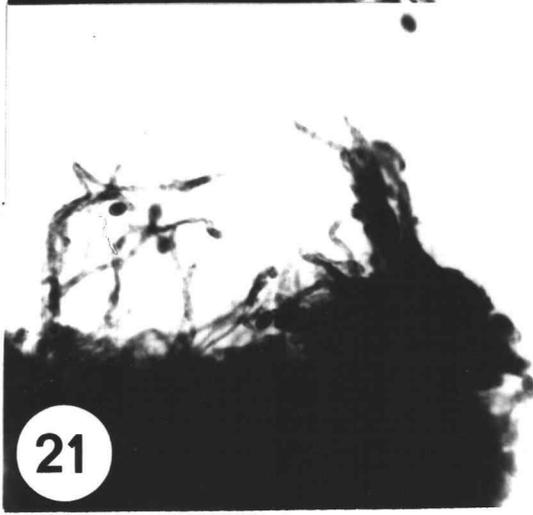
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designated type specimen so long as it exists. In this case, therefore, the name Peziza muelleri Berk. is tied to that Scutellinia species and is preempted for the present species of Anthracobia. The only other name available for this taxon is Anthracobia tristis (Bomm., Rouss., Sacc.) Boudier.

The HOLOTYPE and ISOTYPE specimens of Humaria tristis Bomm., Rouss., Sacc. also differ somewhat from the original description. The species was originally described as having small apothecia (0.75-1.0 mm diam.) with a livid brown hymenium, paraphyses with non-inflated apices, and small, 13-15 x 9  $\mu\text{m}$  spores. The types have a cream-yellow hymenium (rehydrated), paraphyses with gradually clavate apices (5-6  $\mu\text{m}$  diam.), and larger spores (15.5-20(21) x 7  $\mu\text{m}$ ). The Saccardo ISOTYPE at PAD does have a few smaller spores 13-16 x 7.5-9.0  $\mu\text{m}$ , but most spores measure 15.5-18 x 7.5-9  $\mu\text{m}$  and occasionally some to 21 x 9  $\mu\text{m}$ . Except for the slightly smaller spore size and smaller apothecia, the type specimens of H. tristis are identical with Müller's collection of Peziza muelleri from Sealers Cove and with Berkeley's description for that species. Spore size in the other "Anthracobia muelleri" collections annotated by Rifai at Kew varies with the smaller sizes overlapping those of H. tristis. The difference in apothecial size is, in my estimation, insufficient to separate the two species. I am therefore placing these

previously incorrectly assigned Anthracobia "muelleri" (sensu Rifai) collections in the only available taxon, A. tristis (Bomm., Rouss., Sacc.) Boud.

My observations of cultural characteristics for Anthracobia tristis agree with those reported by Roxon and Batra (1973) as A. muelleri. The Utah isolates are definitely homothallic, while the Australian isolates (CUP-52752 & -52753) may be heterothallic. The Swiss collection and isolate agree with Rifai's concept of the species, but the Utah and Venezuelan isolates produce ascospores which are slightly broader than those figured by Rifai (1968). Hymenial coloration of apothecia in culture varies from "Luteous" to a darker "Ochraceous" orange, evidently depending on environmental conditions.

ANTHRACOBIA SUBATRA (Rehm) Moser

Lachnea subatra Rehm in Rabenhorst, Krypt.-Fl. Bd. I, Abh. III: 1045. 1896.

≡ Trichophaea subatra (Rehm) Boudier, Hist. Class. Discom. Eur. 60. 1907.

≡ Anthracobia subatra (Rehm) Moser in Gams, Kleine Krypt.-Fl. Bd. IIa:109. 1963.

= Lachnea capituligera Starbäck, Bot. Notis. 1898:214. 1898.

≡ Anthracobia capituligera (Starb.) Boudier, Hist. Class. Discom. Eur. 65. 1907.

Apothecia usually small, 1-4 mm diam., rarely to 8 mm [fide Starb.], gregarious, sessile, initially moderately cupulate but becoming flattened at maturity, upper third of exterior clothed with dense fascicles of excipular hairs. Margin only slightly elevated, entire to dentate with hair fascicles. Hymenium dark "Chestnut" brown. Excipular hairs superficial, fasciculate, hyphoidal, thin-walled, dark "Sepia" brown en masse, 1-3 septate, cylindrical, 60-90 x 4-7  $\mu\text{m}$ , located mostly on the upper third of the exterior, marginal hair apices greatly enlarged, 10-17  $\mu\text{m}$  diam., other hair apices slightly to moderately clavate, 5-10  $\mu\text{m}$  diam. Ectal excipulum textura angularis, 2-6 cells deep, cells brown-walled and polygonal, more or less elongated perpendicular to the exterior surface, 15-30  $\mu\text{m}$  diam. Medullary excipulum textura intricata, consisting of loosely packed cells 4-15  $\mu\text{m}$  in diam., intergrading with the smaller, more densely packed cells of the subhymenium. Asci cylindrical, 160-200 x 10-15  $\mu\text{m}$ , 8-spored, operculate, not bluing in iodine. Ascospores uniseriate, smooth, biguttulate, elliptical, 16.5-20 x 8-10  $\mu\text{m}$ , immature spores cyanophilic and mature spores cyanophobic in heated cotton blue/lactic acid. Paraphyses slender, septate, unbranched or variably branched, 2-3.5  $\mu\text{m}$  diam. below, apices abruptly clavate to subspherical, 6-10  $\mu\text{m}$  diam., upper half brown-walled.

Cultural characteristics unknown.

Habitat: On burned soil among mosses; known only from Northern Europe (Germany & Sweden).

Holotype: P. Sydow, zwischen Moosen auf einer Brandstelle im Grunewald bei Berlin, June, 1885 (Humaria) (S).

Specimens examined:

Germany: P. Sydow, zwischen Moosen auf einer Brandstelle im Grunewald bei Berlin, June, 1885 (Humaria) (S), (HOLOTYPE of Lachnea subatra); P. Sydow, zwischen Barbata auf einer Brandstelle im Grunewald bei Berlin, June, 1885 (S); P. Sydow, Mycotheca Marchica no. 1058, auf einer Brandstelle im Grunewald bei Berlin, June, 1886 (S).

Sweden: Starbäck, ad terram carbonarium, Knifsta, Uplandia, July, 1895 (S), (HOLOTYPE of Lachnea capituligera).

Notes: Boudier (1907) placed the present species in Trichophaea and included Lachnea capituligera in Anthracobia. I find no evidence he examined either type collection. As Rehm (1896) neglected to mention the fasciculate nature of the excipular hairs in his original description of L. subatra, Boudier's 1907 placement of the species is understandable. Moser transferred L. subatra to Anthracobia in 1973. I concur with Moser's judgment.

Additionally, after examining the type collections of both Anthracobia subatra and A. capituligera, I find both have markedly clavate excipular hairs, similar apothecial coloration, and paraphyses

with brown walls and abruptly inflated apices. Their only major difference is the unbranched paraphyses in A. subatra vs. the occasionally and variably branched paraphyses of A. capituligera. Minor differences were observed in the distribution pattern of hair fascicles and in the extent to which the marginal hair fascicles exceed the hymenium. I do not view these differences to be sufficient at present to maintain the two as separate species. However, cultural studies of the species are lacking and could provide valuable information in the future.

The fuscous brown apothecia, the markedly clavate excipular hairs, and the brown-walled paraphyses with abruptly inflated apices easily make Anthracobia subatra the most distinctive member of the genus.

ANTHRACOBIA SUBATRA (Rehm) Moser var. FUSCA (Vel.) Larsen,  
Comb. Nov.

Lachnea melaloma (Alb. & Schw. ex Fr.) Sacc. var. fusca  
Velenovsky, Mon. Disc. 308. 1934.

Apothecia small, 2-4 mm diam., gregarious, sessile, initially slightly cupulate, becoming flattened to slightly concave at maturity, externally clothed with fascicles of excipular hairs that are aggregated at the margin and scattered below the margin. Margin slightly elevated and finely crenulate due to the fascicles of excipular hairs. Hymenium fuscous when fresh, "Isabelline" after rehydration;

apothecium exterior concolorous to slightly darker. Excipular hairs superficial, fasciculate, thin-walled, hyphoidal, "Sepia" to "Dark Brick" en masse, 2-3 septate, hairs toward the margin more slender, 60-110 x 3-5  $\mu\text{m}$  with apices enlarged to 9  $\mu\text{m}$  diam., hairs toward the base more stout, 80-150 x 5-7.5  $\mu\text{m}$  with apices enlarged slightly to 9  $\mu\text{m}$ ; fascicles very pronounced toward the margin but only scattered patches toward the base. Ectal excipulum textura angularis, 2-4 cells deep, cells isodiametric to polygonal, 15-45  $\mu\text{m}$  diam., cell walls of outermost cells brown-pigmented. Medullary excipulum textura intricata, cells loosely packed, irregular in size and shape, 5-13  $\mu\text{m}$  diam., intergrading with the smaller (3-5  $\mu\text{m}$  diam.) and more densely packed cells comprising the textura intricata tissue of the subhymenium. Asci cylindrical, 175-200 x 11-13  $\mu\text{m}$ , 8-spored, operculate, not bluing in iodine. Ascospores uniseriate, smooth, biguttulate, narrowly elliptical, 18-21 x 7.5-9  $\mu\text{m}$ , immature spores cyanophillic and mature spores cyanophobic in heated cotton blue/lactic acid. Paraphyses slender, septate, unbranched, 1.5-2.0  $\mu\text{m}$  diam. below, apices only slightly and gradually enlarged to 3.0  $\mu\text{m}$  diam., brown-walled, turning green in iodine.

Cultural characteristics unknown.

Habitat: On burned soil and charcoal.

Distribution: Known only from Czechoslovakia.

Holotype: J. Velenovsky, In carbonario, Mnichovice:  
Boskov, August, 1931 (PR 151391).

Specimen examined: I have examined the HOLOTYPE above.

Notes: The HOLOTYPE of the variety fusca has relatively long, slender excipular hairs, 60-110 x 3-5  $\mu\text{m}$  at the margin and 80-150 x 5-7.5  $\mu\text{m}$  below, with the apices of both enlarged to 9  $\mu\text{m}$  maximum diam. The hairs are strongly fasciculate toward the margin and less so below. The paraphyses are only slightly enlarged to 3  $\mu\text{m}$  at the apices, which differs from Anthracobia subatra (Rehm) Moser. The basis for the transfer is the similar hymenial coloration and excipular hair coloration and morphology of A. subatra. However, differences in apical morphology of the paraphyses and in hair length are deemed worthy of varietal recognition.

#### ANTHRACOBIA TAXONOMIC SPECIES "A"

Apothecia small, 1-3 mm diam., gregarious to scattered, sessile, broadly attached, initially concave, becoming slightly concave to flattened at maturity, exterior glabrous to sparingly granular with fascicles of light-brown excipular hairs grouped at the margin and rarely scattered below. Margin slightly elevated, entire to dentate, appearing punctate with patches of light-medium brown excipular hairs. Hymenium yellow-orange, rehydrated "Luteous" to "Pale Luteous," exterior concolorous to slightly darker. Excipular

hairs superficial, fasciculate, hyphoidal, thin-walled and collapsing easily, light-medium brown, "Sienna" to "Cinnamon" en masse, 0-1 septate, peg-like to short-cylindrical with obtuse apices, 20-45(60) x 7-10(15)  $\mu\text{m}$ , arising from clusters or pustules of excipular cells, extremely sparse except at the margin and very inconspicuous. Ectal excipulum textura angularis, 2-4 cells deep, cells large, 15-45  $\mu\text{m}$  diam., mostly isodiametric with some polygonal scattered through the layer, outermost cells with light-brown walls. Medullary excipulum textura intricata, cells loosely packed, irregular in size and shape, cylindrical to barrel-shaped, 5-15  $\mu\text{m}$  diam., intergrading with the smaller (3-6  $\mu\text{m}$  diam.) and more densely packed cells comprising the textura intricata tissue of the subhymenium. Asci cylindrical, 150-190 x 9-12  $\mu\text{m}$ , 8-spored, operculate, not bluing in iodine. Ascospores uniseriate, smooth, biguttulate, broadly elliptical to elliptical, 13-16 x 7-9  $\mu\text{m}$ , immature spores cyanophillic and mature spores cyanophobic in heated cotton blue/lactic acid. Paraphyses slender, septate, commonly branched at varying distances from the apex or base, 1.5-3.0  $\mu\text{m}$  diam. below, apices slightly enlarged to clavate, 3-6(9)  $\mu\text{m}$  diam., containing yellow-orange granules which turn green in iodine.

Cultural characteristics unknown.

Habitat: On burned soil, West Indies & Argentina.

Holotype: D. A. Reid, on base of burned bamboo, Green Hill Waterfall, West Indies, 3 August, 1973 (K).

Specimens examined:

Argentina: R. Singer no. T 2843, on burned soil, Túcumán.

1 November, 1956 (K).

West Indies: D. A. Reid, on base of burned bamboo, Green Hill Waterfall, 3 August, 1973 (K) (HOLOTYPE).

Notes: This species is very similar to Anthracobia macrocystis, but differs in its smaller, broader spores (13-16 x 7-9  $\mu\text{m}$  vs. 17-20 x 7.5-9  $\mu\text{m}$ ), branched paraphyses (vs. unbranched), and in its less conspicuous hymenial margin. Both Reid and Singer reported smaller dimensions for the spores than I found (12-14 x 6-7.5  $\mu\text{m}$ ) and commented on the lack of distinct hairs. As noted in the description, the hairs are very inconspicuous and easily overlooked. I have chosen the collection by Reid as the holotype because it contains more material. Culture attempts have been unsuccessful.

#### ANTHRACOBIA TAXONOMIC SPECIES "B"

Apothecia small, 1-2 mm diam., sessile, narrowly attached, initially concave, becoming flattened to reflexed with maturity, upper portion of exterior and particularly the margin clothed with fascicles of short, blunt, medium-brown, hyphoidal excipular hairs, scattered fascicles continuing to the base. Margin finely dentate, extending only slightly beyond the hymenium, punctated with brown excipular hair fascicles. Hymenium "Orange," rehydrated color "Honey," apothecial

exterior concolorous. Excipular hairs superficial, strongly fasciculate, thin-walled, hyphoidal, "Umber" brown en masse, 2-3 septate, cylindrical but constricted at the septa, obtuse, 60-80 x 10-15  $\mu\text{m}$ ; fascicles mostly grouped at the margin, but some scattered to the base. Ectal excipulum textura angularis, 2-4 cells deep, cells isodiametric to polygonal, 20-40  $\mu\text{m}$  diam., outermost layer of cells with light brown pigmented walls. Medullary excipulum textura intricata, hyphae loosely packed, 5-10  $\mu\text{m}$  diam., grading into the smaller (3-6  $\mu\text{m}$  diam.), more densely packed hyphae of the subhymenium textura intricata. Asci cylindrical, 120-130 x 10-12  $\mu\text{m}$ , 8-spored, operculate, not bluing in iodine. Ascospores uniseriate, smooth, biguttulate, elliptical, 13-16.5 x 7.5-9.0  $\mu\text{m}$ , immature spores cyanophillic and mature spores cyanophobic in heated cotton blue/lactic acid. Paraphyses slender, septate, 2-2.5  $\mu\text{m}$  diam. below, apices scarcely enlarged, 3-4.5  $\mu\text{m}$  diam., containing orange granules which turn green in iodine.

Colonies on agar araneose, white, becoming light-tan with age, growing rapidly. Hyphae delicate, broad, to 15  $\mu\text{m}$  diam., mostly prostrate except toward the margins and on the sides of the plate, there commonly producing upright, white, highly branched, aerial tufts of hyphae with more or less determinate growth, tufts commonly 300-400 x 150-300  $\mu\text{m}$ , becoming light-tan with age. Tuft hyphae soon segmenting to produce easily separated, hyaline to light-tan,

elongated to obtuse-cylindrical arthrospores (oidia), 5-15 x 4-8  $\mu\text{m}$ .

Mating type suspected to be heterothallic.

Habitat: On cow dung.

Distribution: Switzerland.

Specimens examined: Only cultures have been examined.

Isolated by Dr. E. Müller, from apothecia on cow dung, Kt.

Ticino, Valle Maggia, Cevio, Switzerland, 2 September, 1974

(OSC 34,850; HJL-583).

Notes: The small asci and spores, the scarcely enlarged paraphyses apices, the coprophilous habit, and the distinctive imperfect state separate this species from all other Anthracobia species. The only other species reported from dung, "Anthracobia" humana (Vel.) Svrcek, is not an Anthracobia, but rather a species with affinities to Fimaria Vel. and Pseudombrophila Boud. The imperfect state of the present species is very similar to that of A. melaloma, except for being restricted to upright aerial tufts.

## VI. DOUBTFUL AND EXCLUDED SPECIES

ANTHRACOBIA HUMILLIMA Malençon, Bull. Soc. mycol. Fr.  
43:97-98. 1927.

= Trichophaea abundans (Karst.) Boud. fide Binyamini (1972).

Specimens examined:

Anthracobia humillima: France: F. Candoussau no. 517, sur  
une place a charbon, strictement sous Fagus, Vallee de Lesponne  
(Region de Tarbes-), Hautes Pyrenees, 11 August, 1973 (OSC  
34,754--NEOTYPE of Anthracobia humillima Mal.; G; HJL F-213).

India: K.S. Thind Flora of India no. 388, Kalatope, Dalhousie, H. P.,  
14 September, 1963 (K).

Peziza abundans: Finland: P.A. Karsten no. 3147, ad lign.  
carbon., Tavastia australis, Tammela, Mustiala, 25 August, 1866  
(H); P.A. Karsten no. 3148, ad lign. carbonat., Tavastia australis,  
Tammela, Mustiala, 25 August, 1866 (H); P.A. Karsten Fungi  
Fenniae exs. 532, pa kol och svedjel., Mustiala, August, 1866 (K)  
(PARATYPE ? of Peziza abundans Karst.).

Notes: Binyamini (1972) synonymized this species with  
Trichophaea abundans (Karst.) Boud. Larsen (1975) concurred with  
his judgment and designated the Candoussau collection as the NEOTYPE  
for the species since the HOLOTYPE no longer existed (fide Malen-  
çon, l. c. 1973). The non-fasciculate, acute tipped excipular hairs

and Dichobotrys imperfect state (Fig. 22, 23) exclude it from Anthracobia and necessitate its placement in Trichophaea Boudier. My studies (1975) also showed it to be conspecific with T. abundans. Since the epithet "abundans" has priority, its correct name is now Trichophaea abundans (Karst.) Boud.

HUMARIA FLAVOANTHACIACA Rehm, Ann. Myc. 2:35. 1904.

= Patella melaloma (Alb. & Schw. ex Fr.) Seaver, N. Am. Cup-fungi (Operc.) 167. 1928.

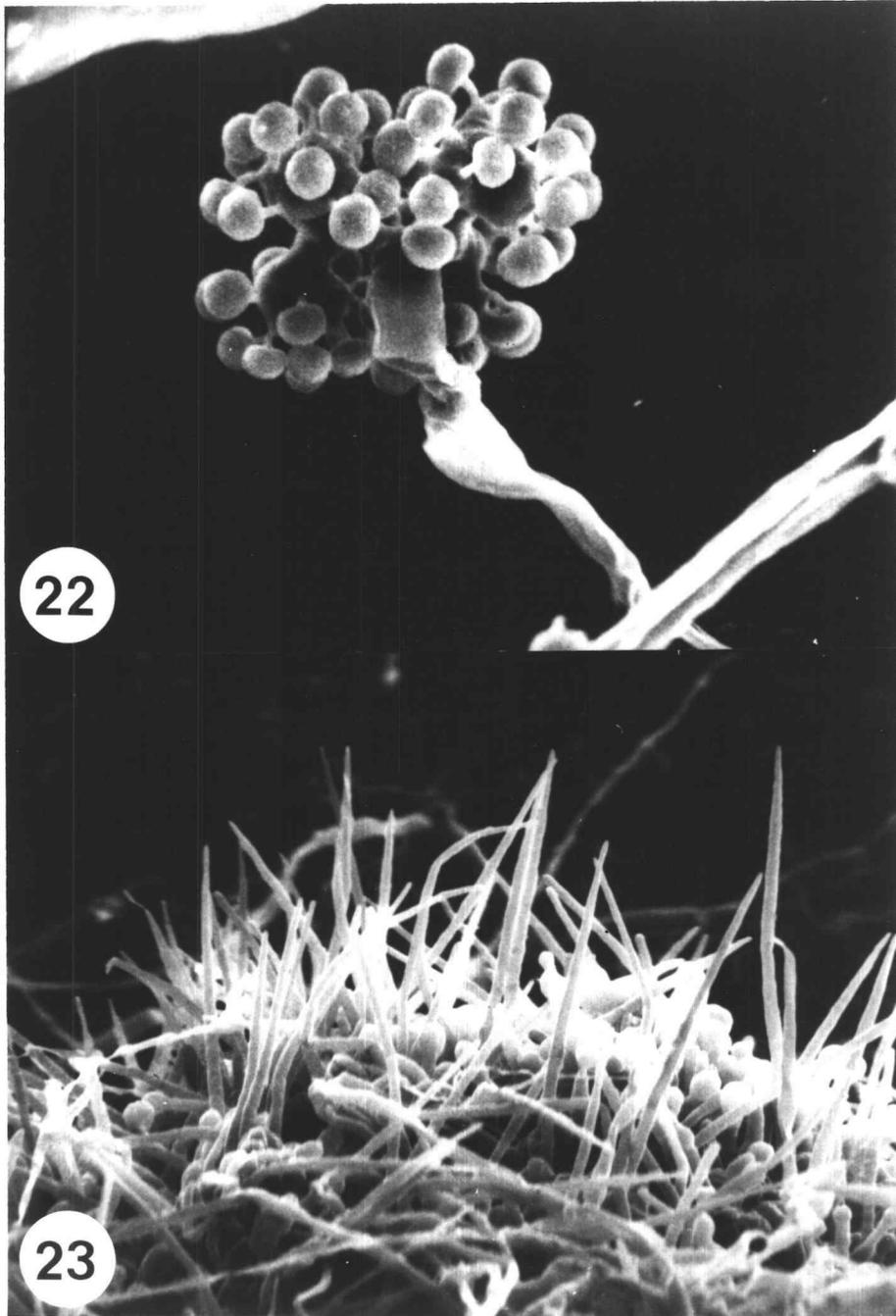
Specimens examined: Austria: Arnold, Auf kal boden der Strassenboschung zwischen Schuldersbach und Ospidale bei Ampezzo, Sudtirol, August, 1874 (sub Rehm: Ascomyceten 557. ?Humaria haszlinkja Cke.) (K) (PARATYPE ? of Lachnea ampezzana Rehm, 1896).

United States: Ohio: Lloyd, (no locality) 1903 (S) (HOLOTYPE ? of Humaria flavoaurantiaca Rehm).

Notes: Seaver (1928) included this species as a synonym of Patella melaloma (Alb. & Schw. ex Fr.) Seaver. I find the HOLOTYPE has very long and slender (90-150 x 3-4.5  $\mu$ m), dark brown ("Dark Brick"), strongly fasciculate excipular hairs with narrowly obtuse to slightly enlarged apices. The hair fascicles are sufficiently tightly grouped to give a macroscopic impression of much larger, single hairs grouped mainly around the margin but some

Figure 22. Dichobotrys imperfect state of Anthracobia humillima.  
2,000X. (SEM).

Figure 23. Acuminate hairs from apothecium of Anthracobia  
humillima. 400X. (SEM).



scattered to the base (Fig. 20). The fascicles are adpressed to, or extend out from the apothecium exterior, and the individual hairs frequently have inflated basal cells and arise from clusters of sub-globose cells of the ectal excipulum. The PARATYPE of Lachnea ampezzana Rehm is a mixed collection with a Pulvinula element and a second organism identical with H. flavoaurantiaca except for having ascospores sculptured with very fine, cyanophillic warts. The paraphysis apices in both species are only slightly enlarged to 4.5  $\mu\text{m}$  diam. Both species should be compared with Peziza hazslinskya Cooke and with Hiemsia Svrcek (1969) which has fasciculate hairs but also has finely warted spores.

LACHNEA BRUNEOLA Rehm in Rabenhorst, Kleine Krypt.-Fl. Bd. I, Abh. III:1048. 1896.

= Anthracobia maurilabra (Cke.) Boud. fide Moser (1963).

No specimens seen.

Notes: Rehm (1896) describes the species as having: a chestnut brown hymenium; a thick apothecial margin; fasciculate, adpressed, 2-3 septate, brown excipular hairs, 45-60 x 12  $\mu\text{m}$ ; slender paraphyses with slightly enlarged, brown apices to 4  $\mu\text{m}$  diam.; and smooth, 1-2 guttulate, spindle-shaped spores, 25-29 x 9-10  $\mu\text{m}$ . The species may have affinities with Anthracobia subatra (Rehm) Moser or with Anthracobia melaloma forma fusca (Vel.) Svrcek which I

include as a variety of A. subatra (Rehm) Moser. Future studies are needed to resolve the proper assignment of this species.

LACHNEA HUMANA Velenovsky, Novit. Mycol. 208. 1939.

≡ Anthracobia humana (Vel.) Svrcek, Acta Mus. nat. Prag. 4B, No. 6 (Bot. No. 1):75. 1948.

Specimens examined: Czechoslovakia: Vacek, ad sterium humanum, Radotin, 19 May, 1940 (?) (PR 150991) (HOLOTYPE of Lachnea humana Vel.); M. Svrcek, ad excrementa humana, in piceto sphagnetoso, montes Jeseniky, ad viam inter montes Vozka et Keprnik, 1420 m s. m., Moravia, 4 July, 1947 (PR 734973).

Notes: Svrcek (1948) expanded the generic limits of Anthracobia to include this species and Lachnea ramosa Vel. as the only members of his new subgenus Pseudoanthracobia Svrcek. I find both species have: eguttulate, finely warted, elliptical spores; highly branched, filiform paraphyses with scarcely enlarged apices; and medium-sized (3-12 mm diam.), substipitate, cream-orange apothecia with contorted, brown, obtuse, superficial excipular hairs which are occasionally grouped in fascicles (Fig. 21). They occur on human dung or on rotting herbaceous plant materials, and they are differentiated on this basis and on the degree of enlargement of the paraphysis apices. Neither one is an Anthracobia sensu Boudier, and the generic limits should, in my estimation, never have been extended to

include them. They have much closer affinities to Fimaria Velenovsky (1934) and to Pseudombrophila Boudier (1885).

The HOLOTYPE now contains only a very few immature apothecia with no asci, spores, or paraphyses present. They are sunken in the substrate and very unobtrusive; so much so that R. P. Korf and J. K. Rogers reported no specimen present when they examined it in 1969. Svrcek's collection contains abundant mature apothecia and would make a good neotype.

LACHNEA RAMOSA Velenovsky, Mon. Discom. 309. 1934.

≡ Anthracobia ramosa (Vel.) Svrcek, Acta Mus. nat. Prag. 4B, No. 6 (Bot. No. 1):74. 1948.

Specimens examined: Czechoslovakia: J. Velenovsky, in caulibus marcidus Trifolii pratensis, sv. Anna, Strancice, October, 1927 (PR 147263) (HOLOTYPE of Lachnea ramosa Vel.); M. Svrcek, ad caul. putr. herbarum (compost), Praha XIX, Fähradni 44, 23 May, 1948 (PR 689992).

Notes: Not an Anthracobia sensu Boudier! See the discussion under the preceding species.

PATELLA CONTRADICTA Seaver, Mycologia 32:567. 1940.

Specimens examined: United States: New York: Seaver, on burnt ground, N. Y. Bot. Garden, Bronx, N. Y. C., 27 June, 1916.

Notes: This species was examined to determine its affinities with Anthracobia subatra (Rehm) Moser and A. capituligera (Stärb.) Boudier. I find it has dark, "Isabelline" brown apothecia after rehydration with smooth, biguttulate, broadly elliptical spores, (12)14.5-16(18) x (8.5)9-10.5(11)  $\mu\text{m}$ . The dark brown, obtuse to narrowly obtuse hairs have enlarged basal cells; the marginal hairs are 1-3 septate, 20-40 x 4-9  $\mu\text{m}$ , weakly to moderately grouped in fascicles, while the hairs below the margin are 3-4 septate and longer, 90-115 x 5-7  $\mu\text{m}$ . The excipular hair morphology and distribution indicate a closer affinity to Trichophaea Boudier than to Anthracobia.

PEZIZA SUBHIRSUTA Schumacher, Saell. 2:433. 1803.

ex Fries, Syst. Myc. II:70. 1822.

= Pyronema subhirsutum (Schum.) Fuckel, Symb. Myc. 320. 1870.

= Aleuria subhirsutum (Schum.) Gillet, Champ. Fr. Discom. fig. 41. 1880.

= Lachnea subhirsutum (Schum.) Lagarde, Ann. Mycol. 4:210, 211. 1906.

= Patella melaloma (Alb. & Schw. ex Fr.) Seaver, N. Am. Cup-fungi (Operc.) 167. 1928. fide Seaver (1928).

No authentic or type specimens examined.

Notes: Dr. Nils Lundquist (pers. comm., 1974) of UPS found no material of Peziza subhirsuta in Schumacher's collection. He did examine Schumacher's illustration 117 no. 3 (1803) but was unable to

identify it. The illustration shows apothecia with a short-haired edge and bore the note "Peziza fulvo aurantiaca patula convexa hirsuta. Materia viridis." The original description is too sketchy to define the species. Fries (1822) indicates the hairs are white, however, which would exclude the species from Anthracobia.

PYRONEMA AURANTIO - RUBRUM Fuckel, Symb. Myc. 319. 1870.

≡ Anthracobia aurantio-zubra Sic! (Fuck.) Boudier, Hist. Class. Discom. Eur. 65. 1907.

Specimens examined: Austria: Fuckel, Kohlenstuckchen (no locality, no date) (G - Herbarium Fuckel 1894) (HOLOTYPE of Pyronema aurantio-rubrum Fuckel).

France: F. Sarrazin, sur la terre ou l'on avait fait du charbon, Les Bois aux environs de Senlis (Oise), July, 1883 (G).

Notes: The HOLOTYPE of this species contains only a Nectria (Hypocreales) of the N. peziza group. The name therefore cannot be used for an Anthracobia. The second collection (F. Sarrazin) in Fuckel's herbarium contains only Pulvinula tetraspora (Hansf.) Rifai.

PYRONEMA PALLENS Saccardo, Mich. 1:69. 1877.

≡ P. aurantio-zubra Sic! Fuckel ssp. pallens (Sacc.) Saccardo, Syll. Fung. 8:108. 1889.

≡ Anthracobia aurantio-zubra Sic! (Fuck.) Boud. ssp. pallens (Sacc.) Boudier, Hist. Class. Discom. Eur. 65. 1907.

Specimens examined: Italy: Saccardo 79, in corio putrescenti  
(no locality, no date) (PAD) (HOLOTYPE ? of Pyronema pallens  
Saccardo).

Notes: The HOLOTYPE ? of this species contains only an  
inoperculate discomycete. The slender, unbranched paraphyses with  
globose apices which tend to stick together are reminiscent of Orbilina  
Fries, but no mature spores could be found.

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