THE LICHEN FAMILY GRAPHIDACEAE IN MEXICO

By Michael Wirth and
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Introduction

The Graphidaceae form a large but very poorly known family of corticolous, crustose lichens widely distributed in tropical regions. The senior author has long had an interest in studying this group, and during his tenure at the Smithsonian Institution as a research assistant, in 1960–61, was afforded the opportunity to carry these plans forward. It was decided that a revision of the Graphidaceae of Mexico would be a realistically delimited area of study. Mexico is known to have a rich tropical flora, and large representative collections are available for study, including some collections made by the junior author and T. R. Soderstrom in southern Mexico and the Pringle material from central Mexico.

In the initial stages of the study it became obvious that type specimens of extra-Mexican species would have to be examined, especially in view of the extensive synonymy that was to be anticipated in a family which has never been treated monographically. To this end, types of many species described by Krempelhuber, Müller-Argau, Nylander, and Vainio were examined. Altogether types of more than 100 taxa were critically investigated. Unfortunately few of the species described by Fée in 1824 were available, and in most cases the current concepts of these species had to be followed. Redinger's (1933, 1935) excellent revisions of Brazilian Graphidaceae have been especially helpful in this respect.

The Fée types are reportedly preserved at Rio de Janeiro, but inquiries there failed to uncover more than a few species. It has been learned recently that a nearly complete series of isotypes was prepared by Müller-Argau when he revised the Fée species in 1887. These specimens are still in the process of being curated and incorporated

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into the general cryptogamic herbarium at Geneva. Because of their fundamental importance in the taxonomy of the Graphidaceae and other tropical crustose families, Fée's many species must eventually be carefully typified, and it is hoped that this can be accomplished in the near future.

The circumscription of the Graphidaceae is far from settled (cf. Santesson, 1952, pp. 44, 45), because this family once included a number of ascolocular genera (e.g., *Opegrapha*). As here considered, the family is taken to include all those ascohymenial lichens which have lirelliform ascocarps and lack columellae. By this definition, all the ascohymenial representatives of the Chiodectonaceae should probably be referred to the Graphidaceae. This transfer would actually be in accord with natural relationships, as the so-called stromata of the Chiodectonaceae are not significantly different from the ascocarps of the Graphidaceae. It is not uncommon to find individuals with polymorphic ascocarps such that half of an individual can be referred to one family and half to another. *Sarcographa* (Chiodectonaceae) and *Phaeographis* (Graphidaceae) are so closely allied as to make identification at the species level nearly impossible. The lack of consistency in the formation of stromatoid tissue renders the taxonomy of this group very unclear.

Another major difficulty in delimiting the Graphidaceae becomes evident in considering the related family Thelotremataceae, which is usually characterized by having round ascocarps. Some species in the Thelotremataceae have lirelline ascocarps and show variations paralleling those of the Graphidaceae. In addition, some species in the Graphidaceae (e.g., *Graphina confluens* (Fée) Müll. Arg., *G. hemisphaerica* (Vain.) Zahlbr., and *G. quassiaecola* (Fée) Müll. Arg.) exhibit a definite trend towards the formation of round apothecia, structurally identical with those of many thelotremataceous species. A further link can be found in *Graphina macrospora* (Krempth.) Müll. Arg., in the ascocarps of which are found columellae (cf. fig. 4), usually considered as being restricted to the Thelotremataceae. It is obvious that the shape of the ascocarps is not a valid criterion for separating families and perhaps not even useful for generic delimitation. Much more work on developmental anatomy is necessary before workable families can be erected in these lichens.

The genera of the Graphidaceae are traditionally separated on the bases of algal host, spore color, and spore septation. As Santesson (1952, p. 46) has already pointed out, the genus of algal host is a poor criterion in lichen taxonomy. Both spore color and septation are characters of sometimes limited usefulness in generic delimitation. There are groups of species which have constantly colorless, thin-walled, four-celled spores. There is also a natural group of species

with brown, thick-walled, five- to eight-celled spores. However, in other cases spore color and septation seem to be too variable to serve as major taxonomic features; they are often so unstable as to vary within a single specimen. See the discussions under *Graphina acharii* (p. 72) and *Phaeographina chrysocarpa* (p. 102) for a more detailed account of this variability.

The genus *Melaspilea*, usually separated from *Graphis* by the cubic shape of the spore locules, has a perfect counterpart in the *Graphis* species allied to *G. turbulenta* Tuck. The spores in both of these groups are almost always 2-locular and identical, and separating them into two genera is quite unrealistic. The spores of *Melaspilea* often show variation in color from hyaline to dark brown.

Within the four major genera, *Graphis*, *Phaeographis*, *Graphina*, and *Phaeographina*, parallel subgeneric divisions into sections have been established. These have been summarized, for the most part, by Redinger (1933, 1935), who recognized 50 of these taxa. The characters used in sectional analysis are discussed below. They have proved in our studies to be highly inconstant and intergrading, and a single species or occasionally a single individual may be placed in either of two sections with equal facility.

1. Degree of excipular carbonization. This character is often useful on the specific level, but it varies considerably. It is difficult to divide the species objectively into major groups on the criteria of "exciple entirely black," "exciple black above and colored below," or "exciple completely brown or colorless." Too often random carbonization will occur in portions of an exciple (see figs. 8, 10–13). In addition, it is not easy to delimit brown exciples from black exciples, since the pigmentation often intergrades.

With regard to carbonization, it might be mentioned that it is necessary to cut sections of the ascocarps as thin as possible, since uncarbonized tissues will often appear black in thick sections. Included air will also cause the same appearance. We have found that the best results are obtained when Hoyer's solution (Anderson 1954) is used as the mounting and clearing agent and the slides are allowed to stand on a warming plate for at least a half hour. This medium clears tissues quickly and completely, yet it does not change their relative densities. Moreover it is an excellent solution in which to demonstrate colored spores, as these do not decolorize at all, while the hymenium and asci become transparent and clear.

2. Open or closed exciples. Exciples in the Graphidaceae cannot always be easily separated into two major types on the basis of whether they are closed basally or not (see figs. 31–35). Even in species with highly carbonized exciples it is often possible to find the basal portion turning brown and uncarbonized or becoming so thin as to be closed

in one part of an ascocarp and open in another. It is difficult to determine where apothecial tissue ends and where thallus or substratum begins in species with only partial carbonization or no darkening of the exciple. In fact, we have been unable to state for many type specimens whether the exciple is open or closed, because one section of an ascocarp would differ from the next.

3. Striation of the exciple. The degree to which excipular labia become striate is not a constant feature. Many individuals exhibit labia which are entire in some portions, crenate in others, and striate elsewhere (see figs. 14–16, 24–27). Furthermore the number of lamellae or dentations in prominently striate labia seems to be correlated with age.

4. Convergent or divergent labia. This character is only partially useful as a taxonomic criterion. Some species have constantly open disks; others vary from rimiform at one stage to gaping at others. (See figs. 31–35, 66, 69, and 70.)

All four of the above characters are useful in separating individual species but intergrade far too much to be maintained as sectional criteria. We have therefore decided to dispense with sectional names in this study. It is impractical to use the myriad sections now recognized until the genera of the Graphidaceae are monographed and new sectional criteria established.

In investigating the Graphidaceae of Mexico, we have attempted to assay specimens for lichen acids whenever possible. Unfortunately type material was sometimes too fragmentary to extract, and color reactions alone had to be used. A KOH+ red reaction is often caused by an unknown substance that does not recrystallize in G.A. o-T. Stictic acid may give a KOH− reaction even though a microchemical test with G.A. o-T. is positive. This color reaction is complicated when the thallus is discolored or the acid is present in seemingly very low concentration.

Salacinic acid and atranorine, so common in foliose lichens, appear to be very rare in the Graphidaceae. On the other hand, norstictic acid (KOH+ red) seems to be one of the most common acids. In addition to atranorine, stictic acid, norstictic acid, and salacinic acid, we have demonstrated zeorine, lecanoric acid, protocetraric acid, lichexanthone, fatty substances, and several unknown acids.

There seems to be some correlation between chemistry and anatomical features in a few species. *Graphina parilis*, with 8-spored asci and stictic acid, and *G. sulcata*, with 2- to 6-spored asci and norstictic acid, are examples of this phenomenon. In other species there are two or more chemical strains but with no apparent correlation with anatomy. It remains to be seen exactly what taxonomic importance chemical components will have in this family. With the

exception of *Rhizocarpon* (Runemark, 1956), no crustose groups have been studied chemically. To aid other investigators we have appended on page 112 a list of type specimens which we have examined for color reactions and lichen acids.

In this study we have described five new species, *Graphina peplophora*, *Graphis glaucopis*, *G. stygioarachnoidea*, *Phaeographina strigops*, and *P. elliptica*, and made two new combinations, *Graphina mexicana* (Zahlbr.) Wirth & Hale and *Phaeographina leiogrammodes* (Kremplh.) Wirth & Hale.

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Key to Species

1. Ascocarps cinnabar red . . . . . **39. Phaeographina chrysocarpa**
1. Ascocarps brown, black, gray, or white.
   2. Spores always 2 locular . . . . . **36. Melaspilea polymorpha**
   2. Spores 3 to many locular.
      3. Spores transversely 3 septate (4 locular) only, no other septae present.
         4. Spores brown, thick walled.
            5. Ascocarps dendritically branched; exciple entirely black; disc black or gray . . . . . **45. Phaeographis sericea**
            5. Ascocarps more or less unbranched; exciple red-brown, black only in spots; disc brown . . . . . **57. Phaeographis inusta**
         4. Spores hyaline (except when senile or obviously shrunken), thin walled.
            6. Ascocarps sessile; exciple black, covered by a white C+ red veil. **22. Graphis afzelii**
            6. Ascocarps more or less immersed, C—; exciple uncarbonized.
               7. Exciple well developed, much thickened below; ascocarps lirelline, immersed . . . . . **29. Graphis grammatica**
               7. Exciple poorly developed, bark-inspersed; mature ascocarps elliptical, with flaring margins . . . . . **32. Graphis platycarpella**
      3. Spores transversely 4 or more septate or muriform.
         8. Spores transversely septate only, never muriform or apically biocellate.
            9. Spores brown, thick walled.
               10. Ascocarps sessile, prominent, often stromatoid; exciple entirely black, closed, much thickened below; hymenium with oil droplets . . . . . **44. Phaeographis exaltata**
               10. Ascocarps somewhat emergent, never sessile, thalline border never prominent or stromatoid; exciple lacking or not greatly thickened below; hymenium not inspersed.

11. Ascocarps rarely branched, slender, elongate; exciple black, dimidiate . . . . . **46. Phaeographis sexloculata**
11. Ascocarps dendritically branched, to 0.4 mm. wide; exciple closed, brown and black . . . **43. Phaeographis dendritica**

9. Spores colorless (brownish when senile or shriveled), thin walled.
12. Exciple totally uncarbonized, with no black or very dark brown tissues.
13. Labia lightly sulcate, sulcae externally concealed by a smooth thalline veil.
14. Ascocarps slender, lirelline . . . . . **30. Graphis implicata**
14. Ascocarps rotund to elliptical . . **7. Graphina hololeucoides**
13. Labia entire.
15. Ascocarps dendritic to asteroid, immersed; spores muriform at maturity . . . . . **21. Graphina virginea**
15. Ascocarps more or less unbranched, elliptical, arranged in rows, subsessile; spores never muriform.
28. Graphis glaucopis

12. Exciple with black or dark tissue (often limited to the labial apices).
16. Exciple carbonized laterally only (often the labial apices only), pale or light brown below.
17. Labia consisting of partially free carbonized hyphae; exciple otherwise totally decolorized.
34. Graphis stygioarachnoidea
17. Labia entire or striate but never composed of free individually carbonized hyphae.
18. Labia distinctly striate.
19. Spores up to 30μ long.
20. Ascocarps quite sessile, prominent; exciple heavily inspersed with crystals . . **26. Graphis endoxantha**
20. Ascocarps emergent to subsessile; exciple without crystals . . . . . **33. Graphis proserpens**
19. Spores more than 30μ long, usually much longer.
21. Exciple and labia black; sulcae few.
49. Graphis striatula
21. Exciple partially brown; sulcae many, deep, black; spores finally muriform . . . **13. Graphina parilis**
18. Labia never striate.
22. Labia barely fuscescent, never highly carbonized; exciple pale, more or less closed; ascocarps elliptical.
28. Graphis glaucopis
22. Labia distinctly carbonized; exciple more or less dimidiate; ascocarps lirelline.
23. Ascocarpa distinctly pruinose . **24. Graphis caesiella**
23. Ascocarps black, epruinose.
48. Graphis scripta group
16. Exciple carbonized laterally and below or dark brown below.
24. Ascocarps caesiopruinose; labia more or less divergent.
35. Graphis subamylacea
24. Ascocarps black or covered by the thallus, epruinose; labia more or less convergent.

25. Spores very long and slender, vermiform; ascocarps concolorous with the thallus; labia denticulate.
50. Graphis vermiformis
25. Spores not vermiform; ascocarps showing some traces of black.
26. Labia more or less entire.
27. Thallus KOH−, P−; labia always lightly crenate or denticulate . . . . . **31. Graphis longula**
27. Thallus KOH+ reddish; labia entire.
28. Ascocarps robust, covered nearly to the apex by a heavy thalline veil; spores 2–6 per ascus, over 75μ long; no acids demonstrated.
23. Graphis anguilliformis
28. Ascocarps slender, *Opegrapha*-like, black; spores 8 per ascus, under 30μ long; norstictic acid present.
25. Graphis desquamescens
26. Labia denticulate to striate.
29. Exciple distinctly carbonized throughout.
30. End locules of some spores biocellate.
1. Graphina acharii
30. End locules of all spores entire.
31. Ascocarps robust, about 0.6 mm. wide; labia deeply striate . . . . **27. Graphis flexibilis**
31. Ascocarps slender, usually less than 0.4 mm. wide; labia crenate to denticulate.
31. Graphis longula
29. Exciple open or brown below.
32. Spores eventually muriform; stictic acid present.
13. Graphina parilis
32. Spores never muriform.
33. Exciple dark brown; labia dissected into free, disconnected black lamellae.
33. Graphis proserpens
33. Exciple completely black; labia confluent with the rest of the exciple.
34. Spores 2–6 per ascus, more than 40μ long; exciple usually closed below, at least by a thin carbonized strip; ascocarps flexuose, occasionally branched.
31. Graphis longula
34. Spores 8 per ascus, less than 45μ long; exciple open below, rarely almost closed; ascocarps *Opegrapha*-like, usually unbranched, straight.
49. Graphis striatula

8. Spores transversely and longitudinally septate (sometimes only in the apical portions).
35. Exciples with no carbonized tissue.
36. Spores one per ascus.
37. Ascocarps and thallus concolorous.
38. Labia striate; exciple pale below the hymenium.
3. Graphina bipartita

38. Labia entire; exciple black or very dark below the hymenium.
4. Graphina confluens

37. Ascocarps (at least the disc) darker than the thallus.
39. Hymenium with prominent crystalline inspersions.
42. Phaeographina elliptica

39. Hymenium without crystals.
56. Phaeographina scalpturata

36. Spores 2–8 per ascus.
40. Labia distinctly striate, the striae often externally concealed by a thalline covering.
41. Ascocarps subsessile, lighter than the thallus.
42. Ascocarps slender, quite flexuose; not mealy.
2. Graphina balbisii

42. Ascocarps robust, round to straight, mealy.
43. Ascocarps round to elliptical; spores 4–6 per ascus.
7. Graphina hololeucoides

43. Ascocarps elongate; spores 2–4 per ascus.
14. Graphina peplophora

41. Ascocarps more or less immersed, concolorous with the thallus.
44. Exciple basally continuous with the thallus by a carbonized band; spores 4–8 per ascus. . **19. Graphina triangularis**

44. Exciple not basally continuous, colorless below; spores 8 per ascus . . . . . **12. Graphina palmeri**

40. Labia entire, not striate.
45. Exciple basally continuous with thallus by a band of more or less carbonized tissue; ascocarps dendritic, fused; disc wide, pruinose . . . . . **8. Graphina insignis**

45. Exciples discrete, never basally continuous.
46. Spores distinctly brown; exciples red-brown, distinctly closed; labia more or less divergent.
47. Ascocarps emergent, with a prominent thalline margin; discs pruinose; spores more than 25μ long.
37. Phaeographina asteroides

47. Ascocarps immersed, without a thalline margin; discs black; spores less than 22μ long.
41. Phaeographina strigops

46. Spores colorless (except brownish when senile); exciples pale to fuscescent, barely closed or open; labia more or less convergent.
48. Spores more than 50μ long, usually much more; ascocarps dendritically branched, never fissurine.
21. Graphina virginea

48. Spores less than 40μ long; ascocarps rarely dendritically branched, often fissurine.
49. Ascocarps intricately intertwined and grouped, gaping.
11. Graphina mexicana

49. Ascocarps never intricately intertwined.
50. Ascocarps KOH− or pale, short, more or less unbranched, gaping; labia dark brown or fuscescent.
20. Graphina virginalis

50. Ascocarps KOH+ purple to black, long slender, branched, usually not gaping; labia pale or reddish. . . . . **16. Graphina scolecitis**

35. Exciple with carbonized tissue.
51. Spores one per ascus.
52. Labia striate.
53. Exciple closed, entirely black . . . **10. Graphina macella**
53. Exciple more or less open, pale or brownish, only the labia carbonized . . . . . **3. Graphina bipartita**
52. Labia entire.
54. Exciples closed, often basally continuous; ascocarps round to lirelline . . . . . **4. Graphina confluens**
54. Exciples more or less open, never basally continuous; ascocarps lirelline.
55. Disc very wide, pruinose . . . . **40. Phaeographina** sp.
55. Disc narrow, epruinose . . . . . **6. Graphina hiascens**
51. Spores 2–8 per ascus.
56. Exciples basally continuous by a more or less carbonized layer.
57. Labia striate, pale; spores over 45μ long.
19. Graphina triangularis
57. Labia entire, brown; spores up to 15μ long.
8. Graphina insignis
56. Exciples not basally continuous.
58. Labia divergent, disc very wide.
38. Phaeographina caesiopruinosa
58. Labia more or less convergent, disc rimiform.
59. Exciples mostly brown or pale, only the labia fuscescent or darker brown.
60. Labia striate; ascocarps not fissurine; spores more than 45μ long . . . . . **12. Graphina palmeri**
60. Labia entire; ascocarps fissurine at maturity; spores less than 40μ long . . . . . **20. Graphina virginalis**
59. Labia and/or exciples distinctly carbonized.
61. Labia entire, sinuous or barely striate.
62. Ascocarps intricately intertwined in discrete groups, naked, sessile, black.
18. Graphina sulcatula var. **conglomerata**
62. Ascocarps not intertwined in discrete groups.
63. Ascocarps asteroidly branched; labia sulcate in some portions; exciple dimidiate.
5. Graphina elongata
63. Ascocarps not asteroidly branched; labia substriate to sulcate.
64. Exciple more or less open, brown or pale below.
13. Graphina parilis
64. Exciple closed, entirely black.
9. Graphina inturgescens
61. Labia distinctly dentate or sulcate.
65. Ascocarps asteroidly branched.
5. Graphina elongata
65. Ascocarps never asteroidly branched.
66. Exciple thick and more or less completely carbonized below the hymenium.
67. Spores 65–150μ long, commonly muriform only in the end cells; labia regularly striate.
1. Graphina acharii

67. Spores 30–45μ long; labia irregularly dissected.
15. Graphina rimulosa
66. Exciple brown or lacking below the hymenium.
68. Exciple completely black laterally, dimidiate and brownish below the hymenium; labia lightly few sulcate . . . . **47. Graphina sophistica**
68. Exciple partially brown laterally; labia more or less free, black, embedded in the brownish exciple.
69. Labia very irregularly dissected and laccrate.
15. Graphina rimulosa
69. Labia lamellar, regular.
70. Spores 2–6 per ascus, with 5–8 transverse septae, 20–35μ long; norstictic acid present.
17. Graphina sulcata
70. Spores 8 per ascus, with 12–20 transverse septae, 28–80μ long; stictic acid.
13. Graphina parilis

1. Graphina

1. Graphina acharii (Fée) Müll. Arg. Mem. Soc. Phys. Hist. Nat. Genève 29, no. 8:38. 1887. FIGURE 1
Graphis acharii Fée, Essai Crypt. Ecorces, 39, *pl. 10, fig. 4*, 1824. Type: South America (not seen).

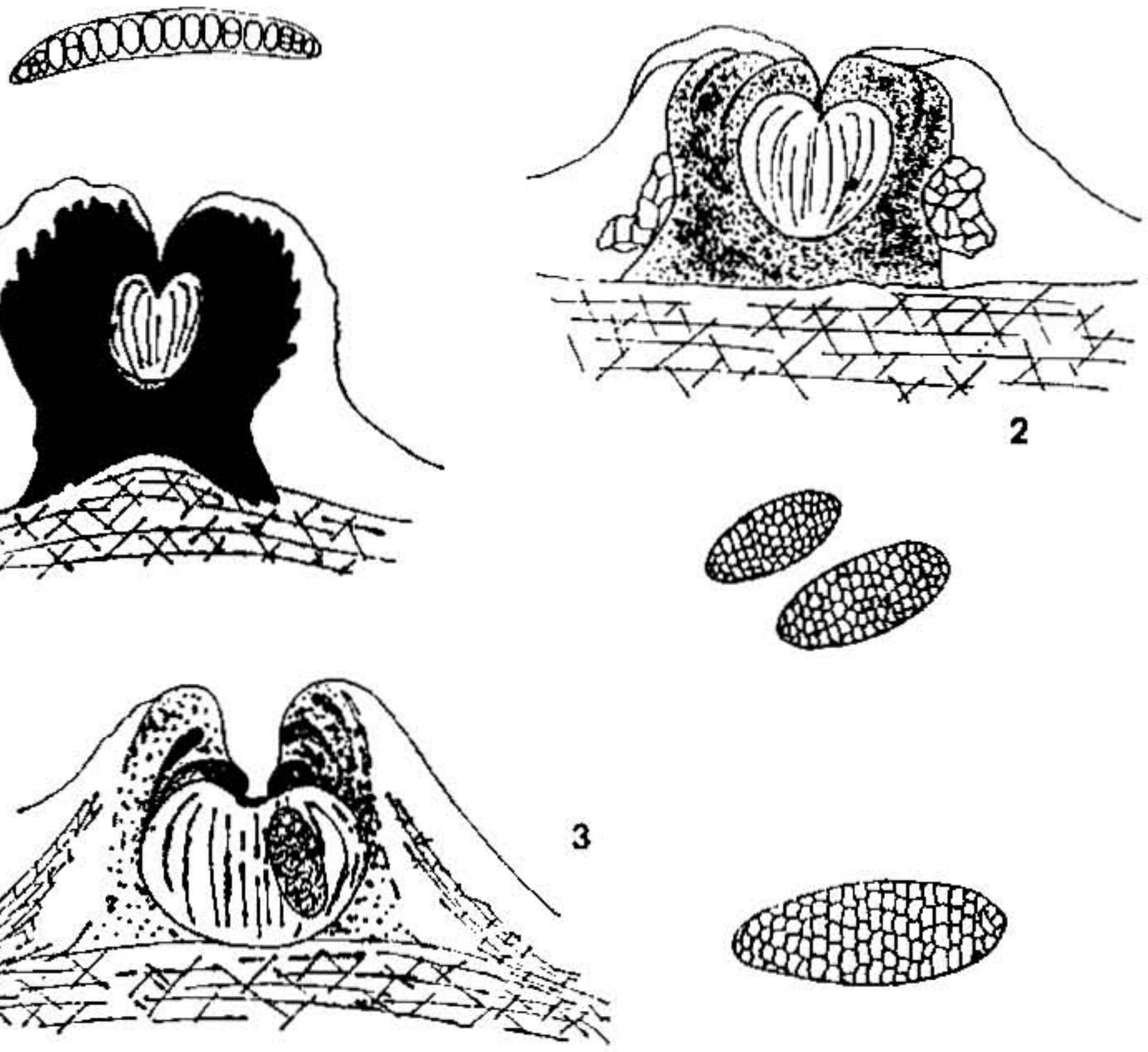
Thallus smooth to rough, continuous. Ascocarps sessile, large, very variable, covered up to or nearly to the apex by a thalline margin; exciple black, closed; labia convergent, striate. Spores 2–8 per ascus, 18–30×1–6 locular, colorless or brownish, 15–25×65–150 μ.

Reactions: KOH+ red, P—, o-T—, no acids demonstrated.[2]

Specimens examined: Chiapas: El Suspiro, *Hale* 20230, 20237, north of Tuxtla Gutiérrez, *Hale* 20067, Lagos de Monte Bello, *Hale* 20437 (US). Morelos: Cuernavaca, *Pringle* 429, 15373 (FH, VT). Tamaulipas: Tamasopo, *Pringle* 34a (FH), 166 p.p. (FH, MICH). Vera Cruz: South of Catemaco, *Hale* 19821 (S, US), Orizaba, *Pringle* s.n. (FH, MICH), Jalapa, *Pringle* 15398 (FH, MICH, VT).

Graphina acharii shows an enormous amount of variation in ascocarp size and shape and spore septation and color. The ascocarps range from elongate and black above to oryzaeform and totally covered with thalline tissue. The spores may be muriform throughout or only geminate at the ends. The completely muriform spores are quite often pale brownish. Considering these characters, we find it difficult to maintain the entity originally described by Krempelhuber as *Graphis inturgescens*, which differs from *Graphina acharii* only in the subentire labia.

[2] In these lists of the species, all specimens examined contained the substances indicated under the heading "Reactions" unless otherwise indicated.



FIGURES 1–3.—1. *Graphina acharii* (Fée) Müll. Arg. (*Pringle* 166 p.p.). 2. *G. balbisii* (Fée) Müll. Arg. (*Pringle* 242). 3. *G. peralbida* (Nyl.) Zahlbr. (holotype, *Pringle* 222).

Graphina acharii apparently exhibits the same type of variation that is found in *Phaeographina chrysocarpa*. A broad treatment of the species will be necessary, based on careful examination of the holotype and the types of several related species, *Graphis illinata* Eschw. in Mart., *Phaeographis cerviculata* Redgr., *Graphina vestitoides* Fink, *G. dealbata* (Nyl.) Müll. Arg., and *G. heteroplaca* Müll. Arg.

2. Graphina balbisii (Fée) Müll. Arg. Flora 65:397. 1882. FIGURE 2

Graphis balbisii Fée, Essai Crypt. Ecorces 48, *pl. 10, fig. 5*, 1824. Type: South America (not seen).

Thallus continuous, smooth to irregular. Ascocarps lighter in color than the thallus, usually unbranched, quite slender and flexuose, 1–4 mm. long; disc rimiform; exciple red-yellow, closed, about 250 μ high; labia 1–3 sulcate, convergent. Spores 4–5 per ascus, 13–18×4–6 locular, 18–26×50–110 μ, occasionally somewhat brownish.

Reactions: KOH+ red, P—, o-T—, no acids demonstrated.

Specimens examined: Morelos: Cuernavaca, *Pringle* 242 (VT), 426 (MICH).

Redinger (1933, p. 61) placed *Graphina balbisii* and his variety *monospora* in section *Chlorographina*. However, the type of var. *monospora*, and what may be a fragment of the type of *Graphis balbisii* in MICH, both show distinctly striate labia, as Müller (1887, p. 45) had earlier observed for the species.

Pringle 119, reported by Eckfeldt (1892, p. 252) as "Graphis balbisii Nyl.," is referable to *Graphis implicata* Fée.

3. Graphina bipartita Müll. Arg. Rev. Mycol. 10:19. 1888. FIGURE 3
Graphis peralbida Nyl. Lich. Trop. Singapore et Labuan 42. 1891. Holotype: Las Palmas, San Luis Potosí, Mexico, *Pringle* 222 (H, isotypes in FH, VT).
Graphina peralbida (Nyl.) Zahlbr. Cat. Lich. Univ. 2:418. 1923.

Holotype: Assuncion, Paraguay, *Balansa* 1876 (G).

Thallus nitid to minutely roughened, continuous or somewhat fissured. Ascocarps immersed to emergent, unbranched or nearly so, usually concolorous with the thallus, 1–3 mm. long, about 0.4 mm. wide, flexuose and somewhat intricate; disc very narrow, occasionally blackish; exciple open or partially closed; labia convergent, with 1–3 dark or carbonized striae; hymenium 60–100 μ high. Spores one per ascus, densely muriform, hyaline or brownish, 23–40×60–100 μ.

Reactions: KOH+ reddish, norstictic acid.

In the type description, *G. peralbida* is cited from a Mexican collection by Eckfeldt. One year later, Eckfeldt (1892, p. 252) listed *Graphis peralbida* giving Pringle as the collector. As the holotype specimen (H) is marked as coming from San Luis Potosí and is identical with *Pringle* 202 in FH and VT, it is certain that this collection by Pringle is the type and that Nylander made a mistaken reference in his publication. This type is identical with *Graphina bipartita*, which is probably pantropical, as we have seen several specimens from Hawaii.

4. Graphina confluens (Fée) Müll. Arg. Mem. Soc. Phys. Hist. Nat. Genève 29, no. 8:45. 1887. FIGURES 4–13
Arthonia confluens Fée, Essai Crypt. Ecorces 55, *pl. 14, fig. 5*, 1824. Type: South America (see below).
?Graphis delicatula Fée, Bull. Soc. Bot. France 21:28. 1874. Syntypes: Brazil, *Glaziou* 3226, 3396 (not seen; see following species).
Graphis macrospora Krempth. Flora 59:380. 1876. Syntypes: Brazil, *Glaziou* 3379, 3380 (M), 3226 (not seen; this is also a syntype of *G. delicatula*).
Graphina macrospora (Krempth.) Müll. Arg. Flora 71:508. 1888.
?Graphina platygrapta Müll. Arg. Flora 71:495. 1888. Type: Cayey, Puerto Rico, *Sintenis* 25 p.p. (not seen).
Graphina epiglauca Müll. Arg. Bull. Soc. Bot. Belg. 32:152. 1893. Type: Costa Rica, *Pittier* (US, isotype).
Graphina collatinensis Redgr. Hedw. 73:59. 1933. Type: Collatina, Espiritu Santo, Brazil, *Bornmüller* 13 (not seen).
Graphina collatinensis var. *ocellariiformis* Redgr. Ark. Bot. 26A, no. 1:24. 1933. Syntypes: Brazil, *Malme* 2351, 2416, 3565, 3576 (S).
Graphina collatinensis var. *lirelliformis* Redgr. Ark. Bot. 26A, no. 1:25. 1933. Holotype: Corcovado, Rio de Janeiro, Brazil, *Malme* 84 (S).

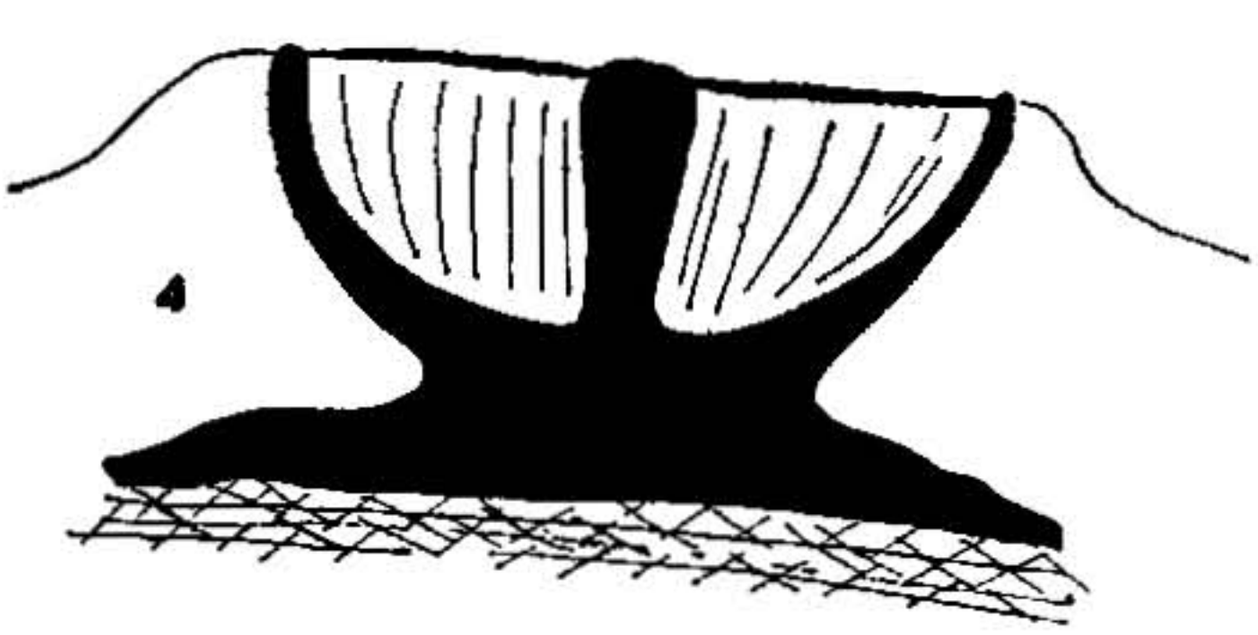
Thallus light colored, continuous, thin to quite thick, often desquamescent. Ascocarps very variable in size and shape, immersed to emergent or sessile, round to lirelline, always covered by a thalline margin; disc narrow to wide, lightly to heavily pruinose; exciple

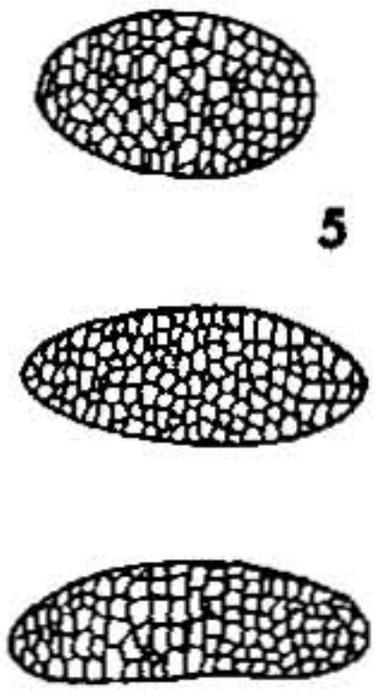
closed, brown or carbonaceous, often basally continuous in a subthalline layer; labia more or less entire, distant, and divergent; hymenium intact or rarely with an incipient columella. Spores one per ascus, densely muriform, hyaline, yellowish, or pale brownish, 25–50× 65–175 μ.

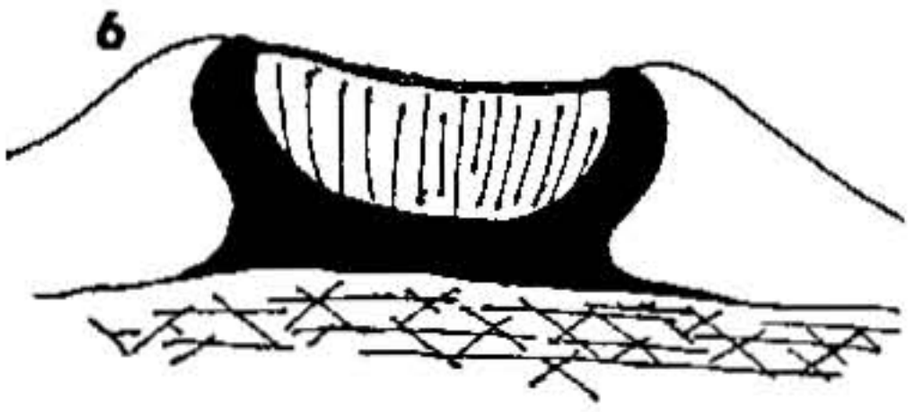
Reactions: See below.

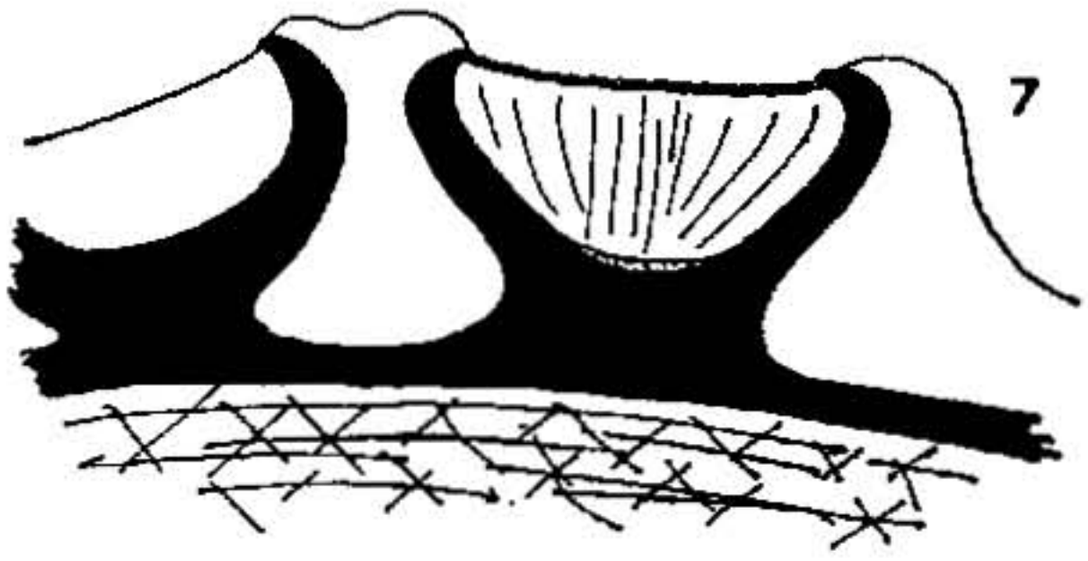
Specimens examined: Chiapas: El Suspiro, *Hale* 20155, 20169 (US). Tamaulipas: Tampico, *Pringle* 8 (W). Vera Cruz: South of Catemaco, *Hale* 19803 (S, US).

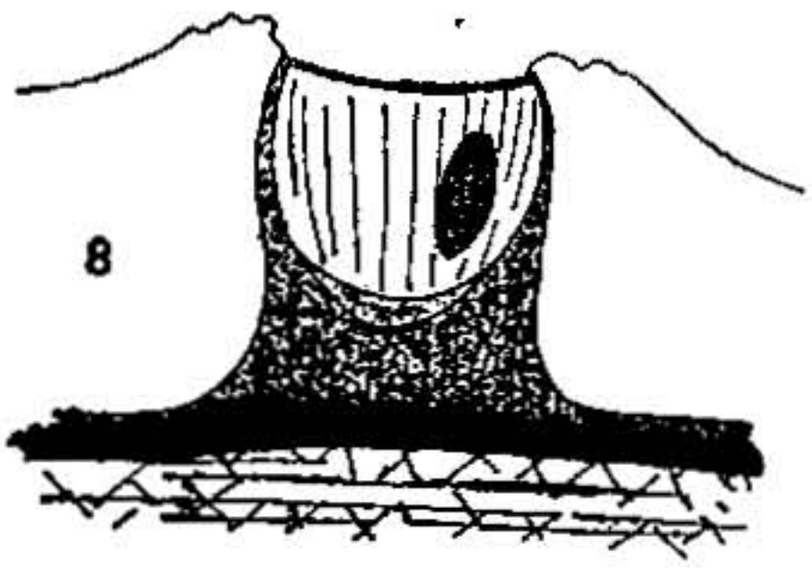
Arthonia confluens Fée was based on two specimens, one from South America on *Cinchona* and one from Guadeloupe on *Jacquinia*. Müller

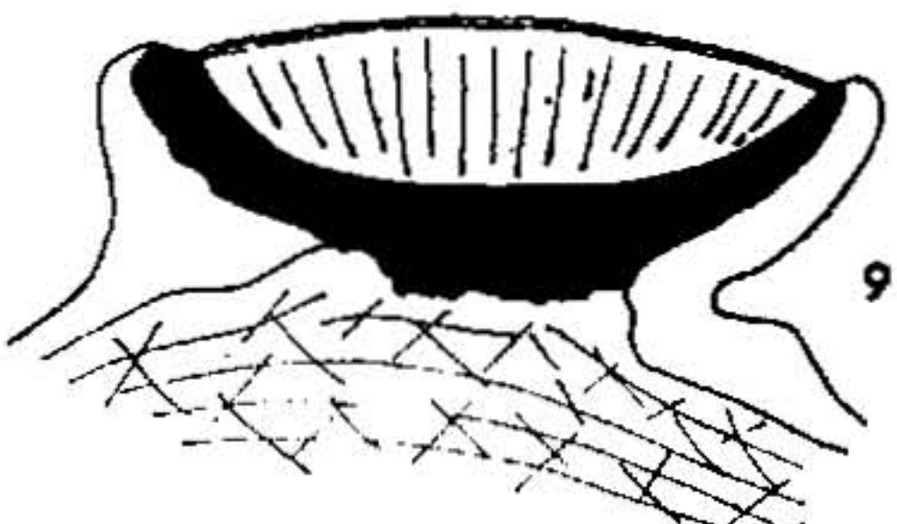












FIGURES 4–9.—4. *Graphina macrospora* (Krempih.) Müll. Arg. (syntype, *Glaziou* 3379). 5. *G. confluens* (Fée) Müll. Arg. Variation in spore shape. 6. *G. epiglauca* Müll. Arg. (isotype, *Pittier* s.n.). 7. *G. collatinensis* var. *ocellariiformis* Redgr. (syntype, *Malme* 3565). 8. *G. collatinensis* var. *lirelliformis* Redgr. (holotype, *Malme* 84). 9. *G. confluens* (Fée) Müll. Arg. (*Pringle* 8).

discovered that the syntypes were heterogeneous and referred the Guadeloupe specimen to *Opegrapha*. We have examined the same specimen (from Rio de Janeiro) and can confirm that it is an *Opegrapha*. The South American material, which becomes the lectotype, has not been seen by us, but Müller's description leaves little doubt in our minds as to its identity.

Graphina confluens seems to be one of the most variable, complex, and widespread *Graphina* species yet encountered. The entity cuts across generic and family boundaries with a continuous, interrelated series of forms which are difficult to separate. In addition, quite a number of species have been described which are probably additional variants. The difficulties involved in this group may best be summarized by examining the following salient features.

1. The extremes of thallus form in this group are quite distinct. At one end of the spectrum of variants are thin, barely continuous, closely adherent thalli; at the opposite end are those forms with thick desquamescent thalli, often with a basal carbonaceous layer. All intermediate stages can be found. In the related *Graphina platycarpina* Zahlbr. the thallus is areolate.

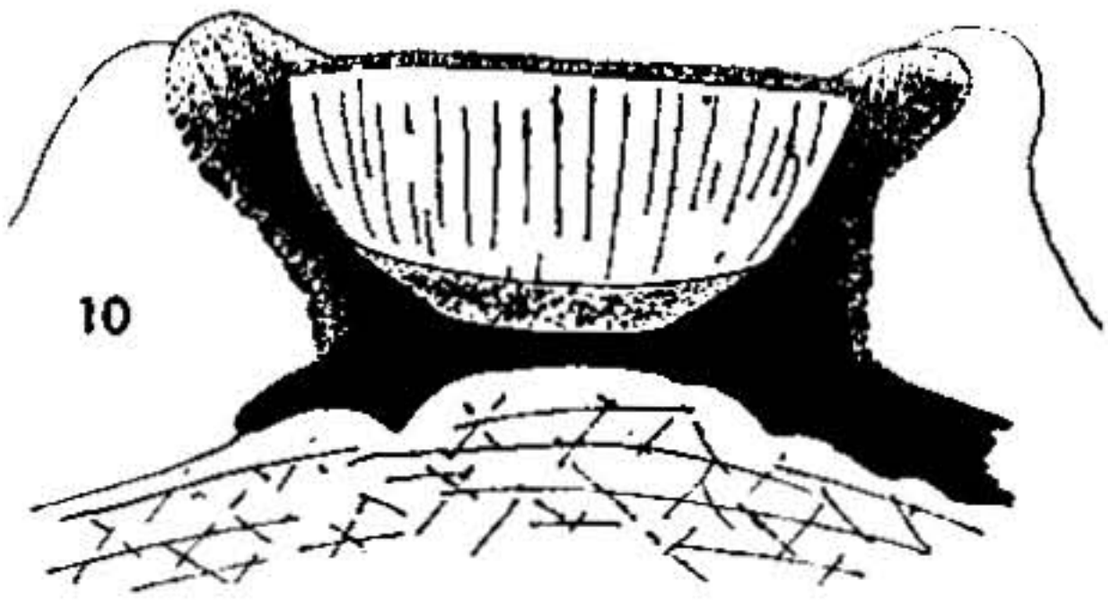
2. The ascocarps vary from completely lirelline to completely round, commonly within the same thallus. Specimens with immersed apothecia-like ascocarps approach the Thelotremataceae very closely. The degree of immersion in the species is highly variable. The extremes are distinct, but the presence of numerous intermediate specimens renders separation nearly impossible.

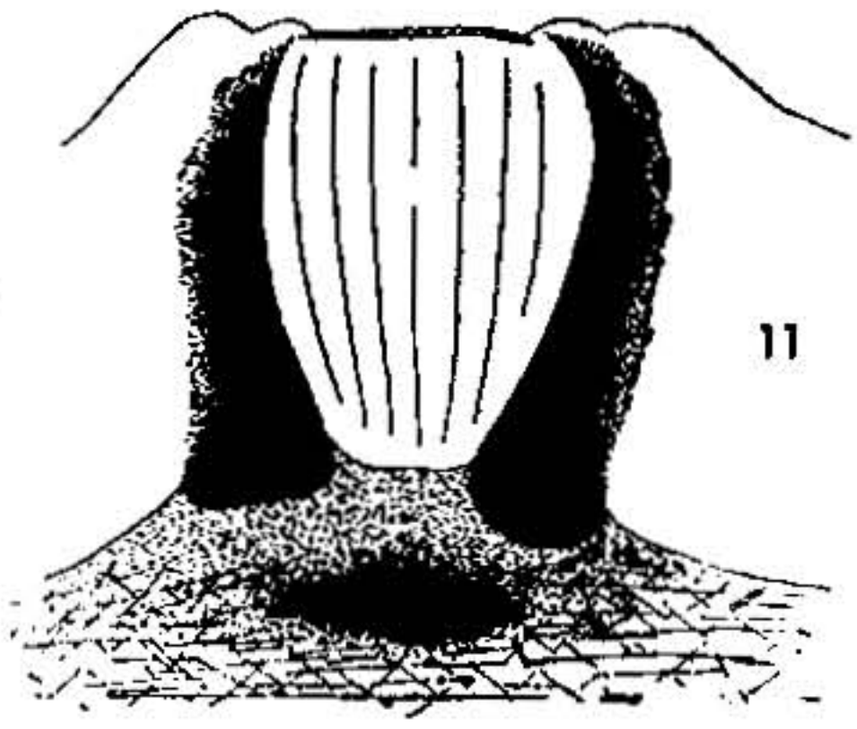
3. The exciples vary in structure from more or less completely carbonized forms (*Graphina epiglauca*, *G. collatinensis* var. *ocellariiformis*, and *G. macrospora*, figs. 4, 6, 7) to entirely brown extremes showing carbonization only in the subthalline layer (*G. collatinensis* var. *lirelliformis*, fig. 8). Between these two extremes one can find exciples which are carbonized only in spots or blackened above and brown below (figs. 10–13).

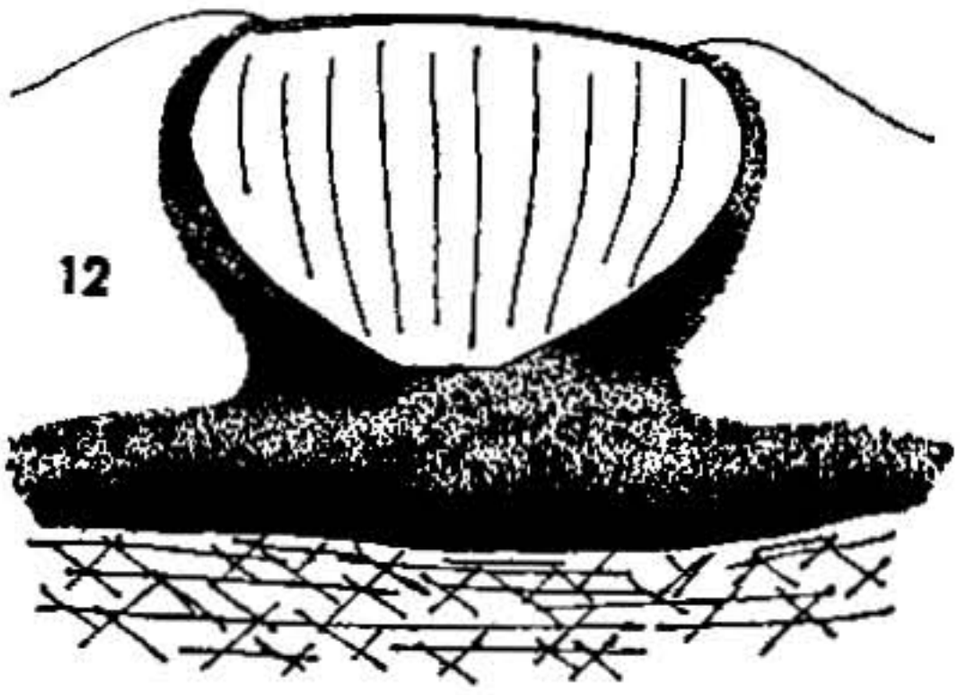
One of the syntypes of *G. macrospora* (*Glaziou* 3379) has exciples which show distinct columellae forming. In all other details of anatomy it is identical with the syntypes of *G. collatinensis* var. *ocellariiformis*. The presence of columellae is not altogether unexpected and provides further evidence of the unity of the Graphidaceae and much of the Thelotremataceae.

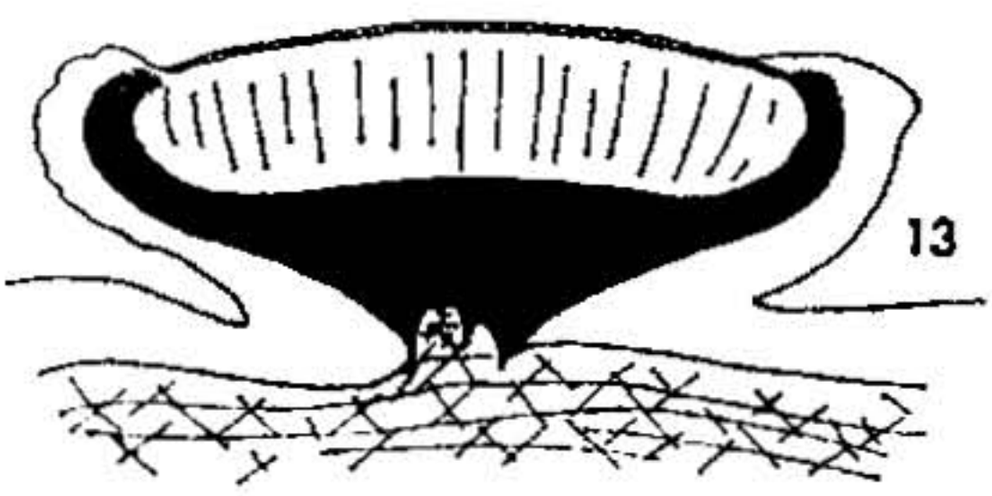
4. Spores that are large and densely muriform, with but one per ascus, are characteristic of all individuals of this polymorphic species. However, the spores vary from completely hyaline to yellowish or brownish. It is thus sometimes difficult to decide whether certain specimens should be placed in *Graphina* or *Phaeographina*.

5. The distribution of *Graphina confluens* as here delimited extends









FIGURES 10–13.—10. *Graphina confluens* (Fée) Müll. Arg. (*Wright* 23). 11. *G. confluens* (*Hioram* 5300). 12. *G. confluens* (*Williams* 7102). 13. *Graphis glaucoleuca* Nyl. nom. nud. (*Wright* 4).

from Mexico, Costa Rica, and the West Indies, to Brazil and Africa. There seems to be no correlation between anatomy and distribution.

6. Lichen acids are present in a bewildering array, apparently unrelated to either anatomy or geographic distribution. Acids demonstrated are as follows (the numbers in parentheses indicate number of specimens):

Stictic acid only: Philippines (1).

Stictic acid, lichexanthone, and a fatty substance: Costa Rica (1), Mexico (3), Cuba (3), Jamaica (1), Puerto Rico (2), and Brazil (2).

Stictic acid and an unknown: Puerto Rico (2).

Lichexanthone only: Cuba (1) and Brazil (3).

Lichexanthone, zeorine, atranorine: Brazil (1).

Norstictic acid: Cuba (1) and Brazil (1).

5. Graphina elongata (Vain.) Zahlbr. Cat. Lich. Univ. 2:405. 1923.

FIGURES 14–16

Graphis elongata Vain. Acta Soc. Faun. Fl. Fenn. 7, no. 7:107. 1890. Holotype: Sitio, Minas Gerais, Brazil, *Vainio* 782 (TUR).

Graphina elongatoradians Fink, Mycologia 19:218. 1927. Holotype: Manatí, Puerto Rico, *Fink* 2049 (MICH). Reactions: KOH+ red, P— (?), o-T—, no acids demonstrated.

Thallus smooth, continuous. Ascocarps slender, semiemergent to subsessile, occurring in large, radiately branched asteroid groups up to 15 mm. in diameter; exciple black, open; labia 1–3 striate, convergent;

hymenium 50 μ high. Spores 2–4 (–6) per ascus, 7–9×1–4 locular, 13–19×25–50 μ.

Reactions: KOH+ red, norstictic acid.

Specimen examined: Chiapas: Lagos de Monte Bello, *Hale* 21069 (US).

The excipular labia of this species are often only faintly striate, and it is necessary to examine sections of several ascocarps to ensure proper identification. The holotype of *G. elongatoradians* differs from that of *G. elongata* only in having somewhat smaller, less emergent ascocarps and in apparently lacking norstictic acid, although the color reaction indicates its presence.

6. Graphina hiascens (Fée) Müll. Arg. Mem. Soc. Phys. Hist. Nat. Genève 29 no. 8:42. 1887. FIGURES 17–20

Opegrapha hiascens Fée, Suppl. Essai Crypt. Ecorces, 25, *pl. 36, fig. 1*, 1837. Type: South America (not seen, isotype at MICH?).

?Opegrapha endochroma Fée, Essai Crypt. Ecorces, 31. 1824. Type: Tropical America (not seen).

Graphis subserpentina Nyl. Acta Soc. Sci. Fenn. 7:465. 1863. Type: Ceylon, *Gardner* (US, isotype).

Graphina subserpentina (Nyl.) Müll. Arg. Bull. Soc. Bot. Belg. 32:152. 1893.

Graphis macgregorii Vain. Ann. Acad. Sci. Fenn. 15A, no. 6:207. 1921. Type: Guam, *MacGregor* 607 (US, isotype).

Graphis orientalis Vain. Ann. Acad. Sci. Fenn. 15A, no. 6:206. 1921. Type: Philippines, Merrill 6716 (isosyntype, US).

Graphina orientalis (Vain.) Zahlbr. Cat. Lich. Univ. 2:416. 1923.

Graphina macgregorii (Vain.) Zahlbr. Cat. Lich. Univ. 2:413. 1923.

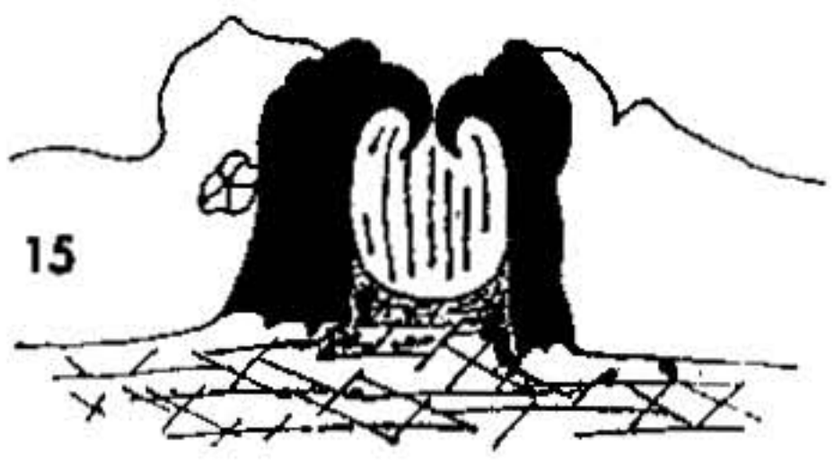
Thallus smooth, granular, or warty, continuous. Ascocarps unbranched, lightly flexuose, semiemergent or subsessile, 0.5–2 mm. long, about 0.5 mm. wide, black above, with a more or less prominent lateral thalline margin; exciple black, open; labia more or less convergent, entire; hymenium 100–200 μ high. Spores one per ascus, occasionally faint brown, 13–16×1–8 locular, 18–32×70–115 μ.

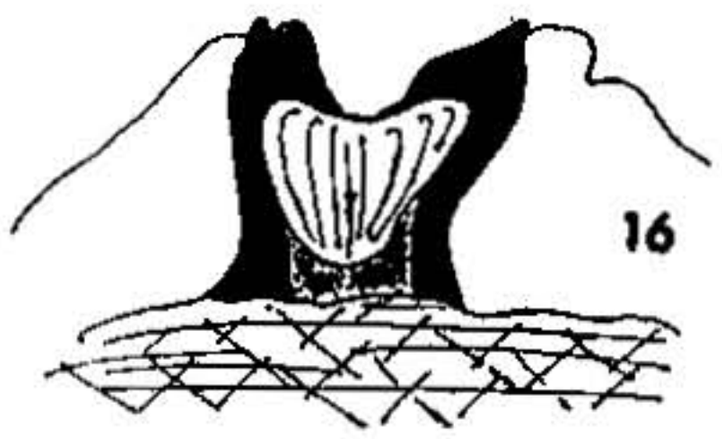
Reactions: KOH+ red, nostictic acid.

Specimens examined: Tamaulipas: Tampico, *Pringle* 5454, 5457 (MICH).

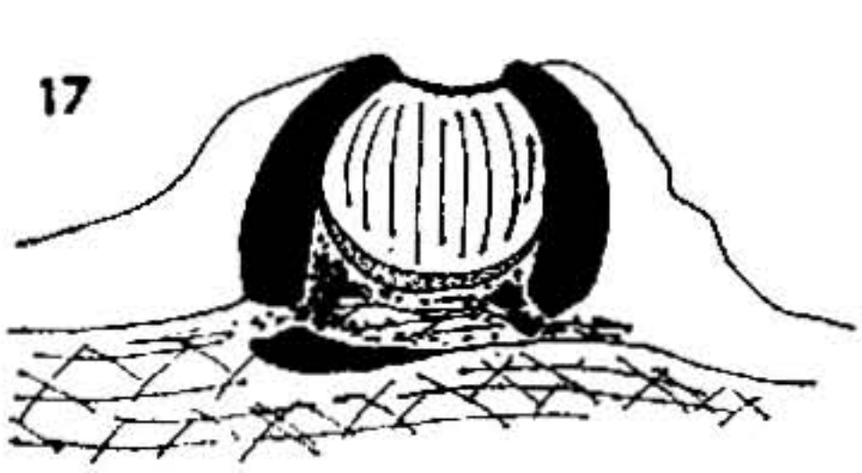
Fée published the name *Opegrapha endochroma* in 1824. Later, in his Supplement, he renamed the same entity *O. hiascens*, supposedly on the basis of better material. Müller, in transferring it to *Graphina*, chose to use the later epithet *hiascens* and listed *O. endochroma* as a synonym. Although *endochroma* has nomenclatural priority, the new combination should not be made until the materials in Fée's collections have been thoroughly examined.

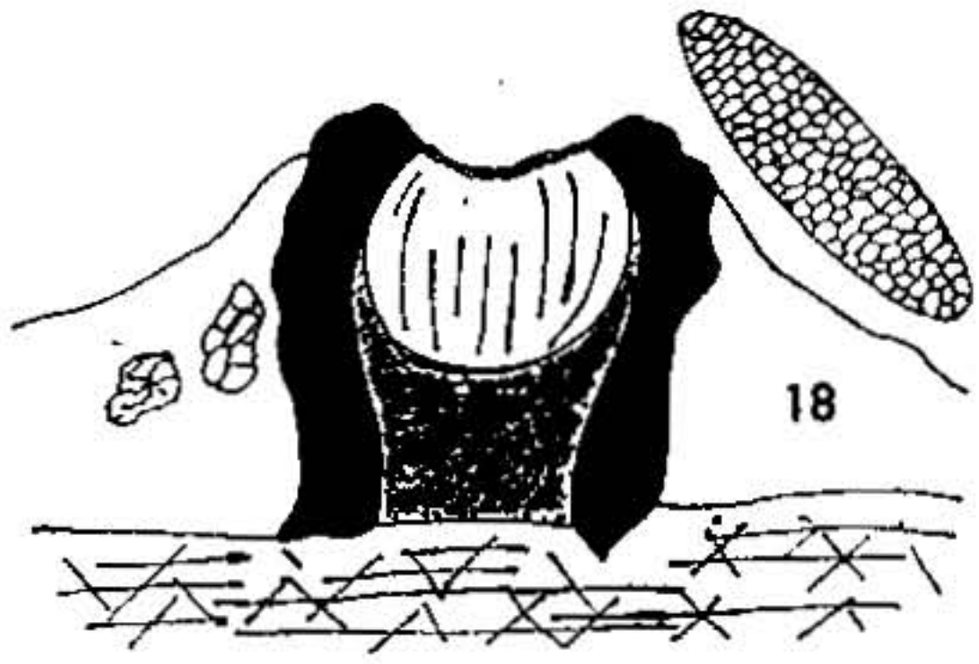
An isosyntype of *Graphis orientalis* (US) differs from typical *Graphina hiascens* only in having totally immersed ascocarps. In our opinion this is insufficient grounds for maintaining this entity as a

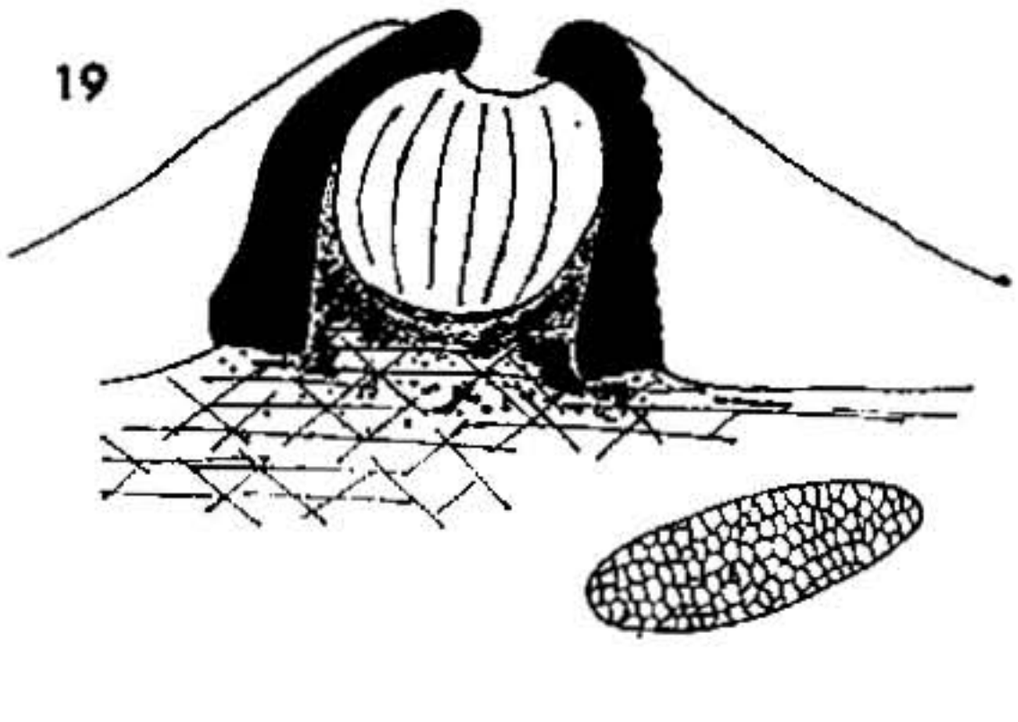


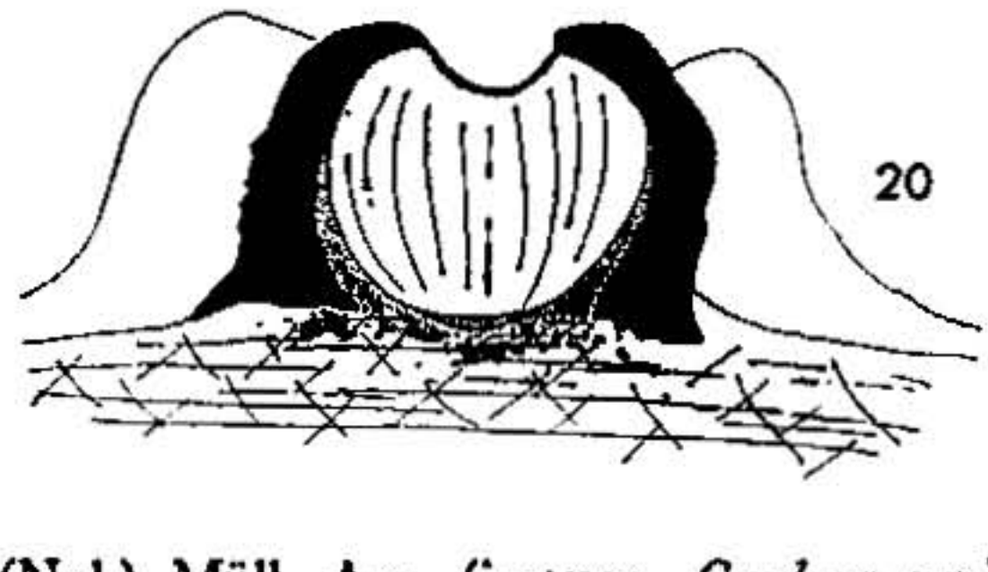


FIGURES 14–16.—14. *Graphina elongata* (Vain.) Zahlbr. (holotype, *Vainio* 782). 15–16. *G. elongatoradians* Fink (holotype, *Fink* 2049).









FIGURES 17–20.—17. *Graphina subserpentina* (Nyl.) Müll. Arg. (isotype, *Gardner* s.n.). 18. *G. macgregorii* (Vain.) Zahlb. (isotype, *MacGregor* 607). 19. *G. orientalis* (Vain.) Zahlbr. (isosyntype, *Merrill* 6716). 20. *G. hiascens* var. *clausior* (Vain.) Zahlbr. (isotype, *Ramos & Edano* 29548).

distinct species, since the degree of immersion is highly variable in this species. Isotypes of *G. macgregorii* and *G. subserpentina* differ from *G. hiascens* only in minor intergrading characters. An isotype of *G. hiascens* var. *clausior* (Vain.) Zahlbr. (US) from the Philippines is distinct in having elongate intricate ascocarps (fig. 20) and in producing stictic acid only.

7. Graphina hololeucoides (Nyl.) Müll. Arg. Flora 65:397. 1882.

FIGURE 21

Graphis hololeucoides Nyl. Ann. Sci. Nat. Bot. ser. 4, 20:266. 1863. Type: Mexico, *Ghiesbreght* (H, isotype).

Thallus uneven, often discontinuous. Ascocarps sessile or subsessile, lighter than the thallus, slightly mealy, unbranched, round to elliptical, 0.5–0.8 mm. wide, 1–1.5 mm. long; exciple barely closed, colorless below; labia internally irregularly striate, slightly darkened; hymenium about 100 μ high. Spores 4–6 per ascus, 20–30×1–4 locular, 15–18×60–100 μ.

Reactions: Thallus KOH−, P−; ascocarps KOH+ faint, P+ red. No microchemical tests made.

Although the isotype is too small to extract, the color reactions suggest the presence of protocetraric acid.

8. Graphina insignis (Vain.) Zahlbr. Cat. Lich. Univ. 2:410. 1923.

FIGURES 22, 23

Graphis insignis Vain. Acta Soc. Faun. Fl. Fenn. 7, no. 7:112. 1890. Lectotype: Carassa, Minas Gerais, Brazil, *Vainio* 1209 (TUR).

Graphina insignis var. *primaria* Redgr. Ark. Bot. 26A, no. 1:21. 1933. Syntypes: Brazil, *Malme* 2299, 3509 p.p. (S).

Graphina insignis var. *imperfecta* Redgr. Ark. Bot. 26A, no. 1:21. 1933. Holotype: Brazil, *Malme* 3514 (S). Reactions: KOH+ red, P−, gummy residue, atranorine only.

Graphina insignis var. *tartarea* Redgr. Ark. Bot. 26A, no. 1:22. 1933. Syntypes: Brazil, *Malme* 2549, 3509 p.p. (S).

Thallus thick, nitid, continuous or fissured, usually carbonized near the substrate, often with soredia-like eruptions. Ascocarps immersed, usually bordered by a lighter area of thallus, irregular, flexuose, simple to asteroidly branched, often anastomosing into large contorted fertile areas, 1–5 mm. long, up to 1 mm. wide; disc plane or depressed, caesiopruinose; exciple closed, pale to dark brown, sometimes carbonized at the very base; labia divergent, entire; hymenium 100–175 μ high, epithecium prominent. Spores 8 per ascus, ovoid, 4–5×1–3 locular, 5–8×10–15 μ.

Reactions: KOH+ red, P−, o-T−, gummy residue, no acids demonstrated.

Specimen examined: Chiapas: Lagos de Monte Bello, *Hale* 20449 (DUKE, REN, S, TNS, US).

Graphina insignis was placed by Redinger in the section *Platygraphopsis*. However, examination of the Vainio syntypes and Redinger's types showed that the exciples are usually uncarbonized or only rarely carbonized at the base. The thick band of black tissue which separates the thallus from the substrate is quite variable, and it seems superfluous to name each variation.

This species is apparently restricted to substrata of decaying organic matter, such as rotten wood, old twigs, grass, and detritus on

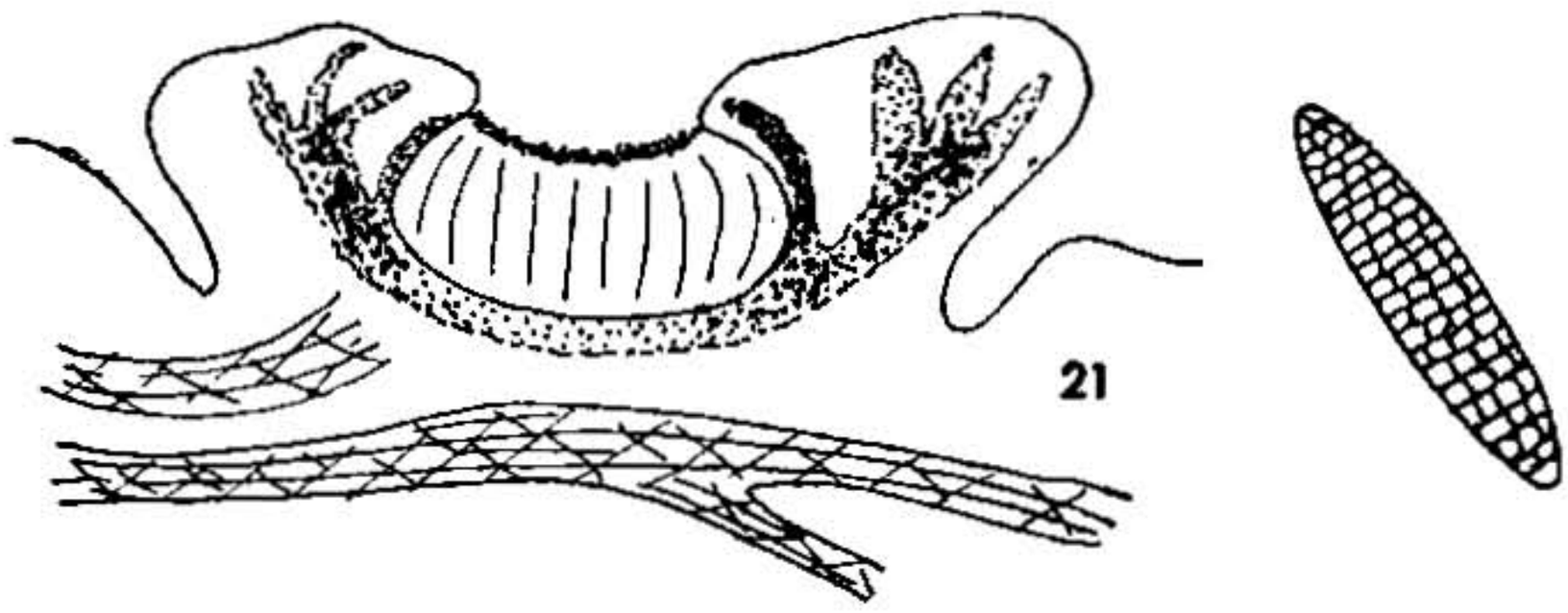
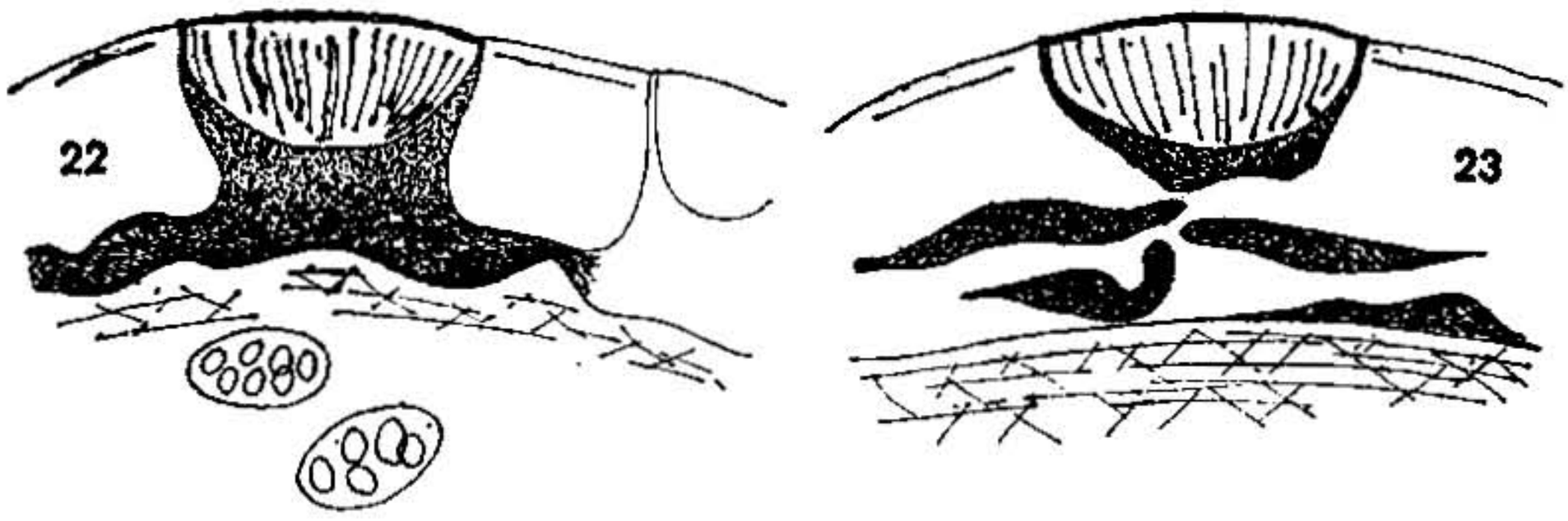


FIGURE 21.—*Graphina hololeucoides* (Nyl.) Müll. Arg. (isotype, *Ghiesbreght* s.n.).



FIGURES 22–23.—22. *Graphina insignis* (Vain.) Zahlbr. (lectotype, *Vainio* 1209). 23. *G. insignis* (*Hale* 20449).

rocks. It forms a heavy thallus with characteristic soredia-like outgrowths and frequently fused ascocarps. It must have a very rapid growth rate to be able to colonize such unstable habitats.

All of the specimens react KOH+ red and yield from acetone a clear gummy residue which is unrecrystallizable. Only one specimen (the holotype of var. *imperfecta*) yielded atranorine.

9. Graphina inturgescens (Kremplh.) Müll. Arg. Flora 71:545. 1888.

FIGURES 24–27

Graphis inturgescens Kremplh. Flora 59:383. 1876. Holotype: Brazil, *Glaziou* 6286 (M).

Graphis phaeospora Vain. Acta Soc. Faun. Fl. Fenn. 7, no. 7:97. 1890. Holotype: Sitio, Minas Gerais, Brazil, *Vainio* 682 (TUR).

Graphina acharii var. *subintegra* Zahlbr. Ann. Mycol. 19:230. 1921. Types: Tampico, Tamaulipas, Mexico, *Pringle* 5 p.p., 25 p.p. (MICH, isosyntypes).

Phaeographina phaeospora (Vain.) Zahlbr. Cat. Lich. Univ. 2:443. 1923.

Thallus continuous, thick, somewhat roughened, saxicolous or corticolous. Ascocarps sessile, flexuose, elongate, rarely branched, to 6 mm. long, covered up to or nearly to the apex by a thalline margin; exciple black, closed; labia convergent, entire or crenate; hymenium 150–300 μ high. Spores 2–4 (–6?) per ascus, colorless or nearly so, 17–30×1–5 locular, 15–30×80–160 μ.

Reactions: KOH+ reddish, P—, no acids demonstrated.

We have been unable to find any differences between the various species listed above other than the fact that the holotype of *G. inturgescens* is saxicolous while the others are corticolous. The spores in all three types are colorless or rarely pale brown, Vainio's name *phaeospora* notwithstanding! The labia vary from entire to crenate and are covered by a thin to thick thalline veil.

It is altogether likely that *G. inturgescens* is referable to the polymorphic *G. acharii*. *Graphina inturgescens* can be provisionally separated by the subentire rather than distinctly striate labia.

10. Graphina macella (Kremplh.) Müll. Arg. Flora 63:23. 1880. FIGURE 28
Graphis macella Kremplh. Flora 59:380. 1876. Holotype: Brazil, *Glaziou* 6289b (M).

Thallus continuous, smooth. Ascocarps semiemergent to subsessile, stout, sparingly branched, straight to flexuose, black above, white striped, 1–5 mm. long, about 0.5 mm. wide; exciple black, closed; labia convergent, 1–4 sulcate; hymenium 150–200 μ high. Spores one per ascus, 25–35×3–12 locular, 20–40×65–130 μ.

Reactions: KOH+ yellow, P—, 0-T—, G.E.—, no acids demonstrated.

Specimen examined: Chiapas: Southeast of San Cristóbal, *Hale* 20275 (US).

Graphina macella is closely related to *G. acharii*, from which it differs in having only one rather rotund spore per ascus. The Mexican material differs from the holotype of *G. macella* in having fewer striae, and the exciple is peculiarly infuscated below. There is little doubt however as to the identity of the two specimens.

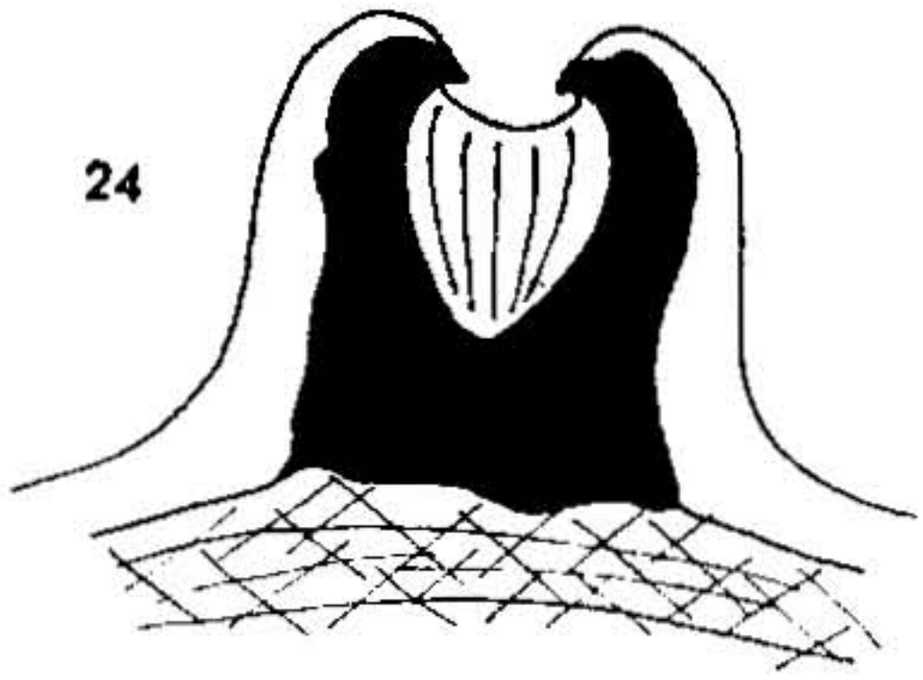
11. Graphina mexicana (Zahlbr.) comb. nov. FIGURE 29
Enterodictyon mexicanum Zahlbr. Ann. Mycol. 19:233. 1921. Holotype: Cuernavaca, Mexico, *Pringle* 20 (W).

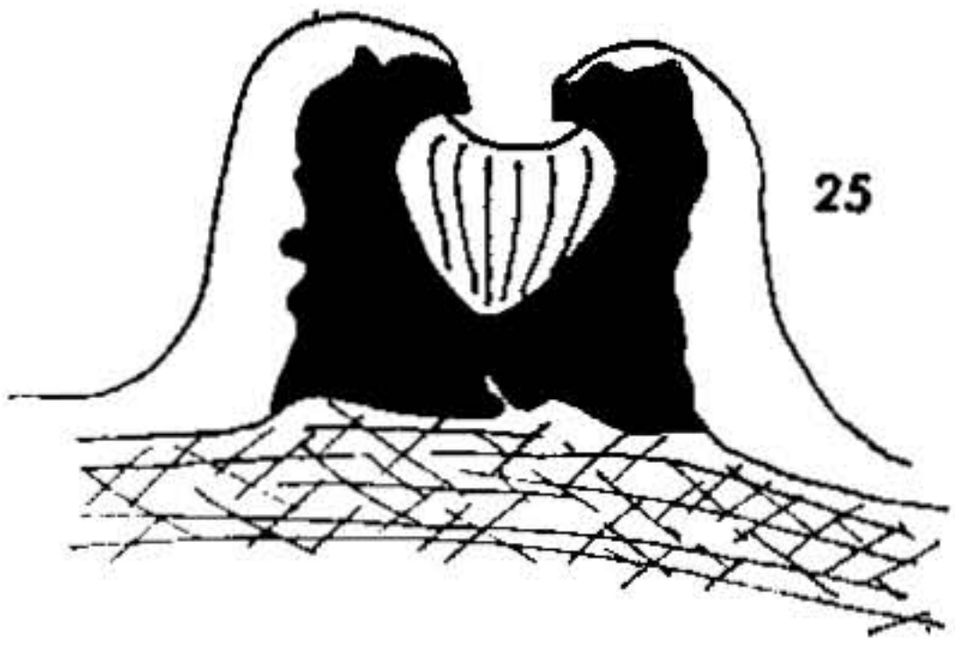
Thallus smooth to minutely roughened, continuous. Ascocarps in densely intricated clusters, appearing as gaping, very light-colored fissures; exciple colorless or rudimentary, barely closed to open; labia convergent at first, then somewhat spreading, composed at least partially of bark cells; hymenium about 90 μ high. Spores 6–8 per ascus, occasionally halonate, 4–5×1–3 locular, 8–13×23–40 μ.

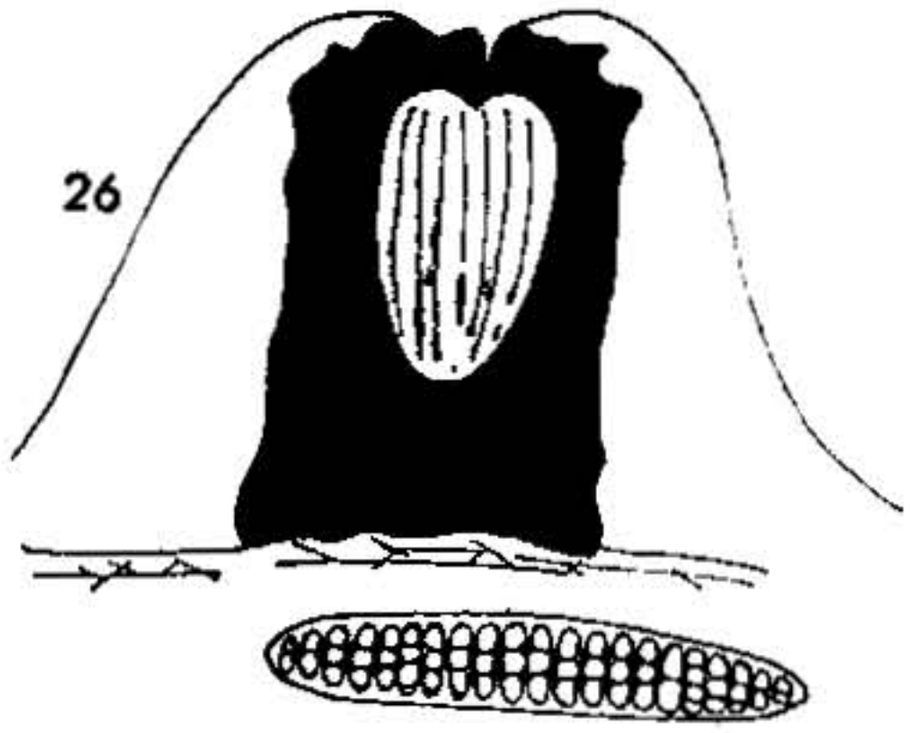
Reactions: KOH+ red, P—, o-T—, no acids demonstrated.

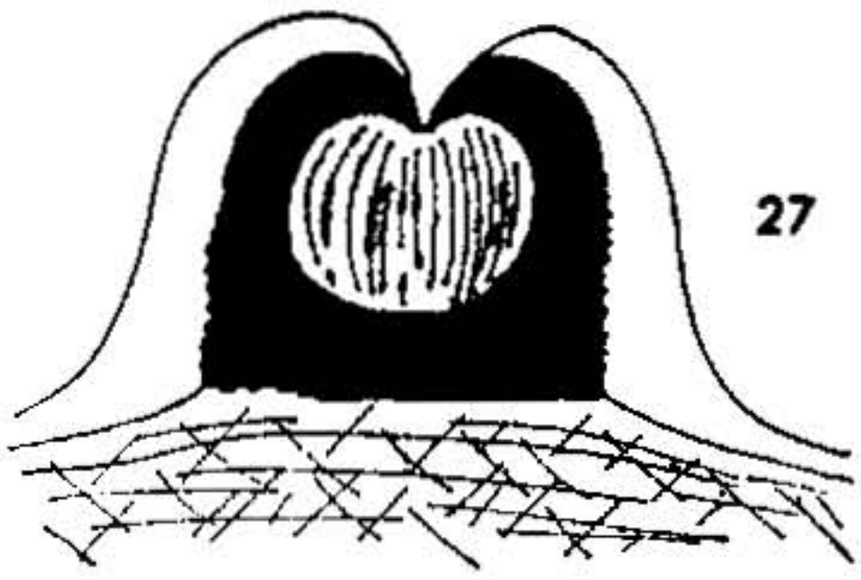
Specimen examined: San Luis Potosí: Las Palmas, *Pringle* 225 (FH, VT).

The holotype of *Enterodictyon mexicanum* is obviously referable to *Graphina*. *Pringle* 225 was determined by Müller (1894, p. 92) as *Medusulina nitida* (Eschw. in Mart.) Müll. Arg., but we could find no trace of anything resembling stromatoid tissue in the specimen. Since the type of *M. nitida* has not been available for comparison and









FIGURES 24–27.—24–25. *Graphina inturgescens* (Kremplh.) Müll. Arg. (holotype, *Glaziou* 6286). 26–27. *Phaeographina phaeospora* (Vain.) Zahlbr. (holotype, *Vainio* 682).

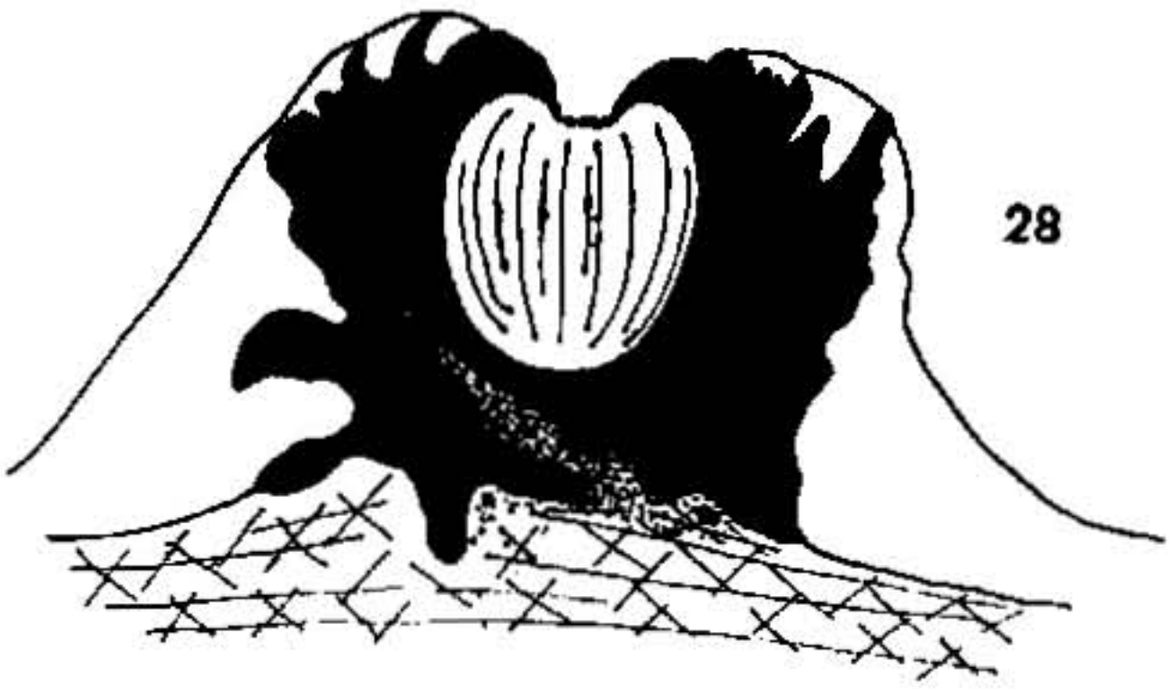


FIGURE 28.—*Graphina macella* (Kremplh.) Müll. Arg. (holotype, *Glaziou* 6289b).

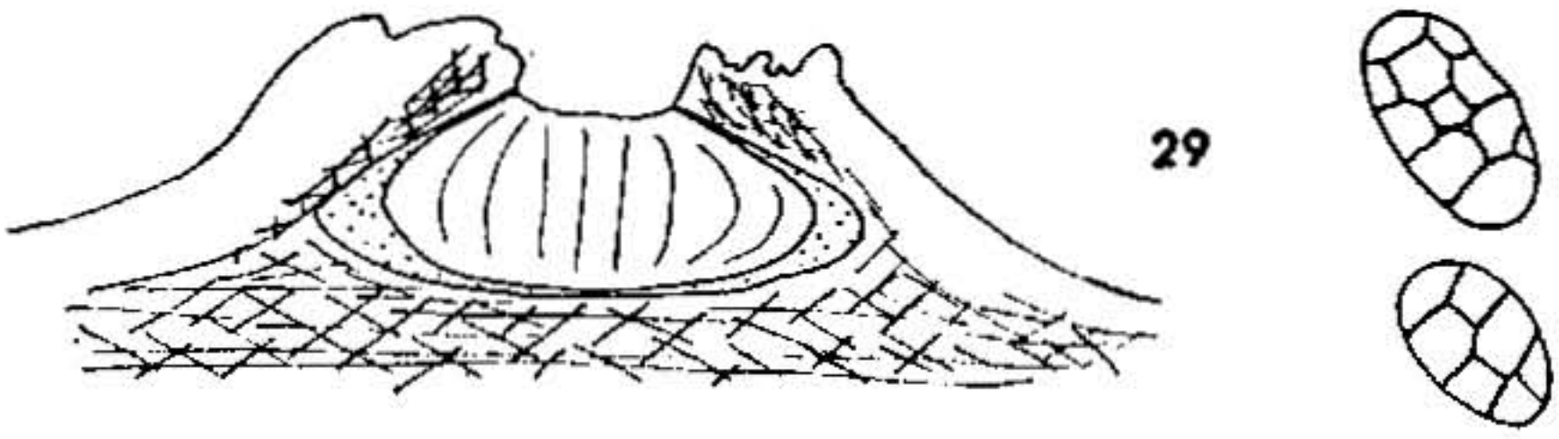


FIGURE 29.—*Graphina mexicana* (Zahlbr.) Wirth & Hale (holotype, *Pringle* 20).

is probably lost, it is best to transfer *Enterodictyon mexicanum* to *Graphina*, even though it may eventually be proved to be a synonym of *Graphina nitida* (Eschw. in Mart.) Müll. Arg.

12. Graphina palmeri Zahlbr. Ann. Mycol. 19:231. 1921. FIGURE 30

Type: Cuernavaca, Morelos, Mexico, *Pringle* 9 (MICH, isotype).

Thallus much fissured and irregular. Ascocarps small, more or less immersed to semiemergent, 0.5–1.5 mm. long, slender, concolorous with the thallus; exciple closed, brown laterally, colorless below the hymenium; labia sulcate, with brown inclusions, covered by a thick thalline margin. Spores 8 per ascus, 12–15×3–6 locular, 15–18×45–75 μ.

Reactions: KOH+ red, unknown acid in G.A. o-T.

The unknown acid in the type is identical with that found in *Graphina triangularis*, *G. virginea*, and *Phaeographis exaltata*. In G.A. o-T. the crystals are somewhat similar to those of barbatic acid.

13. Graphina parilis (Kremplh.) Müll. Arg. Bull. Soc. Bot. Belg. 32:152. 1892. FIGURES 31–35

Graphis parilis Kremplh. Flora 59:422. 1876. Holotype: Brazil, *Glaziou* 3394 (M). Reactions: KOH+yellowish, no chemical tests made.

Graphis annulata Kremplh. Flora 59:445. 1876. Holotype: Brazil, *Glaziou* 3388 (M). Reactions: KOH+ yellowish, no chemical tests made.

Graphina acromelaena Müll. Arg. Bull. Soc. Bot. Belg. 32:152. 1893. Holotype: San José, Costa Rica, *Tonduz* (G).

Graphina achrophaea Müll. Arg. Bull. Herb. Boiss. 3:46. 1895. Type: Louisiana, *Langlois* 751 (US, isotype).

Graphis subducta Vain. Ann. Acad. Sci. Fenn. 15A, no. 6:203. 1921. Type: Luzon, Philippines, *Merrill* 8576 (US, isotype).

Graphina pringlei Zahlbr. Ann. Mycol. 19:230. 1921. Type: Tampico, Tamaulipas, Mexico, *Pringle* 11 (not seen).

Graphina subducta (Vain.) Zahlbr. Cat. Lich. Univ. 2:426. 1923.

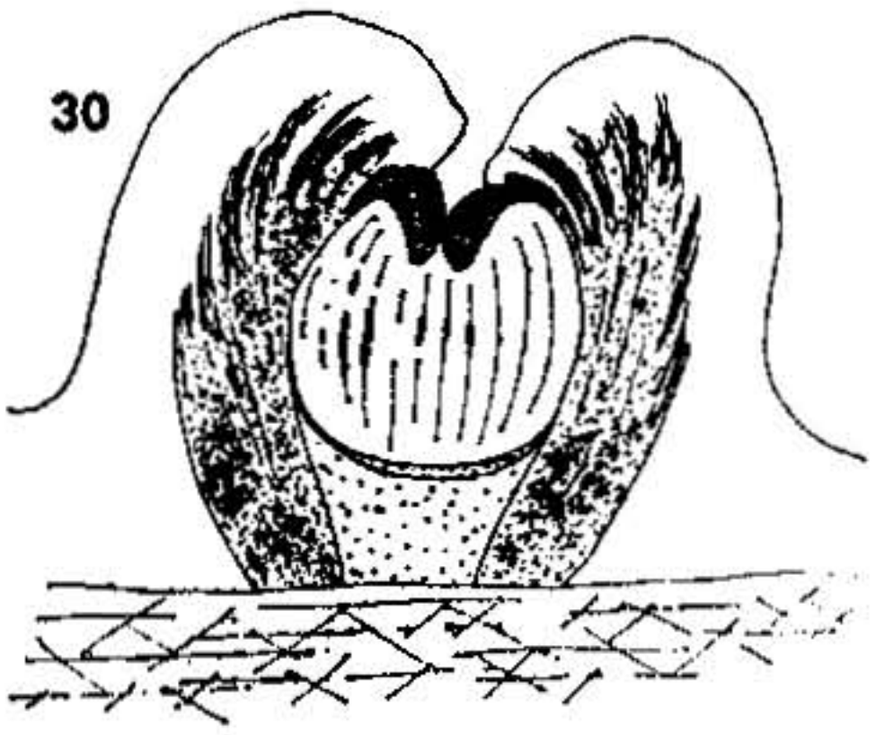
Graphina acrophaea f. *multilamellosa* Redgr. Ark. Bot. 26A, no. 1:52. 1933, Holotype: Colonia Risso, Paraguay, *Malme* 3545 (S).

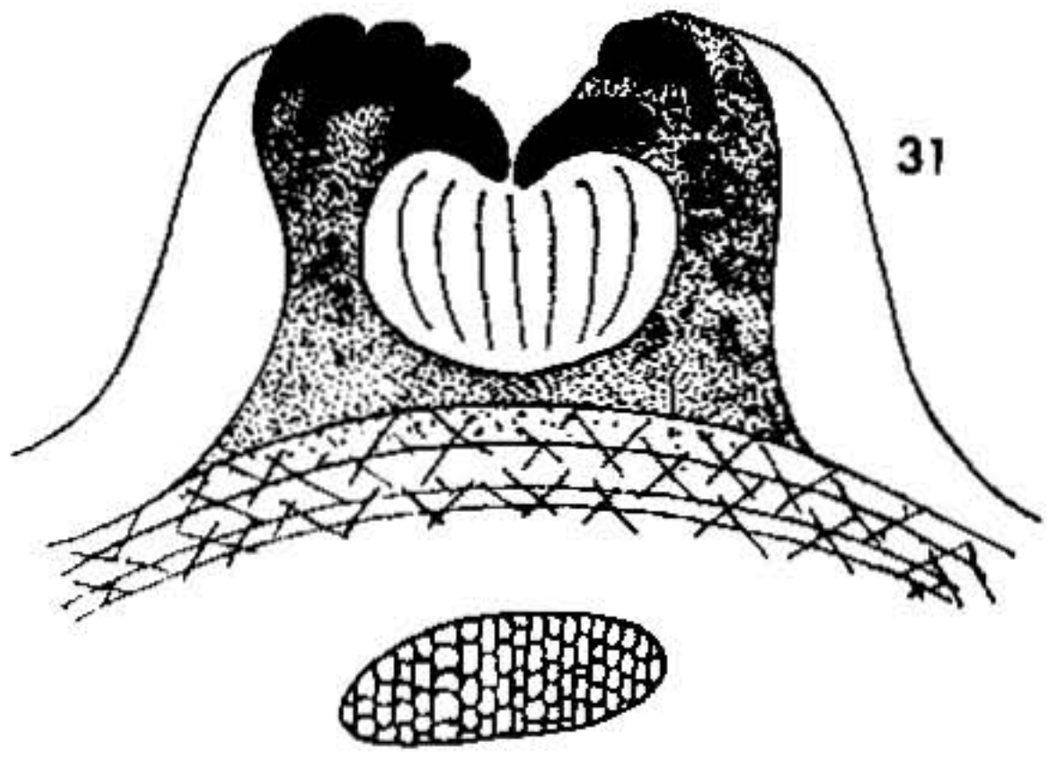
Graphina puiggarii f. *corumbensis* Redgr. Ark. Bot. 26A, no. 1:56. 1933. Syntypes: Matto Grosso, Brazil, *Malme* 3631, 3638 (S).

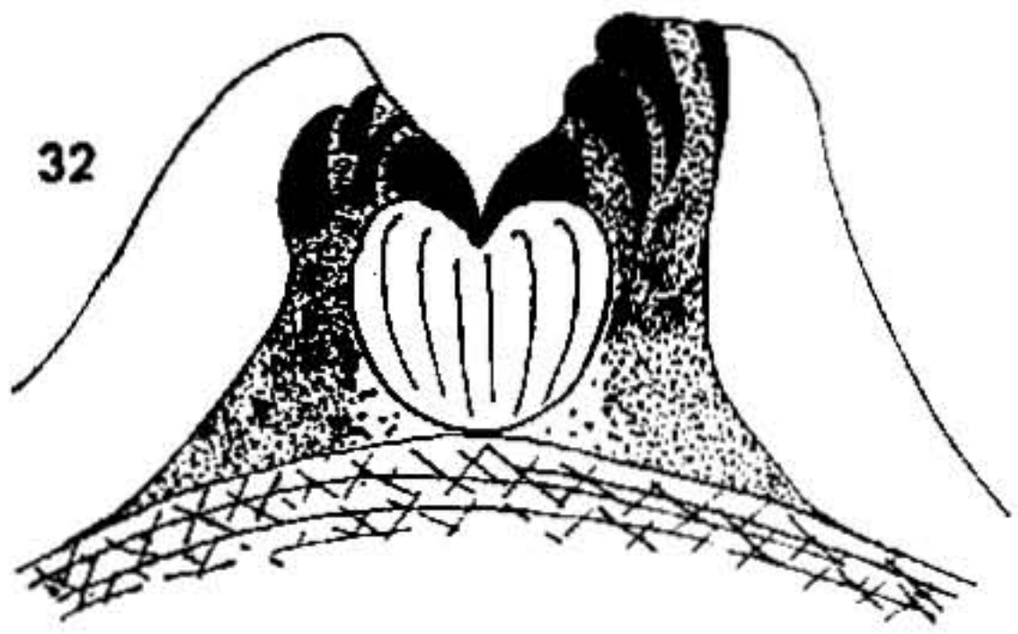
Thallus continuous, smooth to minutely roughened. Ascocarps dispersed to clustered, semiemergent to subsessile, unbranched to 3–4 branched, lightly flexuose to curved and intricate, black above, often with a raised thalline margin, 1–5 mm. long, 0.3–0.6 mm. wide; exciple black above, yellow or pale brown below, closed or open; labia convergent, 4–10 striate, often barely so in some portions of the ascocarps. Spores 8 per ascus, occasionally halonate, 12–20×1–7 locular, 10–20×28–80 μ.

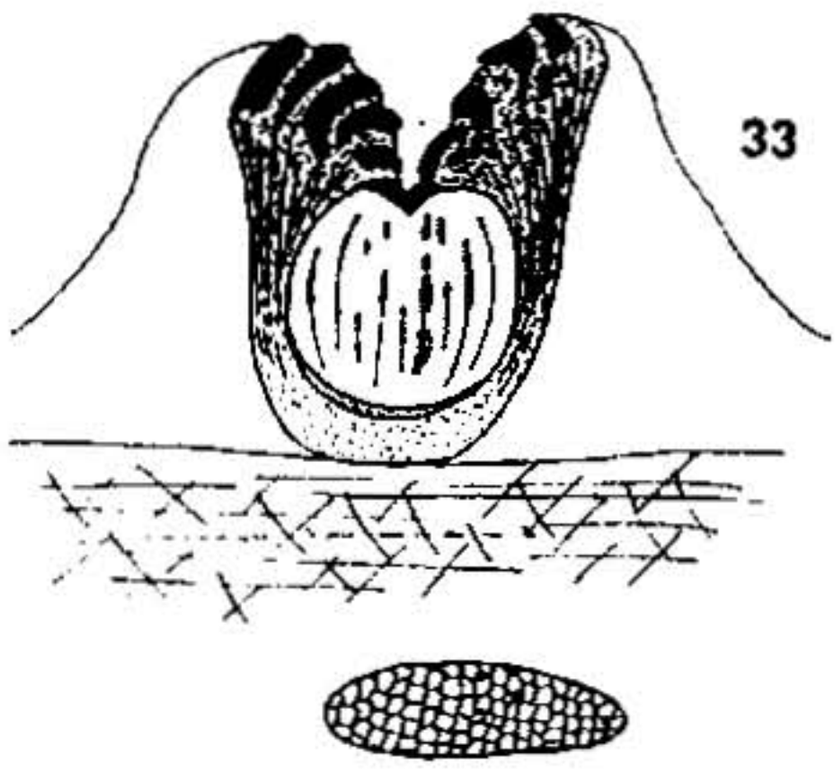
Reactions: KOH+ yellow, stictic acid (accompanied by atranorine only in the holotype of *Graphina acrophaea* f. *multilamellosa* Redgr. and in *Hale* 21145 and *Pringle* 160 p.p.).

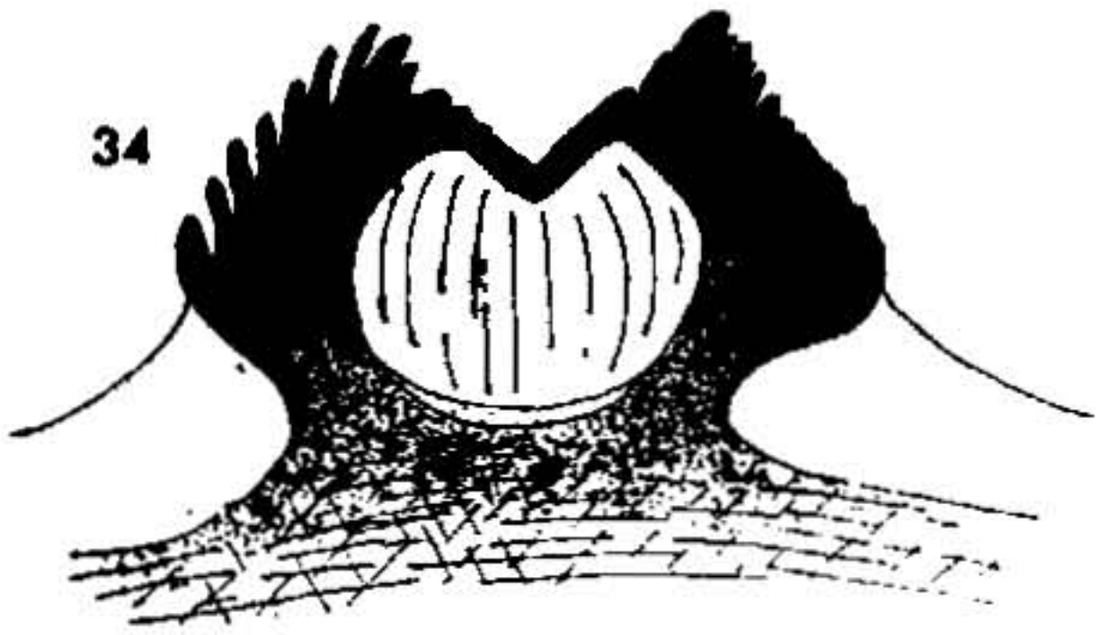
Specimens examined: San Luis Potosí: Tamasopo, *Pringle* 160 p.p. (VT). Vera Cruz: South of Xico near Teocello canyon, *Hale* 21145, south of Catemaco, *Hale* 21085, northeast of Huatusco, *Hale* 19491 (US).

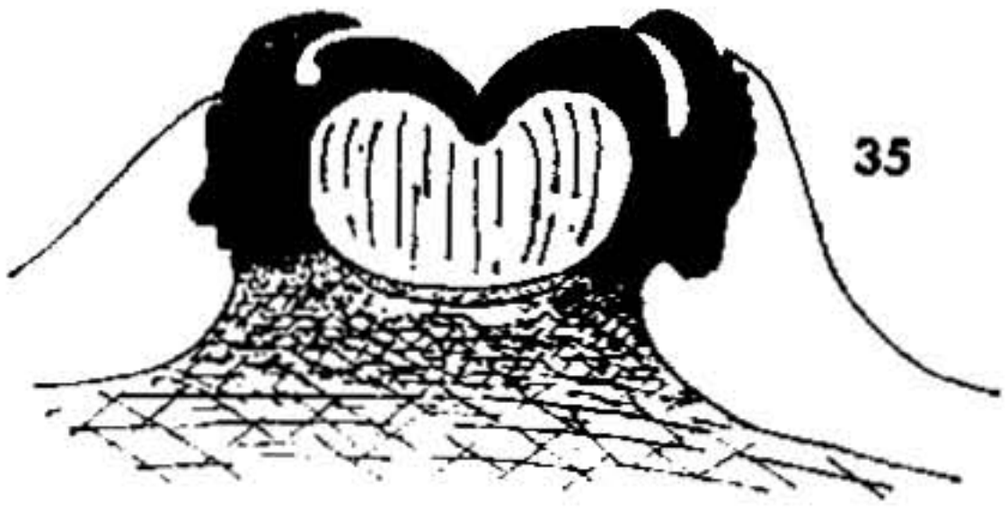












FIGURES 30–35.—30. *Graphina palmeri* Zahlbr. (holotype, *Pringle* 9). 31. *G. parilis* (Krempelh.) Müll. Arg. (holotype, *Glaziou* 3394). 32. *Graphis annulata* Kremplh. (holotype, *Glaziou* 3388). 33. *Graphina acrophaea* Müll. Arg. (isotype, *Langlois* 751). 34. *G. acrophaea* f. *multilamellosa* Redgr. (holotype, *Malme* 3545). 35. *G. puiggarii* f. *corumbensis* Redgr. (syntype, *Malme* 3636).

Examination of the seven types listed above in synonymy disclosed that these individuals are parts of a single variable species. Separating them on the basis of open or closed exciples is difficult, since this character is not constant and intergrading forms are common. Spore size and septation are very similar, considering that these characters normally vary greatly even within a single ascocarp. The number of striae in the labia is apparently related to the age of the specimen, and therefore a name such as *Graphina acrophaea* f. *multilamellosa* is unnecessary.

The type of *Graphina pringlei* Zahlbr. is not at Vienna and may have been lost in World War II. It seems most likely that it is a synonym of *G. parilis*, at least on the basis of the original description and on that of Redinger (1933, p. 50) who last borrowed the specimen. Zahlbruckner cited KOH— as a reaction, but this is not unusual because stictic acid is sometimes so scarce that color tests (though not microchemical tests) are negative.

Although *Graphina puiggarii* var. *corumbensis* Redgr. is referable to *G. parilis*, the holotype of *G. puiggarii* var. *puiggarii* Müll. Arg. (*Puiggari* 506, G) is not. *G. puiggarii* has a completely black, almost closed exciple of different construction from that found in *G. parilis*.

The type of *G. acromelaena* was given by Müller as *Pittier* 6167, but the holotype is labeled Tonduz. According to Dr. C. E. B. Bonner (in litt.), "Types which were published with Pittier numbers appear to have been collected by Tonduz and numbered after Müller had studied the material."

14. Graphina peplophora sp. nov. FIGURE 36

Thallus corticola, continuus, laevis, 70–80 μ crassus, strato corticale plus minusve cellulare, 20–25 μ crasso. Apothecia dispersa, emergentia vel subsessilia, simplicia, raro furcata, recta vel undulata, 1–5 mm. longa, 0.5–1 mm. lata, superne albofarinosa, quam thallo pallidiore, excipulo dimidiato, rufescente, labiis convergentibus, in 5–6 striis clavatis divisis; hymenium ellipticum vel rotundatum, 125–250 μ altum. Sporae decolores vel leviter fuscescentes, 35–78 μ longae, 18–36 μ latae, loculis horizontalibus 10–16, loculis transversis 5–8.

Reactions: KOH+ red, P—, o-T—, no acids demonstrated.

Type in the U.S. National Herbarium, collected at Tampico, Mexico, July 1896, by C. G. Pringle, no. 408 (isotype in MICH).

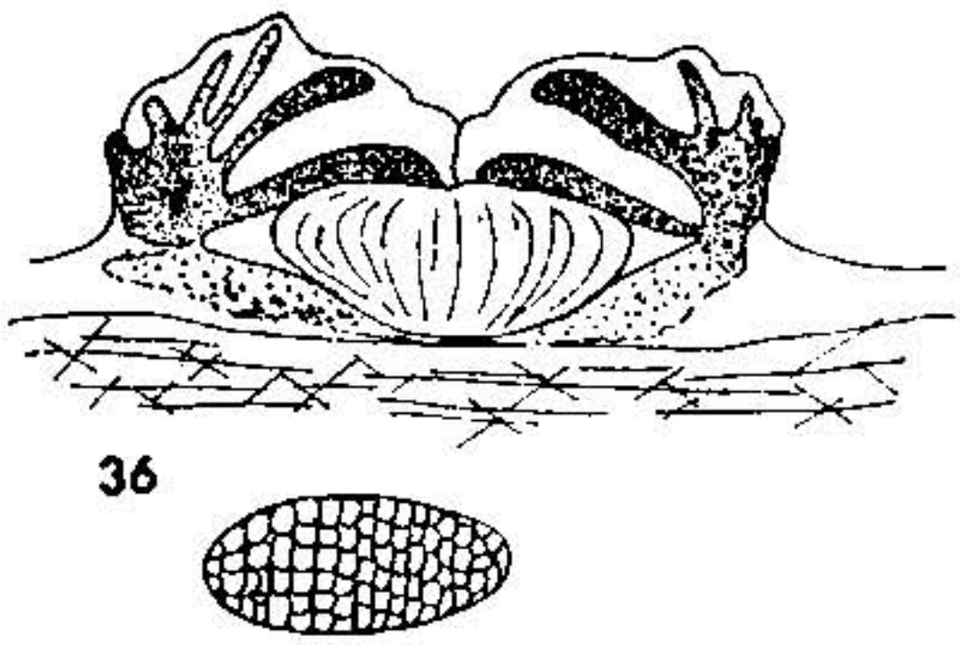
Specimens examined: Mexico. Tamaulipas: Tampico, *Pringle* 15460 (FH, MICH). Cuba. *Wright* 5, 425, 426 (US). Bonin Islands, *Wright* (US).

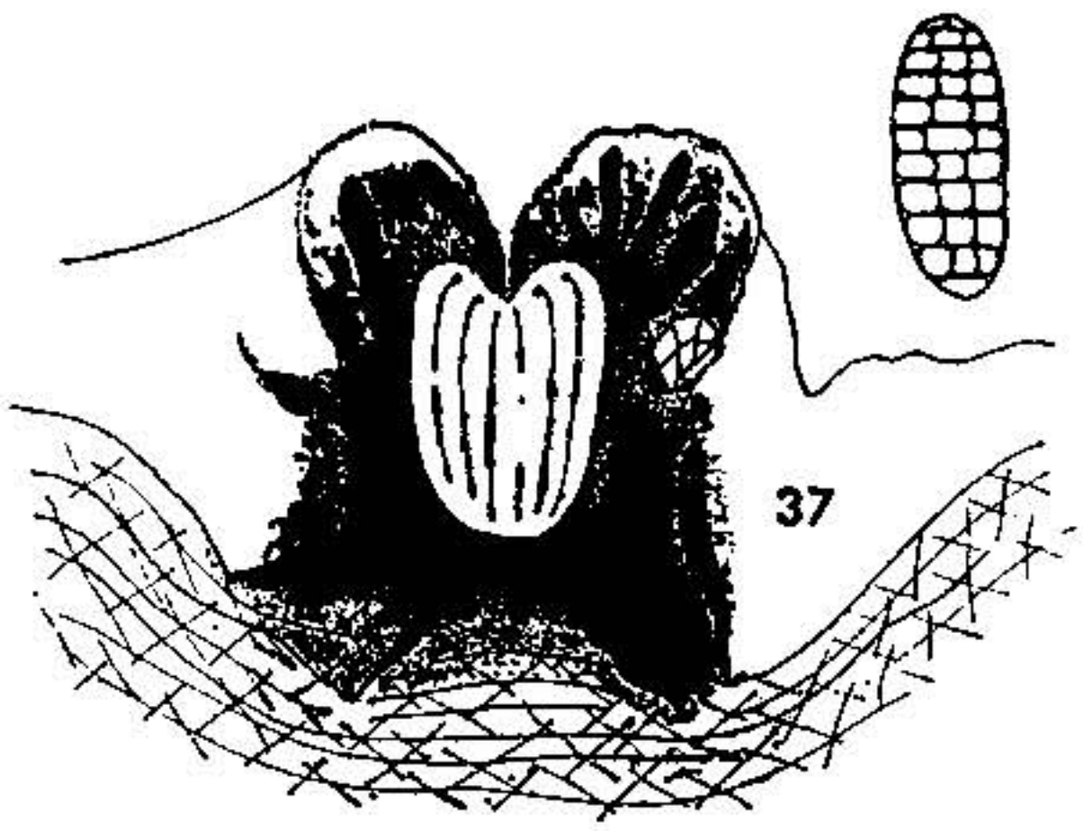
Nylander published this species as a nomen nudum under *Graphis leucocarpa* in Flora 69:103, 1886. On the basis of specimens examined so far, it is difficult to decide whether this entity should be placed in *Graphina* or *Phaeographina*. The spores vary from completely hyaline to pale brown. Its affinities lie structurally with *Graphina*, particularly with *G. corcovadensis* Redgr. which differs in having one spored asci, ascocarps and thallus concolorous, and exciples closed.

15. Graphina rimulosa Redgr. Ark. Bot. 26A, no. 1:39. 1933. FIGURE 37

Holotype: Rio Grande do Sul, Brazil, *Malme* 1089 (S).

Thallus smooth, continuous, rather irregular. Ascocarps emergent, flexuose and irregular, rarely branched, 2–4 mm. long, about 0.4 mm.





FIGURES 36–37.—36. *Graphina peplophora* Wirth & Hale (holotype, *Pringle* 408). 37. *G. rimulosa* Redgr. (holotype, *Malme* 1089).

wide, generally somewhat clumped in elevated groups, each ascocarp surrounded and partially covered by a whitish thalline border; exciple closed, very irregular, partially carbonized, partially dark brown; labia irregularly striate or disintegrated, partially covered with a loose thalline veil; hymenium 120–140 μ high. Spores 6–8 per ascus, 10–13×1–4 locular, 10–15×30–45 μ.

Reactions: KOH+ reddish, no microchemical tests made.

Specimen examined. Hidalgo: Honey Station, *Pringle* 10863 p.p. (VT).

The Pringle collection is nearly identical with the Brazilian holotype. Both show the peculiar whitish lateral covering over the ascocarps and the highly irregular exciple, features which characterize this species.

16. Graphina scolecitis (Tuck.) Fink, Lich. Flora U.S. 115. 1935. FIGURE 38

Graphis scolecitis Tuck. Gen. Lich. 210. 1872. Type: Alabama, U.S.A., *Beaumont* (US, isotype).

Graphina cinerea Fink, Mycologia 19:216. 1927. Holotype: Mayagüez, Puerto Rico, *Fink* 1163 (MICH).

Graphina olivobrunnea Fink, Mycologia 19:216. 1927. Holotype: Mayagüez, Puerto Rico, *Fink* 1224 (MICH).

Thallus smooth to minutely roughened, continuous. Ascocarps emergent to subsessile, usually darker than the thallus but occasionally concolorous, slender, unbranched to 2–3 branched, 1–5 mm. long; exciple open to nearly closed, red-brown; labia entire, often loosely constructed apically; hymenium 50–120 μ high. Spores 8 per ascus, 4–8×1–3 locular, 5–10×13–29 μ.

Reaction: Thallus KOH—, P—; ascocarps KOH+ dark purple, no microchemical tests made.

Specimen examined. San Luis Potosí: Las Palmas, *Pringle* 233 (FH, H, US, VT).

Pringle 233 was identified as the New Caledonian *Graphina adscribens* (Nyl.) Müll. Arg. by Eckfeldt (1892, p. 252). However, we have not checked this type, and there is little reason to suppose that Eckfeldt made a correct determination. The specimens above are all referable to *G. scolecitis*, which was published four years later than *G. adscribens*. The two Fink species differ from typical *G. scolecitis* only in being somewhat smaller.

17. Graphina sulcata Fink, Mycologia 19:217. 1927. FIGURES 39, 40

Holotype: Río Piedras, Puerto Rico, *Fink* 659 (MICH).

Thallus smooth to minutely roughened, continuous. Ascocarps subsessile to semi-immersed, straight to flexuose, entire or sparingly branched, 1–5 mm. long, 0.2–0.5 mm. wide; exciple black above, yellow or brownish laterally, open or nearly closed below; labia 3–4 sulcate, convergent. Spores (2–)4–6 per ascus, 5–8×2–5 locular, 10–20×20–34 μ.

Reactions: KOH+ red, norstictic acid.

Specimens examined: Chiapas: El Suspiro, *Hale* 20233, 20068 (US).

Graphina sulcata differs from the very closely allied *G. parilis* in having 2–6, not 8, spores per ascus, constantly fewer locules per spore, and norstictic rather than stictic acid.

18. Graphina sulcatula Müll. Arg. var. **conglomerata** Müll. Arg. Rev. Mycol. 10:119. 1888. FIGURE 41

Syntypes: Paraguay, *Balansa* 4185a (G), 485 (not seen).

Thallus smooth, very thin. Ascocarps sessile, black, clustered in round or irregular clumps, 1–2 mm. in diameter; disc dark brown; exciple black, closed; labia convergent, entire to lightly crenate; hymenium 75–90 μ high. Spores 6–8 per ascus, 6–8×1–4 locular, 10–13×30–35 μ.

Reactions: KOH−, P−, o-T−, no acids demonstrated.

Specimens examined: Oaxaca: Northwest of Tehuantepec, *Hale* 20629 (US).

The ascocarps of this taxon form distinct isolated clumps which are elevated well above the thallus. They are heavily carbonized, rather brittle, and difficult to section properly.

19. Graphina triangularis Zahlbr. Ann. Mycol. 19:232. 1921. FIGURE 42

Type: Tampico, Tamaulipas, Mexico, *Pringle* 17 (MICH, isotype).

Thallus smooth, very thick, continuous or lightly fissured. Ascocarps more or less immersed, 1–2 branched, flexuose, slender, to 2 mm. long; exciple brown, closed, basally continuous in a carbonized band; labia lightly striate, slightly convergent; hymenium triangular, 280–300 μ high; epithecium brown, thick. Spores 4–8 per ascus, 12–15×5–7 locular, 15–25×45–75 μ.

Reactions: KOH+ red, unknown acid in G.A. o-T.

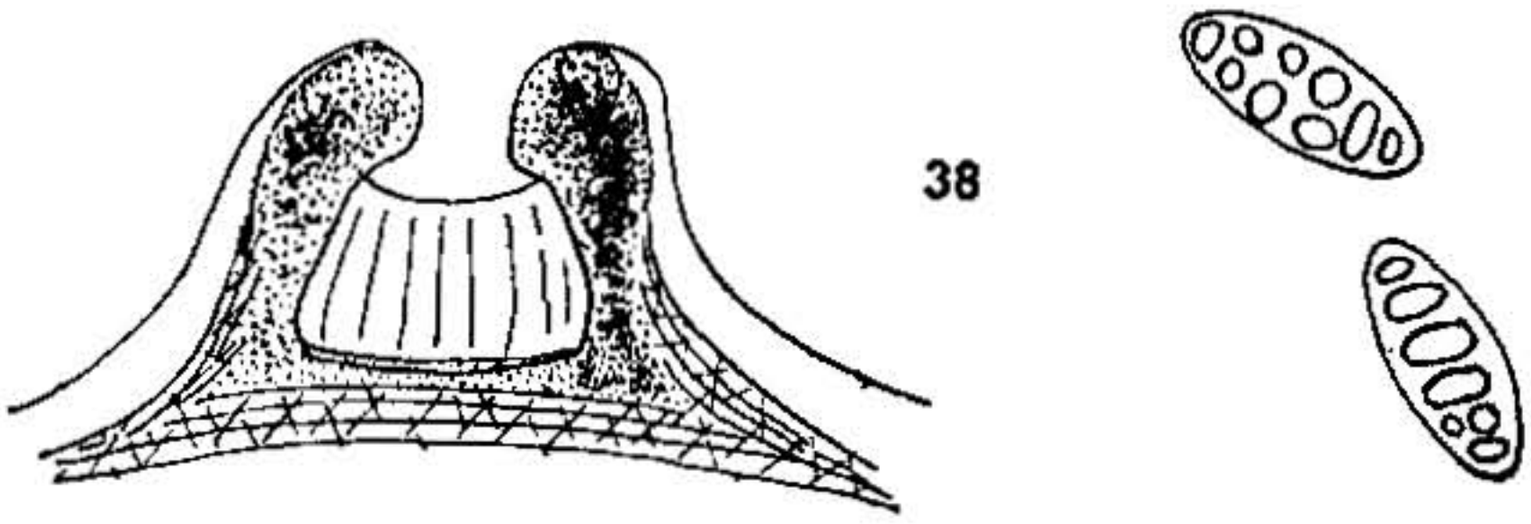
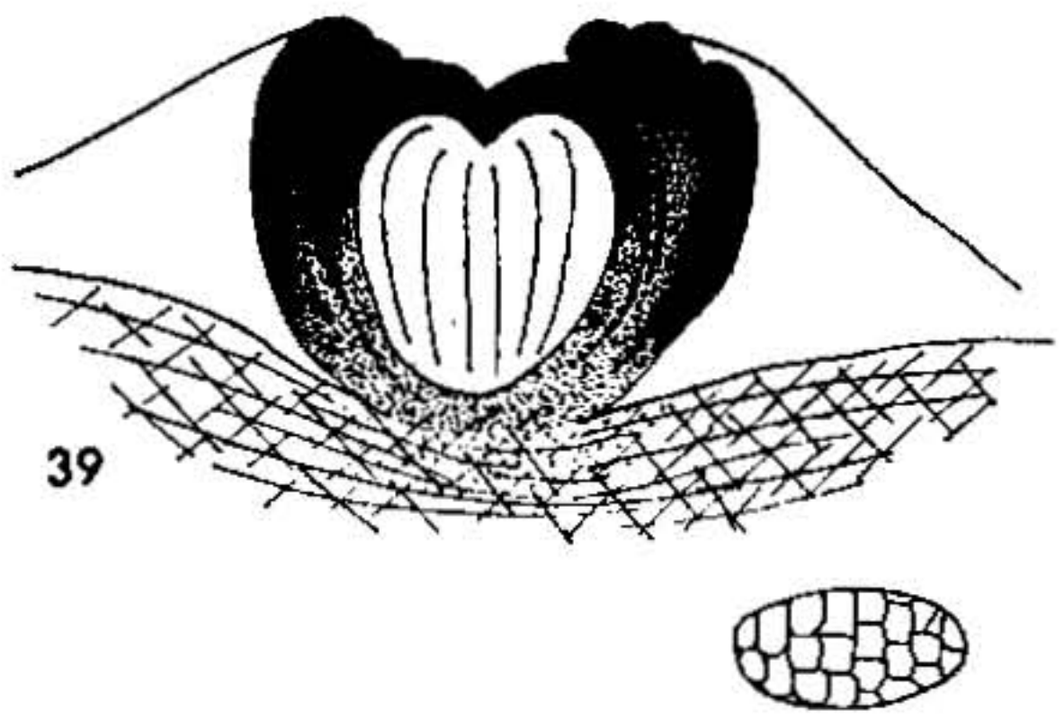
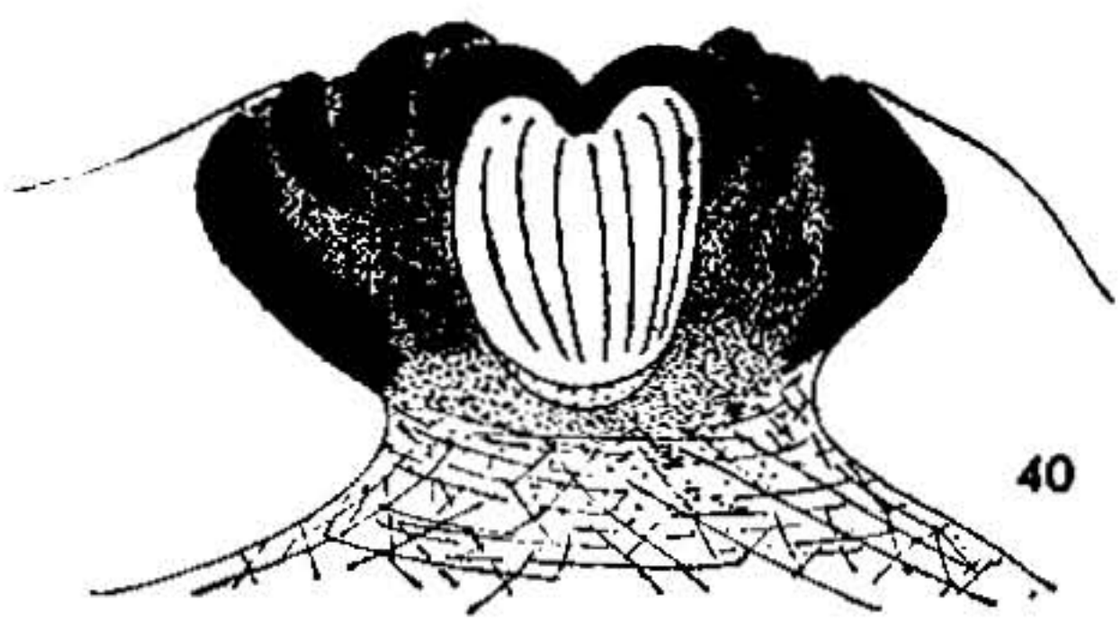
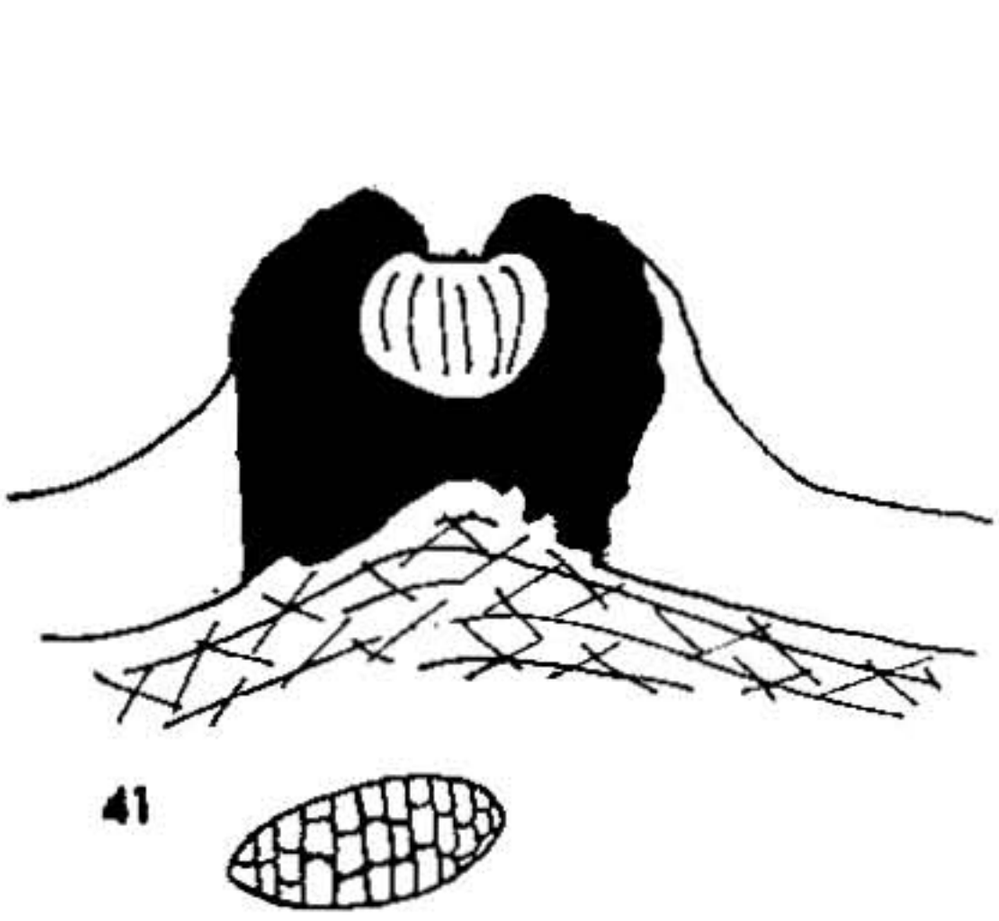


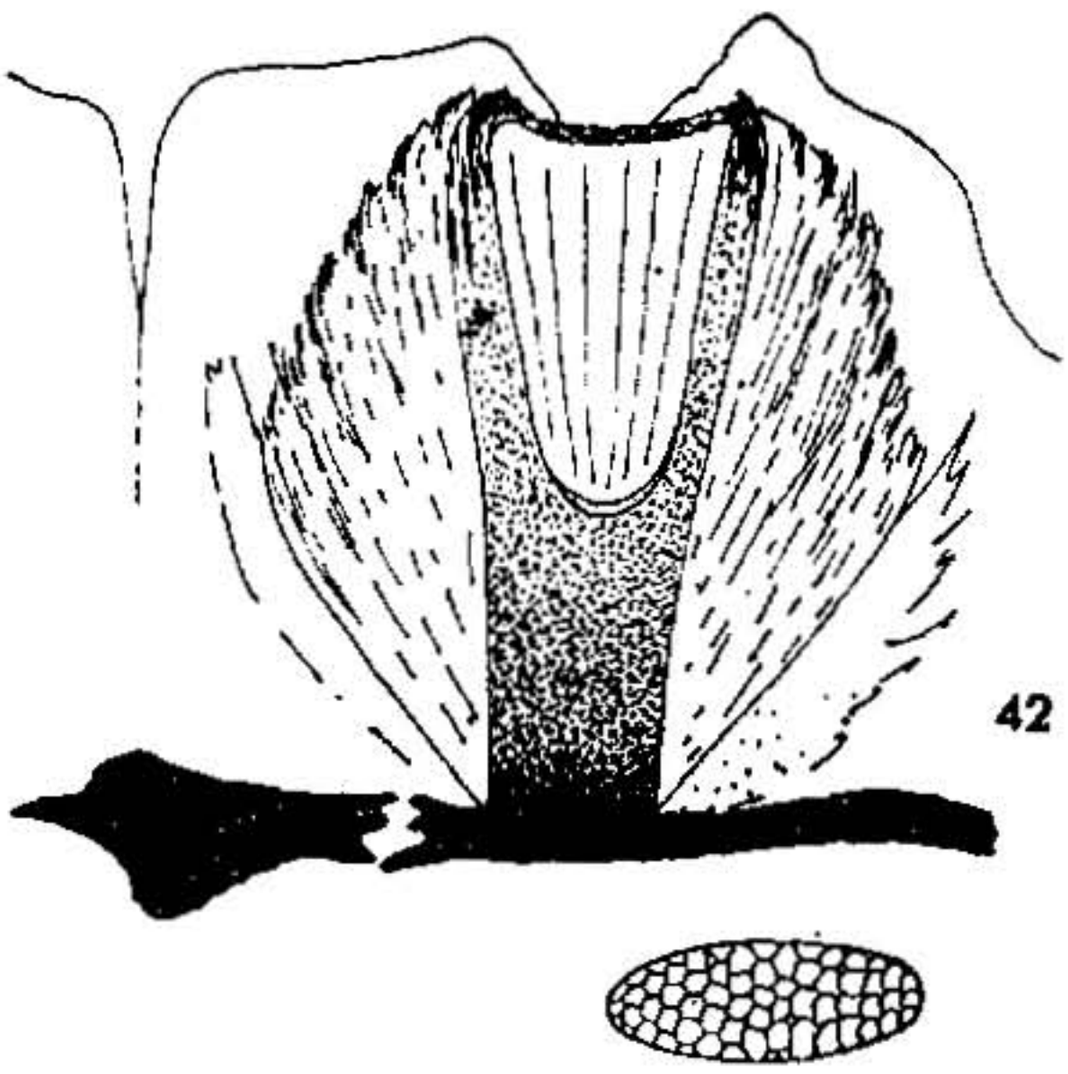
FIGURE 38.—*Graphina scolecitis* (Tuck.) Fink (isotype, *Beaumont* s.n.).





FIGURES 39–40.—39. *Graphina sulcata* Fink (holotype, *Fink* 659). 40. *G. sulcata* (*Hale* 20068).





FIGURES 41–42.—41. *Graphina sulcatula* var. *conglomerata* Müll. Arg. (*Hale* 20629). 42. *G. triangularis* Zahlbr. (isotype, *Pringle* 17).

Graphina triangularis is a distinct species, unlikely to be confused with any other. It is somewhat similar internally to *G aibonitensis* Fink, in that the labia consist of elongate striae arising from a thickened base. The unknown acid is also found in *Graphina palmeri*, *G. virginea*, and *Phaeographis exaltata*.

20. Graphina virginalis (Nyl.) Müll. Arg. Bull. Herb. Boiss. 3:47. 1895.
FIGURE 43

Fissurina virginalis Nyl. Lich. Insul. Guin. 50. 1889. Type: Florida, U.S.A. (US, isotype).

Graphis virginalis Tuck. in Eckf. Bull. Torr. Bot. Club 17:256. 1890. Based on *Fissurina virginalis* Nyl.

Graphina virginalis (Tuck.) Redgr. Ark. Bot. 26A, no. 1:58. 1933. Superfluous combination.

Thallus smooth, continuous. Ascocarps dispersed to somewhat clustered, usually lighter than the thallus, immersed to emergent, sparingly branched, straight to rather flexuose, to 3 mm. long; disc appearing first as a light colored line, then often becoming elevated and fissurine; exciple open or nearly so, colorless laterally; labia convergent, light to dark brown; hymenium about 100 μ high. Spores 8 per ascus, elliptic, often halonate, irregularly few celled, 14–18$\times$ 26–40 μ.

Reaction: KOH+ red, P—, no microchemical test made.

Specimen examined: Chiapas: El Suspiro, *Hale* 20225 (US).

Graphina virginalis is part of the *nitida-leuconephela* complex, a group in need of careful revision.

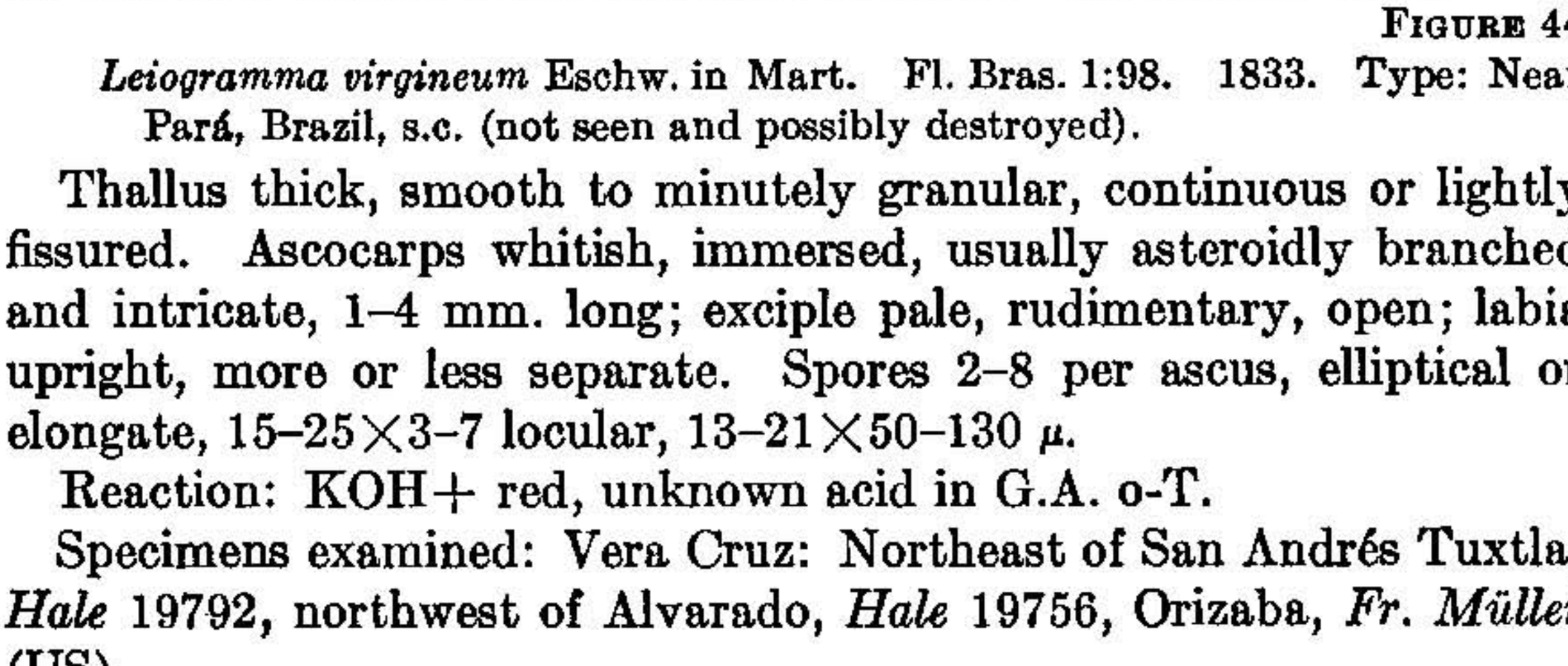
21. Graphina virginea (Eschw. in Mart.) Müll. Arg. Flora 63:41. 1890.
FIGURE 44

Leiogramma virgineum Eschw. in Mart. Fl. Bras. 1:98. 1833. Type: Near Pará, Brazil, s.c. (not seen and possibly destroyed).

Thallus thick, smooth to minutely granular, continuous or lightly fissured. Ascocarps whitish, immersed, usually asteroidly branched and intricate, 1–4 mm. long; exciple pale, rudimentary, open; labia upright, more or less separate. Spores 2–8 per ascus, elliptical or elongate, 15–25$\times$3–7 locular, 13–21$\times$50–130 μ.

Reaction: KOH+ red, unknown acid in G.A. o-T.

Specimens examined: Vera Cruz: Northeast of San Andrés Tuxtla, *Hale* 19792, northwest of Alvarado, *Hale* 19756, Orizaba, *Fr. Müller* (US).



FIGURES 43–44.—43. *Graphina virginalis* (Nyl.) Müll. Arg. (isotype). 44. *G. virginea* (Eschw. in Mart.) Müll. Arg. (*Fr. Müller* s.n.).

The Müller collection from Orizaba was identified as *Graphis cometia* Fée by Nylander (1858, p. 381), a species considered to be a synonym of *G. virginea*.

Graphina virginea seems to vary in the number of spores per ascus. Some specimens have two to three per ascus, others four to six, others six to eight, with no apparent correlations with anatomy or chemistry. The unknown acid is identical with that found in *Phaeographis exaltata*, *Graphina palmeri*, and *G. triangularis*.

2. Graphis

22. Graphis afzelii Ach. Syn. Lich. 85. 1814. FIGURES 45, 46

Holotype: Guinea, *Afzelius* (H). Isotype in UPS.

Graphis atroalba Vain. Acta Soc. Faun. Fl. Fenn. 7, no. 7:123. 1890, non Krempelh. 1875. Holotype: Rio de Janeiro, Brazil, *Vainio* 189 (TUR).

Graphis atroleuca Zahlbr. Cat. Lich. Univ. 2:294. 1923. Based on *G. atroalba* Vain.

Thallus smooth, continuous. Ascocarps sessile, unbranched, usually completely covered by a white thalloid veil, 1–5 mm. long to 1 mm. wide; exciple closed, black and thick above, brown or pale below, often quite thin; labia usually entire, convergent; hymenium 75–125 μ high. Spores 8 per ascus, four locular, 6–9×16–23 μ.

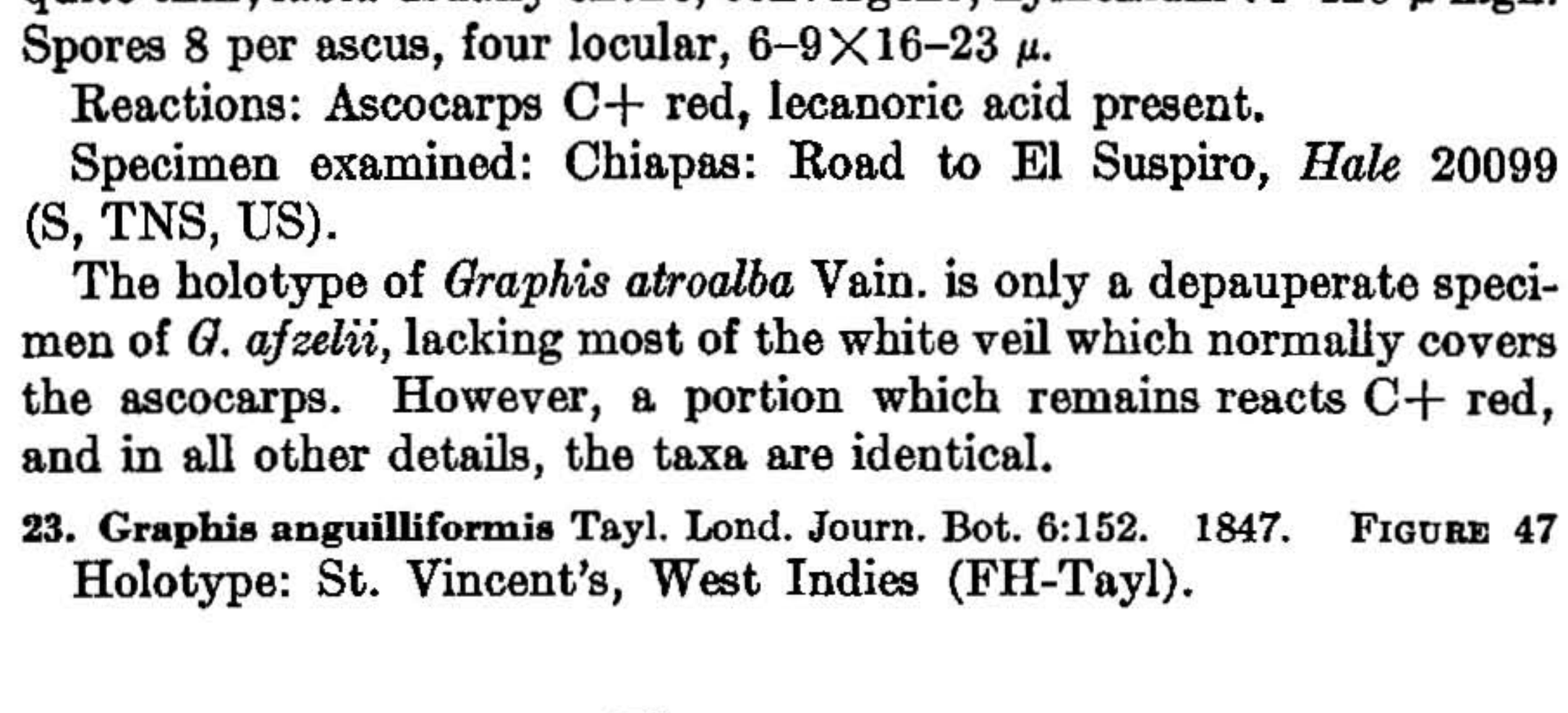
Reactions: Ascocarps C+ red, lecanoric acid present.

Specimen examined: Chiapas: Road to El Suspiro, *Hale* 20099 (S, TNS, US).

The holotype of *Graphis atroalba* Vain. is only a depauperate specimen of *G. afzelii*, lacking most of the white veil which normally covers the ascocarps. However, a portion which remains reacts C+ red, and in all other details, the taxa are identical.

23. Graphis anguilliformis Tayl. Lond. Journ. Bot. 6:152. 1847. FIGURE 47

Holotype: St. Vincent's, West Indies (FH-Tayl).



FIGURES 45–46.—45. *Graphis afzelii* Ach. (isotype). 46. *G. afzelii* (*Hale* 20099).

Thallus smooth to nodular, continuous. Ascocarps sessile, simple to 3–4 branched, 1–5 mm. long, 0.6–0.8 mm. wide, concolorous with the thallus except at the very apex which is usually black; exciple black, entire, covered almost to the apex by a thalline veil; labia entire, convergent; hymenium 175–200 μ high. Spores 2–6 per ascus, 12–18 locular, 10–13×75–100 μ long.

Reactions: KOH+ red, P—, o-T—, no acids demonstrated.

Specimen examined: Hidalgo: Honey Station, *Pringle* 10864 (MICH, VT).

Graphis anguilliformis is usually considered as a synonym of the Brazilian *G. illinata* Eschw., the type of which we have not been able to find. The Pringle material from Mexico is identical in all ways with Taylor's type, and it is perhaps best to continue using this name, which has been typified.

24. Graphis caesiella Vain. Acta Soc. Faun. Fl. Fenn. 7, no. 7:122. 1890. FIGURES 48–50

Holotype: Rio de Janeiro, Brazil, *Vainio* 45 (TUR).

Graphis yaucoensis Fink, Mycologia 19:213. 1927. Holotype: Yauco, Puerto Rico, *Fink* 1691 (MICH).

Thallus continuous, smooth to minutely roughened. Ascocarps distinctly pruinose, immersed, slender, simple to branched and subintricate, often bordered by an irregular slightly raised thalline margin, 0.5–4 mm. long; exciple black, open; labia entire, divergent or slightly convergent; hymenium 75–125 μ high. Spores 8 per ascus, 6–10 locular, 6–10×20–40 μ.

Reactions: KOH+ red, norstictic acid.

Specimen examined: Tamaulipas: Tampico, *Pringle* 62 (FH, MICH).

Graphis caesiella can be separated from the other species in the *G. scripta* complex by the distinctly pruinose ascocarps. It is quite closely related to *G. subamylacea* Zahlbr., which differs only in having a closed exciple. *Graphis yaucoensis* is identical in all respects with the holotype of *G. caesiella*.

Chemically *G. caesiella* is somewhat variable outside of Mexico. The majority of 48 specimens tested contained norstictic acid, but a significant number yielded stictic or protocetraric acids. Thirty-seven specimens with norstictic acid were collected in Louisiana, Mexico, Puerto Rico, Hispaniola, Brazil, and Samoa. Seven specimens with protocetraric acid were from Florida, Cuba, Hispaniola, and Puerto Rico. Four with stictic acid were restricted to the Dominican Republic. There seems to be no correlation between the chemistry and distribution on the basis of this small sample.

25. Graphis desquamescens Fée, Bull. Soc. Bot. France 21:24. 1876. FIGURE 51

Syntypes: Brazil, *Glaziou* 5082 (M), 5016 (see below).

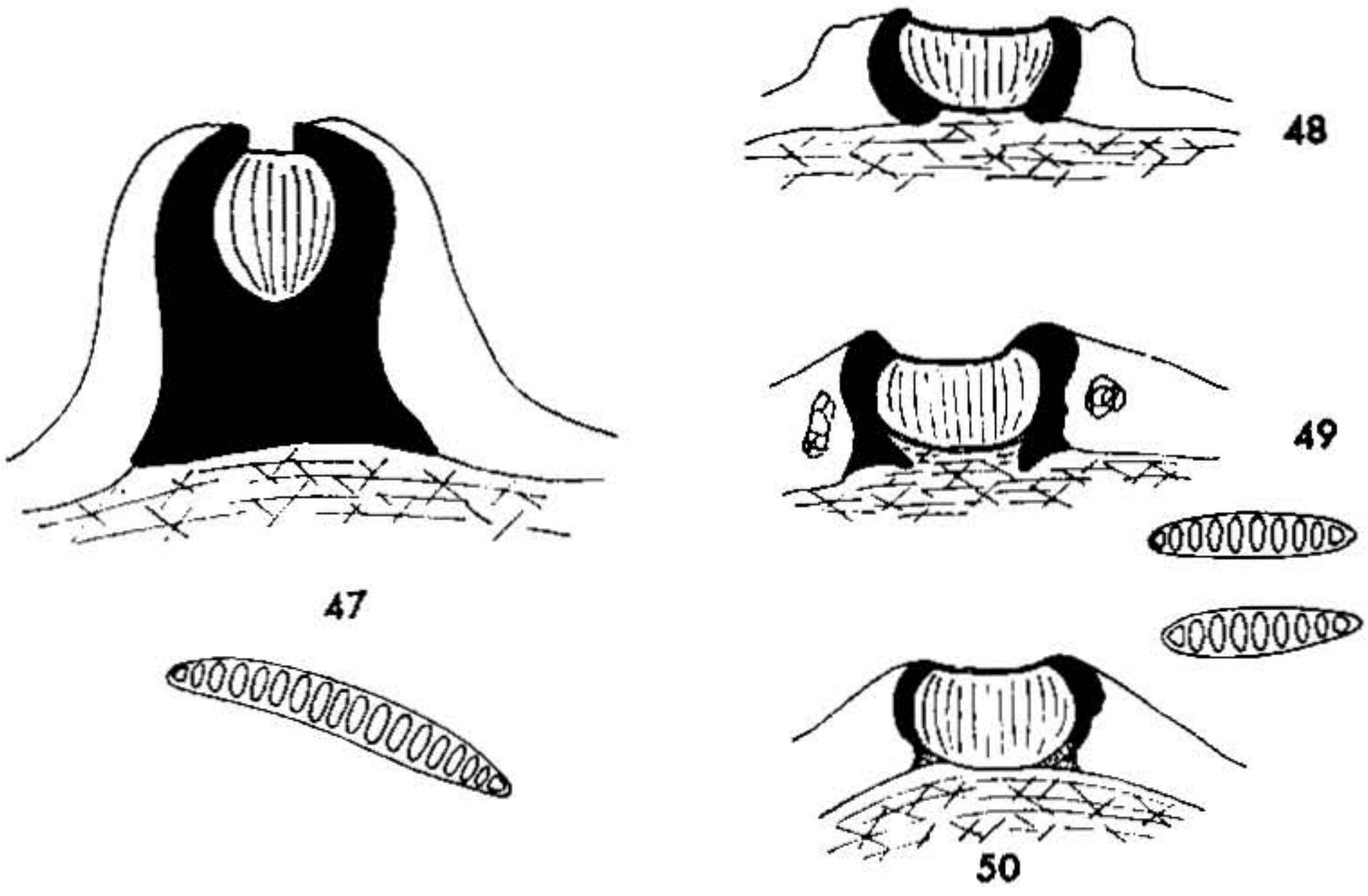
Graphis compulsa Krempl h. Flora 59:419. 1876. Based on *G. desquamescens* Fée.

Thallus continuous, minutely roughened to smooth. Ascocarps subsessile, black, *Opegrapha*-like, slender, often branched, flexuose, 0.5–3 mm. long, often with a low thalline margin; exciple closed, black; labia convergent, entire or very slightly crenate; hymenium 75 μ high. Spores 8 per ascus, 6–8 locular, 5–8×20–28 μ.

Reactions: KOH+ red, norstictic acid.

Specimen examined: Vera Cruz: East of Córdoba, *Hale* 19731 (US).

Graphis compulsa Krempl h. is a superfluous new name for *G. desquamescens* Fée and was based on *Glaziou* 5082. This specimen (M) has norstictic acid and is identical with material collected from many localities throughout the American tropics. Unfortunately we have yet to examine the other syntype of this species.



FIGURES 47–50.—47. *Graphis anguilliformis* Tayl. (holotype). 48. *G. caesiella* Vain. (holotype, *Vainio* 45). 49. *G. yaucoensis* Fink (holotype, *Fink* 1691). 50. *G. caesiella* Vain. (*Pringle* 62).

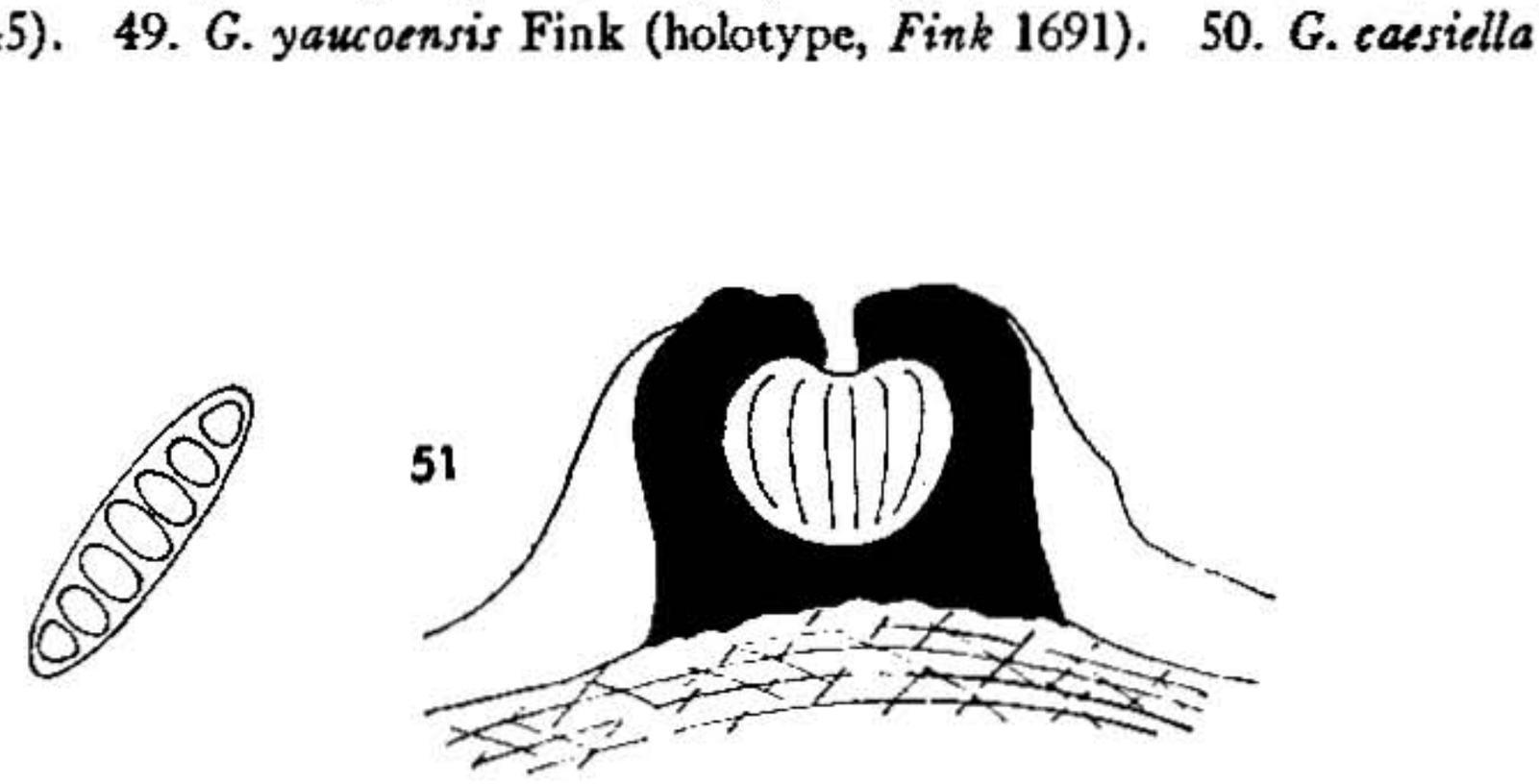


FIGURE 51.—*Graphis compulsa* Krempl h. (holotype, *Glaziou* 5082).

26. Graphis endoxantha Nyl. Bull. Soc. Linn. Norm. ser. 2, 2:110. 1868. FIGURES 52, 53

Graphis subelegans Nyl. Lich. Trop. Labuan Singapore 42. 1891. Holotype: San Luis Potosí, Mexico, *Pringle* 162 (H).

Holotype: New Caledonia, *Pancher* (H).

Thallus smooth, nitid, continuous. Ascocarps sessile, prominent, flexuose, rarely branched, 1–6 mm. long, 0.5–0.7 mm. wide; exciple nearly open to closed, usually much thickened below, yellow, with many prominent crystalline inclusions; labia with many striae, black; hymenium about 100 μ high. Spores 8 per ascus, 6–7 locular, 6–8$\times$ 25–30 μ.

Reactions: KOH+ reddish, P−, no microchemical tests made.

Specimens examined: San Luis Potosí: Las Palmas, *Pringle* 217 (VT), 166 p.p. (FH).

The holotype of *G. endoxantha* is sterile but it is unquestionably identical with *G. subelegans*. The species is closely allied to *G. proserpens* Vain., differing in the nitid thallus, the very prominent ascocarps, and the abundant excipular inclusions.

27. Graphis flexibilis Krempelh. Flora 59:414. 1876. FIGURE 54

Holotype: Brazil, *Glaziou* 5106 (M).

Thallus smooth to warty or fissured. Ascocarps sessile, black above, commonly branched, flexuose, acute, 5–13 mm. long, about 0.6 mm. wide; exciple black, closed, often thickened below; labia convergent, 1–6 sulcate, often with included crystals; hymenium 50–150 μ high. Spores 6–8 per ascus, 15–21 locular, 12–13$\times$60–105 μ.

Reaction: KOH+ reddish, P−, o-T−, G.E.− no acids demonstrated.

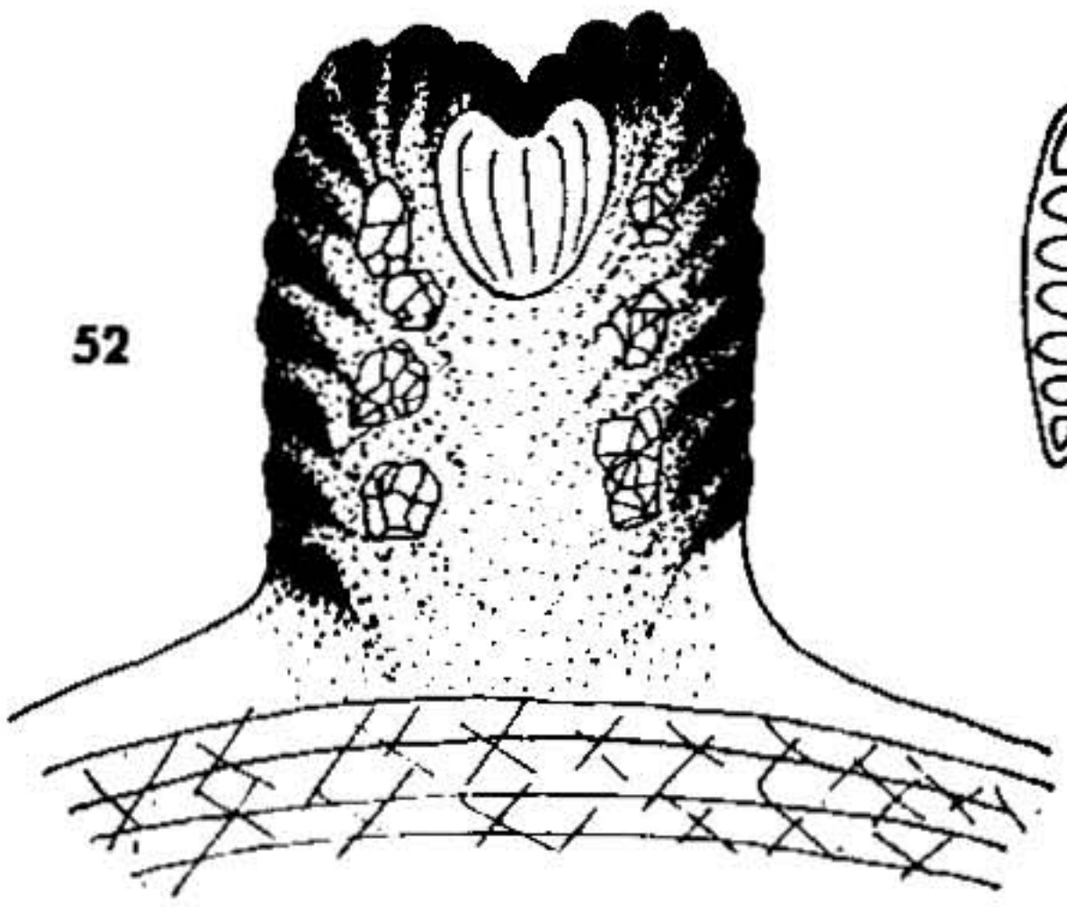
Specimen examined: Chiapas: West of Tuxtla Gutiérrez, *Hale* 19894 (US).

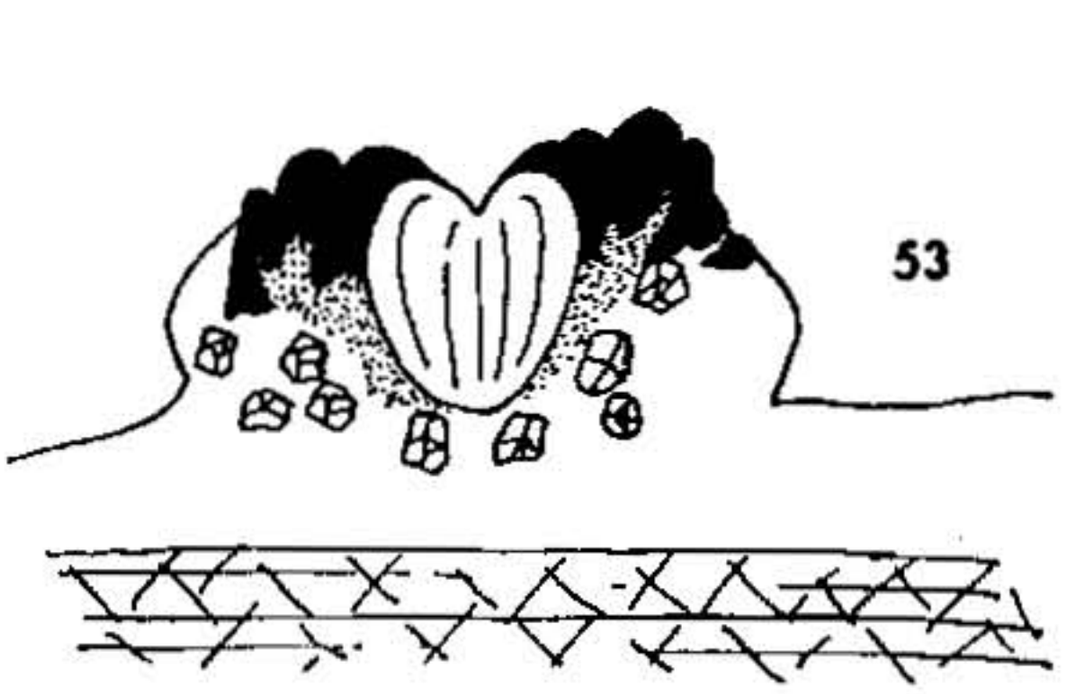
Zahlbruckner (1923, p. 293) placed *Graphis flexibilis* as a synonym of *G. angustata* Eschw. in Mart. As a rule, Eschweiler's types are not available for study to our knowledge, and since in this case the species cannot be typified, it seems appropriate to use Krempelhuber's name.

28. Graphis glaucopis sp. nov. FIGURE 55

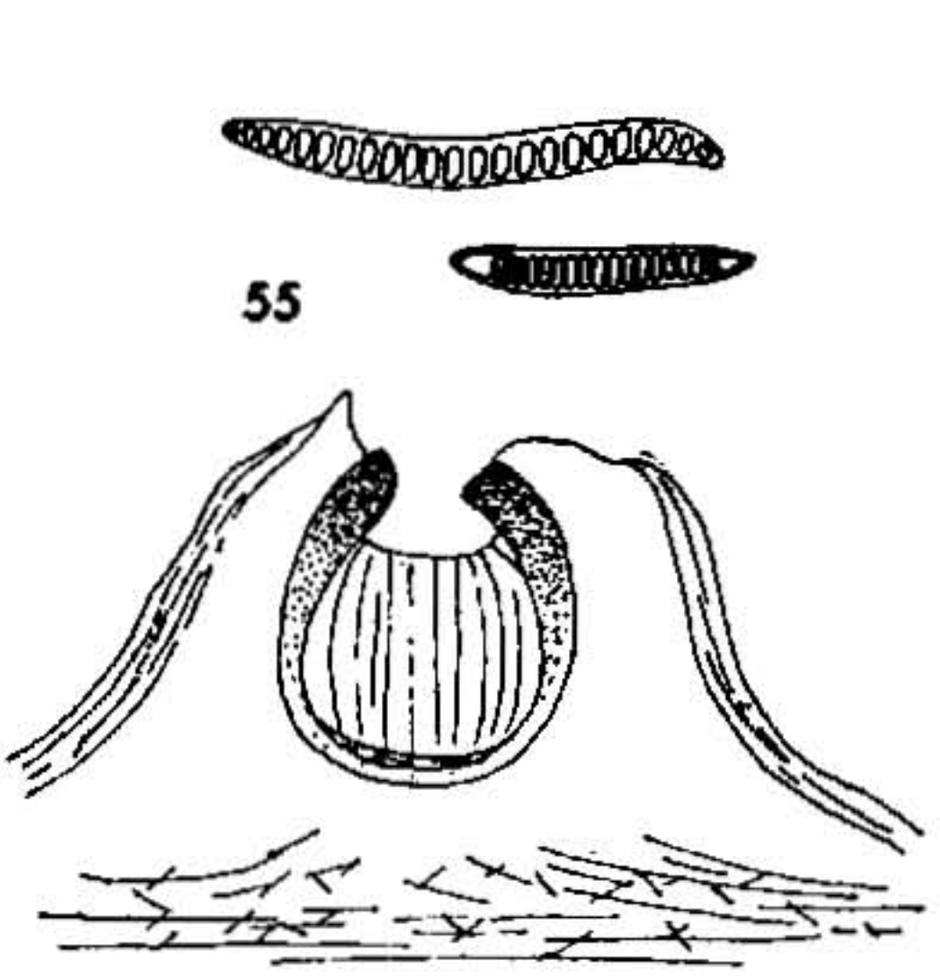
Thallus corticola, continuus, laevis vel nitidulus, 200–250 μ crassus, strato corticale arachnoideo, 25–30 μ crasso. Apothecia subsessilia, elliptica vel oblongo-elliptica, plus minusve simplicia, 0.5–2 mm. longa, 0.4 mm. lata, albofarinosa, superne fuscescentia, excipulo plus minusve integro, pallido, labiis convergentibus, integris, fuscofuligineis; hymenium 150–200 μ altum, epithecio indictincto. Sporae 6nae, loculis 25–27, 16–26$\times$75–260 μ longae.

Reactions: Thallus KOH+ orange, P−; ascocarps KOH+ orange, P+ red, o-T−, G.E.−, no acids demonstrated.





FIGURES 52–53.—52. *Graphis subelegans* Nyl. (holotype, *Pringle* 162). 53. *G. endoxantha* Nyl. (*Pringle* 166 p.p.).



FIGURES 54, 55.—54. *Graphis flexibilis* Krempih. (holotype, *Glaziou* 5106). 55. *G. glaucopis* Wirth & Hale (holotype, *Hale* 20219).

Type in the U.S. National Herbarium, collected in Mexico, El Suspiro, Chiapas, March 22, 1960, by M. E. Hale (no. 20219) (isotypes in S, TNS).

Graphis glaucopis is somewhat difficult to place as to genus. The extremely thick thallus and the heavy walled spores indicate affinities with *Ocellularia*. However, the distinctly elliptical ascocarps, the rimiform disc, and the lack of a columella make it necessary to put the species in *Graphis*.

This species is unusual in the extreme variation in spore size to be found within a single ascocarp. Spore length is a very variable character in the majority of the species of the Graphidaceae, and *G. glaucopis* would seem to represent the extreme of this tendency.

29. Graphis grammatica Nyl. Flora 49:292. 1866. FIGURE 56

Type: Cuba (see below).

Thallus very thick, often fissured and uneven. Ascocarps densely clustered, immersed to depressed, curved and intricate, to 1 mm. long, very slender; disc light brown; exciple pale brown, closed, 150–200 μ high, heavily thickened below the hymenium. Spores 8 per ascus, 4 locular, 4–6×10–18 μ.

Reactions: KOH+ yellow, stictic acid.

Specimen examined: Chiapas: El Sumidero, Tuxtla Gutiérrez, *Hale* 20042 (US).

Graphis grammatica was originally described without citation of collector or number; "Cuba" is the only indication of provenance. Among the Wright Cuban collections, no. 36 is labeled *G. grammatica* Nyl., and these specimens (FH, US) are probably isotypes. They compare very well with the Mexican material (which is sterile), except that *Wright* 36 yielded no stictic acid.

30. Graphis implicata Fée, Bull. Soc. Bot. France 21:27. 1874. FIGURES 57–59

Graphis chlorocarpella Nyl. in Kremplh. Flora 59:413. 1876. Based on *G. implicata* Fée.

Graphis balbisina Nyl. Lich. Trop. Singapore et Labuan 42. 1891. Type: Mexico (see below).

Type: Brazil, *Glaziou* 5036 (MICH, isotype). Reactions: too fragmentary to test.

Thallus continuous or fissured, often uneven. Ascocarps semi-emergent to subsessile, lighter than the thallus, occasionally branched, flexuose and somewhat intricate; exciple closed or nearly so, reddish or yellowish brown; labia lightly sulcate, convergent, often with darkened apices. Spores 8 per ascus, 11–21 locular, 11–13×52–107 μ.

Reactions: KOH+ red, norstictic acid.

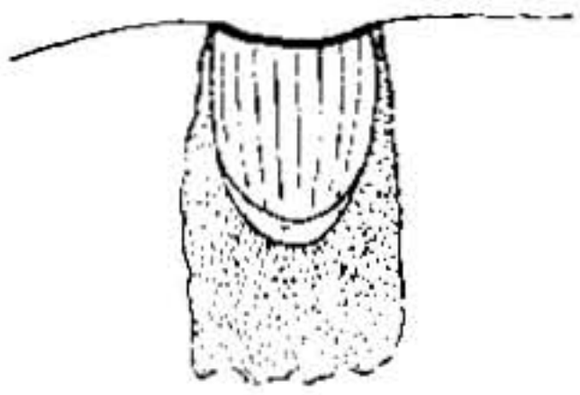
Specimens examined: Nuevo León: Monterrey, *Pringle* 118, 119 (FH, US, VT).

Both *Graphis implicata* and *G. chlorocarpella* are based on *Glaziou* 5036, and are therefore synonymous, as has already been pointed out by Zahlbruckner (1909, p. 108). The isotype in Fink's herbarium is too fragmentary to test; *Pringle* 119 yielded an extremely small amount of norstictic acid.

Graphis balbisina Nyl. was described from Mexico with Eckfeldt as the collector. One year later Eckfeldt (1892, p. 253) listed this species from Mexico, under Pringle's collection 118. It may therefore be assumed that this was the specimen on which Nylander based his description and should be considered as the type (isotypes in FH, US, VT). Nylander's dealings with Eckfeldt are frequently marked by confusion.

31. Graphis longula Kremplh. Flora 59:414. 1876. FIGURE 60

Phaeographis longula (Kremplh.) Zahlbr. Denkschr. Akad. Wiss. Wien 83:109. 1909.



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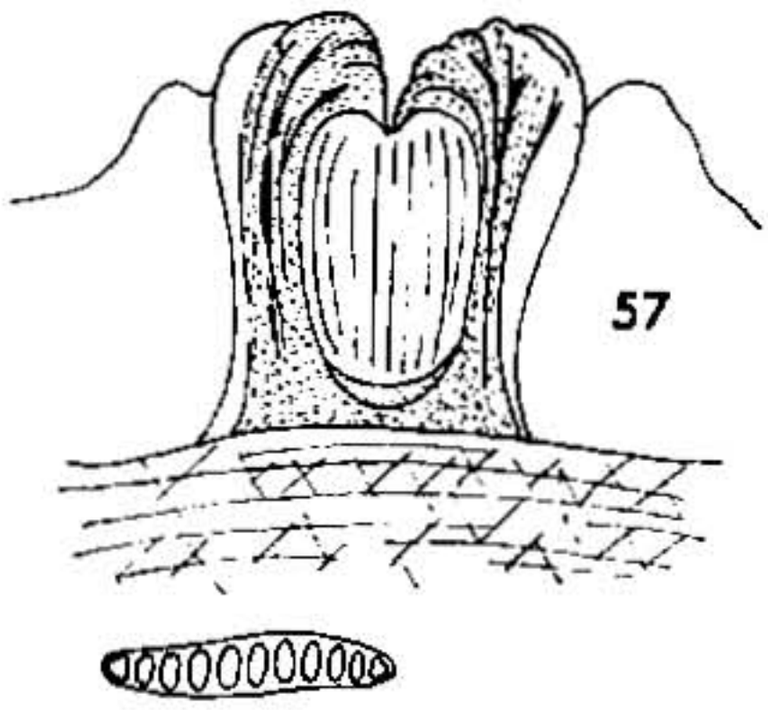

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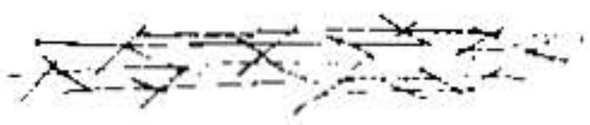

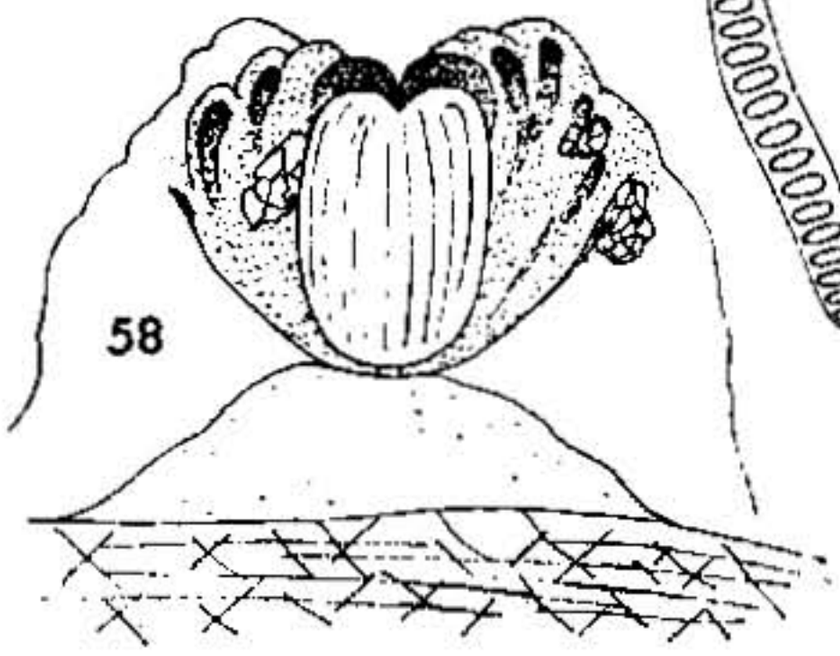

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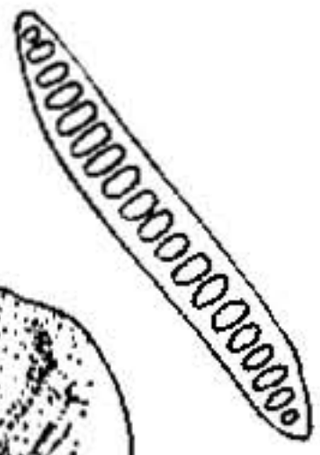

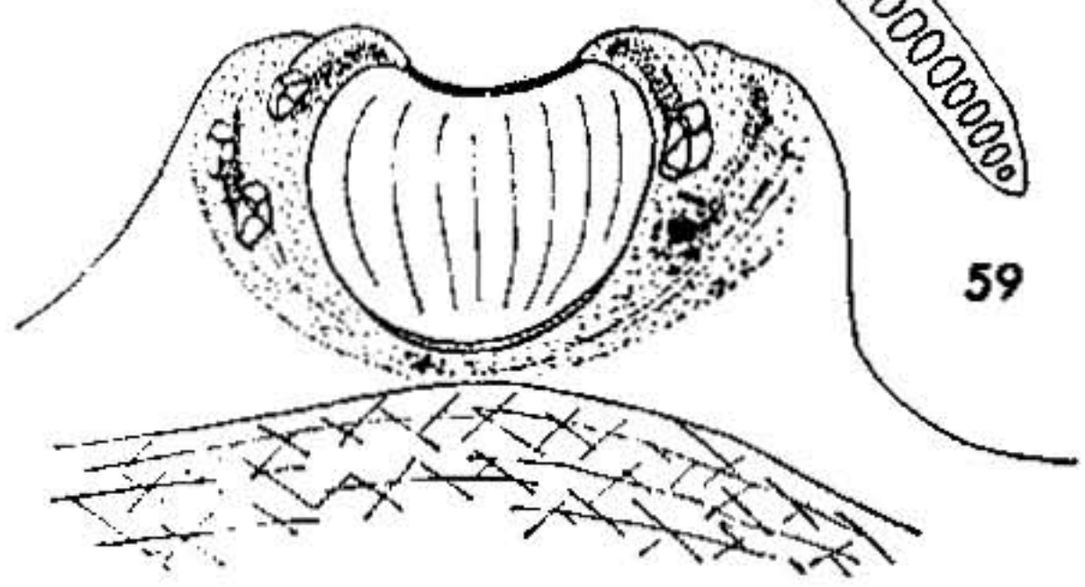

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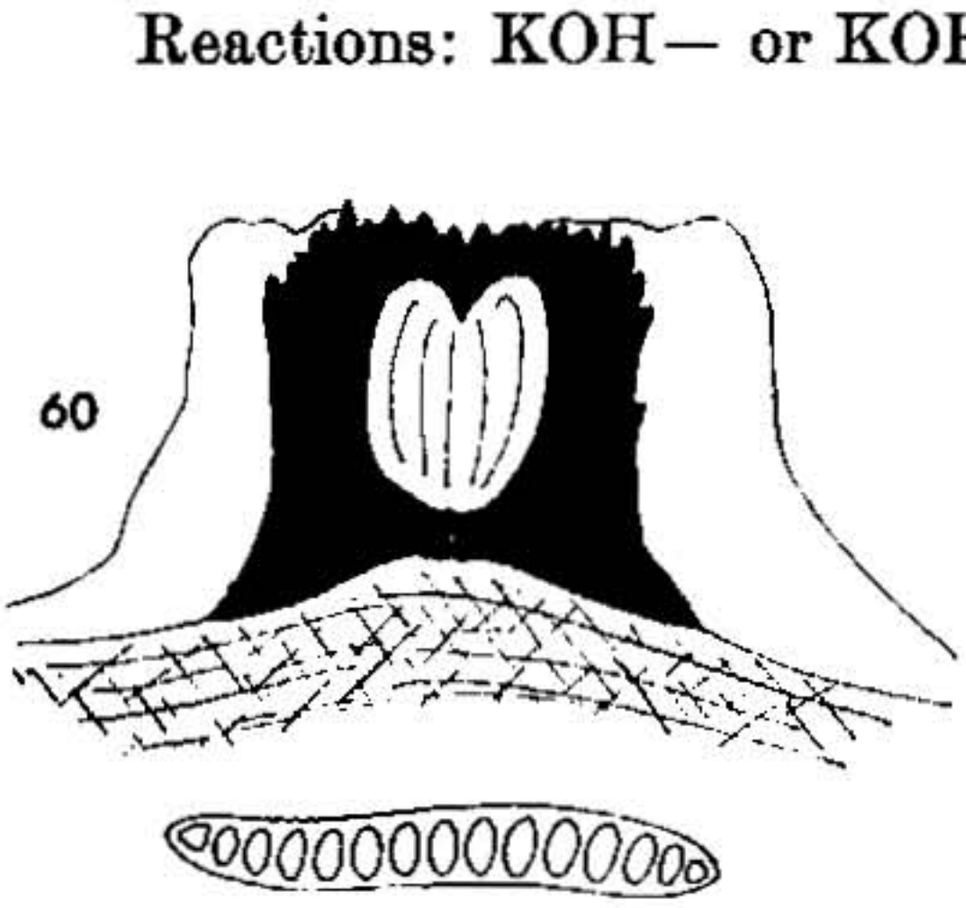
Figures 56–59.—56. *Graphis grammatica* Nyl. (*Wright* 36). 57. *G. implicata* Fée (isotype, *Glaziou* 5036). 58. *G. balbisina* Nyl. (isotype, *Pringle* 118). 59. *G. implicata* Fée (*Pringle* 119).

Holotype: Brazil, *Glaziou* 5497 (M).

Thallus smooth to minutely roughened, continuous. Ascocarps black above, slender, subsessile, elongate, quite flexuose, occasionally branched, 2–10 mm. long, often with a low thalline margin; exciple black, closed; labia convergent, crenate to dentate; hymenium 80–90 μ high. Spores 2–6 per ascus, colorless, 10–17 locular, 9–13×(40)75–90 μ.

Reactions: KOH— or KOH+ yellow, P—, no acids demonstrated.



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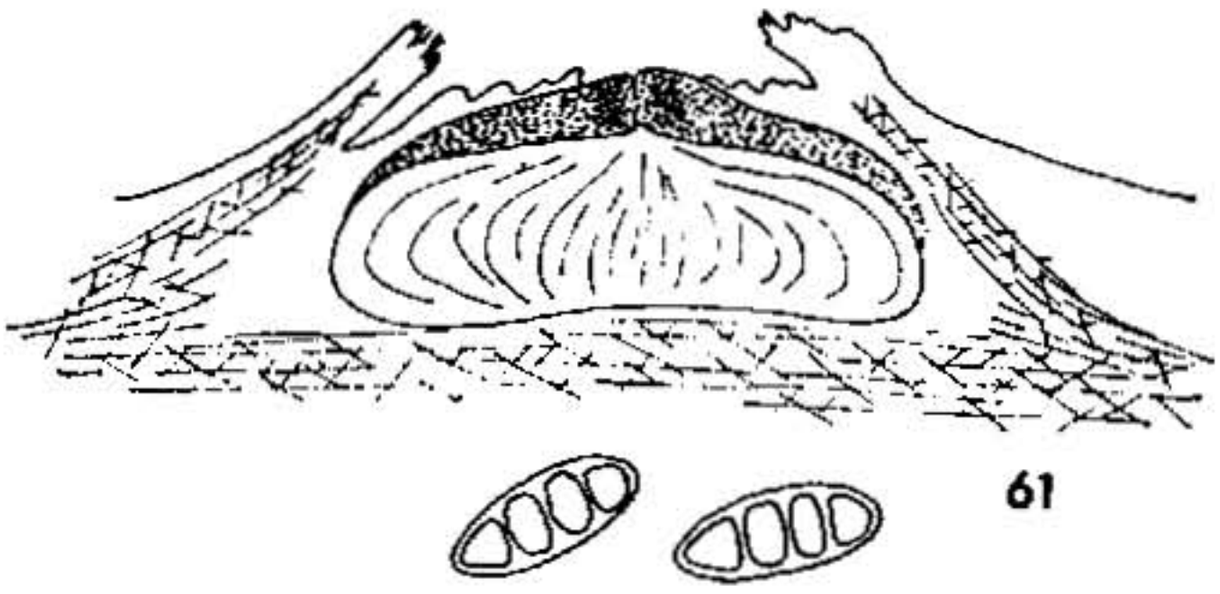

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Figures 60, 61.—60. *Graphis longula* Kremplh. (holotype, *Glaziou* 5497). 61. *G. platycarpella* Müll. Arg. (*Pringle* 210).

Specimen examined: Chiapas: North of Berriozábal, *Hale* 20225 (US).

The spores of *Graphis longula* are quite colorless at maturity, and Zahlbruckner's transfer to *Phaeographis* is unnecessary. It is possible, however, that this species may be referable to *Graphis angustata* Eschw. in Mart.

32. Graphis platycarpella Müll. Arg. Bull. Soc. Bot. Belg. 30:81. 1891. FIGURE 61

Type: Baie de Salinas, Costa Rica, *Pittier* 5236 (not seen).

Thallus smooth, continuous, fairly thick. Ascocarp immersed, round to lirelline, usually unbranched and aggregated, 1–3 mm. long, 0.5–1 mm. wide; thalline margin prominent, white, mealy, erect and flaring, exposing a flat irregular "disc" (actually the excipular labia); exciple open or partially closed, pale and thin laterally; labia thick, light to dark brown, entire, convergent; hymenium 100–150 μ high. Spores usually 4–8 per ascus, 4 locular, 6–12× 12–26 μ.

Reactions: KOH—, P—, o-T—, no acids demonstrated.

Specimen examined: San Luis Potosí: Las Palmas, *Pringle* 210 (FH, VT).

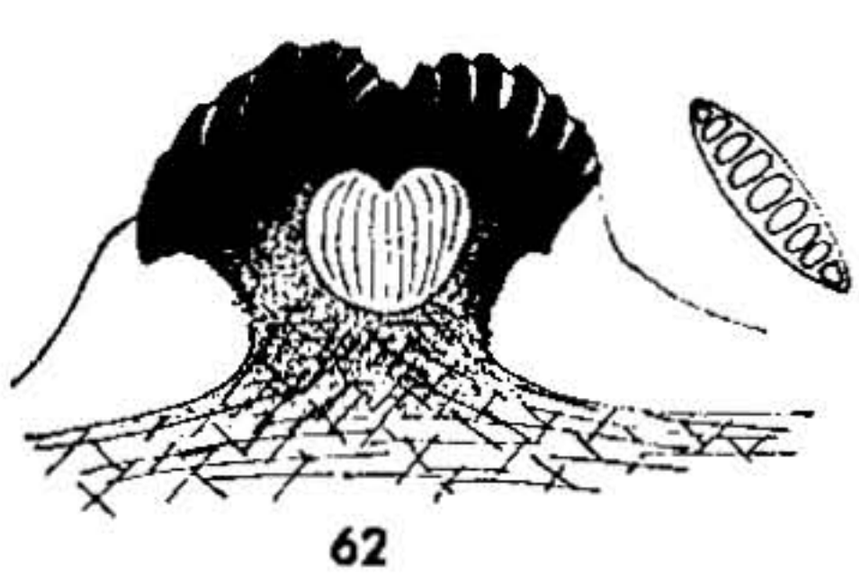
The Pringle material was reported as "*Graphis lactea* Nyl." [=*Graphis lactea* (Fée) Sprengl.] by Eckfeldt (1892, p. 252). However, a fragmentary isotype of *Fissurina lactea* Fée (H) differs internally from the Mexican material. The description of *Graphis platycarpella* is more in accord with *Pringle* 210 and this specimen is tentatively identified as such. This entity is part of the complex series of *Graphis* species which are characterized by 4 locular spores, pale exciples, and more or less fissurine ascocarps. Such species as *Graphis durandi* Müll. Arg., *G. grossula* Müll. Arg., *G. humilis* Vain., *G. lecanorina* Müll. Arg., *G. schizogramma* Vain., and *G. stromatoides* Magn. should be carefully compared in an effort to determine reliable species criteria in this alliance. This group should also be examined with regard to its relationship with the *Graphina nitida-leuconephela-mexicana* complex.

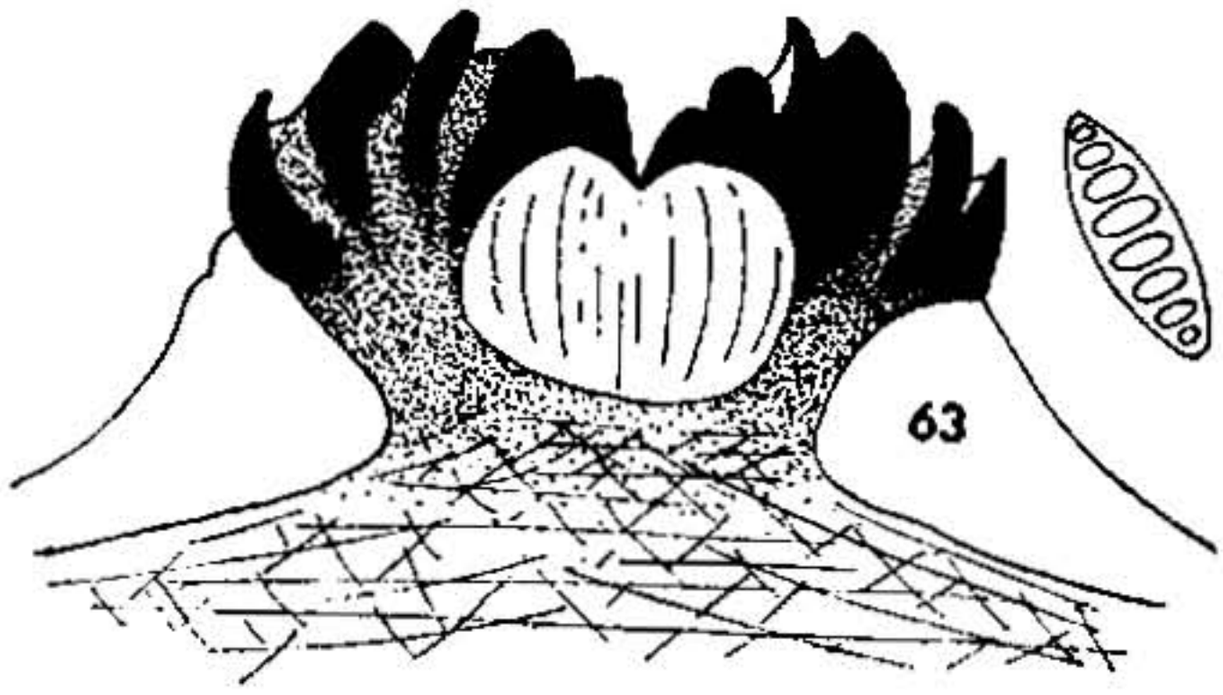
33. Graphis proserpens Vain. Bot. Tidsskr. 29:132. 1909. FIGURES 62, 63

Graphis disserpens Vain. Acta Soc. Faun. Fl. Fenn. 7, no. 7:123. 1890, non *G. disserpens* Nyl. Holotype: Sitio, Minas Gerais, Brazil, *Vainio* 1091 (TUR).

Thallus smooth, continuous. Ascocarps unbranched, subsessile, 1–4 mm. long, 0.2–0.5 mm. wide, black, occasionally with a small lateral thalline margin; exciple black above, red-brown laterally, suffused below, open or nearly closed; labia convergent, 4–7 striate; hymenium 50–60 μ high. Spores 6–8 per ascus, 7–9 locular, 7–8× 18–28 μ.

Reactions: KOH+ red, P—, o-T—, no acids demonstrated.





FIGURES 62, 63.—62. *Graphis proserpens* Vain. (holotype, *Vainio* 1091). 63. *G. proserpens* (*Pringle* 15423).

Specimens examined: Morelos: Near Cuernavaca, *Pringle* 15380 (FH), 15423 (FH, VT).

The name *Graphis disserpens* Vain. was apparently a *lapsus calami*, as Vainio mentioned *G. disserpens* Nyl. in his original description. Vainio himself proposed a new name in 1909.

Graphis proserpens is part of the *rimulosa-elegans-duplicata-striatula* complex. It is possible that further study may prove these entities to be synonymous. Separating them on excipular characters seems rather difficult at the present time.

34. Graphis stygioarachnoidea, sp. nov. FIGURE 64

Thallus corticola, continuus, 38–42 μ crassus, strato corticale arachnoideo, 13–15 μ crasso. Apothecia dispersa, subsessilia, flexuosa, lirellina, raro furcata, 2–5 mm. longa, 0.3–0.4 mm. lata, quam thallo pallidiore, excipulo plus minusve integro, pallido, labiis convergentibus, fuscescentibus; hymenium 100–120 μ altum. Sporae 8nae, 5.5–8× 22–42 μ, loculis 11–16.

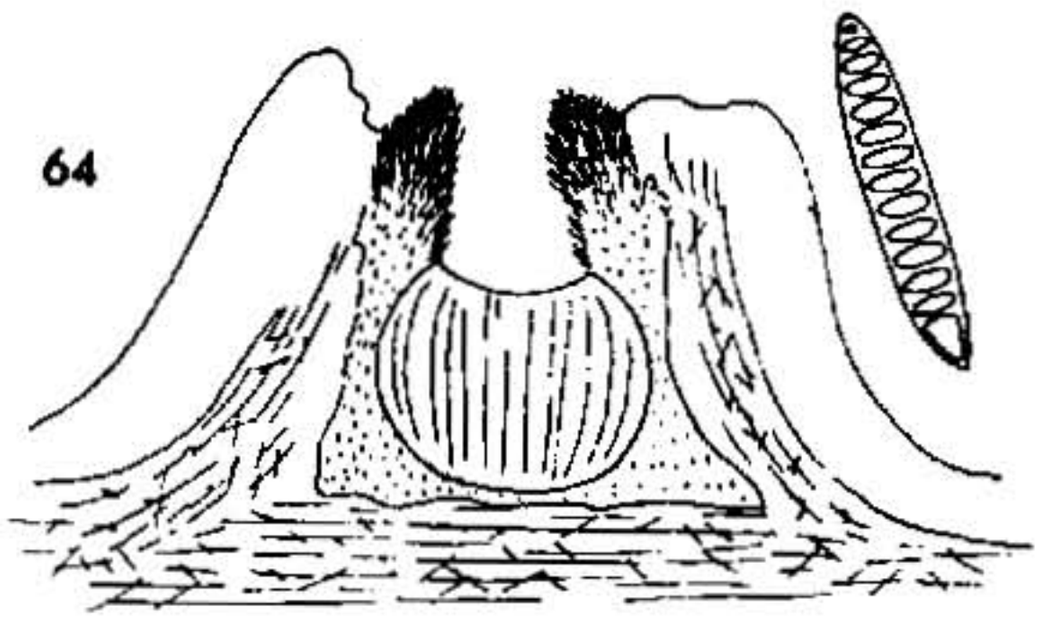


FIGURE 64.—*Graphis stygioarachnoidea* Wirth & Hale (holotype, *Hale* 20399).

Reactions: KOH+ reddish, P+, o-T−, no acids demonstrated.

Type in the U.S. National Herbarium, collected in Mexico, Lagos de Monte Bello, Chiapas, March 25, 1960, by M. E. Hale (no. 20399).

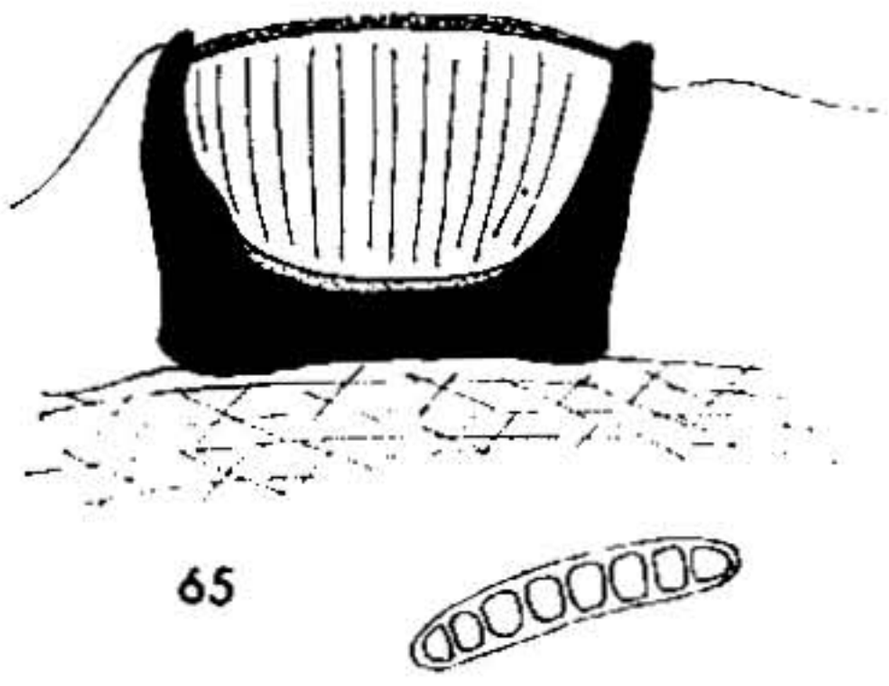
This new species is quite closely related to *G. mosquitensis* Tuck., from which it differs in having the hyphae of the labia free and

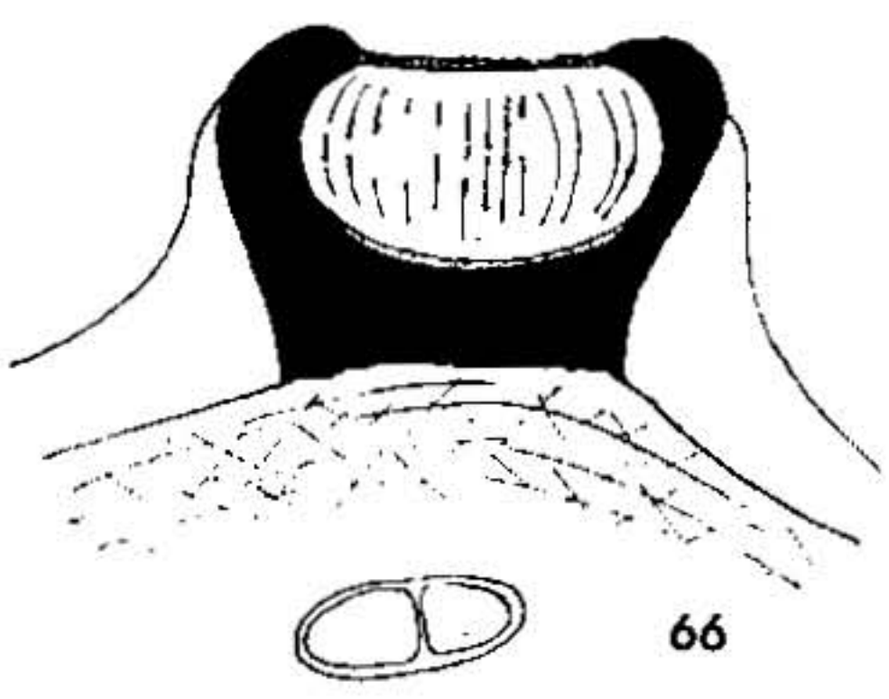
distinctly carbonized, and in the more robust, nearly sessile ascocarps. Although the labia in the holotype of *G. mosquitensis* occasionally show an apical looseness of construction, these hyphae never become free or distinctly black and carbonized.

35. Graphis subamylacea Zahlbr. Ann. Mycol. 19:229. 1921. FIGURE 65

Type: Cuernavaca, Morelos, Mexico, *Pringle* 24 (MICH, isotype).

Thallus continuous, to 100 μ thick, smooth or minutely roughened. Ascocarps immersed, very variable, slender, much branched, often radiate or anastomosing, 1–5 mm. long, about 0.3 mm. wide, level with the thallus or sometimes bordered by very low thalline margins, lightly pruinose or black; exciple black, usually closed; labia entire, divergent; hymenium 100–120 μ high, opaque. Spores 8 per ascus, 6–8 locular, 5–8×17–30 μ.





FIGURES 65, 66.—65. *Graphis subamylacea* Zahlbr. (isotype). 66. *Melaspilea polymorpha* Müll. Arg. (holotype, *Pringle* 98).

Reactions: KOH+ yellow, stictic acid.

Specimen examined: Tamaulipas: Tampico, *Pringle* 412 (MICH).

This species, though fairly distinct, is extremely variable in the form, size, and pruinosity of the ascocarps, the isotype has ascocarps ranging from quite small and highly pruinose to large and almost black. The second collection (*Pringle* 412) is more robust, and externally much like *Graphis caesiella* Vain.

3. Melaspilea

36. Melaspilea polymorpha Müll. Arg. Bull. Herb. Boiss. 2:92. 1894.
FIGURE 66

Holotype: Near Monterrey, Mexico, *Pringle* 98 (G).

Thallus thin, smooth. Ascocarps sessile, unbranched, slightly flexuose, to 1 mm. long; exciple black, closed; labia entire, convergent but exposing a fairly wide disc; hymenium about 60 μ high. Spores 2 locular, brown, 4–8 per ascus, 5–7×14–17 μ.

Reactions: KOH—, P—, no acids demonstrated.

4. Phaeographina

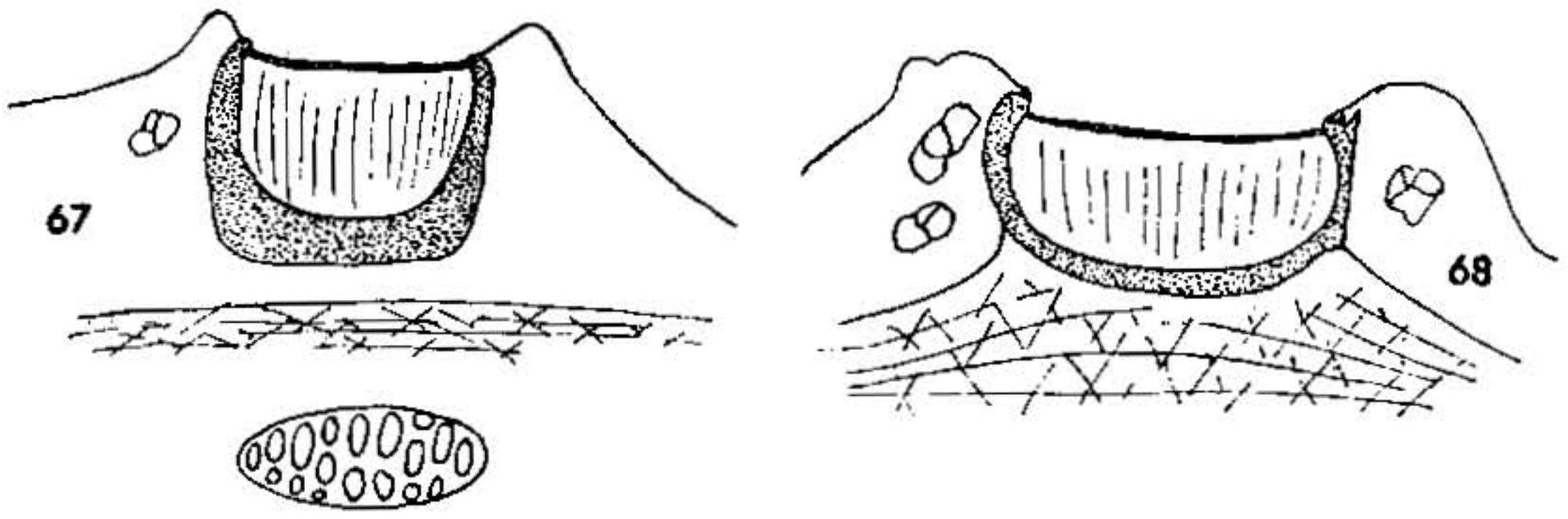
37. Phaeographina asteroides Fink, Mycologia 19:218. 1927. FIGURES 67, 68
Phaeographina caesiopruinosella Fink, Mycologia 19:219. 1927. Holotype: Naranjito, Puerto Rico, *Fink* 140 (MICH).

Holotype: Mayagüez, Puerto Rico, *Fink* 981 (MICH).

Thallus smooth, continuous. Ascocarps usually much branched, 1–3 mm. long, 0.3–0.7 mm. wide, emergent to subsessile; thalline margin more or less prominent, often somewhat lighter than the thallus; disc (and often the whole ascocarp) pruinose; exciple brownish, closed; labia entire, more or less divergent. Spores 8 per ascus, brown, 5–10×2–3 locular, 8–18×25–50 μ.

Reactions: KOH+ red, P−, o-T−, no acids demonstrated.

Specimen examined: San Luis Potosí; Las Palmas, *Pringle* 224 (FH, VT).



FIGURES 67, 68.—67. *Phaeographina asteroides* Fink (holotype, *Fink* 981). 68. *P. caesiopruinosella* Fink (holotype, *Fink* 140).

Pringle 224 was reported by Müller (1894, p. 92) as *Graphina caesioradians* (Leight.) Müll. Arg. [=*Phaeographina caesioradians* (Leight.) Redgr.]. Redinger (1933, p. 99) placed both of Fink's species in synonymy of *P. caesioradians*, but since the type of the Leighton species has not been examined and since Redinger has incorrectly handled other Fink species, this synonymy cannot be verified. In any event, the two Puerto Rican species are identical (except for a slight difference in spore size), and the Pringle material is within the range of variation shown in the Puerto Rican types.

38. Phaeographina caesiopruinosa (Fée) Müll. Arg. Mem. Soc. Phys. Hist. Nat. Genève 29, no. 8:49. 1887. FIGURE 70
Arthonia caesiopruinosa Fée, Suppl. Essai Crypt. Ecorces 36, *pl. 40, fig. 4*, 1837. Type: Tropical America (not seen).

Thallus smooth to slightly roughened, continuous. Ascocarps large, emergent to subsessile, elongate, to nearly round, occasionally branched, 1–10 mm. long, 1–3 mm. wide, with a wide, usually prominent, elevated thalline margin; disc flat, lightly to heavily pruinose;

exciple black, open to nearly closed, usually black laterally and absent below; hymenium 100–250 μ high, clear or inspersed. Spores 8 per ascus, gray to brown, 10–20×2–6 locular, 15–20×45–120 μ.

Reactions: KOH+ reddish or yellow.

Specimens examined: Chiapas: El Suspiro, *Hale* 20133, 20215; west of Tuxtla Gutiérrez, *Hale* 19903 (US). Nuevo León: Monterrey, *Pringle* 113 (FH, VT, US). Vera Cruz: North of Fortín de las Flores, *Hale* 19695; north of Huatusco, *Hale* 19482 (US).

Examination of a large number of specimens from the southern United States and tropical America referable to this common species indicated an intergrading series of excipular forms, varying from completely dimidiate to distinctly carbonized below. There is also intergradation between heavily inspersed hymenia and clear hymenia, elongate nearly unbranched ascocarps and stout lobulate ascocarps. None of these characters seem to show any mutual interrelation. For the moment, it seems best to treat the aggregate as a single widespread variable species.

39. Phaeographina chrysocarpa (Raddi) Redgr. Ark. Bot. 26A, no. 1:83. 1933.

FIGURE 69

Opegrapha chrysocarpa Raddi, Atti Soc. Ital. Sci. 344. 1820. Type: Mandioca, Brazil (not seen).

Graphis chrysocarpa (Raddi) Sprengl. Syst. Veg. 4:253. 1827.

Graphina chrysocarpa (Raddi) Müll. Arg. Flora 63:41. 1880.

Graphis miniata Redgr. Ark. Bot. 27A, no. 3:26. 1935. Syntypes: Brazil, *Mosén* 3145, 3313, 3577 (S).

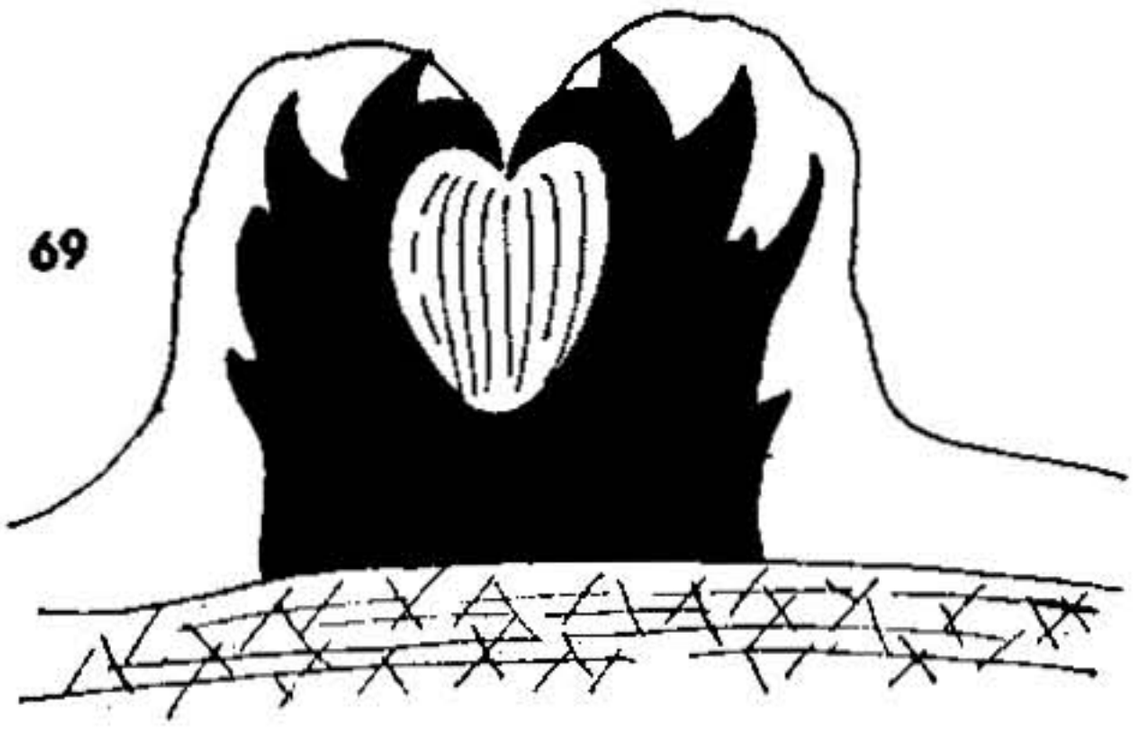
Thallus smooth, continuous. Ascocarps subsessile to sessile, unbranched to asteroidly branched, straight to quite curved, 1–7 mm. long, more or less covered by a cinnabar-red thalline veil, black beneath; exciple black, closed; labia convergent, striate. Spores 4–6 per ascus, colorless, brown, or gray, transversely septate or bi-ocellate at the ends to completely muriform, 10–15×65–150 μ long.

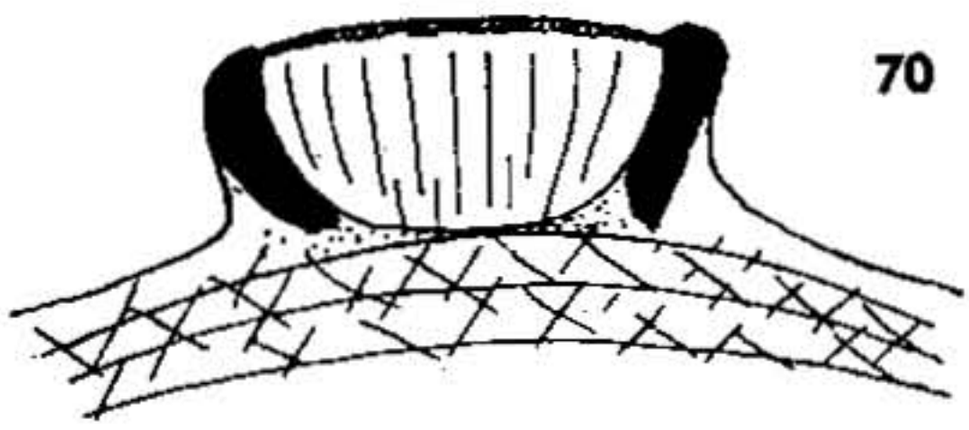
Reactions: Thallus KOH−, P−, no acids demonstrated; ascocarps KOH+ purple.

Specimen examined: Chiapas: El Suspiro, *Hale* 20173 (S, TNS, US).

Phaeographina chrysocarpa is distinguished by its brilliantly colored cinnabar ascocarps. The large series of specimens examined from tropical America showed great variation in spore septation and color. In fact, it was possible to find specimens with cinnabar ascocarps and black closed exciples which could be referred to *Graphis*, *Graphina* *Phaeographis*, or *Phaeographina*. In some cases a single specimen could be assigned to all four genera. As shown in the list of synonyms, this entity has already been placed in three of these genera.

The variation in spore characters throws considerable doubt on the validity of the four traditional genera. Specimens are usually identi-





FIGURES 69, 70.—69. *Phaeographina chrysocarpa* (Raddi) Redgr. (*Hale* 20173). 70. *P. caesiopruninosa* (Fée) Müll. Arg. (*Pringle* 113).

fied as *P. chrysocarpa* on the basis of the cinnabarine ascocarps and entire exciples, regardless of variation in the spores. Is it not possible that other species, especially those lacking such an obvious unifying feature as a pigmented ascocarp, may be assigned to several different genera, when in fact they are simply a single species with polymorphic spores? One may suggest as an example the mass of species which cluster about *Graphina acharii*.

It should also be noted that the cinnabarine ascocarp covering in *P. chrysocarpa* sometimes becomes quite reduced, occurring only at the ends of the lirellae. If this pigmented covering disappeared completely, the resulting species would be very close to *Graphina acharii*, a species which shows similar spore variation. The implication of this is obvious.

One of the syntypes of *Graphis miniata* Redgr. has brown, muriform spores, and it is therefore included in synonymy here. Actually the structure of the ascocarp in this species as illustrated by Redinger is inaccurate; internally *G. miniata* is exactly like typical *Phaeographina chrysocarpa*.

One other species in the Graphidaceae occurs with bright cinnabar ascocarps, *Graphina malmei* Redgr. The holotype (Brazil, *Malme* 3508, S) is indeed distinct, as the exciple is pallid below, and the labia constructed of free lamellae. A second collection from Brazil (*Weir* 6223, BPI) confirms the validity of this species.

40. Phaeographina sp. FIGURE 71

Phaeographina scalpturata auct. non (Ach.) Müll. Arg.

Thallus continuous, smooth to roughened. Ascocarps sessile, very large, sparingly branched, acute, straight to nearly intricate, to 15 mm. long and nearly 2 mm. wide, with a prominent elevated, light-colored thalline margin; disc flat, caesiopruinose; exciple carbonized, dimidiate or sometimes barely closed below. Spores 1 per ascus, brownish, 20–35×150–200 μ, densely muriform.

Reactions: KOH+ red, norstictic acid.

Specimens examined: Chiapas: West of Tuxtla Gutiérrez, *Hale* 19898 (US). San Luis Potosí: Canoas, *Pringle* 305 (VT). Vera Cruz: Northeast of Huatusco, *Hale* 19453; north of Fortín de las Flores, *Hale* 19696, 19704 (US).

An examination of an isotype of *P. scalpturata* (Ach.) Müll. Arg. (see p.110) disclosed that the traditional concept of the species is incorrect. The entity described above, often identified as *P. scalpturata* by such workers as Nylander, Müller, and Redinger, differs considerably from authentic material of that species. The present entity has enormous ascocarps, carbonized exciples, prominent thalline margins, and very large spores; it is extremely widespread and common and must certainly have a valid name, although we have not yet been able to determine what it might be.

41. Phaeographina strigops sp. nov. FIGURE 72

Thallus corticola, continuus, nitidus, 100–170 μ crassus, strato corticale arachnoideo, 13–15 μ crasso. Apothecia elongata, flexuosa et intricata, 4–5 ramulosa, 1–5 mm. longa, 0.1–0.3 mm. lata, disco dilatato, concavo, excipulo integro, fuscorufescente, tenue, labiis integris, divergentibus; hymenium semicirculare, 90–100 μ altum. Sporae 8nae, fuscescentes, 9–13×18–21 μ, loculis horizontalibus 5–6, loculis transversis 1–2.

Reactions: KOH+ yellow, P−, o-T unknown acid.

Type in the U.S. National Herbarium, collected in Mexico, Lagos de Monte Bello, Chiapas, March 25, 1960, by M. E. Hale (no. 20383).

This new species is allied to the Brazilian *P. oxalifera* Redgr., from which it differs in having a black disc, elongate, intricate ascocarps, and an unknown acid instead of norstictic acid.

42. Phaeographina elliptica, sp. nov. FIGURE 73

Thallus corticola, continuus vel fissus, laevis, 100–150 μ crassus, strato corticale subcellulare, 60–75 μ crasso. Apothecia immersa, simplicia, vulgo recta, elliptica vel sublirellina, apicibus rotundatis, 0.75–2 mm. longa, 0.3–0.5 mm. lata, disco planato vel concavo, nigro vel leviter pruinoso, labiis integris, divergentibus, tenuibus; hymenium inspersum, crystallis magnis decoloratis includentibus, 120–150 μ altum, epithecio fusco. Sporae fuscescentes, 1nae, 23–26×90–110 μ, loculis horizontalibus 22–25, loculis transversis 2–6.

Reactions: KOH+ orange, P−, unknown crystals in o-T.

Type in the U.S. National Herbarium, collected in Mexico, north of Berriozábal, Chiapas, March 22, 1960, by M. E. Hale (no. 20088).

Phaeographina elliptica is closely related to *P. scalpturata* (Ach.) Müll. Arg., differing primarily in the peculiar crystalline inclusions in the hymenium. In addition, the thallus shows considerable fissuring,

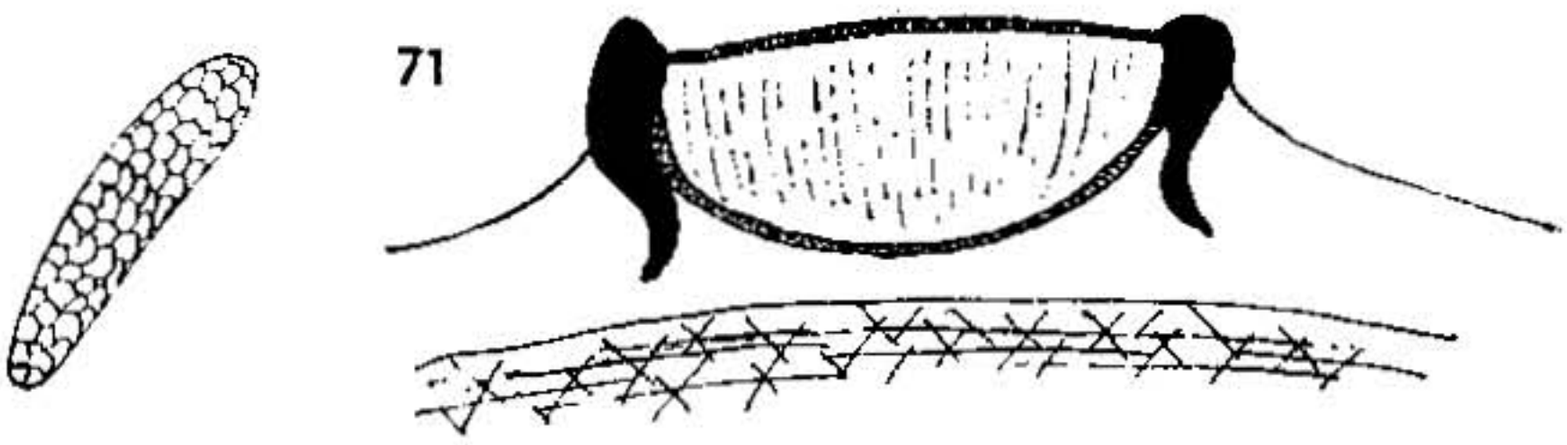


FIGURE 71.—*Phaeographina* sp. (*Hale* 19453).

FIGURES 72, 73.—72. *Phaeographina strigops* Wirth & Hale (holotype, *Hale* 20383). 73. *P. elliptica* Wirth & Hale (holotype, *Hale* 20088).

and the ascocarps are more crowded and elliptical than in typical *P. scalpturata*.

5. Phaeographis

43. Phaeographis dendritica (Ach.) Müll. Arg. Flora 65:382. 1882. FIGURE 74
Opegrapha dendritica Ach. Meth. Lich. 31. 1803. Type: Southern Spain (UPS, isotype).

Thallus smooth, continuous. Ascocarps semiemergent, often desquamescent, simple to asteroidly branched, acute, surrounded by a low, narrow thalline border, 1–3 mm. long, about 0.4 mm. wide; disc black, flat; exciple dark brown to black, closed; labia entire, spreading; hymenium 80–120 μ high. Spores 8 per ascus, brown, 6–8 locular, 8–11×26–42 μ.

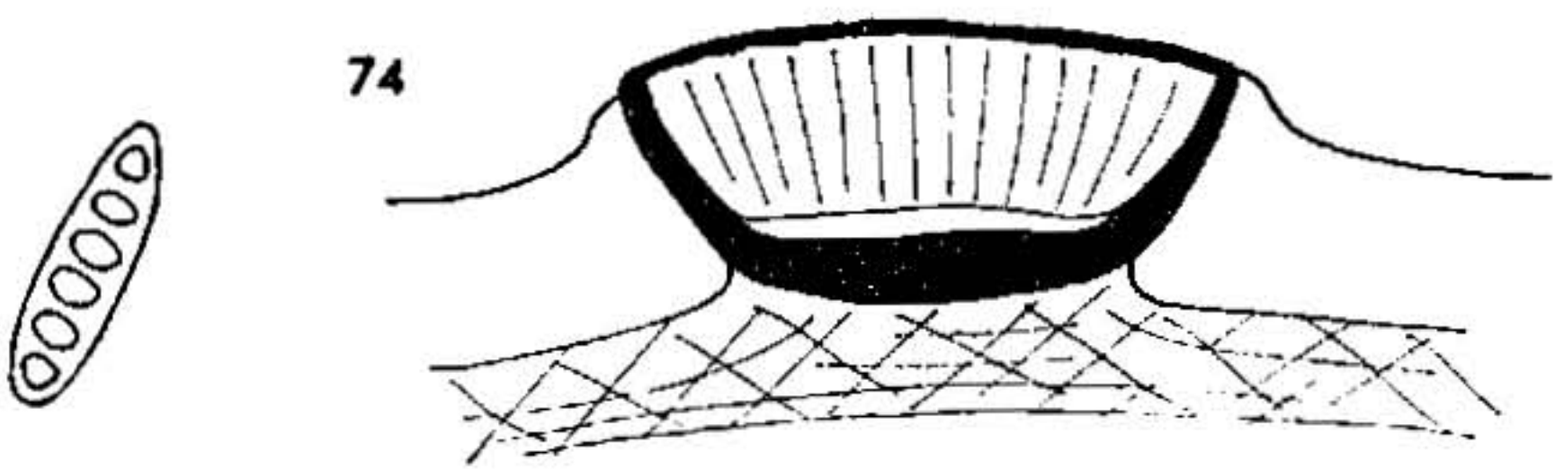


FIGURE 74.—*Phaeographis dendritica* (Ach.) Müll. Arg. (isotype).

Reactions: KOH+ red, norstictic acid.

Specimens examined: Chiapas: West of Tuxtla Gutiérrez, *Hale* 19895 (US). Vera Cruz: Orizaba, *Fr. Müller* (US).

The Mexican specimens are identical in all respects with the isotype. It is altogether possible that the great variability attributed to

P. dendritica may be incorrect and that the numerous subspecific taxa described represent other species.

44. Phaeographis exaltata (Mont. et v. d. Bosch) Müll. Arg. Flora 65:336. 1882. FIGURE 75

Lecanactis exaltata Mont. et v. d. Bosch, Pl. Junghuhn, 4:475. 1855. Type: Java, *Junghuhn* (not seen).

Thallus continuous, smooth to warty. Ascocarps sessile, sparingly branched or unbranched, rotund to lirelline, stout, 0.5–4 mm. long, 0.5–1 mm. wide, often apically rounded, laterally with a very prominent thalline margin much as in *Sarcographa;* disc black, wide; exciple black, closed, thickened below; labia entire, divergent; hymenium inspersed with brown oil droplets, 120–150 μ high. Spores 8 per ascus, 6–10 locular, 8–11×23–32 μ.

Reactions: KOH+ yellow, unknown acid in o-T.

Specimen examined: Chiapas: Lagos de Monte Bello, *Hale* 20394 (US).

This species is one of the numerous transition species between *Sarcographa* and *Phaeographis* and could easily be placed in either genus. The unknown lichen acid is identical with that found in *Graphina virginea, G. triangularis,* etc.

45. Phaeographis sericea (Eschw. in Mart.) Müll. Arg. Flora 71:523. 1888. FIGURE 77

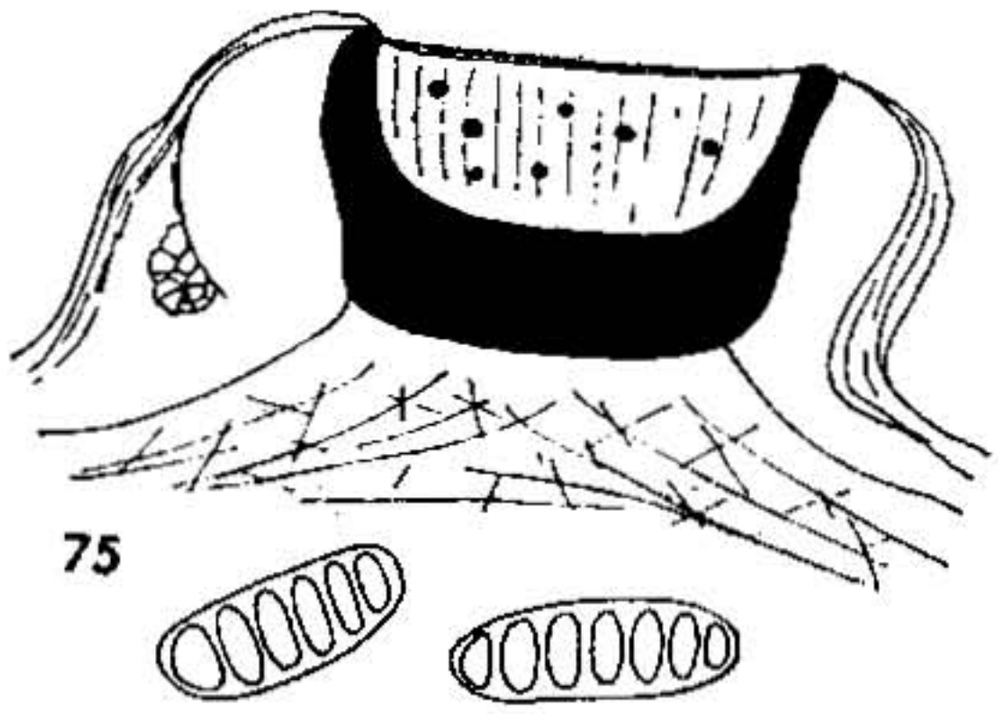
Leiogramma sericeum Eschw. in Mart. Icon. Pl. Crypt. 2:34. 1828. Type: Brazil (not seen).

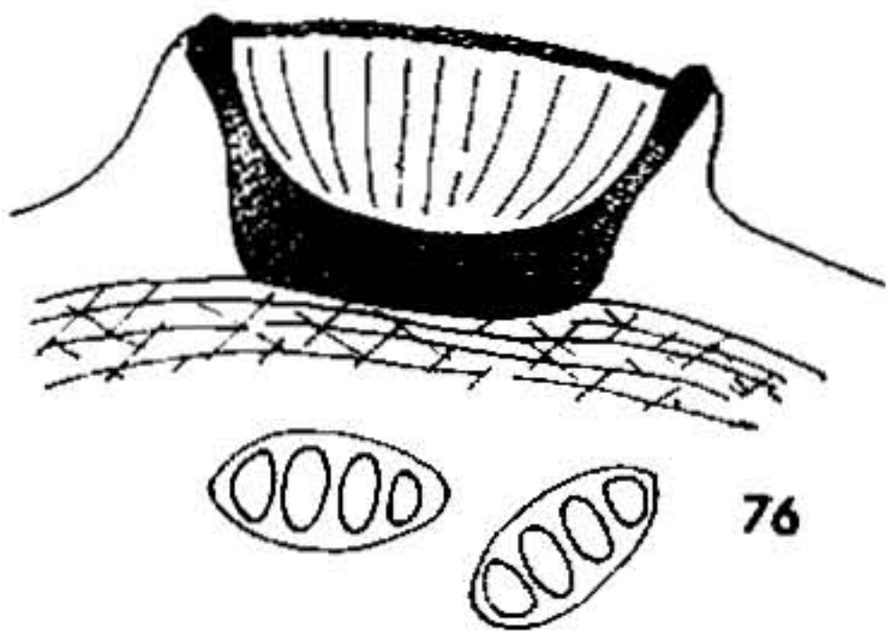
Thallus thin, more or less continuous, smooth. Ascocarps black, often very variable, some lirellae asteroidly branched, immersed, narrow, apically acute, with a mealy, prominent thalline margin, disc black, other lirellae subsessile, lacking a mealy margin, irregularly branched and intricate, apically rounded, disc lightly pruinose, to 0.5 mm. wide; exciple black, closed, thickened below; labia at first convergent, then divergent, entire; hymenium 80–90 μ high. Spores 8 per ascus, 4 locular, 7–8×18–21 μ.

Reactions: KOH+ yellow, P−, o-T−, no acids demonstrated.

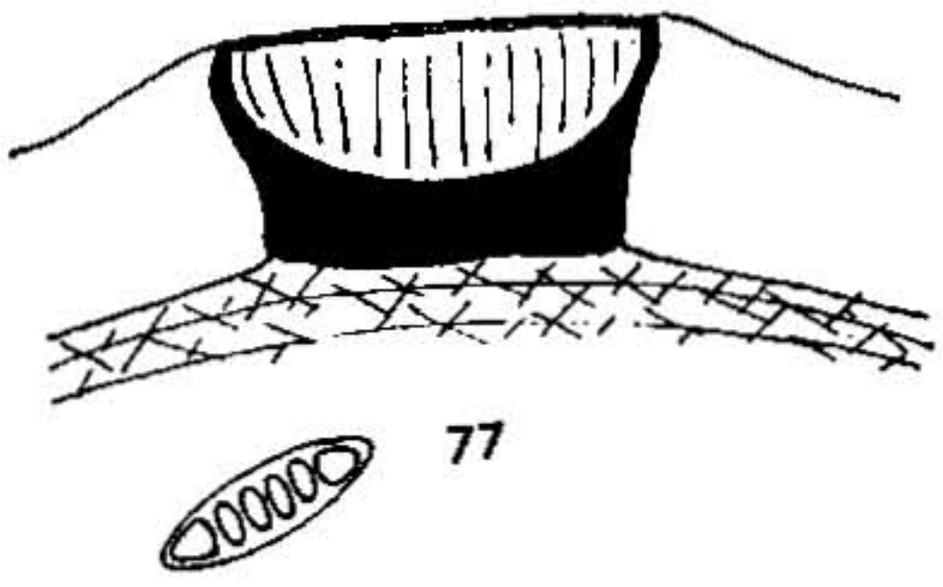
Specimens examined: Chiapas: North of Berriozábal, *Hale* 20107 (S, US). Vera Cruz: East of Córdoba, *Hale* 19727 (US).

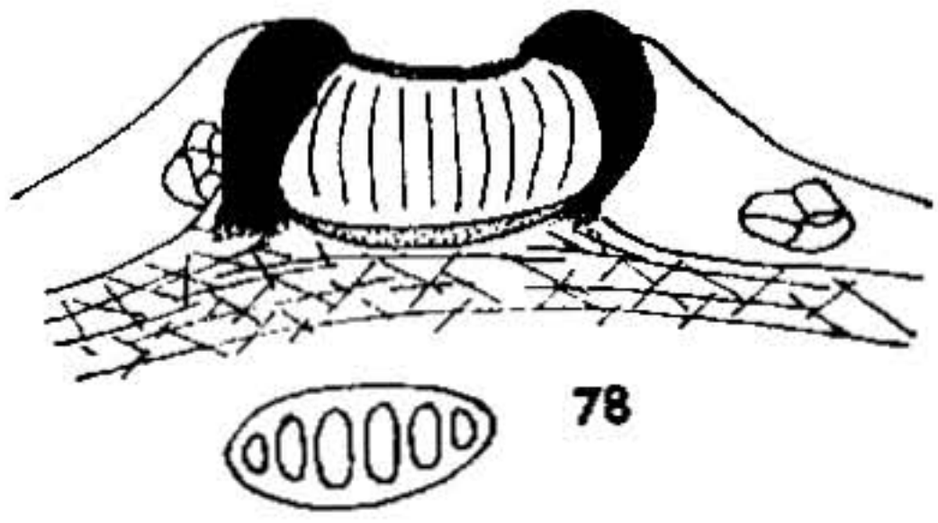
The variation in ascocarp shape in the cited specimens is extremely instructive. Most clusters appear to originate as immersed, radiately branched, acute ascocarps with prominent mealy margins and black discs. Sometimes these "juvenile" forms are simple and unbranched with rotund apices. However, it is not possible to consider these stages as immature, since spores are commonly present, and the "adult" stage is often found interconnected. This later stage lacks the mealy margin, is always subsessile, has lightly pruinose discs and rotund apices, and has an irregular, intricated mode of branching.





FIGURES 75, 76.—75. *Phaeographis exaltata* (Mont. & v. d. Bosch) Müll. Arg. (*Hale* 20394). 76. *P. inusta* (Ach.) Müll. Arg. (isotype, *Kalm*).





FIGURES 77, 78.—77. *Phaeographis sericea* (Eschw. in Mart.) Müll. Arg. (*Hale* 19727). 78. *P. sexloculata* Fink (holotype, *Fink* 1436).

This great variability of form seems to be rather common in those Graphidaceae which have thick walled brown spores with carbonized exciples. In the light of this variation, we should re-examine carefully the species criteria within this group.

There are at least two other species of *Phaeographis* which may well prove to be synonyms of *P. sericea: P. aggregata* Redgr. and *P. substellata* Zahlbr., but we have not yet examined the type specimens.

46. Phaeographis sexloculata Fink, Mycologia 19:215. 1927. FIGURE 78

Holotype: Yauco, Puerto Rico, *Fink* 1436 (MICH).

Thallus smooth, continuous. Ascocarps black, slender, flexuose, semiemergent, unbranched to occasionally branched, 1–3 mm. long; exciple black, open; labia entire, erect or somewhat convergent, but exposing the hymenium; hymenium 65–80 μ high. Spores 8 per ascus, commonly 6 locular, 8–10×18–26 μ.

Reactions: KOH+ yellowish, P—, no microchemical tests made.

Specimen examined: Carmen Island, *Rabenhorst* 25 p.p. (M).

The Mexican material of this species was reported by Kremplehuber (1876, p. 148) as *Graphis* (*Phaeographis*) *leiogrammodes*. However, the holotype of *G. leiogrammodes* has muriform spores.

Excluded or Doubtful Species

47. Graphina sophistica (Nyl.) Müll. Arg. Flora 63:40. 1880.
Graphis sophistica Nyl. Ann. Sci. Nat. Bot. ser. 4, 19:359. 1863. Syntypes: Villeta, Colombia, *Lindig* 876, 902, 2726, 2737 (not seen).

Thallus continuous, smooth. Ascocarps subsessile, sparingly branched or unbranched, black; disc narrow, epruinose; exciple black, open or closed; labia convergent, entire or lightly crenate. Spores 2–4 per ascus, 12–20×35–65 μ.

This species was reported from Monterrey, Mexico, by Müller (1894, p. 92), but we have seen neither this specimen, the type, or any Mexican material referable here.

48. Graphis scripta (L.) Ach. Vet. Akad. Nya Handl. (Stockholm) 145. 1809.
Lichen scriptus L. Sp. Pl. 1140. 1753.

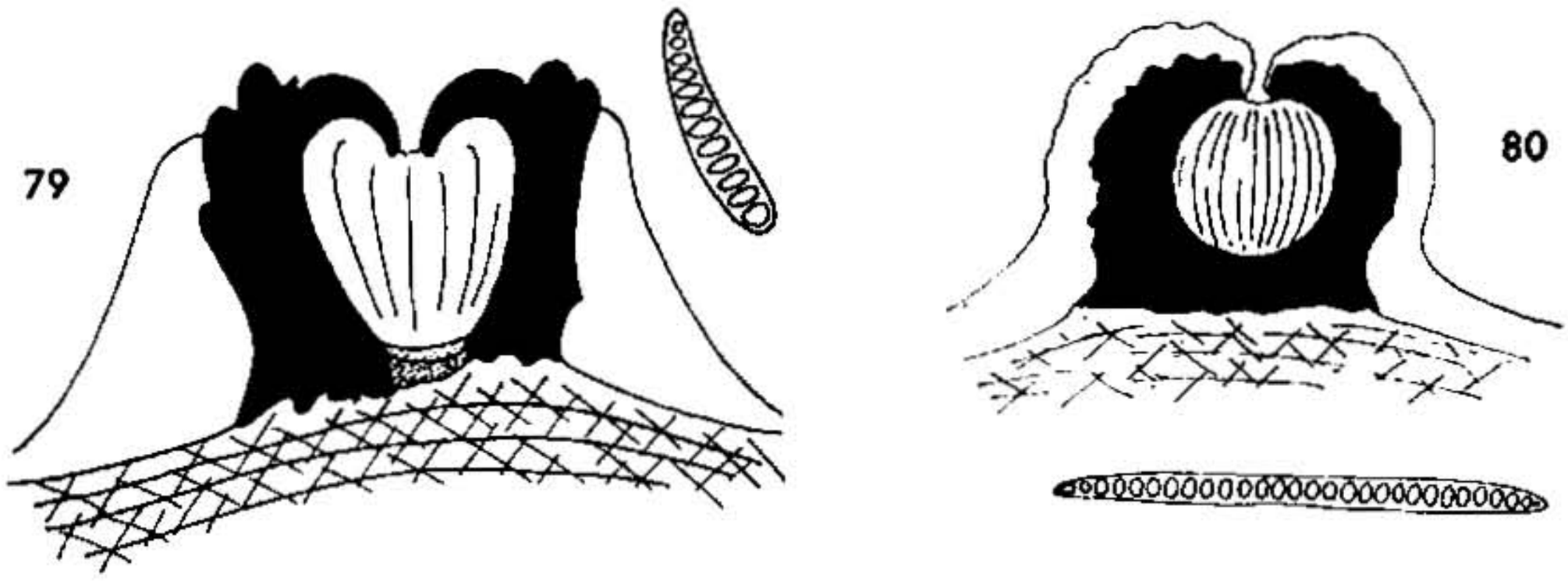
Graphis scripta and a number of closely allied species must be critically examined before any sound taxonomic judgments can be made about this widespread group. Redinger (1935, p. 8) separated *G. tenella* Ach., *G. leptocarpa* Fée, *G. scripta*, *G. lineola* Ach., and *G. pavoniana* Fée on the basis of spore size, degree of ascocarp immersion, and length and branching of the ascocarps. The first three of these four criteria are nearly useless in this group. The isotypes of *G. tenella* Ach. (UPS) have ascocarps with convergent labia which become striate with age. The isotype of *G. lineola* Ach. (UPS) contains a *Melaspilea*, an *Opegrapha* (which conceivably could be a lectotype), and a sterile unidentifiable entity.

Graphis scripta itself can probably be typified through the Dillenian syntype cited by Linnaeus. This would still leave approximately 190 named varieties, forms, etc., listed in Zahlbruckner's Catalog. A critical study of these taxa in addition to numerous related species in *Graphis* and *Phaeographis* will pose a formidable problem for future lichenologists.

49. Graphis striatula (Ach.) Sprengl. Syst. Veg. 4:250. 1827. FIGURE 79
Opegrapha striatula Ach. Syn. Lich. 74. 1814. Type: Guinea (UPS, isotype). Reactions: KOH+ reddish, P−, no microchemical tests made.

Thallus thin, discontinuous. Ascocarps sessile, black, *Opegrapha*-like, straight to slightly flexuose, unbranched, 0.5–2 mm. long, about 0.3 mm. wide; exciple black, usually open, 100 μ high; labia convergent, striate. Spores 8 per ascus, 11–13 locular, 8–10×38–43 μ.

This species was reported from Orizaba, Mexico, by Nylander (1858, p. 381), along with two new varieties, var. *sublaevis* Nyl. and var. *pulverulenta* Nyl. The former variety was described as having branched ascocarps, the latter as having barely striate labia. Müller (1887, p. 35) made the transfer *Graphis duplicata* var. *sublaevis* (Nyl.) Müll. Arg. He distinguished *G. duplicata* from *G. striatula* only by



FIGURES 79, 80.—79. *Graphis striatula* (Ach.) Sprengl. (isotype). 80. *Graphis vermiformis* (Eschw. in Mart.) Nyl. (s. c., FH-Tayl).

the more sessile unbordered ascocarps of the latter. We have not seen any material of these taxa from Mexico.

The isotypes of *G. striatula* and *G. duplicata* actually cannot be separated on the basis of sessile *vs.* nonsessile ascocarps, although they may be maintained by the gross form of the lirellae. In *G. striatula*, they are *Opegrapha*-like, unbranched, nearly straight, and short. In *G. duplicata*, they are elongate, branched, curved and flexuose. It would seem therefore that *G. striatula* var. *sublaevis* is referable to *G. duplicata*, as Müller indicated.

50. Graphis vermiformis (Eschw. in Mart.) Nyl. Flora 41:381. 1858.

FIGURE 80

Graphis illinata var. *vermiformis* Eschw. in Mart. Fl. Bras. 1:83. 1833.
Type: Near Pará, Brazil (not seen).

Thallus thin, continuous, slightly roughened. Ascocarps sessile, unbranched, 1–3 mm. long, 0.5 mm. wide, concolorous with the thallus; exciple black, closed; labia convergent, more or less denticulate or dentate, completely covered by a thalline veil. Spores 8 per ascus, vermiform, 20–25 locular, 7–9×65–75 μ.

This species was reported from Orizaba, Mexico, by Nylander (1858, p. 381), but we have not verified this report. The Guianan specimen on which the above description was based is in the Taylor Herbarium (FH), labeled "Graphis illinita Eschw." and reacts KOH+ brown, P+ brown.

Graphis vermiformis is listed by Zahlbruckner (1923, p. 297) as a synonym of *G. candidata* Nyl. However, Nylander's elevation of var. *vermiformis* to species level antedates the publication of *G. candidata* by 16 years. Hence if the two taxa are identical, *G. vermiformis* has priority. This species is closely related to *Graphis anguilliformis* Tayl., differing in the more slender vermiform spores and completely covered ascocarps.

686-879—63—— 4

51. Melaspilea lentiginosa (Lyell in Leight.) Müll. Arg. Mem. Soc. Phys. Hist. Nat. Genève 29, No. 8:19. 1887.

Opegrapha lentiginosa Lyell in Leight. Ann. Mag. Nat. Hist. 2, No. 13:211. 1854. Types: New Forest, Hants., *Lyell* (US, isosyntype); St. Leonard's Forest, Sussex, England, *Borrer* (not seen).

This species was reported from Orizaba, Mexico, by Nylander (1858, p. 381) but we have not checked this record. The isosyntype of *Opegrapha lentiginosa*, and all specimens we have seen that were referred here by Redinger (1938, p. 228), are lichen parasites on a *Phaeographis* species.

52. Melaspilea leucinoides Müll. Arg. Bull. Herb. Boiss. 2:92. 1894.

Holotype: Jalisco, Mexico, *Pringle* 216 (G).

This entity is an *Opegrapha*.

53. Melaspilea mesophlebia (Nyl.) Müll. Arg. Hedwigia 34:143. 1895.

Opegrapha mesophlebia Nyl. Sert. Lich. Trop. Singapore et Labuan 42. 1891.

Opegrapha mesophlabia Nyl. Bull. Torrey Bot. Club 19:250. 1892. A sphalm. Holotype: San Luis Potosí, Mexico, *Pringle* 230 (II).

This species also belongs in the genus *Opegrapha*.

54. Melaspilea microphlebia (Nyl.) Zahlbr. Cat. Lich. Univ. 2:279. 1923.

Opegrapha microphlebia Nyl. Bull. Soc. Linn. Norm. 2, no. 3:272. 1869. Type: Guadeloupe, *Husnot* (not seen).

Eckfeldt (1892, p. 250) identified *Pringle* s.n., from Monterrey, Mexico, as *Opegrapha microphlebia* Nyl. We have checked the *Pringle* collection (VT) and found that it is indeed an *Opegrapha*.

55. Phaeographina leiogrammodes (Kremplh.), comb. nov. FIGURE 81

Graphis leiogrammodes Kremplh. Natur. For. Kjöben. Vid. Medd. 5:25. 1873. Holotype: Lagõa Santa, Brazil, *Warming* 22 (M). Reactions: KOH+ reddish, P−, o-T−, no acids demonstrated.

Phaeographis leiogrammodes (Kremplh.) Müll. Arg. Nuov. Giorn. Bot. Ital. 23:397. 1891.

The holotype specimen is undoubtedly a *Phaeographina*, externally quite similar to *P. exilior* (Vain.) Zahlbr. The juvenile spores are transversely 4 locular, as described, but at maturity one or all of the 4 locules become biocellate.

Krempelhuber (1876, p. 148) reported this species from Mexico, but these collections are all referable to *Phaeographis*.

56. Phaeographina scalpturata (Ach.) Müll. Arg. Flora 65:399. 1882. FIGURE 82

Graphis scalpturata Ach. Syn. Lich. 86. 1814. Type: South America (UPS, isotype). Reactions: KOH+ reddish, P−, no microchemical tests made.

Thallus smooth, continuous. Ascocarps barely emergent, flexuose, 2–6 mm. long, about 0.4 mm. wide, apically rounded, often surrounded by a lighter thalline area; disc flat, wide, black or lightly pruinose;

FIGURE 81.—*Phaeographina leiogrammodes* (Kremplh.) Wirth & Hale (holotype, *Warming* 22).

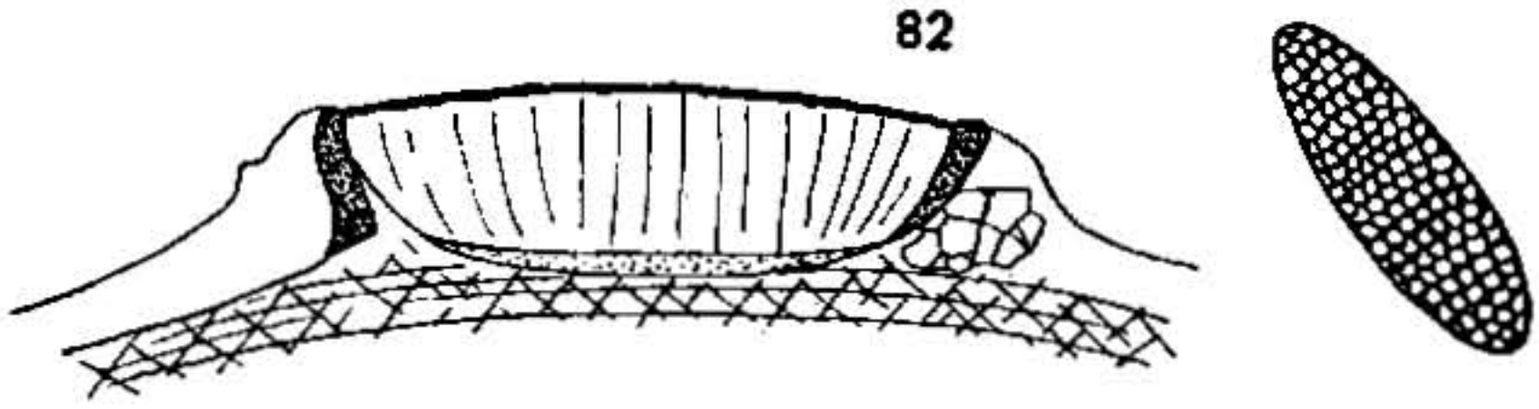


FIGURE 82.—*Phaeographina scalpturata* (Ach.) Müll. Arg. (isotype).

exciple pale brown, open; labia entire, divergent; hymenium clear, 150 μ high. Spores 1 per ascus, densely muriform, 23–26×80–85 μ.

A record from Mexico (*Pringle* 335) reported by Davis (1936) has not been seen. *Phaeographina scalpturata* is evidently a completely misinterpreted species. Many previous workers have mentioned a carbonized exciple and placed the species in section *Eleutheroloma*. Much of the material we have seen under this name, identified by Nylander, Müller, Redinger, etc., has black exciples, huge spores, sessile ascocarps, and prominent thalline margins. This entity, for which we have not been able to determine a specific name, was listed on p. 103 as *Phaeographina* sp. We have examined very few collections, none from Mexico, that can be identified with *P. scalpturata* as here delimited.

57. Phaeographis inusta (Ach.) Müll. Arg. Flora 65:383. 1882. FIGURE 76

Graphis inusta Ach. Syn. Lich. 85. 1814. Type: Canada, *Kalm* (UPS, isotype). Reactions: KOH+ reddish, P−, o-T−, no acids demonstrated.

Thallus continuous, minutely roughened to nitid. Ascocarps semi-emergent, unbranched to sparingly branched, elliptical to lirelline, apically rounded, 0.5–1.2 mm. long, about 0.2 mm. wide, usually without a thalline margin; disc dark brown, slightly concave, wide; exciple red-brown, closed, thickened below; labia entire, divergent, often slightly carbonized; hymenium about 60 μ high. Spores (?6–)8 per ascus, 4 locular, 6–10×16–21 μ.

Nylander's report from Mexico (1858, p. 381) has not been verified. An examination of the isotype of *P. inusta* disclosed that the traditional concept of the species is probably incorrect. *P. inusta* is usually regarded as being much like *P. dendritica*, differing primarily in having an open exciple. However, the authentic material has constantly 4 locular spores and brown closed exciples.

Phaeographis inustoides Fink (holotype: Puerto Rico, *Heller* 4430, MICH) is apparently distinct. It has 5–7 locules per spore, norstictic acid, pale labial apices, and a prominently cellular cortex (chondroid in the sense of Redinger, a fact which throws doubt on his placing this entity as a synonym of *P. punctiformis* (Eschw.) Müll. Arg.).

Type Specimens Examined and Their Chemical Reactions

Graphina

Graphina acharii var. subintegra Zahlbr. [=G. inturgescens (Kremplh. Müll. Arg.]. *Pringle* 5 p.p. (MICH, isosyntype) KOH−, P−.

Graphina acromelaena Müll. Arg. [=G. parilis (Kremplh.) Müll. Arg.]. *Tonduz* s.n. (G, holotype): KOH+ yellow, stictic acid.

Graphina acrophaea Müll. Arg. [=G. parilis (Kremplh.) Müll. Arg.]. *Langlois* 751 (US, isosyntype): KOH+ yellow, stictic acid.

Graphina aibonitensis Fink. *Fink* 2017 (MICH, holotype): KOH+ red, salacinic acid.

Graphina balbisii var. monospora Redgr. *Malme* 494 (S, holotype; FH, isotype): KOH−, P−.

Graphina bipartita Müll. Arg. *Balansa* 1876 (G, holotype): KOH+ red, norstictic acid.

Graphina bothynocarpa Redgr. *Malme* 2464 (S, holotype): KOH−, KC−, P−.

Graphina cinerea Fink. [=G. scolecitis (Tuck.) Fink]. *Fink* 1163 (MICH, holotype): Thallus KOH−, P−; ascocarps KOH+ blackish, P−.

Graphina collatinensis var. lirelliformis Redgr. [=G. confluens (Fée) Müll. Arg.]. *Malme* 84 (S, holotype): norstictic acid.

Graphina corcovadensis Redgr. *Malme* 41 (S, holotype): KOH+ yellow, stictic acid.

Graphina epiglauca Müll. Arg. [=G. confluens (Fée) Müll. Arg.]. *Pittier* s.n. (US, isotype): KOH+ yellow, stictic acid, lichexanthone.

Graphina heteroplacoides Redgr. *Malme* 1227 (S. holotype): KOH+ red, P−, o-T unknown acid.

Graphina incerta Redgr. *Malme* 3644 (S, syntype): KOH−, P−; *Malme* 1890f (S, syntype) [=Graphis (Graphina) leucopepla Tuck.]: P+ red, protocetraric acid.

Graphina interstes Müll. Arg. *Tonduz* s.n. (G. holotype): KOH+ red, o-T unknown acid.

Graphina luridoolivacea Fink. *Fink* 657 (MICH, holotype): KOH+ red, P−, o-T−.

Graphina malmei Redgr. *Malme* 3508 (S, holotype): Thallus KOH− P−; ascocarps cinnabar, KOH+ purple.

Graphina obtectula Müll. Arg. *Tonduz* s.n. (G, holotype): KOH+ yellow, o-T unknown acid.

Graphina olivobrunnea Fink. [=G. scolecitis (Tuck.) Fink]. *Fink* 1224 (MICH, holotype): Thallus KOH−, P−; ascocarps KOH+ purple, P−, o-T−.

Graphina palmeri Zahlbr. *Pringle* 9 (MICH, isotype): KOH+ yellow, o-T unknown acid.

Graphina platycarpa Fink [non G. platycarpa (Eschw. in Mart.) Müll. Arg.] [=G. platycarpina Zahlbr.]. *Fink* 1774 (MICH, holotype): P+ red, protocetraric acid.

Graphina plittii Zahlbr. *Plitt* s.n. (US, BPI, isotypes): KOH+ red, salacinic acid.

Graphina pseudophlyctis var. monospora Redgr. *Malme* 2023, 2177, 3678, 3679 (S, syntypes): KOH−, P—.

Graphina puiggarii Müll. Arg. *Puiggari* 506 (G, holotype): KOH−, P−.

Graphina puiggarii var. corumbensis Redgr. [=G. parilis (Krempth.) Müll. Arg.]. *Malme* 3639, 3636, 3637 (S, syntypes): KOH+ yellow, stictic acid.

Graphina reniformis var. subastroidea Redgr. *Malme* 3520 (S, holotype): P+ red, protocetraric acid and lichexanthone.

Graphina rimulosa Redgr. *Malme* 1089 (S, holotype): KOH+ reddish, P−.

Graphina riopiedrensis Fink. *Fink* 2167 (MICH, holotype): KOH+ yellowish, stictic acid.

Graphina sulcata Fink. *Fink* 659 (MICH, holotype): KOH+ red, norstictic acid.

Graphina sulcatula var. conglomerata Müll. Arg. *Balansa* 4185a (G, syntype): KOH−, P−.

Graphina triangularis Zahlbr. *Pringle* 17 (MICH, isotype): KOH+ yellow-red, o-T unknown acids.

Graphina vestitoides Fink. *Fink* 1986 (MICH, holotype): KOH−, P−.

GRAPHIS

Graphis abaphoides Nyl. (Graphina abaphoides (Nyl.) Müll. Arg.). *Calkins* 134 (US, isosyntype): KOH+ yellowish, P+ red, protocetraric acid and an unknown acid.

Graphis adpressa Vain. *Vainio* 1289 (TUR, holotype): KOH−, P−.

Graphis afzelii Ach. (UPS, isotype): Ascocarps KOH−, P−, C+ red, lecanoric acid.

Graphis albescens Vain. *Vainio* s. n. (TUR, holotype): KOH+ yellow, stictic acid.

Graphis albida Fink. *Fink* 1777 (MICH, holotype): P+ red, protocetraric acid.

Graphis albostriata Vain. [=Graphina albostriata (Vain.) Zahlbr.]. *Vainio* 1538 (TUR, holotype): KOH+ yellow, P−, o-T unknown acid.

Graphis anguinaeformis Vain. [=Graphina anguinaeformis (Vain.) Zahlbr.]. *Vainio* 274 (TUR holotype): KOH−, P−.

Graphis arecae Vain. *Merrill* 6724 US, isotype): KOH+ yellow, stictic acid.

Graphis atroalba Vain. non Krempth. (=G. afzelii Ach.). *Vainio* 189 (TUR, holotype): Ascocarps KOH−, C+ red.

Graphis brachycarpa Vain. *Vainio* 1092 (TUR, holotype): KOH−, P−.

Graphis caesiella Vain. *Vainio* 45 (TUR, holotype): KOH+ red, norstictic acid.

Graphis caesioglauca Redgr. *Malme* 1526 (S, holotype): KOH− P−.

Graphis carassensis Vain. [=Graphina carassensis (Vain.) Zahlbr.]. *Vainio* 1467 (TUR, holotype): KOH+ reddish, P−, no acids demonstrated.

Graphis cladophora Vain. [=Graphina cladophora (Vain.) Zahlbr.]. *Merrill* 7990 (US, isotype): KOH+ red, norstictic acid.

Graphis collosporella Vain. [=Graphina collosporella (Vain.) Zahlbr.]. *Thaxter* 9, 10 (FH, syntypes): KOH+ yellowish, unknown acid.

Graphis compulsa Krempth. [=G. desquamescens Fée]. *Glaziou* 5082 (M, holotype): KOH+ red, norstictic acid.

Graphis dehiscens Vain. [=Graphina!]. *Vainio* 306 (TUR, holotype): KOH+?, P−.

Graphis diaphoroides Müll. Arg. *Lahm* 91 (US, isosyntype): KOH+ red, norstictic acid.

Graphis dimidiata Vain. [=Graphina dimidiata (Vain.) Zahlbr.]. *Vainio* 332 (TUR, holotype): KOH−, P−.

Graphis diorygmatoides Vain. [=Graphina diorygmatoides (Vain.) Zahlbr.]. *Merrill* 8515 (US, isotype): KOH+ red, norstictic acid.

Graphis elongata Vain. [=Graphina elongata (Vain.) Zahlbr.]. *Vainio* 782 (TUR, holotype): KOH+ red, norstictic acid.

Graphis endoxantha Nyl. *Pancher* s.n. (H, holotype): KOH+ reddish, P−.

Graphis eugeniae Vain. *Whitford* 1087 (US, isosyntype): KOH+ red, salacinic acid.

Graphis floridana Tuck. (US, isotype): KOH+ red, norstictic acid.

Graphis granulocarpa Vain. *Vainio* 3680 (TUR, holotype): KOH+ reddish, P−.

Graphis hiascens var. clausior Vain. [=Graphina hiascens var. clausior (Vain.) Zahlbr.]. *Ramos & Edano* 29548 (US, isotype): KOH+ yellow, stictic acid.

Graphis hololeucoides Nyl. [=Graphina hololeucoides (Nyl.) Müll. Arg.]. *Ghiesbreght* s.n. (H, isotype): Ascocarps KOH+ faint yellowish, P+.

Graphis humilis Vain. *Merrill* 9067 (US, isotype): KOH+ red, o-T unknown acid.

Graphis illota Müll. Arg. *Ule* 273 (G, holotype): KOH−, P−.

Graphis immersa Fink. *Fink* 1613 (MICH, holotype): KOH−, P+.

Graphis includens Vain. [=Graphina!]. *Vainio* 765 (TUR, holotype): KOH+ reddish, P−, o-T−.

Graphis inidita var. pularensis Vain. [=Graphina inidita var. pularensis (Vain.) Zahlbr.]. *Ramos* 19446 (US, isotype): KOH+ yellow, stictic acid.

Graphis isidiosa Vain. [=Phaeographina isidiosa (Vain.) Zahlbr.]. *Merrill* 6647 (US, isosyntype): KOH+ red, norstictic acid.

Graphis leucopepla Tuck. [=Graphina!]. *Wilson* 56 (FH, holotype): Thallus KOH−, P−; ascocarps KOH−, P+.

Graphis lutescens Krempth. non Fée [=Phaeographina lutescens (Krempth.) Zahlbr.]. *Glaziou* 3374 (M, holotype): KOH+ red, norstictic acid.

Graphis macgregorii Vain. [=Graphina hiascens (Fée) Müll. Arg.]. *MacGregor* (607 US, isotype): KOH+ red, norstictic acid.

Graphis macrospora Krempth. [=Graphina confluens (Fée) Müll. Arg.]. *Glaziou* 3379 (M, syntype): KOH+ yellow, stictic acid, lichexanthone, a fatty substance.

Graphis miniata Redgr. [=Phaeographina chrysocarpa (Raddi) Redgr.]. *Mosén* 3145, 3313, 3577 (S, syntypes): Thallus KOH−, P−; ascocarps KOH+ purple.

Graphis olivacea Redgr. *Malme* 2267 (S, holotype): KOH+ reddish, P−.

Graphis orientalis Vain. [=Graphina hiascens (Fée) Müll. Arg.]. *Merrill* 6716 (US, isotype): KOH+ red, norstictic acid.

Graphis oscitans Tuck. [=Phaeographina oscitans (Tuck.) Zahlbr.]. *Mann*, s.n. (US, isotype): KOH+ yellow, stictic acid.

Graphis peralbida Nyl. [=Graphina bipartita Müll. Arg.]. *Pringle* 222 (H, holotype; FH, VT, isotypes): KOH+ red, norstictic acid.

Graphis phaeospora Vain. [=Graphina inturgescens (Krempth.) Müll. Arg.]. *Vainio* 682 (TUR, holotype): KOH−, P−.

Graphis pseudosophistica Vain. [=Graphina pseudosophistica (Vain.) Zahlbr.]. *Vainio* 757 (TUR, syntype): KOH+ reddish, P−, o-T unknown acid; *Vainio* 1003 (TUR, syntype): KOH+ red, P−; *Vainio* 1404 (TUR, syntype): KOH−, P−.

Graphis rimulosa var. lignicola Fink. *Fink* 1873 (MICH, holotype): KOH−, P−.

Graphis sitiana Vain. *Vainio* 533 (TUR, holotype): KOH−, P−.

Graphis subamylacea Zahlbr. *Pringle* 24 (MICH, isotype): KOH+ yellow, stictic acid.

Graphis subcabbalistica Vain. [=Graphina!]. *Vainio* 1246 (TUR, holotype): KOH+ reddish, P−.

Graphis subducta Vain. [=Graphina parilis (Krempth.) Müll. Arg.]. *Merrill* 8576 (US, isotype): KOH+ yellow, stictic acid.

Graphis subelegans Nyl. [=G. endoxantha Nyl.]. *Pringle* 162 (H, holotype): KOH+ red, P−.

Graphis subparilis Nyl. *Calkins* s.n. (US, isotype): Thallus KOH−, P−; ascocarps KOH+ purple.

Graphis subserpentina Nyl. [=Graphina hiascens (Fée) Müll. Arg.]. *Gardner* s.n. (US, isotype): KOH+ red, norstictic acid.

Graphis tongloensis Vain. *Merrill* 7985 (US, isotype): KOH−, P−.

Graphis tumidella Fink. *Fink* 1737 (MICH, holotype): KOH−, P−.

Graphis turbulenta Nyl. *Calkins* s.n. (US, isotype): KOH+ red, norstictic acid.

Graphis virens Müll. Arg. *Ule* 275 (G, holotype): KOH+ red, P−, o-T−.

Graphis yaucoensis Fink [=G. caesiella Vain.]. *Fink* 1691 (MICH, holotype): KOH+ red, norstictic acid.

Medusulina

Medusulina texana Müll. Arg. *Eckfeldt* 56A (G, holotype): KOH+ yellow, stictic acid.

Opegrapha

Opegrapha dendritica Ach. [=Phaeographis dendritica (Ach.) Müll. Arg.]. (UPS, isotype): KOH+ red, norstictic acid.

Phaeographina

Phaeographina caesiopruinosa var. abbreviata Redgr. *Malme* 1888, 1492, 1562 (S, syntypes): KOH+ red, P−, o-T−.

Phaeographina difformis Fink. *Fink* 1874 (MICH, holotype): KOH−, P−.

Phaeographina epruinosa Redgr. [=P. explicans Fink in Hedrick]. *Malme* 3662 (S, holotype): KOH+ yellow-red, o-T−.

Phaeographina myriogloena Müll. Arg. *Leprieur* 196 (G, holotype): KOH+ red, P−, o-T−.

Phaeographina oxalifera Redgr. *Malme* 3664 (S, syntype): KOH+ red, norstictic acid.

Phaeographina rhodoplaca Müll. Arg. *Tonduz* s.n. (G, holotype): KOH−, P−.

Phaeographis

Phaeographis astroidea Müll. Arg. [=Graphis!]. *Tonduz* s.n. (G, holotype): KOH+ reddish, P−.

Phaeographis cerviculata Redgr. [=Graphina!]. *Malme* 3531 (S, holotype): KOH+ reddish, P−.

Phaeographis inustioides Fink. *Heller* 4430 (MICH, holotype): KOH+ red, norstictic acid and an unknown acid.

Phaeographis pezizoidea var. pruinosa Redgr. *Malme* 2586C, 2030 (S, syntypes): KOH+ red, norstictic acid.

Phaeographis praestans Müll. Arg. [=Graphis!]. *Tonduz* s.n. (G, holotype): KOH−, P−.

Phaeographis radiatoramosa Redgr. *Mosén* 3578 (S, holotype): KOH+ red, norstictic acid.

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