

Fourteen new *Carbacanthographis* species from the Neotropics, with ecological observation

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Abstract. A revision of neotropical specimens of the genus *Carbacanthographis* (*Graphidaceae*, lichenized fungi) revealed the presence of 14 undescribed species: *Carbacanthographis bulbosa*, *C. clandestinospora*, *C. cristata*, *C. denudata*, *C. granulosa*, *C. inspersomarcenscens*, *C. isidiata*, *C. latisporoides*, *C. lucidocleitops*, *C. minutissima*, *C. multiseptatoides*, *C. nigra*, *C. nitida*, and *C. protocristata*. They are presented below. The genus appears to have a diversity center in semideciduous forests of northern South America, with up to 7 different species on a single tree.

Key words: altitudinal zonation, lichen systematics, primary forest, semi-deciduous forest, tree inventory

Introduction

The genus *Carbacanthographis* Staiger & Kalb belongs to the family *Graphidaceae* (Staiger & Kalb 1999; Staiger 2002). Superficially, it resembles strongly the genera *Allographa* Chevall. and *Graphis* Adans. (Lücking et al. 2009; Lücking & Kalb 2018) with which it shares *Trentepohlia*-like photobionts, a usually carbonized, lirelliform excipulum and colourless, transversely septate or muriform ascospores. It differs from these genera by a different apical structure of the excipulum. The excipulum extends above the hamathecium and the two lips do not close above it, but leave a fissure. The walls of this fissure are covered at the tips by warty periphysoids, which are, however, difficult to observe and were rarely seen during our studies. The hamathecium does not extend into the fissure and leaves a hollow below it (e.g., Staiger 2002, Abb. 18). In *Allographa* and *Graphis*, on the contrary, the hamathecium reaches the contact zone between the excipulum lips and fills it, and periphysoids are absent. The excipulum may have somewhat radiating and apically emergent, smooth hyphae, however. The interrupted growth of the carbonized excipulum, which causes striate lirellae in many species of *Graphis* and *Allographa*, is less evident in *Carbacanthographis*, and clearly striate lirellae are seen only when abraded, e.g., in *C. latispora* Feuerstein & Lücking (Feuerstein et al. 2022, fig. 4E).

The ascospores are also different. In *Allographa* and *Graphis* (Lücking 2009; Lücking et al. 2009), the spore lumina become rounded to lentiform by endospore deposition, and the ascospores have a strong I+ blue-violet color reaction. In *Carbacanthographis*, the ascospores of some species have rounded to lentiform lumina, but then they lack a positive I-reaction. In the other species, little or no endospore is formed, the septa remain thin, and these ascospores may or may not have a positive I-reaction. The inspersion of the hamathecium seems also different from that in *Graphis* and *Allographa*. In these genera, the inspersion is composed of rather large, very unequal, usually several μm wide oil-like droplets, while in *Carbacanthographis* the inspersion consists of minute droplets $\sim 0.5\text{--}1\ \mu\text{m}$ wide (“schwach inspers” in Staiger 2002).

The recent revision of the genus *Carbacanthographis* (Feuerstein et al. 2022), which raised the number of known species to 41, was a great step forward and of much help for our study of further samples of this genus. It allowed us to recognize 14 additional new species, which are presented here and further new species are showing up, e.g., in Aptroot et al. (2022). The genus appears to have a diversity center in our study areas, the Amazonian lowland forests of Brazil and the Guianas. The results of a full inventory of lichens on 18 trees in southern Guyana in 1992 give an impression of the distribution of *Carbacanthographis* species in these trees.

Material and methods

The investigated specimens were collected during several regional inventories of lichens in the Guianas and Brazil.

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They are stored in the herbaria of the Botanical Museum in Berlin (B), of the university of Guyana (BRG), of the Universidade Federal de Sergipe, Campus Professor Alberto Carvalho (ISE), and the personal herbarium of one of the authors (ABL). They were investigated in the usual way by stereomicroscope (dry specimens) and compound microscope (preparations in tap water, without addition of KOH). Ascospores were studied in squash preparations of thick hamathecium sections, so that sufficient spores are available to observe the variation in size and the disposition of the spores inside the ascus. The chemistry was investigated by long-wave UV fluorescence, spot tests and TLC (Orange et al. 2001). Spot tests were done incidentally, and the reactions given in the descriptions are mostly estimated from the chemical content indicated by TLC using solvents A, B and C.

Results

Ecological observations

Here follows an impression of the distribution of *Carbacanthographis* species in neotropical primary forest. It concerns results from an unpublished lichen inventory of 18 trees of different size and sort in an area around the site Kuyuwini Landing in semi-deciduous forest south of the Rupununi savanna in southern Guyana in 1992 (Table 1, extracted from the Lichcol database, <https://archive.bgbm.org/scripts/ASP/lichcol/>). Twelve different species of *Carbacanthographis* were observed on eight of the investigated trees. No species was found on a bit more than half of the trees, 10, including palms, saplings in the undergrowth, and fast-growing trees like *Schefflera*

Table 1. Phorophyte and altitudinal zonation of *Carbacanthographis* species in primary, semi-deciduous forest near Kuyuwini Landing, southern Guyana. Phorophyte data: Tree 1: 60 cm dbh, 32 m tall *Ormosia flava* (MJ 2847, Legumonosae); tree 3: 4 cm dbh, 6 m tall indet. undergrowth tree (*Chrysobalanaceae*); tree 5: 30 m tall *Hymenaea courbaril* (MJ 2828, *Papilionaceae*); tree 6: 32 cm dbh, 28 m tall *Catostemma fragrans* (MJ 3112, *Bombacaceae*); tree 7: 16 cm dbh, 15 m tall *Licania sprucei* undergrowth tree (MJ 3154, *Chrysobalanaceae*); tree 8: 50 cm dbh, 32 m tall *Parinari rodolphii* (MJ 3101, *Chrysobalanaceae*); tree 12: 35 cm dbh, 30 m tall *Laetia procera* (MJ 3001, *Flacourtiaceae*); tree 18: 33 cm dbh, 25 m tall *Hirtella bicornis* var. *pubescens* (MJ 3054, *Chrysobalanaceae*).

<i>Carbacanthographis</i>	Tree nr	Altitudinal range
<i>denudata</i> spec. nov.	5, 6, 8	15–30 m (twigs)
<i>latispora</i> Feuerstein & Lücking	5, 6, 12, 18	15–30 m (twigs)
<i>lucidocleitops</i> spec. nov.	1, 5, 6	20–32 m
<i>marcescens</i> (Fée) Staiger & Kalb	1, 5, 6, 18	10–30 m
<i>minutissima</i> spec. nov.	8	25–30 m (twigs)
<i>multiseptata</i> Feuerstein & Lücking	1, 6, 7	10–32 m (twigs)
<i>multiseptatoides</i> spec. nov.	1, 18	20–32 m (twigs)
<i>protocrenata</i> spec. nov.	6	20–28 m
<i>stictica</i> Staiger & Kalb	3, 5, 6, 7, 12	0–15 m (twigs)
<i>subalbotecta</i> Staiger & Kalb	7	10–15 m (twigs)
<i>subchionophora</i> Feuerstein & Lücking	8	25–30 m (twigs)
<i>violaceospora</i> Kukwa & Flakus	1, 5	25–32 m

morototonii. One species, *C. stictica* Staiger & Kalb, was found exclusively on the lower part of the trunks below 15 m. *Carbacanthographis marcescens* (Fée) Staiger & Kalb was found at 10–25 m and the other 10 species were found above 15 m in the canopy, often on twigs. The most common species was *C. stictica*, found on five trees. *Carbacanthographis latispora* and *C. marcescens* were found on four trees, and *C. denudata* sp. nov., *C. lucidocleitops* sp. nov. and *C. multiseptata* Feuerstein & Lücking on three trees. The other species were found only on one or two trees. Considering the number of *Carbacanthographis* species per phorophyte, 7 species were found on tree no. 6 (28 m tall); 6 species on tree no. 5 (30 m tall); 5 species on tree no. 1 (32 m tall); 3 species on tree no. 7 (15 m tall), 8 (32 m tall) and 18 (25 m tall); 2 species were found on tree no. 12 (30 m tall) while only one species was found on the small undergrowth of tree no. 3 (6 m tall). Also, the different ascocarp forms have an altitudinal zonation. Below 20 m only species with regular, *Graphis*-like ascomata occur (*C. marcescens*, *C. stictica*). Only found in the canopy, often on twigs, are the morphologically deviating ascocarps: the crest-like, very tall lirellae of *C. cristata*, *C. latisporoides*, *C. multiseptatoides* and *C. protocristata*, the abbreviated, round lirellae of *C. latispora* and *C. multiseptata*, and the very reduced ascocarps of *C. minutissima*.

The new species

Carbacanthographis bulbosa Aptroot & M. Cáceres, sp. nov. (Fig. 1)

Mycobank MB 849511

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following characters: thallus verrucose with corticate warts, with protocetraric and norstictic acid; apothecia immersed in the thallus to emergent; ascospores 2–4/ascus, ellipsoid, I-negative, transversely 27–31-septate, 140–200 × 13–26 µm, with thin septa.

Type: Brazil, Rondônia: Porto Velho, Parque Natural Municipal, alt. 100 m, 8°41'10"S, 63°52'05"W, on tree in rain forest, 16 Nov. 2012, M.E.S. Cáceres 15242 & A. Aptroot (ISE – holotype!; ABL – isotype!).

Description. Thallus corticolous, crustose, continuous, verrucose with more or less hemispherical corticate warts of ~0.2–0.3 mm diam., corticate, somewhat shiny, dirty white, up to 5 cm diam., up to 0.1 mm thick, not surrounded by a prothallus; isidia and soralia absent. Photobiont trentepohlioid. Ascomata linear in outline, immersed in the thallus to emergent, solitary, often branched, 0.5–0.7 mm wide, up to 2 mm long, ~0.3 mm high, disc completely closed and only white slit visible, ~0.05 mm wide; labia covered by thallus, including warts, with complete thalline margin. Excipulum completely carbonized. Hamathecium not interspersed, with smooth paraphyses. Ascospores 2–4/ascus, ellipsoid, hyaline, I-negative, transversely septate, 140–200 × 13–26 µm, 27–31-septate, with thin septa, without gelatinous sheath. Pycnidia not observed.

Chemistry. Thallus UV–, K+ yellow turning red, C–, KC–, P+ red. TLC: protocetraric and norstictic acids.



Figure 1. *Carbacanthographis bulbosa* (Cáceres 15242). Scale = 2 mm

Etymology. Named after the warty thallus.

Ecology and distribution. On tree bark in primary rain forest; only known from Brazil.

Remarks. This species is well characterized by its coarse and dense, corticate thallus warts, unlike any other *Carbacanthothesis* species. The most similar species, *C. muriformis* E. Tripp & Lendemer, shares the lirelliform, not crest-shaped ascocarps and large, muriform, I-negative ascospores, and differs by the smooth thallus, the smaller ascospores measuring $114\text{--}162 \times 9\text{--}15 \mu\text{m}$ instead of $140\text{--}200 \times 13\text{--}26 \mu\text{m}$ and the absence of norstictic acid (Feuerstein et al. 2022).

It would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 2 at couplet 8 as: Ascospores $140\text{--}200 \times 13\text{--}26 \mu\text{m}$, 27–31-septate; norstictic and protocetraric acids.

Carbacanthographis clandestinospora Aptroot & M. Cáceres, sp. nov. (Fig. 2)

Mycobank MB 849512

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following characters: thallus verrucose, pseudocyphellate; ascospores with lentiform lumina, I-negative, transversely 7–9-septate, $23\text{--}30 \times 5.5\text{--}7 \mu\text{m}$.

Type: Brazil, Pará: Dom Eliseu, Vila Nazaré, S Fazenda Pantera, alt. 120 m, $3^{\circ}53'56''\text{S}$, $48^{\circ}05'44''\text{W}$, on tree bark in primary rain forest, 29 Oct. 2016, M.E.S. Cáceres & A. Aptroot ISE 40269 (ISE – holotype!; ABL – isotype!).

Description. Thallus corticolous, crustose, continuous, not corticate, dull, pale greenish grey, with scattered, somewhat irregular, concolorous, hemispherical verrucae of ~ 0.1 mm diam., which open apically into pseudocyphellae or almost soralia, occupying areas of up to 15 cm, under 0.1 mm thick, not surrounded by a prothallus; isidia and soralia absent. Photobiont trentepohlioid. Ascomata linear in outline, sessile, solitary, slightly wavy, rarely branched, 0.7–1.2 mm wide, up to 4 mm long, ~ 0.5 mm high, disc closed, labia striate, completely covered by thallus. Excipulum completely carbonized. Hamathecium $\sim 120 \mu\text{m}$ high, finely interspersed with oil droplets, with smooth paraphyses. Ascospores 8/ascus, clavate, hyaline, I-negative, transversely septate, $23\text{--}30 \times 5.5\text{--}7 \mu\text{m}$, 7–9-septate, with thickened septa and lenticular lumina, surrounded by a $1 \mu\text{m}$ thick gelatinous sheath. Pycnidia not observed.

Chemistry. Thallus UV–, K+ yellow turning orange, C–, KC–, P+ orange. TLC: stictic, cryptostictic (trace) and constictic (trace) acids.

Etymology. Named after the similarity of the I-negative ascospores with *Clandestinotrema* Rivas Plata, Lücking & Lumbsch.

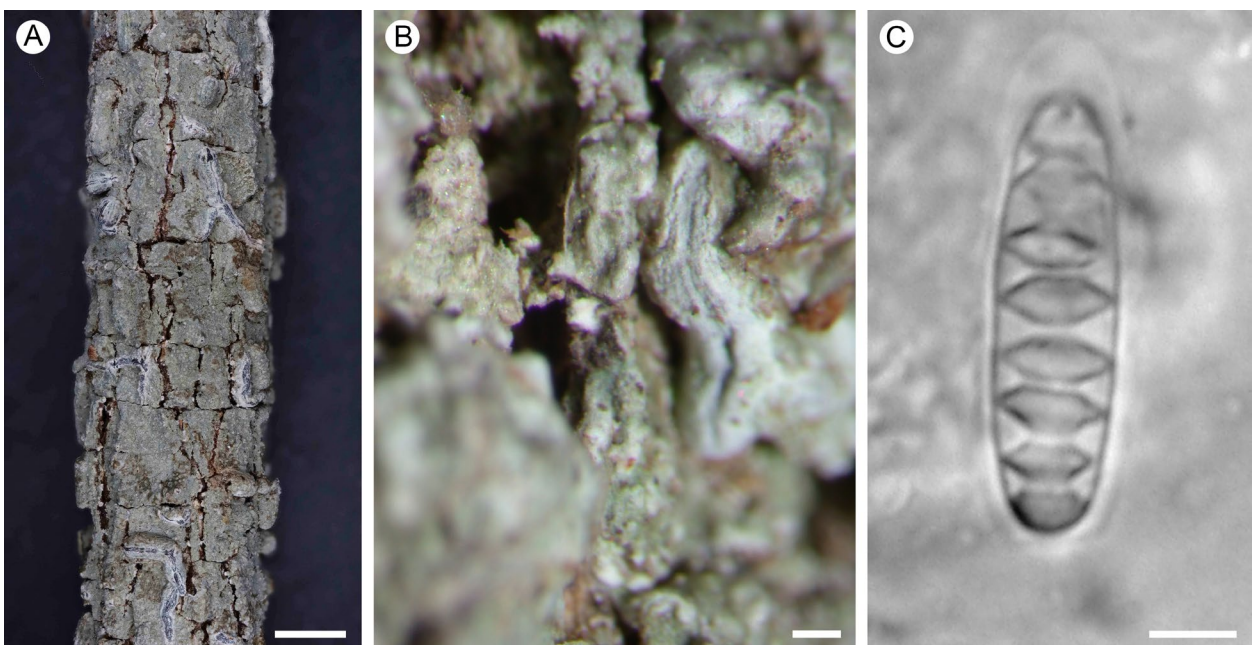


Figure 2. *Carbacanthographis clandestinospora* (Cáceres 40269). A – habit; B – ascocarp and white-tipped (pseudocyphellate) thallus warts; C – ascospore. Scales: A = 2 mm; B = 0.2 mm; C = 5 μm .

Ecology and distribution. On tree bark in primary rain forest; only known from Brazil.

Additional specimens examined (paratypes). BRAZIL. Same as the type, ISE 40234 (ISE!, ABL!). GUYANA. Potaro-Siparuni Region: Kaiteur Falls National Park, around the airstrip, alt. ~400 m, 5°10'N, 59°29'W, Sandstone tableland with premontane sclerophyllous forest, in ~20 m tall forest in narrow valley, 19 Feb. 1996, H. Sipman 40572 [B 60 0209591].

Remarks. This species is well characterized by the verrucose thallus, that becomes pseudocyphellate on the tips of small verrucae, and the lenticular ascospore lumina. It is most similar with *C. stictica*, which differs by the absence of thallus verrucae and the thinner lirellae, 0.3–0.6 mm wide instead of 0.7–1.2 mm wide, without thick thallus cover that may become abraded (Staiger 2002).

The new species would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 2 at couplet 2 as: Thallus warty, the warts becoming apically pseudocyphellate; ascomata sessile; ascospores 23–30 × 5.5–7 µm, 7–9-septate; stictic, cryptostictic (trace) and constictic (trace) acids.

Carbacanthographis cristata Aptroot & M. Cáceres, sp. nov. (Fig. 3)

Mycobank MB 849514

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following characters: thallus with lichexanthone; apothecia sessile, crest-like; ascospores densely muriform, 53–61 × 13–16 µm.

Type: Brazil, Mato Grosso: Chapada dos Guimarães, Pousada do Parque private area, alt. 700 m, 15°26'50"S, 55°49'50"W, on tree bark in primary forest, 12–18 Sep. 2020, A. Aptroot 81941 & M.F. Souza (CGMS – holotype!; ABL – isotype!).

Description. Thallus corticolous, crustose, continuous, corticate, dull, white, occupying areas of up to 15 cm, ~0.1 mm thick, not surrounded by a prothallus; isidia and soralia absent. Photobiont trentepohlioid. Ascomata linear in outline, sessile, solitary, slightly wavy, never branched, 0.4–0.7 mm wide, up to 2 mm long, ~0.5 mm high, crest-like, disc closed, labia striate, completely covered by thallus. Excipulum completely carbonized. Hamathecium not interspersed, with smooth paraphyses. Ascospores 8/ascus, long ellipsoid, hyaline, regularly and densely muriform, 53–61 × 13–16 µm, with rounded lumina, surrounded by a 1 µm thick gelatinous sheath. Pycnidia not observed.



Figure 3. *Carbacanthographis cristata* (Aptroot 81941). Scale = 1 cm.

Chemistry. Thallus UV+ yellow, K–, C–, KC–, P–. TLC: lichexanthone.

Etymology. Named after the tall, mountain crest-like (Latin: *crista*) ascomata.

Ecology and distribution. On tree bark in primary rain forest; only known from the type specimen from Mato Grosso, Brazil.

Remarks. This species is well characterized by the sessile, crest-like apothecia and the lichexanthone in the thallus. The closest species, *C. violaceospora* Kukwa & Flakus, shares the presence of lichexanthone and large, muriform ascospores, and differs by the additional presence of protocetraric acid, the lower, not crest-shaped ascomata and the larger, I+ blue-violet ascospores measuring 90–165 × 9–14 instead of 53–61 × 13–16 µm (Feuerstein et al. 2022).

It would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 3 at couplet 2 as: Ascospores 8 per ascus, 53–61 × 13–16 µm; ascomata crest-like.

Carbacanthographis denudata Sipman, sp. nov.

(Fig. 4)

Mycobank MB 849515

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following characters: thallus with stictic acid aggregate; ascomata without thallus cover or with a narrow basal thallus band; ascospores 1/ascus, I+ blue-violet, regularly and densely muriform, (70–)100–125 × 22–30 µm, ~30 × 7-septate, with thin septa.

Type: Guyana, Upper Takutu district, ~40 km S of Aishalton, Kuyuwini Landing, S-shore of Kuyuwini river, along trail to Kassikaityu river, alt. ~230 m, 59°15'W, 2°06'N, 20–25 m high on 30 m tall *Hymenaea courbaril* (MJ 2828, Papilionac.) tree in ~30 m tall, seasonally dry, undisturbed forest, 10–13 Oct. 1992, H. Sipman 64685 (BRG – holotype!; B 60 0206687 – isotype!).

Description. Thallus corticolous, crustose, continuous, corticate, dull, white, occupying areas of up to 5 cm, ~0.1 mm thick, sometimes with a thin, blackish prothallus; isidia and soralia absent. Photobiont trentepohlioid. Ascomata linear in outline, sessile, solitary, slightly wavy, rarely branched, 0.4–0.6 mm wide, 0.6–1.5 mm long, ~0.5 mm high, disc closed, labia weakly striate, grey to black and without thallus cover or with a narrow basal thallus band. Excipulum completely carbonized. Periphysoids observed, verrucose. Hamathecium 100–180 µm, not interspersed, with smooth paraphyses. Ascospores 1/ascus, long ellipsoid, hyaline, I+ blue-violet, regularly and densely muriform, (70–)100–125 × 22–30 µm, ~30 × 7-septate, with thin septa and indistinct principal septa. Pycnidia not observed.

Chemistry. Thallus UV–, K+ yellow turning orange, C–, KC–, P+ orange. TLC: stictic, cryptostictic (trace) and constictic (trace) acids.

Etymology. Epithet derived from the Latin word for naked, because the black part of the ascomata is mostly exposed.

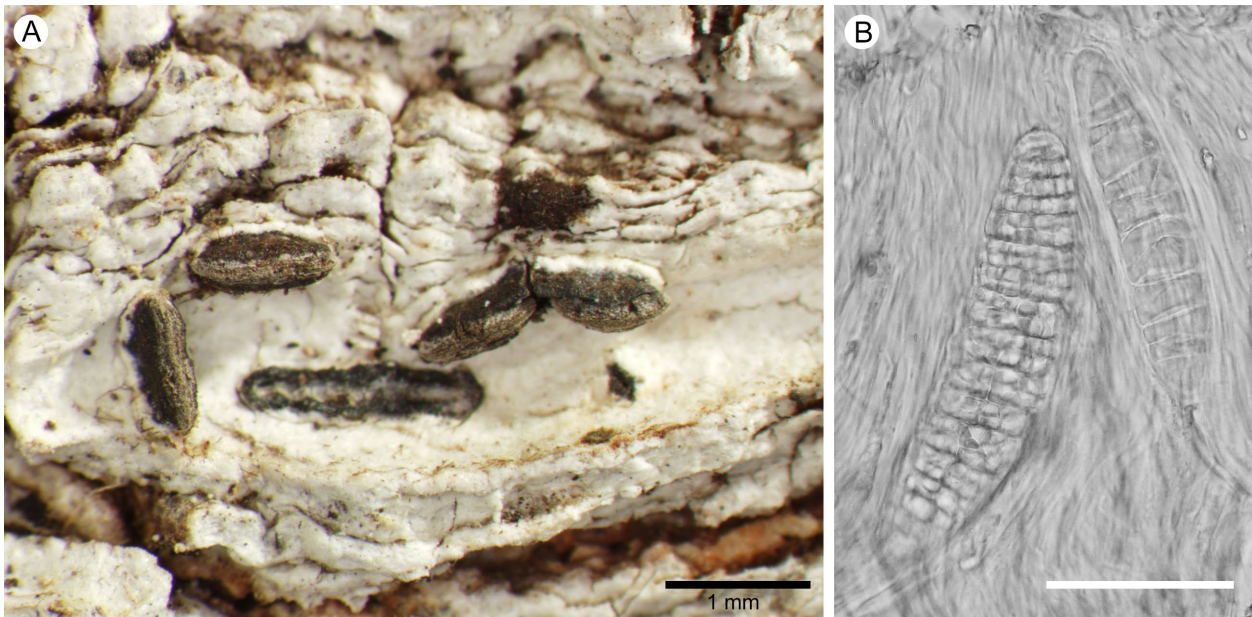


Figure 4. *Carbacanthographis denudata* (Sipman 64658). A – habit; B – full-grown (left) and young (right) ascospores. Scales: A = 1 mm; B = 50 µm.

Distribution and ecology. Known so far from Guyana and Venezuela (Bolivar), growing on canopy twigs and branchlets in semideciduous forest. Host trees: *Catostemma fragrans*, *Hymenaea courbaril*, *Parinari rodolphii*.

Additional specimens examined (paratypes). GUYANA. Upper Takutu district, ~40 km S of Aishalton, Kuyuwini Landing, S-shore of Kuyuwini river along trail to Kassikaityu river, alt. ~230 m, 59°15'W, 2°06'N. 15–20 m high on 30 m tall *Hymenaea courbaril* (MJ 2828, Papilionac.) tree in ~30 m tall, seasonally dry, undisturbed forest. 10–13 Oct. 1992, H. Sipman in 64647 = *Megalalaria endochroma* [B 60 0206650]; id., 20–28 m high on twigs on 32 cm dbh, 28 m tall *Catostemma fragrans* (MJ 3112, Bombacac.) tree in ~30 m tall, seasonally dry, undisturbed forest. 26–28 Oct. 1992. H. Sipman 65125a [B 60 0208420]; id., 25–30 m high on twigs on 50 cm dbh, 32 m tall *Parinari rodolphii* (MJ 3101, Chrysobalanac.) tree in ~30 m tall, seasonally dry, undisturbed forest. 29 Oct. 1992. H. Sipman 65402 [B 60 0207378]. VENEZUELA. Estado BOLIVAR. Cerro Guaiquinima: In central part of upper plateau (near camp 4), alt. ~950 m, ~63°34'W, 5°40'N, low, mossy forest on rocky sandstone slope towards stream, 6 February 1990, H. Sipman 26639 [VEN – holotype; B 60 0084192 – isotype!].

Remarks. *Carbacanthographis denudata* belongs to the group of species with stictic acid aggregate and single, large, muriform ascospores over 100 µm long. Among these species, *C. cleitops* (Fée) Lücking differs by the laterally carbonized excipulum and the white-covered lirellae. The other two species, *C. crassa* (Müll. Arg.) Staiger & Kalb and *C. megalospora* Feuerstein & Lücking, have larger ascospores, mostly over 125 µm long and the carbonized excipulum covered by a whitish layer (Feuerstein et al. 2022).

The new species would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 3 at couplet 5 as: Thallus corticate, smooth; ascospores (70–)100–125 × 22–30 µm; ascomata brown, not covered by whitish layer.

***Carbacanthographis granulosa* Sipman, sp. nov.**

(Fig. 5)

Mycobank MB 849516

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following characters: thallus with white, verruculose to granular surface, with protocetraric acid; excipulum completely carbonized; ascospores hyaline, transversely septate, to 8/ascus, ~24–25 × 7–8 µm, 8-septate, I-negative, with thin septa and wall.

Type: Guyana, Potaro-Siparuni Region, surroundings of Paramakatoi village: Para Mountain, alt. ~1000 m, 59°43'W, 4°41'N, epiphyte in forest on mountain ridge, 25 Feb. 1996, H. Sipman 41428 (BRG – holotype!; B 60 0209704 – isotype!).

Description. Thallus corticolous, crustose, continuous, not corticate, dull, white, occupying areas of up to 10 cm, ~0.1 mm thick, with warty to granulose surface, surrounded by a thin, brownish, felty prothallus; granules not corticate, ~100 µm in diam.; isidia and soralia absent. Photobiont trentepohlioid. Ascomata linear in outline, sessile, solitary, slightly wavy, somewhat branched, 0.5–0.6 mm wide, divided in fragments ~1–3 mm long, ~0.5 mm high, disc closed, labia not striate, white, laterally granular. Excipulum completely carbonized. Periphysoids observed, ~20 × 4 µm, verrucose. Hamathecium 100 µm, not interspersed, with smooth paraphyses. Ascospores up to 8/ascus, long ellipsoid, hyaline, I-negative to pale bluish, transversely septate, 24–33 × 7–8 µm, 8-septate, with thin septa. Pycnidia not observed.

Chemistry. Thallus UV+ yellow, K–, C–, KC–, P+ red. TLC: protocetraric acid.

Etymology. The epithet expresses the granulose surface of the thallus.

Distribution and ecology. Known from a single specimen from montane forest in Guyana.

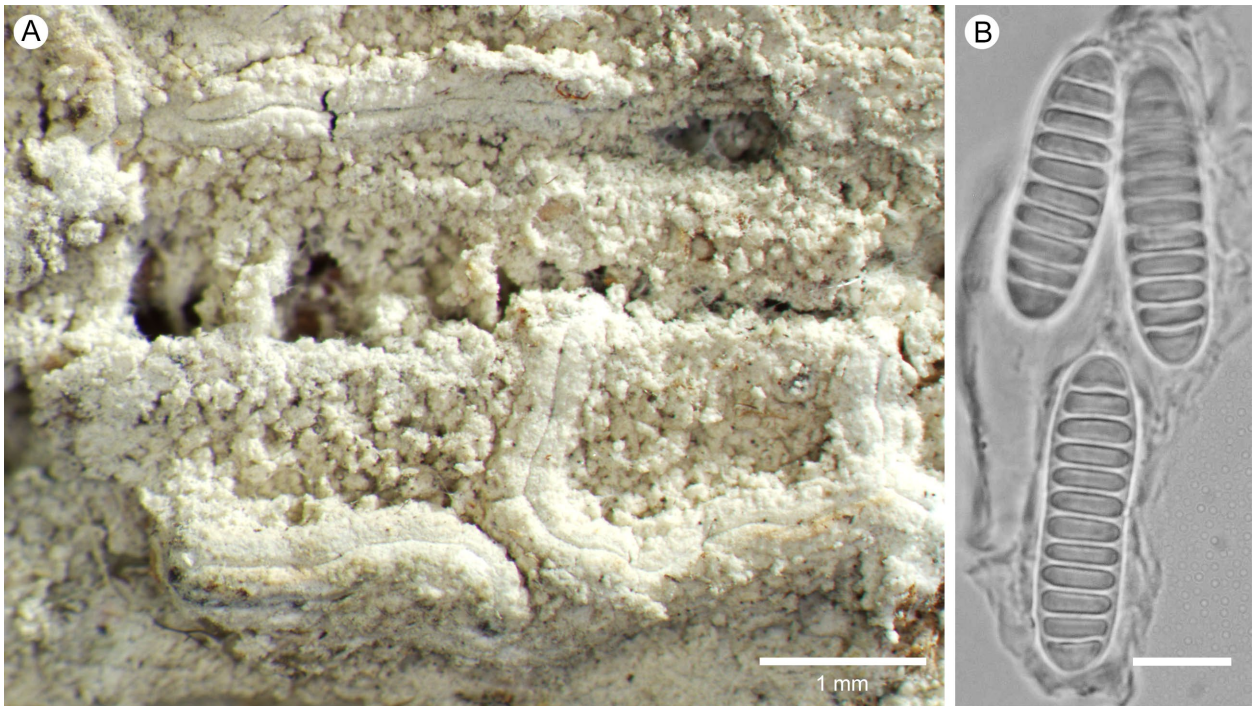


Figure 5. *Carbacanthographis granulosa* (Sipman 41428). A – habit; B – ascospores. Scales: A = 1 mm; B = 10 µm.

Remarks. *Carbacanthographis granulosa* is similar with *C. subchionophora* and differs most clearly because its thallus and ascomata are covered by a granular layer and its ascospores are wider, 7–8 instead of 5 µm wide (Feuerstein et al. 2022).

The new species would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 2 at couplet 15 as: Ascospores $24\text{--}33 \times 7\text{--}8 \mu\text{m}$, 8-septate; thallus granular, not smooth.

Carbacanthographis inspersomarcenscens Aptroot & M. Cáceres, sp. nov. (Fig. 6)

Mycobank MB 849517

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following characters: thallus with salazinic acid; excipulum laterally carbonized; hamathecium finely inspersed; ascospores small, muriform.

Type: Brazil, Amapá: Floresta Nacional do Amapá, upstream of the station, alt. 30 m, $0^{\circ}58'N$, $51^{\circ}36'W$, on tree bark in primary forest, 20 Aug. 2015, M.E.S. Cáceres & A. Aptroot ISE 27346 (ISE – holotype!; ABL – isotype!).

Description. Thallus corticolous, crustose, continuous, following the surface of the substratum, not corticate, dull, pale metallic grey, up to 10 cm diam., up to 0.1 mm thick, not surrounded by a prothallus or with thin, dark brown prothallus; isidia and soralia absent. Photobiont trentepohlioid. Ascomata linear in outline, erumpent, finally superficial on the thallus, solitary, wavy and often sparingly branched, 0.2–0.4 mm wide, up to 10 mm long, 0.2–0.4 mm high, disc closed; labia slightly striate, black but thickly white pruinose, without thalline margin. Excipulum laterally carbonized. Hamathecium 60–90 µm high, finely inspersed with ~0.5 mm wide oily droplets, with

smooth paraphyses. Ascospores 8/ascus, ellipsoid, hyaline, I-negative, muriform, $10\text{--}12\text{--}(16) \times 5\text{--}7 \mu\text{m}$, 3–4(–5) \times (0–)1–2-septate, with rounded lumina, without gelatinous sheath. Pycnidia not observed.

Chemistry. Thallus UV–, K+ red, C–, KC–, P+ orange. TLC: salazinic acid.

Etymology. Named after the strong similarity with *C. marcescens* and the inspersed hymenium.

Ecology and distribution. On tree bark in primary rain forest; only known from Brazil.

Additional specimens examined. COLOMBIA. Caqueta, 2.5 km NE of Araracuara, alt. 250 m, $0^{\circ}37'S$, $72^{\circ}23'W$, ~30 m tall, hardly disturbed forest on Low Terrace of river Caquetá (parcelas de Marcela Torres), Epiphytic, 31 Oct. 1988, H. Sipman & J. Duivenvoorden 27922 (B 60 0144424, ARA). FRENCH GUYANA. Saül, near Roche Bateau, alt. 200–300 m, $3^{\circ}38'N$, $53^{\circ}10'W$, Primary forest, on 40 cm, diam tree, March 1985, A. Aptroot 15372 (B 60 0061703); Upper Mazaruni district, E-bank of Waruma river, ~4 km S of confluence with Kako river (campsite 1), alt. 550 m, $5^{\circ}28'N$, $60^{\circ}47'W$, in ~25 m tall virgin riverain forest, on 15 cm diam. trunk, 9 Feb. 1985, H. Sipman & A. Aptroot 18619 (B 60 0204755); id., Mt. Latipu, ~8 km N of Kamarang, alt. ~600 m, $5^{\circ}57'N$, $60^{\circ}38'W$, in ~15 m tall forest on N-foot, on 50 cm diam. tree trunk, 24 Feb. 1985, H. Sipman & A. Aptroot 18980 (B 60 0204757), 19004 (B 60 0204013, Lichenotheca Latinoamericana 125); Upper Takutu district, ~40 km S of Aishalton, Kuyuwini Landing, S-shore of Kuyuwini river along trail to Kassikaityu river, alt. ~230 m, $2^{\circ}06'N$, $59^{\circ}15'W$, 25–30 m high on 30 m tall *Hymenaea courbaril* (MJ 2828) tree in ~30 m tall, seasonally dry, undisturbed forest, 10–13 Oct. 1992, H. Sipman 64802 (B 60 0206801); Region 7 (Upper Mazaruni Distr.), Paruima Mission, Rain Mountain SE of the village, alt. ~600 m, $5^{\circ}48'N$, $61^{\circ}04'W$, ~25 m tall primary forest on top plateau, 30 April 1997, H. Sipman 39518 (B 60 0165616, BRG, US).

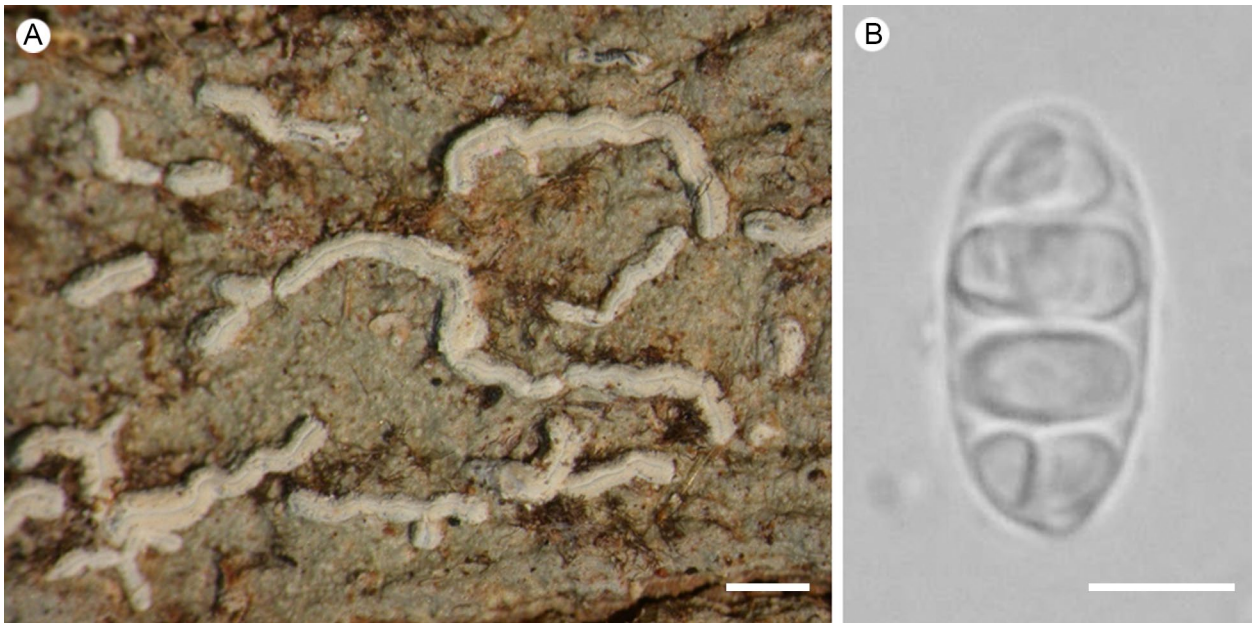


Figure 6. *Carbacanthographis inspersomarcescens*. A – habit (Cáceres 27346); B – ascospore (Sipman & Aptroot 19004). Scales: A = 1 mm; B = 5 μ m.

Remarks. This species is well characterized by the fine inspersion in the hamathecium, the small, muriform ascospores, the presence of salazinic acid and the lateral carbonization of the excipulum. It fully resembles *C. marcescens* except that it has an inspersed hamathecium with fine, ~ 0.5 μ m wide droplets instead of a clear hamathecium (Staiger 2002). Almost all available specimens from the Guianas included so far in *C. marcescens* appeared to have a finely inspersed hamathecium and belong to the new species. Specimen Sipman 64802 deviates by the transversely 6-loculate ascospores without longitudinal septa and the coarser hamathecium inspersion, with 0.5–2 mm wide particles. It might belong to a different species.

The new species would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 1 at couplet 4 as: Thallus lacking soralia; ascospores 10–12(–16) \times 5–7 μ m, 3–4(–5) \times (0–)1–2-septate, I–; salazinic acid; hamathecium finely inspersed, not clear.

Carbacanthographis isidiata Sipman, sp. nov. (Fig. 7)

Mycobank MB 849518

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following characters: thallus with short, somewhat coralloid isidia, containing stictic acid aggregate; lirellae sparse, in radiate groups, low; hamathecium 60 μ m, clear; spores small, submuriform, I-negative, 8/ascus, 12 \times 5 μ m, with thin septa.

Type: Guyana, Potaro-Siparuni Region, Kaieteur Falls National Park: around the airstrip, alt. ~ 400 m, 59°29'W, 5°10'N, sandstone tableland with premontane sclerophyllous forest, epiphyte in ~ 10 m tall forest on plateau, 13–20 Feb. 1996, H. Sipman 40492 (BRG – holotype!; B 60 0210711 – isotype!).

Description. Thallus corticolous, crustose, continuous, thinly corticate, dull, white, occupying areas of up to 15 cm, ~ 0.1 mm thick, surrounded by a thin, brownish prothallus line. Isidia present, cylindrical, not straight,

~ 0.1 mm in diam. and up to 0.3 mm long; soralia absent. Photobiont trentepohlioid. Ascomata linear in outline, sessile, solitary, wavy, densely, tree-like branched, 0.2–0.3 mm wide, up to 2 mm long, ~ 0.2 mm high, disc closed, labia not striate, white-pruinose. Excipulum completely carbonized. Hamathecium 60 μ m, not inspersed, with smooth paraphyses. Ascospores 8/ascus, clavate, hyaline, I-negative, submuriform, 12 \times 5 μ m, 3 \times 0–1 septate, with thin septa. Pycnidia not observed.

Chemistry. Thallus UV–, K+ yellow turning orange, C–, KC–, P+ orange. TLC: stictic, cryptostictic (trace) and constictic (trace) acids.

Etymology. The epithet expresses the presence of isidia on the thallus.

Distribution and ecology. Known from a single specimen from central Guyana, from premontane, humid forest.

Remarks. The low hamathecium, small ascospores and the isidia distinguish *Carbacanthographis isidiata* from all species with the stictic acid aggregate.

The only isidiolate *Carbacanthothesis* known so far, *C. hertelii* Kalb & Staiger, differs by the presence of protocetraric acid and transversely septate ascospores without longitudinal septa (Feuerstein et al. 2022).

The new species would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 3 at couplet 11 as: Stictic acid aggregate; ascospores 12 \times 5 μ m, 3 \times 0–1 septate; thallus isidiolate.

Carbacanthographis latisporoides Sipman, sp. nov.

(Fig. 8)

Mycobank MB 849519

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following characters: thallus with stictic acid aggregate; lirellae elongate, tall, crest-like, hardly thallus-covered; hamathecium 150 μ m,

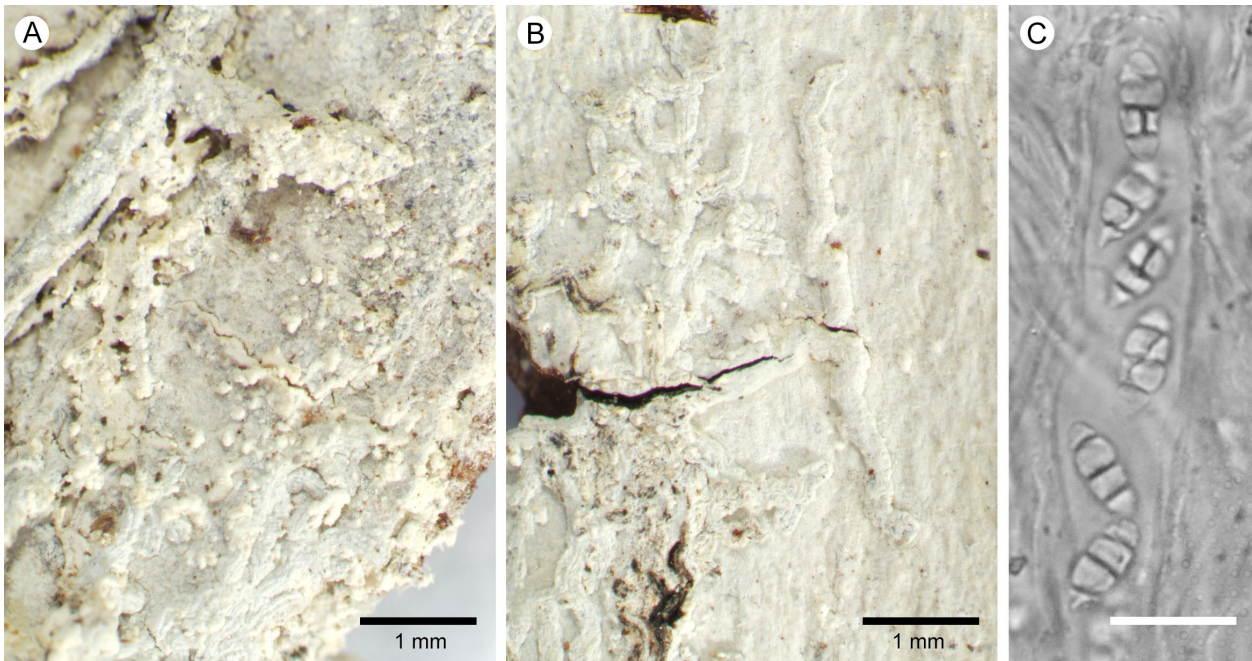


Figure 7. *Carbacanthographis isidiata* (Sipman 40492). A – isidia; B – ascomata; C – ascospores. Scales: A–B = 1 mm; C = 10 µm.

clear; ascospores transversely 11–13-septate, fusiform, 1–2/ascus, I+ violet, $\sim 60\text{--}90 \times 15\text{--}15 \mu\text{m}$, with thick outer wall and thin septa.

Type: Guyana, Potaro-Siparuni Region, Kaieteur Falls National Park: around the airstrip, alt. ~ 400 m, $59^{\circ}29'W$, $5^{\circ}10'N$, sandstone tableland with premontane sclerophyllous forest, epiphyte in ~ 10 m tall forest on plateau, 13–20 Feb. 1996, H. Sipman 40475 (BRG – holotype!; B 60 0210712 – isotype!).

Description. Thallus corticolous, crustose, continuous, thinly corticate, glossy, white, occupying areas of up to 15 cm, ~ 0.1 mm thick, without visible prothallus; isidia and soralia absent. Photobiont trentepohlioid. Ascomata linear in outline, sessile, solitary, slightly wavy, scarcely branched, 0.4–0.7 mm wide, 1–2(–3) mm long, ~ 0.5 mm high, more or less crest-like, disc closed, labia striate, thinly white-pruinose. Excipulum completely carbonized. Periphysoids observed, verrucose. Hamathecium 150 µm,

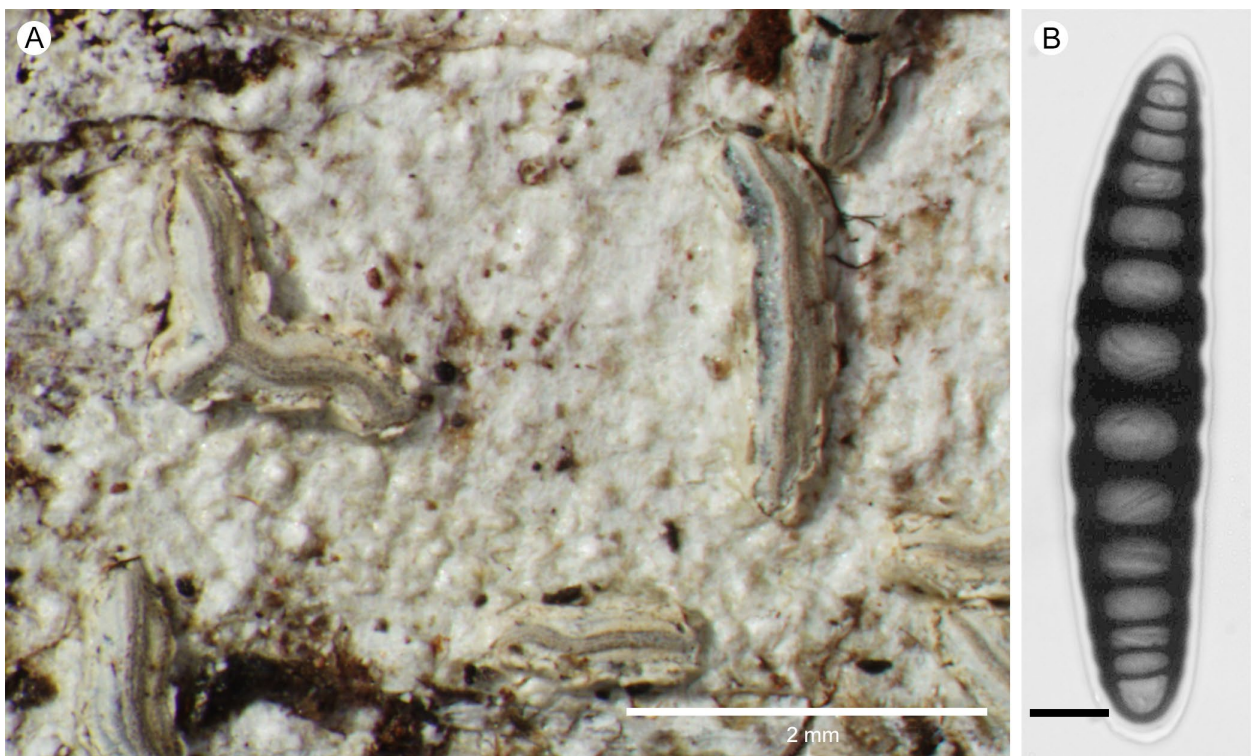


Figure 8. *Carbacanthographis latisporoides* (Sipman 40475). A – abait; B – ascospore stained with Lugol solution (IKI). Scales: A = 2 mm; B = 10 µm.

not interspersed, with smooth paraphyses. Ascospores 1–2/ascus, narrowly ellipsoid, hyaline, I+ blue-violet, transversely septate, $60\text{--}120 \times 15\text{--}25 \mu\text{m}$, 11–13-septate, with thin septa. Pycnidia not observed.

Chemistry. Thallus UV–, K+ yellow turning orange, C–, KC–, P+ orange. TLC: norstictic (trace), stictic, cryptostictic and constictic acids.

Etymology. The epithet expresses the similarity of chemistry and ascospores with *Carbacanthographis latispora*.

Distribution and ecology. Known so far from a single site in southern Guyana, from the canopy of semideciduous tropical lowland forest.

Remarks. The new species resembles closely *C. latispora* by the large, transversely septate ascospores and deviates because the lirellae are elongate, crest-like and not thallus-covered instead of short, rounded, thallus-covered and the ascospores I+ blue-violet instead of I-negative (Feuerstein et al. 2022).

It would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 2 at couplet 7 as: Ascospores $60\text{--}120 \mu\text{m}$ long; ascomata crest-shaped; stictic acid aggregate with trace of norstictic acid.

Carbacanthographis lucidocleitops Sipman, sp. nov. (Fig. 9)

Mycobank MB 849520

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following characters: thallus with stictic acid agg.; lirellae elongate, white outside; hamathecium $175\text{--}200 \mu\text{m}$, clear; spores muriform, fusiform, 1/ascus, I+ blue-violet, $\sim 90\text{--}140 \times 20\text{--}28 \mu\text{m}$, $\sim 30 \times 6$ loculate, with thin wall and septa.

Type: Guyana, Upper Takutu district, $\sim 40 \text{ km S}$ of Aishalton, Kuyuwini Landing, S-shore of Kuyuwini river along trail to Kassikaityu river, alt. $\sim 230 \text{ m}$, $59^{\circ}15'W$, $2^{\circ}06'N$, $20\text{--}28 \text{ m}$ high on 32 cm dbh , 28 m tall *Catostemma fragrans* (MJ 3112, Bombacac.) tree in $\sim 30 \text{ m}$ tall, seasonally dry, undisturbed forest, 26–28 Oct. 1992, H. Sipman 65083 (BRG – holotype!; B 60 0207069 – isotype!).

Description. Thallus corticolous, crustose, continuous, not corticate, dull, white, occupying areas of up to 10 cm , $\sim 0.1 \text{ mm}$ thick, with thin, blackish prothallus; isidia and soralia absent. Photobiont trentepohlioid. Ascomata linear in outline, sessile, solitary, slightly curved, not branched, $0.4\text{--}0.5 \text{ mm}$ wide, $0.6\text{--}1.5\text{--}(3) \text{ mm}$ long, $\sim 0.4 \text{ mm}$ high, disc closed, labia not striate, concolorous with thallus. Excipulum laterally or almost completely carbonized. Hamathecium $\sim 175\text{--}200 \mu\text{m}$ thick, not interspersed, with smooth paraphyses. Ascospores 1/ascus, long ellipsoid, hyaline, with wall and septa I+ blue-violet, regularly densely muriform without distinct principal septa, $90\text{--}140 \times 20\text{--}28 \mu\text{m}$, with $\sim 30 \times 6$ locules, with thin wall and septa. Pycnidia not observed.

Chemistry. Thallus UV+ yellow, K+ yellow turning orange, C–, KC–, P+ orange. TLC: lichexanthone, stictic, cryptostictic (trace) and constictic (trace) acids.

Etymology. The epithet expresses the resemblance with *C. cleistops* and the presence of lichexanthone, which gives a strong, yellow fluorescence in long-wave UV light (“lucidus”).

Distribution and ecology. Known from southern Guyana, where it occurs in the canopy of semideciduous lowland forest. Host trees: *Catostemma fragrans*, *Hymenaea courbaril*, *Ornosia flava*.



Figure 9. *Carbacanthographis lucidocleitops* (Sipman 65083). A – habit; B – ascospore. Scales: A = 1 mm; B = 20 μm .

Additional specimens examined (paratypes). GUYANA. Upper Takutu district, ~40 km S of Aishalton, Kuyuwini Landing, N-shore of Kuyuwini river, alt. ~230 m, 5°21'W, 2°06'N, 25–32 m high on 60 cm dbh, 32 m tall *Ornosia flava* (MJ 2847, Legum.) tree in ~30 m tall, seasonally dry, undisturbed forest, 14–15 Oct. 1992, H. Sipman 64127 [B 60 0206049]; id., S-shore of Kuyuwini river along trail to Kassikaityu river, alt. ~230 m, 59°15'W, 2°06'N, 20–25 m high on 30 m tall *Hymenaea courbaril* (MJ 2828, Papilionac.) tree in ~30 m tall, seasonally dry, undisturbed forest, 10–13 Oct. 1992, H. Sipman 64690 [B 60 0206692]; id., 25–30 m high on same tree, H. Sipman 64794 [B 60 0206793]

Remarks. *Carbacanthographis lucidocleitops* resembles most *C. cleitops*, from which it differs by the presence of lichexanthone (UV+ yellow). Moreover, the excipulum is more strongly carbonized, sometimes completely carbonized, and the ascospores are I+ blue-violet, not I-negative (Feuerstein et al. 2022).

The lirellae are often short, but not rounded. Abraded lirellae may show two black lines from the carbonized excipulum, suggesting that they are not striate, unlike in *C. latispora*, where abraded lirellae may show up to 10 black lines (Feuerstein et al. 2022).

The new species would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 1 at couplet 3 as: Ascospores single, 115–140 × 25–28 µm, I+ blue-violet; hymenium clear; stictic acid aggregate.

Carbacanthographis minutissima Sipman, sp. nov.
(Fig. 10)

Mycobank MB 849521

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following

characters: thallus with lichexanthone and stictic acid aggregate; ascomata rounded, 0.4 mm wide, opening by a short fissure, with carbonized, thin excipulum covered by thin thalloid layer that soon becomes abraded and exposes the dark brown excipulum; hamathecium clear, ~200 µm; ascospores transversely 18–20-septate, hyaline, 8/ascus, I–, 50 × 7 µm.

Type: Guyana, Upper Takutu district, ~40 km S of Aishalton, Kuyuwini Landing, S-shore of Kuyuwini river along trail to Kassikaityu river, alt. ~230 m, 59°15'W, 2°06'N. 25–30 m high on twigs on 50 cm dbh, 32 m tall *Parinari rodolphii* (MJ 3101, Chrysobalanac.) tree in ~30 m tall, seasonally dry, undisturbed forest, 29 Oct. 1992, H. Sipman 65398 (BRG – holotype!; B 60 0207374 – isotype!).

Description. Thallus corticolous, crustose, continuous, thinly corticate, dull, white, occupying areas of up to 3 cm, ~0.1 mm thick, surrounded by a dark brown prothallus; isidia and soralia absent. Photobiont trentepohlioid. Ascomata round, sessile, solitary, ~0.4 mm wide, ~0.2 mm high, opening by short fissure, labia not striate, pale brown, laterally concolorous with thallus. Excipulum thin but completely carbonized. Periphysoids observed, verrucose. Hamathecium 120–140 µm, not interspersed, with smooth paraphyses. Asci cylindrical, without ocular chamber, ~120 × 10–20 µm. Ascospores 8/ascus, elongate-ellipsoid, hyaline, I-negative, transversely septate, ~50–55 × 7 µm, 18–20-septate, with thin septa. Pycnidia not observed.

Chemistry. Thallus UV+ yellow, K+ yellow turning orange, C–, KC–, P+ orange. TLC: lichexanthone, stictic and constictic acids.

Etymology. The epithet expresses the very small, apothecium-like ascomata.

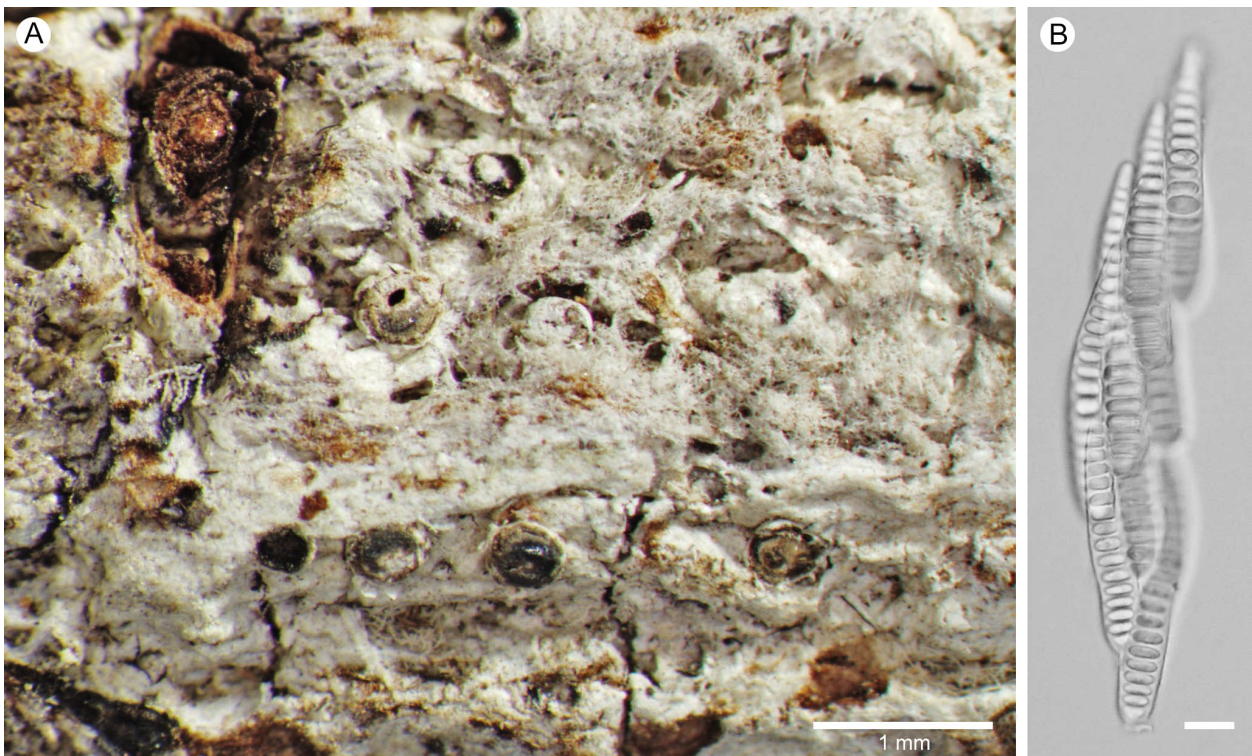


Figure 10. *Carbacanthographis minutissima* (Sipman 65398). A – habit; B – ascospores. Scales: A = 1 mm; B = 10 µm.

Distribution and ecology. Known from a single specimen from southern Guyana, from twigs in the canopy of semideciduous lowland forest. Host tree: *Parinari rodolphii*.

Remarks. This species is similar with *C. latispora* by its rounded ascomata and deviates by the smaller ascospores with short slit-like openings, the smaller, narrower ascospores and the additional presence of lichexanthone (Feuerstein et al. 2022). Old, abraded ascomata may show two or three brown rings, reflecting a regenerating excipulum, and reach a width of 0.6 mm.

The affinity of this species is puzzling. The apothecium-like ascomata differ much from the usual lirellae in the genus *Carbacanthographis*. However, anatomically and chemically the species resembles closely *C. latispora*, which grows in the same habitat, canopy twigs in semideciduous tropical lowland forest, and shares the rounded ascomata. Therefore, the new species is considered to be a next stage in reduction of the ascomata after *C. latispora* and *C. multiseptata*. These two species have rounded ascocarps, in which the affinity with lirellae is still evident by the strong carbonization and the split-like, not pore-like opening. In the ascomata of *C. minutissima*, the carbonization of the excipulum is more strongly reduced and the opening a short fissure. A similar tendency to develop rounded ascomata is known among lirelloid *Graphidaceae* from the genus *Allographa*. Here the species *A. mexicana* (Hale) Lücking & Kalb has perfectly rounded ascomata and only the slit-like opening points to its affinity (Lücking et al. 2009).

Somewhat similar, thelotremoid genera show conspicuous differences: In *Topeliopsis* s.l. (Frisch & Kalb 2006), which comprises *Graphidaceae* with similar, apothecium-like ascomata, *Topeliopsis darlingtonii* A. Frisch & Kalb, (= *Gintarasia darlingtonii* (A. Frisch & Kalb) Lumbsch, Kraichak & Lücking) would fit best, by the presence of stictic acid aggregate and the medium sized, transversely septate ascospores. However, it differs clearly by the stellately incised ascocarp pores (Frisch & Kalb 2006). In *Schizotrema*, the ascomata have a persistent thalline margin and open by slips, not by a short slit (Rivas Plata et al. 2010). The ascomata of the recently described genus *Cryptoschizotrema* Aptroot, Lücking & M. Cáceres (Hyde et al. 2019) resemble in abraded stages by showing similar, concentric, brown rings; however, it has muriform, not transversely septate ascospores, contains psoromic acid instead of stictic acid agg. and lichexanthone, and the ascomata open by a pore, not a slit.

The new species would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 2 at couplet 4 as: Ascospores $\sim 50\text{--}55 \times 7 \mu\text{m}$, 18–20-septate; ascomata rounded, ~ 0.4 mm wide, not lirelliform; thallus with stictic acid aggregate.

Carbacanthographis multiseptatoides Sipman, sp. nov. (Fig. 11)

Mycobank MB 849522

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following

characters: thallus with protocetraric acid; lirellae elongate and tall, thallus-covered; hamathecium $170 \mu\text{m}$, clear; spores transversely septate, I-negative, $1(-4)/\text{ascus}$, $135\text{--}160 \times 17\text{--}18 \mu\text{m}$, $\sim 30\text{--}35$ -septate, with thin septa.

Type: Guyana, Upper Takutu district, ~ 40 km S of Aishalton, Kuyuwini Landing, N-shore of Kuyuwini river, alt. ~ 230 m, $59^{\circ}21'W$, $2^{\circ}06'N$, twigs at 25–32 m high on 60 cm dbh, 32 m tall *Ornosia flava* (MJ 2847, Legum.) tree in ~ 30 m tall, seasonally dry, undisturbed forest, 14–15 Oct. 1992, H. Sipman 64146 (BRG – holotype!; B 60 0206073 – isotype!).

Description. Thallus corticolous, crustose, continuous, not corticate, dull, white, occupying areas of up to 5 cm, ~ 0.1 mm thick, without or with thin, brown prothallus line; isidia and soralia absent. Photobiont trentepohlioid. Ascospores linear in outline, sessile, solitary, slightly wavy, scarcely branched, $0.4\text{--}0.6$ mm wide, $\sim 0.6\text{--}2$ mm long, to 0.8 mm high, crest-like, disc closed, labia weakly striate, usually completely covered by white thallus. Excipulum completely carbonized. Hamathecium $170\text{--}200 \mu\text{m}$, not interspersed, with smooth paraphyses. Ascospores $1(-4)/\text{ascus}$, narrowly ellipsoid, hyaline, I-negative, transversely septate, $135\text{--}160 \times 15\text{--}18 \mu\text{m}$, $30\text{--}35$ -septate, with thin septa. Pycnidia not observed.

Chemistry. Thallus UV–, K–, C–, KC–, P+ red. TLC: protocetraric acid.

Etymology. The epithet expresses the resemblance of chemistry and ascospores to *Carbacanthographis multiseptata*.

Distribution and ecology. Known so far only from southern Guyana, from the canopy of semideciduous lowland forest and savanna shrubs. Host tree: *Ornosia flava*.

Additional specimens examined (paratypes). GUYANA. Upper Takutu district, ~ 35 km S of Aishalton, ~ 4 km N of Kuyuwini Landing, along track to Karaudanawa, alt. ~ 250 m, $\sim 59^{\circ}15'W$, $2^{\circ}08'N$, epiphyte on scattered shrubs and trees along and on small savannah, 31 October 1992, H. Sipman 57063 [B 60 0164439]; id., ~ 40 km S of Aishalton, Kuyuwini Landing, N-shore of Kuyuwini river, alt. ~ 230 m, $59^{\circ}21'W$, $2^{\circ}06'N$, 25–32 m high on 60 cm dbh, 32 m tall *Ornosia flava* (MJ 2847, Legum.) tree in ~ 30 m tall, seasonally dry, undisturbed forest, 14–15 Oct. 1992, H. Sipman 64073a [B 60 0208344].

Remarks. The new species resembles closely in chemistry and ascospores *C. multiseptata* and deviates by the lirellae, which are elongate and tall, crest-like, not rounded (Feuerstein et al. 2022).

The new species would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 2 at couplet 7 as: Ascospores $150\text{--}160 \times 15\text{--}17 \mu\text{m}$, $30\text{--}35$ -septate, I-negative; ascomata crest-shaped; protocetraric acid.

Carbacanthographis nigra Sipman, sp. nov. (Fig. 12)

Mycobank MB 849523

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following characters: thallus thin, whitish, without lichen substances; lirellae black; ascospores small, uniseriate, muriform, $16\text{--}18 \times 10\text{--}11 \mu\text{m}$, $\sim 3 \times 1$ -septate, with thickened septa, I-negative.

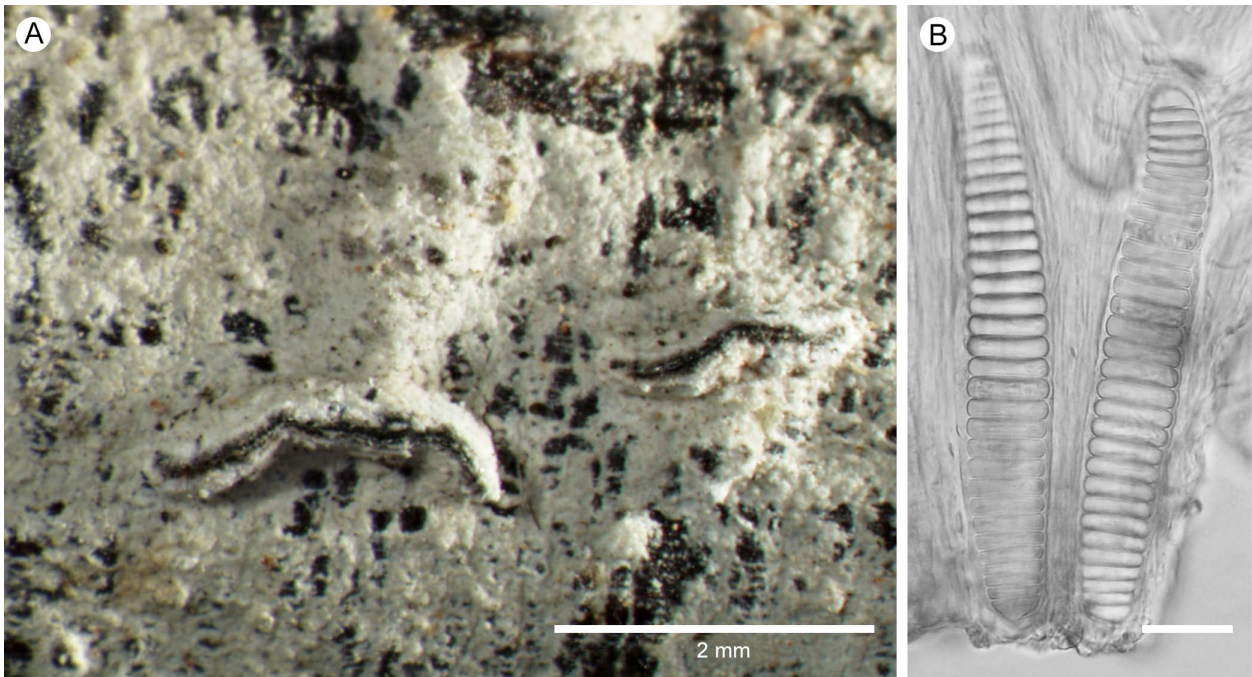


Figure 11. *Carbacanthographis multiseptatoides* (Sipman 64146). A – habit; B – ascospores. Scales: A = 2 mm; B = 20 µm.

Type: Guyana, Upper Mazaruni district, N-slope of mount Roraima (campsite 5), alt. 700 m, 60°46'W, 5°17'N, in ~25 m tall virgin mossy forest, 3 m high on 10 cm diam. tree trunk, 12–19 Feb. 1985, H. Sipman & A. Aptroot 18745 (BRG – holotype!; B 60 0204930 – isotype!).

Description. Thallus corticolous, crustose, continuous, corticate, glossy, white, occupying areas of up to 10 cm, ~0.1 mm thick, prothallus not seen; isidia and soralia absent. Photobiont trentepohlioid. Ascomata linear in outline, sessile, solitary, slightly wavy, slightly branched,

0.3–0.5 mm wide, ~0.5–2 mm long, 0.2–0.3 mm high, disc closed, labia weakly striate, black, not covered by thallus except for a short, basal thalline margin. Excipulum completely carbonized. Warty periphysoids absent. Hamathecium ~120 µm, not interspersed, with smooth paraphyses. Ascospores 8/ascus, uniseriate, shortly ellipsoid, hyaline, I-negative, muriform, 16–18 × 10–11 µm, ~3 × 1-septate, with rounded lumina. Pycnidia not observed.

Chemistry. Thallus UV–, K–, C–, KC–, P–. TLC: not tested while thallus scarce.

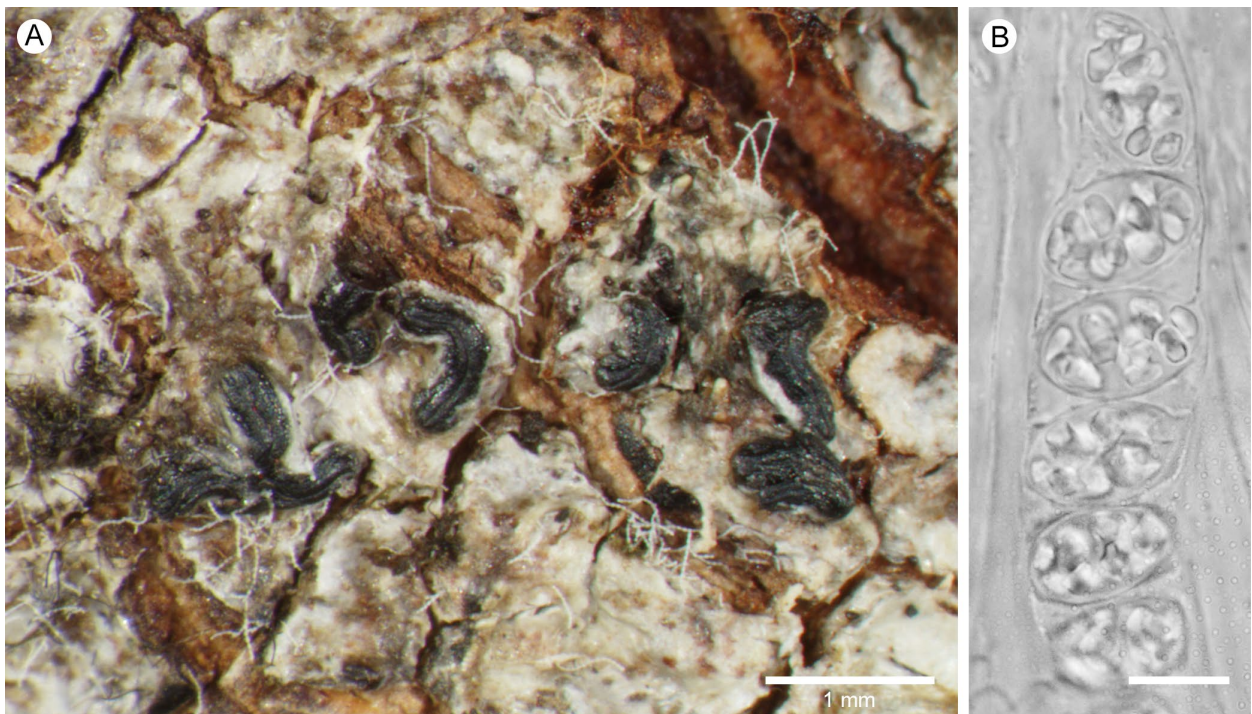


Figure 12. *Carbacanthographis nigra* Sipman (Sipman & Aptroot 18745). A – habit; B – ascospores. Scales: A = 1 mm; B = 10 µm.

Etymology. The epithet expresses the black color of the ascomata.

Distribution and ecology. Known from a single specimen from central Guyana, from humid lower montane forest.

Remarks. *Carbacanthographis nigra* resembles many species of *Graphis* and *Allographa* because of the black lirellae and whitish thallus and the absence of periphysoids. It is included here in *Carbacanthographis* provisionally despite the absence of warty periphysoids because the ascospores have the combination of rounded lumina and a negative I-reaction. The relation with *Allographa* and *Graphis* seems somewhat similar to the relation between *Clandestinotrema* and *Ocellularia* (Rivas Plata et al. 2012). Among *Carbacanthographis* species, *C. coccospora* seems most similar and deviates by the saxicolous habitat, more greenish thallus and pruinose ascomata (Feuerstein et al. 2022).

The new species would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 3 at couplet 7 as: Ascomata prominent, black; ascospores 16–18 × 10 µm, I-negative.

Carbacanthographis nitida Aptroot & M. Cáceres,
sp. nov. (Fig. 13)

Mycobank MB 849524

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following characters: thallus with warts, not pruinose, containing protocetraric acid; ascospores 7-septate, I-negative, 23–26 × 6.5–8 µm.

Type: Brazil, Rondônia: Porto Velho, Parque Natural Municipal, alt. 100 m, 8°41'10"S, 63°52'05"W, on tree in rain forest, 16–19 Nov. 2012, M.E.S. Cáceres & A. Aptroot ISE 15552 (ISE – holotype!; ABL – isotype!).

Description. Thallus corticolous, crustose, continuous, corticate, slightly glossy, not pruinose, with ~0.2 mm wide hemispherical warts that become non-corticate, pale grey, occupying areas of up to 15 cm, up to 0.1 mm thick, not surrounded by a prothallus; isidia and soralia absent. Photobiont trentepohlioid. Ascomata linear in outline, erumpent, solitary, slightly wavy, never branched, 0.5–0.7 mm wide, up to 1.5 mm long, disc closed, labia white, not striate, margin lateral to completely covered by thallus. Excipulum completely carbonized. Hamathecium not interspersed, with smooth paraphyses. Ascospores 8/ascus, clavate, hyaline, transversely septate, I-negative, 23–26 × 6.5–8 µm, 7-septate, with thin septa, without gelatinous sheath. Pycnidia not observed.

Chemistry. Thallus UV–, K–, C–, KC–, P+ red. TLC: protocetraric acid.

Etymology. Named after the glossy thallus.

Ecology and distribution. On tree bark in primary rain forest; so far only known from Brazil.

Additional specimens examined (paratypes). BRAZIL. Rondônia: Same as the type, 14242; Porto Velho, Estação Ecológica de Cuniã, km 760 on road BR 319 N of Porto Velho, alt. 100 m, 8°02'44"S, 63°29'11"W, on tree in rain forest, 20 Nov. 2012, M.E.S. Cáceres 15630, 15635, 15636 & A. Aptroot (all ISE!, ABL!, B!).



Figure 13. *Carbacanthographis nitida* (Cáceres 15552). A – habit; B – ascospores. Scales: A = 5 mm; B = 10 µm.

Remarks. This species is perhaps closest to *C. chionophoroides* Feuerstein & Lücking with similar, rather wide, though somewhat smaller ascospores, without thallus warts (Feuerstein et al. 2022). Very similar is also *C. subchionophora*, which shares the small, transversely septate, I-negative ascospores and the protocetraric acid, and differs by the absence of thallus warts and the narrower ascospores, 4–5 times as long as wide (Feuerstein et al. 2022).

It would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 2 at couplet 15 as: Ascospores $23\text{--}26 \times 6.5\text{--}8 \mu\text{m}$, 7-septate; thallus with warts, not smooth.

Carbacanthographis protocristata Sipman, sp. nov.
(Fig. 14)

Mycobank MB 849525

Diagnosis: Corticolous *Carbacanthographis* differing from all known species in the genus by the combination of the following characters: thallus containing protocetraric acid; ascomata lirelliform, elongate and tall, thallus-covered; hamathecium $200 \mu\text{m}$, clear; ascospores muriform, I+ blue-violet, 8/ascus, $\sim 55\text{--}190 \times 8\text{--}12 \mu\text{m}$, $\sim 25\text{--}40 \times 3$ -septate, with thin septa.

Type: Guyana, Upper Takutu district, $\sim 40 \text{ km S}$ of Aishalton, Kuyuwini Landing, S-shore of Kuyuwini river along trail to Kassikaityu river, alt. $\sim 230 \text{ m}$, $59^\circ 15' \text{W}$, $2^\circ 06' \text{N}$, 20–28 m high on 32 cm dbh, 28 m tall *Catostemma fragrans* (MJ 3112, Bombacac.) tree in $\sim 30 \text{ m}$ tall, seasonally dry, undisturbed forest, 26–28 Oct. 1992, H. Sipman 65078 (BRG – holotype!, B 60 0207064 – isotype!).

Description. Thallus corticolous, crustose, continuous, not corticate, dull, white, occupying areas of up to 5 cm, $\sim 0.1 \text{ mm}$ thick, often surrounded by a thin, blackish prothallus line; isidia and soralia absent. Photobiont trentepohlioid. Ascomata linear in outline, sessile, solitary, slightly

wavy, scarcely branched, 0.4–0.6 mm wide, $\sim 1\text{--}3 \text{ mm}$ long, $\sim 0.6 \text{ mm}$ high, crest-like, disc closed, labia striate, more or less covered by white thallus layer, apically often dark brown. Excipulum completely carbonized. Periphysoids observed, verrucose. Hamathecium $\sim 200 \mu\text{m}$, not interspersed, with smooth paraphyses. Ascospores 8/ascus, hyaline, I+ blue-violet, narrowly ellipsoid, densely muriform, $\sim 55\text{--}190 \times 8\text{--}12 \mu\text{m}$, $\sim 25\text{--}40 \times 3$ -septate, with thin septa. Pycnidia not observed.

Chemistry. Thallus UV[–], K[–], C[–], KC[–], P⁺ red. TLC: protocetraric acid.

Etymology. Named after the tall, mountain crest-like (Latin: *crista*) ascomata and the presence of protocetraric acid.

Distribution and ecology. Known from Central and South Guyana, from canopy branchlets in forest. Host tree: *Catostemma fragrans*.

Additional specimen examined (paratype). GUYANA. Potaro-Siparuni Region, Kaieteur Falls National Park, around the airstrip, alt. $\sim 400 \text{ m}$, $5^\circ 10' \text{N}$, $59^\circ 29' \text{W}$, sandstone tableland with premontane sclerophyllous forest, in $\sim 10 \text{ m}$ tall forest on peat near Menzies Landing. 20 Feb. 1996, H. Sipman 40589 [B 60 0209590].

Remarks. *Carbacanthographis protocristata* shares the combination of protocetraric acid and long, thin-septate, muriform ascospores with several *Carbacanthographis* species. Among these, it differs from *C. violaceospora* by the absence of lichexanthone and the spores being 8/ascus, from *C. muriformis* by the I+ blue-violet ascospores 8/ascus, from *C. subalbotecta* by the larger, $\sim 55\text{--}190 \times 8\text{--}12 \mu\text{m}$ instead of $55\text{--}90 \times 11\text{--}18 \mu\text{m}$, I+ blue-violet ascospores, and from *C. multiseptatoides* by the narrower,



Figure 14. *Carbacanthographis protocristata* (Sipman 65078). A – habit; B – ascospores. Scales: A = 2 mm; B = 20 μm .

~55–190 × 8–12 µm instead of 135–160 × 15–18 µm, I+ blue-violet ascospores (Feuerstein et al. 2022; see above).

The ascomata are distinctly crest-like, much exserted above the substrate (twig bark), higher than wide, and easily braking off.

The new species would key out in the world key of *Carbacanthographis* by Feuerstein et al. (2022) in group key 3 at couplet 4 as: Ascospores 8 per ascus, ~55–190 × 8–12 µm, I+ blue-violet; protocetraric acid.

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