

Studies on Cambodian Species of *Graphidaceae* (*Ostropales*, *Ascomycota*) (II)

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Five species of five genera in the lichen family *Graphidaceae* are newly reported from Cambodia and their distribution ranges are presented as follows: *Dyplolabia afzelii* (Ach.) A. Massal., *Glyphis cicatricosa* Ach., *Leiorreuma melanostrazans* (Leight.) A. W. Archer, *Phaeographis fragilissima* M. Nakan., Kashiw. & K. H. Moon (sp. nov.) and *Sarcographa labyrinthica* (Ach.) Müll. Arg. *P. fragilissima* is distinct from allied species of the genus in having fragile lirellae without striation, apically carbonized exciples, clear hymenia, 5–6 transversely septate brown spores 20–25 × 6–7 µm in size and in producing fumarprotocetraric acid.

(Continued from J. Jpn Bot. 86: 273–278, 2011)

Key words: Cambodia, *Graphidaceae*, lichen, *Phaeographis fragilissima*.

During a lichenological investigation in Cambodia from 2005 to 2013 more than 190 specimens of the *Graphidaceae* were collected. The field work was supported by the National Research Institute for Cultural Properties, Tokyo. Through taxonomic studies based on the specimens collected, 12 species have been reported by the present authors (Nakanishi et al. 2010, Moon et al. 2011 and 2013). This is the fourth report of the family in Cambodia.

Materials and Methods

The present study is based on about 190

specimens of the family *Graphidaceae* collected from 2005 to 2013 by Kashiwadani and Moon near the Angkor Wat ruins, Siem Reap in Cambodia. Specimens reported in the present paper are kept in the herbarium of the National Museum of Nature and Science (TNS) unless otherwise cited. Chemical substances were studied by means of thin-layer chromatography (Culberson & Johnson 1982). Sections of apothecia and thalli were cut by hand-razor and mounted in GAW solution.

1) *Dyplolabia afzelii* (Ach.) A. Massal. in

Neogenea licheum: 6 (1854). [Fig. 1A]

Dyplolabia afzelii is distinct from other species of Cambodian *Graphidaceae* in having simple or weakly branched lirellae covered with white pruina, complete lirella without striation, closed discs, completely carbonized exciples, clear hymenia (I –), 8-spored asci, colorless 4-locular ascospores $13\text{--}15 \times 4.5\text{--}5.0 \mu\text{m}$ in size, and the presence of lecanoric acid.

This species has been well revised by Staiger (2002), who reported it from Africa, North America, South America and tropical Asia (Sri Lanka, the Philippines and Papua New Guinea). This study expands the area of distribution to include Cambodia, where it was occasionally found on tree trunks in rather sunny locations.

Specimens examined: **CAMBODIA**. Prov. Siem Reap: Ta Nei temple, Angkor Wat complex, Siem Reap, on bark, elevation about 30 m, January 15, 2013, H. Kashiwadani 50818 (TNS), K. H. Moon 13168 (NIBR, TNS).

2) *Glyphis cicatricosa* Ach. in Syn. Meth. Lich. 107 (1814).

Glyphis cicatricosa is characterized by crowded lirellae formed in the pseudostroma, lirellae with open discs that are covered with brownish pruina, clear hymenia (I + pale blue), 8-spored asci, hyaline spores with a perispore (halo) and 3-transverse septa $30\text{--}40 \times 7\text{--}8 \mu\text{m}$ in size, and the absence of the production of any specific chemical substance.

This species is well known and widespread in tropical and subtropical areas in Asia, Australia, and North and South America and has been well revised by several authors (Nakanishi 1966, Staiger 2002, etc.). The distribution now includes Cambodia, where it was commonly found on tree bark.

Specimens examined: **CAMBODIA**. Prov. Siem Reap: Around Ta Nei temple, Angkor Wat complex, Siem Reap, on bark, elevation about 30 m, July 27, 2009, H. Kashiwadani (50111, TNS) and K. H. Moon; the same locality, July 19, 2006, H. Kashiwadani (50321, TNS) and K. H. Moon.

3) *Leiorreuma melanostrazans* (Leight.) A. W. Archer in Flora 65: 336 (1882). [Fig. 1B, F]

This species was described by Leighton under the name of *Platygrapha melanostrazans* Leight., based on a specimen collected in Ceylon (Type collection: South of the Island, G. Thwaites 155, BM!–lectotype, *tlc* stictic acid).

The diagnostic characteristics for this species are a thallus continuous and khaki, weakly and irregularly branched apothecia without striation, erumpent lirellae edged with a white line, open discs with gray white pruina, exciples carbonized basally, interspersed hymenia (I –), 8-spored asci, brown spores with (6–)7–9(–10) transverse septa $25\text{--}32 \times 8\text{--}9 \mu\text{m}$ in size and the presence of stictic acid.

This species is understood to have a wide distribution in tropical and subtropical areas in Asia (Archer 2001). The distribution now includes Cambodia, where it is rather common on tree branches.

Specimens examined: **CAMBODIA**. Prov. Siem Reap: Around Ta Nei temple, Angkor Wat complex, Siem Reap, on bark of *Irvingia* sp., elevation about 30 m, July 27, 2009, H. Kashiwadani (50129, TNS) & K. H. Moon; Ta Prohm temple, Angkor Wat complex, Siem Reap, on bark, elevation about 30 m, January 15, 2013, H. Kashiwadani (51187, TNS) & K. H. Moon.

4) *Phaeographis fragilissima* M. Nakan., Kashiw. & K. H. Moon, **sp. nov.**

[Fig. 1C, D, G]

Mycobank No.: MB805560.

Similis *Phaeographis subdividens* sed excipulis propriis carbonaris ad apicem, discis albido-pruinatis, himenio liquido, labiis infirme striatis et acidium fumarprotocetaricum continentibus differt.

Thallus corticolous, pale greenish yellow, ocher in herbaria, corticated. Apothecia stellately branched, up to 2 cm long, 0.14–0.20 mm wide; lirellae erumpent; labia entire, more or less fragile, often exposing tips of dark brown labia; disc open, concave, pruinose with grayish white pruina; exciples carbonized apically, 15–20 μm thick at sides, 20–25 μm thick at base; hymenium clear, not interspersed, I –, 95–100 μm high. Asci 8-spored; spores brown (I –), 5–6

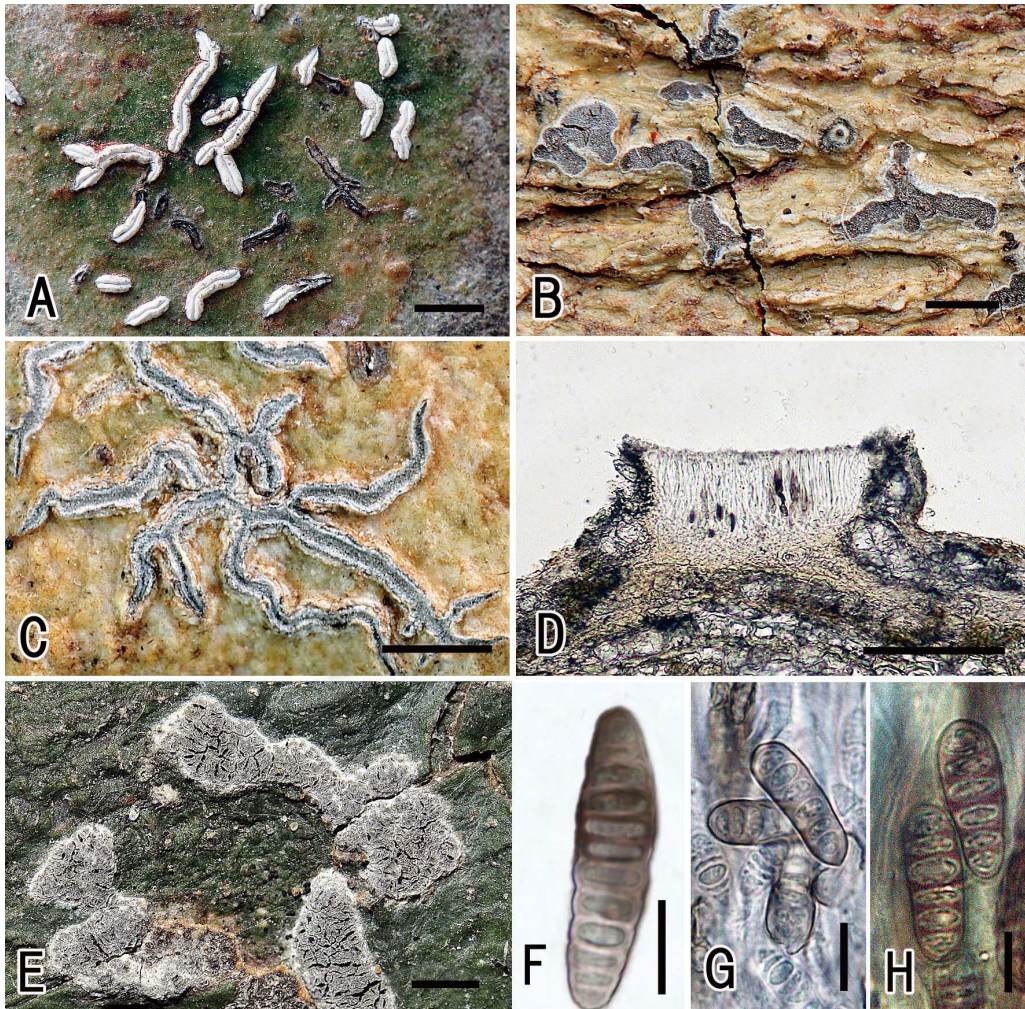


Fig. 1. A. *Dyplolabia afzelii* (Ach.) A. Massal. [H. Kashiwadani (50818) & K. H. Moon]. B, F. *Leiorreuma melanostrazans* (Leight.) A. W. Archer [H. Kashiwadani (50129) & K. H. Moon]. B. Habit. F. Spore. C, D, G. *Phaeographis fragilissima* M. Nakan., Kashiw. & K.H. Moon [H. Kashiwadani (50322) & K. H. Moon]. C. Habit. D. Cross section of an apothecium, showing apically carbonized exciples and a clear hymenium. G. Spores. E, H. *Sarcographa labyrinthica* (Ach.) Müll. Arg. [H. Kashiwadani (50128) & K. H. Moon]. E. Habit. H. Spores. Scale bars: 1 mm = A, B, E, 0.5 mm = C, 100 μ m = D, 10 μ m = F, G, H.

transversely septate $20\text{--}25 \times 6\text{--}7 \mu\text{m}$ in size.

Type collection: CAMBODIA. Prov. Siem Reap: Around Ta Nei temple, Angkor ruins, Siem Reap ($13^{\circ}27'N$, $103^{\circ}53'E$), on tree bark, elevation about 30 m, July 19, 2006, H. Kashiwadani (50322) & K. H. Moon (TNS-holotype).

Chemistry: fumarprotocetraric acid (trace).

Phaeographis fragilissima is unique in the genus in having exciples carbonized

apically, 5–6 transverse septa and in producing fumarprotocetraric acid as a major chemical substance. In general appearance, it resembles *P. subdividens* (Leight.) Müll. Arg., a species reported from Ceylon (Type collection: Central Province, G. Thwaites s.n. (hb. Leighton CL 147, BM!–lectotype) and Australia (Archer 2001); however, it is clearly distinguished from the latter by the exciples carbonized apically and in producing fumarprotocetraric acid as the latter

species has entirely pale exciples and produces no chemical substance. It may be confused with *P. quadrifera* (Nyl.) Staiger, a species reported from West Africa (Type collection: Insula São Tome, Moller 1885, H-NYL 7875!), which differs in having totally pale exciples, submuriform ascospores, and in producing norstictic acid.

In this investigation, the species was found occasionally on tree bark around Ta Nei Temple.

Specimens examined: **CAMBODIA**. Prov. Siem Reap: Around Ta Nei temple, Angkor ruins, Siem Reap (13°27'N, 103°53'E), on bark, elevation about 30 m, July 19, 2006, H. Kashiwadani (50325) and K. H. Moon; the same locality, on bark of *Ficus* sp., July 27, 2009, H. Kashiwadani (50170) and K. H. Moon.

5) *Sarcographa labyrinthica* (Ach.) Müll. Arg., in *Mém. Soc. Phys. Genève* **29**: 62 (1887).

[Fig. 1E, H]

The diagnostic characters for this species are branched and crowded lirellae forming pseudostroma covered with grayish white pruina, narrow labia (0.10–0.12 mm in width) with open discs, proper exciples carbonized basally and laterally, the 8-spored asci, brown spores with 4–6 transverse septa $22\text{--}24 \times 6\text{--}7 \mu\text{m}$ in size and the presence of stictic acid.

This species resembles *Sarcographa fenicis* (Vain.) Zahlbr., a species widely distributed in south-east Asia (Type collection: PHILIPPINES, Luzon, Prov. Benguet, Sablang, ad corticem arboris, E. Fénix, November–December, 1910, *tlc*: stictic acid, TUR-V 27498!); however, the latter species differs in having open discs without pruina and 3-septate spores $15\text{--}20 \times 5\text{--}6 \mu\text{m}$ in size. It may be confused with *S. gyrizans* (Leight.) Müll. Arg., which differs in having

wider labia (0.20–0.23 mm in width), closed discs and submuriform spores.

In this investigation, the species was found rather commonly on tree bark.

Selected specimens examined: **CAMBODIA**. Prov. Siem Reap: Around Ta Nei temple, Angkor Wat complex, Siem Reap, on bark of *Ficus* sp., elevation about 30 m. December 9, 2011, H. Kashiwadani (50350 & 50351, TNS) & K. H. Moon.

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Literature cited

- Archer A. W. 2001. The lichen genera *Phaeographis* and *Phaeographina* (*Graphidaceae*) in Australia. 3: *Phaeographis* – new reports and new species. *Telopea* **9**: 663–667.
- Moon K. H. 2011. Studies on Cambodian species of *Graphidaceae* (*Ostropales*, *Ascomycota*) (I). *J. Jpn. Bot.* **86**: 273–278.
- Moon K. H., Nakanishi M., Aptroot A., Kuchitsu N., Futagami Y., Sophearin S. and Kashiwadani H. 2013. Lichens found in Ta Nei temple and its adjacent areas of Angkor, Siem Reap, Cambodia. *Sci. Conserv.* (52): 43–54.
- Nakanishi M. 1966. Taxonomical studies on the family *Graphidaceae* of Japan. *J. Sci. Hiroshima Univ., Ser. B, Div. 2, Bot.* **11**: 51–131.
- Nakanishi M., Kashiwadani, H., Futagami Y. and Moon K. 2010. Nine species of *Graphidaceae* (*Ostropales*, *Ascomycota*) collected in Siem Reap, Cambodia. *J. Jpn. Bot.* **85**: 313–321.
- Staiger B. 2002. Die Flechten familie *Graphidaceae*. Studien in Richtungeiner naturlicheren Gliederung. *Biblioth. Lichenol.* **85**: 1–526.

文 光喜^a, 中西 稔^b, 二神葉子^c, 柏谷博之^d: カンボジア産モジゴケ科地衣類 (子囊菌門, ピンタケ目) の研究 (II)

筆者等は 2005 年以来, カンボジア王国のタ・ネイ遺跡周辺で採集した標本に基づいて地衣類の分類学的

研究を続けており, これまでに 12 種のモジゴケ科地衣類を報告した (Nakanishi et al. 2010, Moon et al. 2011

and 2013). その後の研究により, *Dyplolabia afzelii* (Ach.) A. Massal., *Glyphis cicatricosa* Ach., *Leiorreuma melanostrazans* (Leight.) A. W. Archer, *Phaeographis fragilissima* M. Nakan., Kashiw. & K. H. Moon, *Sarcographa labyrinthica* (Ach.) Müll. Arg. が新たに確認されたので報告する. 何れもカンボジア新産であり *Phaeographis fragilissima* は新種として記載された. 以下, 各種の概略を述べる.

1) *Dyplolabia afzelii*: 地衣体は平滑, 帯緑褐色. リレラ (*lirella*) は単一または僅かに分岐し地衣体から明瞭に盛り上がる. ラビア (*labia*) は全面に灰白色の粉霜で被われ, 盤は表面からは見えない. 果殻は完全に炭化する. 子嚢層は明瞭で顆粒状物質を含まない. 胞子は1子嚢中に8個, 無色, 4室, $13-15 \times 4-5 \mu\text{m}$. ラビアはC+紅色でレカノール酸を含む.

本種は地球上の熱帯-亜熱帯地域に広く分布する. 地衣体上から明瞭に盛り上がったリレラを持ち, ラビアはレカノール酸を含む白色の粉霜で被われるので他のモジゴケ科地衣類から容易に区別できる.

2) *Glyphis cicatricosa*: 東南アジア, オーストラリア, 南北アメリカの熱帯-亜熱帯に広く分布する種で, 日本にも産する. 分類学的にはよく検討されており, カンボジアにも産することが確認された. 地衣体はやや緑褐色で連続する. リレラは細く擬子座の上に密集して生じる. 盤は開き, 褐色の粉霜で被われる. 胞子は無色, 8-13室, 未熟時に外皮膜 (*perispore*) を持つ, $40-60 \times 8-10 \mu\text{m}$. 地衣成分は含まない.

3) *Leiorreuma melanostrazans*: 地衣体はカーキ色, 連続する. リレラは単一またはわずかに分岐し, 地衣体上に盛り上がる (幅 $0.2-0.3 \text{ mm}$, 長さ $1-3 \text{ mm}$). 線状痕はない. 盤は開き, 灰白色の粉霜で被われる. 果殻の側面は炭化しないが, 底部は厚く炭化する. 子嚢層は顆粒状物質を含む (*inspersed*). 子嚢は8個の胞子を生じる. 胞子は褐色, (6-)7-9(-10)個の横隔膜をもつ, $25-32 \times 8-10 \mu\text{m}$. スチクチン酸を含む.

本種はこれまでに, アジア (インド, インドネシア, スリランカ), オーストラリア, 中米 (フランス領ギアナ, メキシコ) から報告されていた (Archer 2001) がカンボ

ジアでも *Irvingia* sp. 樹幹上に生育するのが見つかった.

4) *Phaeographis fragilissima*: 本種の特徴は次の通りである. 地衣体は淡緑褐色, 連続するが薄い. リレラは基物から突出し, 幅 $0.20-0.25 \text{ mm}$, 長さ $2-3 \text{ mm}$, 不規則に分岐し, やや放射状に広がる. ラビアは上部まで地衣体で被われるが, 剥離しやすい. 線状痕はないが, 地衣体と果殻の間には亀裂を生じる. 盤は開き, 桶状に凹む, 表面に灰白色の粉霜がある. 果殻は側部, 底部共に淡褐色, ラビア頂端部のみ僅かに炭化する. 側糸は明瞭で顆粒状物質を欠く. 子嚢は8個の胞子を生じる. 胞子は褐色, 6-7室, $18-21 \times 5-6 \mu\text{m}$. フマルプロトセトラー酸を含む.

本種の外部形態や胞子の形状がセイロンから記載された *Phaeographis subdividens* (Leight.) Müll. Arg. に似ているが, 後者は果殻先端が炭化せず, 地衣成分を含まないので区別できる. 西アフリカ産の *P. quadrifera* (Nyl.) Staiger も本種に似ているが, 石垣状多室胞子を持ちノルスチクチン酸を含むので区別できる.

カンボジアではタ・ネイ遺跡周辺の樹皮特に枝先に生育する. カンボジア特産.

5) *Sarcographa labyrinthica*: アフリカ, 東南アジア, オーストラリア, 中南米の熱帯域に広く分布する種であり, 次の特徴を持つ. 子器は集合して擬子座上に生じる. リレラは互いに密着し, リレラとリレラの間に深い亀裂を生じる. ラビアは狭い (幅 $0.10-0.12 \text{ mm}$) が盤は開き灰白色の粉霜を生じる. 子嚢層は顆粒状物質を含む. 子嚢は8個の胞子を生じる. 胞子は褐色, (4-)6室, 横隔壁のみを持つ. 主成分としてスチクチン酸を含む.

ホシダイゴケ属 *Sarcographa* としては, カンボジアに *S. gyrizans* (Leight.) Müll. Arg. が分布する. 両種は非常に似ていて成分も同様であるが, 後者のリレラは盤が閉じており, 石垣状多室胞子状を持つので区別できる. なお, 調査地においては, 両種はほぼ同所的に生育している.

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