

Southeast Asian Myxomycetes. I. Thailand and Burma¹

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TROPICAL SOUTHEAST ASIA includes the Philippines, the Indo-Malay Archipelago and Peninsula, Eastern Indochina, and parts of Thailand and Burma (Richards, 1952). Europeans initiated the modern phase of botanical exploration in this region. The floristics were done either locally by resident foreign botanists or by specialists in their native country, working with contributed materials. That which the early residents could not competently identify was sent largely to European and American specialists. The specimens, of necessity, had to be dried or otherwise preserved for a long sea journey. As a consequence many prominent mycologists published on material they knew only from herbarium specimens. In spite of the disadvantages of possible misinterpretation and duplication of work, it is fortunate that this procedure became prevalent; the duplicates now in the herbaria of Europe, South Africa, and America are the only representatives of a large amount of pre-World War II work.

Of the early Southeast Asian botanical centers, only the Bogor collections remain largely intact. The extensive collections in the Philippines National Herbarium in Manila and the Baker Fungus Collection in the University of the Philippines, College of Agriculture, were completely destroyed during the Japanese and American invasions of World War II. Only a few fungus specimens, mostly Baker duplicates, remain in the Singapore Botanical Garden.

Within Southeast Asia, Java, Borneo, and Sumatra were among the better collected areas. Collections from these places were examined by many foreign workers (Berkeley and Broome, 1876; Boedijn, 1927, 1928, 1940; Cesati, 1874; Emoto, 1931 *a*; Fischer, 1907; Höhnelt, 1909; Junghuhn, 1838; Moritzi, 1845; Overeem and

Overeem, 1922; Penzig, 1898; Raciborski, 1884; Zollinger, 1844). Chip (1921) and Sanderson (1922) published from Singapore and the lower Malay Peninsula.³ Other collections were studied abroad (Emoto, 1931 *b*; Lister, 1931; Saccardo and Paoletti, 1888). In the Philippines, though some mycological work has been done, most of the plant taxonomists who have worked there have known little about the fungi. The Myxomycetes of Indochina are completely unknown in the literature.

The present collections are being treated in two parts. This paper deals with the material from Thailand and Burma; the second part concerns collections from the Philippines and will be submitted for publication to the *Philippine Agriculturist*.

Heim (1962) refers briefly to an abundance of Myxomycetes in Thailand. The only Thai specimens of which we are aware are those collected in April–June 1967 by Dr. Emory Simmons and deposited by him in the U.S. National Fungus Collections (BPI). These specimens, which we have not seen, were determined by Dr. Marie L. Farr who kindly supplied us with her list of identifications. They are cited under the collector's (EGS) numbers at the appropriate places. No citations have been found from Burma.

MATERIALS AND METHODS

Collections were made during the summer of 1967 by the senior author. Field specimens and leaf and bark materials for moist chamber culture were mailed from Thailand to the University of Texas under USDA labels. No actual specimens were collected in Burma; the moist chamber material was hand-carried back.

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³ We examined 34 Myxomycetes collected in Singapore and the lower Malay Peninsula which are now in the Singapore Botanical Garden (SING) and found them to be dilapidated. Many of these are dated, annotated, or both, so that they could have been the basis of some of the Malayan citations or included in early monographs.

The nomenclature to be used in this report follows Martin and Alexopoulos (1969). Unless otherwise noted, the Thailand localities are referred to in the following manner: *A*, Khao Yai National Park; *B*, Khaopang, Namtok; *C*, Namtok, Tabkawg, Gankoy, Srabury. The Burmese material was all taken from Dalhouse Park, Royal Lake, Rangoon.

The specimens examined are cited after each locality in which they were collected by the collection number of Don R. Reynolds (DRR). An asterisk following a number indicates that the specimen was developed in moist chamber culture according to Gilbert and Martin (1933). Representative specimens are deposited in the University of Texas Myxomycete Collection, BPI and NYBG.

Class MYXOMYCETES

Subclass 1. CERATIOMYXOMYCETIDAE

Order CERATIOMYXALES

Family CERATIOMYXACEAE

Genus *Ceratiomyxa* Schroeter in Engler and Prantl. Nat. Pfl. 1(1):16. 1899

1. *Ceratiomyxa fruticulosa* (Müll.) Macbr. Thailand. *A*, 1200, 1221, 1231, 1234, 1235, 1237, 1170, 1247; *B*, 1266; *C*, 1172, 1204, 1207

The spores in some collections are $9-11 \times 5.4-6.3 \mu$. The normal range is $10-13 \times 6-7 \mu$. *Ceratiomyxa sphaerosperma* Boedijn known from Indonesia and the neotropics was not found.

Subclass 2. MYXOGASTROMYCETIDAE

Order LICEALES

Family LICEACEAE

Genus *Licea* Schrad. Nov. Gen. Pl. 16. 1797

Other than the citation by Penzig (1898) for *Licea variabilis* Schrad. in Bogor, there are no prior records of *Licea* from tropical Southeast Asia. Moist chamber work should yield many more records.

1. *Licea biforis* Morgan. Thailand. *C*, 1312*
2. *Licea erecta* Thind and Dillon. Thailand. *C*, 1345*

This species was described in 1967 from the foothills of the Eastern Himalayas. Our collection comes from a forested area in central Thailand. The wood on which the sporangia developed was not bamboo, as in the type collec-

tion. The reticulate pattern of the peridium is evident with magnification of $50\times$. It is not so distinct as the original illustration might suggest for the recessions between the anastomosing ridges scarcely show any shade of difference in color. In a lactophenol mount these ridges flatten out, suggesting that they were formed by a shrinkage of the peridium. The spores of the Thai material are smaller ($9-10 \mu$) than those of the Indian type ($13.5-15 \mu$). Our specimen thus approaches *L. operculata*, but because of a complete lack of operculum we tentatively assign it to *L. erecta*.

Family RETICULARIACEAE

Genus *Lycogala* Adans. Fam. Pl. 2:7. 1763

1. *Lycogala exiguum* Morgan. Thailand. *A*, 1258; *C*, 1209

The sporangia in the Khao Yai collection are 1-2 mm; the spores are reticulate, $4.5-5.4 \mu$; the capillitium densely spiny without inflations at the ends or at intervals as in *L. epidendrum*. The external appearance of the Namtok collection is more nearly like that of *L. epidendrum*. However, in both collections the sporangia bear blackish scales that are internally divided into numerous chambers.

Martin (1967) writes that, "*L. exiguum* does suggest a small dark phase of *L. epidendrum*." He concludes that the smaller, darker fruit body containing slender often hyphalike pseudocapillitium and smaller, less strongly reticulate spores in addition to the distinct but variably tessellate warts, separates the former species from *L. epidendrum*.

Family Cribrariaceae

Genus *Cribraria* Pers. Neues Mag. Bot. 1: 91. 1794

1. *Cribraria microcarpa* (Schrad.) Pers. Thailand. *A*, 1251, 1260; *B*, 1174, 1175, 1205, 1213

In two collections, the cup is lacking. The stalk of DRR 1175 is about $6/7$ of the total height, the dictydine granules are pulvinate and pale; the cup is completely lacking. This collection exhibits characteristics common to *C. languescens*, *C. pachydictyon*, and *C. microcarpa*. Some sporangia of DRR 1213 have no peridial cups; others have definite, but small, cups resembling *C. languescens*.

2. *Cribraria violacea* Rex. Thailand. *A*, 1259; *B*, 1297*

Genus *Dictydium* Schrad. Nov. Gen. Pl. 11. 1797

1. *Dictydium cancellatum* (Batsch) Macbr. Thailand. *C*, 1180

Order ECHINOSTELIALES

Family ECHINOSTELIACEAE

Genus *Echinostelium* de Bary, in Rost. Versuch 7. 1873

1. *Echinostelium minutum* de Bary. Thailand. *A*, 1296*; *C*, 1345*

This is the first known collection of any echinosteliaceous species from tropical Asia. *E. minutum* is known from the neotropics and from Australia as well as Europe and North America. We also have a specimen in our collections (UTMC-2102) collected in Malaya by Dr. A. Nawawi in 1969.

Order TRICHIALES

Family TRICHIACEAE

Genus *Arcyria* Wiggers. Prim. Fl. Holsat. 109. 1780

1. *Arcyria cinerea* (Bull.) Pers. Thailand. *A*, 1228*, 1232, 1257, 1308*; *C*, 1181, 1203; Pak Thong Chai, EGS DF 13. Burma. 1309*

Both the very minute globose form with sporangia only 0.1 mm in diameter and the typically tropical digitate form are present among these collections.

2. *Arcyria denudata* (L.) Wettst. Thailand. *A*, 1244; *C*, 1171, 1183, 1184; Pak Thong Chai, EGS GL 9
3. *Arcyria insignis* Kalch. and Cooke. Thailand. *C*, 1200
4. *Arcyria magna* Rex. Thailand. *C*, 1199

This and our collection from the Philippines (DRR 886) constitute the only records outside the western hemisphere of this uncommon species.

Genus *Hemitrichia* Rost. Versuch 14. 1873

1. *Hemitrichia intorta* (A. Lister) A. Lister. Burma. 1352*
2. *Hemitrichia serpula* (Scop.) Rost. Thailand. *A*, 1224

3. *Hemitrichia stipitata* (Masse) Macbr. Thailand. *A*, 1220, 1230; *B*, 1267; *C*, 1173, 1202

Hemitrichia clavata (Pers.) Rost. is included in the Indonesian and Malayan lists. Martin (1949) states, "reported from the tropics, but all tropical collections examined have proved to be *H. stipitata*." This was our experience with these collections and other specimens from the vicinity of Kuala Lumpur (DRR 1149, DRR 1145, DRR 1160) as well as with recent collections in the same area by Dr. A. Nawawi of the University of Malaya.

Genus *Perichaena* Fries, Symb. Gast. 11. 1817

1. *Perichaena chryso sperma* (Currey) Lister. Thailand. *C*, 1295*

Order STEMONITALES

Family STEMONITACEAE

Genus *Clastoderma* Blytt, Bot. Zeit. 38:343. 1880

1. *Clastoderma debaryanum* Blytt. Thailand. *C*, 1346*

Genus *Comatricha* Preuss, Linnaea 24: 140. 1851

1. *Comatricha elegans* (Racib.) G. Lister. Thailand. *A*, 1227
2. *Comatricha laxa* Rost. Thailand. *A*, 1225
3. *Comatricha longa* Peck. Thailand. *A*, 1226; Pak Thong Chai, EGS 117
4. *Comatricha tenerrima* (M. A. Curtis) G. Lister. Thailand. *A*, 1256

The only records from Asia of this species are from Japan.

5. *Comatricha typhoides* (Bull.) Rost. Thailand. *A*, 1223, 1235; *C*, 1217

DRR 1235 is variety *heterospora* Rex. The spores measure 5.5–6 μ and are finely reticulate in addition to exhibiting the characteristic wart clusters.

6. *Comatricha* sp. Thailand. *C*, 1179

This specimen approaches *C. subcaespitosa* in its general morphology. The stalk is $\frac{1}{3}$ to $\frac{1}{2}$ the total height; the capillitium is intricately branched and forms an almost complete net at the surface; the columella reaches almost to the summit. The spores, however, measure uniformly 6–6.5 μ diameter which is much too small for that species and more like those of *C. typhoides* in size. They are, however, darker

and uniformly punctate, lacking the clusters of warts characteristic of that species.

Genus *Diachea* Fries, Syst. Orbis Veg. 143. 1825

1. *Diachea radiata* Lister and Petch. Thailand. *A*, 1242

The spores are 9–10 μ and appear distinctly warted under the oil immersion lens. The peridium is bronze on some sporangia and completely iridescent blue on others. The stalk and columella are of calcareous nodules enclosed in a hyaline membrane layer. The capillitium and peridium originate from this layer. When the stalk is broken, the calcareous nodules spill out. There is no continuous calcareous hypothallus in the collection as recorded by Martin and Alexopoulos (1969) from a Panamanian collection, but rather there is a circular shaped hyaline extension of the stalk's outer sheath.

Genus *Lamproderma* Rost. Versuch 7. 1873

1. *Lamproderma arcyrionema* Rost. Thailand. *A*, 1236, 1239; Pak Thong Chai, EGS DF 20, 108

Genus *Stemonitis* Roth. Mag. Bot. Römer and Usteri 1(2):25. 1787

1. *Stemonitis fusca* Roth. Thailand. *A*, 1240; *C*, 1217
2. *Stemonitis herbatia* Peck. Thailand. *A*, 1195

This species occurs on bark instead of the usual habitat of living herbaceous plants. It could possibly be referred to *S. flavogenita*.

3. *Stemonitis splendens* Rost. Thailand. Boonsong Lekagul Clinic, 6 Custom House Lane, Bangkok, 1262

Order PHYSARALES

Family PHYSARACEAE

Genus *Erionema* Penzig. Myxom. Buitenz. 36. 1898

1. *Erionema aureum* Penzig. Thailand. *C*, 1219

This fruiting was from a large yellow phaneroplasmidium. The yellow elongate sporangia were massed on top of a large fallen log. The elastic capillitium has very few nodes; the spores measure 6–7 μ and, in addition to being minutely punctate, bear distinctive warts in loose clusters.

Genus *Physarella* Peck. Bull. Torrey Club 9:61. 1882

1. *Physarella oblonga* (Berk. and Curt.) Morgan. Thailand. *C*, 1313*

Genus *Physarum* Pers., Neues Mag. Bot. 1:88. 1794

1. *Physarum cinereum* (Batsch) Pers. Burma. 1348*

The spores are 8–9 μ and appear distinctly and closely warted under the oil immersion lens. The warts are dark brownish, rather than clear violaceous. The calcereous nodes are small, roundish. The peridium is a calcareous, bluish grey, rugulose layer. Fruit bodies range from scattered individual sporangia 2.5 mm in diameter to plasmodiocarps 1–3 mm in length, these often flattened into sheets.

It must be noted that if not matured properly fructifications of several physaraceous species produced in culture tend to resemble closely those of *P. cinereum* and that, unless several generations are cultured, there is always danger of misidentification.

2. *Physarum compressum* Alb. and Schw. Thailand. *A*, 1278*

Most spores are 9–10.8 μ , but some are ovoid, $9 \times 11.7 \mu$. The spore wall appears to be double as indicated by a distinct line in the approximate middle of the 1- μ -thick wall. The spore warts are quite evident and evenly distributed.

3. *Physarum flavicomum* Berk. Thailand. *A*, 1249, 1347*; *C*, 1189
4. *Physarum globuliferum* (Bull.) Pers. Burma. 1273*
5. *Physarum melleum* (Berk. and Br.) Massee. Thailand. *A*, 1276*; *C*, 1350*. Burma. 1349*
6. *Physarum nucleatum* Rex. Thailand. *C*, 1215
7. *Physarum nutans* Pers. Thailand. *A*, 1249; *C*, 1185
8. *Physarum oblatum* Macbr. Thailand. 1322*

The color of the peridium and the nodes is a creamy coffee rather than yellow. This collection has sporangia that have a flattened central lime knot as mentioned by Lister (1925). The stalk is darker than the species description suggests. However, specimens on hand determined by G. W. Martin have a black furrowed stalk.

9. *Physarum rigidum* G. Lister. Thailand. Pak Thong Chai, EGS
10. *Physarum tenerum* Rex. Thailand. C, 1176
11. *Physarum viride* (Bull.) Pers. Thailand. B, 1263; C, 1176, 1188, 1189, 1192, 1197, 1198

Family DIDYMIACEAE

Genus *Diderma* Pers. Neues Mag. Bot. 1:89. 1794

1. *Diderma hemisphericum* (Bull.) Hornem. Burma. 1272*

In some fruitings the sporangia were sessile and confluent into plasmodiocarplike formations.

Genus *Didymium* Schrad. Von. Gen. Pl. 20. 1797

1. *Didymium clavus* (Alb. and Schw.) Racib. Thailand. A, 1241; C, 1210
2. *Didymium iridis* (Ditmar) Fries. Thailand. Pak Thong Chai, EGS DF 13. Burma. 1319*, 1353*

DRR 1319 has a black stalk.

3. *Didymium squamulosum* (Alb. and Schw.) Fries. Thailand. A, 1314*, 1317*

Genus *Physarina* von Höhnel. Sitz. Akad. Wien. 118:431. 1909

1. *Physarina echinocephala* Höhnel. Thailand. A, 1351*

The fruit body is pure white. The spores are 9μ and minutely but distinctly warted under $1,000\times$. This species was heretofore known only from Java.

SUMMARY

In this first part of a report of Southeast Asian Myxomycetes, 42 species from Thailand and 7 from Burma are listed. *Echinostelium minutum* is the first member of the Echinosteliaceae to be reported in print from the Asian tropics. *Physarina echinocephala* and *Licea erecta* were previously known only from the type localities.

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LITERATURE CITED

- BERKELEY, M. J., and E. C. BROOME. 1876. Supplement to the enumeration of the fungi of Ceylon, Java. Transactions of the Linnean Society of London (Botany), vol. 15, pp. 82-86.
- BOEDIJN, K. B. 1927. Mycetoza von Sumatra. Miscellanea Zoologica Sumatrana, vol. 17, pp. 1-3.
- . 1928. Verzeichnis der von Sumatra bekannten Mycetoza. Annales mycologici, Berlin, vol. 26, p. 450.
- . 1940. The Mycetoza, fungi and lichens of the Krakatau group. Bulletin du Jardin botanique de Buitenzorg, series III, vol. 16, pp. 358-429.
- CESATI, V. 1874. Mycetum in itinere Borneensi. Hedwigia, vol. 13, p. 186 (abs.).
- CHIP, T. F. 1921. A list of the fungi of the Malay Peninsula. Gardens' Bulletin, Straits Settlements, Singapore, January 7, vol. 2, pp. 311-418.
- EMOTO, Y. 1931 a. Javanische Myxomyceten. Bulletin du Jardin botanique de Buitenzorg, series II, pp. 161-164.
- . 1931 b. The Malayan Myxomycetes. Journal of Botany, British and Foreign, London, vol. 69, pp. 38-42.
- FISCHER, E. 1907. Ueber einige von Herrn. Prof. E. Kissling in Sumatra gesammelte Pilze, Mittheilung der Naturforschenden Gesellschaft in Bern, 1906, pp. 109-123.
- GILBERT, H. C., and G. W. MARTIN. 1933. Myxomycetes found on the bark of living trees. Studies in Natural History, Iowa University, vol. 15, pp. 1-8.
- HEIM, R. 1962. Contribution à la flore mycologique de la Thaïlande. I. Revue de Mycologie, vol. 27, pp. 124-158.
- HÖHNEL, F. VON. 1909. Fragmente zur Mykologie. Javanische Myxomyceten. Sitzungsberichte der kaiserl. Akademie der Wissenschaften in Wien. mathem.-naturw. Classe, vol. 118, pp. 427-442.
- JUNGHUHN, F. W. 1838. Praemissa in Floram

- Cryptogamicam Javae insulae. Fascicules I. Java, pp. 1-86.
- LISTER, A. 1925. A monograph of the Myceto-
zoa. 3rd ed, revised by G. Lister. London,
British Museum (Natural History). xxxii +
296 pp., 222 pls.
- LISTER, G. 1931. Notes on Malayan Myceto-
zoa. Journal of Botany, British and Foreign, Lon-
don, vol. 69, pp. 42-43.
- MARTIN, G. W. 1949. Myxomycetes. North
American Flora, vol. 1, no. 1, pp. 1-190.
- 1967. *Lycogala exiguum*. Mycologia,
vol. 59, pp. 155-160.
- MARTIN, G. W., and C. J. ALEXOPOULOS. 1969.
The Myxomycetes. Iowa City, University of
Iowa Press. 560 pp., 41 col. pls.
- MORITZI, A. 1845. Systematisches Verzeichniss
der von H. Zollinger in den Jahren 1842-
1844 auf Java gesammelten Pflanzen vebst
einer kurzen Beschreibung der neuen Gattun-
zen und Arten. Solothurn.
- OVEREEM DE HASS, V., and C. VAN OVEREEM
DE HASS. 1922. Verzeichnis der in Nieder-
landisch Ost-Indien bis dem Jahre 1920 ge-
fundenen Myxomycetes, Fungi und Lichenes.
Bulletin du Jardin botanique der Buitenzorg,
series III, vol. 4, pp. 1-146.
- PENZIG, O. 1898. Die Myxomyceten der Flora
von Buitenzorg. Flore de Buitenzorg, series II,
Leiden, E. J. Brill, pp. 1-83.
- RACIBORSKI, M. 1884. Ueber die javanischen
Schleimpilze. Hedwigia, vol. 37, pp. 50-55.
- RICHARDS, P. W. 1952. The tropical rain forest;
an ecological study. New York, Cambridge
University Press.
- SACCARDO, P. A., and G. PAOLETTI. 1888. My-
cetes Malacenses. Atti del reale Istituto Ve-
neto di Scienze, series 6, vol. 6, pp. 387-428.
- SANDERSON, A. R. 1922. Notes on Malayan
Mycetozoa. Transactions of the British Myco-
logical Society, vol. 7, pp. 239-256.
- ZOLLINGER, H. 1844. Observationes phyto-
graphicae praecipue genera et species nova
nonnulla respicientes. Natuur-en geneeskun-
dig. Archief voor Nederlandsch-Indië, vol. 1,
pp. 372-405.