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RESEARCH ARTICLE

Myxomycetes of Taiwan XXIV. The genus *Physarum*

Chin-Hui Liu[1*], Jong-How Chang[1] and Fu-Ya Yeh[2]

1. Institute of Plant Science, National Taiwan University, Taipei, Taiwan 10617, R.O.C.
2. Department and Graduate School of Biotechnology, Fooyin University, Kaohsiung, Taiwan 83102, R.O.C.
** Corresponding author. Email: huil4951@ntu.edu.tw*

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ABSTRACT: Species of the genus *Physarum* collected from Taiwan were critically reviewed. In this paper, we also described and illustrated three new records of Taiwan: *Physarum dictyosporum*, *P. nasuense*, and *P. tenerum*, and a rediscovered species *P. flavicomum*. A key to the 51 *Physarum* species of Taiwan is also provided.

KEY WORDS: Myxomycetes, Physaraceae, *Physarum*, Taiwan, taxonomy.

INTRODUCTION

The *genus Physarum*, known as the largest genus in Physaraceae and in Myxomycetes as well, comprises more than 141 species in the world records (Lado, 2005–2013). As might be expected that members in this genus possess a wide range of characters as shown in the key to the species in this paper. They are, however, recognized as a group in the genus *Physarum* by their characters of capillitium, the forms of fruiting body and the ways of peridial dehiscence as mentioned in the key to the genera of Physaraceae (Liu and Chang, 2012). In this paper we compiled data of 48 species of *Physarum* that were previously reported from Taiwan and three new records, *P. dictyosporum* and *P. tenerum* harvested from moist-chamber cultures, and *P. nasuense* on fallen leaves in a tree hole. The species of *P. flavicomum*, the second record since 1929 from Taiwan, is also described in detail. Characteristic examination for the fruiting bodies of these specimens were made by light and scanning electron microscopy as described previously (Liu et al., 2002a).

TAXONOMIC TREATMENTS

Key to species of *Physarum* in Taiwan

1. Fructification usually sessile, sporangiate or plasmodiocarpous, rarely short stalked ……..…….. 2
1’. Fructification stalked ……..…….. 25
2. Spores prominently reticulate ……..…… 3
2’.Spores not as above …… 4
3. Fructification sporangiate, appearing as a kidney bean or a clam, yellowish brown …… ***P. retisporum***
3’. Fructification plasmodiocarpous, varying to sporangiate, white ..... ……***P. dictyosporum***
4. Spores adhering in a cluster of 5–7 ……..... ***P. lakhanpalii***
4’. Spores free, not in clusters …… 5
5. Peridium double or triple ……..... 6
5’.Peridium single or appearing single ……. 15
6. Fructification strongly flattened, approximately isodiametric, closely appressed and angular from pressure, and almost forming a pseudoaethalium; spores 12–14 µm in diameter ...… ***P. tessellatum***
6’. Fructification not flattened, sporangiate or plasmodiocarpous, rarely forming a pseudoaethalium …….. 7
7. Fructification laterally compressed, usually dehiscing more or less along a preformed longitudinal fissure ……..… 8
7’. Fructification not laterally compressed, dehiscing lobate or irregularly or areolate …… 11
8. Fructification white, dehiscent by a preformed fissure ……..… 9
8’. Fructification yellowish …….. 10
9. Spores with conspicuous spines, these sometimes united as ridges, 10–12 µm in diameter, outer peridium calcareous but smooth ……. …….. ***P. echinosporum***
9’. Spores minutely warted, 8–10 µm in diameter, outer peridium calcareous, more or less rough …… ***P. bivalve***
10. Plasmodiocarps terete, or slightly compressed laterally; outer peridium rough; dehiscence apical, but not by a preformed fissure; nodes yellow to pallid ……..…… ***P. superbum***
10’. Plasmodiocarps strongly compressed laterally; outer peridium smooth; dehiscence of the outer peridium along a preformed longitudinal fissure at the top; nodes white …..… ***P. hongkongense***
11. Plasmodiocarps white, short, often broken into sporangium-like sections; dehiscence irregular above …… ***P. laevisporum***
11’. Plasmodiocarps distinctly colored, elongate, branched, or broken into sporangium-like sections; dehiscence irregular or lobate or areolate ……..…… 12
12. Outer peridium smooth …….. 13
12’. Outer peridium areolate, ridged or with pleats …..…….. 14
13. Outer peridium scarlet, not iridescent, inner peridium pale yellow, calcareous …… ***P. nasuense***
13’. Outer peridium violaceous brown, iridescent, inner peridium membranous, shining, with metallic iridescence …… ***P. aeneum***
14. Peridium triple, the two outer peridia closely attached, dull yellow to brown; dehiscence lobate or forming angular fragments ……..… ……..... ***P. bogoriense***
14’. Peridium double, outer peridium yellowish or greenish, with longitudinal ridges or pleats, dehiscing irregularly above ……. …….. ***P. plicatum***
15. Capillitium elastic, duplex, consists of long spikes and small fusiform nodes; plasmodiocarps rosette-like or pseudoaethaliate, hypothallus weak stalk-like ……..……..… ***P. gyrosum***

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15’. Capillitium neither elastic nor duplex; not forming pseudoaethalium or a rosette ……..... 16
16. Mainly plasmodiocarpous, sometimes accompanied by sporangia ... ……..…….. 17
16’. Mainly sporangiate, but often forming short plasmodiocarpous ….. …… 18
17. Fructification usually white or grayish white ……..…… ***P. vernum***
17’. Fructification yellow, ochraceous or pale yellow …….... ***P. serpula***
18. Spores varying from oval, 12–13 × 10–12 μm to glosbose 9–11 μm in diameter, usually encircled by a pale band ……... ***P. ovisporum***
18’. Spores more or less globose, not encircled by a pale band ……. 19
19. Fructification usually white or grayish white ……..…… 20
19’. Fructification yellow, ochraceous or orange-yellow to brownish orange ……. 22
20. Sporangia predominantly sessile; stalk when present yellow; pseudocolumella present, often cylindrical ……. ***P. mutabile***
20’. Sporangiate and sessile or plasmodiocarpous; columella often present ….....… 21
21. Spores 6–8 μm in diameter; columella present ……..…… ***P. sessile***
21’. Spores 9–11 μm in diameter; columella absent …….... ***P. cinereum***
22. Sporangia obpyriform ……..…. 23
22’. Sporangia not as above ……..…. 24
23. Sporangia predominantly obpyriform, yellow; spores 7–8 μm in diameter ……..…… ***P. obpyriforme***
23’. Sporangia subglobose, erect-ovate, or turbinate, orange-yellow to brownish orange; spores 8–10 μm in diameter ….... ***P. braunianum***
24. Sporangia primarily reddish to orange, often fading to ochraceous or dingy white; peridium covered by patches of yellow lime granules and often limeless on the basal part ……..… ***P. auriscalpium***
24’. Sporangia primarily yellow-brown, often with white, yellow or reddish scales or patches; lime rarely continuous ……. ***P. decipiens***
25. Columella present …… 26
25’. Columella lacking …… 30
26. Stalk neither white nor calcareous; columella extending to near the apex of sporangia …… 27
26’. Stalk white, calcareous; columella small, conical, or lacking …. 28
27. Sporangia white, not iridescent; stalk short, black ..... …… ***P. crateriforme***
27’. Sporangia olivaceous, more or less iridescent; stalk slender, orange-brown …… ***P. penetrale***
28. Sporangia orange, honey-yellow, or yellowish brown …….. ……..…. ***P. melleum***
28’. Sporangia white, pinkish or pale ochraceous ……....…. 29
29. Sporangia white, pale ochraceous or pinkish; capillitial threads with small and rounded lime nodes; columella sometimes lacking …….. ……... ***P. globuliferum***
29’. Sporangia white; capillitial threads with large and angular lime nodes; columella often lacking, when present, very short, broadly conical ……..... ***P. leucopus***
30. Sporangia lobate or distorted, often appearing compound ….…. 31
30’. Sporangia usually solitary ……..…. 32
31. Sporangia irregular in shape, much compressed, lenticular, often forming a helvelloid cluster, yellowish or whitish; capillitium of small, fusiform lime nodes, not forming pseudocolumella; stalk yellow, usually long, slender and flexuous ……..…… ***P. polycephalum***
31’. Sporangia multilobate, compound-contorted; peridium ribbed with calcareous thickening; capillitium of large, angular lime nodes, sometimes forming pseudocolumella at the center; stalk short, stout ……. ***P. nicaraguense***
32. Sporangia with a constricted base; stalk weak, stalk-like attachment to the substrate present, arising from the reticulate and extended hypothallus; pseudocolumella often present in the centre of sporangium ……....…. 33
32’. Sporangia with prominent stalks ……..... 34
33. Sporangia aggregated, crowded as a pseudoaethalium; outer peridium crustose, readily shed, the upper usually remained as a cap; spores with spinules evenly distributed, 12–15 μm in diameter ……..... ***P. licheniforme***
33’. Sporangia never look like pseudoaethalium; outer peridium persisting below as a poorly defined cup; spores warted, with larger warts in clusters, smaller than 11 μm in diameter …... ***P. straminipes***
34. Stalk relatively long, usually more than twice as long as the diameter of sporangia ……..... 35
34’. Stalk relatively short, usually much less twice as long as the diameter of sporangia …….. 42
35. Pseudocolumella often present, globose or ball-like ……..….. 36
35’. Pseudocolumella lacking ……..…. 37
36. Stalk yellowish, limeless; peridium with lime granules evenly distributed on the surface; spores 7.5–8.5 μm in diameter …….… ……..….. ***P. nucleatum***
36’. Stalk white, calcareous throughout; peridium with large hemispherical scales or spots as the compact aggregation of lime granules; spores 8–10 μm in diameter ……..….. ***P. stellatum***
37. Sporangia more or less globose …… 38
37’. Sporangia saucer-shaped or lens-shaped …… 39
38’. Sporangia white or grayish white, often with a brown, thickened and persistent base; stalk limeless, yellowish brown; spores 10–12 μm in diameter ……..... ***P. pusillum***
38’. Sporangia white, pale yellow or bright yellow, sometimes iridescent; stalk calcareous, pale yellow; spores 8–11 μm in diameter ……..…….. ***P. tenerum***
39. Sporangia saucer-shaped ……..…. ***P. pezizoideum***
39’. Sporangia lens-shaped ……..……..... 40
40. Sporangia whitish or grayish, iridescent, sometimes nearly limeless; spores 8–9 μm in diameter ……..…… ***P. flavicomum***
40’. Sporangia yellow, encrusted with lime ……..….. 41
41. Spores pale lilac-brown by transmitted light, 7–9 μm in diameter; lime nodes fusiform ……..…. ***P. viride***
41’. Spores violet brown by transmitted light, 9–10 μm in diameter; lime nodes rigid, forked, elongated ……..... ***P. rigidum***
42. Sporangia strongly laterally compressed, fan-shaped …….... ……..…….. ***P. compressum***
42’. Sporangia not as above, more or less globose, ovoid, or cylindrical ……..…. 43
43. Sporangia white, grayish white …… 44
43’. Sporangia distinctly colored ……..….. 48
44. Stalk calcareous throughout or limy except at the basal end ….... 45
44’. Stalk not calcareous, usually membranous, or only frosted a thin layer of lime granules on the surface ……..…. 46
45. Stalk calcareous throughout, orange in color; spores 7–7.5 μm in diameter …… ***P. taiwanianum***
45’. Stalk limy and white except at basal end; spores 10–13 μm in diameter ……..…. ***P. alboradianum***
46. Sporangia globose or depressed globose, very calcareous; often clustered on stalks ……..…… ***P. notabile***
46’. Sporangia not united in clusters ……..…… 47
47. Sporangia globose to subdepressed or ovate, white with darker base, erect; peridium not notably calcareous, sometimes nearly limeless, and then somewhat iridescent; spores 9–11 μm in diameter …… ***P. leucophaeum***
47’. Sporangia white, nodded, lenticular to depressed globose; stalk whitish at the apex, dark below; spores 8–9 μm in diameter …… ***P. album***
48. Sporangia and lime nodes red; pseudocolumella sometimes present …….... ***P. roseum***
48’. Sporangia not reddish ……..…. 49
49. Sporangia iridescent blue or bronze; peridium nearly limeless ...….. ……..…… ***P. psittacinum***
49’. Sporangia yellowish; dehiscence irregular from the apex, base of the sporangium persistent as a calyculus ……..….. 50
50. Sporangia light yellow or creamy yellow, with a limeless, iridescent disc at the base; stalk yellow, limy; spores 7.5–8 μm in diameter ....…..…… ***P. cremiluteum***
50’ Sporangia maize-yellow to pale yellow, iridescent for the lacking of lime granules, reddish at the basal part; stalk limeless, reddish brown; spores 9–13 μm in diameter ……..…….....…. ***P. oblatum***

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Annotated species list

Physarum album (Bull.) Chevall., Fl. gén. env. Paris 1: 336. 1826. Fig. 1

Physarum nutans Pers., Ann. Bot. (Usteri) 15: 6. 1795.
Physarum nutans var. *rubrum* (Nann.-Bremek. & Y. Yamam.) Chao H. Chung, in Chung & Liu, Taiwania 42(4): 282. 1997.

Specimens examined: **TAIWAN**: Hsinchu County: Chinghua University, on bark of *Pinus elliottii*, *BY846M208*, July 5, 1990. Taipei City: main campus of National Taiwan Univ., on bark, *CHL B82*, June 14, 1982. Nantou County: Meifeng, Highlands Experiment Farm, National Taiwan University, on bark of *Cryptomeria japonica*, *CHL B1026*, June 30, 1992.

This species was reported as *Physarum nutans* in a list by Nakazawa (1929). It is characterized by the stipitate and white sporangium which is usually nodding and discoid in shape, lack of both columella and pseudocolumella, and capillitium of fusiform, white lime nodes connected by long colorless threads which are dichotomously branched. Spores in our specimens appear larger in diameter (9.0–11.5 μm) than as described in the references (Martin and Alexopoulos, 1969; Nannenga-Bremekamp, 1991).

Physarum aeneum (Lister) R.E. Fr., Ark. Bot. 1: 62. 1903.

Description and illustration: Liu and Chung (1993).

Physarum alboradianum Gottsb., Nova Hedwigia 15: 363. 1968.

Description and illustration: Liu (1983); Chung and Liu (1997b).

Physarum auriscalpium Cooke, Ann. Lyceum Nat. Hist. New York 11: 384. 1877.

Specimens examined: **TAIWAN:** Taipei City: main campus of National Taiwan Univ., on bark, *CHL B85a*; *CHL B102b*, June 14, 1982.

As noted, this species is often confused with *P. serpula* (Farr, 1961; Martin and Alexopoulos, 1969; Ing, 1999). The distinct characters by which it differs from the latter species are: (1) peridium covered by patches of yellow lime granules and often limeless on the basal part (in *P. serpula*, it is covered by a dense crust of closely incrusted lime grannules, without lime scales), (2) spore diameter smaller (10–13 μm in *P. serpula*), (3) bright green coloration in young or first dried fruiting bodies, a character more often appears in bark culture of this species (Martin. and Alexopoulos, 1969). Based on the first two characters as mentioned above, we transfer our specimens from *P. serpula* (Liu, 1983) to *P. auriscalpium*. All our specimens were collected directly from barks of living trees, thus the distinct phase of green color of young plasmodiocarps was not observed.

Physarum bivalve Pers., Ann. Bot. (Usteri) 15: 5. 1795. Fig. 2

Specimens examined: **TAIWAN**: Taipei City: main campus of National Taiwan Univ., on fallen leaves, *CHL B44*, Mar. 15, 1982; Peitou, Mt. Samoa, on fallen leaves, *Y.F. Chen503*, Aug. 7, 1995.

It was reported in a list by Wang et al. (1981). This species is a very distinctive species. The color and form of plasmodiocarps are characteristics readily recognized.

Physarum bogoriense Racib., Hedwigia 37: 52. 1898.

Description and illustration: Liu and Chung (1993).

Physarum braunianum de Bary, in Rostafinski, Sluzowce Monogr. 105. 1874.

Description and illustration: Liu et al. (2002b).

Physarum cinereum (Batsch) Pers., Neues Mag. Bot. 1: 89. 1794.

Specimens examined: **TAIWAN**: Taipei City: Peitou, Yangmingshan National Park, on fallen leaves, *CHL B1423b*, Apr. 1, 1998; *CHL B2221*, Oct. 10, 2000.

It was reported in a list by Nakazawa (1929). The species very close to *Physarum cinereum* is *P. vernum* in which the fruiting bodies are predominantly plasmodiocarpous and larger in width, the peridium are more limy and crustose, the spores are much darker (almost black in mass) and larger in average size, and pseudocolumella sometimes present.

Physarum compressum Alb. & Schwein., Consp. fung. (Leipzig): 97. 1805.

Description and illustration: Liu (1982).

Physarum crateriforme Petch, Ann. Roy. Bot. Gard. Peradeniya 4: 304. 1909.

Description and illustration: Liu (1982).

Physarum cremiluteum Y.F. Chen & C.H. Liu, Taiwania 43: 186. 1998.

Description and illustration: Liu and Chen (1998).

Physarum decipiens M.A. Curtis, Amer. J. Sci. Arts, Ser. II 6: 352. 1848.

It was reported in a list by Wei and Liu (1989) without any description and illustration.

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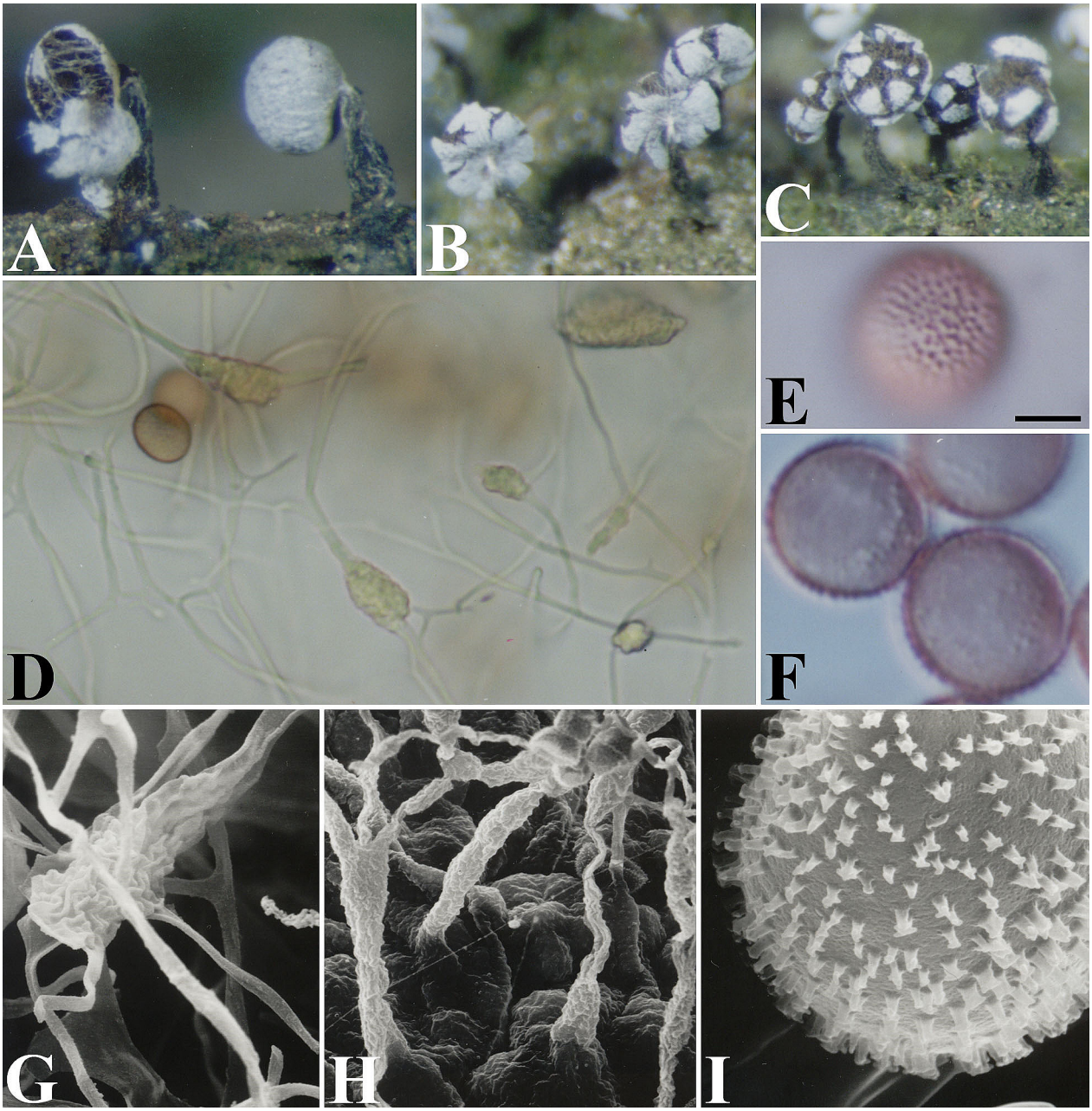


Fig. 1. *Physarum album*. A–C: Fruiting bodies. D: Capillitial threads and lime nodes. E: Surface view of a spore. F: Marginal view of spores. G–H: Capillitium, by SEM. I: Surface markings of a spore. Scale bars: A = 200 μm; B–C = 320 μm; D = 10 μm; E–F = 4 μm; G = 4 μm; H = 11 μm; I = 0.7 μm.

Physarum dictyosporum G.W. Martin, Brittonia 14: 183. 1962. Fig. 3

Fructification plasmodiocarpous, scattered with rounded and sessile sporangia, gregarious, 0.4–0.6 mm in diameter, 0.5–0.6 mm tall, the plamodiocarps up to 2.2 mm long, sinuous, very rarely branched, on inconspicuous dark brown hypothallus. Peridium double, the outer layer a limy crust, white, the inner peidium membranous, translucent, dehiscent irregularly. Capillitium abundant, the nodes white, angular and irregular in shape, connected by inconspicuous threads. Spores black in mass, violaceous brown by transmitted light, globose, 10–15 μm (mostly 10–11 μm) in diameter, the surface markings banded reticulate, with tall, coarse and dark warts connected by stout bands. Plasmodium white.

Specimen examined: **TAIWAN:** Kaohsiung City: Taliao,

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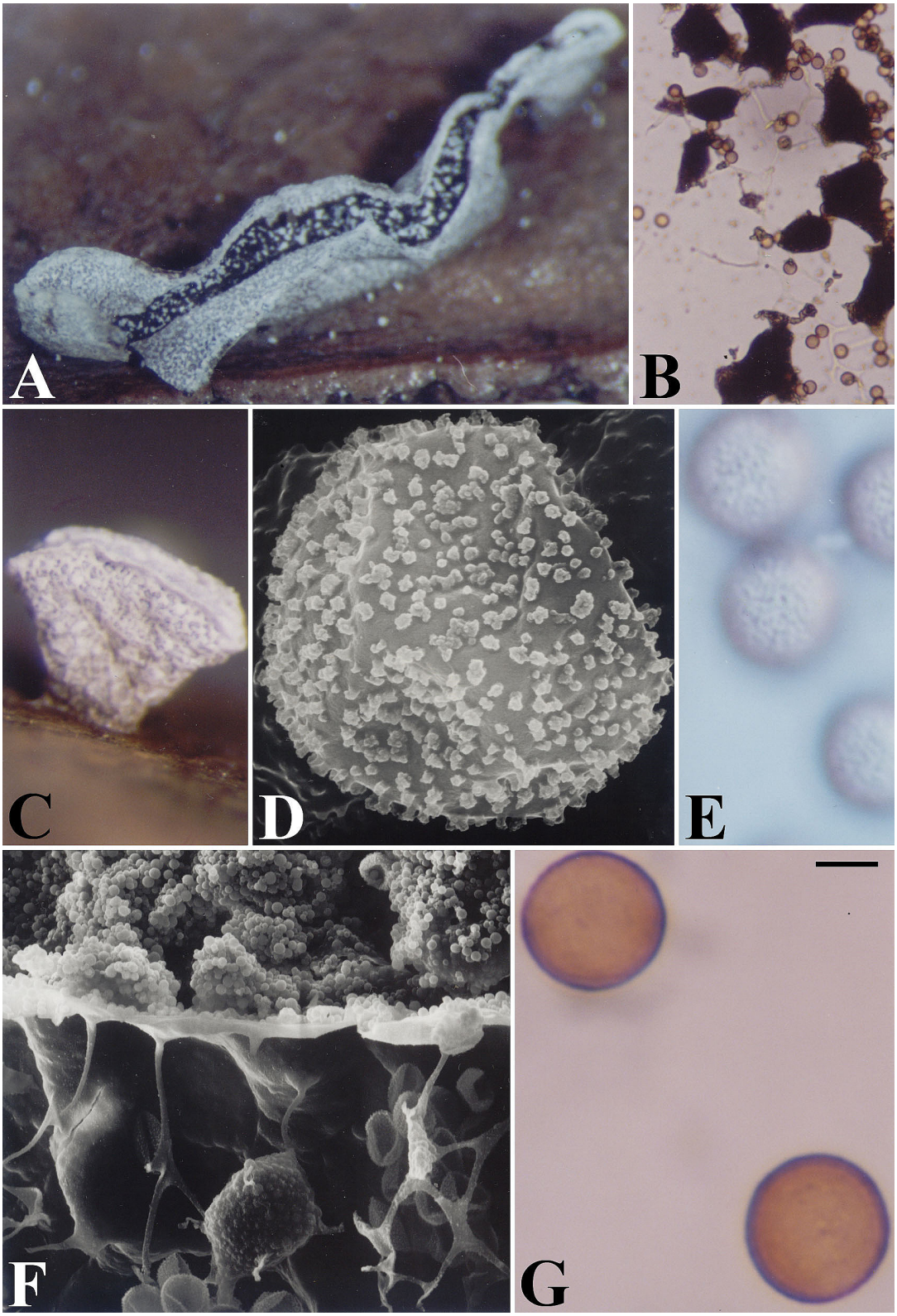


Fig. 2. ***Physarum bivalve.*** **A & C: Fruiting bodies. B: Capillitium. D: Surface markings of spore, by SEM. E: Surface view of spores. F: Portion of a dehiscent plasmodiocarp, showing the outer and inner peridium with capillitium and spores in the fruiting body, by SEM. G: Marginal view of spores. Scale bars: A = 520 µm; B = 40 µm; C = 210 µm; D = 1 µm; E = 5 µm; F = 8.7 µm; G = 3.5 µm.**

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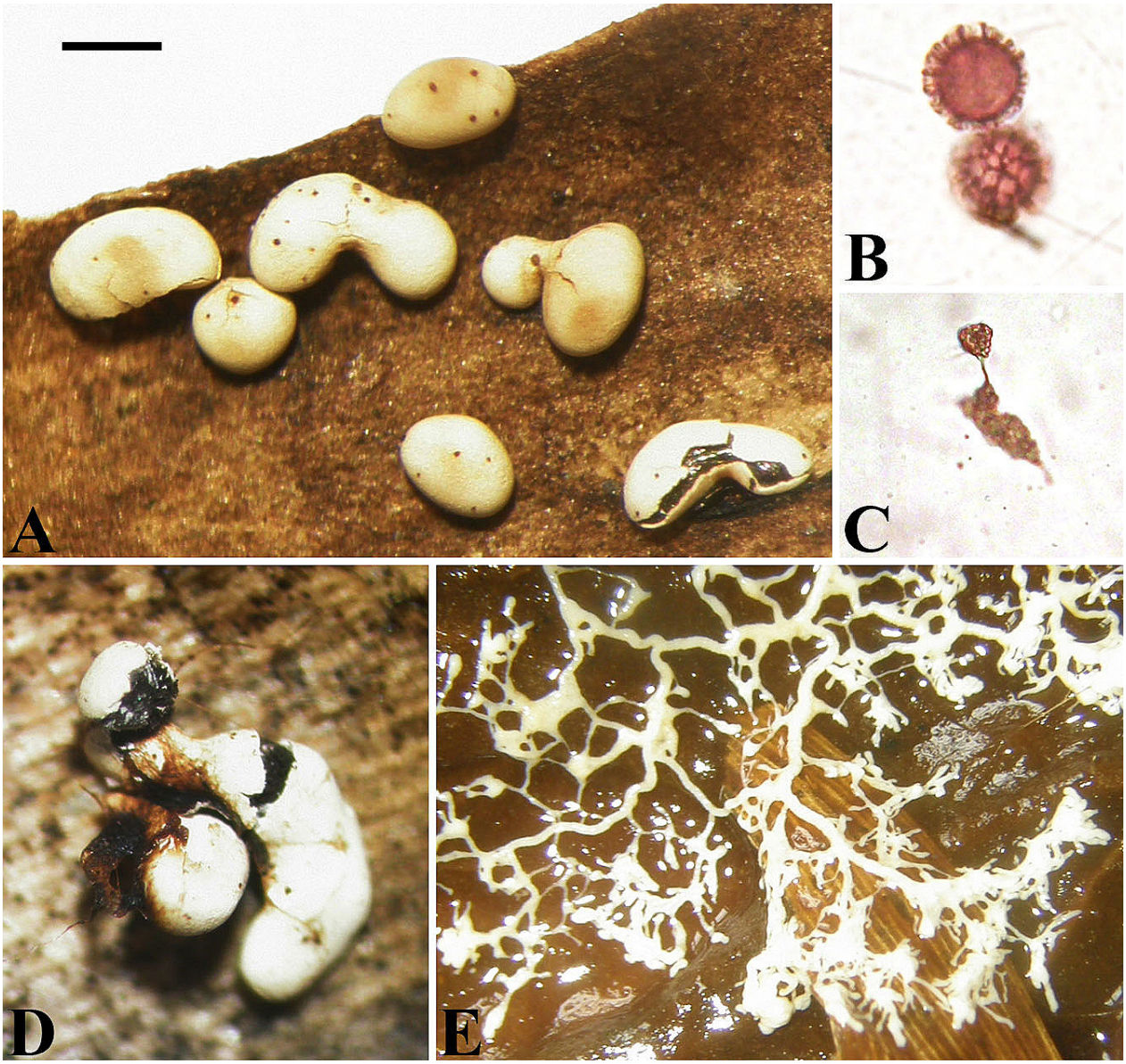


Fig. 3. *Physarum dictyosporum*. A: Fruiting bodies. B: Spores. C: Capillitium. D: Dehiscent fruiting bodies, showing black spores mass. E: Plasmodium. Scale bars: A, D = 325 μm; B = 8 μm; C = 20 μm; E = 0.8 mm.

Fooyin University, on fallen leaves, *F.Y. Yeh40*, June 3, 2011 (moist-chamber culture: Apr. 29–June 3, 2011).

The reticulate spore surface markings are the most distinct character of this species in the primarily plasmodiocarpous species of *Physarum*. Other characters are the white, crustose outer peridium with a close inner peridium and the short and inconspicuous capillitial threads connecting numerous white lime nodes. *Physarum echinosporum* is also a species with white plasmodiocarpous fruiting bodies which, however, are laterally compressed, and not terete as that of this species. It is new to Taiwan.

Physarum echinosporum Lister, J. Bot. 37: 147. 1899.

Description and illustration: Liu and Chung (1993).

Physarum flavicomum Berk., London J. Bot. 4: 66. 1845. Fig. 4

Fructification gregarious, sporangiate, 0.77–1.35 (–1.79) mm in total height. Sporangia stipitate, nodding, slightly depressed globose or lenticular, 0.45–0.62 mm in diameter, umbilicate at the base, whitish or grayish, iridescent, sometimes nearly limeless. Stalk long, pale

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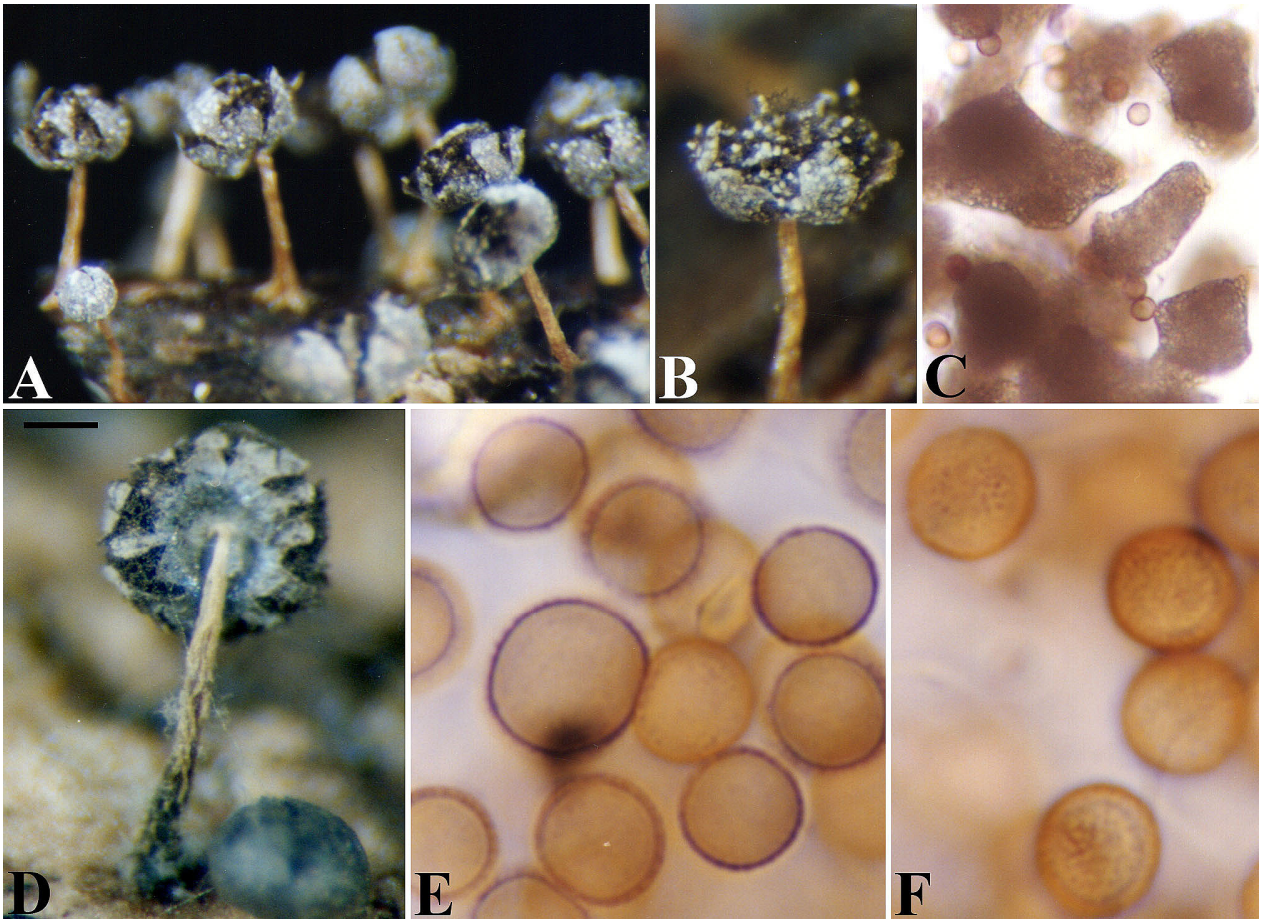


Fig. 4. *Physarum flavicomum*. A: Fruiting bodies. B: A dehiscent fruiting body. C: Capillitium. D: One fruiting body, showing back side view of the sporangium. E: Marginal view of spores. F: Surface view of spores. Scale bars: A = 325 µm; B, D = 210 µm; C = 30 µm; E–F = 5 µm.

yellowish or pale brownish, darker or black near the base, slender, tapering, wrinkled. Hypothallus membranous, colorless. Peridium membranous, covered with delicate white lime granules, often nearly limeless, dehiscence beginning fragmentally at the top, persistent and petaloid at the lower portion. Columella absent. Capillitium delicate reticulate, lime nodes small, fusiform or angular, orange yellow. Spores dark brown in mass, pale under transmitted light, globose, 8–9 µm in diameter, minutely warted, with faint clustered-warts. Plasmodium orange yellow.

Specimens examined: **TAIWAN:** Taipei City: Peitou, Yangmingshan National Park, on fallen leaves, *Y.F. Chen496*, Sept. 7, 1997. Pingtung County: Wanlideshan forest, on a dead log, *Y.F. Chen35*, plasmodium collected on Aug. 3, 1995, fruiting bodies harvested on Aug. 9, 1995.

This is the second record of *Physarum flavicomum* in Taiwan. The first record was reported by Nakazawa in 1929. It is very similar with *P. viride* in the nodding habit of fruiting bodies, the small and yellow lime nodes and the colorless capillitial threads radiating from the base of peridium. They can be distinguished, however, by the branching pattern of capillitial threads, which is dichotomous in *P. viride* but reticulate in *P. flavicomum*. In addition, sporangia of this species are often nearly limeless and appearing iridescent in contrast with the always limy sporangia in *P. viride*.

The color of stalk in our specimens is never reddish brown as described in the reference (Martin and Alexopoulos, 1969) but is paler, yellowish or yellowish brown.

Physarum globuliferum (Bull.) Pers., Syn. Meth. Fung. 1: 175. 1801.

It was reported as a new record without any description and illustration (Wang et al., 1981).

Physarum gyrosum Rostaf., Sluzowce Monogr. 111. 1874.

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It was reported as a new record without any description and illustration by Wang et al. (1981).

Physarum hongkongense Chao H. Chung, Slime Moulds of Hong Kong 19. 1997.

Description and illustration: Chung and Tzean (1998a).

This rarely discovered species was first reported from Hong Kong. The subsequent records were from Japan, Taiwan, and New Zealand (Stephenson, 2003; Yamamoto, 2006).

Physarum laevisporum Agnihothr., Sydowia 16: 121. 1963.

Description and illustration: Liu et al. (2001).

Physarum lakhanpalii Nann.-Bremek. & Y. Yamam., Proc. Kon. Ned. Akad. Wetensch., C. 90: 335. 1987.

Description and illustration: Chung and Liu (1997a).

Physarum leucophaeum Fr., in Fries & Palmquist, Symb. gasteromyc. 3: 24. 1818.

It was reported in a list by Nakazawa (1929), but no specimen was deposited in Taiwan.

Physarum leucopus Link, Ges. Naturf. Freunde Berlin Mag. 3: 27. 1809.

Description and illustration: Liu (1983).

Physarum licheniforme (Schwein.) Lado, Cuad. Trab. Fl. Micol. Iber. 16: 70. 2001.

Physarum didermoides var. *lividum* (Rostaf.) Lister, J. Bot. 36: 161. 1898.

It was reported in a list by Nakazawa (1929) as *Physarum didermoides* var. *lividum*, but no specimens were deposited in Taiwan.

Physarum melleum (Berk. & Broome) Massee, Monograph of the Myxogastres (London): 278. 1892.

Description and illustration: Liu (1982).

Physarum mutabile (Rostaf.) G. Lister, Monogr. Mycetozoa, Edn 2 (London): 53. 1911.

Description and illustration: Chung and Liu (1997c).

Physarum nasuense Emoto, Bot. Mag. Tokyo 45: 551. 1931. Fig. 5

Fructification plasmodiocarpous, gregarious or scattered, often constricted in the forms of short, pulvinate plasmodiocarps, or scattered, sessile sporangia, 0.19–0.45 mm in diameter. Hypothallus and columella lacking or inconspicuous. Peridium double, outer layer red, cartilaginous, thick; inner layer membranous, pale yellow, densely covered in patches with lime granules, closely attached to the outer peridium, dehiscence lobate or irregular. Capillitium netted, lime node pale yellow, rounded or angular, various in size, the connecting threads slender and pale yellowish. Spores dark brown in mass, brown by transmitted light, distinctly warted, globose, 8–10 μm in diameter. Plasmodium orange-red.

Specimens examined: **TAIWAN:** Pengtung County: Nanjenshan, on fallen leaves, *CHL B1296*, Sept. 21, 1997; on fallen leaves in the tree hole of *Cyclobalanopsis championii*, *CHL B1343*, Nov. 22, 1997.

This species is a rather rare one in the world. It was first collected in Nasu forest of Japan (Hattori, 1935; Martin and Alexopoulos, 1969). In Taiwan, we found this specimen on the fallen leaves in Nanjenshan forest, southern Taiwan. Our specimen is different from Nasu's collection in the color of lime nodes. In our collection, the lime nodes didn't show the reddish tint as described in the reference (Martin and Alexopoulos, 1969). The species is a new record in Taiwan.

Physarum nicaraguense T. Macbr., Bull. Iowa Univ. Lab. Nat. Hist. 2: 382. 1893.

It was reported in a list by Nakazawa (1929), but no specimen was deposited in Taiwan.

Physarum notabile T. Macbr., N. Amer. Slime-moulds, Edn 2 (New York): 80. 1922.

It was reported in a list by Nakazawa (1929), but no specimen was deposited in Taiwan.

Physarum nucleatum Rex, Proc. Acad. Nat. Sci. Philadelphia 43: 389. 1891.

Description and illustration: Liu (1980).

Physarum oblatum T. Macbr., Bull. Nat. Hist. Univ. Iowa 2: 384. 1893.

Description and illustration: Shi (1981).

Physarum obpyriforme C.H. Liu & Y.F. Chen, Taiwania 43: 186. 1998.

Description and illustration: Liu and Chen (1998).

Physarum ovisporum G. Lister, J. Bot. 59: 90. 1921.

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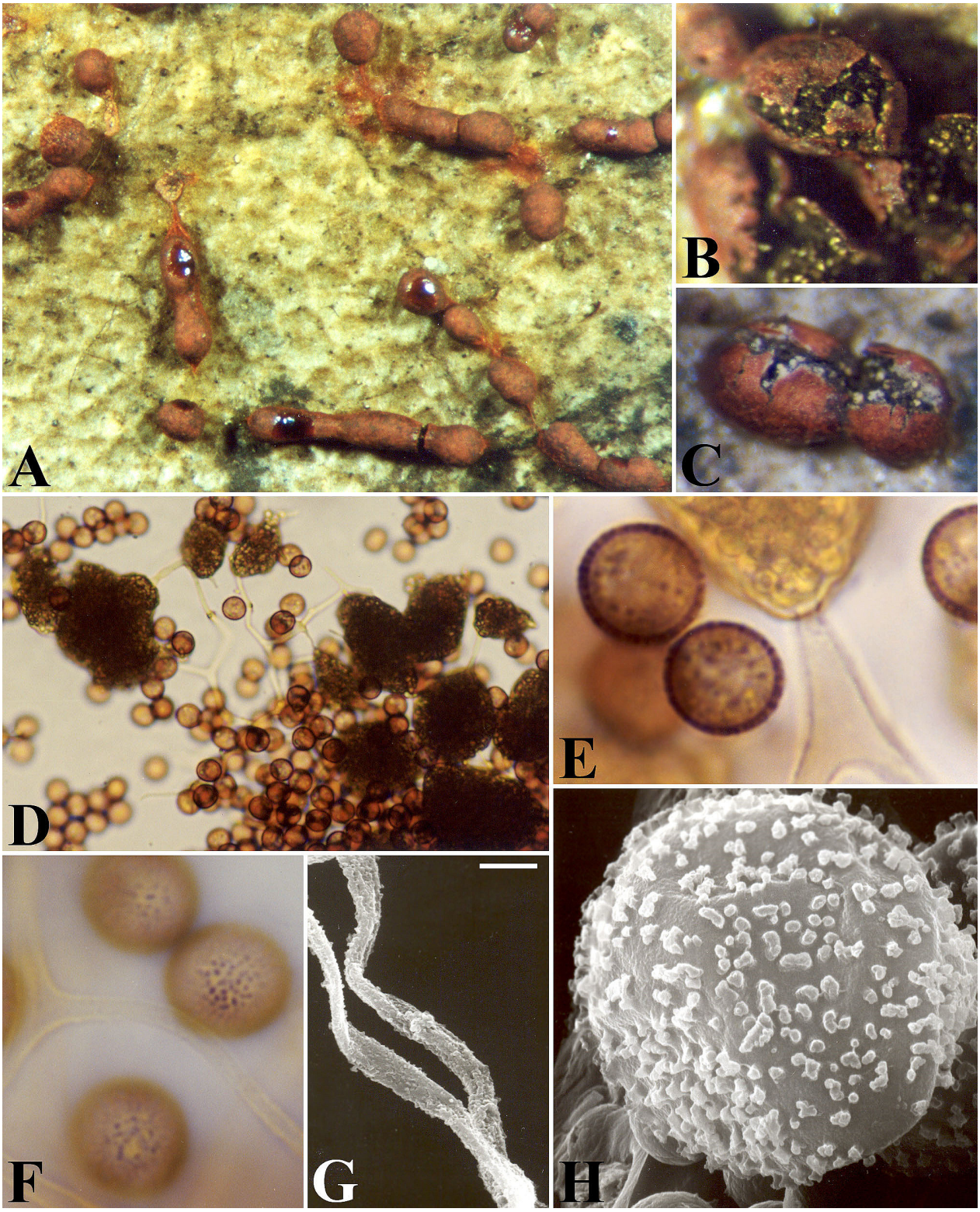


Fig. 5. ***Physarum nasuense*****. A: Fruiting bodies. B–C: Dehiscent fruiting bodies. D: Capillitium and spores. E: Marginal view of spores. F: Surface view of spores. G: Capillitial threads, by SEM. H: Surface markings of spore, by SEM. Scale bars: A = 525 µm; B–C = 200 µm; D = 20 µm; E–F = 4 µm; G = 2 µm; H = 0.8 µm.**

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It was reported in a list by Nakazawa (1929), but no specimen was deposited in Taiwan.

Physarum penetrale Rex, Proc. Acad. Nat. Sci. Philadelphia 43: 389. 1891.

Description and illustration: Chung and Liu (1997b).

Physarum pezizoideum (Jungh.) Pavill. & Lagarde, Bull. Soc. Mycol. France 19: 87. 1903.

Specimens examined: **TAIWAN:** Taipei City: Farm of National Taiwan University, on bark of dead wood, *CHL B560*, Apr. 23, 1986; on bark of dead wood, *CHL B65*, Apr. 15, 1982.

It was reported in a list by Nakazawa (1929). This species is easy to recognize by its outer appearance. The saucer-shaped sporangia, the slender, orange-brown stalk and the large spores are the characteristics of this species.

Physarum plicatum Nann.-Bremek. & Y. Yamam., Proc. Kon. Ned. Akad. Wetensch., C. 93: 284. 1990.

Description and illustration: Chung and Liu (1997b).

Physarum polycephalum Schwein., Schriften Naturf. Ges. Leipzig 1: 63. 1822.

Physarum polymorphum var. *obrusseum* (Berk. & M.A. Curtis) Lister, Monogr. Mycetozoa, Edn 1: 48. 1894.

Description and illustration: Liu (1980).

Physarum psittacinum Ditmar, in Sturm, Deutschl. Fl., Pilze 1: 125. 1817.

Description and illustration: Chung and Liu (1997b).

Physarum pusillum (Berk. & M.A. Curtis) G. Lister, Monogr. Mycetozoa, Edn 2 (London): 64. 1911.

Description and illustration: Liu (1982).

Physarum retisporum G.W. Martin, K.S. Thind & Rehill, Mycologia 51: 159. 1959.

Description and illustration: Liu (1989).

Physarum rigidum (G. Lister) G. Lister, Monogr. mycetozoa, 3rd Edn (London): 36. 1925.

Description and illustration: Liu (1980).

Physarum roseum Berk. & Broome, J. Linn. Soc., Bot. 14: 84. 1873.

Specimens examined: **TAIWAN:** Pingtung County: Wanlideshan, on bark, *Y.F. Chen441*, Aug. 27, 1996 (moist-chamber culture: Oct. 4, 1995 - Aug. 27, 1996); on bark, *Y.F. Chen450*, Jan. 31, 1997 (moist-chamber culture: Mar. 4, 1996- Jan. 31, 1997); on bark, *Y.F. Chen449*, Jan 31, 1997 (moist-chamber culture: June 19, 1996- Jan 31, 1997).

This is a common species in Taiwan, and Nakazawa (1929) first reported it in a list. The fruiting bodies of this species are quite distinct in color with scarlet red, stalked sporangia and red, angular, large lime nodes. It resembles *P. pulcherrimum*, from which it differs in capillitium (small, rounded lime nodes in *P. pulcherrimum*) and the lacking of columella.

Physarum serpula Morgan, J. Cincinnati Soc. Nat. Hist. 19: 29. 1896.

It was reported as a new record without any description and illustration by Wang et al. (1981).

Physarum sessile Brândza, Ann. Sci. Univ. Jassy 11: 116. 1921.

Description and illustration: Liu (1982).

Physarum stellatum (Massee) G.W. Martin, Mycologia 39: 461. 1947.

Description and illustration: Wang and Chien (1987).

Physarum straminipes Lister, J. Bot. 36: 163. 1898.

Description and illustration: Liu (1982).

Physarum superbum Hagelst., Mycologia 32: 385. 1940.

Description and illustration: Chung and Tzean (1998b).

Physarum taiwanianum Chao H. Chung & C.H. Liu, Taiwania 41: 92. 1996.

Description and illustration: Chung and Liu (1996).

Physarum tenerum Rex, Proc. Acad. Nat. Sci. Philadelphia 42: 192. 1890. Fig. 6

Fructification gregarious, sporangiate, stipitate, nodding or erect, 0.83–1.54 mm in total height. Sporangia white, pale yellow or bright yellow, sometimes iridescent, globose, slightly depressed, 0.24–0.38 mm in diameter. Stalk calcareous, pale yellow, orange to yellowish brown, slender, tapering. Hypothallus membranous, orange-brown, small, discoid. Peridium membranous, covered with white, pale yellow or bright yellow lime granules. Dehiscence lobate. Columella none. Capillitium netted, abundant, lime nodes bright yellow, small, rounded, 7–18 μm in

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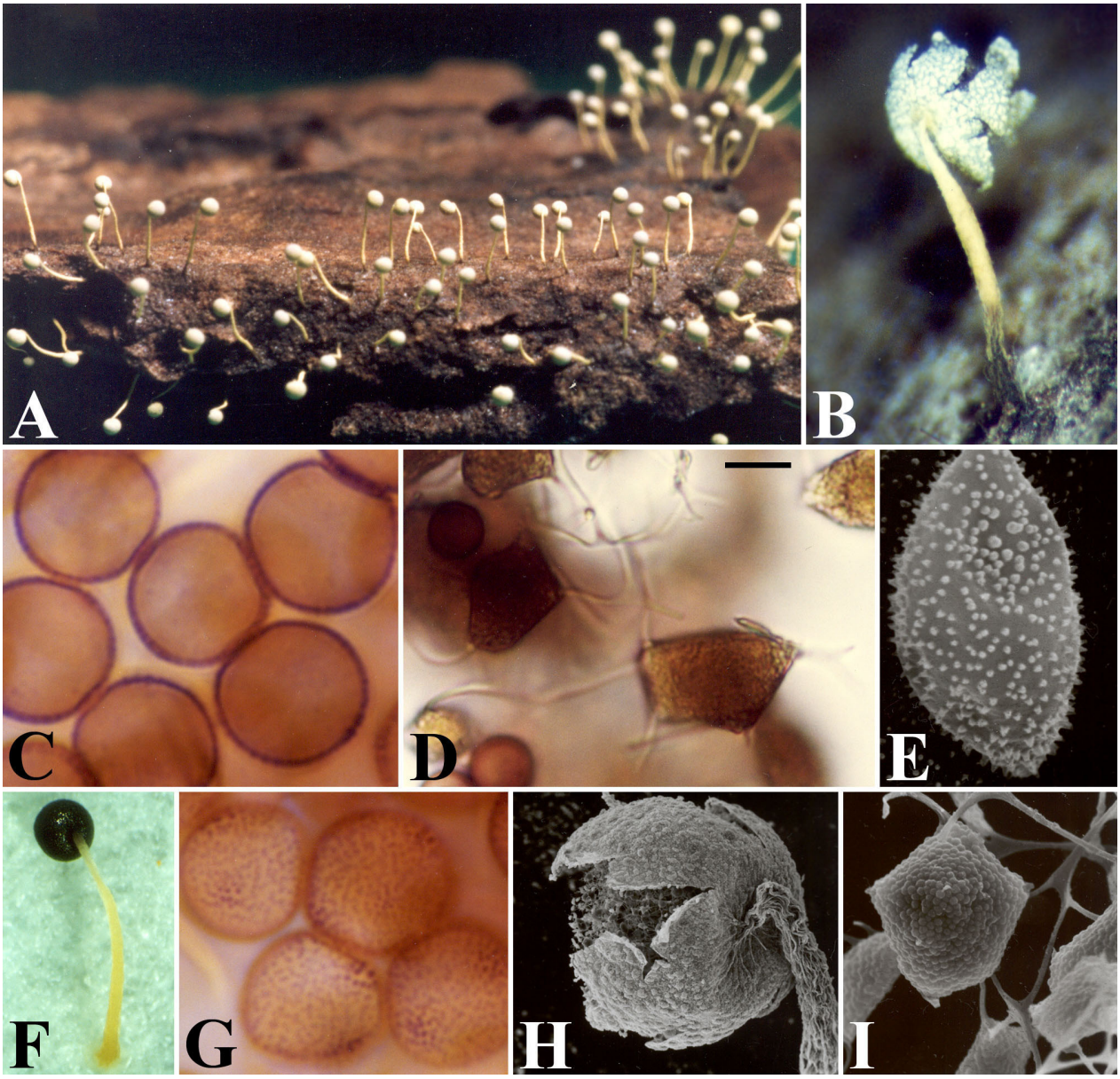


Fig. 6. *Physarum tenerum*. A: Fruiting bodies. B: Dehiscent fruiting body. C: Marginal view of spores. D: Capillitium. E: Surface markings of spore, by SEM. F: One young fruiting body. G: Surface view of spores. H: Dehiscent fruiting body, by SEM. I: Capillitium, by SEM. Scale bars: A = 1 mm; B = 200 µm; C, G = 5 µm; D = 10 µm; E = 1.5 µm; F = 250 µm; H = 90 µm; I = 7.2 µm.

diameter or smaller, the threads colorless. Spores dark brown in mass, lilac-brown under transmitted light, globose to subglobose, 7.5–9.5 (–10.0) µm in diameter, minutely warted, with clustered warts. Plasmodium bright yellow.

Specimens examined: **TAIWAN:** Pingtung County: Nanjenshan, on dead wood, *CHL B1301a*, Sept. 21, 1997; Wanlideshan, on bark, *Y.F. Chen367*, July 20, 1996 (moist-chamber culture: Apr. 8–July 20, 1996).

The yellow or yellowish sporangia, the calcareous and yellowish stalk, and the abundant capillitium with small and yellow lime nodes are the distinct characters of this species. Our specimens appear to be small in total height, diameters of sporangia and spores, but with characters fulfill the descriptions for this species. This is a newly recorded species in Taiwan.

Physarum tessellatum G.W. Martin & M.L. Farr, in Farr, Lloydia 22: 300. 1960.

It was reported as a new record without any description and illustration (Wang et al., 1981).

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Physarum vernum Sommerf., in Fries, Syst. Mycol. 3: 146. 1829. Fig. 7

Specimens examined: **TAIWAN:** Taipei City: Peitou, Yangmingshan National Park, on fallen leaves, *CHL B2326*, June 15, 2002; main campus of National Taiwan Univ., on fallen leaves, *WCL389*, Apr. 11, 1995.

It was reported in a list by Wang et al. (1981). This species most likely to be confused with *P. cinereum*. The fruiting bodies of *P. cinereum*, however, are predominantly sporangiate, the spores are brown in mass and lighter in transmitted light. The presence of pseudocolumella in *P. vernum* is a distinct character separating it from *P. cinereum*.

Physarum viride (Bull.) Pers., Ann. Bot. (Usteri) 15: 6. 1795.

Physarum viride var. *aurantium* (Bull.) Lister, Monogr. Mycetozoa (London): 47. 1894.

Specimens examined: **TAIWAN:** Pingtung County: Wanlideshan, on dead wood, *Y.F. Chen269a*, July 9, 1996. Touyuan County: Fusing Hsiang, Duonyuanshan, on the fruiting bodies of mushroom on dead wood, *CHL B1429*, Apr. 19, 1998.

It was reported in a list by Nakazawa (1929). This is a very common species of *Physarum*, usually found abundantly in the forests. The general habit (depressed globose or lenticular sporangia and long stalk) is similar to *P. album*. Nevertheless the yellow sporangia and the yellow lime nodes are distinctive characters separating this species from *P. album* which is whitish and never yellow.

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Liu, C.-H., J.-H. Chang, and I.-G. Huang. 2001. Myxomycetes of Taiwan XIII. One new record and one new variety. Taiwania **46**: 325–331.

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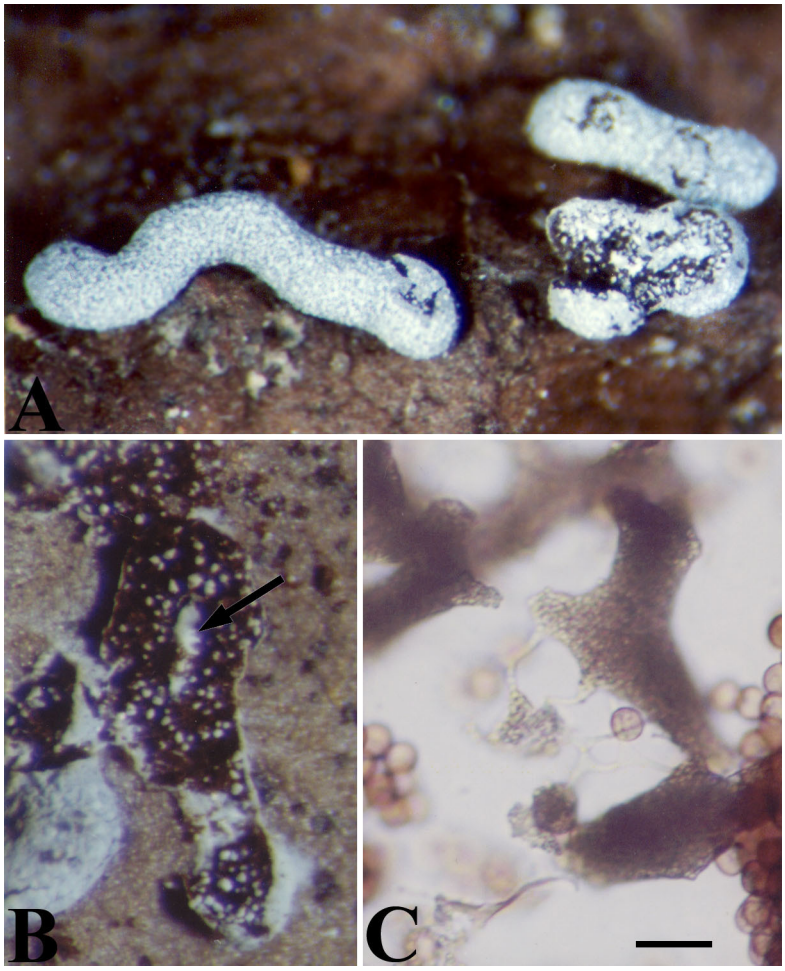


Fig. 7. *Physarum vernum*. A: Fruiting bodies. B: Dehiscent fruiting body, showing the pseudocolumella (arrow). C: Capillitium. Scale bars: A = 320 μm; B= 200 μm; C= 25 μm.

臺灣黏菌(二十四)：絨泡黏菌屬

劉錦惠[1*]、張仲豪[1]、葉富雅[2]

1. 國立臺灣大學，生命科學院植物科學研究所，10617 臺北市，臺灣。
2. 輔英科技大學，生物科技系暨研究所，83102 高雄市，臺灣。
* 通信作者。*Email: huil4951@ntu.edu.tw*

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摘要：本篇整理與訂正臺灣產絨泡黏菌屬的成員，其中網孢絨泡黏菌（*Physarum dictyosporum*）、深紅絨泡黏菌(*P. nasuense*)和細弱絨泡黏菌（*P. tenerum*）為三種臺灣新記錄之黏菌，黃頭絨泡黏菌(*P. flavicomum*)為再度發現的臺灣標本紀錄，內文並提供臺灣所有紀錄的絨泡黏菌屬的物種檢索表。

關鍵詞：真黏菌綱、絨泡黏菌科、絨泡黏菌屬、臺灣、分類。

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