Bot. Bull. Academia Sinica **16**: 159-176 (1975)

AQUATIC PHYCOMYCES OF TAIWAN I.[1]

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(Received for publication January 18, 1975)

Abstract

From September 1973 to December 1974, 32 species have been identified and 24 species of them were reported as new to Taiwan. They are *Pythiopsis humpreyana, Achlya ambisexulis, A. dubia, A. recurva, A. caroliniana, A. debaryana, A. klebsiana, A. apiculata, A. proliferoids, Saprolegnia diclina, S. subterranea, S. ferax, S. terrestris, S. parasitica, Brevilegnia longicaulis, Dictyuchus monosporus, Geolegnia inflata, Aphanomyces helicoides, A. cladogamus, A. stellatus, Allomyces arbuscula, A. javanicus, A. moniliformis,* and *Rozella allomycelis.*

Introduction

Water molds of Taiwan have seldom been investigated, though late Sawada first recorded a number of species in 1912. No further study had been carried out on this field until Chien (1972; 1974) described two species of *Allomyces*, i.e., *A. macrogynus* and *A. neo-moniliformis*. We began our survey on water molds from September 1973 to December 1974, and 32 species were isolated and identified. They included one species of *Pythiopsis*, nine species of *Achlya*, five species of *Saprolegnia*, three species of *Aphanomyces*, one species of *Thraustotheca*, two species of *Dictyuchus*, two species of *Brevilegnia*, one species of *Geolegnia*, five species of *Allomyces*, two species *Olpidiopsis* and *Rozella allomycelis*. Baiting technique described elsewhere (Johnson, 1956; Scott, 1961; Sparrow, 1960) was used for isolating water molds. Corn meal agar served well as medium for fungus growth and development.

Descriptions

Pythiopsis humphreyana Coker. Mycologia 6: 292, pl. 148. 1914. (Plate 1, Figs. 1-2)

Hyphae slender, sparingly branched, about 11-25 μ thick which are stoutest in the neighborhood of the asexual reproductive bodies. Sporangia varying in shape from spherical, oval or pyriform to elongate and irregular forms; dis-

(1) Paper No. 162 of the Scientific Journal Series, Institute of Botany, Academia Sinica.

charging by a short or rather long papilla and usually proliferating from below in a cymose manner. Oogonia generally borne exactly like sporangia and not to be distinguished from these when young, apical and often in group by cymose branching; usually spherical with a basal neck. Oogonia 30–37.5 μ in diameter. Oospore subeccentric, 1–2 predominantly 1 in number; 27 μ in diameter. Antheria arising from immediately below the oogonium.

Collected from soil and water samples in all seasons. (Dec. 16, 1974. Shih-lin, Taipei).

Achlya ambisexualis Raper. Amer. J. Bot. 26: 639. 1939. (Plate 1, Figs. 3–4)

Plant dioecious. Mycelium of oogonial thallus extensively dense; principal hyphae stout, 40–60 μ in diameter at base. Gemmae abundant, spherical, filiform, often irregular; terminal single or catenulate; zoosporangia abundant; clavate or fusiform; 500×60 μ; renewed sympodially. Mycelium of antheridial thallus extensive diffuse, slender. Oogonia abundant; lateral or terminal rarely intercalary; spherical, infrequently pyriform; 32–80 μ in diameter, predominantly 50–65 μ. Oogonial stalk 1/4–3 times the diameter of oogonia in length, usually 1/2–3/2 times; stout, tapering toward base; straight. Antheridial branches long, profusely branched; irregular; wrapping about the oogonium and sometimes attendant hyphae. Antheridial cell tubular or clavate; attached by projections or laterally appressed. Fertilization tube not observed. Oospheres maturing. Oospores eccentric; spherical; filling the oogonium; 1–20 in number usually 7–14; 18–30 μ in diameter, predominantly 20–25 μ, Germination not observed.

Collected three from soil samples. (Nov. 4, 1974. Nankang, Taipei; rice field)

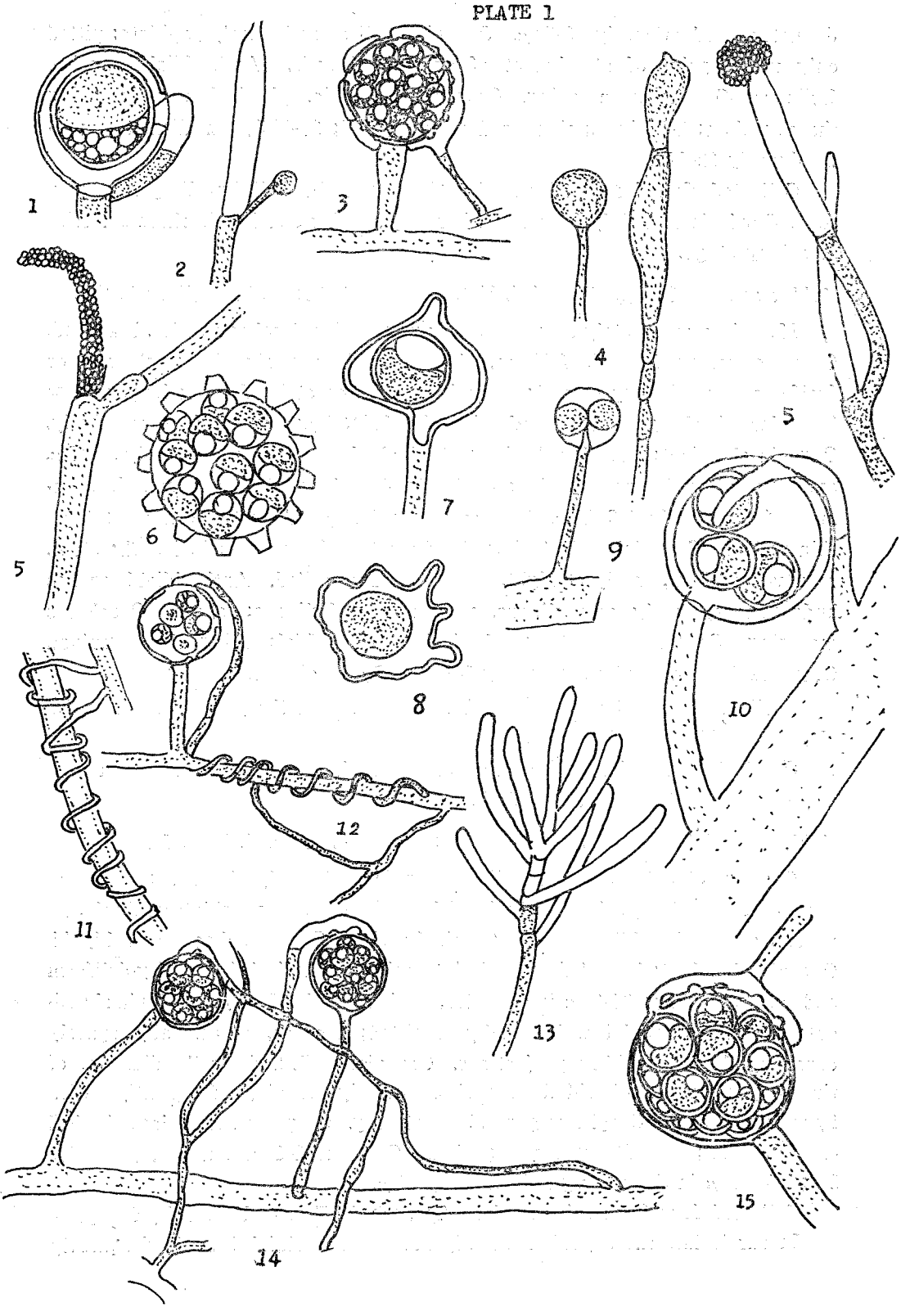
Achlya dubia Coker. Saprolegniaceae, 135. 1923. (Plate 1, Fig. 5)

Zoosporangia discharge thraustothecoid from primary and secondary zoosporangia. Oogonia abundant; lateral; spherical or pyriform; 30–80 μ in

Explanation of Plate 1

Fig. 1-2. ***Pythiopsis humphereyana.*** 1. Oogonium subeccentric; with a androgynous antheridial branch. ×600. 2. Elongated, emptied zoosporangium ×200. Figs. 3-4. ***Achlya ambisexualis.*** 3. Oospore eccontric; maturing; filling the oogonium ×300. 4. Kinds of gammae ×80. Fig. 5. ***A. dubia.*** Thraustothecoid and achlyoid zoosporangia ×200. Fig. 6 ***A. recurva.*** Oogonial wall truncate ×400. Figs. 7-9. ***A. caroliniana.*** 7, 8 Irregular oogonia. ×600. 9. Oogonium with a inner growth. ×240. Fig. 10. ***A. debaryana*** Oogonium with monoclinous antheridial branches. ×800. Figs. 11-13. ***A. proliferoids.*** 11. Coiling antheridial branch. ×200. 12. Oogonium not entirely covered by monoclinous antheridial branches. 13. Sporangia renewed basipetalously. ×100. Figs. 14-15. ***A. klebsiana.*** 14. Oogon a with monoclinous and diclinous antheridial branches. ×200. 15. Oospores filling the oogonium. ×800

PLATE 1



diameter, predominantly 40–50 μ. Oogonial wall smooth rarely papillate: pitted only under point of attachment of antheridial cells. Antheridial branches diclinous. Oospheres maturing. Oospores eccentric, spherical, usually filling the oogonium; 1–15 in number predominantly 2–5; 20–32.5 μ in diameter, predominantly 22–27 μ.

Collected five from soil samples (Sept. 2, 1974. Shih-lin, Taipei; garden soil). Our isolates mainly from soil, often lose the thraustothecoid characteristics at colony stage.

Achlya recurva Cornu. Ann. Sci. Nat. Bot., ser. 5, 15: 22. 1872. (Plate 1, Fig. 6)

Mycelium moderately extensive, diffuse; principal hyphae slender, branched. Gemmae rarely formed, filiform. Zoosporangia not abundant; clavate or fusiform, occassionally curved; apex frequently constricted into a long, narrow irregular discharge tube; predominantly 300×35 μ; renewed sympodially. Oogonia abundant; lateral; spherical; 63–35 μ in diameter, predominantly 55–45 μ, exclusive of wall ornamentation; unpitted; densely with truncate wall ornamentation; usually 1.5–7.5 μ, predominantly 9–11 μ. Apex of ornamentations thin walled. Oogonial stalk 1 time the diameter of oogonium in length; stout, recurved or bent, rarely straight, sometimes once-coiled. Antheridial branches androgynous, rarely monoclinous, very rarely diclinous; short. Oospheres maturing. Oospores eccentric; spherical or ellipsoidal; filling the oogonium. Oospores 2–13 in number, generally 5–8; 20–25 μ in diameter.

Easily collected at any place in Taipei throughout the year. (Nov. 22, 1973. Yang-ming Shan; garden soil).

Our isolate is different from that of Johnson's (1956) by the shorter truncate wall ornamentation in oogonium.

Achlya caroliniana Coker. Bot. Gaz. 50; 381. 1910. (Plate 1, Figs. 7–9)

Gemmae abundant, filiform. Zoosporangia moderately abundant; fusiform; renewed sympodially; frequently furnished with one to several lateral discharge pores or tubes in addition to the terminal orifice. Zoospore discharge achlyoid. Oogonia abundant; lateral, frequently intercalary; spherical, frequently doliform and with apiculate; 55–30 μ in diameter, predominantly 35–45 μ. Oogonia abundant; lateral. Oogonial wall usually unpitted; smooth, occasionally sparely ornamented with papillate projections. Oogonial stalk 2 times the diameter of the oogonium. Antheridial branches usually lacking, frequently with hypogynal branch. Oospheres generally maturing. Oospores eccentric; spherical or ellipsoidal; not filling the oogonium. Oospores 1–8 in number, generally 1–4; 15–32.5 μ in diameter, predominantly 20 μ.

Collected four from soil samples (Apr. 4, 1974. Taiwan University Campus).

In our isolate the oogonium usually has no antheridial branch, frequently

with hypogynal cell growing into the oogonium, which is like that of *Achlya hypogyna*.

Achlya debaryana Humphrey. Proc. Am. Phil. Soc. 17: 117. 1892. (Plate 1, Fig. 10)

Mycelium extensive. Zoospore discharge achlyoid. Gemmae filiform, or irregular; abundant. Oogonia abundant; lateral; 42.5–97 μ in diameter predominantly 50–70 μ. Oogonial wall usually unpitted. Oogonial stalk straight, sometimes curved. Antheridial branch monoclinous rarely androgynous. Oospheres maturing. Oospores eccentric; spherical; not filling the oogonium; 1–12 in number generally 4–7 in the oogonium; 22.5–45 μ in diameter, generally 25–27.5 μ.

Collected seven at many places in Taipei. (Man 26, 1974. Yang-ming Shan; egg plant field).

Our isolate is remarkably close to *Achlya americana*, a species which was established fundamentally on the basis of pitted oogonia and many oospores in the oogonium as contrasted with unpitted oogonia and fewer oospores of our isolate. And it is much like *Achlya klebsiana* with unpitted nature of oogonial walls in both species. But *A. klebsiana* established on the basis of the diclinous and the remotely originating monoclinous antheridial branches, is different from the monoclinous and androgynous antheridial branches of our isolate. In fact, our isolate more close to *Achlya cambrica;* but the former without "Pseudopapillate" oogoium. We believed our isolate as *Achlya debaryana* on the basis of the monoclinous and androgynous antheridial branch, unpitted oognial wall, maturing oospore and without "Pseudopapillate" oogonium.

Achlya proliferoides Coker. Saprolegniaceae, P. 115. 1923. (Plate 1, Figs. 11–13).

Mycelium extensive, moderately dense; principal hyphae stout; branched; 50–110 μ in diameter at base. Gemmae very abundant, filiform or irregular occasionally branched; usually intercalary and catenulate, rarely single. Zoosporangia not abundant; filiform, fusiform; in general 300×45 μ; renewed sympodially. Zoospore discharge achlyoid; spore cluster not persistent at exit pore. Encysted spore 10 μ in diameter. Oogonia abundant; lateral, not intercalary; spherical, rarely pyriform; 40–66 μ in diameter, predominantly 50–60 μ; immature ones frequently proliferating. Oogonial wall pitted; smooth; occasionally irregular on inner surface. Oogonial stalks 1–3½ times the diameter of the oogonium in length, generally 1–2 times; stout; often curved or bent, rarely coiled once. Antheridial branches diclinous, infrequently monoclinous, with a remote origin; usually coiling about hyphae which may or may not bear oogonia, but losing feature as colony ages; irregular, much branched; wrapping about or not wrapping about the oogonium. Antheridial

cell tubular, clasping the oogonium; attached by projections, rarely laterally appressed. Fertilization tube not observed. Oospheres frequently not maturing. Oospores eccentric; spherical or ellipsoidal; usually not filling the oogonium; 1–12 in number, generally 4–9; 17.5–31.5 μ in diameter, predominantly 20–24 μ.

Collected twice from soil samples. (Sept. 27, 1974. Yang-ming Shan; rice field)

Achlya klebsiana Pieters. Bot. Gaz. 60: 486. 1915. (Plate 1, Figs. 14–15)

Mycelium limited diffuse, principal hyphae slender; average 50 μ in diameter. Gemmae moderately abundant; filiform. Oogonia very abundant; spherical or pyriform; 40–76 μ in diameter. Oogonial wall smooth; pitted only under point of attachment of antheridial cells, rarely at other places, or unpitted. Oogonial stalk 1–6 times the diameter of the oogonium in length, generally 1–3 times; straight, infrequently bent or curved. Antheridial branches diclinous, occasionally to extremely rarely monoclinous. Antheridial cell tubular or clavate, occasionally irregular; attached by short or long projections. Fertilization tube not observed. Oospheres maturing. Oospores eccentric; sherical occasionally ellipsoid; generally filling the oogonium; 1–15 in number predominantly 2–8; 20–35 μ in diameter predominantly 20–25 μ. Germination of oospore not observed.

Collected many isolates from all over the places of rice field, river, well, stream and garden soil througout the year. (Sept. 24, 1974. Yang-ming Shan)

Achlya flagellata Coker. Saprolegniaceae, 116. 1923. (Plate 2, Fig. 16)

Gemmae abundant; filiform, pyriform or irregular; terminal or intercalary single or catenulate. Zoosporangia abundant; filiform, 50–300 μ; renewed sympodially. Oogonia abundant; lateral, spherical or pyriform, 35–95 μ in diameter, predominantly 50–60 μ. Oogonial wall pitted; smooth; oogonial stalk ½–6 times the diameter of the oogonium in length, generally 2 times; stout; usually branch, occasionally bent or curved. Antheridial branches diclinous, occasionally monoclinous. Oospheres not maturing. Oospores eccentric, spherical, or ellipsoidal not filling the oogonium; 1–13 in number generally 4–7; 15–23 μ in diameter, predominantly 18–21 μ. Mature oospore not germination.

Collected many isolates from any place at many time. (Oct. 11, 1973. Yang-ming Shan, garden soil)

One of our isolates has frequently monoclinous. Although the latter still belong to *Achlya flagellata* in Johnson's opinion, we suggest that they be not the same strain at least. Because this characteristic is considerably stable in successive subcultures.

Achlya apiculata deBary. Bot. Zeit. 46: 635, pl. 10, figs. 3–5. 1888. (Plate 2,

Figs. 17–18)

Mycelium diffuse, extensive; principal hyphae 40–75 μ in diameter at base. Gemmae abundant; filiform; terminal, single or catenulate; functioning as zoosporangia. Zoosporangia sparse; fusiform; 200–500 μ long by 25–35 μ in diameter; renewed sympodially or in basipetalous succession. Zoospore discharge achlyoid. Oogonia variable in abundance; lateral, occasionally terminal, rarely located in a discharged zoosporangium; apiculate, occasionally spherical or pyriform, rarely oval, very rarely irregular; 45–80 μ long by 40–70 μ in diameter, predominantly 60–70×50–60 μ. Oogonial wall unpitted; inner surface, usually smooth. Oogonial stalk ½–6 times the diameter of the oogonium in length, usually 2–4 times; stout; curved or once-coiled, rarely diclinous; sparingly branched. Antheridial cells short, tubular, slightly irregular; laterally appressed; not persistent. Oospheres almost always maturing. Oospores subcentric; spherical or ellipsoid; filling or not filling the oogonium; 1–7 in number, usually 2–4; 25–45 μ in diameter, predominantly 35–40 μ.

Collected once from soil sample. (Dec. 2, 1974. Yang-ming Shan; garden soil) This isolate is much like *Achlya apiculata* var. *prolifica*, by (1) the predominant number of oospores 2–4; (2) oospore 37–39 μ (3) the predominant size of the oogonia, 50–60 μ in diameter. But in this isolate the inner surface of the well is rarely irregular, which is different from *A. apiculata* var. *prolifica*.

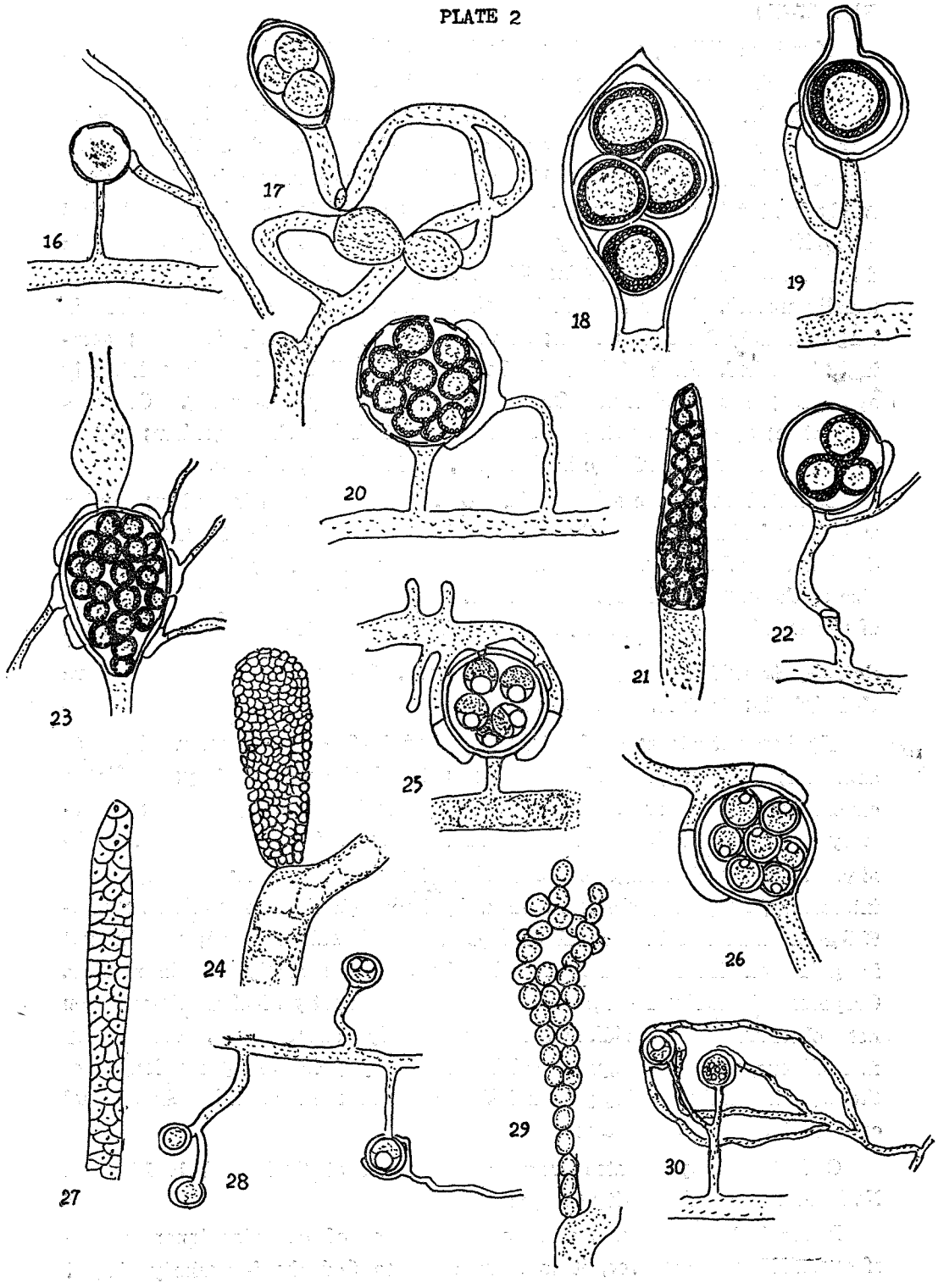
Saprolegnia subterranea (Dissmann) Seymour. The genus *Saprolegnia*. Nova Hedwigia 19: 59. 1970. (Plate 2, Fig. 19)

Hyphae not stout; moderately branched 10–20 μ in diameter. Gemmae abundant; filiform, spherical or irregular; terminal or intercalary; single or catenulate; function as zoosporangia. Zoosporangia fusiform, filiform; frequently bent; variable in length and diameter; renewed internally or sympodially. Zoospore discharge saprolegnoid. Oogonia abundant; lateral, rarely intercalary, frequently clustered on a hyphae; spherical or pyriform; 27.5–52.5 μ in diameter, in general 35–45 μ. Oogonial wall unpitted; smooth; not irregular on inner surface; occasionally with one rarely two in number. Oospores subcentric; 20–45 μ in diameter, predominantly 30–40 μ. Germination not observed. Antheridial branches usually androgynous, occasionally monoclinous, when androgynous arising from any point along the length of the oogonial stalk; sparingly branched, lacking on some oogonia. Antheridial cell simple, laterally appressed.

Collected many isolates from river, stream at Spring. (Feb. 15, 1974. National Taiwan University Campus)

In our isolate we cannot observe the presence of irregular inner surface of oogonial wall; however, it is more often to find the irregularly shaped

PLATE 2



oogonia having wavy or irregular wall which may be extended into papillae and thus it is alike to *Isoachlya intermedia* (Johnson and Surratt, 1955), but according to Seymour (1970), *Saprolegnia subterranea* is the valid combination including *I. intermedia* and *I. subterranea.*

Saprolegnia ferax (Gruith) Thuret. Ann. Sci. Nat. Bot. Ser, III, 14: 214, pl. 22. 1850 (Plate 2, Figs. 20–21)

Hyphae stout, 20–50 μ in diameter, sparingly branched. Gemmae abundant, variable in shape, filiform pyriform, often irregular; terminal or intercalary; single or catenulate; functioning as zoosporangia. Zoosporangia filiform; renewed by internal proliferation. Zoospore discharge saprolegnoid. Oogonia generally abundant, rarely forming only after prolonged period of time; terminal or lateral; sometimes intercalary or catenulate; spherical or pyriform, sometimes clavate; (40)–60–70(140) μ in diameter. Oogonial wall pitted; often with basal in growth. Oogonial stalk short in general, sometimes branched. Oosphere maturing. Oospores centric, or subcentric; spherical, (1)–7–12–(35) in number; (20)–22–25–(30) μ in diameter, sometimes lacking; monoclinous or androgynous. Antheridial cells tubular or clavate, sometimes branched laterally or rarely apically appressed usually persistent.

Collected in coller water; is wide-spread in Taipei. (April 4, 1974. Shih-lin, river). One of our isolates has antheridia on less than 10 percent of the oogonia, the others have antheridia on all the oogonia, but Seymour (1970) and others show them to be unrecognizable as distinct entities. Additionally, we find the cylindrical oogonium grows in the sporangia in some of our isolates. In Taiwan this species isolated and recorded by Chung without describing it in detail, but two simple figures.

Saprolegnia terrestris Cookson ex Seymour. The genus *Saprolegnia.* Nova Hedwigia 19: 37. 1970. (Plate 2, Fig. 22)

Explanation of Plate 2

Fig. 16. *A. flagellata.* Oosphere not maturing. ×200. Figs. 17-18. *A. apiculata.* 17. Oognial stalk bent, or once colled. ×200. 18. Oogonium apiculate; with subcentric oospores. ×800. Fig. 19. *Saprolegnia subterranea.* Ogonium with androgynous antheridial branchcs. ×800. Figs. 20-21. *S. ferax.* 20. Oogonium with monoclinous antheridial branches. ×200. 21. Terminal cyclindrical oogonium. ×200. Fig. 22. *S. terrestris.* Oogonial stalk coiled, with androgynous antheridial branches. ×250. Fig. 23. *S. parasitica.* Catenulate oogonia with diclinous antheridial branches wrapping about. ×200. Figs. 24-26. *Thraustotheca clavata.* 24. Zoosporangium ×200. 25. Oogonium containing full ripe eccentric oospores ×800. 26. Ogonium with abnormal oospores. ×800. Fig. 28. *D. monosporus.* Oospore eccentric. ×200. Fig. 29. *Brevilegnia sp.* 29. Thraustothecoid zoosporangium. ×400. Fig. 30. *B. longicaulis.* Oospore eccentric; oogonium with diclinous antheridial branches. wrapping about. ×200.

Hyphae slender; 19–30 μ in diameter. Gemmae present, filiform, clavate or irregular; function as zoosporangia. Zoosporangia moderately abundant; filiform or clavate, often contorted; 300×35 μ; renewed by internal proliferation. Zoospore discharge saprolegnoid; encysted spore 7–9 μ in diameter, Oogonia abundant; terminal or lateral, inferquently intercalary; spherical; 50-80 μ, predominantly 57–67 μ in diameter. Oogonial wall unpitted; smooth without papilla; oogonial stalk variable in length, 1–6 times the diameter of oogonium; bent, frequently coiled, rarely straight, rarely branched. Oospores subcentric, rarely centric; spherical; 22–40 μ, predominantly 30–35 μ in diameter; 1–5 in number, predominantly 2–4. Antheridial branches androgynous, arising from immediately below the oogonium, sometimes monoclinous; generally one per oogonium. Antheridial cell simple apically or laterally appressed, becoming inconspicuous.

Collected several isolates from river at cooler weather. (Nov. 9, 1974. Yang-ming Shan; garden soil)

This species is most readily recognized by (1) the antheridial branches androgynous, arising from immediately below the oogonium (2) the subcentric oospore (3) the prevalence of 2–4 subcentric oospores in an oogonium. But in this isolate, monoclinous antheridial branches and bent, curved even coiled oogonial stalk were frequently observed, which were not described by Seymour (1970). These characteristics are more stable as colony stage on corn meal agar and on hempseed in the diluted water. We suppose this isolate is a strain of *Saprolegnia terrestris* Cookson ex Seymour.

Saprolegnia parasitica Coker. Saprolegniaceae, p. 57, pl. 18. 1923. (Plate 2, Fig. 23)

Hyphae not stout; 20–30 μ in diameter. Gemmae abundant; clavate, pyriform or irregular; terminal; single or frequently catenulate; functioning as oogonia or zoosporangia. Zoosporangia abundant; cylindrical, clavate, straight, (80)–100–250–(500)×20–30 μ; renewed by internal proliferation. Zoospore discharge saprolegnoid. Oogonia usualluy sparse, often formed only after prolonged period of time; terminal or lateral; clavate, pyriform or irregular; 40–80×60–100 μ. Oogonial wall unpitted, thin, smooth. Oospheres maturing. Oospores subcentric. Antheridial branches diclinous, often wrapping about the oogonium. Antheridial cell tubular or clavate, simple; laterally appressed. Antheridial cell not persistent.

Collected many isolates in cooler water. (Dec. 2, 1974. Yang-ming Shan; river)

Saprolegnia diclina Humphrey. Trans. Amer. Phil. Aoc. (N. S.), 17: 109, pl. 17 Figs. 50–53. 1893)

Gemmae pyriform; terminal or intercalary; single or catenulate; functioning as zoosporangia. Zoosporangia abundant; clavate or filiform; renewed by internal proliferation. Zoospore discharge saprolegnia. Oogonia usually abundant; often forming only after prolonged period of time; terminal or lateral, rarely intercalary; spherical or pyriform; usually 50–70 μ in diameter. Oogonial wall unpitted or pitted only under point of attachment of antheridial cell. Oogonial stalks straight. Oospheres maturing. Oospores centric or rarely subcentric; spherical, frequently filling the oogonium; usually 8–16 in number. Antheridial branches almost present; diclinous; slender, irregular, infrequently branched; not persistent. Antheridial cells tubular or clavate.

Collected once from water. (Dec. (16, 1974. Shih-lin; river)

Thraustotheca clavata Humphrey. Trans. Am. Phil. Soc. 17: 131. 1892. (Plate 2, Figs. 24–26)

Main hyphae stout; straight, reaching a length of 2cm, and a thickness of 20–120 μ, averaging about 35 μ; profusely branching into secondary hyphae near their tips; secondary hyphae, much curved and twisted, and often curiously knobled and gnarles. Sporangia 40–80×70–36 μ; terminal or rarely intercalary; renewed sympodial, usually thraustothecoid. Gemmae not abundant. Oogonia abundant, lateral rarely intercalary; spherical or pyriform, often proliferating; 37.5–75 μ in diameter, predominantly 45–67 μ, unpitted or with slightly pitted. Oospores maturing or not maturing. Oospores 1–17 in number; predominantly 21–24 μ. Antheridial branches diclinous; very crooked and stout, often wrap around the oogonia. Antheridial cell club-shaped.

Collected several isolates from soils. (Oct. 10, 1973. Yang-ming Shan; garden soil). In Taiwan, Sawada reported *Dictyuchus clavata* in 1912, which belongs to *Thraustotheca* now, but he did not find its sexual stage. We have two kinds of isolates: One is with maturing oosphere and smaller oospore about 17–22 μ in diameter, which is like that of *Thraustotheca clavata* Humphrey described; the other is with not maturing oosphere and large oospores about 21–24 μ in diameter. Perhaps the latter is a strain of the former. Further study is needed to disclose its nature.

Dictyuchus sterile Coker. Saprolegniaceae, p. 151–152, pl. 52, figs. 1–11. 1923. (Plate 2, Fig. 27)

Primary spores not escaping from from the sporangium, but remaining in the sporangium and forming there a network of walls from which, the secondary zoospore emerge. And more often, sporangia falling off from the base and free, Oogonia unknown. We suppose that Sawada's *D. monosporus* should belong to *D. sterile*, for the lack of sexual stage.

Collected many isolates from soil and water samples. (Aug. 27, 1974. Tainan;

garden soil).

Dictyuchus monosporus Leitgeb. Jahrb. f. wiss. Bot. 7: 357, pl. 22, figs. 1–12, pl. 23, figs. 1–8. 1869. (Plate 2, Fig. 28)

Vegetative state like *D. sterile*. Oogonia terminal, single, on long or short branches of main threads, spherical; 22.5–30 μ in diameter; unpitted. Antheridia always present, usually several to each oogonium, borne on slender branches of diclinous origin which often completely enwrap the oogonium. Egg single, spherical, smooth, eccentric.

Collected on hempseed and oak twigs in water. (June 24, 1974. Shih-lin; oak twigs).

Brevilegnia sp (Plate, 2, Fig. 29)

Primary zoospores not escaping from the sporangium, but remaining in the sporangium and spore discharge just like that of *Thraustotheca*. Oogonia unknown.

Collected from soil samples. (Nov. 9, 1974. Taipei; garden soil)

Brevilegnia longicaulis Johnson. Mycologia, vol. 42, p. 243–244, fig. 1 1950. (Plate 2, Fig. 30)

Mycelium depauperate, forming a dense growth on hempseed; 20–50 μ in diameter at base; delicate and branching, sporangia abundant, terminal; clavate to long cylindrical; 98–600 μ long by 20–28 μ in diameter, averaging 150–350 × 22–25 μ; generally 2–4 spores wide, branching, sometimes producing spore in a single row in part, but not in the whole; secondary sporangia arising by sympodial branching. Encysted spores spherical, angular, 10–12.5 μ in diameter. Spore discharge thraustothecoid. Oogonia abundant; spherical 24–37.5 μ in diameter, predominantly 28–32.5 μ; rising singly on long slender, curved, lateral stalks; wall smooth; hyaline; unpitted. Oospore 1 in number, spherical and not filling the oogonium; eccentric; 21.5–30 μ in diameter, generally 22.5–28 μ. Antheridial branches diclinous, long irregular and branched, often wrapping about the oogonium, never observed androgynous; one to three antheridia to the oogonium. Gemmae lacking.

Collected twice from soil samples. (Oct. 2, 1974. Yang-ming Shan; sweet potato field)

Geolegnia inflata Coker and Harvey. Elisha Mitchell Sci. Soc., 41: 135. 1925. (Plate 3, Figs. 31–32)

Mycelium of very limited growth, forming a dense, opaque mat; hyphae slender, 5–17 μ thick. Spores, 15–17.5 μ by 16–22 μ, in a single row; without any motile stage; escaping by decaying thin-walled sporangium. Oogonia abundant, 12.5–17.5 μ in diameter. Antheridia present and androgynous.

Oospheres maturing; oospore one in number, eccentric.

Collected once on hempseed from soil samples. (Dec. 2, 1974. Yang-ming Shan; citrus soil)

Aphanomyces helicoides von minden. Kryptogamenfl. Mark Brandenburg, 5: 559 1915. (Plate 3, Fig. 33)

Hyphae 5–9 μ in diameter, delicate, branched and forming characteristic knots. Zoosporangia filamentous, long, formed from undifferentiated vegetative hyphae, isodiametric. Primary zoospore cysts 8–11.5 μ in diameter. Oogonia terminl on lateral branches of variable length, often formed in dense clusters; spherical; 21–38 μ in diameter; smooth-walled; contents finely granular with a large, central oil globule. Antheridia one to five, large elongate cylindrical, closely wrapped about the oogonium. Antheridial stalk simple or branched; diclinous or monoclinous; sometimes forming helicoidal spirals wrapping about the oogonial stalk, and extensively wrapping about themselves and around adjacent hyphae. Fertilization tubes not observed. Germination on the oospore by the formation of a single germ tube.

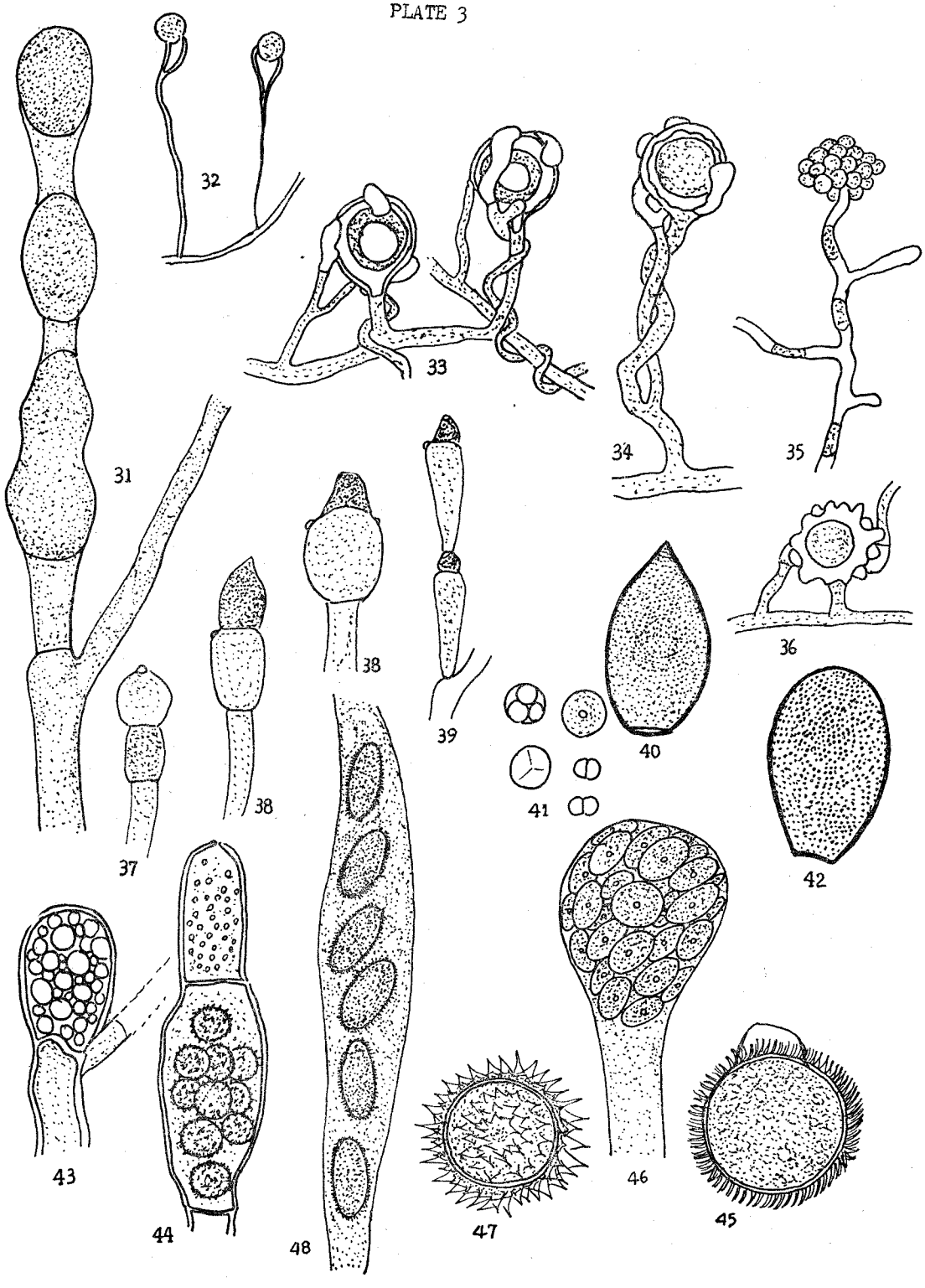
Collected once from soil sample. (Oct. 3, 1974. Yang-ming Shan; garden soil). The most distinctive characteristic of *Aphanomyces helicoides* is antheridial stalk sometimes forms helicoidal spirals wrapping about the oogonial stalk. But on the oogonial stalk which is short, the helicoidal spiral is not investigated. So, Minden (1915) considered it to be closely related to *Aphanomyces laevis*. The asexual reproduction structure and the sexual organ may occur simultaneously on snake skin or hempseed "baits" in water culture.

Aphanomyces cladogamus Drechsler. J. Agric. Res., 38: 335. figs. 5–7. 1929. (Plate 3, Figs. 34–35)

Hyphae 3.5–10 μ in diameter. Zoosporangia not tapering markedly toward the apex of vegetative hyphae, and with numerous lateral branches of variable length. Primary zoospores elongated, encysting preemergence at the orifice. Primary zoospore cysts 7–10 μ in diameter, discharge period, and the abnormal development of them to form mycelia being observed. Oogonia terminal on lateral branches of variable length, spherical, 19–33 μ in diameter, wall irregularly thick with a smooth outer surface and a sinuous inner contour but not pronounced. Oospore hyaline to yellow, 13.5–25.6 μ in diameter, thick walled, contents granular with a large central oil globule; long oogonial stalk may winding about the antheridial filament. Antheridia 2–3 in number; wrapping extensively about the oogonium. Antheridial stalk long, branched; monoclinous, diclinous, or androgynous in origin. Fertilization tubes short. Germination of the oospore not observed.

Collected several isolates from soil samples. (Aug. 21, 1974. Taipei; garden

PLATE 3



soil)

Aphanomyces stellatus de Bary. Jahrb. Wiss. Bot., 2: 178, pl. 19. figs. 1–13. 1860. (Plate 3, Fig. 36)

Hyphae 4–7 μ in diameter, delicate, hyaline, straight and sparingly branched. Zoosporangia filamentous, unbranched, formed from undifferentiated vegetative hyphae; primary zoospores elongate with rounded ends, encysting upon emergence at the orifice. Oogonia terminal on lateral branches of variable length; spherical or subspherical; 23.5–32.2 μ in diameter, covered with bluntly conical tubercles up to 6.5 μ in length. Oospore single; 15–26 μ in diameter; contents homogeneous, lacking a conspicuous oil globule. Antheridia one to several, cylindrical-clavate. Antheridial stalk unbranched, diclinous or monoclinous, rarely androgynous in origin. Oospore germination by the formation of a branched germ tube.

Collected once from soil sample. (July 16, 1974. Taipei; garden soil)

Sexual reproduction occurs on snake skin "baits" in water culture as well as on corn meal agar.

Allomyces arbuscula Butler. Ann. Bot. London, 25: 1027, figs. 1–18. 1911 (Plate 3, Fig. 37)

Hyphae sympodially or dichotomously branched with pseudosepta. Sporangia single or catenulate; broadly ellipsoidal or ovoid, with rounded apex ends; 35–60 μ long by 25–35 μ in diameter; forming 1–3 discharge papillae. Resting sporangia abundant, ovoid, with round apex and truncate base, 25–55μ long by 20–40 μ in diameter average 32–25 μ; exospore thick-walled, brown, minute punctate, upon germination from posteriorly uniflagellate planotes. Sexual thallus similiar to the asexual, gametangia at first terminal in pairs, later catenulate; alternating, the large globse, clavate, or ovoid colorless

Explanation of Plate 3

Figs. 21–32. ***Geolegnia inflata.*** 31. Zoosporangium ×200. 32. Oogonia with androgynous antheridal branches. ×200. Fig. 33. ***Aphanomyces helicoides.*** Antheridial branches coiling about the oogonial stalk ×1000. Figs. 34–35. ***A. cladogamus*** 34. Inner wall of oogonium irregular. ×1000. 35. Zoosporangium. Fig. 36. ***A. stellatus.*** Oogonium covered with bluntly conical tubercles ×1000. Fig. 37. ***Allomyces arbuscula.*** Gematangial pair ×200. Fig. 38. ***A. javanicus.*** Gematangial pair. ×200. Fig. 39. ***A. macrogynus.*** Gematangial pair. ×200. Fig. 40–41. ***A. moniliformis.*** 40. Resting sporangium. ×800. 41. Isogamous gametes emerging from cysts; couplated gametes ×800. Fig. 42.***A. neomoniliformis.*** Resting sporangium. Figs. 43–44. ***Rozella allomycelis.*** 43. Abnormal resting sporangium of ***A. macrogynus*** ×800. 44. Zoosporangia and resting spore. Figs. 45–46. ***Olpidiopsis saprolegniae*** var. ***saprelegniae.*** 45. Resting spore with companion cell. ×800. 46. Zoosporangia ×200. Figs. 47–48. ***Olpidiopsis fusiformis.*** 47. Resting spore. ×800. 48. Zoosporangia. ×200.

female gametangium terminal, 30–55 μ in diameter, subtended by a short to long cylindrical or barrel-shape male gametangium; 25–60 μ in diameter; with faintly golden or salmon-pink contents. Female gamete colorless; nearly spherical; 10 μ in diameter, Male gamete spherical 8 μ in diameter.

Collected twice on hempseed from soil samples. (Feb. 29, 1974. Lu-shan; grass soil). There are two kinds of isolates, one with smaller resting sporangium which is alike to *A. arbusuculus* var. *minor*, the other with larger resting sporangia (average 40 μ in diameter) which is like *A. arbusculus*. But these varieties depended upon the size of resting sporangia are not acceptable now, as integrates between the varieties occurred.

Allomyces macrogynus (Emerson) Emerson and Wilson. Mycologia, 46: 429. 1954. (Plate 3, Fig. 38)

Collected many isolates from garden soil in Taiwan. (Sept. 5, 1973. Taipei; garden soil)

This species had been reported in Taiwan by Dr. Chien. From the description we know that his isolate has the following differences compared with the isolate of Emerson's: (1) The former have smaller zoosporangia and resting sporangia. (2) In the former, the catenulate gametangia are rarely observed. These differences did not appear in all of our isolates of *A. macrogynus*. And we found *Rozella allomycis* (plate 3, Figs. 43–44) that is parasitic in hyphae of *A. macrogynus*.

Allomyces javanicus. Kniep. Berichte Deutsch. Bot. Gesell., 47: 211, Figs. 1–7. 1929. (Plate 3, Fig. 38)

Hyphae sympodially or dichotomously branched. Zoosporangia ovoid terminal or catenulate; with one or several discharge papillae. Zoospores ovoid. Resting spores ovoid or subspherical, with rounded apex and truncate base; 30–45×40-70 μ in diameter. Sexual plant similar to asexual. Gametangia somewhat irregularly arranged terminal; single in pairs, rarely catenulate; the male terminal or rarely subterminal, cylindrical, with narrow apex; pigmented; 35–50 μ long by 25–40 μ width; subtended by the somewhat larger; more ovoid female gametangium, which is 35–75 μ long by 32–55 μ in diameter.

Collected one isolate on hempseed from soil. (Oct. 9, 1973. Taichung; citus soil)

Allomyces moniliformis Coker and Braxton. J. Elisha Mitchell Sci. Soc., 42: 139, pl. 10. 1926. (Plate 3, Figs. 40–41)

Vegetative structures resembling *A. arbuscular*. Primary sporangia narrowly clavate or cylindrical; 90 μ long by 45 μ in greatest diameter with an apical papilla. Secondary sporangia formed predominantly in basipetal succes-

sion; ovoid to nearly spherical with truncate ends; contents pink, becoming brown as the zoospores approach maturing. Resting sporangium narrowly to broadly ovoid, with truncate base and pronounced apical beak; 50–105 μ long by 30–45 μ in great width, predominantly 70–90 μ long by 35–42 μ width; generally slipping out of their containers at maturing, the exospore thick-walled; dark orange brown; widely spaced pits. Germination by cystogenes type; cysts 12–15 μ in diameter; isogamous gametes from the cyst 7.5–9.5 μ in diameter.

Collected many isolates from soil in Taipei. (Sept. 21, 1973 Taipei; garden soil)

Allomyces neo-moniliformis Indoh. Sci. Rci. Rept. Tokyo Bunrika Daigaku, Sect. B, 4: 271, figs. 2d, 31–33, 34. 1940. (Plate 3, Fig. 42)

Vegetative structures resembling *A. arbuscula*. Sporangia terminal, cymose or catenulate; resting spores, terminal or cymose oval to elongate, to almost clavate; 32–85 μ long by 27–50 μ; broad with broadly rounded apex and scat tered pits; planots form isogames; 8–11 μ in diameter; fuse in pairs. Zygote producing on the germinating sporophyte plant.

Collected many isolates from garden soils in Taipei and Tainan. (Oct. 3, 1973. Taipei; garden soil)

Our isolate the cyst is larger than that of Indoh's (1940).

Olpidiopsis saprolegniae var. saprolegniae (Braun) Cornu. Ann. Sci. Nat. Bot., v. 15: 145, pl. 3, fig. 10. 1872. (Plate 3, Figs. 45–46)

Parasitic in hyphae of *Saprolegnia ferax*. Sporangium predominantly spherical subspherical ovoid, or ellipsoidal; very variable in size 20–110 μ in diameter; generally terminal, occasionally intercalary in the hypertrophied host filaments; wall thin, smooth, brownish; discharge tube, one or two narrowly cylindrical of variable length. Zoospore not observed. Resting spore spherical; 20–25 μ in diameter; dark brown color with a thick wall, the outer surface densely covered with slender sharp spines 5–7.5 μ in length. Germination not observed. Companion cell from one to two, ovoid or nearly spherical 10–22.5 μ in diameter, wall thin, smooth, colorless. (Oct. 3, 1974. Taipei; river)

Sawada (1912) collected this species but he didn't observe the sexual stage. In our isolates there are some points which is different from Cornu's isolate, that the resting spore is smaller and color deeper, sharp spines of resting spore are shorter, and companion cell is smaller.

Olpidiopsis fusiformis Cornu. Ann. Sci. Nat. Bot., v. 15: 147, pl. 4, figs. 1–4. 1872. (Plate 3, Figs. 47–48)

Parasitic in hyphae of *Achlya* sp. collected on hempseed from soil and

water samples. (Oct. 10, 1974. Taipei; garden soil)

This species was recorded by Sawada (1912), but he was mistaken as two species existing in one host, and identified them as *Pseudolpidium stellatum* Sawada and *Pseudolpidium fusiformis* Cornu. Now we know that there are only one species with two kinds of sporangia: one is smooth on the sporangial wall, the other is spiny. And it has a dark color resting spore, spherical, with broad subulate spines.

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臺灣的水生菌 I

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本文裏描述三十二種水生菌，其中二十四種爲臺灣新記錄者。