

AQUATIC PHYCOMYCETES OF TAIWAN II⁽¹⁾

TIN-SON CHIOU and HO-SHII CHANG

Institute of Botany, Academia Sinica
Taipei, Taiwan, Republic of China

(Accepted for publication November 20, 1975)

Abstract

Nine species of water molds were described including two new species and two new combinations. They are *Pythiopsis terrestris* (Höhnk) Chiou & Chang, *Dictyuchus variabilis* (Indoh) Chiou & Chang, *Pythiopsis subcentrica* Chiou & Chang, and *Achlya formosana* Chiou & Chang.

Introduction

Water molds of Taiwan have seldom been investigated, only Sawada 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*. We began our survey on water molds in September 1973 and reported 32 species in 1975. Now we continued to describe nine species of Saprolegniaceae including three species of *Pythiopsis*, two species of *Saprolegnia*, two species of *Achlya*, one species of *Dictyuchus* and *Aphanomyces parasiticus*.

Description

Pythiopsis terrestris (Höhnk) Chiou & Chang comb. nov.

Bremerhaven 1: 85, Tafel 15, figs. 1-6. (Plate 1, Figs. 1-9)

Hyphae vegetativae delicates. Zoosporangia elongata; zoosporae emissae, ex orificio zoosporangium natantes; zoosporangia secunda intra prima vel subter vel latere formata. Zoosporae monoplaneteace. Oogoniis copiosis, sphaericis, vel plures papillas habentibus, ant irregularibus; 17.5-30 μ in diam., plerumque 20-25 μ excl. papillis. Tunica oogoniorum non-punctulate. Oosporis 15-(17.5-22)-25 μ , sphaericis, subcentricae vel centricae, quae singularis in oogoniis. Ram antheridiales sunt rarissimo, et tunc sunt androgyni, quorum antheridia non exurgunt immediate post oogonium.

(1) Paper No. 168 of the Scientific Journal Series, Institute of Botany, Academia Sinica. The previous series title of this study appeared in this bulletin of volume 16: 159-176 was unfortunately mis-printed which should be corrected as "Aquatic Phycomyces of Taiwan I."

Vegetative hyphae slender, much branched, 9–30 μ in diametes, thickest at the terminal. Zoosporangia rare or moderately abundant; elongate; 100–450 \times 20–30 μ ; sporangia renewed by lateral branches, rarely internal proliferation. Zoospores discharge saprolegnoid, pip shaped with two apical cilia, sprouting by germ-tube after the first encystment (monomorphic). Gemmae rare or moderately abundant, spherical, elongate or irregular; single or catenulate. Oogonial wall thin, unpitted and more or less papillate; 30–(25–20)–17.5 μ exclusive of papillae. Immature oogonia possessing a conspicuous mucilage layers. Oosphere maturing. Oospores subcentric, rarely centric; one in the oogonium, 15–(17.5–22)–25 μ in diameter. Antheridial branches very rare, if any, androgynous, antheridial branches not arising from immediately below the oogonium.

Type locality: Taipei, Shih-lin; compost; Oct. 15, 1973.

Type specimen: type culture is deposited in the herbaria of the Institute of Botany, Academia Sinica.

Höhnk (1952) erected a new genus *Aplanopsis* with one species *A. terrestris*, and Dick (1960) established a new species *A. spinosa* by spiny oogonial wall. However, no species of *Aplanopsis* produced asexual reproduction, therefore, *Aplanopsis* was not complete as Sparrow (1960) suggested.

Recently we collected an isolate of this genus. We found that the isolate formed many zoosporangia on hempseed in water two days after cultivation at 20°C under light condition. Some sporangia grew from slender or stouter hyphae. Hyphae were thicker in the neighborhood of sporangia. Sporangia renewal was by sympodial branches, rarely by internal proliferation. Zoospores are pear shaped, with two terminal flagellates. They leave from the mouth and swim away. At higher temperature such as 25°C they soon became encysted. Cysts are 9–12 μ in diameter, predominantly 10 μ and did not form secondary zoospores at 10°C to 25°C.

The presence of monomorphic zoospore, saprolegnoid zoospore discharge and a conspicuous mucilage layers in immature oogonial wall, indicate that our isolate, in fact, is a species of the genus *Pythiopsis*. So *Aplanopsis terrestris* Höhnk is only a strain of *Pythiopsis terrestris* without asexual reproduction.

P. terrestris can be distinguished from *Aplanopsis spinosa* Dick (1960) only by having papillate oogonial wall instead of spiny one. However, until the zoosporangia can be observed, *A. spinosa* will still remain as an imperfectly known species.

P. terrestris can also easily be distinguished from other species of *Pythiopsis* by subcentric oospore structure instead of subeccentric type. Moreover, antheridial branches were often absent in our isolate. So we erected it *P. terrestris* as a new species of *Pythiopsis*.



Plate 1, Figs. 1-9. *Pythiopsis terrestris*. 1. Immaturing zoosporangium and much branched sexual reproductive hyphae. $\times 100$. 2. 3. & 4. Various types of zoosporangia. $\times 200$. 5. One immaturing zoosporangium and one papillate oogonium. $\times 200$. 6. One much branched sexual reproductive hyphae. $\times 200$. (Adapt from H6hnik, 1952). 7. Immaturing oogonium with an obvious mucilage layer, $\times 1000$. 8. & 9. Irregular oogonia with one subcentric oospore. $\times 1000$.

Pythiopsis subcentrica Chiou & Chang sp. nov.

(Plate 2, Figs 1-14)

Hyphae vegetativae delicatae. Zoosporangia elongata; zoosporae emissae, ex orificio zoosporangium natantes; zoosporangia secunda intra prima vel subter vel latere formata. Zoosporae monoplaneticae. Oogoniis copiosis, sphaericis, vel plures papillas habentibus, aut irregularibus; 27-41 μ in diam., plerumque 30-35 μ excl papillis. Tunica oogoniorum non-punctulate. Oosporis 22.5-(26-30)-35 μ , sphaericis, subcentricae vel centricae, quae singularis in oogoniis. Rami antheridiales abundant, exurgentes immediate infra oogonium, quorum antheridia non persistent.

Vegetative hyphae slender, much branched, 10-30 μ in diameter, thickest at the terminal. Zoosporangia rare or moderately abundant; 100-400 \times 20-30 μ ; sporangia renewed by lateral branches, rarely internal branches, rarely internal proliferation. Zoospores discharge saprolegnoid, pip shaped with two apical cilia sprouting by germ tube after the first encystment (monomorphic). Gemmae abundant, spherical, elongate, or irregular; single or catenulate. Oogonial wall thin, unpitted and more or less papillate; 27-(30-35)-41 μ exclusive of papillae. Immature oogonia possessing a conspicuous mucilage layers. Oosphere maturing. Oospores subcentric, rarely centric; one in the oogonium, 22.5-(26-30)-35 μ in diameter. Antheridial branches abundant, arising from immediately below the oogonium, antheridia not persistent.

Type locality: Taipei, Yang-ming Shan; garden soil; April 1, 1974.

Type specimen: Type culture is deposited in the herbaria of Inst. of Botany, Academia Sinica.

Base on monomorphic zoospore, saprolegnoid spore discharge and immature oogonial wall possessing a conspicuous mucilage layer, just as *Pythiopsis terrestris* (Höhnk) Chiou & Chang, we identify this isolate to be a species of *Pythiopsis*, but this isolate can be distinguished from *P. terrestris* by having larger oogonia and oospores. Moreover the antheridial branches of this isolate were abundant and arose mainly from immediately below the oogonium. So we believe that they are not the same species.

Pythiopsis subcentrica can be separated from other members of *Pythiopsis* by possessing subcentric oospores, elongated sporangia and much branched sexual reproductive hyphae. So we suggested that *Pythiopsis subcentrica* is a new species of *Pythiopsis*.

Pythiopsis humphreyana Coker. Mycologia 6: 292, pl. 148, 1914. (Plate 3, Figs. 10-15)

This species were erected by Coker (1923), but the oospore structure had not been observed. Lund (1934) described this species with eccentric oospore

PLATE 2

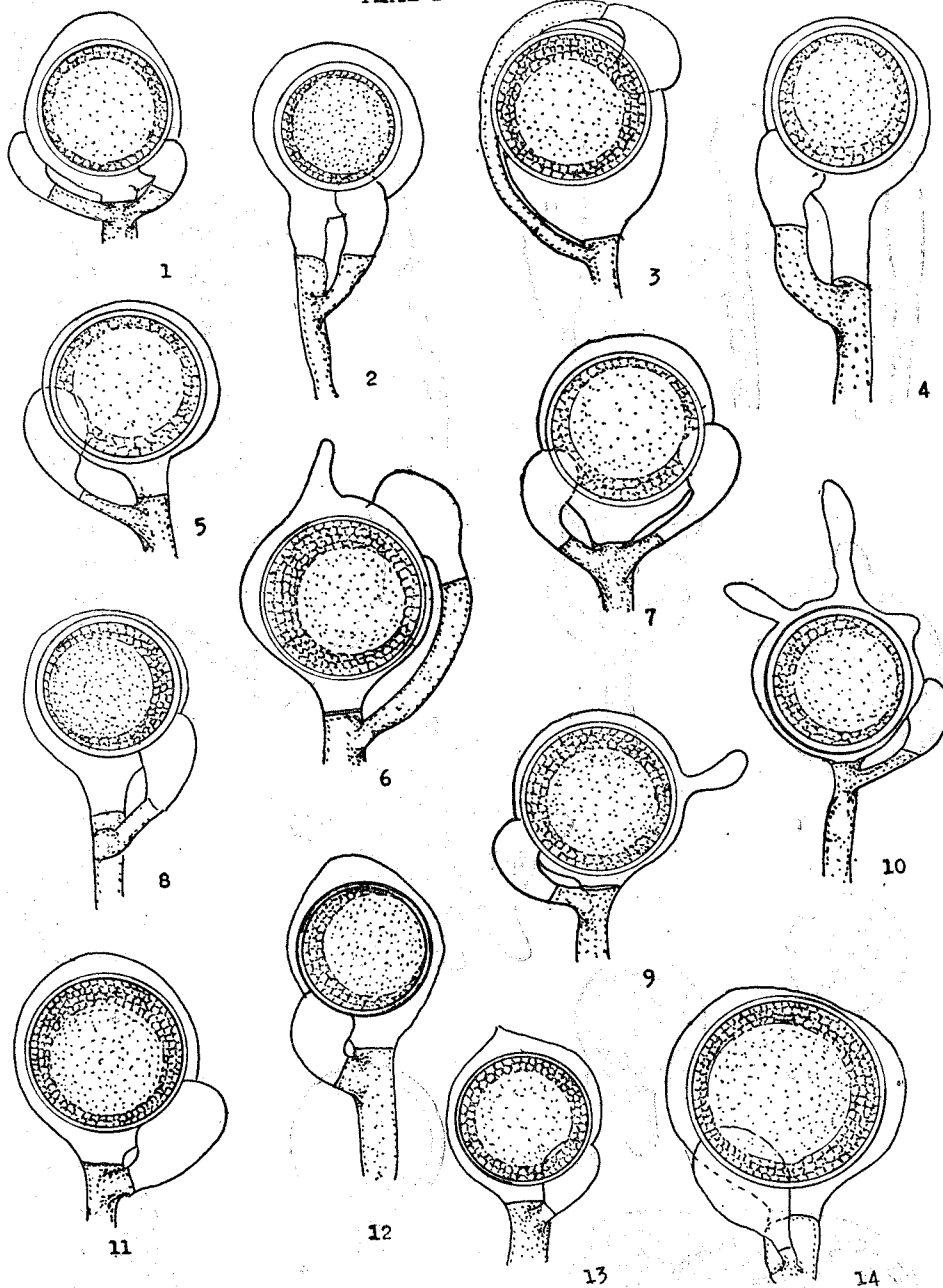
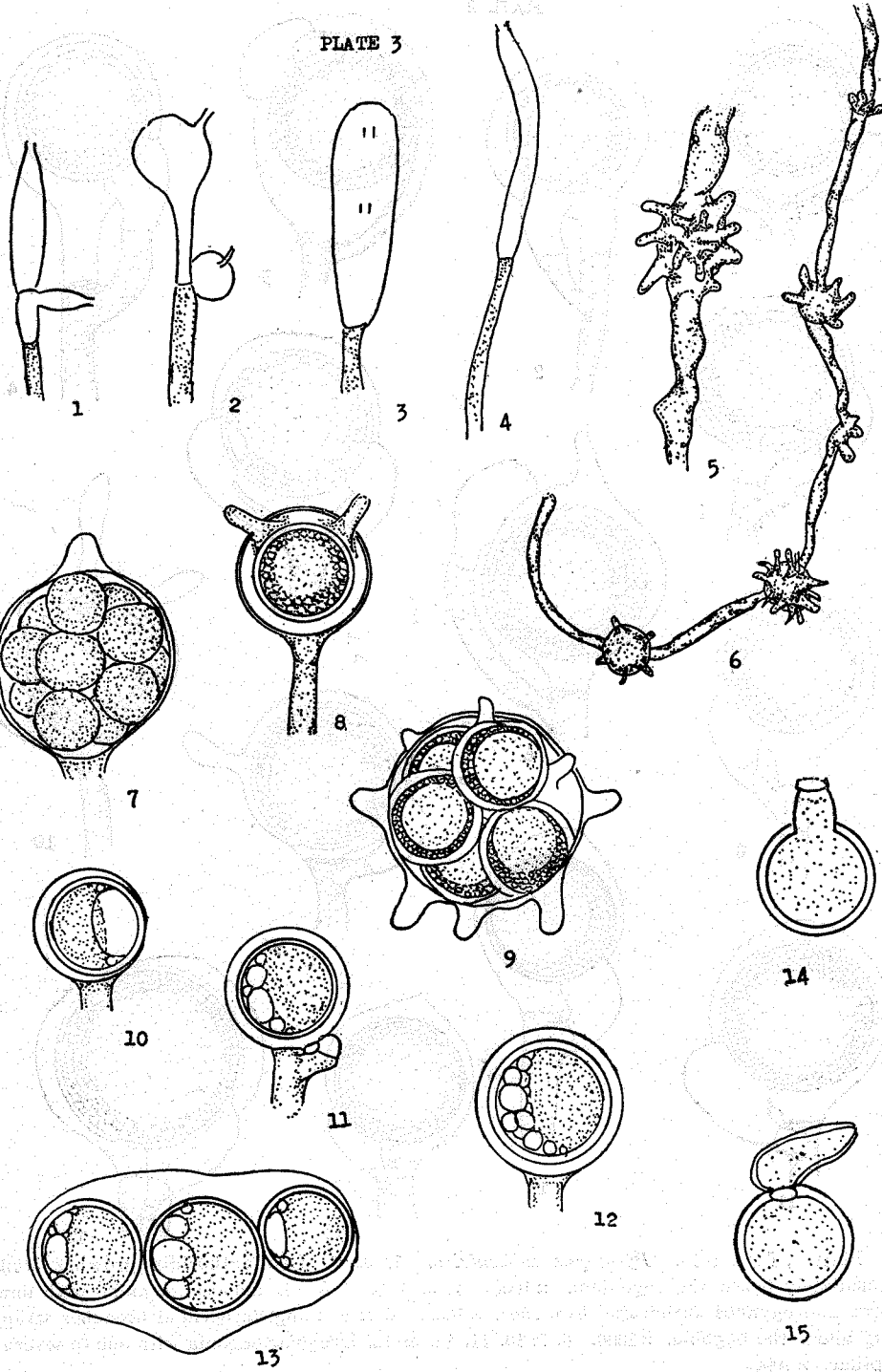


Plate 2, Figs. 1-14. *Pythiopsis subcentrica*. 1. & 7. Two antheridia growing from immediately below the oogonium. $\times 1000$. 2. 4. 5. 8. 11 & 14. Smooth oogonia with one, short, androgynous antheridial branches. $\times 1000$. 3. & 6. Long antheridial branches wrapping about the oogonia. $\times 1000$. 6. 9. 10. 11. 12. & 13. Irregular oogonia with one to several papillae. $\times 1000$.

PLATE 3



type, which was different from that of *P. cymosa*. Dick (1974) suggested that *P. humphreyana* might be a species of the genus *Saprolegnia* (or *Isoachlya*). The aforementioned opinions made this species become somewhat vague to identify. Recently we identified many isolate of *Pythiopsis* as *P. humphreyana* (Chiou et al 1975). Present study showed that they possessed subeccentric oospore type, large oogonia and oospores, monomorphic primary zoospore and no basal antheridial branches. Moreover, we found the germination of this oospore type. So we suggest it should be retained in the genus *Pythiopsis* and be a valid species, just as Coker (1923) described.

Ookubo & Kobayasi (1955) erected a new species *Pythiopsis papillata* with dimorphic zoospores and did not mention whether the immature oogonial wall of their fungus with or without a conspicuous muclilage layer. Based on their origin description, we think that *P. papillata* is closer to Pythiaceae by hyphae diameter, oospore type and antheridial branches origin. However, lacking the material, we cannot make further discussion.

The following key is proposed for the separation of four species of *Pythiopsis*.

Key to Species of *Pythiopsis*

Sporangia elongated; sexual reproductive hyphae much branched; oospore subcentric.

Antheridial branches very rare, if any, not growing immediately

below the oogonium; oospore averaging 17.5–22 μ*P. terrestris*

Antheridial branches abundant, almost arising immediately below

the oogonium; oospores averaging 26–30 μ*P. subcentrica*

Sporangia globula, clavate or elongated; sexual reproductive hyphae not much branched; oospore subeccentric.

Sporangia globula or clavate; oogonia sometimes with a few blunt outgrowth, with basal antheridial branches; oospore about

14.5–18.5 μ *P. cymosa*

Sporangia occasionally elongated; oogonia always smooth; oospore

one, sometimes two, rarely up to four, about 25–30 μ thick;

without basal antherial branches.....*P. humphreyana*

Plate 3, Figs. 1–9. *Saprolegnia asterophora*. 1. 2. 3. & 4. Various types of zoosporangia. $\times 200$. 5. & 6. Initial oogonia with irregular oogonial wall. $\times 200$. 7. One papillate oogonium filling with eleven oospores. $\times 800$. 8. One papillate oogonium with one oospore. $\times 800$. 9. Oogonium filling with subcentric type I and type II oospores. $\times 800$.

Plate 3, Figs. 10–15. *Pythiopsis humphreyana*. 10. Subeccentric oospore with one large and a few small oil drops on one side. $\times 800$. 11. Androgynous antheridial branches growing from immediately below the oogonium. $\times 800$. 12. Subeccentric oospore. $\times 800$. 13. Irregular oogonium with three oospores. $\times 800$. 14. & 15. Germinated oospore with stout, short germ tube. $\times 800$.

Saprolegnia asterophora deBary Jahrb. F. Wiss. Bot. 2: 189, pl. 20, figs. 25-27, 1860. (Plate 3, Figs. 1-9)

Zoosporangia rare, secondary zoosporangia formed basipetally, not by internal proliferation. Gemmae abundant, irregular, sometimes becoming zoosporangia. Zoospore discharge saprolegnoid. Oogonial abundant, terminal or more frequently lateral on long or short branches, rarely intercalary; roughly spherical, often irregular or broadly lobed; papillation variable, nearly smooth to moderately or rarely densely covered with long papillae. Oogonia 25-66 μ in diameter, exclusive of papillae, predominantly 40-50 μ . Antheridial rare, if any, androgynous. Oogonium containing 1-14 oospores, mostly 4-6. Oospores 15-35 μ in diameter, predominantly 20-27 μ ; centric, subcentric type I or rarely subcentric type II.

Collected one from Taipei, Dec. 25, 1974.

Dick (1969a) used subcentric to designate oospores with one or more layers of large oil droplets on one side of the oospore. This type of oospore structure could be easily recognized in *Pythiopsis cymosa* deBary, and *P. humphreyana* Coker, but not in Dick's isolates of *Scoliolegnia blehaminsis* and *S. subeccentrica*. The oospores of the latter two species are closer to subcentric type II. In our isolate of *Saprolegnia asterophora* the subcentric type II oospores were also observed and with somewhat smaller droplets compared to those of *S. blehaminsis* and *S. subeccentrica*. We were convinced that *S. blehaminsis* and *S. subeccentrica* seemed to be only subcentric type II and rarely centric type. Based on above observation we suggest that these oospore structures did not seem to be significant enough for separating species as Dick applied in three species of *Scoliolegnia*.

Our isolate of *Saprolegnia asterophora* showed a wide variation in several characters: the oogonium possessed from one to fourteen oospores, but mostly with 4-6, its oogonial wall papillae were regular to irregular and antheridia were rare. Like other members of *Saprolegnia*, our isolate is thin and unpitted oogonial wall. Besides based on oospore structure, Dick (1969b) separated *Scoliolegnia asterophora*, *S. subeccentrica* and *S. blehaminsis* by their oospore number, the presence or absence of antheridia and oogonial wall papillation and sporangial renewal. Since our isolate showed such a wide variation in above mentioned characters which were derived from the same hyphae tip. We suspected that Dick was treating the same species of organism. Except with the papillate oogonia, the genus *Scoliolegnia* is difficult to separate from *Saprolegnia* and so Seymour (1970) has doubted the validity of genus *Scoliolegnia*.

Dictyuchus variabilis (Indoh) Chiou & Chang comb. nov.

Habkubutsugaku-Zasshi, Tokyo (Magazine Nat. Hist.) 38(72): 87, figs. 1-2.
(Plate 4, Figs. 1-2)

Mycelium spissum, breve, quod abundantes in Cammabis staivae seminibus gignitus. Hyphis plerumque non ultra 8.0 mm. longis, crassis, et ad vasim ramosis; mediis hyphis hyphis plerumque $24\ \mu$ diam. Sporangii cipiiosis, clavatis in longis cylindricalibus, $350\ \mu$ longis, $20\ \mu$ diam; terminalibus, cymosis. Aliquibus sporangiis Achlya instar; plerumque truiireticulis formis. Oogoniis globosis, $21-30\ \mu$, plerumque $26\ \mu$ diam, tunica oogoniorum non-punctulatis. Oosporis I, plerotic, guttulis oleosis excentrice. Antheridiis androgenus, gracilibus, multis in oogoniis applicatis.

Mycelium depauperate, forming a dense growth on hempseed. Hyphae usually not more than 8.0 mm. long, averaging $24\ \mu$ in diameter near the center; delicate and branching. Sporangia abundant, terminal, clavate to long-cylindrical, $20-30 \times 200-550\ \mu$, averaging $20 \times 350\ \mu$; generally 3-5 spores wide, not branching. Secondary sporangia arising by cymose branching; a few of the early sporangia under favorable conditions, discharge spores as in *Achlya*, in older cultures the majority of the sporangia are of the true-net type I and very rarely brevilegnoid type. Gemmae rare, terminal or intercalary; single or catenulate. Oogonia abundant, spherical rarely subspherical, $20-30\ \mu$ in diameter of the oogonium, often branch. Oospore single, plerotic, eccentric. Antheridial branches androgynous, always wrapping about the oogonium. Antheridia up to $8\ \mu$ thick. Antheridial branches not developing sporangia. Oospores germinating by short or longer, slender, unbranched germ tubes, bearing small clavate true net I sporangium.

Type locality: Taipei; garden soil; Oct. 20, 1974.

Type specimen: type culture is deposited in the herbaria of the Institute of Botany, Academia Sinica.

Indoh (1941) erected a new species *Brevilegnia variabilis*, which differs from its allied species *Brevilegnia bispora* Couch and *Brevilegnia parvispora* Höhnk by possessing true net type dictyuchoid sporangia. This characteristics was found in the genus *Dictyuchus*, not in *Brevilegnia*. So Johnson (1975) suspected that *B. variabilis* was a species of *Dictyuchus*. Indoh's *B. variabilis* was not satisfactorily illustrated. Nevertheless from his description and two figures, we found that our isolate is very similar to his isolate by possessing plerotic oospores, dictyuchoid and achlyoid type sporangia being observed, androgynous antheridial branches wrapping about the oogonium, and lacking large irregular antheridia. Concurrently we observed many true net type I sporangia with persistent sporangial wall in germination oospores and older

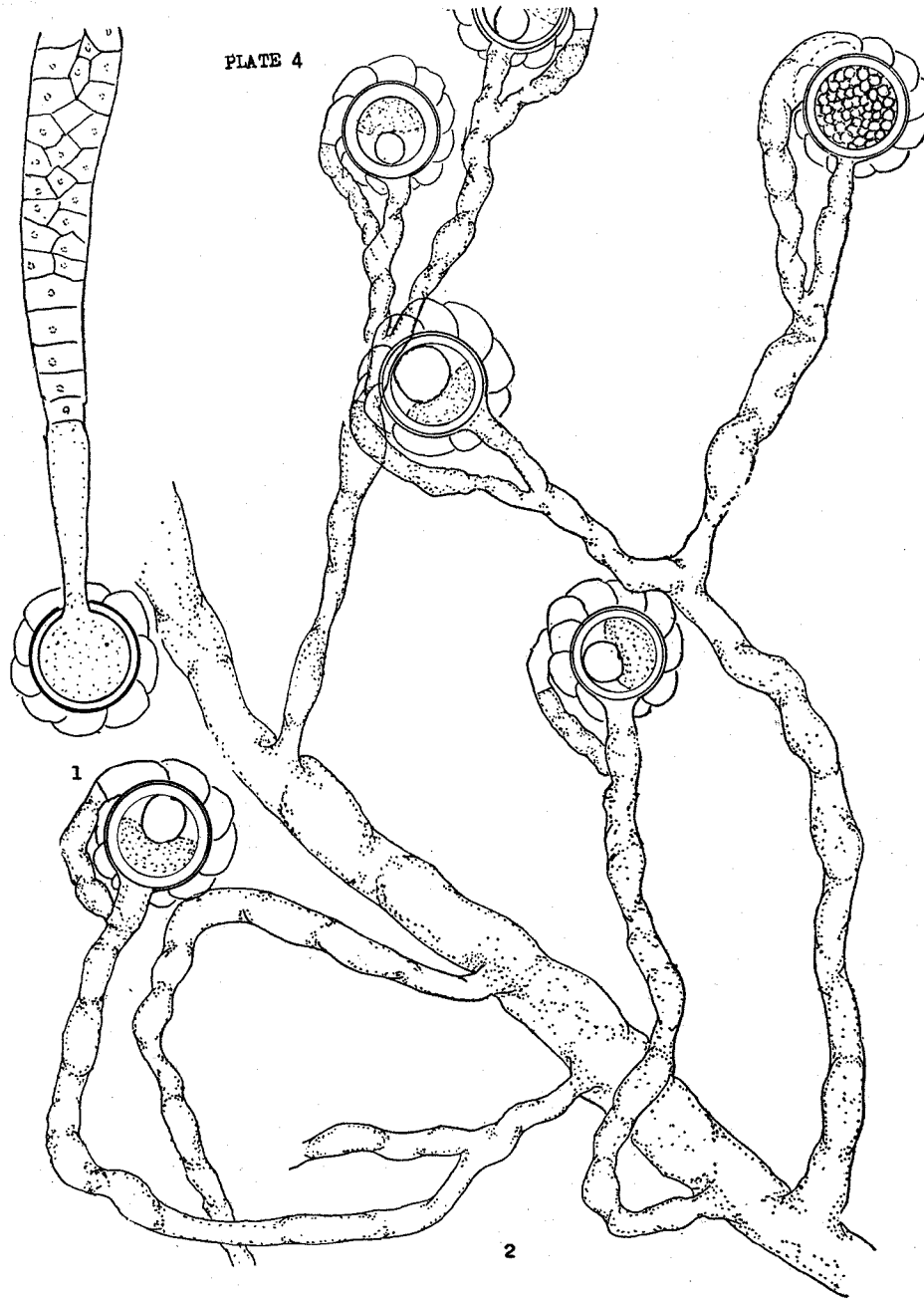


Plate 4, Figs. 1-2. *Dictyuchus variabilis*. 1. Germinated oospore showing a typical ture net type I sporangium. $\times 800$. 2. Long stalk oogonia with one plerotic oospore; recurved androgynous antheridial branches always wrapping about the oogonium. $\times 800$.

culture. Therefore we believe that our isolate and Indoh's are the same species and it is logical to transfer this species to *Dictyuchus*.

Dictyuchus variabilis possesses characteristics which relate it more closely to *Dictyuchus pseudoachlyoides* Benenk, than to the other species of *Dictyuchus*. This species differs from *D. pseudoachlyoides* in possessing plerotic oospores, smaller oogonia, which wrapping about by a recurved antheridial branch.

The plerotic oospore is rarely found in family Saprolegniaceae.

Achlya formosana Chiou & Chang sp. nov.

(Plate 5, Figs. 1-7)

Thallis non gynandromictibus. Mycelium corporis modicum et deneum, Hyphis 60-110 μ crassis. Gemmis abundantibus, filiformibus vel subfiliformibus vel golbosis; singulis vel catenatis. Zoosporangiis fusiformibus clavatisve, vel moniliformibus; 150-700 μ longis, 20-45 μ diametro, plerumque 250-325 \times 30-40 μ ; sympodialiter vel basi seriatim proliferantibus. Zoosporiis generis propriis. Oogonia golbosa 37.5-62.5 μ , plerumque 40-45 μ diam. Tunica oogoniorum nullis punctulis notatis et omnino leve. Antheridiis declinis, raro monoclinis, gracilibus, multis in oogoniis applicatis. Oospaeris non maturescentibus. Oosporis ecentro dispositis, oogonia non implentibus; numero 2-17, plerumque 5-9; diametro 17.5-25 μ , plerumque 20-23 μ .

Plant monoecious. Mycelium extensive, moderately dense; four-day old colony 1.5-2.0 cm in diameter on hempseed culture at 25°C. Principal hyphae stout, branched, 60-110 μ in diameter at base; numerous, slender and profusely branched. Secondary hyphae intermingled with primary ones. Gemmae abundant; filiform or subfusiform, occasionally spherical; single or catenulate, functioning as zoosporangia. Zoosporangia abundant, clavate, fusiform, occasionally moniliform; 150-700 \times 20-45 μ in basipetalous succession. Zoospore discharge achlyoid. Spore cluster not persistent at exit pore; encysted spore 9-11 μ in diameter. Oogonia proliferation not observed. Oogonial wall smooth, pitted only under the point of antheridial cells. Oogonial stalk 1-4 times the diameter of the oogonium in length, stout, straight, infrequently bent or curved. Antheridial branches declinous, sometimes monoclinous; usually coiling about hyphae which may or may not bear oogonia, not losing this feature as colony ages; irregular, frequently branched; laterally appressed or attached by projections; persistent. Antheridia up to 25 μ in width. Fertilization tube not observed. Oosphere usually not maturing. Oospores eccentric; spherical, not filling the oogonium; 2-17 in number, generally 5-9; 17.5-25 μ in diameter, predominantly 20-23 μ . Germination not observed.

Type locality: Taipei; garden soil; May 15, 1974.

Type specimen: type culture is deposited in the herbaria of the Institute

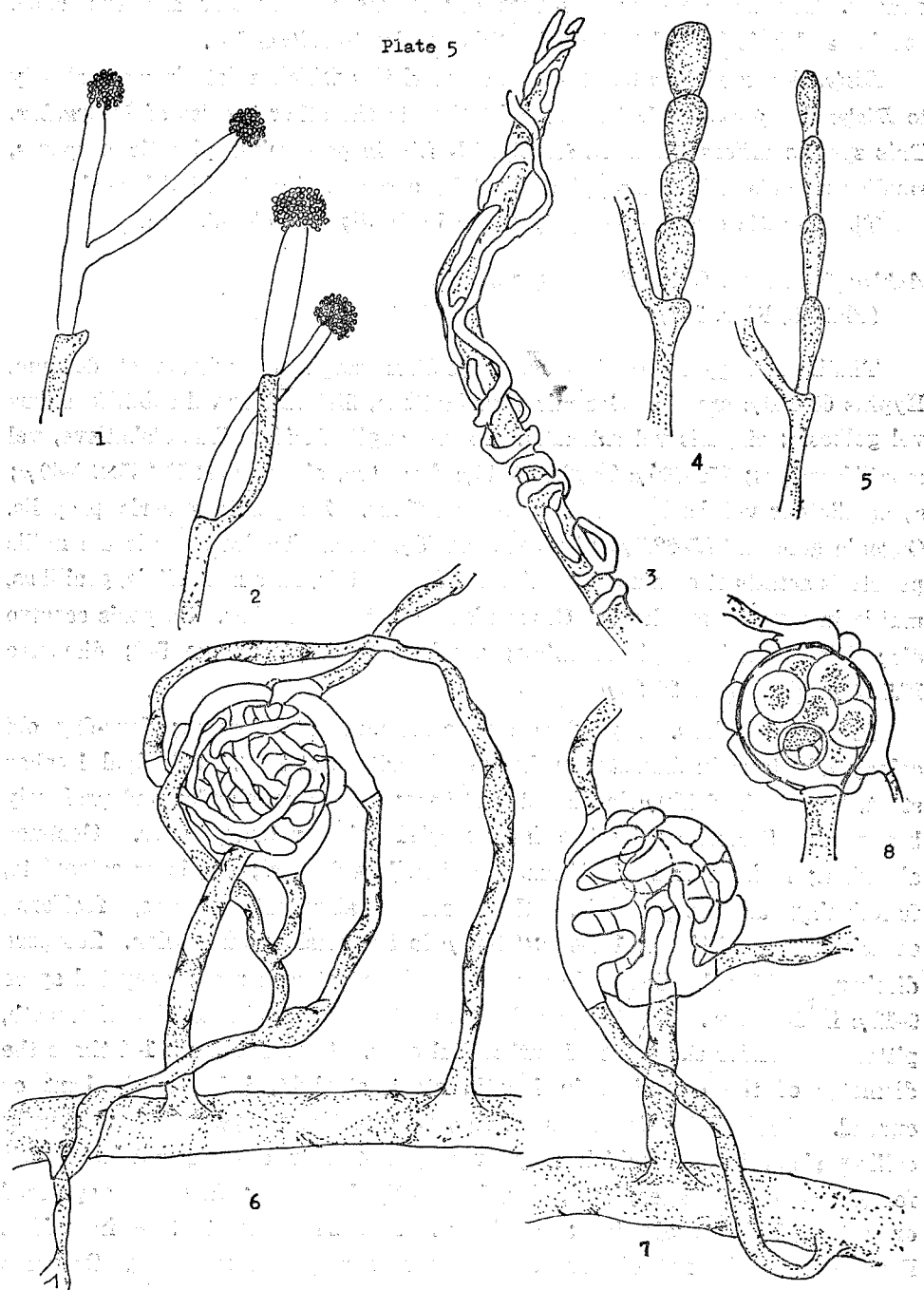


Plate 5, Figs. 1-8. *Achlya formosana*. 1. Basipetal branching sporangia. $\times 200$. 2. Sympodial branching sporangia. $\times 200$. 3. Antheridial branches wrapping about the hyphae. $\times 200$. 4. & 5. Catenulating gemmae. $\times 200$. 6. & 7. Monoclinous and diclinous antheridial branches wrapping about the oogonium. $\times 800$. 8. Oogonium with many immaturing and a maturing oospore. $\times 800$.

of Botany, Academia Sinica.

Our isolate is very similar to *Achlya flexuosa* Nagai in possessing declinuous or rarely monoclinal antheridial branches, which entirely wrap around the oogonium and contain immaturing oospheres. But *A. flexuosa* rarely form sexual organs, if any, only in some old culture (Nagai, 1931), which is similar to Wolf's isolate of *A. bisexualis* (1944), and was thought to be self-conjugating form of *A. bisexualis* (Barksdale 1962). Our isolate is strictly monoecious when it derived from single hyphal tip culture, and forms stable sexual organs at colony stage. We believe that our isolate is a new water mold.

Concurrently our isolate is similar to *A. proliferoides* and *Achlya flagellata*. In fact *A. proliferoides* could be the synonymous of *A. flagellate* (Johnson, 1956). Oogonia of our isolate were not proliferating, always entirely covered by antheridial branches. The coiling antheridial branches were not losing as colony age. So our isolate can easily be separated from *A. proliferoides*. Although Elliott (1967) claimed that the coiling antheridial branches is not a reliable character for delimiting the species, however, our observation showed that the presence or absence of coiling antheridial branch and its persistency seemed to be the reliable criteria to separate the species. And whether the antheridial branches always wrapping about the oogonium or not is important character. So we think that our isolate differs from *A. flagellata* and *A. proliferoides*.

Saprolegnia diclina Humphrey. Trans. Amer. Phil. Soc. (N.S.), 17: 109, pl. 17, figs. 50-53, 1893. (Plate 6, Figs. 1-5)

Hyphae not stout; 20-32 μ in diameter. Gemae abundant; clavate, pyriform or irregular; terminal; single or frequently catenulate; functioning as oogonia or zoosporangia. Zoosporangia abundant; cylindrical, clavate, straight, renewed by internal proliferation. Zoospore discharge saprolegnoid, Oogonia usually sparse, often formed only after prolonged period of time; terminal or lateral; clavate, pyriform or irregular; 40-80 \times 60-200 μ . Oogonial wall unpitted or very rarely pitted; thin; smooth. Oospheres maturing, Oospores subcentric or centric. Antheridial branches declinuous, often wrapping about the oogonium. Antheridial cell tubular or clavate, simple; laterally appressed. Antheridial cell not persistent.

Collected from diseased fish in Taipei at Nov. 27, 1974.

Seymour (1970) stated that *Saprolegnia diclina*, *S. parasitica* and *S. australis* could be separated from one to another by oospore type and oogonial pitting. He pointed out that the oospores of *S. australis* and *S. parasitica* were mostly subcentric, whereas *S. diclina* were centric, rarely subcentric. Many isolate of *Saprolegnia* we collected and examined are *S. parasitica* and *S. diclina*

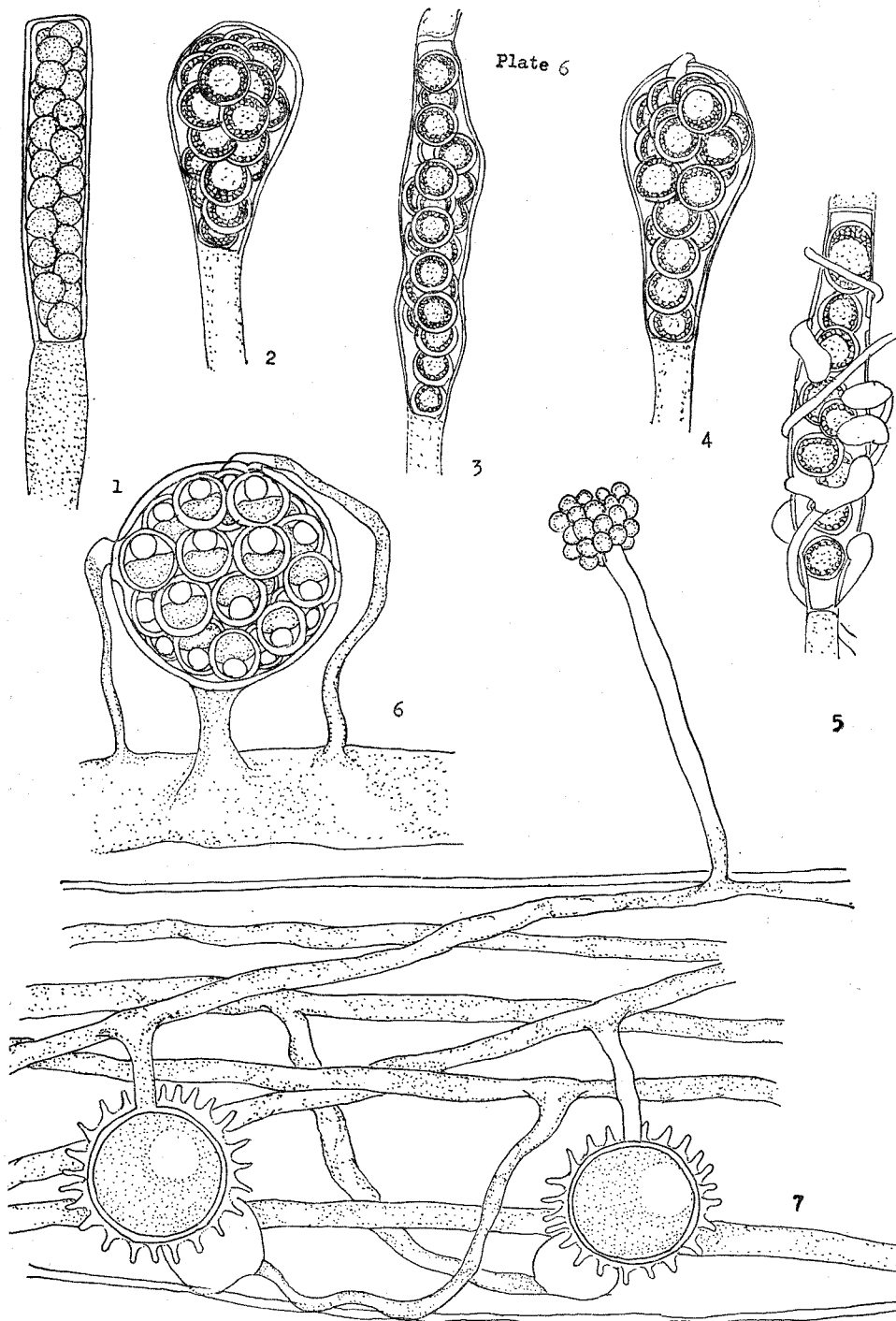


Plate 6, Figs. 1-5. *Saprolegnia diclina*. 1. 2. 3. & 4. Unspored oogonia filling with subcentric or centric oospores. $\times 400$. 5. Spored oogonium wrapping about by diclinous antheridial branches. $\times 400$. Fig. 6. *Achlya americana*, with numerous maturing oospores. $\times 800$. Fig. 7. *Aphanomyces parasiticus*, parasitic in the hyphae of *A. americana*. $\times 1200$.

(Chiou et al, 1975). They possessed subcentric type, however centric oospore types were frequently present too. Thus they could be distinguished only by oogonial pitting, and we suggest *S. australis* is synonym of *S. diclina*.

Here describes an isolate of *S. diclina* in possessing very rare pits. We examined hundreds oogonia for the presence of pits and found only one with sparse pits. From this isolate we thought oogonial pitting is not a reliable character for distinguishing *S. diclina* from *S. parasitica*.

The present study provides further evidence showing the close relationship among *S. diclina*, *S. parasitica* and *S. australis*.

Aphanomyces parasiticus Coker. The Saprolegniaceae, P. 165. pl. 57, figs. 1-13. 1923. (Plate 6, Fig. 6-7)

Hyphae 3-7 μ in diameter, intramatrical at first, later penetrating the walls of the host filament; hyaline; straight and unbranched but becoming swollen and distorted with age. Zoosporangia long, filamentous, unbranched; not different from the vegetative hyphae, isodiametric. Primary zoospore cysts 9-11 μ in diameter. Discharge poroid. Secondary zoospores reniform; laterally biflagellate. Oogonia terminal on short, lateral branches; spherical, almost filling the oogonium; contents finely granular with a conspicuous, central oil globule. Antheridial stalk long, unbranched, diclinous in origin. Oospore germinating not observed.

Collected one from rice seeding in Taipei. Dec. 20, 1974.

This fungus was parasitic on typical form of *Achlya americana* (Plate 6, Fig. 6) We observed it attacking the mycelium and immature oogonia of the host, not the gemmae or mature reproductive structures.

Acknowledgments

We are particularly indebted to Prof. T. W. Johnson, Jr., Duke University, who so kindly gave advice and concerned papers. Concurrently, our thanks are due to Prof. M. W. Dick, Reading University, for the valuable advice he gave us; Prof. P. A. Volz, Eastern Michigan University, for sending us many reprints, and Prof. C. Y. Chien, National Taiwan Normal University, for giving encouragement.

Literature Cited

- BARKSDALE, A. W. 1965. *Achlya ambisexualis* and a new cross-conjugating species of *Achlya*. Mycologia 57: 493-501.
- BENEKE, E. S. 1948. A new species of *Achlya* and of *Dictyuchus*. J. of Elisha Mitchell Sci. Soc. 64: 261-265.
- CHIEN, C. Y. 1972. *Allomyces macrogynus*—An isolation, culture and observation. Chinese Biosci. 1: 31-36 (in Chinese).

- CHIEN, C. Y. 1974. Studies on Taiwanese aquatic fungi I. *Blastocladia* and *Allomyces*. Trans. Mycol. Soc. Japan **15**: 178-185.
- CHIOU, T. S., W. HSU and H. S. CHANG. 1975. Aquatic Phycomycetes of Taiwan I. Bot. Bull. Academia Sinica **16**: 159-176.
- COKER, W. C. 1923. The Saprolegniaceae with notes on other water molds. The University of North Carolina Press, Chapel Hill. 201 p.
- COKER, W. C. and H. H. BRAXTON. 1926. New water molds from the soil. J. Elisha Mitchell Sci. Soc. **42**: 139-149.
- COKER, W. C. and VELMA D. MATTHEW. 1937. Saprolegniales. North American Flora **2**(1): 15-67.
- COUCH, J. N. 1931. Observations on some species of water molds connecting *Achlya* and *Dictyuchus*. J. Elisha Mitchell Sci. Soc. **46**: 225-230.
- DICK, M. W. 1969a. Morphology and taxonomy of the Oomycetes, with special reference to Saprolegniaceae, Leptomitaceae and Pythiaceae. 1. Sexual reproduction. New Phytol. **68**: 751-775.
- DICK, M. W. 1969b. The *Scoliolegnia asterophora* aggregate, formerly *Saprolegnia asterophora* deBary (Onmycetes). J. Linn. Soc. London Bot. **62**: 255-266.
- DICK, M. W. 1974. Saprolegniales. In The Fungi (G. C. Ainsworth and A. S. Sussman, eds.) Vol. 4b: 113-144. Academic Press, New York.
- ELLIOTT, R. F. 1967. Morphological variation in New Zealand Saprolegniaceae 1. *Achlya caroliniana* Coker and *A. flagellata* Coker. N. Z. Bot. **5**: 418-423.
- ELLIOTT, R. F. 1968. Morphological variation in New Zealand Saprolegniaceae 2. *Saprolegnia terrestris* Cookson and *S. australis* sp. nov. N. Z. J. Bot. **6**: 94-105.
- HÖHNK, W. 1952a. Die in Nordwestdeutschland gefundenen uber- und boden-bewohnenden Saprolegniaceae. Veröffentl. Inst. Meeresforsch. Bremerhaven **1**: 52-90.
- HOWARD, K. L., R. SEYMOUR and T. W. JOHNSON, Jr. 1970. Aquatic fungi of Iceland: Saprolegniaceae. J. Elisha Mitchell Sci. Soc. (N.S.) **17**: 63-79.
- INDOH, H. 1941. Observations on some aquatic molds collected from Micronesia (preliminary note). Habkubutsugaku-Zasshi, Tokyo (Mag. Nat. Hist.) **33**: 86-91.
- JOHNSON, T. W., Jr. 1951. An isolate of *Dictyuchus* connecting the false-net and true-net species. Mycologia **43**: 365-372.
- JOHNSON, T. W., Jr. 1956. The genus *Achlya*: Morphology and taxonomy. The University of Michigan Press. Ann Arbor. 180 p.
- JOHNSON, T. W., Jr, K. L. HOWARD, and D. PADGETT. 1973. Aquatic fungi of Iceland: *Brevilegnia* Coker and Couch. Acta Bot. Island. **2**: 7-24.
- JOHNSON, T. W., Jr. 1975. Aquatic fungi of Iceland: *Brevilegnia bispora* Couch, and some related forms. (in press).
- KANOUSE, B. 1932. A physiological and morphological study of *Saprolegnia parasitica*. Mycologia **24**: 431-452.
- NAGAI, M. 1931. Studies on the Japanese Saprolegniaceae. J. Fac. Agr., Hokkaido Imp. Univ. **32**: 1-43.
- OOKUBO, M. and Y. KOBAYASI. 1955. Studies on the water moulds on kertinized materials. Nagaoa **5**: 1-10.
- PADGETT, D. E. and R. L. SEYMOUR. 1974. Variability of zoospore discharge in species of the genus *Dictyuchus*. Mycologia **66**: 615-627.
- SCOTT, W. W. 1961. A monograph of the genus *Aphanomyces*. Va. Agr. Exp. Station. Tech. Bull. **151**: 95 p.
- SCOTT, W. W. 1964. Fungi associated with fish-disease Devel. Ind. Microb. **5**: 109-123.
- SEYMOUR, R. L. 1970. The genus *Saprolegnia*. Nova Hedwigia (Beiheft) **19**: 1-124.
- SPARROW, F. K. Jr. 1960. Aquatic Phycomycetes. 2nd Ed. The University of Michigan Press. 1187 p.

臺灣的水生菌 II

邱灯松 張和喜

中央研究院植物研究所

本文描述九種水生菌，其中兩種是新種，另外兩種是新組合種。