

CHAPTER 36

PYTHIOPSIS de Bary Bot. Zeitung (Berlin) 46:609. 1888

Monoecious. Sporangia short, spherical, oval, lobed, pyriform, or elongate, cylindrical to narrowly clavate, and somewhat irregular; exit papilla prominent or long, often terminal, but occasionally laterally positioned near the sporangial base; more than one exit papilla on some sporangia; renewed sympodially, sometimes forming terminal clusters of sporangia on short hyphae, or renewed in a basipetalous manner. Spores monomorphic, and of the primary type only; emerging from the exit orifices and swimming immediately. Gemmae usually abundant; similar in shape to the sporangia; often catenulate. Oogonia lateral or terminal; spherical, oval, or pyriform. Oogonial wall unpitted; smooth, wavy, or sparsely papillate, or with one or more elongate, cylindrical ornamentations. Oogonial stalks usually simple, short, unbranched. Oospores subeccentric; generally one to three. Antheridial branches androgynous, monoclinal, or diclinous; simple, short. Antheridial cells clavate, apically appressed.

Type species: *Pythiopsis cymosa* de Bary, Bot. Zeitung (Berlin), 46:632, pl. 9, fig. 1. 1888.

Spore discharge in *Pythiopsis* species is like that in *Saprolegnia*, that is, the planonts swim away immediately upon release but their subsequent behavior is different. Following a period of motility, the primary spores (apically biflagellate) encyst. The cysts eventually germinate by producing a new hyphal rudiment directly. Empty cysts are to be seen in some cultures, suggesting that the encysted protoplast may emerge as a motile cell (and perhaps do so repeatedly). However, we have not observed any reniform motile cells in axenic cultures of species of *Pythiopsis*, hence we can only assume on the basis of lack of evidence that repeated encystment and excystment involves only the primary planonts.

Because some species of *Pythiopsis* can produce elongate sporangia, they may be mistaken for representatives of *Saprolegnia* [T. W. Johnson and Surratt (1955), for example, misidentified a *Pythiopsis* as a species of *Isoachlya* (now merged with *Saprolegnia*)]. Unlike the sporangia of *Saprolegnia* species, those of *Pythiopsis* display a prominent, usually elongate, and sometimes sinuous discharge tube (or attenuate papilla) even after spore release. Furthermore, in most specimens of *Pythiopsis* varying numbers of swollen, saccate, lobed, or branched sporangia will be encountered; such sporangia are rare in species of *Saprolegnia*.

Key to the species of *Pythiopsis*

1. Oospores subeccentric *P. cymosa* (p. 577)
1. Oospores centric or subcentric 2
 2. Oogonial wall smooth or very sparsely provided with short, inconspicuous papillae *P. humphreyana* (p. 579)

- 2. Oogonial wall provided with conspicuous, short or long, broad or narrow papillae or bullations, or with cylindro-conic projections 3
- 3. Oogonial wall provided with short, broad papillae or bullations uniformly thickened throughout *P. irregularis* (p. 582)
- 3. Oogonial wall provided with truncate or rounded, cylindro-conic projections conspicuously thickened at the apex *P. papilliformis* (p. 583)

Pythiopsis cymosa de Bary
 Bot. Zeitung (Berlin) 46:632, pl. 9, fig. 1. 1888
 (Figure 85 A-H)

Monoecious. Mycelium diffuse, moderately extensive; hyphae slender, sparingly to moderately branched. Sporangia globose, broadly obovate, clavate, or infrequently cylindrical, sometimes lobed or branched; renewed cymosely or in basipetalous succession commonly, occasionally sympodially; 50-263 x 30-62 µm. Spores monomorphic, pyriform and apically biflagellate on emergence; discharge and behavior of primary spores saprolegnoid, but no secondary ones formed; very rarely aplanoid; primary spore cysts 8-12 µm in diameter. Gemmae usually abundant; globose or subglobose, obovate, broadly pyriform, occasionally cylindrical; terminal or intercalary, single or catenulate. Oogonia generally terminal, occasionally lateral or intercalary; predominantly spherical, infrequently obpyriform or napiform, rarely slightly irregular or angular; (16-) 18-32 (-41) µm in diameter. Oogonial wall unpitted; almost always smooth, extremely rarely with 1-3 broad, blunt, inconspicuous protrusions. Oogonial stalks short, stout, straight or very slightly irregular; unbranched. Oospores subeccentric; spherical to oval, occasionally ovoid to broadly ellipsoidal in intercalary oogonia; 1(-3) per oogonium, and nearly filling it; (14-) 18-26 (-38) µm in diameter; germination not observed. Antheridial branches usually present, inconspicuous; predominantly monoclinal on terminal oogonia, usually androgynous on lateral ones or only rarely or infrequently monoclinal, very rarely dichlinal; short, slender, unbranched; persisting. Antheridial cells short, clavate, usually curved or bent; occasionally to frequently hypogynous or hemihypogynous; persisting; apically or laterally appressed; fertilization tubes present, not persisting.

The majority of the oogonia of *Pythiopsis cymosa* are spherical and smooth-walled, and each almost always contains only one subeccentric oospore. These characters set this species apart from all others in the genus.

Not surprisingly, variations occur in some features of de Bary's species. Humphrey (1893) and Coker (1923) found the oospores of *Pythiopsis cymosa* to be rather small: 18 µm and 14.8-18.5 µm in diameter, respectively. Nolan and Lewis (1974) collected a specimen of *P. cymosa* with somewhat larger oospores -- 17.1-26.6 µm in diameter -- than either Humphrey's or Coker's forms. The oogonia in specimens

collected by Coker (1923) were (as we deduce from the illustration) more commonly ornamented (although sparsely) than was usual in any of our collections of this species. Certainly Coker's presentation suggests that the oogonia of *P. cymosa* are more apt to be ornamented than are those of *P. humphreyana*, yet we find the reverse to be true. De Bary (1888: pl. 9, fig. 1c) illustrated a membrane-like envelope around an oogonium of *P. cymosa*, and Humphrey (1893) also detected in his specimens a gelatinous outer layer on some oogonia. We have not seen such a condition in our isolates.

With respect to the characteristics critical to recognition of *Pythiopsis cymosa*, there appears to be no disagreements among the various existing descriptions. The antheridial branches commonly arise directly below the oogonium (Fig. 85 A, D, E), and are either strictly androgynous (Fig. 85D) or are hypogynous. When the latter, the hypogynal cell is usually lobed (Fig. 85 A-C), giving the impression of an antheridial apparatus of androgynous origin. Nolan and Lewis (1974) refer to this configuration as a semihypogynous origin, and we are adopting this terminology, but with a necessary orthographic amendment, hemihypogynous (*see also Leptolegnia*). There appears to be universal agreement among those who have studied *P. cymosa* most carefully that the mature oospores (Fig. 85 A-E) are subeccentric.

Nolan and Lewis (1974:173, pl. 14, fig. 9) were the first, so far as we are aware, to observe the emergence of a planont when a primary spore cyst of *Pythiopsis cymosa* germinated. They do not mention whether those planonts were pyriform and apically biflagellate or reniform and laterally biflagellate. If the excysting spores were primary ones then planont production was simply a case of repeated emergence. However, if the motile spores emerging from primary spore cysts were of the secondary type the status of *Pythiopsis* is surely in doubt since it would have been demonstrated that the spores of at least one of its species was dimorphic (and therefore strictly saprolegnoid). Further study of the fate of the primary spore cysts in *P. cymosa* is mandatory in light of the discovery by Nolan and Lewis. We have observed the cysts in our specimens to form only a new hypha directly upon germination.

CONFIRMED RECORDS: -- AFRICA: Alabi (1967: pl. 13, figs. f, g). CANADA: Maestres (1977:149, figs. 24-26); Nolan and Lewis (1974:174, pls. 13, 14). CZECHOSLOVAKIA: Cejp (1959a:116, fig. 31). GERMANY: de Bary (*loc. cit.*); Richter (1937:234). ICELAND: Howard *et al.* (1970: figs. 1-3). INDIA: Prabhuji (1979:70, pl. 6. Misidentified as *P. humphreyana*). JAPAN: Hoshina *et al.* (1960:71, fig. 7); S. Ito (1936:72, fig. 30); Nagai (1931:3, pl. 1, figs. 1-11); Okane (1977:15, fig. P). LATVIA: Apinis (1929a: 209). MIDDLE EUROPE: Migula (1903:63, pl. 2, fig. 3). REPUBLIC OF CHINA: Chiou and Chang (1976:40, pl. 3, figs. 10-15); Chiou *et al.* (1975:159, pl. 1, figs. 1, 2; misidentified in both reports as *P. humphreyana*). UNITED STATES: R. L. Butler (1975: figs. 1-8); Coker (1914:290, pl. 147; 1923:18, pl. 1); Humphrey (1893:113, pl. 17, figs. 60-68). USSR: Naumov (1954:63).

RECORDED COLLECTIONS: -- AFRICA: Alabi (1971a, b; 1973); El-Hissy (1974: pl. 2, fig. a(?)). BRITISH ISLES: Cook and Morgan (1934); Dick (1962, 1963, 1966); Dick and Newby (1961); Hunter (1975); Perrott (1960); R. E. Roberts (1963); Willoughby (1974). CANADA: Dick (1971c); Maestres and Nolan (1978). DENMARK: A. Lund

(1978). GERMANY: Höhnk (1956a). JAPAN: Okane (1978); Suzuki (1961f). NEW ZEALAND: Karling (1966f). POLAND: Staniak (1971). UNITED STATES: Coker (1927); T. W. Johnson (1956a); V. D. Matthews (1927); Rooney and McKnight (1972). USSR: Logvinenko (1970); Meshcheryakova (1974); Mil'ko and Belyakova (1968).

SPECIMENS EXAMINED: -- ICELAND (2), TWJ. UNITED STATES (5), RLS.

Pythiopsis humphreyana Coker
Mycologia 6:292, pl. 148. 1914
(Figure 85 I-R)

Pythiopsis intermedia Coker and Harvey, in J. V. Harvey, J. Elisha Mitchell Sci. Soc. 41:157, pls. 17,18. 1925.

Isoachlya intermedia (Coker and Harvey) Coker, in Coker and Matthews, North Amer. Fl. 2(1):27. 1937.

Cladolegnia intermedia (Coker) [sic] Johannes, Feddes Repert. Spec. Nov. Regni Veg., p. 214. 1955.

Pythiopsis subcentrica Chiou and Chang, Bot. Bull. Acad. Sin. 17:40, pl. 2. 1976.

Monoecious. Mycelium extensive; diffuse; hyphae slender, sparingly branched. Sporangia spherical, oval, obpyriform to pyriform, or short and irregularly cylindrical or lobed to branched; renewed in a cymose fashion or sympodially, rarely by internal proliferation; exit papilla usually prominent; 60-308 x 17-81 μm . Spores monomorphic, pyriform and apically biflagellate on emergence; discharge and behavior of primary spores saprolegnoid, but no secondary ones formed; primary spore cysts 8-12 μm in diameter. Gemmae abundant; spherical, oval, obpyriform to pyriform, or short and irregularly cylindrical or lobed to branched; usually terminal, single or catenulate. Oogonia lateral or terminal, infrequently intercalary; resembling spherical or subglobose sporangia when immature; spherical, obpyriform, or pyriform, and usually irregular in outline or with one to a very few prominent conical to cylindro-conic wall extensions of various lengths, infrequently with a single, small, apical papilla, very rarely lobed; (21-) 35-45 (-89) μm in diameter, including wall ornamentations. Oogonial wall unpitted; smooth or with one to a few short, broad papillae, or with cylindro-conic projections; usually simply irregular, rarely bullate; wall of immature oogonia may be surrounded by a mucilaginous layer. Oogonial stalks ($1/3$ -) 2-4 (-7) times the diameter of the oogonium, in length; slender, often irregular; unbranched to glomerulate. Oospores subcentric; spherical to broadly oval or ellipsoidal, occasionally pyramidal from mutual pressure; 1-2 (-4) per oogonium, and generally not filling it; (20-) 25-32 (-40) μm in diameter; at germination forming a branched germ hypha that may or may not bear terminal sporangia. Antheridial branches androgynous or monoclinal (terminal oogonia); usually short, irregular; unbranched or once- to twice-branched, rarely more; persisting. Antheridial cells (or branches) short clavate to tubular, usually sharply bent; infrequently or occasionally hypogynous, or hemihypogynous; apically appressed, occasionally laterally attached; fertilization tubes often present, persisting.

The descriptions of *Pythiopsis humphreyana* (Coker, 1923), *P. intermedia* (J.V. Harvey, *loc. cit.*), and *P. subcentrica* (Chiou and Chang, *loc. cit.*) are alike in most details, suggesting that a single species was the subject in all three instances. On the other hand, the various illustrations of these species are not entirely in accord. Coker (1923: pl. 2) depicted primarily smooth oogonia for *P. humphreyana* and Chiou and Chang (*loc. cit.*) did likewise for *P. subcentrica*. The drawings by Coker and Harvey (J. V. Harvey, *loc. cit.*) show mostly irregular to very sparsely ornamented oogonia for *P. intermedia*. The configuration of the total sexual apparatus of all these species, as they are illustrated is nearly identical.

Coker (1923) reported that *Pythiopsis humphreyana* always had smooth oogonia (the description refers to irregular ones, however), and the antheridial branches were not strictly basal (compare Figs. 85 A and P) to the oogonium. These he cited as the two characteristics of *P. humphreyana* separating it from *P. cymosa*. We have examined one slide of preserved material of *P. humphreyana* -- so labeled by Coker -- in which there are a very few oogonia with hypogynous antheridial cells identical to those commonly found in *P. cymosa* and which Coker and Harvey clearly depicted for *P. intermedia*. As the date of the slide prepared by Coker is 1926, the specimen thereon probably was not the first to be collected and described by him in 1923. There also are some irregular to angular oogonia in Coker's specimen of *P. humphreyana*, but these could have been distorted as a result of the preservation process. Coker (*loc. cit.*) reported that the oospores of *P. humphreyana* were centric, but in a footnote to the description published in 1923 he expressed doubt about the accuracy of this observation. In their compilation of the Saprolegniaceae, Coker and Matthews (1937) followed A. Lund (1934), who stated that the oospores were eccentric (but containing one or several refractive droplets). As in Coker's *P. humphreyana*, the oogonia in Lund's material were smooth-walled. We cannot account for Lund's description of the oospore type, but these cells are universally subcentric in our material. Coker's preserved specimen is of no assistance in this respect, and it seems likely that he never saw mature oospores in his species.

Coker and Harvey (J. V. Harvey, *loc. cit.*) separated *Pythiopsis intermedia* from *P. humphreyana* chiefly on two characteristics of the former: the frequent occurrence of basal antheridia (androgynous branches as well as hypogynous cells) and the production of oogonia with an irregular or wavy wall. As Coker's own specimen of *P. humphreyana* so decisively shows, antheridial structures like those in *P. intermedia* were indeed present. Moreover, since Coker and Harvey recognized smooth oogonia (and illustrated one) in *P. intermedia*, this character, too, fails to separate the two species. Were Coker and Harvey accurate in describing the oospores of *P. intermedia* as the subcentric type? Two figures (J. V. Harvey, *loc. cit.*, pl. 18, figs. 6, 10) show oospores that are unquestionably centric. As there are no predominating features to be singled out as characteristic of one but not the other of the two species, we believe they represent only one taxon.

Chiou and Chang (*loc. cit.*) asserted that *Pythiopsis subcentrica* could be distinguished from all other species in the genus by reason of its subcentric oospores. They had among their isolates specimens identified as *P. humphreyana*, but these

produced subeccentric oospores. However, it is not Coker's species but de Bary's *P. cymosa* alone that has this type of oospore. The antheridial apparatus in *P. subcentrica* cannot be distinguished in any appreciable way from that in *P. humphreyana*, and as other characteristics of *P. subcentrica* are in agreement with what is known of *P. humphreyana*, merger of the two is adequately justified.

Two additional comments on the structure and behavior of *Pythiopsis humphreyana* (*sensu lato*) are pertinent. Coker and Harvey (J. V. Harvey, *loc. cit.*) discovered that *P. intermedia* spores were diplanetic, and regarded this condition as a significant variation in the concept of the genus *Pythiopsis*. However, the motile cells emerging from the primary spore cysts were identical to the primary planonts in shape and flagellar insertion, and thus, the spores were in fact monomorphic as is characteristic of the genus. Some immature oogonia of *P. subcentrica* (= *humphreyana*), Chiou and Chang (*loc. cit.*) reported, were surrounded by mucilaginous layers. They noted a similar condition in *P. terrestris* (see discussion of *Aplanopsis*). None of our specimens of *P. humphreyana* displayed a sheath or envelope around any oogonia. No specimens of *P. subcentrica* exist so far as we are aware (Liu Chin-hui, communication) and thus the ensheathed oogonial apparatus cannot be further studied and evaluated.

On the basis of what they called a diplanetic condition in *Pythiopsis intermedia*, Coker and Matthews (1937) assigned this species to *Isoachlya*. Such a disposition was needless because the spores were not dimorphic (though they could undergo repeated emergence). As *Cladolegnia* is not recognized as a separate genus, Johannes' transfer of *P. intermedia* to it is obsolete. *Pythiopsis intermedia* is not synonymous with *Saprolegnia subterranea* (= *itoana*) as Seymour (1970) proposed.

In the overall aspect of its sexual apparatus *Pythiopsis humphreyana* resembles *P. cymosa*. The oospore types in the two species are different (subcentric and subeccentric, respectively). The oogonia of *P. humphreyana* are not as prominently ornamented (Fig. 85 I-P) as are those of either *P. irregularis* or *P. papilliformis*.

CONFIRMED RECORDS: -- DENMARK: A. Lund (1934:7, fig. 1). INDIA: Prabhuji and Srivastava (1978b:138). UNITED STATES: Beneke (1948b:50); Burton (1940:4, pls. 1-3); Coker (*loc. cit.*, 1923:20, pl. 2); Coker and Harvey (J. V. Harvey, *loc. cit.*); T. W. Johnson and Surratt (1955:123 figs. 14, 16, 22, 24); A. W. Ziegler (1948b:20, pl. 3, fig. 2; 1952:8, pl. 2, fig. 9).

RECORDED COLLECTIONS: -- BRITISH ISLES: Cook and Morgan (1934). GERMANY: Höhnk (1956a). RUMANIA: Toma (1970). UNITED STATES: Coker (1927); Coker and Braxton (1926); J. V. Harvey (1925b, 1930); G. C. Hughes (1959, 1962); T. W. Johnson (1956a); T. W. Johnson and Surratt (1955); V. D. Matthews (1927); Rajagopalan (1963:115, fig. 1H-L(?)); Scott (1960b); A. W. Ziegler (1958b).

SPECIMENS EXAMINED: -- AUSTRALIA (1), OCEANIA (2), SOUTH AMERICA (4), UNITED STATES (3) and preserved collection, W. C. Coker; WEST INDIES (1), RLS.

Pythiopsis irregularis Seymour
Mycotaxon 92:1-10, figs. 12-24. 2005
(Figure 86 A-M)

Monoecious. Mycelium extensive; hyphae slender, sparingly branched. Sporangia naviculate, lobed, or irregularly swollen; discharge papillae conspicuous, with slightly thickened, flaring wall; renewed internally or cymosely; not persisting; lobed sporangia 90-115 x 77-86 μm , naviculate ones 91-163 x 24-38 μm . Spores monomorphic; discharge and behavior of primary spores saprolegnoid, but no secondary ones produced; primary spore cysts 8-15 μm in diameter. Gemmae abundant in old cultures; variable in shape; generally smooth-walled; terminal, lateral, or intercalary, single or catenulate. Oogonia terminal, lateral, or intercalary; rarely developing in discharged sporangia; generally irregular and prominently ornamented, occasionally dolioform, cylindrical, or clavate, rarely angular or spherical; (29-) 33-37 (-52) μm in diameter, inclusive of wall projections. Oogonial wall sometimes pitted under region of attachment of antheridial cells, very rarely elsewhere as well; provided with short, broad, conspicuous papillae or bullations uniformly thickened throughout; very rarely smooth. Oogonial stalks 1-3 times the diameter of the oogonium in length; stout, straight or curved, seldom branched. Oospores subcentric, very rarely centric; spherical or oval; 1-2 (-3) per oogonium, but not filling it; (22-) 27-2 (-38) μm in diameter; germination unknown. Antheridial branches androgynous; short, occasionally sparingly branched; generally 1-2 per oogonium; persisting. Antheridial cells simple; clavate or tubular, occasionally sharply bent, infrequently lobed or once-branched; persisting; apically or laterally appressed; fertilization tubes present but not persisting.

Holotype: Fig. 86 A-M; Accession Nr. MS 245, Randall Library Special Collection, Univ. of North Carolina at Wilmington (USA), bog soil, El Yunque, Puerto Rico, 12 January 1974.

The sporangia of *Pythiopsis irregularis* are exceptionally variable in shape, but each characteristically has a terminal, conspicuous discharge papilla. After spore release the cylindrical remnant of the exit apparatus appears prominently flared (Fig. 86 A-C), but other members of the genus may exhibit a similar feature.

Generally stout, prominent papillae (Fig. 86 E, G, J) project from the oogonia of *Pythiopsis irregularis*, but in those instances when the ornamentations show a low profile the oogonium has an irregular configuration (Fig. 86 D, L). The wall irregularities are

uniformly thickened throughout, in contrast to the condition in *P. papilliformis*. In common with *P. cymosa* and *P. humphreyana*, *P. irregularis* often has short, unbranched, androgynous antheridial branches (Fig. 86 D, F, G, L, M), but the new species lacks a hemihypogynous antheridial apparatus such as is found in the former two taxa. While the oogonia of *P. humphreyana* ordinarily are irregular in general configuration, they are not as prominently papillate (Fig. 85 M, N) as are those of *P. irregularis* (Fig. 86 G, M). Where conspicuous wall extensions are produced by oogonia of *P. humphreyana*, they are sparse rather than abundant as in *P. irregularis*.

Pythiopsis irregularis is widespread in tropical regions, where it is commonly found in conjunction with *P. humphreyana*. In these areas, *P. irregularis*, like other members of the genus, is seemingly restricted in occurrence to cool, wet habitats such as montane bogs, marshes, and rainforest soils.

SPECIMENS EXAMINED: -- AUSTRALIA (1), SOUTH AMERICA (4), UNITED STATES (1; type). WEST INDIES (2), RLS.

Pythiopsis papilliformis Seymour
Mycotaxon 92:1-10, figs. 25-29. 2005
(Figures 86 N, O, 87 A-C)

Monoecious. Mycelium extensive; hyphae slender, sparingly branched. Sporangia cylindrical, clavate, lobed, ellipsoidal, obovate, globose, or irregular; discharge papillae occasionally subapical; renewed cymosely, rarely internally; not persisting; 40-230 x 21-84 μm . Spores monomorphic; discharge and behavior of primary spores saprolegnoid, but no secondary spores produced; primary spore cysts 8-13 μm in diameter. Gemmae rare; clavate, spherical, or obpyriform; usually smooth-walled; terminal, lateral, or intercalary; single, rarely catenulate. Oogonia terminal, lateral, or intercalary; single, occasionally catenulate; spherical to slightly irregular or occasionally elongate, dolioform, subglobose, or obpyriform, but always conspicuously ornamented; spherical ones (42-) 46-59 (-67) μm in diameter, exclusive of wall ornamentations; elongate ones 53-103 x 25-60 μm , exclusive of wall projections. Oogonial wall pitted under region of attachment of antheridial cells, rarely elsewhere; provided abundantly

or sparsely with conspicuous, broadly to narrowly cylindro-conical projections rounded or nearly truncate and thin-walled at the apex; ornamentations 7-48 x 7-22 μm . Oogonial stalks 1-6 times the diameter of the oogonium, in length; stout or slender; straight, curved, sharply bent, or irregular; seldom branched. Oospores subcentric, rarely centric; spherical or ellipsoidal; 1-2(-5) per oogonium and filling it or not; spherical ones (21-) 38-42(-45) μm in diameter; ellipsoidal ones 38-48 x 33-46 μm ; germination unknown. Antheridial branches androgynous, rarely monoclinal; slender, seldom irregular or branched; usually 1-2 per oogonium; not persisting. Antheridial cells simple; broadly clavate or short tubular, straight or sharply bent; persisting; apically appressed, rarely laterally attached; fertilization tubes present but not persisting.

Holotype: Figs. 87 A-C, 86 N, O; Accession Nr. MS 246, Randall Library Special Collection, Univ. of North Carolina at Wilmington (USA), isolated from roadside forest soil, highway BR 174 to Boa Vista 74.1 km from Manaus, Brazil, 5 March 1978.

In this species, the oogonial wall ornamentations constitute the chief feature of recognition. They are cylindro-conical, for the most part, generally rather long (7-48 μm), and are thin-walled at the rounded or nearly truncate apex (Fig. 86 N, O). The nature of the apex of the wall projections distinguishes *Pythiopsis papilliformis* immediately from *P. irregularis*; in the latter, the wall of the ornamentations is uniformly thickened. In our experience, the sporangia of *P. papilliformis* are much less abundant than are those of *P. irregularis*.

Like *Pythiopsis papilliformis*, *Achlya recurva* has prominent oogonial wall ornamentations that are thin at the apex. The two species cannot be easily confused, however, because of the considerable difference in spore behavior, and the fact that the *Achlya* has eccentric rather than centric or subcentric oospores.

Geographically, *Pythiopsis papilliformis* is known only from Amazonas. It commonly occurs in this area in moist, rainforest soil along with *P. irregularis* and *P. humphreyana*.

Pythiopsis sp.

Entries marked by an asterisk (*) report recovery of the unidentified species from fish.

BRITISH ISLES: O'Sullivan (1965); Pickering and Willoughby (1977*); Willoughby (1978*); Willoughby and Collins (1966). CENTRAL AMERICA: Sörgel (1941). DENMARK: A. Lund (1978). GERMANY: Höhnk (1956a). JAPAN: Hoshina *et al.* (1958). PHILIPPINES: Dogma (1975). SOUTH AMERICA: Sörgel (1941). UNITED STATES: J. V. Harvey (1942); Kauffman (1908); M. W. Ward (1939). WEST INDIES: Sörgel (1941).

EXCLUDED TAXA

Pythiopsis intermedia Chaudhuri and Banerjee
Proc. Indian Acad. Sci. (Sect. B) 15:221, pl. 2. 1942

Chaudhuri and his collaborators (1947:24f) stated that *Pythiopsis intermedia* Chaudhuri and Banerjee was not the same as *P. intermedia* Coker and Harvey because the latter had been "...abandoned and renamed *Isoachlya intermedia* Coker and Harvey..." We agree that the fungi similarly named were not the same; *P. intermedia* Chaudhuri and Banerjee (*loc. cit.*, pl. 2, fig. 8) evidently was described from a mixed culture, one element of which was a species of *Pythium* or *Phytophthora*. Bhatt and Manandhar (1973:230, fig. 3) reported finding *P. intermedia* Chaudhary [*sic*] and Mathews [*sic*] in Nepal. They saw only sporangia, but the illustrations are inaccurate either for a *Pythiopsis* or a pythiaceous fungus.

Pythiopsis papillata Ookubo and Kobayasi
Nagaoa 5:8, fig. 6. 1955

If this species was in fact isolated at least into unifungal culture, it cannot be retained in *Pythiopsis*, because the spores are dimorphic. Chiou and Chang (1976) concluded that *P. papillata* was pythiaceous and the diameters of its hyphae would certainly suggest such an affinity. The fungus recovered on human hair and nails used as bait, may indeed represent a valid species, but a different generic assignment is necessary to accommodate it.

Pythiopsis terrestris (Höhnk) Chiou and Chang
Bot. Bull. Acad. Sin. 37: pl. 1. 1976

This new combination was established for a specimen of *Aplanopsis terrestris* mixed with hyphae of a second fungus that was possibly a *Pythiopsis*. See discussion of *Aplanopsis* and its species.

Pythiopsis sp. Kobayasi and Konno
Bull. Natl. Sci. Mus. 16:502, fig. 10 K-N. 1973

The illustrations of the oogonia and antheridia of this unnamed *Pythiopsis* seem to depict *Protoachlya polyspora*. However, the ovoid sporangia, opening very broadly to release the spores, comprise a feature of *Pythiopsis* sp. that usually is not associated with *Protoachlya*. Whether the planonts were monomorphic or dimorphic is not known, but this must be determined before the fungus can be identified and assigned to its proper genus.