Annotated List of Species of Microsporidia

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The species included in this list are all the named ones that have come to my attention and many of the unnamed ones. Probably several of the former were overlooked unintentionally, while many of the latter were consciously omitted. Unnamed species are included according to convenience but expenditure of the time and energy necessary to search out and list all such species mentioned in the literature did not seem feasible.

It is no longer feasible to attempt to compile all the published information on microsporidia, as did Kudo a half-century ago (1924a). Like Weiser (1947a, 1961a), I have been selective in presenting information about the different species. The selective effort has been directed mainly toward data that seemed to have taxonomic value. Furthermore, the relevant data have often been subjectively evaluated and those judged to be inaccurate (such as claims that the spore structure was similar to that in the myxosporidia) were either ignored or questioned. In many cases, it was impossible to judge the accuracy of the claims. Furthermore, many descriptive details (staining intensities, details of nuclear division, etc.), the inclusion of which might be more confusing than enlightening to the reader, have been ignored.

When presenting the synonymies I have tried to cite all the literature that pertains to the history of the nomenclature of the different species. Usually I have cited also literature containing important descriptive data, as well as comprehensive papers that will serve to introduce the reader to other literature. I have not tried to make exhaustive reference to subsequent users of a particular scientific name.

Information on each species is presented according to an out-

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line that is designed to render conspicuous the most pertinent of the nomenclatural data and the most useful of the taxonomic characters. The outline is similar to that followed by Kudo (1924a) in his monograph. The most significant modification is that Kudo's "vegetative form" (which includes all life cycle stages excepting the spore) is broken up into "vegetative stages" and "sporulation stages." I have retained "spore" as a "main heading" because of the great taxonomic importance of this stage, although "spore" is logically subordinate to "sporulation stages." In a more complete and logical outline "sporulation stages" might be broken down into "sporont," stages in "sporogony," stages in "spore morphogenesis" ("sporogenesis"), and "spore." "Vegetative stages" would be broken down into headings that I can not now anticipate. Possibly these would include "first merogony" and "second merogony." Some place in the sequence of stages, possibly after "second merogony," it may eventually be necessary to include a heading for a sexual process ("autogamy"?) and the zygote ("sporont"?).

I have taken a conservative attitude toward making changes in classification of species. The general rule was to make no change without a compelling reason. The most common reason was that the available data regarding a particular species were in sharp disagreement with the characters (as exemplified by the type species) of the genus to which that species was previously assigned. When reassignment seemed necessary, the species in question was, if possible, transferred to a genus which it seemed to fit. When a species did not seem to fit any established genus, which was very frequently the case, it was transferred to the collective group *Microsporidium*. When there was merely doubt, but no clear evidence, that a species was improperly classified, that doubt was usually expressed but no action was taken. Quite frequently the data about a species were too few to provide any basis for judgement about the correctness of the generic assignment. In such cases, I have followed the original author (or latest reviser), often without comment but fully realizing that errors in assignment are probably being frequently perpetuated. Since I, myself, am quite uncertain about the correctness of many of the generic assignments that I have retained (or made), I hope that the readers will not accept these assignments uncritically.

Since nomenclatural matters are governed by the "International Code of Zoological Nomenclature," I have tried scrupulously to follow the code.

I recommend that microsporidiologists try to arrive at an understanding of what kinds of characters are pertinent to an adequate species description and develop a format for presenting such characters in synoptic form. Descriptive statements in such a synopsis should be presented in telegraphic style, using technical terminology universally understood. Such a synopsis accompanying every species description should tend to promote clarity of thinking and universal understanding about the nature of a particular species. At the same time, it would obviate the need for tedious searching of lengthy and rambling publications to pick out essential details of information.

Eventually, all important data about each species should be put into a form that is compatible with a computorized data storage and retrieval system.

The summaries below represent a very imperfect attempt to start a trend toward realization of the recommendations just made. I anticipate that all of the summaries will have to be rewritten and perfected at some future time.

Phylum MICROSPORA ph. n.
Class RUDIMICROSPOREA cl. n.
Order METCHNIKOVELLIDA Vivier, 1975
Family METCHNIKOVELLIDAE Caullery & Mesnil, 1905

Genus *Metchnikovella* C. & M., 1897

Metchnikovella spionis C. & M., 1897

Metchnikovella spionis C. & M., 1897, C. R. Acad. Sci., 125, 789, Figs. 1-3. Caullery & Mesnil, 1914, C. R. Soc. Biol., 77, 528, Fig. 1. Caullery & Mesnil, 1919, Ann. Inst. Pasteur (Paris), 33, 224. Caullery, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 930. Stubblefield, 1955, J. Parasitol., 41, 444.

Host and Site: [GREGARINIDA] *Polyrhabdina brasili* C. & M. in gut of the polychaete annelid *Spio martinensis;* cytoplasm.

Vegetative Stages: No data.

Sporulation Stages: Sporocyst elongated, swollen at middle, 20-40 x 4 μm; with typical elongate thickenings at ends and containing 16 spores. Small bodies (probably spores) formed also in clear vacuoles and hyalin "trainées."

Spore: About 2.5 μm long.

Locality: France (coast of the Channel).

Remarks: Type species by subsequent designation C. & M., 1914.

Metchnikovella berliozi Arvy, 1952

Metchnikovella berliozi Arvy, 1952, Bull. Lab. Marit. Dinard, 36, 9, Figs. 4-9, 11, 12.

Host and Site: [GREGARINIDA] *Lecudina franciana* Arvy in gut of the sipunculid *Phascolion strombi* Montagu; cytoplasm.

Vegetative Stages: No data.

Sporulation Stages: Sporocyst 10-12 x 3.5 μm, containing 16 spores.

Spore: Biconical, 3 x 1 μm, with Feulgen positive dot at one end, and with both ends more chromophilic than the center.

Locality: France (Dinard).

Metchnikovella brasili C. & M., 1919

Metchnikovella brasili C. & M., 1919, Ann. Inst. Pasteur (Paris), 33, 226, Fig. E2. Stubblefield, 1955, J. Parasitol., 41, 444.
Host and Site: [GREGARINIDA] *Polyrhabdina brasili* C. & M. in the polychaete annelid *Spio martinensis;* cytoplasm.
Vegetative Stages: No data.
Sporulation Stages: Sporocysts ovoid, 10 x 5 µm, with about 12 spores.
Spore: In the figure the spores are relatively large and short-elliptical.
Locality: France (coast of the Channel).

Metchnikovella claparedei C. & M., 1914

Metchnikovella claparedei C. & M., 1914, C. R. Soc. Biol., 77, 528, Fig. 7. Caullery & Mesnil, 1919, Ann. Inst. Pasteur (Paris), 33, 232, Figs. A7, K. Stubblefield, 1955, J. Parasitol., 41, 444.
Host and Site: [GREGARINIDA] An unidentified gregarine in a polychaete annelid, *Phyllodoce* sp. (?); cytoplasm.
Vegetative Stages: No data.
Sporulation Stages: Only the sporocyst known; it is very long, swollen in the middle, and apparently rounded at the ends.
Spore: No data.
Locality: Hebrides Islands.
Remarks: Description taken by Caullery and Mesnil (1914, 1919) from a report by Claparède (1861). The parasite was placed with hesitation in the Genus *Metchnikovella* because the great length-width ratio is more characteristic of *Amphiamblys*.

Metchnikovella hessei Mesnil, 1915

Metchnikovella hessei Mesnil, 1915. Caullery & Mesnil, 1919, Ann. Inst. Pasteur (Paris), 33, 228, Fig. G.
Host and Site: [GREGARINIDA] *Monocystis mitis* Leidy in the terrestrial oligochaete annelid *Fridericia polychaeta;* cytoplasm.
Vegetative Stages: No data.
Sporulation Stages: Sporocyst banana-shaped, 10-12 x 3-4 µm containing about 12 spores in 2 rows.
Spore: The figure shows small spherical spores.
Locality: France (Haute-Saône).
Remarks: Description by Mesnil not seen. Data taken from Caullery and Mesnil.

Metchnikovella hovassei Vivier, 1965

Metchnikovella hovassei Vivier, 1965, C. R. Acad. Sci., 260, 6982, Figs. 1-5. Vivier, 1966, J. Protozool. 13(Suppl.), 41. Vivier & Schrevel, 1973, Protistologica, 9, 95, Figs. 1-35.
Host and Site: [GREGARINIDA] *Lecudina pellucida* (Köll.) in the gut of the polychaete annelid *Perinereis cultifera* Grube; cytoplasm.

Vegetative Stages: Uninucleate, spherical forms have a diameter of 3 µm. These develop into plasmodia.
Sporulation Stages: The plasmodia break up into sporoblasts and these transform into spores. Meantime, they may remain within a membrane-bound vacuole or they may become surrounded by a thick-walled cyst.
Spore: Subspherical or ovoid, 1.75 x 1.25 µm. Inside is a "manubrium" capped with a "polar body." Posteriorly, the "manibrium" swells into a "gland" and this continues into an open cap. With a single horseshoe-shaped nucleus.
Locality: France.
Remarks: Vivier's (1965) electron microscope study on the spore of this species demonstrated a basic similarity between the metchnikovellids and the microsporidia. In 1966, Vivier described plasmodial stages. In these works, he showed that the small bodies seen by Caullery and Mesnil (and other authors) within the "clear areas" and "trains" were spores like those formed within the sporocyst. Vivier and Schrevel have made a detailed study of the morphology and life cycle.

Metchnikovella incurvata C. & M., 1914

Metchnikovella incurvata C. & M., 1914, C. R. Soc. Biol., 77, 528, Fig. 2. Caullery & Mesnil, 1919, Ann. Inst. Pasteur (Paris), 33, 227, Fig. A2. Stubblefield, 1955, J. Parasitol., 41, 444.
Host and Site: [GREGARINIDA] *Polyrhabdina pygospionis* C. & M. in the polychaete annelid *Pygospio seticornis;* cytoplasm.
Vegetative Stages: No data.
Sporulation Stages: Sporocyst fusiform, slightly thickened at ends, incurved, 18-22 x 4 µm, with 16 spores.
Spore: Ovoid, about 1 µm.
Locality: France (coast of the Channel).
Remarks: Described briefly in 1914 and more fully in 1919.

Metchnikovella legeri C. & M., 1914

Metchnikovellida legeri C. & M., 1914, C. R. Soc. Biol., 77, 528, Fig. 6. Caullery & Mesnil, 1919, Ann. Inst. Pasteur (Paris), 33, 231, Figs. A6, J. Stubblefield, 1955, J. Parasitol., 41, 444.
Host and Site: [GREGARINIDA] *Sycia inopinata* Leg. in the polychaete annelid *Audouinia tentaculata;* cytoplasm.
Vegetative Stages: No data.
Sporulation Stages: Sporocysts very curved, with thick walls that are especially thick at the ends, 20-30 x 5-7 µm, containing at least 32 spores in 2 or 3 rows.
Spore: The figure shows relatively large spherical spores.
Locality: France (Belle-Isle en mer).
Remarks: Described very briefly in 1914 and more fully in 1919.

Metchnikovella martojai Corbel, 1967

Metchnikovella martojai Corbel, 1967, Protistologica, 3, 365, Figs. 1-4.

Host and Site: [GREGARINIDA] *Gregarina cousinae* Corbel, in the gut of the cricket *Grillus assimilis* Fab.; cytoplasm.

Vegetative Stages: First stages appear as indistinct trains in the host cytoplasm, the amoeboid "germs" transform into ovoid "sporonts" dispersed in the cytoplasm. The "sporont" is limited by a distinct membrane.

Sporulation Stages: Certain "sporonts" contain about 10 spores. Sporocysts, ovoid, up to 50 µm long.

Spore: Spherical, 2-3 µm, refringent.

Locality: France.

Remarks: This is the only report of a metchnikovellid hyperparasitic in a non-annelid host. The description is vague and some of the characters (such as the voluminous and almost empty sporocyst) are unusual. Therefore, the nature of this parasite is open to question.

Metchnikovella mesnili (Dogiel, 1922) Vivier, 1975

Caulleryetta mesnili Dogiel, 1922, Ann. Inst. Pasteur (Paris), 36, 575, Figs.

Metchnikovella mesnili (Dogiel, 1922) Vivier, 1975, Protistologica, 11, 352.

Host and Site: [GREGARINIDA] *Selenidium* sp. in the gut of the polychaete annelid *Travisia forbesi;* cytoplasm.

Vegetative Stages: No data.

Sporulation Stages: Sporocyst bottle-shape, being rounded at one end and elongated at the other. Cyst contains 8-12 spores.

Spore: No data.

Locality: U.S.S.R. (Gulf of Kula).

Metchnikovella minima C. & M., 1914

Metchnikovella minima C. & M., 1914, C. R. Soc. Biol., 77, 528, Fig. 5. Caullery & Mesnil, 1919, Ann. Inst. Pasteur (Paris), 33, 230, Figs. A5, I. Stubblefield, 1955, J. Parasitol., 41, 444.

Host and Site: [GREGARINIDA] *Selenidium cirriatuli* (Lank.) in gut of the polychaete annelid *Audouinia* sp., probably *A. tentaculata;* cytoplasm.

Vegetative Stages: No data.

Sporulation Stages: Sporocyst about 8.7 x 4.3 µm, containing about 20 spores.

Spore: The figure shows slightly elongated spores.

Locality: France (Belle-Isle en mer).

Remarks: Described very briefly in 1914 and more fully in 1919.

Metchnikovella nereidis C. & M., 1914

Metchnikovella nereidis C. & M., 1914, C. R. Soc. Biol., 77, 528, Fig. 4. Caullery & Mesnil, 1919, Ann. Inst. Pasteur (Paris), 33, 228, Fig. A4. Stubblefield, 1955, J. Parasitol., 41, 444.

Host and Site: [GREGARINIDA] *Lecudina pellucida* (Köll.) [?] in gut of the polychaete annelid *Platynereis dummerilii;* cytoplasm.

Vegetative Stages: No data.

Sporulation Stages: Sporocysts ovoid, 10-12 x 4 µm, containing about 8 spores in 2 rows.

Spores: The figure shows small spherical spores.

Locality: Not mentioned.

Remarks: Described very briefly in 1914 and more fully in 1919.

Metchnikovella oviformis C. & M., 1914

Metchnikovella oviformis C. & M., 1914, C. R. Soc. Biol., 77, 528, Fig. 3. Caullery & Mesnil, 1919, Ann. Inst. Pasteur (Paris), 33, 227, Figs. A3, F. Stubblefield, 1955, J. Parasitol., 41, 444.

Host and Site: [GREGARINIDA] *Polyrhabdina pygospionis* C. & M. in gut of the polychaete annelid *Pygospio seticornis;* cytoplasm.

Vegetative Stages: No data.

Sporulation Stages: Sporocysts ovoidal, 14 x 6.5 µm, without thickened ends, with 8 spores.

Spore: The figure shows small spherical spores.

Locality: Not mentioned.

Remarks: Described very briefly in 1914 and more fully in 1919.

Metchnikovella polydorae Reichenow, 1932

Metchnikovella polydorae Reichenow, 1932, *in* "Tierwelt der Nord- und Ostsee" (Grimpe & Wagler, eds.), 21(II), 21, Fig. 8. Stubblefield, 1955, J. Parasitol., 41, 444.

Host and Site: [GREGARINIDA] *Selenidium* sp. in the gut of the polychaete annelid *Polydora* sp.

Vegetative Stages: No data.

Sporulation Stages: Sporocyst straight or slightly bent, 10-14 x 3 µm with 12-14 spores.

Spore: The figure shows ovoidal spores.

Locality: Germany.

Metchnikovella schereschevskaiae Stubblefield, 1955

Microsporidyopsis nereidis Schereschewsky, 1925, Arch. Russe. Protist. Moscow, 3, 144, Figs. 1-13.

Metchnikovella scherschevskaiae Stubblefield, 1955, J. Parasitol., 41, 445. Vivier, 1975, Protistologica, 11, 353.

Host and Site: [GREGARINIDA] *Dolyocystis* sp. in the gut of the polychaete annelid *Nereis parallelogramma* Clap.; cytoplasm.

Vegetative Stages: There are said to be some spherical bodies that unite in pairs to form cysts.
Sporulation Stages: Sporocyst 8-10 x 3.5-4 µm, with a chromophilic mass at one end, containing 8-12 spores.
Spore: Spherical, 1.6 µm, with a large vacuole and a chromatic mass in the shape of a skull cap.
Remarks: Was said to be intermediate between the Metchnikovellidae and the microsporidia, showing affinitities to the latter by the mode of cyst formation and presence of a vacuole in the spore. Stubblefield, after transferring this species to the Genus *Metchnikovella*, had to give it a new specific name because *nereidis* was preoccupied. On page 445, he spelled the name as given above but on page 444 he spelled it *Shereschevskaiae*. Although the transliteration in either case may be questionable, incorrect transliteration is not considered incorrect original spelling. In such a case of multiple original spellings, the reviser may adopt one (Art. 32).

Metchnikovella selenidii Averinzew, 1908

Metchnikovella selenidii Averinzew, 1908, Trav. Soc. Imp. Nat. St. Petersburg, 38, 109 [*fide* Caullery & Mesnil, 1919, Ann. Inst. Pasteur (Paris), 33, 212, 229, Fig. H]. Stubblefield, 1955, J. Parasitol., 41, 444.
Host and Site: [GREGARINIDA] *Selenidium* sp. in gut of the polychaete annelid *Ophelia limacina;* cytoplasm.
Vegetative Stages: No data.
Sporulation Stages: Filamentous plasmodia present. They break up and the cells thus formed are thought to unite in pairs Meantime the entire parasite encysts and each cell within the cyst is a spore. Sporocysts very bent, 15-20 x 7 µm, and containing 18-20 spores.
Spore: Elliptical, 2 µm long.
Locality: U.S.S.R. (Bay of Kola).
Remarks: Caullery and Mesnil did not find the evidence for the sexual process convincing.

Metchnikovella wohlfarthi Hildebrand & Vivier, 1971

Metchnikovella wohlfarthi H. & V., 1971, Protistologica, 7, 131, Figs. 1-11. Hildebrand, 1974, Protistologica 10, 5, Figs. 1-11.
Host and Site: [GREGARINIDA] *Lecudina tuzetae* Schrevel in the gut of the polychaete annelid *Nereis diversicolor;* cytoplasm.
Vegetative Stages: Plasmodia, studied with the electron microscope by Hildebrand (1974), much like those in other microsporidia. No diplocarya seen.
Sporulation Stages: The plasmodia divide into sporoblasts and these develop into spores.

Spore: Ovoid, 3 x 1.9 µm. Electron microscopy demonstrated a "manubrium," "gland," "polar plate," "some circular elements," and an oval nucleus.
Locality: France (Port de Pt Fort-Philippe, Nord).

Genus *Amphiacantha* Caullery & Mesnil, 1914

Amphiacantha longa C. & M., 1914

Amphiacantha longa C. & M., 1914, C. R. Soc. Boil., 77, 528, Fig. 10. Caullery & Mesnil, 1919, Ann. Inst. Pasteur (Paris), 33, 234, Fig. B10. Stubblefield, 1955, J. Parasitol., 41, 444.
Metchnikovella (Amphiacantha) longa (C. & M., 1914) Caullery, 1953, *in* "Traité de Zoologie" (P.P. Grassé, ed.), 1(2), 930.
Host and Site: [GREGARINIDA] *"Ophioidina (=?Lecudina) elongata* ou espece voisine" [C. & M., 1914] in the polychaete annelid *Lumbriconereis tingens* or similar species.
Vegetative Stages: No data.
Sporulation Stages: Cysts fusiform, 70-80 x 4.5 µm, usually straight but sometimes curved or twisted, containing a variable number (sometimes more than 100) of spores.
Spore: No data.
Locality: France (coast of the Channel).
Remarks: Type species by monotypy. Named in 1914 and described more fully by the same authors in 1919.

Amphiacantha attenuata Stubblefield, 1955

Amphiacantha attenuata Stubblefield, 1955, J. Parasitol., 41, 443, Figs. 36-45.
Host and Site: [GREGARINIDA] *Lecudina* sp. in the polychaete annelid *Lumbriconereis;* cytoplasm.
Vegetative Stages: A complicated (and questionable) developmental sequence, leading to "gametocysts" was reported.
Sporulation Stages: Mature cyst fusiform, containing 30-60 (usually 45-50) "gametocytes" [spores].
Spore: "Gametocyte" [spore] spherical or subspherical, 3-4 µm.
Locality: U.S.A. (Marin County, California).

Amphiacantha ovalis Stubblefield, 1955

Amphiacantha ovalis Stubblefield, 1955, J. Parasitol., 41, 443, Figs. 1-35.
Host and Site: [GREGARINIDA] *"Lecudina (Ophioidina)* sp." in *Lumbriconereis latreilli* and *L. zonata;* cytoplasm.
Vegetative Stages: Similar to those of *A. attenuata.*
Sporulation Stages: Mature cysts cylindrical, 40-95 x 6-8 µm, contain usually 14-32 "gametocytes" [spores]. Rarely over 40.
Spore: "Gametocyte" [spore] oval, 7-8.5 µm long.
Locality: U.S.A. (Marin County, California).

Remarks: Stubblefield gave a detailed description of the life cycle but repeating it here would only introduce confusion because it has no resemblance to that which other authors have seen.

Genus *Amphiamblys* Caullery & Mesnil, 1914

Amphiamblys capitellides (C. & M., 1897) C. & M., 1914
Metchnikovella capitellides C. & M., 1897, C. R. Acad. Sci., 125, 789. Fig. 4.
Amphiamblys capitellidis (C, & M., 1897) C. & M., 1914, C. R. Soc. Biol., 77, 528, Fig. 8. Caullery & Mesnil, 1919, Ann. Inst. Pasteur (Paris), 33, 232, Fig. B8. Stubblefield, 1955, J. Parasitol., 41, 444.
Metchnikovella (Amphiamblys) capitellidis (C. & M., 1897) Caullery, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 930.
Host and Site: [GREGARINIDA] *Ancora* sp. in gut of the polychaete annelid *Capitellides giardi;* cytoplasm.
Vegetative Stages: No data.
Sporulation Stages: Cysts 35-40 x 2.5 µm, containing 32 spores.
Spore: Figure as small spheres but not described.
Locality: France (coast of the Channel).
Remarks: Type species by subsequent designation, Sprague, [Designated in the "Classification"]. The authors originally (1897) created the specific name of this species by using the generic name of the associated annelid as a noun in apposition *(capitellides)*. Later (1914), for no evident reason, they changed the spelling to *capitellidis*. Since *capitellides* appears to be correct original spelling this is the form we must use. The form resulting from the apparently inadvertent change has no standing in nomenclature. Most of the descriptive data were given by Caullery and Mesnil in 1919.

Amphiamblys ancorae Reichenow, 1932
Amphiamblys ancorae Reichenow, 1932, *in* "Tierwelt der Nord- und Ostsee" (Grimpe & Wagler, eds.), Vol. 21(II), pp. 21, Fig. 9. Stubblefield, 1955, J. Parasitol., 41, 444.
Host and Site: [GREGARINIDA] *Ancora sagittata* in the polychaete annelid *Capitella capitata;* cytoplasm.
Vegetative Stages: No data.
Sporulation Stages: Cysts 50-60 x 4.5 µm, containing many spores. Spores in 2 rows and so oriented that those opposite each other in the rows form crosses.
Spore: Narrow oval with refractive point at end.
Locality: Germany (Helgoländ).

Amphiamblys capitellae C. & M., 1914

Amphiamblys capitellae C. & M. [*partim*], 1914, C. R. Soc. Biol., 77, 528, Fig. 9a, b. Stubblefield, 1955, J. Parasitol., 41, 444.
Amphiamblys capitellae C. & M., 1914, *capitellae* C. & M., 1919, Ann. Inst. Pasteur (Paris), 33, 233, Figs. B9a, b, L; Pl. V-fig. 6.
Metchnikovella (Amphiamblys) capitellae (C. & M., 1914) Caullery, 1953. *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 930.
Host and Site: [GREGARINIDA] A gregarine, "form en comete," in the polychaete annelid *Capitella capitata;* cytoplasm.
Vegetative Stages: Appear as clear spaces among the cysts. When stained each has indistinct outline and encloses a central chromatic granule; often lined up.
Sporulation Stages: Rod-shaped cysts arranged in a bundle, 50-60 x 3 µm, with an undetermined number of spores. Spores may also be formed independently of the cysts.
Spore: Ovoid, very refrigent, 3 x 2 µm.
Locality: France (coast of the Channel).
Remarks: In 1914, the authors applied the same name to parasites in different gregarine hosts. Later (1919), they decided that forms in the different hosts were "varieties". Vivier elevated *A. capitellae* var. *longior* to specific rank (see *A. longior* below).

Amphiamblys caulleryi (Mackinnon & Ray, 1931) Reichenow, 1932

Metchnikovella caulleryi M. & R., 1931, Q. J. Microsc. Sci., 74, 449, Figs. 11, 12.
Amphiamblys caulleryi (M. & R., 1931) Reichenow, 1932, *in* "Tierwelt der Nord- und Ostsee" (Grimpe & Wagler, eds.), 21(II), 21.
Host and Site: [GREGARINIDA] *Polyrhabdina polydorae* C. & M. in gut of the polychaete annelid *Polydora flava* Clpde.; cytoplasm.
Vegetative Stages: "Hyphal stages" figured but not described.
Sporulation Stages: Cyst tube-like, 85-100 x 2.5-3 µm, containing 20-30 spores.
Spore: Fusiform (according to figure), 3 x .75 µm.
Locality: England (Plymouth).

Amphiamblys longior C. & M., 1919

Amphiamblys capitellae C. & M. [*partim*], 1914, C. R. Soc. Biol. 77, Fig. 9c.
Amphiamblys capitellae C. & M., 1914, var. *longior* C. & M., 1919, Ann. Inst. Pasteur (Paris), 33, 217, 234, Fig. 9c.
Amphiamblys longior C. & M., 1919. Vivier, 1975, Protistologica, 11, 354.
Host and Site: [GREGARINIDA] *Ancora sagittata* type in gut of a polychaete annelid *Capitella capitata(?);* cytoplasm.

Vegetative Stages: No data.
Sporulation Stages: Cysts similar to those of *A. capitellae* but longer, 80 x 3.5 μm, and arranged in bundles of 25-30.
Spore: No data.
Locality: France.
Remarks: Vivier regarded the variety as a subspecies and elevated it to rank of species. "Change of rank of a taxon within the family-, genus-, or species-group does not affect the authorship of the nominal taxon" ["International Code of Zoological Nomenclature," Art. 50 (see Stoll, 1961)].

Class MICROSPOREA Corliss & Levine, 1963
Order CHYTRIDIOPSIDA Weiser, 1974
Family CHYTRIDIOPSIDAE Sprague, Ormières & Manier, 1972

Genus *Chytridiopsis* Schneider, 1884

Chytridiopsis socius Schneider, 1884

Chytridiopsis socius Schneider, 1884, Arch. Zool. Exp. Gén., 2, 14, Figs. 1-4. Léger & Duboscq, 1909, Arch. Zool. Exp. Gén. Ser. 5 Notes Rev., 1, 9, Fig. 1. Manier & Ormières, 1968, Protistologica, 4, 181, Fig. 1, Pl. 1. Sprague, Ormières & Manier, 1972. J. Invertebr. Pathol., 20, 228, Figs. 1-3.
Host and Site: [COLEOPTERA] *Blaps mortisaga* L., adult, intestinal epithelium [Schneider]; *B. mucronata* Latr. [Léger & Duboscq]; *B. lethifera* Marsh [Manier & Ormières].
Lesion: No gross signs of infection mentioned.
Vegetative Stages or "endogenous cycle": Merogony in the usual sense, resulting in the unspecialized merozoites which usually reinfect the same cell, unknown and presumed absent. Léger and Duboscq described "schizonts" that produce "schizozoites" which are liberated into the lumen of the gut as "petits amibes" to produce auto-infection, this being called an endogenous cycle. Manier and Ormières found that the "schizozoites" have polar filaments and are indistinguishable from the stage generally regarded as the spore.
Sporulation Stages or "exogenous cycle": Léger and Duboscq described a sexual process (which Manier and Ormières could not confirm) preceding sporogony. Sporogonial plasmodia form thick-walled cysts ("kystes durables") 10-15 μm in diameter within which many spores develop. These cysts are eliminated to infect new hosts (exogenous cycle).
Spores: Spherical, 1.5 μm, with single (?) nucleus, with short (2 turns) polar filament; without endospore and polaroplast.
Locality: France.

Remarks: Type species by monotypy. The host cell contains very few parasites, typically 1, and this lies in a depression in the host cell nucleus. The endogenous cycle involves formation of spores within a thin membrane (cyst) and the exogenous cycle involves thick-walled cysts; otherwise, no morphological differences are evident. Manier and Ormières made the interesting observation that parasites on the proximal side of the nucleus produce the thick-walled cysts while those on the distal side do not. Early workers favored the idea that *Chytridiopsis* is a fungus, although Léger and Duboscq said the idea that it belongs with Microsporidia should not be rejected. Manier and Ormières, using electron microscopy, demonstrated the polar filament.

Chytridiopsis aquaticus Léger & Duboscq, 1909

Chytridiopsis aquaticus L. & D., 1909, Arch. Zool. Exp. Gén. Ser. 5 Notes Rev., 1, 12.

Host and Site: [COLEOPTERA] *Helodes minutes* L., larvae (presumably intestinal epithelium).

Lesion: No data.

Vegetative Stages or "endogenous cycle": An endogenous cycle, as in *C. socius*, was observed.

Sporulation Stages or "exogenous cycle": "Ookysts" subspherical or ovoid, 11-18 μm, and containing numerous spores.

Spores: Spherical, 1 μm.

Locality: France.

Remarks: Described very briefly and without figures.

Chytridiopsis clerci L. & D., 1909

Chytridiopsis clerci L. & D., 1909, Arch. Zool. Exp. Gén. Ser. 5 Notes Rev., 1, 12.

Host and Site: [COLEOPTERA] *Diapteris boleti* L.; intestinal epithelium.

Lesion: No data.

Vegetative Stages or "endogenous cycle": An endogenous cycle, as in *C. socius*, was observed.

Sporulation Stages or "exogenous cycle": Cysts spherical with very thick wall and measuring 7-12 μm.

Spores: Oval, 3 x 1.4 μm.

Locality: France.

Remarks: It is noteworthy that spores in this genus may not always be spherical. This species described very briefly and without figures.

Chytridiopsis hahni Jírovec, 1940

Chytridiopsis hahni Jírovec, 1940, Arch. Protistenkd., 94, 84, Fig. 4.

Host and Site: [OLIGOCHAETA] *Rhynchelmis limosella;* gut epithelium.

Developmental Stages: Only plasmodia, masses of "sporonts" (sporoblasts?) and spores were seen.

Spore: Spherical, 2-2.5 µm, uninucleate.

Locality: Czechoslovakia.

Remarks: This is probably not a species of *Chytridiopsis* because it does not seem to have a thick-walled sporophorous vesicle and it does not clearly show a close association with the host cell nucleus. It may not be a microsporidium. It is retained provisionally in the Genus *Chytridiopsis* for lack of a better alternative.

Chytridiopsis limnodrili Jirovec, 1940

Chytridiopsis limnodrili Jírovec, 1940, Arch. Protistenkd., 94, 84, Fig. 3.

Host and Site: [OLIGOCHAETA] *Limnodrilus missionicus;* gut epithelium.

Developmental Stages: Small uninucleate forms develop into plasmodia with numerous nuclei. Large plasmodia, 12-14 x 8-10 µm, break up into sporoblasts that develop into spores. A delicate membrane enclosing the sporoblasts was illustrated by the author but not mentioned.

Spore: Spherical, 2-2.2 µm, with 2 chromatin granules.

Locality: Argentina.

Remarks: This is probably not a species of *Chytridiopsis* because it does not seem to have a thick-walled sporophorous vesicle and it does not clearly show a close association with the host cell nucleus. It may not be a microsporidium. It is retained provisionally in the Genus *Chytridiopsis* for a lack of a better alternative.

Chytridiopsis pachyiuli Granata, 1929

Chytridiopsis pachyiuli Granata, 1929, Atti. Soc. Tosc. Sci. Nat. (Proc. Verb.), 38, 16.

Host and Site: [MYRIAPODA] *Pachyiulus communis* (Savi); intestinal epithelium.

Lesion: No data.

Vegetative Stages: The "schizont" is situated in distal part of the cell. It liberates "schizozoites" along with secretion from the epithelium.

Sporulation Stages: Cyst oval, 10-17 x 18-25 µm; is liberated with total expulsion of the cell.

Spore: 1.8-2 µm.

Locality: Not stated, presumably Italy.

Remarks: Described very briefly and without illustrations.

Chytridiopsis schizophylli (Trégouboff, 1913) Jírovec, 1940

Chytridioides schizophylli Trégouboff, 1913, Arch, Zool. Exp. Gén. Notes Rev., 52, 25.
Chytridiopsis schizophylli (Trégouboff, 1913) Jírovec, 1940, Arch. Protistenkd., 94, 84, Figs. 1, 2.
Host and Site: [MYRIAPODA] The diplopod *Schizophyllum mediterraneum* Latzel; intestinal epithelium.
Lesion: No data.
Vegetative Stages: First stage a small (1.5 μm), spherical body within the host cell cytoplasm. This schizont grows into a multinucleate body 15-20 μm in diameter, during which it depresses the host-cell nucleus. Schizogony follows, with production of many binucleate schizozoites. These (probably morphologically similar to spores) are discharged into the gut lumen, where they are said to become amoeboid, and cause auto-infection.
Sporulation Stages: Some plasmodia become surrounded by thick-walled spherical cysts, 15-20 μm. The cyst contents divide into 2 spheres and these subdivide asynchronously to produce, eventually, spores. Early division products separated by temporary cytoplasmic partitions.
Spore: Spherical, 1.5 μm, with nucleus, "en diplocoque."
Locality: France (Banyuls-sur-mer).
Remarks: Jirovec referred to this as a species of *Chytridiopsis* without specifically indicating that he was using a new combination. Therefore, the new combination is attributed to him on the reasonable assumption that he intended to make it. In any case, the distinguishing character of *Chytriodioides*, presence of temporary cytoplasmic partitions between cells in early stages to sporogony, does not seem to constitute a compelling reason to reinstate the genus.

Chytridiopsis schneideri L. & D., 1909

Chytridiopsis schneideri L. & D., 1909, Arch. Zool. Exp. Gén. Ser. 5 Notes Rev., 1, 12.
Host and Site: [MYRIAPODA] The centipede *Lithobius mutabilis* Koch; intestinal epithelium.
Lesion: No data.
Vegetative Stages or "endogenous cycle": An endogenous cycle, as in *C. socius*, was observed.
Sporulation Stages or "exogenous cycle": Cysts spherical, 20-25 μm, some with macrospores and some with microspores.
Spores: Ovoid, with small clear vacuole.
Locality: France.
Remarks: The authors thought a new genus should be created for this species because of the 2 sizes of spores. Species described very briefly and without figures.

Chytridiopsis typographi (Weiser, 1954) Weiser, 1970

Haplosporidium typographi Weiser, 1954, Věstn. Česk. Spol. Zool., 18, 221, Figs. 2-6. Weiser, 1963, *in* "Insect Pathol." (Steinhaus, E. A., ed.), 2, 315, Figs. 6-7.

Chytridiopsis typographi (Weiser, 1954) Weiser, 1970, J. Invertebr. Pathol., 16, 439.

Host and Site: [COLEOPTERA] *Ips typographus* and *Dendroctonus pseudotsugae;* midgut epithelium.

Lesion: Illustrations show hypertrophy of infected cells.

Vegetative Stages: No data.

Sporulation Stages: Cyst spherical, 10-15 μm. containing 15-30 spores.

Spores: Spherical to broad oval, 1.5-2 μm, with "one centrally situated nucleus and a curved dark red rod attached at end to the spore wall."

Locality: Europe and British Columbia.

Remarks: Weiser (1970) said the European material (in *Ips)* and the American material (in *Dendroctonus)* "do not show major differences." The possibility that these represent 2 species, nevertheless, seems evident.

Chytridiopsis variabilis L. & D., 1909

Chytridiopsis variabilis L. & D., 1909, Arch. Zool. Exp. Gén. Ser. 5 Notes Rev., 1, 12, Fig. 2.

Host and Site: [COLEOPTERA] *Trox perlatus* L.; intestine.

Lesion: No data.

Vegetative Stages or "endogenous cycle": An endogenous cycle, as in *C. socius,* was observed.

Sporulation Stages or "exogenous cycle": "Oocysts" spherical, very variable in size, 9-16 μm.

Spores: Spherical, 2 μm.

Locality: France.

Remarks: Described very briefly and illustrated with 1 figure.

Chytridiopsis xenoboli (Ganapati & Narasimhamurti, 1960) comb. n.

Nephridiophaga xenoboli G. & N., 1960, Parasitology, 50, 581, Figs. 1-9.

Host and Site: [MYRIAPODA] The millipede *Xenobolus carnifex;* gut epithelium.

Lesion: No data.

Vegetative Stages: "Amoebulae," 4.5 x 4 μm, in the gut lumen penetrate the epithelial cells and grow into plasmodia. (Origin of the amoebulae not stated.)

Sporulation Stages: By endogenous budding, plasmodia produce uninucleate bodies presumed to be gametes. These thought to join to make zygotes with develop into spores. Cyst "a tough, thin, transparent membrane."

Spore: Spherical, 3 μm, with excentrically situated nucleus, bivalve(?).

Locality: India.

Remarks: Having had opportunity to compare slides of the type species of *Chytridiopsis*, *C. socius*, (Courtesy of R. Ormieres), and this parasite of *Xenobolus* (courtesy of C. C. Narasimhamurti), I feel that the latter is not a haplosporidian but probably a microsporidian belonging to the CHYTRIDIOPSIDAE. This one develops in close association with the host cell nucleus, a fact which was not mentioned by the authors but which represents an essential character of the CHYTRIDIOPSIDAE. I place it in the Genus *Chytridiopsis* provisionally and, because the durable cyst is relatively thin, with some hesitation. All the *Chytridiopsis*-like parasites of myriapods need further taxonomic consideration.

Family HESSEIDAE Ormières & Sprague, 1973

Genus *Hessea* Ormières & Sprague, 1973

Hessea squamosa Ormières & Sprague, 1973

Hessea squamosa O. & S., 1973, J. Invertebr. Pathol., 21, 239, Figs. 1-23.
Host and Site: [DIPTERA - SCIARIDAE] *Sciara* sp., larva; gut.
Lesion: Infected cells hypertrophied, lesion visible only microscopically.
Vegetative Stages: Binary and multiple fission of stages with paired nucli.
Sporulation Stages: A plasmodium surrounds itself with a thick-walled cyst and then, by a process of cytoplasmic partitioning, becomes divided into several binucleate sporonts. Each sporont divides into two sporoblasts, one becoming a spore and the other degenerating. Thus, the species seems to be disporoblastic-monosporous.
Spore: Spherical or oval, 1.5-2.5 µm, with polaroplast rudimentary or absent, endospore rudimentary or absent, coiled polar filament with about 3 turns. Typically (?) with 1 nucleus, sometimes 2. Many anomalous spores formed.
Cyst: Sporocyst or sporophorous vesicle spherical or oval, 10-15 µm, ornamented with a mosaic of polygonal plaques from which lamellate projections extend.
Locality: France (Sète).
Remarks: Perhaps the cyst (sporophorous vesicle) is not homologous with the pansporoblastic membrane (sporophorous vesicle) in the PANSPOROBLASTINA. It appears around a plasmodium which arises from a stage that seems to correspond to the "sporont mother cell" [Kudo, 1974a (pp. 144)] of some species and which divides into sporonts, while the pansporoblastic membrane appears around a plasmodium which arises from a sporont and divides into sporoblasts. Type species by monotypy.

Genus *Steinhausia* Sprague, Ormieres & Manier, 1972

Steinhausia mytilovum (Field, 1924)
Sprague, Ormiéres & Manier, 1972

Haplosporidium mytilovum Field, 1924, Bull. U.S. Bur. Fish for 1921-1922, 38, 220, Figs. 208-211. Vincentiis & Renzoni, 1963, Arch. Zool. Ital., 47, 21, Figs. 1-6.
Chytridiopsis mytilovum (Field, 1924) Sprague, 1965, J. Protozool., 12, 385, Figs. 1-16.
Steinhausia mytilovum (Field, 1924) S., O. & M., 1972, J. Invertebr. Pathol., 20, 231.
Host and Site: [MOLLUSCA] The mussel *Mytilus edulis* L.; ova [Field, Sprague]. *M. galloprovincialis* Lam.; ova [V. & R.].
Vegetative Stages: No data.
Sporulation Stages: Sporogonial plasmodium, within cystic membrane, develops into many spores.
Spore: Spherical or slightly elongated, about 3 μm (stained); containing large anterior "vacuole" and a pair of nuclei [Sprague].
Locality: U.S.A. (Atlantic coast) [Field, Sprague]. Italy (Gulf of Naples [V. & R.].
Remarks: Type species by original designation.

Steinhausia brachynema (Richards & Sheffield, 1971)
Sprague, Ormieres & Manier, 1972

Coccospora brachynema R. & S., 1970, SIP (Soc. Invertebr. Pathol.) Newsl., 2, 12 [*nomen nudum*]. Richards & Sheffield, 1971, Proc. IV Int. Colloq. Insect Pathol., 1970, 438, Figs. 1-29.
Steinhausia brachynema (R. & S., 1971) S., O. & M., 1972, J. Invertebr. Pathol., 20, 231.
Host and Site: [MOLLUSCA] The snail *Biomphalaria glabrata;* primarily in gut epithelium but also sometimes in adjacent tissue in hemocoel and sometimes in mantle. Similar spores were seen in *B. helophila* and *B. pfeifferi*.
Vegetative Stages: No data.
Sporulation Stages: Sporogonial plasmodia "divide into polygonal masses, one around each nucleus. These masses separate to form spherical sporoblasts up to 4 μ in diameter" [R. & S.].
Spore: Spherical, 2.6 (2-3) μm, with a single central nucleus. Everted filament about 25 μm long and terminates in spherical body. Electron microscopy shows a peculiar honeycomb-like outer layer on the internally coiled filament.
Locality: Laboratory stock derived from a cross between snails of Brazilian and Puerto Rican origin.
Remarks: The apparent presence of 1 nucleus in the spore of this species and 2 in the type species is a discrepancy needing further consideration. The effective date for the pub-

lication is 1971. The name first appeared in print as a *nomen nudum* in SIP Newsletter in 1970. The paper was presented at the IVth International Colloquium on Insect Pathology later in the same year. The proceedings of the colloquium, appeared in print in 1971, about a year after the meeting, without a publication date but showing only the date of the meeting.

Steinhausia ovicola (Léger & Hollande, 1917)
Sprague, Ormières & Manier, 1972

Chytridiopsis ovicola L. & H., 1917, C. R. Soc. Biol., 80, 62, Figs. 1-4. Sprague, 1965, J. Protozool., 12, 389.
Steinhausia ovicola (L. & H., 1917) S., O. & M., 1972, J. Invertebr. Pathol., 20, 231.
Host and Site: [MOLLUSCA] The oyster *Ostrea edulis* L.; ova.
Vegetative Stages: No data.
Sporulation Stages: Sporogonial plasmodium, within a cystic membrane, develops into 40-60 spores.
Spore: Spherical, 2.3 μm, with a peripheral nucleus surrounded by clear space. Opposite the nucleus is a vacuole enclosing a lightly stained mass.
Locality: France (Marennes).
Remarks: Léger and Hollande described the sporogonial plasmodium under the heading of "Stades vegetatifs." Possibly, as in *Chytridiopsis*, only sporulation stages occur. The authors said that the mass of spores is "sans enveloppe Kystique" but they evidently referred to the thick cystic wall of the type seen in *Chytridiopsis socius*. Sprague (1965) infers that a relatively thin and inconspicuous membrane is actually present. The report of only 1 nucleus in the spore of this species needs to be reconciled with the fact that Sprague, using the Feulgen reaction, found 2 in the type species, *S. mytilovum*.

Family BURKEIDAE fam. n.

Genus *Burkea* gen. n.

Burkea gastesi (Puytorac & Tourret, 1963) comb. n.

Coccospora gatesi P. & T., 1963, Ann. Parasitol. Hum. Comp., 38, 861, Figs. 1-14.
Host and Site: [ANNELIDA-OLIGOCHAETA] *Pheretima hawayana* and *P. californica*; longitudinal muscles of body wall.
Lesion: Cysts, spherical or ovoid, up to 1.5 mm, and surrounded by hypertrophied muscle cells, push out into the body cavity. Coelomocytes are concentrated around the cystic envelope. In addition, groups of spores not in cysts lie between the myofibrils. Some of these spores become phagocytized. Cystic envelope a distinct wall.

Vegetative Stages and Sporulation Stages not distinguished: In early stage there are relatively few nuclei in the cyst and they are highly variable in size. Later there are numerous small nuclei of the same size.

Spore: Spherical or subspherical, 2.5-3 µm, with slight depression or thin area at anterior end. Spore wall apparently a single electron-dense layer (the usual lucent layer being absent) covered by an irregularly thick mucocalyx. Polaroplast not developed but in its place are stacks of flattened Golgi vesicles. Polar filament usually coiled 9 times around the middle area of the spore contents. Posterior vacuole large and containing conspicuous inclusion body. Nucleus single.

Locality: U.S.A. (Oahu, Hawaii). Ascension Island.

Remarks: Type species by original designation. In 1961, Weiser suppressed the Genus *Coccospora* by transferring its type species to *Nosema*. Unless this genus is to be resurrected, a possibility that seems highly undesirable at present, *C. gatesi* must be removed from it. Because this species, which was rather well described, does not fit any recognized genus or family, a new genus and a new family are proposed to contain it and similar species. In the spores the contents apparently shrank away from the wall, creating artifacts in the form of an opening in the anterior part of the membrane and a large space around the contents.

Burkea eisenia sp. n.

"microsporidian" Burke, 1970, J. Invertebr. Pathol., 16, 145, Figs. 1-4.

Host and Site: ANNELIDA-OLIGOCHAETA *Eisenia foetida;* epidermis.

Lesion: A single cyst was seen. It was about 50 µm in diameter and contained numerous spores. "The presence of membrane fragments and structures resembling mitochondria between the spores, and the conformation of the cyst wall itself, suggest the infection of a single cell."

Vegetative and Sporulation Stages: No data.

Spore: Spherical, 2 µm. Wall a trilaminate membrane (not being differentiated into endospore and exospore) covered with a fibrillar substance (mucocalyx) and with a dense mass of substance on the anterior pole. Nucleus single. Polaroplast not developed but in its place are flattened cisternae and small vesicles of the Golgi apparatus. Polar filament coiled around middle portion of spore contents. Posterior vacuole large and with lipid inclusions.

Locality: U.S.A. (Massachusetts?).

Remarks: The only other species similar to this one is *B. gatesi* (Puytorac & Tourret, 1963). This one is distinguished by having slightly smaller spores that are covered with a thinner glyco-calyx, having an anterior protuberance instead of a depression, being in epidermis instead of muscle and being in a different host species.

Order MICROSPORIDA Balbiani, 1882
Suborder PANSPOROBLASTINA Tuzet, Maurand, Fize, Michel & Fenwick, 1971
Family PLEISTOPHORIDAE Stempell, 1909

Genus *Pleistophora* Gurley, 1893

Pleistophora typicalis Gurley, 1893

"Sporozoaire" Thélohan, 1891, C. R. Soc. Biol., 112, 168.
Pleistophora typicalis Gurley, 1893, Bull. U.S. Fish Com. for 1891, 11, 410. Thélohan [*partim*], 1895, Bull. Sci. Fr. Belg., 26, 361, Figs. 133-137(?).
Plistophora typicalis (Gurley, 1893) Labbé [*partim*], 1899, *in* "Das Tierreich" (O. Butschli, ed.), 5, 108. Kudo [*partim*], 1924, Ill. Biol. Monogr., 9(2/3), 167, Figs. 597, 598(?).
Host and Site: [PISCES] *Cottus scorpius;* muscles.
Vegetative Stages: Uninucleate bodies without envelopes, thought to represent the first phase of development, were 4 x 2.5-3 µm.
Sporulation Stages: Small spheres, about 15 µm in diameter, and covered with a thin transparent envelope were present. Some of these contained small protoplasmic globules, 2.5-3 µm; each of these was destined to form a spore.
Spore: Ovoid, 3 x 1.5-2 µm, with large posterior vacuole.
Locality: France (Concarneau).
Remarks: Type species by monotypy. Gurley's description was based on that which Thélohan (1891) gave for an unnamed organism. It referred specifically and only to a parasite found in *Cottus scorpius,* although later authors, beginning with Thelohan (1895) and without stated reasons, attributed parasites of various other fish hosts to the same species. It seems highly probable, in view of differences in spore size, that these species in the different hosts are not identical. Therefore, taxonomic clarity will be enhanced if we do not, until there appears to be some justification for it, consider any species other than that in the type host to be *P. typicalis.*

Pleistophora acerinae (Vaney & Conte, 1901) comb. n.

Plistophora acerinae V. & C., 1901, Ann. Soc. Linn., Lyon, 47, 105, Figs. 3, 4. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 169, Figs. 599, 600.
Host and Site: [PISCES] *Acerina cernua;* mesentery.
Lesion: Whitish, elongated masses, about 3 mm long, on mesentery.
Vegetative Stages: No data.
Sporulation Stages: Sporoblasts surrounded by a thin wall that becomes thick after spores are formed.
Spore: Ovoidal, 3 x 2 µm; polar filament 15 µm.
Locality: France (Lyon).

Pleistophora amasiae (Stammer, 1956) comb. n.

Plistophora amasiae Stammer, 1956, Proc. Int. Congr. Zool., 14, 354, Fig. 8.
Stempellia amasiae (Stammer, 1956) Weiser, 1961, Monogr. Angew. Entomol., 17, 107. Issi, 1968, Acta Protozool., 6, 351.
Host and Site: [DIPTERA-BIBIONIDAE] *Amasia funebris* Meigen, larva; fat body.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblast with 8, 16, 24 or more spores. The figure shows plainly a pansporoblastic membrane.
Spore: Egg-shaped, 4-6 x 2.5-3 µm, with posterior vacuole.
Locality: Germany (near Erlangen).
Remarks: The original figure shows 3 spore clusters, each distinctly enclosed within a pansporoblastic membrane. One consists of about 16 spores, another probably contains about 64 spores, and the third probably contains a few hundred spores. The author said nothing about frequency. There is no evident reasons why this species should be excluded from Genus *Pleistophora* or assigned to *Stempellia*. Probably this taxon has not been properly established because the name was not "accompanied by a statement that purports to give characters differentiating the taxon" ["International Code of Zoological Nomenclature," Art. 13 (see Stoll, 1961)].

Pleistophora anguillarum (Hoshina, 1951) comb. n.

Plistophora anguillarum Hoshina, 1951, J. Tokyo Univ. Fish., 38, 35, text figs. 1-4, Pls. 1, 2.
Host and Site: [PISCES] *Anguilla japonica;* trunk muscles.
Vegetative Stages: Multiplication by binary fission.
Sporulation Stages: Cysts within the muscles contain numerous sporonts. Each sporont in the cyst produces ordinarily 4 or 8 sporoblasts but sometimes produces 2, 3, 5, 6, 7, 9, 16 or, in the case of microspores, one sporont generally produces 16 spores or more.
Spore: Ovoid, one side somewhat concave. Macrospores 7.9 x 4.5 µm; microspores 3.6 x 2.5 µm (fresh). Polar filament 400-440 µm.
Locality: Japan (near Odawara).

Pleistophora blattae (Weiser, 1961) comb. n.

Plistophora sp. Mercier, 1908, Arch. Protistenkd., 11, 374, Figs. 1-16. Kudo, 1924, Ill. Biol. Monogr. 9(2/3), 178, Figs. 633-638. Debaisieux, 1927, C. R. Acad. Sci., 94, 1406.
[*non*] *Pleistophora periplanetae* (Lutz & Splendore, 1903) Perrin, 1905, Proc. Camb. Phil. Soc., 13, 204.
Pleistophora periplanetae (L. & S., 1903) *sensu* Georgévitch [*partim*], 1927, Arch. Zool. Exp. Gén., 66, 1, Figs. 1-42, 95-97.
Plistophora blattae Weiser, 1961, Monogr. Agnew. Entomol., 17, 56.
[?] *Nosema periplanetae* L. & S., 1903, *sensu* Selmair, 1962, Arch Mikrobiol., 43, 292.

Host and Site: [BLATTARIA] *Blatta orientalis;* fat body [Mercier]. *Blatella germanica;* fat body [Selmair].

Lesion: The infected fat body becomes greatly hypertrophied, causing noticeably distended abdomen. It appears white through the transparent abdominal tissues between the chitinous rings. Normal and abnormal mitosis was seen in cells of infected tissue. Since mitosis does not normally occur in fat body cells of adult insects, the condition was called neoplasia.

Vegetative Stages: Small meronts, 2-3 μm in diameter, after an active period of multiplication grow into plasmodia. Around each nucleus a small cytoplasmic area individualizes.

Sporulation Stages: "le meront devient ainsi un sporonte puis un pansporoblast. Le numbre des spores contenues dans ce dernier est variable, il est tojours superior à huít" [Mercier]. At maturity the thin membrane of the pansporoblast ruptures and the spores disperse in the tissue.

Spore: Ovoid, 5-6 x 2.53 μm. A spiral filament was demonstrated.

Locality: France.

Remarks: Mercier's description of the sporulation stages is rather vague. Thus, the parasite he studied is not clearly a species of *Pleistophora.* A parasite with superifically similar spores was discovered in the lumen of the Malpighian tubules of *Periplaneta americana* by Lutz and Splendore (1903) and named *Nosema periplanetae.* This species and/or similar ones have been studied later by many authors under various generic names (*Nosema, Pleistophora, Coelosporidium, Peltomyces, Plistophora, Nephridiophaga*). All these authors found spores with internal structure showing no resemblance to that of microsporidian spores. Woolever (1966), after an electron microscope study, concluded that these nonmicrosporidian spores belong to Protozoa of the Genus *Nephridiophaga.* One author, Georgévitch (1927), studying these parasites in the Malpighian tubules, saw among them some microsporidian spores, and considered *N. periplanetae* to be a microsporidian. Debaisieux (1927) concluded that Georgévitch saw in his smears a mixture which included some spores of the microsporidian parasites reported by Mercier. Only by adopting the view of Debaisieux and, furthermore, concluding that no microsporidia have yet been demonstrated in the Malpighian tubules of cockroaches can we explain why only Georgévitch, of all authors who studied the parasites of the Malpighian tubules, saw some spores with polar filament. A conclusion needing to be more clearly stated is that *Nosema periplanetae* L. & S., 1903, better known as *Pleistophora periplanetae* (L. & S., 1903), is not one of the microsporidia. Selmair recognized microsporidia in the fat body of *Blatella germanica* and, without describing them, tentatively identified them as *N. periplanetae* L. & S. We must conclude that this author saw *P. blattae* or a similar species.

Pleistophora bohemica (Weiser, 1946) Arvy & Peters, 1976

Plistophora bohemica Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 254, Fig. 7. Weiser, 1961, Monogr. Angew. Entomol., 17, 51.
Pleistophora bohemica (Weiser, 1946) Arvy & Peters, 1976, Ann. Parasitol. Hum. Comp., 51, 127.
Host and Site: [EPHEMEROPTERA] *Cloeon rufulum* Müll., larva; site not stated.
Vegetative Stages: Like the species in larvae of Simuliidae, large nuclei in mitosis appear doing schizogony.
Sporulation Stages: Uninucleate sporonts grow into 10-15 nucleate plasmodia. Ripe pansporoblasts measure 15-30 x 15-25 μm.
Spore: Regularly oval, 6-7 x 2-3 μm, showing a small posterior vacuole when fresh. Polar filament up to 100 μm and somewhat thickened in the basal part.
Locality: Czechoslovakia (near Chotěboř).
Remarks: Most of the data are from Weiser's (1961) monograph, since the original description is in Czech.

Pleistophora bufonis (King, 1907) Canning, manuscript

Bertramia bufonis King, 1907, Proc. Acad. Nat. Sci. Phila., 59, 273, Figs. 1-31.
[?] *Plistophora bufonis* Guyênot & Ponse, 1926, C. R. Soc. Biol., 94, 3. Guéynot & Ponse, 1926, Rev. Suisse Zool., 33, 213-250, Pl. 1 + 6 textfigures. Jírovec, 1936, Věstn. Česk. Spol. Zool., 4, 62. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 51.
Host and Site: [AMPHIBIA] *Bufo lentiginosus;* in ova of Bidder's organ [King]. *Bufo vulgaris* [G. & P.].
Vegetative Stages: Reproduction by repeated binary fission [King].
Sporulation Stages: A merozoite develops into a sporogonial plasmodium that divides into at least 30 sporoblasts within a cyst. Each sporoblast develops into a spore [King].
Spore: Ends oval, the middle region with a slight constriction, about 3 x 1.5 μm [King]. Macrospores 4-4.5 μm [G. & P.].
Locality: U.S.A. (New York). Switzerland [G. & P.].

Pleistophora caecorum (Chapman & Kellen, 1967) Clark & Fukuda, 1971

Plistophora caecorum C. & K., 1967, J. Invertebr. Pathol., 9, 500 Figs. 1-20.
Pleistophora caecorum (C. & K., 1967) C. & F., 1971, *ibid.*, 18, 400.
Host and Site: [DIPTERA-CULICIDAE] *Culiseta inornata,* larva and adult; caeca.
Vegetative Stages: Reproduction by multiple fission of spherical plasmodia.
Sporulation Stages: Pansporoblast produces many sporoblasts (Figs. 12-15 show some of them uninucleate and some binucleate).

Spore: Cylindrical, 4.03 x 1.44 μm, uninucleate?, polar filament at least 10 times as long as the spore.
Locality: U.S.A. (Louisiana).

Pleistophora californica (Steinhaus & Hughes, 1949) comb. n.

Plistophora californica S. & H., 1949, J. Parasitol., 35, 71, Fig. 2, Pl. G. Weiser, 1961, Monogr. Angew. Entomol., 17, 95. Kudo & Daniels, 1963, J. Protozool., 10, 112, Figs. 1-14.
Host and Site: [LEPIDOPTERA] The potato tuberworm *Gnorimoschema operculella* (Zeller), larva; mainly in fat body and Malpighian tubules but also in most other tissues. Several other insect species were experimentally susceptible: [LEPIDOPTERA] *Colias philodice eurytheme* Bdvl., *Phryganidia californica* Pack., *Danaus plexipus* Linn., *Macrocentrus ancylivorus* Roh., *Perisierola emarginata* Roh., *Cremastus flavoorbitalis* Cameron, *Carpocapsa pomonella* (Linn.), *Vanessa carye* (Hüb.). [HYMENOPTERA] *Copidosoma koehleri* Blanchard. [NEUROPTERA] *Chrysopa californica* Coq.
Vegetative Stages: Not definitely identified.
Sporulation Stages: Sporogonial plasmodia produce variable number of sporoblasts. As few as 4 or more than 100 spores may be formed in a "packet" or "bundle." Groups of 8 common, 16 most common, over 100 not unusual. Presence of a pansporoblastic membrane could not be determined.
Spore: "The spores are fairly uniform in shape" [ellipsodial or slightly ovoidal in the figures]; 1.5-3 x 0.8-1.2 μm, 2 x 1 μm average" [S. & H.].
Locality: U.S.A. (California).
Remarks: Because of the highly variable number of spores that develop from the sporont, Steinhaus and Hughes conclude, "it would appear that the genus *Plistophora* is in need of revision to more adequately embrace such species as *P. kudoi* Sprague & Ramsey and the one here described."

Pleistophora cargoi (Sprague, 1966) Sprague, 1970

Plistophora cargoi Sprague, 1966, J. Protozool., 13, 196, Figs. 1-15.
Pleistophora cargoi (S., 1966) Sprague, 1970, *in* "Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), p. 425.
Host and Site: [DECAPODA] The crab *Callinectes sapidus* Rathbun; muscles.
Vegetative Stages: No data.
Sporulation Stages: "Sporont gives rise to a variable number of binucleate [?] sporoblasts (32 - over 100), each of which develops into a spore" [S., 1966].

Spore: Generally ellipsoidal, 3.3 x 5.1 µm (life); polar filament about 80 µm, unevenly thick throughout most of its length but narrowing abruptly to a short terminal portion. The nucleus, in Feulgen preparations, usually appeared single and elongated, sometimes double.
Locality: U.S.A. (vicinity of Solomons Island, Maryland).
Remarks: The statement that the sporoblast is binucleate was probably based on insufficient evidence. Now, after looking again at the slides, it is by no means certain that the "binucleate sporoblasts" were not an earlier stage showing division (sporogony). The overwhelming impression now is that sporulation stages are typically mononucleate.

Pleistophora carpocapsae Simchuk & Issi, 1975

Pleistophora carpocapsae S. & I., 1975, Parazitologiya (Leningr.), 9, 293, Figs. 1-26.
Host: [LEPIDOPTERA] *Carpocapsa pomonella* L., larva and pupa.
Vegetative Stages: Merogony by multiple fission, a first sequence with small nuclei and a second sequence with large nuclei.
Sporulation Stages: A sporont forms pansporoblasts containing 4-64 sporoblasts and these develop into spores.
Spore: 2.25 x 1.05 µm.
Locality: U.S.S.R. (Moldavia).

Pleistophora centroptili (Weiser, 1946) Arvy & Peters, 1976

Plistophora centroptili Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 253, Fig. 6. Weiser, 1961, Monogr. Angew. Entomol., 17, 51.
Pleistophora centroptili (Weiser, 1946) Arvy & Peters, 1976, Ann. Parasitol. Hum. Comp., 51, 126.
Host and Site: [EPHEMEROPTERA] *Centroptilum luteolum* Müll. and *Cloeon dipterum* L., larva; fat body.
Vegetative Stages: Ellipsoidal stages, 5-6 µm broad, develop during schizogony. They break up into uninucleate meronts which grow to threads with 2-4 nuclei. These are 8 x 3 µm. From them arise diplocarya and young sporonts.
Sporulation Stages: Sporogonial plasmodium has 12-15 nuclei. The "sporonts" [sporoblasts?] pinch off the protoplasmic mass like fingers. Spores lie on one another in the pansporoblast.
Spore: Oval, 4.5 x 2-3 µm.
Locality: Czechoslovakia (near Chotěboř).
Remarks: Because of some ambiguity in the description, it is not clear that a pansporoblastic membrane (an essential character of *Pleistophora)* is present in this species. Most of the data are taken from Weiser's (1961) monograph, since the original description is in Czech.

Pleistophora cepedianae (Putz, Hoffman & Dunbar, 1965) Rogers & Gaines, 1975

"Microsporidia" Bangham, 1941, Ohio J. Sci., 41, 443.
Plistophora cepedianae P., H. & D., 1965, J. Protozool., 12, 3, Figs. 1, 2, 4-11, 23. Putz & McLaughlin, 1970, *in* "A Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), p. 125, Fig. 1.
Pleistophora cepedianae (P. H. & D., 1965) R. & G., 1975, *in* "The Pathology of Fishes" (W. E. Ribelin & G. Migaki, eds.), pp. 128.
Host and Site: [PISCES] *Dorosoma cepedianum* (Le Suer); visceral cavity.
Lesion: One large cyst fills the visceral cavity and protrudes from it. Visceral organs compressed. Spores may escape from the cyst into the body cavity. No host reaction around the cyst.
Vegetative Stages: Schizonts cylindrical, straight or "C"-shaped, 35 x 3.3 µm, with variable number of nuceli, with a "cup-structure" at one end. Schizogony produces binucleate bodies.
Sporulation Stages: Sporont, uninucleate, develops into plasmodium which divides into 6-20 uninucleate sporoblasts.
Spore: Pyriform, 4.9 x 2.3 µm (preserved), with anterior and posterior vacuoles.
Locality: U.S.A. (Ohio).

Pleistophora chaobori (Rapsch, 1950) Clark & Fukuda, 1971

Plistophora chaobori Rapsch, 1950, Z. Parasitenkd., 14, 429, Figs. 1-4. Weiser, 1961, Monogr. Angew. Entomol., 17, 116, Fig. 54.
Pleistophora chaobori (Rapsch, 1950) C. & F., 1971, J. Invertebr. Pathol., 18, 400.
Host and Site: [DIPTERA-CHAOBORIDAE] *Chaoborus crystallinus* de Geer, larva; under the gut and in the epidermis.
Lesion: White spheres, 0.5-1 mm were visible. In the epidermis were white specks.
Vegetative Stages: Only oval multinucleate stages [Weiser (1961)].
Sporulation Stages: The number of spores developing within the pansporoblastic membrane ("sporoblasten-Membran") is highly variable between 3 and about 60 [Rapsch].
Spore: Ovoid, 6.5 x 4 µm, with distinct vacuole in broad end.
Locality: Germany (Braunschweig) [Rapsch]. Czechoslovakia (near Prague) [Jirovec & Weiser *in* "Weiser , 1961,]. "Monogr. Angew. Entomol."
Remarks:
Rapsch described and illustrated a pansporoblastic ("sporoblast") membrane, although neither the description nor the

photograph given by Weiser indicates that a membrane is present. Perhaps this is not a species of *Pleistophora*.

Pleistophora chironomi (Debaisieux, 1931) comb. n.

Plistophora chironomi Debaisieux, 1931, C. R. Soc. Biol., 107, 914, Figs. 3, 4. Jírovec, 1936, Vestn. Cesk. Spol. Zool., 4, 62. Weiser, 1943, Zool. Anz., 141, 255, Abb. 1-figs. 1-30, Abb. 2-figs. 1-13. Weiser, 1947, Acta Soc. Sci. Nat. Morvaciae, 18, 40. Thomson, 1960, J. Insect Pathol., 2, 364. Weiser, 1961, Monogr. Angew. Entomol., 17, 121.

Host and Site: [DIPTERA-CHIRONOMIDAE] *Chironomus* sp., larva; fat body [Debaisieux]. *Camptochironomus tetans*, larva; fat body [Weiser (1943)].

Lesion: The parasitic mass extends throughout the body cavity, forming compact tumors that are often in irregular layers.

Vegetative Stages: Conet (1932), using the same materials as Debaisieux, found that the uninucleate germ gives rise by successive nuclear divisions to first and second order diplocarya, the later being copulae that becomes zygotes. Thus, at least four zygotes arise from each germ.

Sporulation Stages: The zygote divides successively to produce 16, more or less, sporoblasts in rosette formation or in a moruliform mass [Conet]. Sporoblasts arise as digitiform projections from the plasmodium and remain attached together by the residual protoplasm until their ripening [Weiser].

Spores: Oval, 6.5-7.5 x 3.5-4 µm in life; with anterior and posterior vacuoles and internally visible filament [Debaisieux]. Oval, 6.7 x 4-4.5 µm [Weiser].

Locality: Origin unknown. Larvae obtained from market (presumably in Belgium) that supplied them for fishing [Debaisieux]. Vicinity of Plön, Germany [Weiser].

Remarks: This species may not have a pansporoblastic mambrane, in which case it does not belong to the Genus *Pleistophora*. It does not seem to belong to any other established genus and to transfer it to the collective group would involve difficulties because I found it necessary to propose the combination *Microsporidium chironomi* (Voronin, 1975). To avoid difficult nomenclatural problems, I shall provisionally consider this as *Pleistophora chironomi* (Debaisieux, 1931).

Pleistophora collessi (Laird, 1959) Clark & Fukuda, 1971

Plistophora collessi Laird, 1959, J. Protozool., 6, 37, Figs. 1-20. Thomson, 1960, 1960, J. Insect Pathol., 2, 364. Weiser, 1961, Monogr. Angew. Entomol., 17, 114.

Pleistophora collessi (Laird, 1959) C. & F., 1971, J. Invertebr. Pathol., 18, 400.

Host and Site: [DIPTERA-CULICIDAE] *Culex tritaeniorrhynchus* Giles [type host] and *C. gelidus* Theobald, adult; egg follicle.

Lesion: Causes degeneration of the oocyte, nurse cells and epithelium of the invaded follicle, within the distended limiting membrane of which a spherical cyst is formed. Cysts, 45-340 (av. 220) μm, white and opaque.

Vegetative Stages: Meront produce 4, 8 or (rarely) 16 merozoites. "Some of the latter ultimately initiate sporont formation" [Laird].

Sporulation Stages: Sporogonial plasmodium contains up to 300 (av. 200) nuclei. Each nucleus with a surrounding bit of cytoplasm becomes a sporoblast. The nucleus of each sporoblast divides and the young spore is binucleate; autogamy then occurs and the mature spore becomes uninucleate [?].

Spore: Oval, 2.2-2.9 x 1.2-1.7 (av., 2.5 x 1.4) μm; binucleate when young, becoming uninucleate by autogamy. Polar filament 15-20 μm.

Locality: Malaya (Singapore).

Pleistophora culicis (Weiser, 1947) Clark & Fukuda, 1971

Plistophora kudoi Weiser, 1946, Vestn. Cesk. Spol. Zool., 10, 261, Fig. 10.

[*non*] *Plistophora kudoi* Sprague & Ramsey, 1941, Anat. Rec., 81, 132

Plistophora culicis Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 37 [incorrect date (1945) cited]. Garnham, 1956, W.H.O. Bull., 15, 846, Figs. A,B. Lainson & Garnham, 1957, Trans. Roy. Soc. Trop. Med. Hyg., 51, 6. Canning, 1957, *ibid.*, 8. Canning, 1957, Riv. Malariol., 36, 39, Figs. 1-30. Bano, 1958, Nature (Lond.), 181, 430. Thomson, 1960, J. Insect Pathol., 2, 364. Weiser, 1961, Monogr. Angew. Entomol., 17, 115. Reynolds, 1966, Nature (Lond.), 210, 967. Reynolds, 1970, Bull. Entomol. Res., 60, 339. Weiser, 1971, SIP (Soc. Invertebr. Pathol.) Newsl. 3, 25. Weiser & Coluzzi, 1972, Folia Parasitol. (Prague), 19, 202, Figs. 1-8.

Plistophora culisetae Weiser & Coluzzi, 1964, Riv. Malariol., 43, 51, Figs. 1-3. Weiser & Coluzzi, 1966, *in* "Proceedings of the First International Congress of Parasitology" (A. Corradetti, ed.), p. 596.

Pleistophora culicis (Weiser, 1947) C. & F., 1971, J. Invertebr. Pathol., 18, 400.

Host and Site: [DIPTERA-CULICIDAE] *Culex pipiens* [type host] larva; Malpighian tubules. Also *C. fatigans, Anopheles gambiae, A. stephensi, A. albimanus, Culiseta longiareolata;* gut, fat body, connective tissue, exceptionally gonad [various authors, summarized by Weiser & Coluzzi (1972)]. Hazard and Chapman, W.H.O. Bull. (in press) list also: *Aedes aegypti* L., *A. triseriatus* (Say), *Anopheles dureni* Edwards, *A. franciscanus* McCracken, *Culex salinarius* Coquillet, and *C. territans* Walker.

Vegetative Stages: Reproduction by multiple fission that is repeated. The final uninucleate products initiate the sporulation sequence.
Sporulation Stages: Sporont develops into a sporogonial plasmodium that produces many spores [up to 60 (Weiser, 1946), 8-100 (Canning)].
Spore: Oval, 4 x 2.5 μm [Weiser, 1946]. Macrospores 5.1 x 3.7 μm in smears; microspores 3.7 x 2.2 μm when fresh and 4.0 x 2.6 μm in smears [Canning]. In *Culiseta longiareolata* spores 3.8-4.8 x 2.4 μm; in *A. gambiae* macrospores 5.9 x 3.7 μm [Weiser & Coluzzi (1972)].
Locality: Czechoslovakia. England. Italy.
Remarks: The name *Plistophora culicis* was apparently used for the first time by Weiser in 1947, as a replacement name for *P. kudoi* Weiser, 1946, preoccupied. However, the date 1945 was incorrectly given with this name. There has been a confusion of dates since that time.

Pleistophora cyclopis (Leblanc, 1930) comb. n.

Plistophora cyclopis Leblanc, 1930, Ann. Soc. Sci. Bruxelles (Ser. B), 59, 274, Figs. 6-8. Jírovec, 1936, Věstn. Česk. Spol. Zool., 4, 62.
Host and Site: [COPEPODA] *Cyclops albidus*. Site not mentioned.
Vegetative Stages: No data.
Sporulation Stages: Spores irregularly grouped in packets of about 20.
Spores: Regularly conical with rounded ends, 7-8 x 3 μm (fresh), mostly pyriform when stained.
Locality: Belgium (vicinity of Liège).

Pleistophora dallii (Zhukov, 1962) comb. n.

Plistophora dallii Zhukov, 1962, [*fide* Shulman *in* "Key to Parasites of Freshwater Fish of the U.S.S.R.," (Pavlovskii, ed.), p. 162]. Shulman, *loc. cit.*, Fig. 310. Lom & Weiser, 1969, Folia Parasitol. (Prague), 16, 197.
Host and Site: [PISCES] "Alaska blackfish"; in subcutaneous connective tissue at base of fins.
Lesion: "Cysts visible with naked dye, apparently formed from one hypertrophied cell" [Shulman].
Vegetative Stages: No data in sources consulted.
Sporulation Stages: "Over 16 spores formed from pansporoblast" [Shulman]. "Spores of *Plistophora dalli* are formed in typical *Plistophora* pansporoblasts, yet are glued together in pairs" [L. & W.].
Spore: "Length of spore over 6 μ ..., length 3.9-5.5, width 2.2 μ" [Shulman].
Locality: U.S.S.R. ("Chukotka waters").
Remarks: Not having access to the original publication, I was unable to verify the spelling of the name (*dallii* or *dalli?*) and

the length of the spore (over 6 μm or 3.9 μm?). This species seems to be like *Glugea* in producing a cell hypertrophy tumor but like *Plistophora* in producing spores within pansporoblastic membranes.

Pleistophora daphniae (Weiser, 1945) comb. n.

Plistophora daphniae Weiser, 1945, Acta Soc. Sci. Nat. Moravicae, 17, 6. Weiser, 1947, *ibid.*, 18, 23.
Host: [CLADOCERA] *Daphnia pulex.*
Spore: Ellipsoidal, 5-6 x 2-2.5 μm.
Locality: Czechoslovakia (Chotěboř).
Remarks: This species was briefly described in the Czech language.

Pleistophora destruens Delphy, 1916

Pleistophora destruens Delphy, 1916, C. R. Acad. Sci., 163, 72-73, Figs. 1, 2.
Plistophora destruens (Delphy, 1916) Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 179.
Host and Site: [PISCES] *Migul auratus;* muscles.
Lesion: Infected muscle degenerating, posterior part of host body bent.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblasts yellowish-orange to yellowish-ochre, with persistent membrane.
Spore: Ovoid, subpyriform 2.5-3.5 x 1.5-2.5 μm. Polar filament 10-12 times as long as the spore.
Locality: France (Tatihou).

Pleistophora dixipi (Purrini & Weiser, 1975) comb. n.

Plistophora dixipi P. & W., 1975, Anz. Schädlingskd. Pflanzen-Umweltschutz., 48, 40, Figs. 1-3.
Host and Site: [ORTHOPTERA] *Bacillus rossi* F.; ovary.
Vegetative Stages: No data.
Sporulation Stages: Sporont with diplocaryon develops into sporogonial plasmodium that produces a variable number of uninucleate sporoblasts and then develop into a variable number of spores.
Spore: Long-oval in three size classes: 3.5 x 2.4 μm, 4.7 x 2.5 μm, 6.0 x 0.3 μm. All spores from one pansporoblast belong to one size class. Spore uninucleate.
Locality: France (Paris).

Pleistophora ehrenbaumi (Reichenow, 1929) Rogers & Gaines, 1975

Plistophora ehrenbaumi Reichenow, 1929 [*fide* Doflein-Reichenow, 1953, "Lehrbuch der Protozoenkunde," 6th ed., p. 1026]. Doflein-Reichenow, 1953, *loc. cit.*, also pp. 1007, 1008, and Fig. 1013. Claussen, 1936, Dtsch. Tierarztl. Worchenschri. 44, 307 [*fide* Doflein-Reichenow, 1953, *loc. cit.*, and pp. 1074].

Pleistophora ehrenbaumi (Reichenow, 1929) R. & G., 1975, *in* "The Pathology of Fishes" (W. E. Ribelin & G. Migaki, eds.), pp. 128.
Host and Site: [PISCES] *Anarrhichas lupus;* musculature. Also *A. minor* [Claussen].
Lesion: Causes a large swelling from the size of a walnut to the size of a fist. The muscle bundles in the lesion become displaced or destroyed and the area filled with spores. No host reaction is evident. In *A. minor,* Claussen found a large swelling with smaller ones near by.
Vegetative Stages: No data in source consulted.
Sporulation Stages: Pansporoblasts with few spores usually contained 4, 8 or 16. When many spores were present the number was highly variable.
Spore: Morphologically similar to that in *P. longifilis* Schuberg. Size highly variable and inversely related to the number in the pansporoblast, 3 x 1.5-7.5 x 3.5 µm. Polar filament 120-300 µm.

Pleistophora elegans (Auerbach, 1910) comb. n.
Plistophora elegans Auerbach, 1910, Zool. Anz., 36, 441 [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 186, Figs. 612].
Host and Site: [PISCES] *Abramis brama X Leuciscus rutilus;* connective tissue and ova.
Vegetative Stages: Meronts, multinucleate at certain stages, abundant in connective tissue. Young stages carried by blood.
Sporulation Stages: Sporulation only in ova.
Spore: Elongate narrow, 10 x 4 µm. Binucleate [?].
Locality: Germany (Karlsrhue).
Remarks: The description is so incomplete that one cannot judge whether the generic assignment is correct.

Pleistophora enterobia (Stammer, 1956) comb. n.
Plistophora enterobia Stammer, 1956, Proc. Int. Congr. Zool., 14, 353, Fig. 7. Weiser, 1961, Monogr. Angew. Entomol., 17, 107.
Host and Site: [DIPTERA-BIBIONIDAE] *Bibio varipes* Meigen and *B. clavipes* Meigen, larva; epithelial cells of intestinal ceca.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblasts produce 12, 16 or 24 spores.
Spore: Oval, 2-3 x 1.5-2 µm.
Locality: Germany (Erlangen).
Remarks: Probably this taxon has not been properly established because the name was not "accompanied by a statement that purports to give characters differentiating the taxon ["International Code of Zoological Nomenclature," Art. 13 (see Stoll, 1961)].

Pleistophora fidelis (Hostounský & Weiser, 1975) comb. n.

Plistophora fidelis H. & W., 1975, Věstn. Česk. Spol. Zool., 39, 108, Fig. 2, Pls. IB and IIB.
Host and Site: [COLEOPTERA] *Polygramma undecimlineata* Stal.; epithelium of midgut. Experimental host *Leptinotarsa decemlineata* (Say).
Vegetative Stages: First schizont rounded, multinucleate form. Merozoite develops into ribbons of second schizont which divide into merozoites.
Sporulation Stages: Sporogonial plasmodia with nonpersistent membranes, produce numerous uninucleate sporoblasts that develop into spores.
Spore: Oval, 2-2.5 x 1-1.2 μm, uninucleate.
Locality: Cuba.

Pleistophora gadi (Poljansky, 1955) comb. n.

Plistophora gadi G. Poljansky *in* Yu. I. Poljansky, 1955, Tr. Zool. Inst. Akad. NAUK SSSR, 19, 33, Fig. 13. Shulman, 1962 *in* "Keys to Parasites of Freshwater Fish of the U.S.S.R.," (Pavlovskii, ed.), p. 80, 135.
Host and Site: [PISCES] The "Atlantic cod"; muscles.
Lesion: Large tumors, 0.5-0.8 cm diameter, are filled with pansporoblasts.
Developmental Stages: Pansporoblasts, 18-23 μm in diameter, contain large numbers of spores.
Spore: Ovate, slightly narrowed at anterior pole, 5.4-7.2 x 2.7-3.6 μm. Large vacuole in larger part.
Locality: U.S.S.R. (Barents Sea).

Pleistophora geotrupina (Lipa, 1968) comb. n.

Plistophora geotrupina Lipa, 1968, Acta Protozool., 6, 341, Figs. 1-13.
Host and Site: [COLEOPTERA] The dung beetle *Geotrupes stercorarius* L., *G. stercorosus* Scriba, *G. vernalis* L.; fat body, intestine, Malpighian tubules.
Vegetative Stages: Plasmodial forms with as many as 50 nuclei were seen.
Sporulation Stages: Development of spores in the pansporoblast is asynchronous.
Spore: Ellipsoidal, 5.5-8 x 3.9-5 μm (stained with Giemsa).
Locality: Poland (Bialowieza, Gola, Janówka, Puszczykowo).

Pleistophora heteroica (Moniez, 1887) Canning, manuscript

"Corps oscillants" Vlacovich, 1867, Atti Ist. Veneto, Ser. 3, 11, 5 [*fide* Labbé, 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 109].

Nosema heteroica Moniez, 1887, C. R. Acad. Sci., 104, 1313.
Plistophora heteroica (Moniez, 1887) Labbé, 1899, *loc. cit.*
"Gen. incert." *heteroica* (Moniez, 1887) Kudo., 1924, Ill. Biol. Monogr., 9(2/3), 196.
Host: [REPTILIA] *Coluber carbonarius (Zamenis gemonesis).*
Vegetative Stages: No data.
Sporulation Stages: Spherical vesicles with 8, 16, 64 and more spores [Labbé].
Spore: Ovoid, 6-7 x 2-3 µm, with a clear terminal vacuole [Labbé].
Locality: Italy.

Pleistophora hippoglossoideos Bosanquet, 1910

Pleistophora hippoglossoideos Bosanquet, 1910, Zool. Anz., 35, 434, Figs. 1-6.
Plistophora hippoglossoideos (Bosanquet, 1910) Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 175, Figs. 619-622. Kabata, 1959, Parasitology, 49, 313.
Host and Site: [PISCES] *Hippoglossoides limandoides;* muscle. *(Drepanopsetta hippoglossoides* Gill is the name used by Kabata, apparently a synonym.)
Lesion: "Cysts" in the form of oblong structures with rounded edges, closely packed, sometimes in large numbers, up to 10 x 2.5 mm, appear on the wall of visceral cavity on both sides of the host [Kabata]. Seen by Bosanquet (in fin muscle that he received in paraffin) as small whitish nodules. The nodules were made up of masses of cysts, measuring 20-25 µ in diameter.
Vegetative Stages: No data.
Sporulation Stages: Uninucleate forms (sporonts?), plasmodia, cysts containing uninucleate sporoblasts and cysts containing numerous spores were seen [Bosanquet].
Spore: Oviform or pyriform, 3.7 x 2.2 µm [Kabata]. 3.5 x 3 µm [Bosanquet].
Locality: Kabata found this species widely distributed over the northern North Sea. The origin of Bosanquet's material, received from Dr. Woodcock, is uncertain.

Pleistophora husseyae (Michelson, 1963) comb. n.

Plistophora husseyi Michelson, 1963, J. Insect Pathol., 5, 28, Figs. 1-12.
Plistophora husseyae Michelson, 1963, emend. Becker & Pauley, 1968, J. Invertebr. Pathol., 12, 434.
Host and Site: [MOLLUSCA-GASTROPODA] Aquatic pulmonate snails. Natural infection in *Physa* sp.; experimental infections in *P. heterostropha* Say, *Aplexa hypnorum* (L.), and *P. cubensis* Pfeifer. All organs and tissues excepting the radular cartilage.

Vegetative Stages: Binucleate schizonts seen. Plasmodia with 4, 8 (usually) or as many as 32 nuclei undergo multiple fission to produce merozoites.
Sporulation Stages: Some merozoites develop into plasmodia, with 16-60 or more nuclei, which undergo sporogony to produce sporoblasts within a pansporoblastic membrane.
Spore: Reniform or egg-shaped, 4.8-5.4 x 3.2 μm, with prominent posterior vacuole (fresh). Polar filament 32-65 μm.
Locality: U.S.A. [*Physa* sp. from near New Orleans, Louisiana. *Physa cubensis* from St. Crois, Virgin Islands, and the other 2 from Boston, Massachusetts (U.S.A.)].

Pleistophora hyperparasitica (Codreanu, 1967) Arvy & Peters, 1976

Plistophora hyperparasitica Codreanu, 1967, Protistologica, 3, 351.
Pleistophora hyperparasitica (Codreanu, 1967) Arvy & Peters, 1976, Ann. Parasitol. Hum. Comp., 51, 135.
Host and Site: [GREGARINIDA] Hyperparasite of the gregarine *Enterocystis rhithrogenae* M. Codreanu, 1940, in nymphs of the ephemerid insect *Rhithrogena semicolorata* (Curt.); in cytoplasm; suppresses gamogony.
Vegetative Stages: No data.
Sporulation Stages: Spores grouped by 8 or more in rosettes.
Spore: Pyriform, about 2.6 μm long; macrospores 4 μm.
Locality: Roumania (Sinaia).
Remarks: Very briefly described without figures. The data given are inadequate for judging the accuracy of the generic determination. The new name combination is used here only to satisfy the Law of Priority, with no implication that the organism is thought to be correctly classified.

Pleistophora hyphessobryconis (Schäperclaus, 1941) Rogers & Gaines, 1975

Plistophora hyphessobryconis Schäperclaus, 1941, Wochenschr. Aquarien Terrareinkunde 39/40, 381, Figs. 6-8. Schaperclaus, 1954, "Fischkrankheiten," 373, Figs. 197-202. Lom & Vávra, 1961, Wiad. Parazytol., 7, 838, 1 fig. Steffens, 1962, Z. Parasitenkd., 21, 535, Figs. 1-4. Lom & Corliss, 1967, J. Protozool., 14, 141, Figs. 1-24. Lom & Weiser, 1969, Folia Parasitol. (Prague), 16, 196. Lom, 1969, J. Protozool., 16 (Suppl.), 17.
Ichthyosporidium sp. Porter & Vinall, 1956, Proc. Zool. Soc. Lond., 126, 397, Figs. 1-16.
Pleistophora hyphessobryconis (Schäperclaus, 1941) R. & G., 1975, *in* "The Pathology of Fishes" (W. E. Ribelin & G. Migaki, eds), pp. 130.

Host and Site: [PISCES] The neon fish *Hyphessobrycon innesi* Myers [type host]; primarily in muscles but also in many other tissues. Other hosts: *H. flammeus, H. cardinalis, H. c. callistus, H. heterorhabdus, H. rosaceus, Hemigrammus erythrozonus, H. ocellifer, H. pulcher, Hasemania marginata, Brachydanio rerio, B. nigrofasiatus, Puntius lineatus, Carassius auratus, Phoxinus phoxinus, Xiphophorus helleri, Apistogramma reitzigi* [Steffens]; *Cyprinis carpio, Tinca tinca* [experimental, Lom].
Lesion: Appears "as individual pansporoblasts distributed throughout the muscular fibers [in the type host], or as large tumor-like cysts in the body cavity and in the organs, particularly in the mesentery" [L. & W.].
Developmental Stages: Pansporoblasts 26-33 μm in diameter, produce many spores within a distinct pansporoblastic membrane.
Spore: Oval, 5-6 x 3.3 μm.
Locality: Germany and many other parts of the world in aquarium fish.

Pleistophora intestinalis Chatton, 1907

Pleistophora intestinalis Chatton, 1907, C. R. assoc. Franc. avance. sci., 36, 800, Fig. 2.
Plistophora intestinalis (Chatton, 1907) Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 174, Figs. 617, 618. Jírovec, 1936, Zool. Anz., 116, 138, Fig. 1c, d.
Host and Site: [CLADOCERA] *Daphnia magna* and *D. pulex;* midgut epithelium.
Vegetative Stages: No data.
Sporulation Stages: A small cyst, consisting of a single pansporoblast and containing spores, arises in the epithelial cell of the gut [Jírovec].
Spore: Pyriform, 3 x 2 μm, with posterior vacuole in life and anterior one when stained. Uninucleate in Feulgen preparations [Jírovec].
Locality: France (Paris). Czechoslovakia (Moravia).

Pleistophora jiroveci (Weiser, 1942) Costé-Mathiez & Tuzet, manuscript

Plistophora jiroveci Weiser, 1942, Zool. Anz. 140, 126, Fig. 1. Weiser, 1961, Monogr. Angew. Entomol., 17, 120.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Prochironomus anomalus*, larva; fat body [Weiser (1942)]. *Glyptotendipes* sp. and *Chironomus thummi* K. [Weiser (1961)].
Vegetative Stages: Not observed.
Sporulation Stages: In sporogony, 20-30 nucleate plasmodia arise and produce spores. Chiefly, the plasmodia produce young spores in the periphery while nuclei in the interior divide for a while. Most often over 20 spores are produced and usually there is no pansporoblastic membrane.
Spore: Ovoid, 3-4 x 2-2.3 μm. Macrospores 8 x 2.5 μm.

Locality: Czechoslovakia (vicinity of Chotěboř).
Remarks: It is not clear that this species has a pansporoblastic membrane, an essential character of *Pleistophora*. Furthermore, simultaneous presence of spores and dividing nuclei within a plasmodium is unusual. The generic determination must be regarded as provisional until we have more data.

Pleistophora kudoi (Sprague & Ramsey, 1941) comb. n.

Plistophora kudoi S. & R., 1941, Anat. Rec., 81, 132. Sprague & Ramsey, 1942, J. Parasitol., 28, 399, Figs. 1-40. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 28. Steinhaus & Hughes, 1949, J. Parasitol., 35, 73. Weiser, 1961, Monogr. Angew. Entomol., 17, 56.
[*non*] *Plistophora kudoi* Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 261, Fig. 10.
Host and Site: [BLATTARIA] The cockroach *Blatta orientalis;* epithelial cells of ceca and midgut.
Vegetative Stages: Elongated plasmodia with as many as 10 nuclei in linear arrangement undergo multiple fission to produce small spherical merozoites.
Sporulation Stages: Sporogonial plasmodia undergo sporogony to produce, usually, many sporoblasts within a pansporoblastic membrane. The number of sporoblasts produced by a pansporoblast is highly variable, being from 2 (rare) to a very large number.
Spore: Highly variable in size and shape. Reniform, pyriform or ovoid, 3.5 μm long, average 3.2 x 1.75 μm (fresh). Polar filament 25-50 μm.
Locality: U.S.A. (Illinois, West Virginia, Kentucky).
Remarks: The name of the species was published by Sprague and Ramsey in a preliminary note in 1941 and the detailed description was published in 1942. It is doubtful that this species in a terrestrial insect is congeneric with the type species in a marine fish but present limited knowledge does not provide a satisfactory basis for distinguishing a separate genus.

Pleistophora leasei (Gassouma, 1972) comb. n.

Plistophora leasei Gassouma, 1972, Parasitology, 65, 33, Pl. 5, Fig. B.
Host and Site: [DIPTERA-SIMULIDAE] *Simulium ornatum* Mg., larva; fat body.
Lesion: Numerous spore masses throughout the haemocoel. Masses reddish, giving the infected larva externally visible reddish spots, especially on ventral side of abdomen. Color due to deposition of pigment, insectorubin, or spore masses.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblast 16-32 spores, easily separated from their grouping.

Spore: Subelliptical, 5.6 x 4.0 µm, with large Feulgen-positive nucleus.
Locality: England.

Pleistophora lintoni Streett & Sprague, 1974

Pleistophora sp. Sprague, 1970, *in* "Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), pp. 426. Sprague & Couch, 1971, J. Protozool., 18, 531.
Pleistophora lintoni S. & S., 1974, J. Invertebr. Pathol., 23, 155, Figs. 1-4.
Host and Site: [DECAPODA] The grass shrimp *Palaemonetes pugio* Holthius; mucles.
Lesion: Abdominal muscles opague white. In cross section of infected muscle, the parasite appeared as roughly rounded masses; in longitudinal sections, the masses were elongated.
Vegetative States: No data.
Sporulation Stages: Sporogonial plasmodium produces many spores within a pansporoblastic membrane.
Spore: Rather uniform, ellipsoidal to ovoidal, 2.5-3.3 x 1.4-2.2 µm, 3.0 x 1.7 average (formalin fixed); with anterior and posterior clear zones.
Locality: U.S.A. (Sapelo Island, Georgia).
Remarks: Streett's name was misspelled "Street," it is corrected here.

Pleistophora longifilis (Schuberg, 1910) comb. n.

Plistophora longifilis Schuberg, 1910, Arb. a. d. Kaiserl. Gesundheitsamte., 33, 405, Figs. 1-44. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 177, Figs. 622-732, 760, 768, textfig. B3. Shulman, 1962, *in* "Key to Parasites of Freshwater Fish of the U.S.S.R.," (Pavlovskii, E. N. ed.), p. 135, Fig. 307.
Host and Site: [PISCES] *Barbus fluviatilis;* testis.
Lesion: Rounded white spots appear on the surface of the infected organ. Nucleus of infected host cell conspicuously hypertrophied.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblast produces an inconstant but large number of spores within a pansporoblastic membrane.
Spore: Pyriform, with large clear space in either end and a ring-shaped sporoplasm between. Uninucleate. Macrospores up to 12 x 6 µm and microspores 3 x 2 µm. Polar filament up to 150 µm.
Locality: Germany (Heidelberg). U.S.S.R. (rivers emptying into the Black Sea).

Pleistophora lutzi nom. n.

Pleistophora-form α Lutz & Splendore, 1904, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. 1, Orig., 36, 647, Figs. 17,25.
Nosema simulii form α Lutz & Splendore, 1908, Zentralbl. Bakeriol. Parasitenk. Infektionskr. Hyg. Abt. 1, Orig., 46, 312, Fig.29A[?].

Plistophora simulii α (Lutz & Splendore, 1904) [1908], Debaisieux Gastaldi, 1919, Cellule, 30, 196.
Plistophora simulii (Lutz & Splendore, 1908) Debaisieux & Gastaldi, 1919, Kudo [*partim*], 1924, Ill. Biol. Monogr., 9(2/3), 170.
Host and Site: [DIPTERA-SIMULIIDAE] *Simulium venustum* Say and *S. ochraceum* Walker, larva; cysts in body cavity.
Vegetative Stages: No data.
Sporulation Stages: Many spores develop within the pansporoblast.
Spore: Quite variable in form and size. From short, round egg-shape to short cylindrical; anterior end pointed, posterior rounded; with vacuole in broad end. Frequently, an anomalous form, twice as large as normal, occurs. Size 5.5-8.5 x 4.5-5.5 μm. Polar filament up to 120 μm.
Locality: Brazil.
Remarks: Lutz and Splendore described two *Pleistophora* forms (species) and called them *Nosema simulii* forms α and β. Jírovec (1943) selected the latter as the species of *Pleistophora* to which the name *simulii* should apply. This left form α without a name. Since no one seems to have renamed this species, a new name is proposed now.

Pleistophora macrospora Cépède, 1906

Pleistophora macrospora Cépède, 1906, C. R. Acad. Sci., 142, 57.
Plistophora macrospora (Cépède, 1906) Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 173, Figs. 613-616.
Host and Site: [PISCES] *Cobitus barbatula;* muscles of the lateral wall of the abdomen near the anus.
Lesion: A single lesion was found on one host fish. It was a yellowish white tumor about 3 mm in diameter, containing a mass of innumerable pansporoblasts.
Vegetative Stages: No. data.
Sporulation Stages: Pansporoblasts 25-30 μm in diameter, with wall showing clearly a double contour. The contents vary according to the stage of development. More often it contains numerous spores.
Spore: *In vivo,* 8.5 x 4.25 μm; polar filament 225 μm [Cépède]. Length 8 μm [Léger & Hesse (1916)].
Locality: France (near Grenoble).
Remarks: Léger and Hesse (1916, p. 1049-1053) saw much detail of the spore structure but some of their interpretations were inaccurate according to modern knowledge.

Pleistophora macrozoarcidis (Nigrelli, 1946) Rogers & Gaines, 1975

Ichthyosporidium sp. Nigrelli *in* Fischthal, 1944, J. Parasitol., 30, 35.

Plistophora macrozoarcidis Nigrelli, 1946, Bull. Bingham Oceanogr. Collect. Yale Univ., 9, 191, text figs. A, B, Pls. 2-5. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 50.
Pleistophora macrozoarcidis (Nigrelli, 1946) R. & G., 1975, *in* "The Pathology of Fishes" (W. E. Ribelin & G. Migaki, eds.), pp. 128.
Host and Site: [PISCES] *Macrozoarces americanus;* skeletal muscles.
Vegetative Stages: Reproduction by repeated binary fission.
Sporulation Stages: A binucleate cell, after nuclear fusion, forms a pansporoblast. "The latter, by repeated nuclear division, gives rise to a variable number of sporoblasts, each of which develops into a spore" [Nigrelli (1946)].
Spore: Usually oval, 3.5-5.5 μm long (live). Macrospores also occur.
Locality: U.S.A. (North Atlantic).

Pleistophora milesi Pillai, 1974

Pleistophora milesi Pillai, 1974, J. Invertebr. Pathol., 24, 234, Figs. 1-8.
Host and Site: [DIPTERA-CULICIDAE] The mosquito *Maorigeoldia argyropus,* larva; fat body mainly but also head capsule and anal gills. Laboratory infection also in *Aedes (Finlaya) notoscriptus*.
Lesion: Cysts, 1-3 mm or more, white or black, or white with some black spores. The black spores melanized and encapsulated. Body of infected larva swollen.
Vegetative Stages: A "schizogonic form" was illustrated.
Sporulation Stages: Pansporoblasts ("encapsulated") 14.4-28 μm, mean 20.9 μm; 18-80 or more spores per pansporoblast.
Spore: Normal spores 3.2 x 1.6 - 4.4 x 1.84 μm, mean 3.6 x 1.7 μm.
Locality: New Zealand (Karekare, Auckland).
Remarks: The generic placement needs confirmation.

Pleistophora mirandellae Vaney & Conte, 1901

Pleistophora mirandellae V. & C., 1901, C. R. Acad. Sci., 133, 644.
Plistophora mirandellae (V. & C., 1901) Kudo, 1924, Ill Biol. Monogr., 9(2/3), 168.
Host and Site: [PISCES] *Alburnus mirandella* Blanch.; ovary and ovum.
Vegetative Stages: Uninucleate bodies in cytoplasmic cavities in egg mentioned.
Sporulation Stages: Small, dark colored cysts, with resistant envelopes, contain numerous spores that serve to infect new host fish. Large, clear cysts with less resistant envelopes, contain numerous macrospores that serve for autoinfection.
Spore: Macrospores 12 x 6 μm, with vacuole in one end; polar filament very long. Microspores 7.5 x 4 μm.

Locality: France (Lyon?).
Remarks: This species does not seem typical of *Pleistophora*.

Pleistophora miyairii (Kudo, 1924) Sprague, 1970

Nosema anomalum (?) Miyairi, 1909 "A Guide to the Study of Parasitic Protozoa," pp. 133 [*fide* Kudo, 1924, Ill. Biol. Monogr. 9(2/3), 175].
Plistophora miyairii Kudo, 1924, *loc. cit.*
Pleistophora miyairii (Kudo, 1924) Sprague, 1970, *in* "A Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko ed.), p. 425.
Host and Site: [DECAPODA] *Atyephira* sp.; digestive tract.
Vegetative Stages: No data.
Sporulation Stages: "Multinucleate sporont?" 15-30 µm, containing numerous refringent bodies rounded and 3 µm in diameter or oval and 6 x 3 µm.
Spore: Oval, 9 (rarely 13) x 7 µm, with iodinophilous vacuole in posterior end. Polar filament about 90 µm, some shorter, and some 120 µm.
Locality: Japan.
Remarks: Description from Kudo (1924), since original paper not available. The generic designation is quite uncertain but there are no data that tend to exclude this species from the Genus *Pleistophora*.

Pleistophora mochlonicis (Rapsch, 1956) Clark & Fukuda, 1971

Plistophora mochlonicis Rapsch, 1956, Mitt. Munch. Entomol. Ges., 44/45, 446, Figs. 5, 6.
Pleistophora mochlonicis (Rapsch, 1956) C. & F., 1971, J. Invertebr. Pathol., 18, 400.
Host and Site: [DIPTERA-CHAOBORIDAE] *Mochlonyx culiciformis* de Geer, larva, pupa and imago; in epidermis and fat tissue of all segments.
Vegetative Stages: No data.
Sporulation Stages: Usually 10-30 but often more than 100 spores develop within a fine membrane.
Spore: Pyriform, 7.5 µm long, with vacuole in either end.
Locality: Germany (Braunschweig).

Pleistophora multispora (Strickland, 1913) comb. n.

Glugea multispora Strickland, 1913, J. Morphol., 24, 75, Pl. 4-figs. 1-14.
Thelohania multispora (Strickland, 1913) Debaisieux & Gastaldi, 1919, Cellule, 30, 189, Figs. 1-18. Kudo, 1924, Ill. Biol. Monogr. 9(2/3), 154, Figs. 543-548, 705. [?] Henrard, 1930, Rev. Zool. Bot. Afr., 19, 227.

Plistophora simulii (Lutz & Splendore, 1904) [1908] D. & G., 1919. Jírovec [*partim*], 1943, Zool. Anz., 142, 176. Maurand, 1966, Bull. Soc. Zool. Fr., 91, 621, 1 pl., Figs. 1-8.

Plistophora simulii Lutz & Splendore, 1904 [1908], forma *multispora* Weiser, 1946. Weiser, 1961, Monogr. Angew. Entomol., 17, 126. Frost, 1970, Can. J. Zool., 48, 890.

Host and Site: [DIPTERA-SIMULIIDAE] *Simulium bracteatum* [misindentification of *S. aureum* Fries, according to Hazard and Oldacre, 1975] and [type host] *S. vittatum* [Strickland]. *S. maculatum* (Meig.) [D. & G.]. *Simulium* sp. [Henrard]. *S. vittatum* and *S. venustum* [Frost]. Larva; fat body.

Vegetative Stages: Young plasmodia have single nuclei and older ones have diplocarya. The diplocarya seem to undergo autogamy and produce zygotes [Maurand].

Sporulation Stages: Sporogony results in 30-60 sporoblasts in the pansporoblast [Strickland]. A number of diplocaryotic cells arise within a common membrane and these, by autogamy, become zygotes; each zygote produces 8 sporoblasts [D. & G.].

Spore: Elliptical, 4 x 2.5 μm [Strickland]. Oval, 4.5 x 2-2.5 μm [Maurand].

Locality: U.S.A. (Boston) [Strickland]. Belgium (Louvain) [D. & G.]. Africa (Belgium Congo) [Henrard]. Canada (Newfoundland) [Frost]. France [Maurand].

Remarks: Since there is doubt that this species is identical with *Pleistophora simulii*, it seems that taxonomic orderliness would be better served by treating it provisionally as distinct. In 1961, Weiser cited two of his 1946 papers but I am unable to find in either of them any reference to this species.

Pleistophora myotropha (Codreanu, 1957) comb. n.

Plistophora myotropha Codreanu, 1957, Ann. Sci. Nat. Zool., 19, 568, Figs. 1i-k, 2i-k, 4g-k, Pl.1, Fig. 3.

Host and Site: [ANOSTRACA] The brine shrimp *Artemia salina* (L.); all the trunk muscles and infrequenly other tissues.

Vegetative Stages: No data.

Sporulation Stages: Sporonts produce 4, 8, 16 or 32 spores, most often 8 or 16.

Spore: Very refringent, conical-ovoid, sometimes recurred, with large posterior vacuole; 5.3-6 μm (life) with a single nucleus as seen in Feulgen preparations. Some microspores, 3-4 μm, present in some of the muscle tissues.

Locality: Roumania (Tékirghiol).

Remarks: Since *Plistophora* Labbé, 1899, is a junior synonym of *Pleistophora* Gurley, 1893, this species if transferred to the older nominal genus.

Pleistophora myotrophica (Canning, Elkan & Trigg, 1964) Canning, 1976

Plistophora sp. Elkan, 1963, Br. J. Herpetol., 3, 89. Canning & Elkan, 1963, Parasitology, 53, 11.

Plistophora myotrophica C., E. & T., 1964, J. Protozool., 11, 157, Figs. 1-28. Canning, 1966, *in* "Proceedings of the First International Congress of Parasitology" (A. Corradetti, ed.), p. 446.

Pleistophora myotrophica (C., E. & T., 1964) Canning, 1976, *in* "Comparative Pathobiology: Biology of the Microsporidia" (L. A. Bulla, Jr. and T. C. Cheng, eds.), Chapter entitled "Microsporidia in Vertebrates: Host-Parasite Relations at the Organismal Level."

Host and Site: [AMPHIBIA] *Bufo bufo* L., adult; striated muscle.

Lesion: Lysis of myofibrils by the parasite leads to the formation of fusiform spaces in the fibers packed with microsporidian spores. A cyst wall is not formed. Atrophy of the muscles occurs. Toads become emaciated and suffer heavy mortality.

Vegetative Stages: Reproduction by binary fission, multiple fission and plasmotomy.

Sporulation Stages: Sporonts give rise to large numbers of spores not [?] bounded by a membrane.

Spore: Oval, 3.5-6.7 x 2-3 µm when fresh, 3.2-4.5 x 1.9-2.6 µm in sections.

Locality: England.

Pleistophora neustriae (Günther, 1958) comb. n.

Plistophora neustriae Günther, 1958, Z. Pflanzenkr. Pflanzenpathol. Pflanzenschutz., 65, 535. Weiser, 1961, Monogr. Angew. Entomol., 17, 96.

Host and Site: [LEPIDOPTERA] *Malacosoma neustria* L., larva; fat body and midgut epithelium. *Lymantria dispar* L. and *Hyponomeuta malinella* Zell. [experimentally infected hosts].

Vegetative Stages: Uninucleate schizonts often paired, rarely arranged in band-form.

Sporulation Stages: Schizonts give rise to sporonts that develop into pansporoblasts with 16 or, more frequently, more nuclei and measuring 8-15 µm in diameter.

Spore: Elliptical to bean-shaped, 3.0 x 1.8 µm, with "vacuole" in either end. Polar filament 80-120 µm.

Locality: Germany (Bautzen).

Remarks: Although this species resembles *P. schubergi*, it does not infect the principal host, *Euproctis chrysorrhoea*, of the latter parasite.

Pleistophora oolytica (Weiser, 1949) Canning, 1976

Plistophora oolytica Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 50, Tab. 9 [*nomen nudum*]. Weiser, 1949, Parasitology, 39, 166, Figs. 1, 2.

Pleistophora oolytica (Weiser, 1949) Canning, 1976, *in* "Comparative Pathobiology: Biology of the Microsporidia" (L. A. Bulla, Jr. and T. C. Cheng, eds.), Chapter entitled "Microsporidia in Vertebrates: Host-Parasite Relations at the Organismal Level."

Host and Site: [PISCES] *Leuciscus cephalus* L. [type host] and *Esox lucuis;* ovary.

Vegetative Stages: Uni- and binucleate forms and plasmodia.

Sporulation Stages: Division of the sporogonial plasmodium occurs, "and chains of sporonts are formed which may divide further. This second division gives rise to the spore."

Spore: In *Leuciscus cephalus* three types occurred; the largest were 8.4 x 4.2 µm, medium-sized ones, 5.5-6-6.5 x 3.5 µm and small ones, 3 x .15 µm. In *Esox* the spores measured 7 x 3-3.5 µm, 5 x 3 µm, and 3 x 1.5 µm.

Locality: Czechoslovakia (the first from the Svitava River, near Brno, and the second from Ricka, near Brno).

Remarks: Weiser named and described this species in 1947 (pp. 50, 64) but did not then validate the name by giving a list of characters purporting to distinguish this species from others.

Pleistophora operophterae (Canning, 1960) comb. n.

Plistophora operophterae Canning, 1960, J. Parasitol., 46, 755, Figs. 1-16.

Host and Site: [LEPIDOPTERA] The winter moth *Operophtera brumata* (L.), larva; salivary gland, gut, fat body, muscles, Malpighian tubules.

Vegetative Stages: Reproduction by multiple fission.

Sporulation Stages: Binucleate "pre-sporonts" arise by schizogony and "nuclear fusion takes place to produce the sporonts." Sporogony then produces a variable number (10 to probably over 100) uninucleate sporoblasts. "The membrane forming the outer wall of the sporont separates and remains as a thin covering to the sporoblasts."

Spore: Oval, 2.3 x 1.5 µm, uninucleate.

Locality: England.

Remarks: The new name combination is used because *Pleistophora* Gurley, 1893, has priority over *Plistophora* Labbé, 1899.

Pleistophora ovalis (Rapsch, 1956) Clark & Fukuda, 1971

Plistophora ovalis Rapsch, 1956, Mitt. Munch. Entomol. Ges., 44/45, 447, Fig. 7.

Pleistophora ovalis (Rapsch, 1956) Clark & Fukuda, 1971, J. Invertebr. Pathol., 18, 401.

Host and Site: [DIPTERA-CHAOBORIDAE] *Mochlonyx culiciformis* de Geer, larva, pupa, imago; epidermis, fat body, tracheae, gut epithelium, Malpighian tubules, male gonad, all segments.
Vegetative Stages: No data.
Sporulation Stages: Well over 100 spores develop in a cyst about 25-100 μm in diameter.
Spore: Elongate-oval, 5-6 x 2.5 μm. In section preparations, a pigment granule often appeared on one or both poles. Polar filament 30-40 μm.
Locality: Germany (Braunschweig).

Pleistophora ovariae (Summerfelt, 1964) Rogers & Gaines, 1975

Plistophora ovariae Summerfelt, 1964, Trans. Am. Fish. Soc., 93, 7, Fig. 1. Wilhelm, 1965, Diss. Abstr., 26, 566. Summerfelt & Warner, 1970, *in* "A Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), p. 142, Figs. 1-17. Summerfelt & Warner, 1970, J. Wildl. Dis., 6, 457.
Pleistophora ovariae (Summerfelt, 1964) R. & G., 1975, *in* "The Pathology of Fishes" (W. E. Ribelin & G. Migaki, eds.), p. 128.
Host and Site: [PISCES] The golden shiner *Notemigonus crysoleucas;* ovary.
Vegetative Stages: Binary and multiple fission [Wilhelm (1965)]. "Sporonts" [pansporoblasts] 17.8-22.8 x 15.0-17.8 μm.
Sporulation Stages: Eight, 12 or 16 spores produced within a membrane, with 12 being the most frequent number [Summerfelt]. "A single nucleus remained undivided in the primary sporont while two, four, or more sporoblasts were formed. In later stages this nucleus was no longer observed, only 8, 16 or 20 to 38 sporoblasts or spores were present in the sporont" [Wilhelm].
Spore: Ovoid or ellipsoidal; with very large posterior vacuole, 8.42 x 4.24 μm (fresh), uninucleate. Three small projections from the spore wall extend into the posterior vacuole.
Locality: U.S.A. Originally reported from bait hatcheries in four states; found by Summerfelt and Warner (1970) in 12 states.
Cysts: Macroscopically visible white spots (1.0-1.75 μm) in the infected ovary are aggregates of cysts (345-550 μm). The nature of the "cysts" is not explained in the original description but Summerfelt and Warner say, "the white, macroscopic spots, or 'cysts,' consist of an amorphous mass of ovarian stroma and spores released from disintegrating oocytes."

Pleistophora plectopterae (Weiser, 1946) comb. n.

Plistophora plectopterae Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 247, Fig. 1t-v. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 17, 29. Thomson, 1960, J. Insect Pathol., 2, 366. Weiser, 1961, Monogr. Angew. Entomol., 17, 52.

Host and Site: [PLECTOPTERA] *Chloroperla* sp., larva. Site not stated.
Vegetative Stages: No data.
Sporulation Stages: A large plasmodium with many nuclei develops into pansporoblast with many spores. The pansporoblast breaks up in water.
Spore: Egg-shaped, 6-6.5 x 4 μm.
Locality: Czechoslovakia (near Chotěboř).
Remarks: Most of the data were taken from Weiser's (1961) monograph, since the original paper is in Czech.

Pleistophora reciprocaria (Buitendag, 1965) comb. n.
Plistophora reciprocaria Buitendag, 1965, S. Afr. J. Agric. Sci., 8, 79, Figs. 1-3, Pl. 1.
Host and Site: [LEPIDOPTERA] The citrus looper *Ascotis selenaria reciprocaria* Walk., larva; in fat body, trachea, Malpighian tubules and (secondarily) the blood.
Vegetative Stages: Schizont oblong, 9 x 2 μm. Schizont becomes globuse, thus developing into a pansporoblast.
Sporulation Stages: Within the pansporoblast no less than 20 spores, sometimes hundred, were seen. No pansporoblastic membrane was seen but the spores seemed to be held together by a kind of cytoplasm.
Spore: 6 x 4.5 μm; polar filament 13-14 times as long as the spore.
Locality: South Africa (Pretoria).
Remarks: The new name combination is used because *Plistophora* Labbé, 1899, is a junior synonym of *Pleistophora* Gurley, 1893. The pansporoblastic membrane in this species could have been very delicate and easily overlooked. When the size of the spores shown in Fig. 1A is compared with the magnification given, the spore seems to be about 3 x 1.75 μm. It seems likely that there is an error in the magnification given.

Pleistophora salmonae (Putz, Hoffman & Dunbar, 1965) Rogers & Gaines, 1975
Plistophora sp. Wales & Wolf, 1955, Calif. Fish Game, 41, 184.
Plistophora salmonae P. H. & D., 1965, J. Protozool., 12, 3, Figs. 3, 12, 26.
Pleistophora salmonae (P., H. & D, 1965) R. & G., 1975, *in* "The Pathology of Fishes" (W. E. Ribelin & G. Migaki, eds.), p. 128.
Host and Site: [PISCES] *Salmo gairdneri* Richardson; gill.
Lesion: Cysts, 50-212 μm in diameter and with no limiting membrane, found throughout the gill tissues. Tips of heavily infected gill filaments were badly clubbed.

Vegetative Stages: No data.
Sporulation Stages: "Sporont," 6-8 μm in diameter, contained about 16 spores. Several "sporonts" in one small cyst.
Spore: Pyriform, 4.5 x 2.2 μm (preserved), with anterior and posterior vacuoles.
Locality: U.S.A. (California).

Pleistophora sauridae Narasimhamurti & Kalavati, 1972

Pleistophora sauridae N. & K., 1972, Proc. Indian Acad. Sci., Sect. B, 76, 165, Fig. 1.
Host and Site: [PISCES] The marine fish *Saurida tumbil;* visceral muscles.
Lesion: Cyst surrounded by host tissue, an outer muscular and an inner epithelial layer. No inflammation, hyperplasia or injury to host tissue was noted. No host yielded more than 10 cysts.
Vegetative Stages: No data.
Sporulation Stages: Near the periphery of the cyst were "sporonts" [plasmodia] with variable number of nuclei. More advanced stages were in the center of the cyst. A pansporoblast produces many spores within a pansporoblastic membrane.
Spore: Oval, 3.6-4.2 x 2.0-2.2 μm when fresh, uninucleate, with posterior and anterior vacuoles. Polar filament uniformly thin and 50 μm long.
Locality: India (Andhra).

Pleistophora scatopsi (Hiller, 1959) comb. n.

Plistophora scatopsi Hiller, 1959, Parasitology, 9, 464, Figs. 1-53.
Host and Site: [DIPTERA-SCATOPSIDAE] *Scatopse notata* Mg., all stages; midgut and ceca.
Vegetative Stages: Binary and multiple fission.
Sporulation Stages: First stages not identified. Sporogonial plasmodium seems to divide in either of two ways: Direct breaking up, without constriction of cytoplasm, to form uninucleate sporoblasts or constriction of cytoplasm after migration of nuclei to periphery.
Spore: Pyriform, 4-6 x 2-3 μm, uninucleate with "anterior polar cap" from which polar filament arises.
Locality: England (in laboratory cultures at the University of Cambridge).
Remarks: The new name combination is used because *Pleistophora* Gurley, 1893, has priority over *Plistophora* Labbé, 1899. The generic determination of this species needs confirmation, since an essential character of this genus (a pansporoblastic membrane) was neither mentioned nor shown in the figures. It is interesting to note that Hiller and Vávra, both in 1959, appear to have independently introduced the term "polar cap," apparently for the same structure as demonstrated by different methods.

Pleistophora schubergi aporiae (Veber, 1956) comb. n.

Plistophora aporiae Veber, 1956, Česk. Parasitol., 3, 181, Figs. 1-6. Lipa, 1963, Pr. Nauk. Inst. Ochr. Rosl. Warsz., 5, 133, Figs. 49-64.
Plistophora sp. Lipa, 1957, Acta Parasitol. Pol., 5, 559.
Plistophora schubergi Zwölfer, 1927. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 96.
Plistophora schubergi form *aporiae* Veber, 1956. Weiser, 1961, *ibid.*, 76.
Plistophora schubergi aporiae Veber, 1956. Issi, 1969, Prog. Protozool. Proc. Int. Congr. Protozool., 3, 377. Issi, 1971, Parazitologiya (Leningr.), 5, 299.
Host and Site: [LEPIDOPTERA] *Aporia crataegi* L., larva; midgut epithelium [Veber]. Also *Pieris rapae, P. brassicae, Manestra brassicae, Euproctis chrysorrhoea* and *Malacosoma neustria* [Issi].
Vegetative Stages: Not described in the German summary of Veber's paper.
Sporulation Stages: In cross sections of the pansporoblast 20-30 spores were found.
Spore: Short oval, 2 x 1.5 µm. Macrospores, 4-5 x 2.5 µm, rare.
Locality: Czechoslovakia. Poland. U.S.S.R.

Pleistophora schubergi balbianii (Veber, 1963) comb. n.

Plistophora balbiani Veber, 1963, Prog. Protozool. Proc. Int. Congr. Protozool., 1, 504, Pls. 1, 2. Veber, 1963, *ibid.*, 505. Issi & Lipa, 1968, Acta Protozool., 6, 282. Lom & Weiser, 1972, Folia Parasitol. (Prague), 19, 361, Pl. 4, Fig. 3.
Plistophora schubergi balbianii Veber, 1963. Issi, 1969, Prog. Protozool. Proc. Int. Congr. Protozool., 3, 377.
Plistophora schubergi balbiani Veber, 1963. Issi, 1971, Parazitologiya (Leningr.), 5, 299.
Host and Site: [LEPIDOPTERA] *Antherea pernyi* Guérin [type host], larva; epithelium of midgut [Veber (1963)]. Experimentally also in *Eurpoctis chrysorrhoea* and *Stilpnotia salicis* but not *Lymantria dispar* or *Bombyx mori* [Veber (1963)] . Also *Leucoma salicis* and *Malacosoma neustria* [Issi (1971)].
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: 2 x 1.5 µm. Oval, with coarsely wrinkled surface pattern [L. & W.].
Locality: Czechoslovakia.
Remarks: Data to substantiate the generic determination are lacking. This species is said to be morpholically indistinguishable from *Plistophora schubergi* Zwölfer, 1927, but different in host specificity. Issi treated it as a subspecies of *P. schubergi*. Lom and Weiser used the date of the Congress

(1961) rather than the date of publication of the Proceedings (1963) as the publication date of the name.

Pleistophora schubergi hyphantriae (Weiser, 1957) Nordin & Maddox, 1972

Plistophora hyphantriae Weiser, 1957 [*fide* Issi, 1969, Prog. Protozool. Proc. Int. Congr. Protozool., 3, 377].
Plistophora schubergi hyphantriae Weiser, 1957. Weiser, 1961, Monogr. Angew. Entomol., 17, 98, Fig. 45. Issi, 1971, Parazitologiya (Leningr.), 5, 298.
Pleistophora schubergi hyphantriae (Weiser, 1957) N. & M., 1972, S. I. P. (Soc. Invertebr. Pathol.) Newsl., 4(3), 20. Nordin & Maddox, 1974, J. Invertebr. Pathol., 24, 2.
Host and Site: [LEPIDOPTERA] *Hyphantria cunea* [type host], *Lymantria dispar, Euproctis chrysorrhoea, Antheraea pernyi*, larva; midgut.
Developmental Stages: No available data.
Spore: Ovoidal, 2.5 x 1.5 µm.
Locality: Czechoslovakia. U.S.A. (Illinois).
Remarks: I have been unable to locate a reference to Weiser's (1957) paper containing the original description.

Pleistophora schubergi noctuidae (Veremtchuk & Issi, 1968) comb. n.

Plistophora cf. *schubergi* Zwölfer. Issi & Nilova, 1967, Izv. Akad. Nauk. Tadzh. SSR Otd. Biol. Nauk., 1, 67, Fig. 2.
Plistophora schubergi noctuidae V. & I., 1968, Int. Congr. Entomol., 13, 107 [Abstr. pap.]. Issi, 1969, Prog. Protozool. Proc. Int. Congr. Protozool., 3, 377. Issi & Chervinskaya, 1969, Zool Zh., 48, 1140. Issi, 1971, Parazitologiya (Leningr.), 5, 299.
Plistophora noctuidae (Lipa & Issi, 1970). Lipa, 1971, Proc. IV Int. Colloq. Insect Pathol., 1970, 153.
Host: [LEPIDOPTERA] *Agrotis segetum* [type host], *A. exclamationis, A. ypsilon, A. c-nigrum, Acrtia caja, Chloridea obsoleta, Ch. dipsacea, Hadena sordida, Mamestra trifolii, M. brassicae, Euproctis chrysorrhoea*, larva. [NEMATODA] *Neoaplectana* sp. [V. & I.].
Structure and Development: Said to be morphologically indistinguishable from other subspecies of *P. schubergi*, differing only in host range.
Locality: U.S.S.R.
Remarks: In 1971, Issi attributed the name of this subspecies to Issi and Nilova, 1967. In the reference she cited, however, I find only the name *Plistophora* cf. *schubergi*. Therefore, it seems that the scientific name was first used by and is properly attributable to Veremtchuk and Issi, 1968. Unfortunately, I am handicapped by being unable to read Russian.

Pleistophora schubergi pandemis (Veber, 1957) comb n.

Plistophora pandemis Veber, 1957, Vestn. Cesk. Spol. Zool., 21, 189, Figs. 1-3.

Plistophora schubergi Zwölfer, 1927. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 96.

Plistophora schubergi form *pandemis* Veber, 1957. Weiser, *ibid.*, 98, Fig. 44.

Plistophora schubergi pandemis Veber, 1957. Issi, 1969, Prog. Protozool. Proc. Int. Congr. Protozool., 3, 377. Issi, 1971, Parazitologiya (Leningr.), 5, 299.

Host and Site: [LEPIDOPTERA] *Pandemis corylana* Fbr. [type host] and *Euproctus chrysorrhoea*, larva; midgut epithelium

Vegetative Stages: No data given in the German summary.

Sporulation Stages: Pansporoblast 6-7.5 μm in diameter.

Spore: Ovoidal, 3 x 2 μm.

Locality: Czechoslovakia.

Pleistophora schubergi schubergi (Zwölfer, 1927) Kaya, 1973

Plistophora schubergi Zwölfer, 1927, Z. Angew. Entomol., 12, 499. Zwölfer, 1927, Verh. Dtsch. Ges. Angew. Entomol., 6, 100, Figs. 1-3. Günther, 1956, Z. Angew. Zool., 43, 397. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 96. Lipa, 1963, Pr. Nauk. Inst. Ochr. Rosl. Warsz., 5, 137, Figs. 65-75. Issi, 1968, "Proc. of the All-Union 'Scientific-Research Institute for Plant Protections'" Leningrad 31, 339.

Plistophora schubergi schubergi Zwölfer, 1927. Issi, 1969, Prog. Protozool. Proc. Int. Congr. Protozool., 3, 377. Issi, 1971, Parazitologiya (Leningr.), 5, 298.

Pleistophora schubergi (Zwölfer, 1927) Kaya, 1973, J. Invertebr. Pathol., 22, 356 [subspecies *schubergi?*].

Host and Site: [LEPIDOPTERA] *Euproctis chrysorrhoea* L. = *Nygmia phaeorrhoea* Don. [type host], *Porthetria dispar* L. and *Malacosoma neustria* L., larva, pupa, adult; midgut epithelium [Zwölfer (1927)]. *Phalera bucephala* [Günther (1956), experimental]. *Thaumetopoea processionea, Leucoma salicis* [Issi (1971)] *Anisota senatoris* and [experimental] *Alsophila pometaria, Estigmene acraea, Hyalophora cecropia, Hyphantria cunea, Malacosoma americanum, M. disstria, Porthetria dispar* and *Symmerista canicosta* [Kaya (1973)].

Lesion: Infected tissue milky white [Zwölfer].

Vegetative Stages: Earliest stage a small uninucleate cell. This develops into a cylindrical plasmodium up to 20 x 3-5 μm. The cylinder breaks into mostly binucleate cells. These undergo autogamy to produce the initial stage of sporogony [Zwölfer].

Sporulation Stages: The initial cell (zygote?) develops into plasmodia which divide into as many sporoblast as there are nuclei [Zwölfer].
Spore: Bean-shaped to elliptical, 2.5 x 1.5 μm, uninucleate; polar filament 35 μm.
Locality: Germany, U.S.S.R., and U.S.A.
Remarks: The species studied by Kaya is provisionally regarded as this subspecies, since the author cited Weiser (1961) in connection with his identification but did not specify any of the "forms" that Weiser recognized.

Pleistophora sciaenae Johnston & Bancroft, 1919

Pleistophora sciaenae J. & B., 1919, Sydney J. Roy. Soc. N. S. W., 52, 526, Figs. 7, 13[*fide* Zool. Rec., 57(2), 9, 25].
Plistophora sciaenae (J. & B., 1919) Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 180.
Host and Site: [PISCES] *Sciaena australis;* ovary.
Lesion: Cysts formed. Infection starts in connective tissue of ovary and cyst becomes pressed down among developing ova.
Developmental Stages: No data.
Spore: Pyriform, 3-5 x 2-3 μm.
Locality: Australia (Ipswich).
Remarks: Descriptive data from Kudo. As Kudo remarked, the information is too limited to permit generic determination.

Pleistophora shiplei (Drew, 1910) comb. n.

Glugea shiplei Drew, 1910, Parasitology, 3, 55, Figs. 1-3. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 123, Fig. 317. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 47.
Plistophora shiplei (Drew, 1910) Reichenow, 1932, *in* "Tierwelt d. Nord- und Ostsee" (Grimpe & Wagler, eds.), pp. 80.
Host and Site: [PISCES] *Gadus luscus;* skeletal muscles and those of stomach and intestine.
Lesion: Cysts, up to 5 x 3 mm, were scattered all over the body muscles. They "contained a colourless gelatinous substance, in which one or more opaque white spots could be seen with the naked eye: the cyst wall was very thin and transparent" [Drew]. Under low power, the white body "appeared to consist of a dense mass of minute spores" [Drew]. In sections the "cyst wall was very slight, consisting in places of a thin layer of connective tissue with a few leucocytes, in other places it appeared to be entirely absent" [Drew]. Within the cyst was a large "trophozoit" that contained a large number of nuclei.
Sporulation Stages: Present in the cysts were many "pansporoblasts in various stages of spore formation" [Drew]. Spores were in small spherical masses consisting of large numbers of spores within their pansporoblastic membranes or polysporophorus vesicles.
Vegetative Stages: No data.

Spore: Pyriform, 3.5 x 2.5 μm.
Locality: England (Plymouth).

Pleistophora simulii (Lutz & Splendore, 1908) Maurand, 1975

Pleistophora form β L. & S., 1904, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. 1, Orig., 36, 647, Figs. 18, 23.
Nosema simulii form β L. & S., 1908, *ibid.*, 46, 312.
Glugea polymorpha form 4 Strickland, 1911, Biol. Bull., 21, 320, 328, Fig. 17.
Plistophora simulii form β (L. & S., 1908) Debaisieux & Gastaldi, 1919, Cellule, 30, 196. Jírovec, 1943, Zool. Anz., 142, 176. Weiser, 1961, Monogr. Angew. Entomol., 17, 126.
Plistophora simulii (L. & S., 1904)[1908] Debaisieux & Gastaldi, 1919. Kudo [*partim*], 1924, Ill. Biol. Monogr., 9(2/3), 170. Jírovec [*partim*], 1943, Zool. Anz., 142, 176. Vávra, 1965, C. R. Acad. Sci., 261, 3468, Figs. 9, 10. Maurand, 1967, Ann. Parasitol. Hum. Comp., 42, 285, Figs. 1-4.
Pleistophora simulii (L. & S., 1904) [1908] Maurand, 1975, Ann. Parasitol. Hum. Comp., 50, 374.
Host and Site: [DIPTERA-SIMULIIDAE] *Simulium venustum* Say and *S. ochraceum* Walker [L. & S. (1904)]. *Simulium* sp. [Jírovec (1943)]. *S. aureum* Fries and *S. bezzii* Corti Maurand. Larva. Fat body.
Vegetative Stages: No data.
Sporulation Stages: "*Pleistophora*-form" [L. & S.].
Spore: Regularly ovoidal or elongate, 4.5-5.5 x 2.5-3.5 μm. Polar filament 50 μm. Jîrovec (1943) found in this or a similar species a single nucleus. Lutz and Splendore (1908) gave the name *simulii* to two forms (species) that they designated as *Pleistophora* forms α and β in 1904. Jîrovec (1943) selected form β as the species to bear this name (see also *P. lutzi* = form α).

Pleistophora sogandaresi (Sprague, 1966) Sprague & Couch, 1971

Plistophora sp. Sogandares-Bernal, 1962, J. Parasitol., 48, 493, Figs. 5, 6. Sogandares-Bernal, 1965, Tulane Stud. Zool., 12, 80, Figs. 5, 6.
Plistophora sogandaresi Sprague, 1966, J. Protozool., 13, 196.
Pleistophora sogandaresi (Sprague, 1966) S. & C., 1971, J. Protozool., 18, 530.
Host and Site: [DECAPODA] The crayfish *Cambarellus puer* Hobbs; muscles.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblastic membrane contained 19-21 spores.
Spore: Comma-shaped, 6-9 x 4 μm, with clear area in anterior end and with posterior vacuole in opposite end.
Locality: U.S.A. (vicinity of Covington, Louisiana).

Pleistophora sulci (Rašín, 1936) comb. n.

Cocconema sulci Rasín, 1936, Vestn. II sjezdu veterinaru CSR, I. cast, str. 20 [*fide* Rasín, 1949, Vestn. Cesk. Spol. Zool., 13, 295] Rasín, 1949, *loc. cit.*, Figs. 1-7.

Host and Site: [PISCES] *Acipenser ruthenus;* ova.

Lesion: Infected ova milky white and hypertrophied. An outer zone contains pansporoblasts with sporoblasts and inside this is a zone that contains pansporoblasts with spores.

Vegetative Stages: Remanents of vegetative stages of multiplication were mentioned.

Sporulation Stages: A large number of spores produced in each pansporoblast.

Spore: Spherical, 2.5 μm, with polar filament 120 μm long. The "planont" (evidently, the sporoplasm) uninucleate.

Locality: Czechoslovakia (Danube in Noravia).

Remarks: Rasín (1936, 1949) evidently published the name twice as new. The data reported here were taken from the 1949 paper which gives the title of the previous one in a footnote (pp. 295). This species cannot remain in *Cocconema,* a suppressed genus. Its characters seem to justify its being assigned to *Pleistophora.*

Pleistophora tahoensis (Summerfelt & Ebert, 1969) Rogers & Gaines, 1975

Plistophora tahoensis S. & E., 1969, Bull. Wildl. Dis. Accoc., 5, 330, Figs. 1-21.

Pleistophora tahoensis (S. & E., 1969) R. & G., 1975, *in* "The Pathology of Fishes" (W. E. Ribelin & G. Migaki, eds.), pp. 130.

Host and Site: [PISCES] *Cottus beldingi;* abdominal muscles.

Vegetative Stages: Reproduction by multiple fission was described.

Sporulation Stages: Some merozoites undergo sporogony, each producing many sporoblasts within a pansporoblastic membrane. Each sporoblast transforms into a spore.

Spore: Ovoidal, about 6 x 3 μm (fresh). Polar filament about 140 μm.

Locality: U.S.A. (Lake Tahoe, Nevada).

Pleistophora thienemanni (Weiser, 1943) comb. n.

Thelohania chironomi Debaisieux, 1928, Cellule, 38, 391, Figs. 1-24.

[*non*] *Thelohania chironomi* Jírovec, 1940, Zool. Anz., 130, 124, Fig. 1.

[*non*] *Plistophora chironomi* Debaisieux, 1931, C. R. Soc. Biol., 107, 914, Figs. 3, 4.

Plistophora thienemanni Weiser, 1943, Zool. Anz., 141, 263. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 40. Thomson, 1960, J. Insect Pathol., 2, 366. Weiser, 1961, Monogr. Angew. Entomol., 17, 120.

Host and Site: [DIPTERA-CHIRONOMIDAE] *Chironomus* sp., larva; gut.

Vegetative Stages: Binucleate germs, with closely associated nuclei, common in heavily parasitized cells. Nuclear division results in more pairs of nuclei. Fission usually binary, sometimes multiple with rosette formation. Nuclear division without cytoplasmic division results in large plasmodia with paired nuclei. These nuclei fuse to give zygotic nuclei.

Sporulation Stages: The zygote nuclei in the plasmodium are "sporonts primitifs." Each zygote nucleus undergoes 3 successive divisions to produce 2nd, 3rd, and 4th generation "sporonts." Then, a spore membrane develops to enclose each nucleus with a zone of cytoplasm. Numerous spores grouped in morula-like mass [Debaisieux].

Spore: Oval, 2 x 1.5 μm with a clear vacuole in each end.

Locality: Belgium (Louvain).

Remarks: Since the sporogony, resulting in masses containing many spores, is not typical for *Thelohania*, Weiser transferred this species to *Plistophora*. Because this created a secondary homonym of *P. chironomi* Debaisieux, 1931, Weiser proposed the new name. Probably this species is also not typical of *Pleistophora* but more data are needed to settle this question.

Pleistophora tillingbournei (Gassouma, 1972) comb. n.

Plistophora tillingbournei Gassouma, 1972, Parasitology, 65, 32, Pl. 5, Fig. A. Gassouma & Ellis, 1973, J. Gen. Microbiol., 74, 33, Figs. 4-7, 13.

Host and Site: [DIPTERA-SIMULIIDAE] *Simulium ornatum*, larva; fat body.

Lesion: Two spore masses were situated latero-ventrally in the bulbous part of the larva.

Vegetative Stages: No data.

Sporulation Stages: Pansporoblast produced 64-128 spores that cohered in a compact group difficult to separate.

Spore: Subelliptical, with posterior vacuole, 4.5-3.3 μm; polar filament with 20-21 coils; epispore covered with tubular projections.

Locality: England.

Pleistophora tuberifera (Gasimagomedov & Issi, 1970) comb. n.

Plistophora tuberifera G. & I., 1970, Zool. Zh., 49, 1119, Fig. 2.

Host and Site: [PISCES] Bighead goby *Neogobius kessleri gorlap* (Iljin), Caspian round goby *N. melanostomus affinis* (Eichwald), Hyrcanian goby *N. caspius* (Eichwald); subcutaneous layer of musculature, appearing first as "shapeless hummocky growths" later displacing the muscle tissue.

Lesion: Shapless hummocky growths, 550 x 200 μm, arise on the muscle surface. Muscle tissue finally becomes displaced by spores.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblasts 22-32 μm, containing sometimes 20-50 spores but usually more.
Spore: "The shape of the spores in one host individual varies from oval with one narrower pole to typically pear-shaped. The dimensions of spores in different species of gobies differ greatly. In one individual of the bighead goby, the spore dimensions (in microns) were 3.6 x 1.8, in another - 4.8-5.4 x 2.4-3, in the Hyrcanian goby with heavy infestation 9.6 x 5.4, in the round goby - 6.0-7.2 x 3.0-3.6 in one and 8.0-8.4 x 4.2 - in another."
Remarks: It is noted that there is a distinct discontinuity in size of spores found in the different host species. Therefore, three distinct species may be included as one. The data were taken partly from a translation in English, by Robert M. Howland, of the original article in Russian.

Pleistophora vayssierei (Hesse, 1905) Arvy & Peters, 1976

Nosema vayssierei Hesse, 1905, C. R. Assoc. Franc., 33, 917.
Glugea vayssieri (Hesse, 1905) Auerbach, 1910, "Die Cnidosporidien," p. 38, 191.
Plistophora vayssierei (Hesse, 1905) Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 172.
Pleistophora vayssierei (Hesse, 1905) Arvy & Peters, 1976, Ann. Parasitol. Hum Comp., 51, 126.
Host and Site: [EPHEMEROPTERA] *Baetis rhodani* Pictet, larva; fat body.
Lesion: The ventral side of the infected host was chalky white.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblasts contain a variable number of spores.
Spores: Pyriform, 3-4 x 1-2 μm. Polar filament 17-19 μm.
Locality: France (Montessaux).
Remarks: Kudo (1924) transferred this species provisionally to *Plistophora* because of the statement about the pansporoblast. The generic assignment remains provisional because this species is very poorly known.

Pleistophora vermiformis Léger, 1905

Pleistophora vermiformis Léger, 1905, Bull. mém. de l'Ass. franc. p. l'Avencem. d. Sc., 9, 330.
Host and Site: [PISCES] *Cottus gobio;* muscle.
Lesion: Elongate masses, 3-4 mm long, are situated parallel to the muscle fibers.
Vegetative Stages: No data.

Sporulation Stages: Each parasitic mass in the muscle contains numerous "sporoblastes spheriques," each enclosing a large quantity of spores.
Spore: Has typical microsporidian form with a distinct vacuole in the large end.
Locality: France (Touraine).

Pleistophora waltairensis Kalavati & Ganapati, 1971

Pleistophora waltairensis K. & G., 1971 [*nomen nudum*], SIP (Soc. Invertebr. Pathol.) Newsl., 3, 22.
Host and Site: [DERMOPTERA] *Euborellia plebeja* Dohrn (= *E. stalli*); epithelium of Malpighian tubules.
Vegetative Stages: "Schizonts" mentioned but not described.
Sporulation Stages: Pansporoblast 9.0-25.0 μm, with thin membrane and containing a variable number of spores, always more than 16.
Spore: Oval, 5.4 x 2.0 μm (fresh), with "vacuole" at either end.
Locality: India (Waltair).
Remarks: The name proposed for this species is treated as a *nomen nudum* because it is not "accompanied by a statement that purports to give characters differentiating the taxon" ["International Code of Zoological Nomenclature," Art. 13 (see Stoll, 1961)].

Plistophora sp. Awakura, Kurahashi & Matsumoto, 1965

Plistophora sp. A., K. & M., 1965, Bull. Jap. Soc. Sci. Fish., 1965. Terao *et al.*, 1966, Sci. Rep. Hokk. Fish Hatchery 21, Figs. 4. 5.
Host and Site: [PISCES] *Salmo gairdnerii iridens*; muscles of heart and body.
Descriptive Data: None.
Locality: Japan (Hokkaido).

Pleistophora sp. Baxter, Rigdon & Hanna, 1970

Pleistophora sp. B. R. & H., 1970, J. Invertebr. Pathol., 16, 289, Figs. 1, 2. Sprague & Couch, 1971, J. Protozool., 18, 531. Lightner, 1974, Proc. 3rd U.S.-Jap. Mtg. Aquaculture, Tokyo, Jap., pp. 93, Fig. 21.
Plistophora sp. Kruse *in* Sprague, 1970, *in* "Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), p. 426.
Host and Site: [DECAPODA] The shrimp *Penaeus setiferus* and *P. aztecus*; skeletal muscles. In one host individual the parasite was found also in cardiac muscle, pericardium, wall of stomach and hepatopancreas.
Lesion: Abdominal muscles opaque.
Vegetative Stages: "Developing stages" were numerous in the muscles.

Sporulation Stages: "Cysts varied in size but contained 40 or more spores which, at the periphery of the cysts, appeared to be palisaded" [B., R. & H.].
Spore: "Spores were numerous in the muscle ..." [B., R. & H.] but were not described.
Locality: U.S.A. (Galveston Bay, Texas).

Plistophora sp. Bond, 1937

Plistophora sp. Bond, 1937, J. Parasitol., 23, 230, Fig. 1
Bond, 1938, Trans. Am. Microsc. Soc., 57, 120.
Host and Site: [PISCES] *Fundulus heteroclitus* (Linn.); muscle [Bond (1937)]. Also, spinal cord [Bond (1938)].
Lesion: A slight swelling, about 1 mm, appeared on the anterior body surface. Sections "showed general oedema and muscle degeneration with much infiltration near the center of the infected tissue. ...within the remaining sarcolemma of the most degenerate fibers or in the nearly intrafibrillar spaces were found small masses containing typical microsporidian spores. ...The pansporoblastic nuclei in a number of cases were similar to the structure of the surrounding tissue nuclear forms" [Bond (1937)]. In the outer layer of the spinal cord were scattered forms with few spores; no pathology was apparent [Bond (1938)].
Vegetative Stages: No data.
Sporulation Stages: The "parasitic masses" contained 10-18 spores.
Spore: Oval, 2.5-3 x 1.5-2 μm.
Locality: U.S.A. (Chesapeake Bay, near Baltimore, Maryland).
Remarks: It seems clear that the "parasitic masses" containing "pansporoblastic nuclei" and spores were host cells, probably phagocytes, containing microsporidian spores of undetermined origin. This conclusion eliminates the only clue regarding the genus to which the species belongs.

Plistophora sp. Brooks, 1967

Plistophora sp. Brooks, 1967, J. Elisha Mitchell Sci. Soc., 83, 174.
Host and Site: [MOLLUSCA-GASTROPODA] The gray field slug *Deroceras reticulatum* (Müller); epithelial cells of gut.
Lesion: Infected tissue milky in appearance.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblasts with up to 100 or more spores.
Spore: Macrospores 6.7 x 2.0 μm, microspores 4.5 x 2.0 μm.
Locality: U.S.A. (North Carolina.

Plistophora sp. Chapman, Woodward & Petersen, 1967

Plistophora sp. C. W. & P., 1967, Proc. N. J. Mosq. Exterm. Assoc., 54, 56.
Host: [DIPTERA-CERATOPOGONIDAE] *Culicoides* sp., larva.

Descriptive Data: None.
Locality: U.S.A. (Louisiana).

Plistophora sp. C., W. & P., 1967

Plistophora sp. C. W. & P., 1967, Proc. N. J. Mosq. Exterm. Assoc., 54, 56.
Hose: [DIPTERA-CULICIDAE] *Orthopodomyia signifera* (Coquillett), larva.
Descriptive Data: None.
Locality: U.S.A. (Louisiana).

Plistophora sp. C., W. & P., 1967

Plistophora sp. C., W. & P., 1967, Proc. N. J. Mosq. Exterm. Assoc., 54, 56.
Host: [DIPTERA-CULICIDAE] *Aedes vexans* (Meigen), larva.
Descriptive Data: None.
Locality: U.S.A. (Louisiana).

Plistophora sp. C., W. & P., 1967

Plistophora sp. C., W. & P., 1967, Proc. N. J. Mosq. Exterm. Assoc., 54, 56.
Host: [DIPTERA-CULICIDAE] *Aedes canadensis* (Theobald), larva.
Descriptive Data: None.
Locality: U.S.A. (Louisiana).

Plistophora sp. C., W. & P., 1967

Plistophora sp. C., W. & P., 1967, Proc. N. J. Mosq. Exterm. Assoc., 54, 56.
Host: [DIPTERA-CULICIDAE] *Toxorhynchites rutilus septentrionalis* (Dyar & Knab), larva.
Descriptive Data: None.
Locality: U.S.A. (Louisiana).

Plistophora sp. C., W. & P., 1967

Plistophora sp. C., W. & P., 1967, Proc. N. J. Mosq. Exterm. Assoc., 54, 56.
Host: [DIPTERA-CHIRONOMIDAE] *Corethella brakeleyi*, larva.
Descriptive Data: None.
Locality: U.S.A. (Louisiana).

Pleistophora sp. Drew, 1909

Pleistophora sp. Drew, 1909, Parasitology, 2, 193.
Plistophora sp. Drew, 1909. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 179.
Host and Site: [PISCES] "a cod"; muscle.
Lesion: Diffuse pigmented areas of a brownish color were present in the muscles. The muscle showed signs of degeneration and inflammation was present in regions surrounding the most acute infection.

Vegetative Stages: No data.
Sporulation Stages: Each pansporoblast produced a large number of spores within a polysporophorous vesicle.
Spore: Oval, about 3 x 2.5 μm.
Locality: Iceland.

Plistophora sp. Georgévitch, 1930

Plistophora sp. Georgevitch, 1930, C. R. Soc. Biol., 65, 326.
Host and Site: [ISOPTERA] *Reticulitermes lucifugus* Rossi; Malpighian tubules.
Descriptive Data: None.
Locality: Yugoslavia.

Plistophora sp. Ghittino, 1974

Plistophora sp. Ghittino, 1974, Riv. Ital. Piscicolt. Ittiopatol., 9, 53, Fig. 7.
Host and Site: [PISCES] "yellowtail"; muscle.
Lesion: "Fig. 7" shows "cysts of *Plistophora* sp. in the muscles of a cultivated yellowtail." The parasite causes "severe lesions in body muscles."
Locality: Japan.
Other Data: None.

Pleistophora sp. Hopper, Meyers & Cefalu, 1970

Pleistophora sp. H., M. & C., 1970, J. Invertebr. Pathol., 16, 372, Figs. 1-9.
Host and Site: [NEMATODA] *Metoncholaimus scissus;* "throughout most tissues."
Lesion: There was "cellular distention and lysis." Pseudocoelomocytes, contiguous to microsporidian masses, showed hypertrophy although they were not parasitized.
Vegetative Stages: No data.
Sporulation Stages: "Cysts containing more than 20 cells are present."
Spore: Ovoid, sometimes reniform, 3.8 x 1.5 μm; polar filament 2-10 times length of spore.
Locality: U.S.A. (Biscayne Bay, Florida).
Remarks: It is not at all clear that the "cysts" were pansporoblastic membranes. The generic determination needs to be confirmed.

Plistophora sp. Issi & Lipa, 1968

Plistophora sp. I. & L., 1968, Acta Protozool., 6, 285.
Host and Site: [LEPIDOPTERA] *Thaumetopoea processionea* L.; no data on site.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spores: Oval, 2.0-3.1 x 1.0-2.0 μm (stained).
Locality: U.S.S.R. (Carpathian region).

Remarks: The authors say that in 1965, Evlakhova and Shvetsova previously reported this organism, using the same material.

Pleistophora sp. Johnson, 1972

Pleistophora sp. Johnson, 1972, ASB (Assoc. Southeast Biol.) Bull., 19, 77.
Host and Site: [DECAPODA] The blue crab *Callinectes sapidus;* site not mentioned.
Lesion: No data.
Vegetative and Sporulation Stages: No data.
Spore: Smaller than that of *P. cargoi* [Johnson, personal communication].
Locality: U.S.A. (North Carolina).

Pleistophora sp. Kellen & Lindegren, 1970

Pleistophora sp. K. & L., 1970, J. Invertebr. Pathol., 16, 344.
Host and Site: [LEPIDOPTERA] The navel orangeworm *Paramyelois transitella,* larva; fat body, silk gland, salivary gland, and midgut.
Vegetative Stages: No data.
Sporulation Stages: "Pansporoblast containing over 50 spores were commonly observed."
Spore: Oval to pyriform, 2.39 x 1.30 μm (fresh).
Locality: U.S.A. (California).

Plistophora sp. Lie, Basch & Umathevy, 1966

Plistophora sp. L., B. & U., 1966, J. Parasitol., 52, 456.
Host and Site: [TREMATODA] Hyperparasite of redia of *Echinostoma histricosum* L. & U, *E. audyi* L. & U., *Echinoparyphium dunni* L. & U., and *Hypoderaeum dingeri* Lie in the freshwater snail *Lymnaea rubiginosa* (Michelin).
Lesion: Heavily infected rediae were mere sacs full of spores.
Locality: West Malaya.
Remarks: No descriptive data.

Plistophora sp. Liu & King, 1971

Plistophora sp. L. & K., 1971, J. Am. Vet. Med. Assoc., 159, 1578, Figs. 1-4.
Host and Site: [REPTILIA] *Sphenodon punctatus;* tongue and skeletal muscles.
Lesion: Muscle tissue white, fragile, with "extensive destruction and myositis."
Vegetative and Sporulation Stages: "Protozoa in various stages of development--from fusiform bodies 18 to 21 μm long by 7 to 11 μm wide of schizogony containing numerous spherical uninucleate individuals to mature spores derived from a group of sporoblasts ... in the sporonts of the sporogony--were observed in the muscle fibers ... ." Elsewhere "spores in the cyst of

sporogony cycles" were mentioned. However, [?] "The groups of spores were not surrounded by any membrane."
Spore: Pyriform, 3.96 x 2.22 μm, with anterior and posterior vacuoles (stained).
Locality: U.S.A. (Bronx Zoo, New York). Host animals collected on Stephens Island, New Zealand.
Remarks: It is not clear whether this is a species of *Pleistophora,* since no pansporoblastic membrane was seen. However, it should be noted that *Pleistophora myotrophica* (Canning, Elkan & Triggs, 1964), a similar species in toads, shows no evident effect on its host after two months and may not kill the host for more than two years. The idea that the host individuals had a subclinical infection while still in New Zealand seems reasonable. The authors suggested that the infection was acquired in the zoo, since the hosts (a male and a female) had been there more than four months.

Plistophora sp. Putz, 1970

Plistophora sp. Putz, 1965, *in* Putz & McLaughlin, 1970, *in* "Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), p. 131.
Host: [PISCES] *Salvelinus fontinalis.*
Descriptive Data: None.
Locality: U.S.A.

Pleistophora sp. Sanders & Poinar, 1976

Pleistophora sp. S. & P., 1976, J. Invertebr. Pathol., 28, 109, Figs. 1-13.
Host and Site: [DIPTERA-CULICIDAE] *Aedes sierrensis,* larva; usually in posterior midgut epithelium, rarely the Malpighian tubules and gastric caeca.
Vegetative Stages: Not specifically mentioned, possible represented by certain small uninucleate and binucleate cells.
Sporulation Stages: Sporont with diplocaryon undergoes series of successive binary fissions within a pansporoblastic membrane, the end products being many uninucleate sporoblasts, which develop into spores, with the intermediate stages "prosporoblasts."
Spore: Oval, 1.7 x 0.8 μm, uninucleate, with external ridges when immature. Polar filament 8.0-12.0 μm.
Locality: U.S.A. (California).
Remarks: The authors point out that the sporogony is not like that which Weiser (1961a) regards as typical for *Pleistophora,* multiple fission.

Plistophora sp. Smirnoff, 1965

Plistophora sp. Smirnoff, 1965, Ann. Soc. Entomol. Que., 10, 122. Fig. 1A, B, D. Amagier & Smirnoff, 1974, Entomophaga, 19, 136, Figs. 2-4.

Host and Site: [LEPIDOPTERA) The ugly-nest caterpillar *Archips cerasivoranus* (Fitch), larva; midgut epithelium and fat body. Experimental host: larva of the spruce budworm *Chroistoneura fumiferana* (Clemens).
Lesion: Host larva sluggish, with orange-yellow discoloration and wrinkled skin.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblast 6-8 μm containing 16-20 spores.
Spore: Oval, about 2.0-1.2 μm, with polar filament about 23 μm.

Plistophora sp. Spangenberg & Claybrook, 1961

Plistophora sp. S. & C., 1961, J. Protozool., 8, 151. Li, Baker & Andrew, 1963, Proc. Soc. Exp. Biol. Med., 113, 259.
Host and Site: [COELENTERATA] *Hydra littoralis;* epidermis and gastrodermis.
Lesion: No observable change in morphology or physiology of adult hydra but eggs from infected females rarely hatched and the young hydra from them were very pale, distored and nonviable.
Vegetative Stages: No data.
Sporulation Stages: "Single spores were predominant in the epidermis, whereas sporonts containing varying numbers of spores were more numerous in the gastrodermis" [S. & C.].
Spore: Ovoid, 2-3 x 1-2 μm; polar filament 28-38 μm.
Locality: U.S.A. (Texas).
Remarks: Spangenberg and Claybrook did not know how their animals became infected but Li *et al.* (1963) traced the infection to *Artemia* used for feeding the *Hydra*. The later authors cultured *Hydra* cells and found their cultures contaminated with the microsporidian which destroyed their cultures. The predominance of the single spores in the epidermis raises a question about the generic identity of the microsporidian, although Spangenberg and Claybrook credited Kudo with making the identification.

Plistophora sp. Thomson & Smirnoff, 1960

Plistophora sp. T. & S., 1960, Can. J. Zool., 38, 439, Fig. 1. Issi, 1971, Parasitologiya (Leningr.), 5, 298.
Host and Site: [LEPIDOPTERA] *Aletia oxygala luteopallens;* midgut epithelium.
Lesion: No data.
Vegetative Stages: Multiple fission during which "it would appear that the paired nuclei unite," [T. & S.] results in uninucleate cells.
Sporulation Stages: Plasmodia with 4-60 nuclei seen. "It is believed that the nuclei unite in pairs ... ." The sporont develops into many spores.
Spores: (Stained) 1.5 x 0.75 μm.
Remarks: The authors do not indicate whether a pansporoblastic membrane, an essential character of *Pleistophora,* was present.

Issi, apparently, considered this parasite to be a member of the *Pleistophora schubergi* complex.

Plistophora sp. Wellborn *in* Putz & McLaughlin, 1970

Plistophora sp. Wellborn, 1966 [1970] *in* P. & M., 1970, *in* "Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), pp. 131.
Host: [PISCES] *Dorosoma petenense*.
Descriptive Data: None.
Locality: U.S.A.

Pleistophora sp. Wilson, 1975

Pleistophora sp. Wilson, 1975, Can. J. Zool., 53, 1800, Figs. 8-18.
Host and Site: [LEPIDOPTERA] *Choristoneura fumiferana;* gut.
Vegetative Stages: Reproduction by multiple fission, possibly also by plasmotomy and binary fission.
Sporulation Stages: Sporonts gave rise to a large and variable number of spores.
Spore: 1.4 x 2.5 μm (1.2-1.8 x 1.9-2.9) fresh. 1.4 x 2.4 μm (1.2-1.7 x 1.9-2.7) stained. Polar filament 21.3-53.2 μm (42 av.).
Locality: Canada (Ontario) and U.S.A. (Minnesota).

Pleistophora sp. Woodcock, 1904

"Sporocyst" Linton, 1901, Bull. U. S. Fish Com. for 1899, 19, 455.
Pleistophora sp. Woodcock, 1904, Trans. Liverpool Biol. Soc., 18, 129.
"Gen. et sp. incert" (Linton, 1901) Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 193.
Host and Site: [PISCES] The butterfish *Rhombus triacanthus (=Stromateus triacanthus);* liver.
Lesion: Sporocyst "white, globular, 1.5 mm in diameter. When compressed it liberated immense numbers of spores, which were in large part aggregated into globular or oblong clusters, the larger as much as 0.02 mm in diameter" [Linton].
Developmental Stages: No data.
Spore: Short and thick, with bluntly rounded ends, about 2.5 μm and a little less broad.
Locality: U.S.A. (Massachusetts).
Remarks: The very brief description could apply to a *Glugea* cyst but there seems to be no compelling reason for removing the species from *Pleistophora*.

Plistophora sp. Young, 1969

Plistophora sp. Young, 1969, Vet. Rec., 84, 99, Figs. 1, 2.
Host and Site: [PISCES] The cod *Gadus morhua* L.; muscles of skin.
Lesion: Many muscle fibers in the skin lesions contained microsporidia. "The infected fibers were often surrounded by a fibroblastic response, and neutrophils with pycnotic nuclei were seen associated with the superficial ulceration."
Vegetative Stages: No data.
Sporulation Stages: "The Microsporidia were in brown cysts about 1 mm by 0.2 mm and aligned along the long axis of the muscle fibers. Each consisted of a variable number of sporoblasts which contained up to 100 spores ... ."
Locality: England (Essex).
Remarks: The description of the lesions suggests that factors other than the microsporidia were involved in producing them.

Genus *Mitoplistophora* Codreanu, 1966

Mitoplistophora angularis Codreanu, 1966

Mitoplistophora angularis Codreanu, 1966, *in* "Proceedings 1st International Congress of Parasitology" (A. Corradetti, ed.), pp. 602.
Host and Site: [EPHEMEROPTERA] *Emphemera danica*, nymphs; fat body.
Lesion: No data.
Vegetative Stages: No data.
Sporulation Stages: Spores "assembled by 8, 16, 32, 48 or more, seldom by twos developed in fusiform or triangular sporonts, surrounded by a very resistant membrane, so that the spores are difficult to spread. The spores of every sporont have a bi- or tripolar arrangement, touching each other towards the center by their bases, and directing their apex against the 2 or 3 angles of the sporont. Each angle is prolonged by a flagelliform sinuous filament ... ."
Spore: Pyriform, 4 x 2 μm.
Locality: Roumania (Transylvania).
Remarks: Type species by monotypy.

Family PSEUDOPLEISTOPHORIDAE fam. n.

Genus *Pseudopleistophora* gen. n.

Pseudopleistophora szollosii sp. n.

Pleistophora sp. Szollosi, 1971, J. Invertebr. Pathol., 18, 1, Figs. 1-14.
Host and Site: [POLYCHAETA] The marine polychaete *Armandia brevis*; egg.

Lesion: No sign of cellular pathology was detected.
Vegetative Stages: Not distinguished from sporulation stages.
Sporulation Stages: Early plasmodium has 2-12 visible diplocarya. Parasite at this stage has a tortuous limiting membrane interdigitating with the host cell cytoplasm. Around the parasite is a giant cisterna of rough endoplasmic reticulum, the "perivacuolar cisterna." The plasmodium separates from the membrane mentioned above, forming around itself a "sporogony vacuole," but having still a limiting membrane. Vesicles arise between the diplocarya and fuse with one another, and with the limiting membrane of the plasmodium, to cut the plasmodium into many sporoblasts. Dense granules occur in the vesicles.
Spore: Ovoidal, about 4 x 2.3 μm (as judged from the author's Fig. 14) binucleate, with relatively thin endospore and with 8 turns in the polar filament.
Locality: U.S.A. (Friday Harbor, Washington).
Remarks: Type species of a monotypic genus. Whether the membrane around the plasmodium should be interpreted as a pansporoblastic membrane is problematical. A pansporoblastic membrane enclosing dicplocaryotic sporoblasts would be unique. The kind of sporogony seen here distinguishes this from all other species.

Family DUBOSCIQIIDAE fam. n.

Genus *Duboscqia* Pérez, 1908

Duboscqia legeri Pérez, 1908

Duboscqia legeri Pérez, 1908, C. R. Soc. Biol., 65, 631. Kudo, 1942, J. Morphol., 71, 307, Figs. 1-81. Théodoridès, 1963, Vie Milieu 14(4), [Suppl.], 27.
Duboscqia sp. Kudo, 1941, J. Parasitol., 27(6, Suppl.), 32.
Host and Site: [ISOPTERA] The termite *Termes lucifugus* Rissi; body cavity [Pérez]. *Reticulitermes flavipes;* fat body [Kudo].
Lesion: Infected cells appear as cysts attached to midgut. Host cell nuclei become extremely hypertrophied [Kudo].
The cyst (xenoma) is an infected and greatly hypertrophied fat cell with nucleus. The nucleus of the infected host cell also becomes exceedingly hypertrophied and polymorphic, with branching and budding.
Vegetative Stages: An uninucleate schizont develops into a plasmodium that divides into 16 schizonts within a common membrane. The delicate membrane breaks, liberating the schizonts which apparently repeat the schizogony. Finally, certain schizonts produce 2 sporonts [Kudo].

Sporulation Stages: The sporont is characterized by a distinct, loosely fitting membrane which stains rose-red with Giemsa's solution. By a series of successive divisions, 16 (sometimes only 8) uninucleate sporoblasts are formed and each develops into a spore. During sporogony, the cytoplasm may divide completely into 2 bodies within the pansporoblastic membrane at the end of the first nuclear division or into 4 at the end of the second, or sometimes, into 8 at the end of the third.
Spore: Oval, 5 x 2.5 μm [Pérez]; ovoid to elliptical with nearly equally rounded extremities; 4.3-5.9 x 2.2-3 μm, uninucleate [Kudo].
Locality: France (Landes de Gascogne) [Perez]; U.S.A. (Solomons, Maryland) [Kudo]; France (Banyuls-sur Mer) [Théodoridès].
Remarks: Type species by monotypy.

Duboscqia chironomi Voronin, 1975

Duboscqia chironomi Voronin, 1975, Parazitologiya (Leningr.), 9, 375, Figs. 10-28.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Chironomus plumosus* L., larva; fat body.
Vegetative Stages: Merogony by multiple fission, producing uninucleate merozoites.
Sporulation Stages: Cell with diplocaryon becomes zygote (sporont) that develops into sporogonial plasmodium producing 16 spores.
Spore: Egg-shaped, 6.2 (5.8-6.5) x 3.8 (3.6-4.0) μm when fresh, 5.4 (4.9-5.8) x 3.8 (3.6-4.1) μm when stained with Giemsa.
Locality: U.S.S.R. (northeast).

Duboscqia coptotermi Kalavati & Narasimhamurti, 1976

Duboscqia coptotermi K. & N., 1976, J. Parasitol., 62, 323, Figs. 1-6.
Host and Site: [ISOPTERA] *Coptotermes heimi* (Wasm.); epithelium of midgut.
Lesion: Infected cells and their nuclei, hypertrophied. Heavily infected tissue opaque white.
Vegetative Stages: Stages with as many as 16 nuclei seen.
Sporulation Stages: Sporogonial plasmodia irregular in outline, 23 x 9 μm, producing 16 sporoblasts that transform into 16 spores.
Spore: Oval to ellipsoidal, 5.6-6.6 x 2.5-3.5 μm when fresh. Uninucleate. Polar filament 45-55 μm.
Locality: India (Waltair).

Duboscqia sidae Jírovec, 1942

Duboscqia sidae Jírovec, 1942, Zool. Anz., 140, 130, Fig. 3. Jírovec, 1942, Věstn. Král. České. Spol. Nauk. Třída Mat.-Příroověd., 1942, 4, Fig. 5. Weiser, 1945, Acta Soc. Sci. Nat. Moravicae, 17, 3, Fig. 3a-b. Weiser, 1947, *ibid.*, 18, 22. Král, 1961, Věstn. Česk. Spol. Zool., 25, 91.

Host and Site: [CLADOCERA] *Sida crystallina* [type host]; body cavity. *Daphnia pulex* [Weiser]. *Daphnia magna* [Král].
Vegetatives Stages: No data.
Sporulation Stages: Pansporoblast usually contains 16 spores, sometimes 8.
Spore: Oval or with one pole slightly narrowed, 3 x 1.2-1.6 µm.
Locality: Czechoslovakia.
Remarks: More data are needed to demonstrate that this species is congeneric with the type, *D. legeri*, in termites.

Duboscqia sp. Lom & Vávra, 1963

Duboscqia sp. Lom & Vávra, 1963, Věstn. Česk. Spol. Zool., 27, 5, Fig. 2.
Host: [COPEPODA] *Macrocyclops albidus*.
Developmental Stages: No data.
Spore: Covered with a mucous layer that swells in water.
Locality: Czechoslovakia.
Remarks: More data are needed to determine whether species like this in aquatic crustacea are congeneric with the type species, *D. legeri*, in a terrestrial insect.

Genus *Trichoduboscqia* Léger, 1926

Trichoduboscqia epeori Léger, 1926

Trichoduboscqia epeori Léger, 1926, C. R. Acad. Sci., 182, 727, Fig. Léger, 1926, Trav. Lab. Hydrobiol. Pisc. Univ. Grenoble, 18, 9, Figs. 1-3. Weiser, 1971, Monogr. Angew. Entomol., 17, 49, Fig. 26.
Host and Site: [EPHEMEROPTERA] *Epeorus torrentium* Eat. and *Rhithrogena semicolorata* Curt., larva; fat body.
Lesion: Infected tissue white.
Vegetative Stages: No data.
Sporulation Stages: Usually 16 spores arise within a pansporoblastic membrane. Membrane ornamented with 4 delicate spines, each about 20-22 µm long. Sometimes the membranes encloses 12 spores and has 3 spines. Rarely, there are 8 spores and 2 spines.
Spore: Ovoid acuminate, like a grape seed, 3.5-4 µm long and showing no vacuole in life.
Locality: France (Grenoble).

Family THELOHANIIDAE Hazard & Oldacre, 1975

Genus *Thelohania* Henneguy, 1892

Thelohania giardi Henneguy, 1892

"un parasite" Henneguy & Thélohan, 1892, C. R. Acad. Sci., 114, 1554.

Thelohania giardi Henneguy *in* H. & T., 1892, Ann. Microgr., 4, 639, Figs. 9-25. Gurley, 1893, Bull. U. S. Fish Com. for 1891, 11, 410. Mercier, 1908, C. R. Acad. Sci., 146, 34, Figs. 1-16. Mercier, 1909, Mem. Acad. R. Belg. Classe Sci., 2, 30, Pl. 2. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 130. Hazard & Oldacre, 1975, U.S. Dep. Agric. Tech. Bull. 1530, 92 [see this reference for more extensive synonymy].

Host and Site: [DECAPODA] *Crangon vulgaris;* muscle.

Vegetative Stages: Binary and multiple fission. Some products were thought to be isogametes and copulation of a pair of gametes resulted in a copula or sporont [Mercier (1909)].

Sporulation Stages: The sporont produces 8 sporoblasts within a pansporoblastic membrane and these transform into spores.

Spore: Pyriform, 5-6 μm long, with very fine longitudinal striations [H. & T.].

Locality: France (Boulogne).

Remarks: Type species by subsequent designation, Gurley. Very little is known about this taxonomically very important species. Mercier studied it in some detail but many of his results (especially, his account of spore development and structure, suggesting a similarity to the myxosporidia) are clearly inaccurate.

Thelohania acuta (Moniez, 1887) Schröder, 1914

Microsporidia acuta Moniez, 1887, C. R. Acad. Sci., 104, 185. Moniez, 1887, C. R. Acad. Sci., 104, 1314.

Plistophora obtusa (Moniez, 1887) Labbé [*partim*], 1899, in "Das Tierreich" (O. Bütschli, ed.), 5, pp. 109.

Thelohania acuta (Moniez, 1887) Schröder, 1914, Zool. Anz., 43, 324, Figs. 4-7. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 133, Figs. 435-439. Jírovec, 1942, Zool. Anz., 140, 130, Fig. 2. Weiser, 1945, Acta Soc. Sci. Nat. Moravicae, 17, 3. Weiser, 1947, *ibid.*, 18, 22. Hazard & Oldacre, 1975, U. S. Dep Agric. Tech. Bull., 1530, 94.

Pyrotheca acuta (Moniez, 1887) Hesse, 1935, Arch. Zool. Exp. Gén., 75, 660.

Host and Site: [CLADOCERA] The type host *Daphnia pulex* [Moniez, Jírovec]; hypodermal cells [Jírovec]. [COPEPODA] *Cyclops gigas (=C. viridis* Jurine) [Moniez, Schröder]; fat body [Schröder].

Lesion: The infected *Daphnia* white color [Jírovec].

Vegetative Stages: No data.

Sporulation Stages: Uninucleate cell develops into octonucleate pansporoblast which produces 8 spores [Jírovec]. Eight spores develop within a pansporoblastic membrane [Schröder].

Spore: Pointed anteriorly, 5 x 2 μm [Moniez]. Anterior end pointed and posterior rounded, 4.5-5 x 2-2.2 μm; young spores binucleate [Jírovec].

Locality: France (Lille) [Moniez]. Germany (Landstuhl) [Schröder]. Czechoslovakia (Chotěboř and Zbraslav) [Jírovec].
Remarks: The description by Moniez was limited to the name of the hosts and the size and shape of the spores. This gives us no idea of the generic classification of the parasite. Jîrovec's description included the same data and we must assume he worked with the same parasite. For identification purposes, Schröder's description may be less reliable because the parasite he observed was not in the type host. The data given by Jírovec are all consistent with his generic determinations, excepting a statement that young spores always contain 2 nuclei. It is puzzling, however, that none of Jírovec's figures show 2 nuclei. Possibly the statement was a mistake. In any case, it raises a question about the generic assignment that cannot be answered now. Hazard and Oldacre think this species does not belong to the THELOHANIIDAE.

Thelohania apodemi Doby, Jeannes & Rault, 1963

Thelohania apodemi D., J. & R., 1963, C. R. Acad. Sci., <u>257</u>, 248, Figs. 1-9. Doby, Jeannes & Rault, 1965, Cesk. Parasitol., 12, 136. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., <u>1530</u>, 94.
Host and Site: [MAMMALIA] The field mouse *Apodemus sylvaticus* (Mulots), in the brain; in well-defined colonies, in irregular heaps of free spores or in phagocytes.
Sporulation Stages: "Initial cells of the pansporoblasts" occur in the peripheral part of the colony. This undergoes sporogony to form 8 sporoblasts, each of which develops into a spore, within a pansporoblastic membrane.
Spore: Ovoid, sometimes slightly constricted in the middle; 4-5 x 2-2.5 μm. When stained, the spore shows 2 vacuoles separated by a zone of cytoplasm "in which one or perhaps two nuclei are often visible."
Locality: France (different localities) [D. J. & R. (1963, 1965)].
Remarks: Hazard and Oldacre feel that this species does not belong to the THELOHANIIDAE.

Thelohania argyresthiae Issi & Lipa, 1968

Thelohania argyresthiae I. & L., 1968, Acta Protozool., <u>6</u>, 282, Fig. 1. Hazard & Oldacre, 1975. U. S. Dep. Agric. Tech. Bull., <u>1530</u>, 94.
Host and Site: [LEPIDOPTERA] *Argyresthia conjugella* Zell., larva; fat body.
Vegetative Stages: No data.
Sporulation Stages: Eight spores produced from each sporont.
Spore: 3-6 (mainly 3.1-4.0) x 2.0-3.1 μm (stained).
Locality: U.S.S.R. (Vilnius region).

Thelohania asterias Weiser, 1963

Thelohania asterias Weiser, 1963, Zool. Anz., 170, 226, Figs. 1, 2a-h. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 94.
Host and Site: [CHIRONOMIDAE] *Endochironomus nynchoides* Gr., larva; fat body.
Vegetative Stages: Infrequently, round schizonts, 8-10 µm, were seen.
Sporulation Stages: Sporogony results in 8 oval sporoblasts and these develop into spores embedded in a mass of jelly.
Spores: Irregularly pyriform, 8-9 x 4 µm.
Locality: Czechoslovakia (vicinity of Zedrec).
Remarks: Hazard and Oldacre place this on a list of "doubtful" species.

Thelohania avacuolata Gassouma, 1972

Thelohania avacuolata Gassouma, 1972, Parasitology, 65, 32, Pl. 1, Fig. 2; Pl. 2, Fig. E.
Host and Site: [DIPTERA-SIMULIIDAE] *Simulium ornatum* Mg., larva; fat body.
Vegetative Stages: No data.
Sporulation Stages: Spores broke away from pansporoblast very early so that groups of 8 were rare.
Spore: Truncate-oval, without posterior vacuole, 3.9 x 2.9 µm.
Locality: England.

Thelohania baetica Kudo, 1923

Thelohania baetica Kudo, 1923, J. Parasitol., 10, 23, Figs. 23-31. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 94.
Host and Site: [EPHEMEROPTERA] *Baetis pygmata* Hagen (?), nymph; fat bodies.
Lesion: The nucleus of the infected host cell was hypertrophied.
Vegetative Stages: "Nuclear material becomes divided into two groups, each being composed of two deeply staining bodies" [Kudo]. (Diplocarya?).
Sporulation Stages: "Octosporoblastic sporonts were formed exclusively" [Kudo].
Spore: Oval, 4-4.5 x 2.5 µm (fresh); polar filament 100 µm.
Locality: U.S.A. (Spring Valley, New York).
Remarks: The author did not mention a pansporoblastic membrane but the illustrations seem to show a nonpersistent one. Hazard and Oldacre think that this species does not belong to the THELOHANIIDAE.

Thelohania baueri Voronin, 1974

Thelohania baueri Voronin, 1974, Acta Protozool., 13, 213, Fig. 1a-m; Pl. 1-Figs. 3, 4. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 94.

Host and Site: [PISCES] *Gasterosteus aculeatus* [type host] and *Pungitius pungitius*, egg.
Vegetative Stages: Figures show multiple fission of small plasmodia resulting in binucleate cells.
Sporulation Stages: A variable number of spores develop within the pansporoblast. In *Pungitius* there were 4-16, usually 8, spores in the pansporoblast; in *Gasterosteus* there were 6 - more than 16, usually 9-12.
Spore: Pyriform, with large posterior vacuole. Fresh spores, 4.5-6.0 μm (av., 5.4 x 2.7 μm). Macrospores 6.0-7.3 x 3.2-3.5 μm, uncommon, more frequent in *Gasterosteus*.
Locality: Finish Bay.
Remarks: The generic determination may be questioned because the pattern of variation of the number of spores produced in the pansporoblast is not typical for *Thelohania* and because *Thelohania* is not likely to occur in fish. Differences in the parasite as seen in the 2 hosts suggest that this may be 2 species.

Thelohania bertrami Gassouma, 1972

Thelohania bertrami Gassouma, 1972, Parasitology, 65, 30, Pl. 2, Fig. 13.
Host and Site: [DIPTERA-SIMULIIDAE] *Simulium ornatum* Mg., larva; fat body.
Lesion: Large spore masses were packed in the haemocoele. Body of larva distended, milky white, sometimes pinkish at posterior end. Nuclei of infected host cell hypertrophied, persistent.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblast with moderately rigid membrane. Sporoblast generally with appearance of having double nucleus.
Spore: Subelliptical, 4.2 - 3.1 μm.
Locality: England.

Thelohania breindli Weiser, 1946

Thelohania breindli Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 277, Fig. 4. Weiser, 1961, Monogr. Angew. Entomol., 17, 119. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 94.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Chironomus thummi* K., larva; fat body.
Vegetative Stages: Mainly binucleate schizonts were seen.
Sporulation Stages: Round pansporoblasts with always 8 spores occur.
Spores: 2.2-3 x 1 μm. Macrospores 4-5 x 1 μm.
Locality: Czechoslovakia (vicinity of Chotěboř).
Remarks: Hazard and Oldacre place this in a list of "doubtful" species.

Thelohania cambari Sprague, 1950

Thelohania cambari Sprague, 1950, J. Parasitol., 36, 46. Sprague & Couch, 1971, J. Protozool., 18, 530. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 94.

Host and Site: [DECAPODA] The freshwater crayfish *Cambarus bartoni* Fabricius; muscles.

Lesion: Infected muscles opaque white.

Vegetative Stages: No data.

Sporulation Stages: Sporogonial plasmodium gives rise to 8 spores within a nonpersistent membrane.

Spore: Oval, 4.2 x 2.2 μm (life); polar filament 80-90 μm.

Locality: U.S.A. (vicinity of Hiawassee, Georgia).

Remarks: Hazard and Oldacre place this in a list of "doubtful" species.

Thelohania canningae Gassouma, 1972, emend.

Thelohania canningi Gassouma, 1972, Parasitology, 65, 31, Pl. 2, Fig. C. Gassouma, 1973, J. Gen. Microbiol., 74, 33, Fig. 11.

Host and Site: [DIPTERA-SIMULIIDAE] *Simulium ornatum* Mg., larva; fat body.

Vegetative Stages: No data.

Sporulation Stages: Pansporoblast membrane rigid, "so that each spore was hard to separate from the 8-spore capsule" [Gassouma].

Spore: Subelliptical, 4.7 x 3.6 μm, with rather small nucleus; polar filament with 9-10 coils; surface smooth.

Locality: England.

Remarks: Since Elizabeth Canning is a woman, the rules require that a species name derived from her name end in *-ae*.

Thelohania ceccaldii Vivares, 1975

Thelohania ceccaldii Vivares [*nomen nudum*] in Vivares *et al.*, 1974, C. R. Acad. Sci., 279, 371. Vivares, 1975, Ann. Sci. Nat. Zool. Biol. Anim. 17, 172, Figs. 8, 9, 25-34.

Host and Site: [DECAPODA] *Processa edulis edulis* Risso, 1816; skeletal muscles.

Vegetative Stages: Mereont diplocaryotic.

Sporulation Stages: Pansporoblast fusiform, octosporous.

Spore: Pyriform, 4.5 x 2.0 μm (fresh). Polar filament about 40 μm. Nucleus u-shaped.

Locality: France (Marseille).

Remarks: This species is much like *T. macrocystis* Gurley, 1893, which Hazard and Oldacre (1975) recently transferred to *Chapmanium*. While these two species are probably congeneric, it is not clear that they belong either to *Thelohania* or *Chapmanium*. Therefore, no action regarding the classification is taken now. Probably they should go eventually into a new genus.

Thelohania cepedei Hesse, 1905

Thelohania cepedei Hesse, 1905, C. R. Assoc. Franç., 33, 919. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 146. Weiser, 1961, Monogr. Angew. Entomol., 17, 70. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 94.
Host and Site: [COLEOPTERA] *Omophlus brevicollis* Mls.; epithelial cells of Malpighian tubules.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblasts usually contain 8 spores, sometimes 4 macrospores.
Spore: Highly variable in shape and size; oval or elliptical, sometimes pyriform, sometimes curved into an arc; 3-6 x 2-2.5 µm. Polar filament 20-25 µm.
Locality: France.
Remarks: Hazard and Oldacre think this species does not belong in the THELOHANIIDAE.

Thelohania cheimatobiae Krieg, 1956

Thelohania cheimatobiae Kreig, 1956, Naturwissenschaften, 43(8), 186, Figs. 1, 2. Weiser, 1961, Monogr. Angew. Entomol., 17, 93. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 94.
Host and Site: [LEPIDOPTERA] *Cheimatobia brumata* L., larva; primarily in fat body and secondarily free in the hemocoel.
Vegetative Stages: No data.
Sporulation Stages: Unicellular sporonts develop into pansporoblasts with 8 spores.
Spore: Oval or slightly pyriform, 5-5.75 x 2.5-3.25 µm; polar filament 40-80 µm.
Locality: Germany (Darmstadt).
Remarks: Hazard and Oldacre think this species does not belong in the THELOHANIIDAE.

Thelohania columbaczense Weiser, 1960

Thelohania columbaczense Weiser, 1960, Věstn. Česk. Spol. Zool., 24, 196, Fig. 1. Weiser, 1961, Monogr. Angew. Entomol., 17, 125. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 94.
Host and Site: [DIPTERA-SIMULIIDAE] *Simulium reptans columbaczense*, pupa; fat body and lymphocytes.
Vegetative Stages: Uninucleate stages undergo binary fission. Some meronts develop diplocarya and these, by nuclear fission, become sporonts.
Sporulation Stages: The sporont nucleus divides 3 times, producing a plasmodium with 8 nuclei. Cytoplasmic division then produces spherical sporoblasts. "The membrane of the pansporoblast is dissolved and the sporoblasts, connected with the rests of the cytoplasm are transformed in pyriform spores with a round vacuole on the broader end" [Weiser (1960)].

Spore: Pyriform, 3-3.5 x 1.5-1.8 μm; with "doubled nucleus" [Weiser (1960)].
Locality: Yugoslavia (near Golubac, in Cataracts of the Danube).
Remarks: The double nucleus in the spore is inconsistent with the characters of the Genus *Thelohania*. Further data are needed to resolve this discrepancy. Hazard and Oldacre place this on a list of doubtful species.

Thelohania contejeani Henneguy 1892

Thelohania contejeani Henneguy *in* H. & T., 1892, Ann. Microgr., 4, 639, Figs. 26, 27. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 135, Figs. 44, 45. Dollfus, 1935, Bull. Soc. Cent. Agric. Pêches, 42, 119. Schäperclaus, 1954, "Fischkrankheiten," p. 143. Sumari & Westman, 1970, Ann. Zool. Fenn., 7, 193, Figs. 1, 2. Voronin, 1971, Parazitologiya (Leningr.), 5, 186, Figs. 1-24. Vey, Vago & Charpy, 1971, C. R. Hebd. Seances Acad. Agric. Fr., 57, 1540. Vey & Vago, 1973, *in* "Freshwater crayfish" (S. Abrahamsson, ed.), p. 166, Figs. 1-14. Cossins, 1973, *ibid.*, pp. 151, Figs. 1-10. Maurand & Vey, 1973, Ann. Parasitol. Hum. Comp., 48, 411, Figs. 1-8. Cossins & Bowler, 1974, Parasitology, 68, 81, Fig. 1, Pls. 1-4. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 90 [see this reference for more extensive synonymy].
Thelohania sp. V. & V., 1972, Ann. Hydrobiol., 3, 61, Figs. 1-5.
[?] *Thelohania pallipedis* Vivares, 1975, Ann. Sci. Nat. Zool. Biol. Anim. 17, 172.
Host and Site: [DECAPODA] The freshwater crayfish *Astacus fluviatilis* Fabricius *(= A. astacus)* [H. & T. (1892)]. *A. pallipes* Lereboullet (= *Atlantoastacus pallipes* = *Austropotamobius pallipes)* [Dollfus, V. V. & C. (1971), V. & V. (1972, 1973), Cossins]. In muscles, heart, brain, connective tissues around gut, envelopment of ovary [V. & V. (1973)], eggs [Voronin], central nervous system [C. & B.].
Lesion: Muscles become white.
Vegetative Stages: Binary and multiple fission [S. & W.].
Sporulation Stages: Pansporoblast produces 8 spores. Vey and Vago (1973) presented an excellent electron microscope picture showing sporogony typical of this genus. Pansporoblast membrane nonpersistent [S. & W.].
Spore: Ovoid, 2-3 μm long, with posterior vacuole [H. & T]. Average dimensions 3.4 x 1.8 μm [S. & W.]. Ovoid, 3.5 x 1.8 μm [Cossins]. Ovoid, 3.4 x 2.3 μm [V. V. & C.]. Nucleus horseshoe shape, sometimes giving the impression of being double [C. & B., and personal communication from both A. Vey and A. R. Cossins]. Maurand and Vey, Vey and Vago (1972, 1973) and Cossins made electron microscope studies on the spore.

Locality: Widespread in France [H. & T., Dollfus, V. V. & C., V. & V.]. Germany [Schäperclaus]. Finland [S. & W.]. U.S.S.R. [Voronin]. England [Cossins].

Thelohania corethrae Schuberg & Rodriguez, 1915

Thelohania corethrae S. & R., 1915, Arb. a. d. Kaiserl, Gesundheitsamte., 50, 122, Figs. 1-42. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 157, Figs. 553-557, 755, 756. Leblanc, 1932-3, Cellule, 41, 7, Figs. 1-36. Fantham, Porter & Richardson, 1941, Parasitology, 33, 198, Figs. 60-74. Weiser, 1961, Monogr. Angew. Entomol. 17, 110. Vávra, 1965, C. R. Acad. Sci., 261, 3469, Fig. 11. Sikorowski & Madison, 1968, J. Invertebr. Pathol., 11, 390, Figs. 1, 2. Hazard & Oldacre, 1975, U.S. Dep. Agric. Tech. Bull., 1530, 94.

Host and Site: [DIPTERA-CHAOBORIDAE] *Corethra (Savomyia) plumicornis*, larva; oenocyte [S. & R.]. *Chaoborus crystallinus* (Syn.: *Corethra plumicornis*) [Leblanc]. *Chaoborus flavicans* Meigen [F., P. & R.]. *Chaoborus astictopus* [S. & M.].

Vegetative Stages: During schizogony the merozooites tend to remain together for a while in the form of clusters of 2, 4, and 8 binucleate cells.

Sporulation Stages: Sporont, uninucleate by autogamy, produces 8 spores; sporogony within a membrane that is very difficult to see and that disappears before the spores are developed [S. & R.]. Binucleate cells are starting point for sporogony and these ultimately produce 8 binucleate sporoblasts [F., P. & R.]. Eight sporoblasts with sample nucleus are formed [Leblanc]. Fantham *et al.* figured a distinct pansporoblastic membrane, although other authors did not.

Spore: Pyriform [S. & R.]. Oval, highly variable in size, 4.7-7.3 x 2.1-3.7 μm [F.P. & R.]. Pyriform, about 7 x 4.5 μm [Leblanc].

Locality: Germany (Berlin) [S. & R.]. Belgium (near Louvain) [Leblanc]. Canada (near Montreal) [F. P. & R.]. Czechoslovakia (Prague) [Weiser]. U.S.A. (California, near Healdsburg) [S. & M.].

Remarks: Unfortunately, the original authors did not give spore dimensions. All authors agreed on the shape (which, according to the figures, is ovoid), although they used different adjectives to describe it. This may not be a species of *Thelohania*, since it is uncertain that a pansporoblastic membrane is present or that the sporoblast is uninucleate. Hazard and Oldacre place it on a list of "doubtful" species.

Thelohania cyclopis Weiser, 1945

Thelohania cyclopis Weiser, 1945, Acta Soc. Sci. Nat. Moravicae, 17, 9, Fig. 3i-k. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 94.

Host: [COPEPODA] *Cyclops vicinus.*
Spore: Ovoid, 4-5 x 2-3 µm.
Locality: Czechoslovakia.
Remarks: The description was in the Czech language and no translation was available. Hazard and Oldacre placed this on a list of "doubtful" species.

Thelohania dasychirae Issi & Lipa, 1968

Thelohania dasychirae I. & L., 1968, Acta Protozool., 6, 284. Hazard & Oldacre, 1975, U.S. Dep. Agric. Tech. Bull., 1530, 94.
Host and Site: [LEPIDOPTERA] *Dasychira pudibunda* L., larva; fat body.
Vegetative Stages: No data.
Sporulation Stages: Eight spores produced from each sporont.
Spore: Oval, 3.2-5.8 x 2.0-3.0 µm.
Locality: U.S.S.R. (Suchomi, Caucasus).
Remarks: Hazard and Oldacre placed this on a list of "doubtful" species.

Thelohania debaisieuxi Coste-Mathiez & Tuzet, manuscript

Thelohania chironomi Jírovec, 1940, Zool. Anz., 130, 124, Fig. 1. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 40. Thomson, 1960, J. Insect Pathol., 2, 358. Weiser, 1961, Monogr. Angew. Entomol., 17, 120. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 94.
[*non*] *Thelohania chironomi* Debaisieux, 1928, Cellule, 38, 391, Figs. 1-24.
Host and Site: [DIPTERA-CHIRONOMIDAE] The chironomid *Trichocladius* sp., larva; fat body [Jírovec]. *Diamesa thienamanni* [Weiser (1946)].
Vegetative Stages: No data.
Sporulation Stages: Pansporoblasts regularly contained 8 spores [Jírovec].
Spore: Oval, 5-5.2 x 2.8-3.2 µm [Jírovec].
Locality: Czechoslovakia (vicinity of Prague) [Jírovec], (vicinity of Chotěboř) [Weiser].
Remarks: Hazard and Oldacre think that this species does not belong to the THELOHANIIDAE.

Thelohania disparis Timofejeva, 1956

Thelohania disparis Timofejeva, 1956 [*fide* Weiser, 1961, Monogr. Angew. Entomol., 17, 94]. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 94.
Host and Site: [LEPIDOPTERA] *Lymantria dispar* L., larva; fat body.
Vegetative Stages: No data.
Sporulation Stages: Octosporous pansporoblasts spherical, 12 µm in diameter.

Spore: Ovoid, 4.42-7.37 x 2.36-2.95 µm. From the illustrations, Weiser judged the size to be more like 4.5-5.5 x 2.4-3 µm.
Locality: Not given.
Remarks: Since the original paper was not available, all data were taken from Weiser. Hazard and Oldacre, for reasons not given, think this species does not belong to the THELOHANIIDAE.

Thelohania duorara Iversen & Manning, 1959

Thelohania hunterae Jones, 1958 [*nomen nudum*], ASB (Assoc. Southeast. Biol.) Bull., 5, 10.
Thelohania sp. Kruse, 1959, Tulane Stud. Zool., 7, 128, Figs. 14-20.
Thelohania duorara I. & M., 1959, Trans. Am. Fish. Soc., 88, 130, Fig. 1. Iversen & Van Meter, 1964, Bull. Mar. Sci. Gulf Caribb., 14, 549. Hutton, 1964, Trans. Am. Microsc. Soc., 83, 440. Iversen, 1969, FAO Fish. Rep., 3(57), 1137. Hazard & Oldacre, 1975, U.S. Dep. Agric. Tech. Bull., 1530, 92.
Host and Site: [DECAPODA] The shrimp *Penaeus duorarum* [I. & M.], *P. brasiliensis* [I. & V.]. and *P. aztecus* [Hutton]. In muscles.
Vegetative Stages: No data.
Sporulation Stages: Eight spores develop within the pansporoblast.
Spore: Ovoid, 5.4 x 3.6 µm (life), polar filament about 38 µm [I. & M.].
Locality: U.S.A. (coast of Florida).

Thelohania fibrata (Strickland, 1913) Debaisieux & Gastaldi, 1919

Nosema simulli [δ] Lutz & Splendore, 1908, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I. Orig., 46, 312, Fig. 29[?].
Glugea fibrata Strickland, 1913, J. Morphol., 24, 71, Pl. 3.
Thelohania fibrata (Strickland, 1913) D. & G., 1919, Cellule, 30, 192, Figs. 19-39. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 152, Figs. 532-542, 776. [?] Henrard, 1930, Rev. Zool. Bot. Afr., 19, 228. Jírovec, 1943, Zool. Anz., 142, 175. Weiser, 1961, Monogr. Angew. Entomol., 17, 125. Maurand & Bouix, 1969, C. R. Acad. Sci., 269, 2216, text fig., Pl. 1. Ezenwa, Howlett & Hedge, 1974, J. Parasitol., 60, 975. Liu & Liu, 1974, J. Morphol., 143, 337, Figs. 2, 3, 4, 6, 7. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.
Host and Site: [DIPTERA-SIMULIIDAE] *Simulium bracteatum* [misidentification of *S. aureum* Fries, according to Hazard and Oldacre, 1975] and *S. hirtipes (?)*, larva; fat body [Strickland]. *Simulium* sp. [L. & S.], *S. maculatum* Meig. [D. & G.]. *Simulium* sp. [Jírovec]. Weiser listed *S. venustum* Say and *S. ocraceum* Cogn. as hosts, saying that the species occurs in most of the SIMULIIDAE. *Simulium damnosum* [E., H. & H.].

Vegetative Stages: Binary and multiple fission with many nuclei in diplocaryon stages. A zygote arises by fusion nuclei in a cell with a diplocaryon [D. & G.].
Sporulation Stages: The sporont develop usually into 8 sporoblasts, sometimes 4 large ones. Debaisieux and Gastaldi found a nonpersistent pansporoblastic membrane, although Strickland found none.
Spore: Egg-shaped, 5-5.5 x 3-3.5 µm [L. & S.]. Oval, 5.8-6.6 x 3.5 µm; macrospores 7.8-9 x 4.7-5.1 µm [Strickland]. Uninucleate [Jírovec].
Locality: Brazil [L. & S.]. U.S.A. (Boston) [Strickland]. Belgium (Louvain) [D. & G.]. Africa (Belgian Congo) [Henrard] and (Ivory Coast) [E., H. & H.]. Czechoslovakia (Prague and Chotěboř) [Jírovec].
Remarks: Hazard and Oldacre, for reasons not given, think this species does not belong to the THELOHANIIDAE.

Thelohania grapsi Prowazek, 1910

Thelohania grapsi Prowazek, 1910, Arch. Schiffs Trop. Hyg., 14, 301, Fig. 6.
Host and Site: [DECAPODA] *Grapsus haematocheira;* musclature.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblast octosporous.
Spore: Ovoid, 0.7 x 0.3 µm, binucleate. Polar filament 50-70 µm.
Locality: Japan.
Remarks: The spore dimensions given appear to be erroneous. It seems more probably that they were 7.0 x 3.0 µm. Since most indications are that this is a true *Thelohania,* the spore was probably uninucleate.

Thelohania grassii Missiroli, 1929

Thelohania grassi Missiroli, 1929, Riv. Malariol., 8, 395, Figs. 21-22. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.
Thelohania grassii Missiroli, 1929, emend. Weiser, 1961, Monogr. Angew. Entomol., 17, 114 [see this reference for more extensive synonymy].
Host and Site: [DIPTERA-CULICIDAE] *Anopheles maculipennis* Meigen; egg.
Vegetative Stages: Involve repeated binary fission.
Sporulation Stages: A pansporoblast with 8 nuclei arises and this produces 8 sporoblasts.
Spore: Not described.
Locality: Italy.
Remarks: Hazard and Oldacre placed this on a list of "doubtful" species.

Thelohania herediteria Bulnheim, 1971

Thelohania sp. Bulnheim, 1969, Verh. Dtsch. Zool. Ges., 32, 251, Fig. 5.

Thelohania herediteria Bulnheim, 1971, Z. Parasitenkd., 35, 241, Figs. 1-7. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.

Host and Site: [AMPHIPODA] The brackish-water amphipod *Gammarus duebeni* Lilljeborg, females only; in muscles, ovaries, oviducts, and adipose tissue.

Lesion: No special morphological or physiological effects except for slightly reduced viability.

Vegetative Stages: Occur in ovary and adipose tissue. Earliest stage a small, round uninucleate cell. Division results in more uninucleate cells or binucleate, oval cells with rounded nuclei. The terminal schizont is a fusiform cell with a diplokaryon.

Sporulation Stages: Occur in muscles and oviducts. Sporogony initiated by autogamy of the nuclei of a diplocaryon. Three divisions of the sporont produce 8 uninucleate sporoblasts and these transform into spores.

Spore: Elongate, 4.5-6 x 1.9-2.7 μm (av. 5.04 x 2.15) with a large posterior vacuole, when fresh. Fixed spores 3.5-4.5 x 1.5-2 μm. Rarely 4 macrospores occur when only 2 sporogonic divisions take place. Spore uninucleate. Polar filament about 25 μm.

Remarks: Hazard and Oldacre placed this on a list of "doubtful" species.

Thelohania hessei Weiser, 1961

Cocconema octospora Léger & Hesse, 1921, C. R. Acad. Sci., 173, 1420.

Thelohania hessei (L. & H., 1921) Weiser, 1961, Monogr. Angew. Entomol., 17, 119.

Thelohania hessei Weiser, 1961. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.

Host and Site: [DIPTERA-CHIRONOMIDAE] *Tanytarsus* sp., larva; intestinal epithelium.

Vegetative Stages: No data.

Sporulation Stages: Spores most often in groups of 8.

Spore: Spherical, 2.1 μm.

Locality: France (vicinity of Grenoble).

Remarks: Weiser transferred this species to *Thelohania* because of the grouping of spores and gave it a new specific name to avoid creating a homonym of *T. octospora* Henneguy, 1892. He incorrectly attributed to Léger and Hesse the specific name that he, himself, proposed. Hazard and Oldacre, for reasons not stated, think this species does not belong in the THELOHANIIDAE. Actually, the data are too limited to permit formation of a well founded opinion on the systematic position of the species.

Thelohania janus Hesse, 1903

Thelohania janus Hesse, 1903, C. R. Acad. Sci., 137, 418. Weiser, 1961, Monogr. Angew. Entomol., 17, 106. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.

Host and Site: [TRICHOPTERA] *Limnophilus rhombicus* L., larva; fat body.

Lesion: Parasites form large clusters in the thorax and abdomen.

Vegetative Stages: No data.

Sporulation Stages: Pansporoblasts containing 4 macrospores each and pansporoblasts containing 8 microspores each were present in about equal numbers. The former were spherical (5 μm) or ellipsoidal (4.5 x 5.5-6 μm) and the latter spherical (5.5 μm).

Spores: Macrospores bean-shaped, 6 x 2 μm. Microspores ovoid, 3 x 2 μm, with polar filament 24-25 μm.

Locality: France (near Grenoble).

Remarks: The presence of pansporoblasts with 4 macrospores and pansporoblasts with 8 microspores in about equal numbers is not typical of *Thelohania*. It suggests that there was a mixed infection. It is also reminiscent of the type species of *Stempellia*, *S. mutabilis*. It is noteworthy that only one infected host individual was observed and it would be of interest to know whether another would have shown the same situation. Pending further information, however, it may be well to reserve judgement on the taxonomic problem. Hazard and Oldacre, for reasons not given, think this does not belong to the THELOHANIIDAE.

Thelohania maenadis Pérez, 1904

Thelohania maenadis Pérez, 1904, C. R. Soc. Biol., 57, 214. Pérez, 1905, Bull. Sta. Biol. d'Arcachon, 8, 16. Hazard & Oldacre, 1975, U.S. Dep. Agric. Tech. Bull., 1530, 93, [see this reference for more extensive synonymy]. Vivares, 1975, Ann. Sci. Nat. Zool. Biol. Anim. 17, 143, Figs. 1-3, 10-24.

Host and Site: [DECAPODA] *Carcinus maenas* [type host] and *C. mediterraneus* Czerniavsky [Vivares]; skeletal muscles.

Lesion: The muscles of the infected host become milky white. Pansporoblasts accumulate in dense fusiform masses in the muscles.

Developmental Stages: The final stage is a group of 8 spores within a pansporoblastic membrane.

Spore: Ovoid, 5 x 4 μm, with posterior vacuole (fresh).

Locality: France (Arcachon).

Remarks: Most of those stages reported by Pérez were found by Chatton and Poisson (1931) to be a peridinian that they named *Hematodinium perezi*.

Thelohania minispora Gassouma, *nom. nov.*

Thelohania minuta Gassouma [junior primary homonym], 1972, Parasitology, 65, 30, Pl. 2, Fig. A. Gassouma & Ellis, 1973, J. Gen. Microbiol., 74, 33, Figs. 1, 2, 3, 8, 9, 10, 12.
[*non*] *Thelohania minuta* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 163.
Host and Site: [DIPTERA-SIMULIIDAE] *Simulium ornatum* Mg., larva; fat body.
Lesion: Infection formed 1-2 spore masses, situated latero-ventrally in haemocoel of bulbous part of body. Opaque without milky color. Nuclei of infected host cell hypertrophied, persistent.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblastic membrane thin and delicate, spores becoming readily separated.
Spore: Subelliptical, 3.2 x 2.9 μm; polar filament with 4-5 coils; surface smooth.
Locality: England.
Remarks: The new name was proposed in a letter from Gassouma dated 12 August 1975.

Thelohania minor Georgévitch, 1954

Thelohania minor Georgévitch, 1954, Bull. Acad. Serbe Sci., Sci. Méd., 11, 25, Figs. 1-54. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.
Host and Site: [AMPHIPODA] *Gammarus* sp.; posterior abdominal muscles.
Vegetative Stages: Binary fission of small spherical cells.
Sporulation Stages: Microsporonts and macrosporonts, corresponding to the spores produced, were reported. Sporont develops into plasmodium that undergoes sporogony to produce a variable number of sporoblasts (1, 2, 4, 8, 10, 12, 16, the most common number being 8).
Spore: Triangular, with two points rounded and the other truncate.
Locality: Albania (Lake of Ohrid).
Remarks: According to our information, Figs. 1-54 belonging to this Georgévitch's (1954) article did not appear in the publication. In the absence of the figures and of certain essential descriptive details, it is difficult to judge the nature of this organism. Therefore, its position in *Thelohania* is regarded as provisional. Hazard and Oldacre, for reasons not stated, feel that it does not belong to the THELOHANIIDAE.

Thelohania muelleri (Pfeiffer, 1894) Stempell, 1902

Glugea müllleri Pfeiffer[*partim*], 1894, Correspondenzbl. allgem. ärtz. Ver. Thüringen, 21-22 [*fide* Labbé, 1899, "Das Tierreich," 5, 109]. Pfeiffer [*partim*], 1895, "Protoz. Krankh., Suppl.," 54-60, 72 (*fide* Labbé, 1899, *loc. cit.*].

Plistophora mülleri (Pfeiffer, 1894) Labbé [*partim*] 1899, *loc. cit.*
Thelohania mülleri (Pfeiffer) Stempell, 1902, Zool. Jahrb. Anat., 16, 235, Figs. 1-109. Léger & Hesse, 1917, C. R. Soc. Biol., 80, 13, Figs. 1-3. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 136, Figs. 459, 460. Goodrich, 1928, Q. J. Microsc. Sci., 72, 326. Ryckeghem, 1930, Cellule, 39, 410, Figs. 16-19. Lipa, 1967, Acta Protozool., 5, 95. Bulnheim, 1971, Z. Parasitenkd., 35, 253, Fig. 8.
Host and Site: [AMPHIPODA] *Gammarus pulex* [most authors]. Also *G. chevreuxi* [Goodrich]. Muscle.
Lesion: All the body muscles from the head backward, including the appendages, infected. Host appears, to the naked eye, to have yellowish-white stripes [L. & H.].
Vegetative Stages: Meronts undergo binary fission, budding and multiple fission involving formation of short chains [Stempell].
Sporulation Stages: Sporont undergoes three divisions, producing eight sporoblasts that develop into eight spores within a membrane.
Spore: Pyriform, 3-4 µm long, with vacuole at one end; polar filament 15 µm [Pfeiffer, *fide* Kudo]. Typically ovoid, often slightly reniform, about 5 µm long; polar filament 22-24 µm [L. & H.]. More or less pyriform, 4-5 x 2 µm; polar filament 22-24 µm [Bulnheim].
Locality: Europe (several countries).

Thelohania nana Kellen & Lindegren, 1969

Thelohania nana K. & L., 1969, J. Invertebr. Pathol., 14, 333, Figs. 84-102. Kellen & Lindegren, 1970, *ibid.*, 16, 344. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.
Host and Site: [LEPIDOPTERA] The Indian meal moth *Plodia interpunctella*, all stages; primarily in fat tissue, rarely in muscle. Also in the navel orangeworm *Paramyelois transitella* [K. & L. (1970)].
Vegetative Stages: Binary fission stages figured.
Sporulation Stages: Sporogony typically results in 8 sporoblasts, frequently 2-6, within a pansporoblastic membrane.
Spore: 2.07 x 1.86 µm; macrospores up to 3.5 x 2.25 µm (fresh); 2.27 x 1.60 µm after Giemsa.
Locality: U.S.A. (Fresno and Sacramento, California).
Remarks: Hazard and Oldacre place this on a list of "doubtful" species.

Thelohania ochridensis Georgévitch, 1950

Thelohania ochridensis Georgévitch, 1950, Glasn, srpsk. Akad. Belgrade, n.s., 196, 39, figs. [*fide* "Zoological Record," 89 (Protozoa), 20]. Georgévitch, 1952, Bull. Acad. Serbe Sci. Arts Cl. Sci. Math. Nat., 4, 183, Figs. 1-46. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.

Host and Site: [AMPHIPODA] *Gammarus* sp.; abdominal muscle.
Vegetative Stages: Repeated binary fission with formulation of masses or chains of cells, each about 5-7 μm.
Sporulation Stages: Sporont, 7-9 μm, divides into sporoblasts which use up all the cytoplasm and are enclosed within the pansporoblastic membrane. Usually there are 8 sporoblasts but sometimes 1, 2, 4 or 6.
Spore: Microspores (those in groups of 8) elliptical, 5-6 μ long. Macrospores (those in smaller groups) pyriform, 7-9 μm.
Locality: Albania (Lake of Ochride).
Remarks: The name of this species was published twice as new, 1950 and 1952. The earlier article (in Serbian) was not available and the data were taken from the second. The author reported that the spore develops as a multicellular body, like that in Myxosporidia, but this cannot be accepted. Hazard and Oldacre, for reasons not stated, think this species does not belong to the THELOHANIIDAE.

Thelohania octospora Henneguy, 1892

"Sarcosporidie" Henneguy, 1888, Soc. Philom. Mem. Cent., 1888, 164, Figs. A-D.
Thelohania octospora Henneguy *in* Henneguy & Thélohan, 1892, Ann. Microgr. 4, 639, Figs. 1-8. Kudo [*partim*], 1924, Ill. Biol. Monogr., 9(2/3), 134, Figs. 441-442. Vivares, 1975, Ann. Sci. Nat. Zool. Biol. Anim., 17, 160, Figs. 38-41.
Inodosporus octospora (H., 1892) Overstreet & Weidner, 1974, Z. Parasitenkd., 44, 169.
Inodosporus octosporus (H., 1892) O. & W., 1974. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 55.
Orthothelohania octospora (H., 1892) Codreanu & Balcescu-Codreanu [*partim*], 1974, *in* "Proceedings of the Third International Congress of Parasitology," 1, 16.
[*non*] *Thelohania octospora* H., 1892. Goodrich, 1920, Arch. Zool. Exp. Gén. Notes Rev., 59, 17. Codreanu, 1966, *in* "Proceedings of the First International Congress of Parasitology" (A. Corradetti, ed.), p. 602. Codreanu & Balcescu-Codreanu, 1974, *in* "Proceedings of the Third International Congress of Parasitology," 1, 15.
Host and Site: [DECAPODA] *Palaemon rectirostris* [type host] and *P. serratus*. Muscles.
Vegetative Stages: Meront with diplocaryon [Vivares].
Sporulation Stages: Octosporous. Numerous small secretion granules appear within the pansporoblastic membrane during sporogony, becoming tubular during sporogenesis [Vivares].
Spore: 3-4 μm long [H., 1888]. Microspores about 4 μm and macrospores about 6.5 μm [calculated from electron micrographs of Vivares]; nucleus single, U-shaped.
Locality: France (Le Croisic, Concarneau, Roscoff, La Rochelle).

Remarks: Goodrich (1920) found a microsporidium in *Palaemon serratus* that had tails on the spores. She identified this species as *T. octospora*, which Henneguy and Thélohan (1892) had reported in the same host. Codreanu found similar spores in *P. elegans* and later Codreanu and Balcescu-Codreanu (1974) rediscovered tailed spores in *P. serratus*. All these authors presumed that Henneguy had overlooked tails on the spores because he did not mention them. However, Vivares (1975), using electron microscopy, observed spores without tails in *P. serratus* and concluded that 2 octosporous species occur in this host, 1 with tails [see *Inodosporus* sp. Sprague] and 1 without. Therefore, there is no longer any basis for the assumption that *T. octospora* has tailed spores and no justification for transferring it to another genus.

Thelohania ovicola (Auerbach, 1910) Kudo, 1924

Plistophora ovicola Auerbach, 1910, Zool. Anz., 35, 767 [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 149].
Thelohania ovicola (Auerbach, 1910) Kudo, *loc. cit*., Figs. 520-524. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.
Host and Site: [PISCES] *Coregonus exiguus bondella;* eggs.
Lesion: Infected eggs milky white.
Vegetative Stages: Apparently, no data.
Sporulation Stages: Earliest stage seen had 4 nuclei. One figure shows 8 cells (sporoblasts?) within pansporoblastic membrane. Another figure shows 6 spores within a pansporoblastic membrane.
Spore: Oval, often constricted in middle, with "vacuole" in each end, 6-8 x 4-6 μm. Polar filament 25-30 μm. Said to contain 4 nuclei but this is not acceptable.
Locality: Switzerland (Lake of Neuchatel).
Remarks: The generic identity is questionable. Hazard and Oldacre, for reasons not given, think this species does not belong to the THELOHANIIDAE.

Thelohania paguri Pérez, 1927

Thelohania paguri Pérez, 1927, Bull. Soc. Zool. Fr., 52, 100. Sprague & Couch, 1971, J. Protozool., 18, 530. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 93.
Host and Site: [DECAPODA] The hermit crab *Eupagurus bernhardus* (L.); coelom.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblasts spherical, 12 μm.
Spores: Ovoid, 4.7 x 2.9 μm.
Locality: France (Wimereux).

Thelohania petrolisthis Sprague, 1970

Thelohania sp. Sprague, 1950, Occ. Pap. Mar. Lab. La. St. Univ., 5, 5, Fig. 3.
Thelohania petrolisthis Sprague, 1970, *in* "Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), p. 425. Sprague & Couch, 1971, J. Protozool., 18, 530. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 93.
Host and Site: [DECAPODA] The crab *Petrolisthes armatus* (Gibbs); muscle.
Vegetative Stages: No data.
Sporulation Stages: Eight spores develop within a very persistent pansporoblast.
Spore: Ovoid, about 3 x 2 µm.
Locality: U.S.A. (Barataria Bay, Louisiana).

Thelohania pinguis Hesse, 1903

Thelohania pinguis Hesse, 1903, C. R. Acad. Sci., 137, 418. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 141. Weiser, 1943, Zool. Anz., 141, 262, Fig. 4. Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 275, Fig. 2. Weiser, 1961, Monogr. Angew. Entomol., 17, 119. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Tanypus varius* Meig., larva; fat body.
Lesion: The fat body becomes greatly hypertrophied, fills the body cavity, and compresses the organs. Sometimes it ruptures and liberates the pansporoblasts that they contain into the coelom.
Vegetative Stages: Have not been clearly distinguished from early sporulation stages.
Sporulation Stages: Each pansporoblast, spherical and 6-6.5 µm or ellipsoidal and 7 x 4 µm, contains 8 spores.
Spores: Ovoidal or pyriform, 3-3.5 x 2 µm; polar filament 20 µm [Hesse]. 3 x 1.8-2 µm [Weiser].
Locality: France [Hesse]. Czechoslovakia (vicinity of Chotěboř) [Weiser (1943)].
Remarks: Hazard and Oldacre, for reasons not given, think this species does not belong to the THELOHANIIDAE.

Thelohania plectrocnemiae Weiser, 1946

Thelohania plectrocnemiae Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 258, Fig. 9. Weiser, 1961, Monogr. Angew. Entomol., 17. 71. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.
Host and Site: [TRICHOPTERA] *Plectrocnemia geniculata* McLach., larva; site not stated.
Vegetative Stages: Ribbon-shaped, short schizonts with 2-4 nuclei are formed. Multinucleate stages rare.

Sporulation Stages: In sporogony, 2-, 4-, and 8-nucleate plasmodia arise with a distinct membrane. Around the nuclei boundaries arise and delimit the sporoblasts. Mature pansporoblast "semmelartige," (Weiser, 1946) 9-10 x 6 μm. Its membrane becomes autolysed when the spores are fully developed. The spores, with broad ends oriented inwardly, remain stuck together by the protoplasmic residuum.
Spore: Egg-shaped, 3.5-4 x 2 μm.
Locality: Czechoslovakia (near Chotěboř).
Remarks: Since the original description is in Czech, most of the information is taken from Weiser's (1961) monograph.

Thelohania pristiphorae Smirnoff, 1966

Thelohania pristiphorae Smirnoff, 1966, J. Invertebr. Pathol., 8, 361, Figs. 1, 2. Smirnoff, 1968, *ibid.*, 10, 419, Figs. 1-3. Smirnoff, 1968, *ibid.*, 11, 321. Smirnoff & Chu, 1968, *ibid.*, 12. 388. Smirnoff, 1971, Can. Entomol., 103, 1165, Figs. 1-6. Smirnoff, 1974, J. Invertebr. Pathol., 23, 114, Fig. 1. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.
Host and Site: [HYMENOPTERA] The larch sawfly *Pristiphora erichsonii* [type host], all stages; hypodermis. Experimental hosts, *P. geniculata, Hemichroa crocea, Neodiprion swainei* Midd., *N. lecontei* Fitch., *N. pratti banksianae* Roh., *Dahlbominus fuscipennis* Zett., *Diprion polytoma, Pikonema alaskensis, Arge pectoralis, Trichiocampus viminalis, T. irregularis.* [LEPIDOPTERA] *Malacosoma disstria, M. americanum.*
Lesion: Infected larva yellowish, with small brownish or black spots on thoracic segments.
Vegetative Stages: Earliest stages seen were binucleate terminal schizonts.
Sporulation Stages: Uninucleate sporont develops into octonucleate plasmodium which divides into 8 sporoblasts. "The wall of the mature sporont appears to rupture before the eight uninucleate sporoblasts are transformed into mature spores" [Smirnoff (1966)].
Spore: Bean-shaped, 2.42-1.41 μm.
Locality: Canada (Québec).
Remarks: Hazard and Oldacre thank this species does not belong in the THELOHANIIDAE.

Thelohania pyriformis Kudo, 1924

Thelohania pyriformis Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 162, Figs. 738-742. Kudo, 1925, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. 1 Orig., 96, 433, Figs. 12-25. Kudo, 1960, AIBS (Am. Inst. Biol. Sci.) Tech. Rep., p. 56. Thomson, 1960, J. Insect Pathol., 2, 361. Weiser, 1961, Monogr. Angew. Entomol., 17, 112. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.

Host and Site: [DIPTERA-CULICIDAE] *Anopheles* sp., larva; fat body [Kudo (1925, 1960)], *A. crucians* or *quadrimaculatus* [Kudo (1924)].
Lesion: The single infected specimen was opaque yellowish and body was completely filled with spores.
Vegetative Stages: No data.
Sporulation Stages: "The sporont membrane is indistinct and the eight sporoblasts become separated from one another during the course of further changes" [Kudo (1925)].
Spore: Pyriform, with clear space in posterior end, 4.8-5.4 x 2.7-3 μm (fresh) and 3.5-4.2 x 2-2.8 μm (stained). Polar filament 80-120 μm.
Locality: U.S.A. (Georgia).
Remarks: Kudo summarized the description of this species in his monograph (1924) in anticipation of the original description in press that appeared in 1925. Kudo (1925, 1960) gave the host as *Anopheles* sp. In 1924, he said the host was *A crucians* or *A. quadrimaculatus* but both Thomson and Weiser misinterpreted Kudo's statement to mean that both these mosquito species were found to be infected. Hazard and Oldacre, for reasons not stated, think this species does not belong to the THELOHANIIDAE.

Thelohania reniformis Kudo & Hetherington, 1922

Thelohania reniformis K. & H., 1922, J. Parasitol., 8, 130, Figs. 1-28. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 160, Figs. 679-683. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.
Host and Site: [NEMATODA] *Protospirura muris* in the mouse *Mus musculus;* intestinal epithelium.
Vegetative Stages: "A slow multiplication by binary fission seems to be the only division process" [K. & H.].
Sporulation Stages: "The schizonts become sporonts" [K. & H.]. The sporont undergoes 3 nuclear divisions and its cytoplasm then divide to make 8 sporoblasts, each of which develops into a spore. The membrane around the 8 spores is distinct.
Spore: Reinform, 3-4 (3.4 av.) x 1.5-1.8 μm (fresh); polar filament 45-55 μm.
Locality: U.S.A. (Urbana, Illinois).
Remarks: Hazard and Oldacre, for reasons not stated, think this species does not belong to the THELOHANIIDAE.

Thelohania rhithrogenae Weiser, 1946

Thelohania rhithrogenae Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 252, Fig. 5. Weiser, 1961, Monogr. Angew. Entomol., 17, 48. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.

Host and Site: [EPHEMEROPTERA] *Rhithrogena hybrida* Eaton, larva; fat body.
Vegetative Stages: The first schizonts are round, each with a large nucleus containing a karyosome. They grow into ribbon-shaped second schizonts that transform into diplocarya.
Sporulation Stages: Sporont develops into pansporoblast 10-12 μ in diameter. Sporoblasts pinch off as finger-like projections of the plasmodium and develop into spores. The pansporoblasts have 8 or only 4 spores.
Spore: Pyriform, 5-5.5 x 2.5-3 μm, with vacuole in posterior end. Polar filament 40 μm.
Locality: Austria (near Lunz).
Remarks: Most of the data are taken from Weiser's (1961) monograph, since the original description is in Czech. It does not appear that a pansporoblastic membrane, an essential character of *Thelohania*, is present in this species. The classification needs further consideration when more data becomes available. Hazard and Oldacre, for reasons not stated, feel that this species does not belong to the THELOHANIIDAE.

Thelohania ryckeghemi nom. n.

Thelohania müllerí var. *minuta* Ryckeghem, 1930, Cellule, 30, 410, Fig. 20.
Host and Site: [AMPHIPODA] *Gammarus pulex* L.; muscles.
Vegetative Stages: No data.
Sporulation Stages: Spores grouped by 8.
Spore: Like that of *T. muelleri* but smaller, 3 x 1.5 μm.
Locality: Belgium.
Remarks: Distinguishable from *T. muelleri* only by having a smaller spore, 3 x 1.5 μm, as compared with 4.5 x 2 μm. The author said he would not hesitate to consider this a distinct species had he found it in a different host. Rather than trying to solve the complicated taxonomic problems of distinguishing subspecies of *T. muelleri*, it seems better to elevate this taxon to specific rank. Using *minuta* as a specific name, however, creates a junior primary homonym of *T. minuta* Kudo, 1924, and thereby necessitates the intoduction of a new name.

Thelohania simulii Gassouma, 1972

Thelohania simulii Gassouma, 1972, Parasitology, 65, 31, Pl. 2, Fig. D.
Host and Site: [DIPTERA-SIMULIIDAE] *Simulium ornatum* Mg., larva; fat body.
Lesion: "Numerous spore masses of markedly different sizes filled the whole haemocoele including the proleg and head capsule of the larva."
Vegetative Stages: No data.

Sporulation Stages: Pansporoblastic membrane thin and delicate.
Spore: Subelliptical, 5.9 x 3.8 μm.
Locality: England.

Thelohania similis Weiser, 1957

Thelohania similis Weiser, 1957, Věstn. Česk. Spol. Zool., 21, 75, Figs. 6-8, Pl. 2-Figs. 2-3. Weiser, 1957, Z. Angew. Entomol., 40, 515, Figs. 5-6, Weiser, 1961, Monogr. Angew. Entomol., 17, 94, Fig. 43. Lom & Weiser, 1972, Folia Parasitol. (Prague), 19, 361, Pl. 3, Fig. 6. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.
Host and Site: [LEPIDOPTERA] *Nygmia phaeorrhoea (Euproctis chrysorrhoea* L.), larva; fat body. Also, *Lymantria dispar* L. and *Stilpnotia salicis* L.
Vegetative Stages: Rounded schizonts with up to 8 nuclei. The final stage, a diplocaryotic cell.
Sporulation Stages: Nuclei of the diplocaryotic cell fuse to make a vesicular nucleus. Sporogony follows, producing 8 sporoblasts that develop into 8 spores.
Spore: Broad oval, 5.2-6.2 x 2-2.5 μm, binucleate.
Locality: Czechoslovakia (near Bratislava).
Remarks: The supposed binucleate condition of the spore, being inconsistent with the characters of *Thelohania,* raises doubt about the generic classification of this parasite. Hazard and Oldacre, for reasons not given, think this species does not belong to the THELOHANIIDAE.

Thelohania sogandaresi sp. n.

Thelohania sp. Sogandares-Bernal, 1962, J. Parasitol., 48, 493, Figs. 1-4. Sogandares-Bernal, 1965, Tulane Stud. Zool., 12, 79, Figs. 1-4.
Host and Site: [DECAPODA] The freshwater crayfish *Cambarellus shufeldti* (Faxon, 1881); body musculature.
Vegetative Stages: No data.
Sporulation Stages: Live pansporoblasts 6-9 μm. Eight sporoblasts formed and these transform into 8 spores within the pansporoblastic membrane.
Spore: Ovoidal, 3-3.5 x 1.2-1.6 μm, with anterior and posterior clear areas separated by a darker middle area.
Locality: U.S.A. [Louisiana. Originally found at Chacahoula, later (1965) found in several host specimens near Covington.]
Remarks: Sogandares-Bernal described this species in 1962 and distinguished it from other species in 1965. He then said, "The specific identity ... awaits information regarding filament length and life-history, but low incidence of natural infection makes the necessary study difficult to complete." Since he has already taken every step toward establishing this taxon except naming it, taxonomic orderliness would be better served if it had a name. Having recently ascertained

that the author still has no plans for naming this species, I now propose the name *Thelohania sogandaresi* sp. n. in honor of its discoverer.

Thelohania tipulae Weissenberg, 1926

Thelohania tipulae Weissenberg, 1926, Arch. Protistendk., 54, 458, Figs. 31-38. Weiser, 1961, Monogr. Angew. Entomol., 17, 106. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.

Host and Site: [DIPTERA-TIPULIDAE] The crane fly *Tipula lateralis*, larva; fat body.

Lesion: Infected fat body greatly hypertrophied.

Vegetative Stages: No data.

Sporulation Stages: Spores regularly seen in groups of 8 within a pansporoblastic membrane.

Spore: Oval, 5 x 3 μm.

Locality: Germany (Grieswald).

Remarks: Hazard and Oldacre, for reasons not stated, think this species does not belong in the THELOHANIIDAE.

Thelohania vandeli Poisson, 1924

Thelohania vandeli Poisson, 1924, C. R. Acad. Sci., 178, 666, Figs. 13-15. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 27. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.

Host and Site: [AMPHIPODA] *Niphargus stygius* Schiödte; site not stated.

Vegetative Stages: No data.

Sporulation Stages: Pansporoblasts octosporous.

Spore: Ovoid, 6-6.5 x 3 μm. Numerous abnormal spores also found.

Locality: France (near Paris).

Remarks: Hazard and Oldacre, for reasons not stated, think this species does not belong to the THELOHANIIDAE.

Thelohania vanessae Chorine, 1930

Thelohania vanessae Chorine, 1930, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I Orig., 117, 86, Figs. 1-17. Weiser, 1961, Monogr. Angew. Entomol., 17, 92. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull. 1530, 95.

Host and Site: [LEPIDOPTERA] *Vanessa urticae* L., larva; in blood, fat body, gonad, wall of midgut.

Vegetative Stages: Uni- and binucleate forms reported.

Sporulation Stages: Binucleate forms become uninucleate sporonts. These undergo both nuclear and cytoplasmic division to produce 2, then 4, then 8 cells or sporoblasts that transform into spores.

Spore: Ovoid, 4.2-6 x 3.4 μm. Polar filament 60-150 μm.

Locality: Yugoslavia (Zagreb). Weiser (1961) has new material from U.S.S.R. (Kiev).

Remarks: The author, comparing this species with *T. mesnili*, emphasizes the fact that in sporogony each nuclear division is accompanied by a cytoplasmic division. He gives no indication that sporulation occurs within a pansporoblastic membrane but leaves the impression that there is no such membrane. Therefore, this species may not have the essential characters of the Genus *Thelohania*. Pending further information, however, there is not an adequate basis for reassignment. Hazard and Oldacre think this species does not belong to the THELOHANIIDAE.

Thelohania varians (Léger, 1897) Debaisieux, 1919

Glugea varians Léger [*partim*], 1897, C. R. Acad. Sci., 125, 262.
Thelohania varians (Léger, 1897) Debaisieux, 1919, Cellule, 30, 47, Figs. 1-141. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 139, Figs. 461-489, 771, 775. Jírovec, 1943, Zool. Anz., 142, 175. Weiser, 1961, Monogr. Angew. Entomol., 17, 124. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull. 1530, 95.

Host and Site: [DIPTERA-SIMULIIDAE] *Simulium ornatum* Meig, larva; body cavity [Léger]. Also in Malpighian tubules [Jírovec]. Also in *S. reptans;* fat body and (after rupture of pseudocysts) oenocytes and phagocytes [Weiser].

Lesion: Large white cysts occur in the body cavity, causing the abdominal region to be white and distended.

Vegetative Stages: Debaisieux gave details of nuclear division involving diplocarya; he also reported a sexual process.

Sporulation Stages: The pansporoblast produces 8 spores [Léger, Debaisieux, Jírovec, Weiser].

Spore: 4-5 μm long [Léger]; 5-5.5 x 3-4 μm [Jírovec]; 5.5-6 x 3-4 μm [Weiser].

Locality: France (Grenoble) [Léger]; Belgium (Louvain) [Debaisieux]; Czechoslovakia (Lńaře and Chotěboř) [Jírovec].

Remarks: Léger included forms that produced cysts containing an indefinite number of macrospores (8 μm long). Debaisieux observed similar forms and thought they might represent a second species. Among later authors, only Kudo (1924), seems to have mentioned this part of the original *G. varians*. I believe, however, he misunderstood Léger's description, for he said that macrospores and microspores occur either in the same or in different cysts. My understanding is that they do not occur in the same cysts. Hzaard and Oldacre think this species does not belong to the THELOHANIIDAE.

Thelohania weiseri Günther, 1960

Thelohania weiseri Günther, 1960, Z. Angew. Entomol., 46, 212, Figs. 1-10. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.

Host and Site: [LEPIDOPTERA] *Tortrix viridana* L., larva; fat body.
Vegetative Stages: Reproduction by binary fission and multiple fission of small plasmodia. The final cell has a diplocaryon that undergoes fusion.
Sporulation Stages: The pansporoblast produces 8 spores within a delicate membrane.
Remarks: Hazard and Oldacre think this species does not belong to the THELOHANIIDAE.

Thelohania wurmi Weiser, 1946

Thelohania wurmi Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 251, Fig. 4. Weiser, 1961, Monogr. Angew. Entomol., 17, 48. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.
Host and Site: [EPHEMEROPTERA] *Baetis pumilis* Burm., larva; in muscle and connective tissue of gut, forming cysts on outer surface.
Vegetative Stages: Small schizonts with a few nuclei infrequently seen.
Sporulation Stages: Sporonts 7-10 μm; octosporous pansporoblast 10-12 μm.
Spore: Ellipsoidal, 5-6 x 2 μm.
Locality: Czechoslovakia (near Chotěboř).

Thelohania sp. Allen & Buren, 1974

Thelohania sp. A. & B., 1974, J. N. Y. Entomol. Soc., 82, 128, Fig. 1.
Host and Site: [HYMENOPTERA] The red fire ant *Solenopsis invicta* Buren; fat body.
Vegetative Stages: Schizonts observed.
Sporulation Stages: Octosporous, spores enclosed within a membrane.
Spore: Pyriform, 3.4 x 2.0 μm (fixed).
Locality: Brazil (Mato Grosso).

Thelohania sp. Banerjee, 1968

Thelohania sp. Banerjee, 1968, Ann. Entomol. Soc. Am., 61, 544, Fig. 1.
Host and Site: [LEPIDOPTERA] The sod webworm *Crambus trisectus* (Walker), larva, pupa, adult; fat body, silk gland, Malpighian tubules, midgut, meconia. Experimental host *C. teterrellus* (Zincken), larva.
Lesion: Diseased larva became flaccid and contracted, with dorsum blackened.
Vegetative Stages: No data.
Sporulation Stages: "Occurs in packets containing 8 spores each."
Spore: No descriptive data.
Locality: U.S.A. (Illinois).

Thelohania sp. Bargeton & Couteaux, 1935

Thelohania sp. B. & C., 1935, Bull. Soc. Zool. Fr., 60, 337, Figs. 1-2.
Host and Site: [OLIGOCHAETA] *Lumbricus rubellus* Hoffm.; muscles of body wall.
Lesion: Multilocular cysts, oval or fusiform, 10-100 μm, deform the muscle fibers. The wall of the cyst and of its locules is made of a homogenous material.
Vegetative Stages: Dividing cells seen in some compartments of the cysts.
Sporulation Stages: Sporoblasts and spores recognized. In a compartment, 8 or fewer spores were seen.
Spore: Ovoid, 4 x 2 μm, with a large vacuole occupying about two-thirds of the spore.
Locality: France (Paris).
Remarks: This is a very poorly described species. Its assignment to *Thelohania* is questionable.

Thelohania sp. Hall, 1952

Thelohania sp. Hall, 1952, J. Parasitol., 38, 487.
Host and Site: [LEPIDOPTERA] The fawn-colored lawn moth *Crambus bonifatellus* (Hulst), larva and pupa.
Vegetative Stages: No data.
Sporulation Stages: Spores grouped together in clusters of 8.
Spores: About 4 μm long.
Locality: U.S.A. (California).

Thelohania sp. Johnson & Brooks, 1968

Thelohania sp. J. & B., 1968, J. Elisha Mitchell Sci. Soc., 84, 446.
Host: [AMPHIPODA] The freshwater amphipod *Hyalella azteca*.
Developmental Stages: No data.
Spore: Size, 4.5 x 2.2 μm.
Locality: U.S.A. (North Carolina).

Thelohania sp. Johnson & Brooks, 1968

Thelohania sp. J. & B., 1968, J. Elisha Mitchell Sci. Soc., 84, 446.
Host: [AMPHIPODA] The freshwater amphipod *Crangonyx seratus*.
Developmental Stages: No data.
Spore: Size, 6 x 3 μm.
Locality: U.S.A. (North Carolina).

Thelohania sp. Laigo & Paschke, 1966

Thelohania sp. L. & P., 1966, J. Invertebr. Pathol., 8, 269, Figs. 1, 2.
Host and Site: [LEPIDOPTERA] *Pieris rapae*, larva; infection general.
Vegetative Stages: Schizonts generally spherical.

Sporulation Stages: Sporont divides 3 times, producing 8 sporoblasts that develop into 8 spores.
Spore: 5.62-6.85 (av. 6.17) x 3.12-2.75 (av. 3.42) μm. Polar filament 56.15 μm, av.
Locality: U.S.A. (Indiana).

Thelohania sp. Laird, 1966

Thelohania sp. Laird, 1966, *in* "Proceedings of the First International Congress of Parasitology" (A. Corradetti, ed.), pp. 595.
Host and Site: [DIPTERA-CULICIDAE] *Aedes (Stegomya) albopictus* Skuse, larva; fat body.
Vegetative Stages: No data.
Sporulation Stages: "Its pansporoblasts each contain eight spores."
Spore: "Pyriform, and (apart from the rather smaller size) superficially resemble those of *Nosema aedis* Kudo."
Locality: Singapore.

Thelohania sp. Lavrentiev, Khaliulin & Ivanov, 1969

Thelohania sp. L., K. & I., 1969, Prog. Protozool. Proc. Int. Congr. Protozool., 3, 236.
Host and Site: [DIPTERA-CULICIDAE] *Aedes* sp., larva; haemolymph.
Developmental Stages: "all developmental stages" mentioned but not described.
Spore: Not described.
Locality: U.S.S.R. (near Shelanger village in Mary A.S.S.R.).

Thelohania sp. Nouvel & Nouvel, 1935.

Thelohania sp. N. & N., 1935, Bull. Inst. Océanogr. (Monaco), 685, 8.
Host and Site: [DECAPODA] The shrimp *Athanas nitescens* Leach; muscle.
Lesion: Infected individual was opaque white.
Vegetative Stages: No data.
Sporulation Stages: Each pansporoblast produces 8 spores.
Spore: No data.
Locality: France (Roscoff).

Thelohania sp. Overstreet & Weidner, 1974

Thelohania sp. O. & W., 1974, Z. Parasitenkd., 44, 175.
Host and Site: [DECAPODA] *Palaemonetes pugio* Halthius.
Descriptive Data: None.
Locality: U.S.A. (Mississippi).
Remarks: The authors merely mentioned "another species of *Thelohania* from *P. pugio* in Mississippi to be described later."

Thelohania sp. Pérez, 1927

Thelohania sp. Pérez, 1927, Bull. Soc. Zool. Fr., 52, 101, footnote.
Host and Site: [DECAPODA] *Galathea squamifera* Leach; muscles.
Descriptive Data: None.
Locality: France (Nice).

Thelohania sp. Splittstoesser & McEwen, 1968

Thelohania sp. S. & M., 1968, J. Invertebr. Pathol., 12, 231, Figs. 1, 2.
Host and Site: [LEPIDOPTERA] *Hyalophora cecropia*, larva [type host] and *Trichoplusia ni*, larvae and adults, by experimental infection; fat body.
Lesion: Infected *Trichoplusia* larvae changed color from green to yellow with dark mottling and often with a translucent enlargement of the anal segments.
Vegetative Stages: Binucleate schizonts described.
Sporulation Stages: Plasmodia with 4 and 8 nuclei were seen. Octosporoblastic.
Spore: Living, 3.85-5.5 x 1.65-2.75 (av. 4.94 x 2.06) µm. Polar filament up to 155 µm.
Locality: U.S.A. (New York?).

Thelohania sp. Tanada, 1962

[?] "Microsporidian" Tanada & Chang [*partim*], 1962, J. Insect Pathol., 4, 129.
Thelohania sp. Tanada, 1962, *ibid.*,495.
Host and Site: [LEPIDOPTERA] The armyworm *Pseudaletia unipunctata* (Hayworth) larva, and (experimentally) the alfalfa caterpillar *Colias eurytheme* Boisduval.
Descriptive Data: None.
Locality: U.S.A. (Hawaii).

Thelohania sp. Thomas, 1971

Thelohania sp. Thomas *in* Sprague & Couch, 1971, J. Protozool., 18, 530.
Host and Site: [DECAPODA] The shrimp *Penaeus semisulcatus* de Hann; gonad and muscles.
Vegetative Stages: No data.
Sporulation Stages: "There are eight spores inclosed in a membrane."
Spore: "Oval with vacuole near broad end."
Locality: South India.
Remarks: The data above were contained in a personal communication from Dr. M. M. Thomas. Dr. E. S. Iversen examined spores supplied by Dr. Thomas and found that they "may be slightly more pointed" than spores of *T. duorara* Iverson & Manning "and have a smaller vacuole which seems to be flattened on one side rather than perfectly round" (personal communication).

Thelohania sp. Vernick, Sprague & Krause, in press

Thelohania sp. V., S. & K., J. Protozool. [in press].
Host and Site: [DECAPODA] *Pandalus jordani* Rathbun; skeletal muscle.
Vegetative Data: No data.
Sporulation Stages: Octosporous
Spore: Not described.
Locality: Canada (British Columbia).
Remarks: This species was reported in an electron microscope study that was concerned mainly with the Golgi complex. Another study to include more descriptive data is planned.

Thelohania sp. Vivares, 1973

Thelohania sp. Vivares, 1973, Vie Milieu, 23, 202.
Host: [DECAPODA] *Macropipus depurator*.
Vegetative Stages: No data.
Sporulation Stages: Octosporous.
Spore: 5 x 4 μm.
Locality: France (near Sète).

Thelohania sp. Wilson, 1975

Thelohania sp. Wilson, 1975, Can. J. Zool., 53, 1799, Figs. 1-7.
Host: [LEPIDOPTERA] *Choristoneura fumiferana*.
Vegetative Stages: Octosporous.
Spore: Fresh, 2.6 x 4.5 μm (2.1-3.2 x 4.3-4.8). Stained with Giemsa, 2.4 x 4.3 μm (1.9-3.0 x 3.8-4.8). Polar filament 123-300 μm (av. 190 μm).
Locality: Canada (Ontario) and U.S.A. (Minnesota).

Genus *Agmasoma* Hazard & Oldacre, 1975

Agmasoma penaei (Sprague, 1950) H. & O., 1975

Thelohania penaei Sprague, 1950, Occ. Pap. Mar. Lab. La. St. Univ., 5, 4, Fig. 2. Sprague & Couch, 1971, J. Protozool., 18, 530.
Agmasoma penaei (Sprague, 1950) H. & O., 1975, U. S. Dep. Agric. Tech. Bull. 1530, 8, Figs. 1-3.
Host and Site: [DECAPODA] The shrimps, *Penaeus setiferus* [type host] and *P. indicus*; gonad.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblast produces 8 spores.
Spore: Pyriform, 4 x 2.2 μm; polar filament 70 μm, with a thicker proximal half tapering abruptly to a thinner distal half. Macrospores 6-7 x 2.5-4.2 μm.
Locality: U.S.A. (vicinity of Grand Isle, Louisiana). South Africa.
Remarks: Type species by monotypy.

Genus *Amblyospora* Hazard & Oldacre, 1975

Amblyospora californica (Kellen & Lipa, 1960) H. & O., 1975

Thelohania californica K. & L., 1960, J. Insect Pathol., 2, 1, Figs. 1-32. Kellen & Wills, 1962, *ibid.*, 4, 45, Figs. 1, 10-15. Kellen & Wills, 1962, *ibid.*, 321. Kellen & Wills, 1963, Prog. Protozool. Proc. Int. Congr. Protozool., 1, 490. Kudo & Daniels, 1963, J. Protozool., 10, 112, Figs. 1-14. Kellen, Clark & Lindegren, 1966, Exp. Parasitol., 18, 251, Figs. 1-2. Kellen, Clark & Lindegren, 1967, J. Invertebr. Pathol., 9, 22.

Thelohania opacita Kudo, 1922. Weiser [*partim*]. 1961, Monogr. Angew. Entomol., 17, 113.

Nosema lunatum K., C. & L., 1967, J. Invertebr. Pathol., 9, 22, Figs. 41-59.

Amblyospora californica (K. & L., 1960) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 16, Figs. 8-11 [see this reference for fuller synonymy].

Host and Site: [DIPTERA-CULICIDAE] *Culex tarsalis* Coquillett, larva and adult; adipose tissue [K. & L.]. Ova of female [K. & W. (1962)]. Experimental infections in hybrids *Culex tarsalis* x *C. erythrothorax* and *C. tarsalis* x *C. peus* [K., C. & L. (1966)].

Vegetative Stages: Young schizonts uninucleate. Older schizonts have "twin nuclei" [diplocarya]. Autogamy occurs to produce a sporont nucleus [K. & L.].

Sporulation Stages: [In the male host] The sporont develops into a sporogonial plasmodium that produces 8 sporoblasts and, finally, 8 spores within a pansporoblastic membrane. These stages do not occur in the female [K. & W. (1963)]. In the adult female the diplocarya develop into isolated spores [K., C. & L. (1967)].

Spore: Octospore ovate, with a single elongated nucleus. Size when fresh 6.8-10.4 x 5.0-6.5 μm; when stained, 5.45-8.72 x 4.3-5.4 μm. Polar filament 57-156 μm, av. 106 μm. Monospore form crescent-shaped, 12.86 x 3.75 μm, binucleate.

Locality: U.S.A. (California).

Remarks: Transmission is transovarian. Electron microscopy by Kudo and Daniels demonstrated that the octospore has shape typical of *Thelohania* and unlike that of *Parathelohania*. Kellen *et al.* (1966), finding that the parasite does not develop normally in the hybrid hosts, concluded that it is probably host specific. Type species by original designation.

Amblyospora amphipodae H. & O., 1975

Amblyospora amphipodae H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 11, Figs. 4-7.

Host and Site: [AMPHIPODA] *Crangonyx richmondensis* Ellis; hepatopancreas.

Lesion: Whitish discolorations of hepatopancreas noted.

Vegetative Stages: No data.

Sporulation Stages: Octosporous. Granules of moderate size appear during sporogony, persist after spores become mature, and then some tubules are also present.

Spore: [First sequence] Broadly, oval, with ends equally truncate, 4.35-5.46 x 3.02-3.39 μm (fresh), without mucous envelope. Polar filament with 9 coils, the first 3-1/2-4 being broad and the remaining ones narrow. Spores suspected of belonging to a second sporulation sequence were conical, 9.06-10.3 x 3.55-3.76 μm, with thin exospore layer; polar filament with nearly 40 coils; binucleate (?).

Locality: U.S.A. (Florida).

Amblyospora benigna (Kellen & Wills, 1962) H. & O.,1975

Thelohania benigna K. & W., 1962, J. Insect Pathol., 4, 55, Figs. 9, 58-63. Kellen, Chapman, Clark & Lindegren, 1965, W H O/EBL/32.65, 2.

Amblyospora benigna (K. & W., 1962) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 14 [see this reference for fuller synonymy].

Host and Site: [DIPTERA-CULICIDAE] *Culex apicalis* Adams, larva; hemocoel [K. & W.], limited to adipose tissue [K., C., C. & L.], adipose tissue [H. & O.].

Lesion: One or 2 minute localized areas of infection were visible only when the host was viewed under a microscope.

Vegetative Stages: Concerning some or all of 8 species described, the authors said they saw uninucleate or binucleate, rarely quadrinucleate, schizonts.

Sporulation Stages: Sporont produces 8 spores.

Spore: Fresh, 4.15 x 2.68 μm. Stained, 4.02 x 2.95 μm.

Locality: U.S.A. (California).

Remarks: Hazard and Oldacre said that stages in the adult female are unknown.

Amblyospora bicortex (Baudoin, 1969) H. & O., 1975

Thelohania bicortex Baudoin, 1969, Protistologica, 5, 444, Figs. 5-9.

Amblyospora bicortex (Baudoin, 1969) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 14.

Host and Site: [TRICHOPTERA] *Phryganea grandis* and *Trichostegia minor*, larva; general infection.

Vegetative Stages: No data.

Sporulation Stages: Electron microscopy revealed a system of

tubules grouped around the sporoblasts within the pansporoblast.
Spore: Ovoid, 7.5 x 5.5 μm, with a thick exospore; polar filament 150 μm. Electron microscopy showed the exospore to be very irregular on the surface.
Locality: France (near Lake Chamboa).
Remarks: Hazard and Oldacre believe the spores seen in *Thelohania minor* were one of two spore forms belonging to *Amblyospora trichostegiae* (Baudoin, 1969).

Amblyospora bolinasae (Kellen & Wills, 1962) H. & O., 1975

Thelohania bolinasae K. & W., 1962, J. Insect Pathol., 4, 48, Figs. 3, 22-27.
Amblyospora bolinasae (K. & W., 1962) H. & O., 1975, U. S. Dep. Agric. Tech. Bull. 1530, 15 [see this reference for fuller synonymy].
Host and Site: [DIPTERA-CULICIDAE] *Aedes squamiger* (Coquillett), larva; hemocoel. In fat body [H. & O.].
Lesion: Heavily infected larvae had mottled appearance.
Vegetative Stages: Concerning some or all of 8 species studied, the authors said they saw uninucleate and binucleate, rarely quadrinucleate, schizonts.
Sporulation Stages: Sporont usually produced 8 spores, sometimes 4.
Spore: Fresh, 6.89 x 4.85 μm. Stained, 5.70 x 4.45 μm.
Locality: U.S.A. (California).

Amblyospora bracteata (Strickland, 1913) H. & O., 1975

"*Thelohania*-Form," "Octosporen," Lutz & Splendore, 1904, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I, Orig., 36, 646, Figs. 19, 24.
Nosema simulii γ L. & S., 1908, *ibid.*, 46, 312.
Glugea bracteata Strickland, 1913, J. Morphol., 24, 66, Pl. 2.
Thelohania bracteata (Strickland, 1913) Debaisieux & Gastaldi, 1919, Cellule, 30, 194, Figs. 40-60. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 150, Figs. 525-531. [?] Henrard, 1930, Rev. Zool. Bot. Afr., 19, 229. Jírovec, 1943, Zool. Anz., 31, 174. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae 18, 42. Thomson, 1960, J. Insect Pathol., 2, 357. Weiser, 1961, Monogr. Angew. Entomol., 17, 123. Vávra, 1965, C. R. Acad. Sci., 261, 3468, Figs. 1-3. Maurand, 1967, Ann. Parasitol. Hum. Comp., 42, 285, Fig. 5. Liu, Darley & Davies, 1971, J. Protozool., 18, 592, Figs. 1-3. Liu & Davies, 1972, Tissue Cell, 4, 1, Figs. 1-9. Liu & Davies, 1972, Parasitology, 64, 341, Pls. 1-3. Liu & Davies, 1972, J. Protozool., 19, 461, Figs. 1-10. Liu & Davies, 1972, J. Invertebr. Pathol., 19, 208, Figs. 1-9. Liu & Davies, 1972, J. Invertebr. Pathol., 20, 176, Figs. 1-4. Liu, 1972, J. Parasitol., 58, 1151, Figs. 1-7.

Liu & Davies, 1973, J. Protozool., 20, 622, Figs. 1-7.
Liu & Davies, 1973, Can. J. Zool., 51, 217, Pls. 1, 2.
Liu & Liu, 1974, J. Morphol., 143, 337, Figs. 1-8.
Amblyospora bracteata (Strickland, 1913) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 15.

Host and Site: [DIPTERA-SIMULIIDAE] *Simulium bracteatum* Coquillett [should be *S. aureum* Fries, according to H. & O.] and *S. hirtipes* Fries, larva; fat body [Strickland]. Found in *Simulium* sp. by Lutz and Splendore (1904, 1908), in *S. maculatum* Meig. by Debaisieux & Gastaldi, in *S.* sp. by Henrard, in *S.* sp by Jírovec, in *S. vittatum* Zetterstedt by Liu *et al.* (1971). Maurand added *S. monticola*, *S. ornatum*, and *S. variegatum*. Hazard and Oldacre designated *S. aureum* as the host. Weiser (1961) listed also *S. ocraceum* Coq. and *S. venustum* Say as hosts.

Vegetative Stages: Very little reliable data. Strickland mistook the hypertrophied host cells for myxosporidiums. Debaisieux and Gastaldi found a few plasmodia and many diplocarya. A zygote was formed by fusion of paired nuclei.

Sporulation Stages: Sporont develops into 8 sporoblasts and these transform into 8 spores. The pansporoblastic membrane normally persists until spores are formed and then disappears [Strickland]. Liu *et al.* (1971) studied the fine structure of the pansporoblastic membrane and its contents.

Spore: Regularly ovoidal, 3.5 x 2.5 μm, polar filament 35 μm [L. & S. (1904)]. Short-elliptical, 3 x 2.5-2.7 μm [Strickland].

Locality: Brazil [L. & S.]. U.S.A. (Boston) [Strickland]. Belgium (Louvain) [D. & G.]. Belgian Congo [Henrard]. Czechoslovakia (near Prague and Chotěboř) [Jírovec]. Canada (Ontario) [L. D. & D.]. France (Montpellier) [Maurand].

Remarks: 1904 is usually given as the date when the name *Nosema simulii* was proposed. Lutz and Splendore actually described three forms of this "species" in 1904, but they did not apply this name to them until 1908. The name *simulii* was reserved for the β form by Jírovec in 1943 (see *Pleistophora simulii*). Hazard and Oldacre mentioned only one host, *S. aureum*. They feel that the microsporidia reported in other hosts are distinct species.

Amblyosporo callosa H. & O., 1975

Amblyospora callosa H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 19, Figs. 12-15.

Host and Site: [TRICHOPTERA] *Rhyacophila fuscula* (Walker), larva; adipose tissue.

Vegetative Stages: No data.

Sporulation Stages: One sequence results in 8 spores within a rather persistent pansporoblastic membrane; sporogony accompanied by formation of large and minute granules. Another sequence ends with isolated spores.

Spores: Those of one sequence, turncate at both ends, 2.32-2.92 x 2.07-2.49 µm (preserved), with thick exospore and thinner endospore; polar filament with 5 thick proximal coils and 6 narrow distal coils. Those of other sequence similar to those of *A. amphipodae* but smaller, 3.02-4.08 x 1.64-2.60 µm, and with polar filament forming 15 coils.
Locality: U.S.A. (Massachusetts).

Amblyospora campbelli (Kellen & Wills, 1962) H. & O., 1975

Thelohania campbelli K. & W., 1962, J. Insect Pathol., 4, 51, Figs. 6, 40-45. Kellen, Chapman, Clark & Lindegren, 1965, W H O/EBL/ 32-65, 7.
Amblyosporoa campbelli (K. & W., 1962) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 20 [see this reference for fuller synonymy].
Host and Site: [DIPTERA-CULICIDAE] *Culiseta incidens* (Thomson), larva; hemocoel.
Lesion: Infected larva usually swollen and dull grayish-white.
Vegetative Stages: Concerning some or all of 8 species described, the authors said they saw uninucleate and binucleate, rarely quadrinucleate, schizonts.
Sporulation Stages: Sporonts usually produce 8, sometimes 4, spores.
Spore: Fresh, 6.01 x 4.13 µm. Stained, 5.47 x 3.38 µm.
Locality: U.S.A. (California).
Remarks: E. I. Hazard (personal communication) believes that infection said by Kellen and Wills to be in the hemocoel were actually in the fat body.

Amblyospora canadensis (Wills & Beaudoin, 1965) H. & O., 1975

Thelohania inimica canadensis W. & B., 1965, J. Invertebr. Pathol., 7, 11, Figs. 1, 2. Bailey, Barnes & Dewey, 1967, *ibid.*, 9, 354, Figs. 1-7.
Amblyospora canadensis (W. & B., 1965) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 22, Figs. 16-18 [see this reference for fuller synonymy].
Host and Site: [DIPTERA-CULICIDAE] *Aedes canadensis* (Theobald), larva; adipose tissue.
Vegetative Stages: No data.
Sporulation Stages: Sporont produces 8 spores.
Spore: Stained, 5.42 x 1.19 µm.
Locality: U.S.A. (Pennsylvania and Maryland).

Amblyospora gigantea (Kellen & Wills, 1962) H. & O., 1975

Thelohania gigantea K. & W., 1962, J. Insect Pathol., 4, 46, Figs. 2, 16-21.

Amblyospora gigantea (K. & W., 1962) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 25 [see this reference for fuller synonymy].
Host and Site: [DIPTERA-CULICIDAE] *Culex erythrothorax* Dyar, larva; hemocoel.
Lesion: Heavily infected larva opaque white.
Vegetative Stages: Concerning some or all of 8 species studied, the authors said they saw uninucleate and binucleate, rarely quadrinucleate, schizonts.
Sporulation Stages: Sporont usually produced 8 spores, sometimes 4.
Spore: When fresh, 8.10 x 5.48 μm. Stained, 6.69 x 5.18 μm.
Locality: U.S.A. (California).
Remarks: E. I. Hazard (personal communication) believes that infection said by Kellen and Wills to be in the hemocoel were actually in the fat body.

Amblyospora inimica (K. & W., 1962) H. & O., 1975

Thelohania inimica K. & W., 1962, J. Insect Pathol., 4, 53, Figs. 7, 46-51.
Amblyospora inimica (K. & W., 1962) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 26 [see this reference for fuller synonymy].
Host and Site: [DIPTERA-CULICIDAE] *Culiseta inornata* (Williston), larva; hemocoel.
Lesion: Infected larvae swollen and grayish-white.
Vegetative Stages: Concerning some or all of 8 species described, the authors said they saw uninucleate and binucleate, rarely quadrinucleate, sporonts.
Sporulation Stages: Sporonts usually produce 8 spores, sometimes 4.
Spore: Fresh, 5.73 x 3.92 μm. Stained, 5.43 x 4.11 μm.
Locality: U.S.A. (California).
Remarks: E. I. Hazard (personal communication) believes that infections said by Kellen and Wills to be in the hemocoel were actually in the fat body.

Amblyospora keenani H. & O., 1975

Amblyospora keenani H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 28, Figs. 21-24.
Host and Site: [DIPTERA-CULICIAE] *Aedeomyia squamipennis* (Lynch Arribalzaga), larva; adipose tissue.
Lesion: Infection shows through the cuticle as scattered white spots.
Vegetative Stages: No data.
Sporulation Stages: Only an octosporous sequence known. Sporogony accompanied by formation of granules that clump into large particles, tending to disappear later.

Spore: 4.19-4.79 x 2.76-3.23 µm (fresh), 2.76-3.29 x 1.96-2.49 µm (preserved). Macrospores 3.82-6.10 x 2.49, without visible vacuole in life; with thin mucous envelope. Polar filament with 6 thick proximal coils and 2 thin distal coils.
Locality: Panama Canal Zone.

Amblyospora khaliulini H. & O., 1975

Thelohania sp. Nöller, 1920, Arch. Protistenkd., 41, 187 [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 158, 207]. Kudo, *loc. cit.*, Fig. 558.
Thelohania sp. Welch, 1960, J. Insect Pathol., 2, 386, Figs. 1, 2.
Thelohania opacita var. *mariensis* Khaliulin & Ivanov, 1971, Parasitologiya, 5, 100, Figs. 1-3.
Amblyospora khaliulini H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 30, Figs. 25, 26 [see this reference for more extensive synonymy].
Host and Site: [DIPTERA-CULICIDAE] *Aedes communis* (DeGeer) [= *A. nemorosus* of Noller], larva; haemolymph and adipose tissue.
Vegetative Stages: No data.
Sporulation Stages: Only one sequence known. Sporogony accompanied formation of large vacuolate aggregations of granules that tend to disappear fully. Occasionally tetrasporous [Welch].
Spore: Living, 6.05-7.26 x 4.2-4.8 µm; truncate at both ends, posterior end invaginated (Bouin-Heidenhain preparations). Polar filament with 3-1/2 coils in broad proximal portion [H. & O.]. Oval, 5.6-8.7 x 3.4-5.3 (av. 7.4 x 4.6) µm [Welch].
Locality: [As given by Hazard and Oldacre] Canada (Manitoba); Czechoslovakia; Germany; U.S.A. (Alaska, Massachusetts); U.S.S.R. (Mari ASSR).

Amblyospora lairdi (Weiser, 1965) H. & O., 1975

Thelohania lairdi Weiser, 1965, Zool. Anz., 175, 232, Figs. 1, 2D-O.
Amblyospora lairdi (Weiser, 1965) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 32.
Host and Site: [TRICHOPTERA] *Polycentropus flavomaculatus* Pict., larva; fat body.
Vegetative Stages: After a series of divisions of the oval schizont, stages with large nuclei showing chromosomes arise.
Sporulation Stages: During sporogony, the pansporoblast differentiates an outer zone of cytoplasm into which chromatin clumps are discharged when the nucleus undergoes its first (reduction) division. Sporoblasts uninucleate, egg-shaped, 4-4.5 x 4 µm.

Spore: With gelatinous covering, up to 15 μm in diameter. Dimensions not given, although those given for the sporoblast may have been intended for the spore.
Locality: Czechoslovakia (River Doubravka near Bilke, Southeast Bohemia) [Weiser].

Amblyospora minuta (Kudo, 1924) H. & O., 1975

Thelohania minuta Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 163, Figs. 745-748. Kudo, 1925, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I Orig., 96, 436, Figs. 73-86.
[*non*] *Thelohania minuta* Gassouma, 1972, Parasitology, 65, 30, Pl. 2A.
Thelohania rotunda Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 162, Figs. 743, 744. Kudo, 1925, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I Orig., 96, 435, Figs. 59-61.
Amblyospora minuta (Kudo, 1924) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 32, Figs. 27-29 [see this reference for fuller synonymy].
Host and Site: [DIPTERA-CULICIDAE] *Culex erraticus* (Dyer & Knab) (= *C. lepricini* of Kudo), larva; adipose tissue.
Lesion: "The posterior part of the body showed some masses of the parasite that were visible with the unaided eye" [Kudo (1925)].
Vegetative Stages: No data.
Sporulation Stages: Octosporous [Kudo]. Accompanied by secretion of large granules of uniform size, some aggregating to form large particles [H. & O.]. "We have seen a few oblong spores in adult females which we believe to be monospores" [H. & O.].
Spore: The normal (*minuta*) type in larva, fresh, ovoid with equally rounded ends, 3.5-3.9 x 2.4-2.7 μm; stained, truncate at ends, 2.5-3.3 x 1.5-2 μm. Aberrant (*rotunda*) type, stained, broadly oval or subspherical, 2.5-3 x 2.3-2.7 μm [Kudo]. Polar filament of normal spores with 4 coils, the broad proximal portion consisting of 2-1/2 coils; the *rotunda* spores, being aberrant, did not show good structural detail with electron microscopy; sporulation stages in adult female not studied by electron microscopy [H. & O].
Locality: U.S.A. (Georgia, Louisiana).
Remarks: Kudo used the names *Thelohania minuta* and *T. rotunda*, in 1924, in anticipation of the original descriptions which were than in press but which did not appear in print until 1925. Hazard and Oldacre combined these forms because they found both kinds of spores mixed together within a common pansporoblastic membrane and considered the *rotunda* forms to be aberrant.

Amblyospora mojingensis H. & O., 1975

Amblyospora mojingensis H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 36, Figs. 30, 31.

Host and Site: [DIPTERA-CULICIDAE] *Anopheles eiseni* Coquillett, larva; adipose tissue.
Vegetative Stages: No data.
Sporulation Stages: Only the octosporous sequence known.
Spore: Preserved microspores, 2.6-3.5 x 2.4-2.6 μm; macrospores, 3.7-4.5 x 2.8-3.3 μm. Polar filament with 7 coils, 4 in the broad proximal portion.
Locality: Panama Canal Zone.

Amblyospora noxia (Kellen & Wills, 1962) H. & O., 1975

Thelohania noxia K. & W., 1962, J. Insect Pathol., 4, 49, Figs. 4, 28-33.
Amblyospora noxia (K. & W., 1962) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 38.
Host and Site: [DIPTERA-CULICIDAE] *Culex thriambus* Dyar, larva; adipose tissue.
Lesion: Infected larva was dull gray ventrally.
Vegetative Stages: Concerning some or all of 8 species studied, the authors said they saw uninucleate and binucleate, rarely quadrinucleate, schizonts.
Sporulation Stages: Sporonts usually produce 8 spores, sometimes 4.
Spore: Fresh, 6.58 x 4.47 μm. Stained, 5.34 x 4.04 μm.
Locality: U.S.A. (California).

Amblyospora opacita (Kudo, 1922) H. & O., 1975

Thelohania opacita Kudo, 1922, J. Parasitol., 8, 75, Fig. A. Kudo, 1924, J. Parasitol., 11, 84, Textfig. + Figs. 1-33. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 159. Weiser, 1961, Monogr. Angew. Entomol., 17, 112, Fig. 51.
[?] *Parathelohania opacita*. Fowler & Reeves, 1975, J. Invertebr. Pathol., 26, 1, Fig. 9.
Amblyospora opacita (Kudo, 1922) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 38, Figs. 32-36 [see this reference for fuller synonymy].
Host and Site: [DIPTERA-CULICIDAE] *Culex territans*, and *Culex* sp., larva; fat body. Also reported in *Aedes nemorosus* by Weiser (1946), and in *A. vexans* Meig., *A. annulipes* Meig., and *A. communis* Deg. by Weiser (1961) and by Khaliulin & Ivanov (1971). Weiser said Bresslau and Buschkeil (1919) found probably the same species in *Theobaldia annulata* Schrk. [= *Culiseta annulata*]
Lesion: Body of infected larva strinkingly opaque.
Vegetative Stages: Schizonts multiply by binary fission. At the end of schizogony binucleate forms are formed. After fusion of the nuclei the sporont is produced.
Sporulation Stages: Usually octosporous, sometimes tetrasporous with production of abnormally large spores.

Spore: Broadly elliptical, normal spores 5.5-6 x 3.5-4 µm; polar filament 110 µm. Abnormal spores, 8-8.5 x 4.5-5.5 µm) with polar filament 200 µm. Spore covered by gelatinous capsule [Weiser (1969)].
Locality: U.S.A. (New York, Alabama, Georgia). Czechoslovakia (Chatěboř).
Remarks: The identification as *T. opacita* of parasites found in mosquitoes other than the type host should be regarded as provisional. This species was described in the December, 1921, issue of the Journal of Parasitology which was actually issued 16 January 1922. The latter date is, therefore, the effective date of publication of the name. Kudo identified the host as *Culex testaceus (C. apicalis)* but Hazard and Oldacre say the correct identification is *C. territans* Walker.

Amblyospora trichostegiae (Baudoin, 1969) H. & O., 1975

Thelohania trichostegiae Baudoin, 1969, Protistologica, 5, 444, Figs. 1-4.
Amblyospora trichostegiae (Baudoin, 1969) H. & O., 1975, U. S. Dept. Agric. Tech. Bull., 1530, 42.
Host and Site: [TRICHOPTERA] *Trichostegia minor*, larva; fat body at first and then silk glands and digestive tubes.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblasts, 15 µ in diameter, contain 8 spores.
Spore: Pyriform, 8.5 x 4 µm; polar filament 150 µm. Internal details were revealed with electron microscopy.
Locality: France (near Clermont-Ferrand).
Remarks: Baudoin found other spores which he identified as *Thelohania bicortex*. Hazard and Oldacre believe they represent a second spore form of *A. trichostegiae*.

Amblyospora unica (Kellen & Wills, 1962) H. & O., 1975

Thelohania unica K. & W., 1962, J. Insect Pathol., 4, 49, Figs. 5, 34-39.
Amblyospora unica (K. & W., 1962) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 43.
Host and Site: [DIPTERA-CULICIDAE] *Aedes melanimon* Dyar, larva; adipose tissue.
Lesion: Infected larva was grayish-white ventrally.
Vegetative Stages: Concerning some or all of 8 species described, the authors said they saw uninucleate and binucleate, rarely quadrinucleate, schizonts.
Sporulation Stages: Sporonts usually produce 8 spores, sometimes 4.
Spore: Fresh, 6.53 x 4.97 µm. Stained, 5.63 x 4.42 µm.
Locality: U.S.A. (California).

Remarks: E. I. Hazard (personal communication) believes that infections said by Kellen and Willis to be in the hemocoel were actually in the fat body.

Amblyospora sp. Hazard & Chapman , in press

Amblyospora sp. H. & C., W H O Bull. in press.
Host: [DIPTERA-CULICIDAE] *Aedes thibaulti* Dyar & Knab.
Other Data: None

Amblyospora sp. H. & C., in press

Amblyospora sp. H. & C., W H O Bull. in press.
Host: [DIPTERA-CULICIDAE] *Culex pipiens pipiens* L.
Other Data: None

Amblyospora sp. Hazard & Oldacre, 1975

Thelohania nr. *opacita* Anderson, 1968, J. Invertebr. Pathol., 11, 442, Figs. 5-10.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 43.
Host and Site: [DIPTERA-CULICIDAE] *Aedes abserratus* (Felt & Young), larva; fat body.
Development Stages: Octosporous.
Spore: Fresh, 7.0 x 5.1. Stained, 6.2 x 4.9.
Locality: U.S.A. (Connecticut).

Amblyospora sp. H. & O., 1975

Thelohania opacita. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 113.
Amblyospora sp. H. & O., 1975, U.S. Dep. Agric. Tech. Bull., 1530, 43.
Host: [DIPTERA-CULICIDAE] *Aedes annulipes* (Meigen).
Descriptive Data: None
Locality: Czechoslovakia.

Amblyospora sp. H. & O., 1975

Thelohania nr. *opacita* Anderson, 1968, J. Invertebr. Pathol., 11, 442, Figs. 17-22.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 43.
Host and Site: [DIPTERA-CULICIDAE] *Aedes cantator* (Coquillett), larva; fat body.
Development Stages: Octosporous.
Spore: Fresh, 7.1 x 4.9 μm. Stained, 6.2 x 4.7 μm.
Locality: U.S.A. (Connecticut).

Amblyospora sp. H. & O., 1975

Thelohania opacita. Tour, Rioux & Croset, 1971, Ann. Parasitol. Hum. Comp., 46, 209, Fig. 5(?).
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 43.
Host and Site: [DIPTERA-CULICIDAE] *Aedes caspius* (Pallas), larva; fat body(?).
Developmental Stages: Mostly sporulation stages seen.
Spore: Microspores (more common) and macrospores, 5-9 x 3-6 μm.
Locality: France (south).

Amblyospora sp. H. & O., 1975

Thelohania sp. Kellen, Chapman, Clark & Lindegren, 1965, J. Invertebr. Pathol., 7, 163.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 43.
Host and Site: [DIPTERA-CULICIDAE] *Aedes cataphylla* Dyar, larva; fat body.
Developmental Stages: Sporulation seen in male larva only.
Spore: 6.43 x 4.49 μm.
Locality: U.S.A. (California.

Amblyospora sp. H. & O., 1975

Thelohania nr. *opacita* Anderson, 1968, J. Invertebr. Pathol., 11, 442, Figs. 35-40.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 43.
Host and Site: [DIPTERA-CULICIDAE] *Aedes cinereus* (Meigen), larva; fat body.
Developmental Stages: Octosporous.
Spore: Fresh, 6.8 x 4.9 μm. Stained, 5.9 x 4.4 μm.
Locality: U.S.A. (Connecticut).

Amblyospora sp. H. & O., 1975

Thelohania opacita. Tour, Rioux & Croset, 1971, Ann. Parasitol. Hum. Comp., 46, 209, Fig. 5(?).
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 43.
Host and Site: [DIPTERA-CULICIDAE] *Aedes detritus* (Haliday), larva; fat body(?).
Developmental Stages: Mostly sporulation stages seen.
Spore: Microspores (more common) and macrospores, 5-9 x 3-6 μm.
Locality: France (south).

Amblyospora sp. H. & O., 1975

Thelohania sp. Kellen, Chapman, Clark & Lindegren, 1965, J. Invertebr. Pathol., 7, 163.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 43.

Host and Site: [DIPTERA-CULICIDAE] *Aedes dorsalis* (Meigen), larva; oenocyte and fat body.
Developmental Stages: Spore stages found in both males and females.
Spore: 7.18 x 4.76 µm.
Locality: U.S.A. (California).

Amblyospora sp. H. & O., 1975

Thelohania nr. *opacita* Anderson, 1968, J. Invertebr. Pathol., 11, 442, Figs. 23-28.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 43.
Host and Site: [DIPTERA-CULICIDAE] *Aedes excrucians* (Walker), larva; fat body.
Developmental Stages: Octosporous.
Spore: Fresh, 6.8 x 4.8 µm. Stained, 6.3 x 5.2 µm.
Locality: U.S.A. (Connecticut).

Amblyospora sp. H. & O., 1975

Thelohania sp. Chapman, Gorham & Fukuda, 1973, Mosq. News. 33, 465-466 [*fide* H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44].
Amblyospora sp., H. & O., 1975, *loc. cit.*
Host: [DIPTERA-CULICIDAE] *Aedes fitchii* (Felt & Young).
Descriptive Data: Not on hand.
Locality: U.S.A. (Alaska).

Amblyospora sp. H. & O., 1975

Thelohania sp. Chapman, Woodward, Kellen & Clark, 1966, J. Invertebr. Pathol., 8, 453.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Host and Site: [DIPTERA-CULICIDAE] *Aedes grossbecki* Dyar & Knab, larva; oenocyte.
Developmental Stages: Sporulation seen in male larva only.
Spore: 7.06 x 4.92 µm.
Locality: U.S.A. (Louisiana).

Amblyospora sp. H. & O., 1975

Thelohania sp. Kellen, Chapman, Clark & Lindegren, 1965, J. Invertebr. Pathol., 7, 163.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Host and Site: [DIPTERA-CULICIDAE] *Aedes hexodontis* Dyar, larva; fat body.
Developmental Stages: Sporulation stages seen in male larva only.
Spore: 7.33 x 5.49 µm.
Locality: U.S.A. (California).

Amblyospora sp. H. & O., 1975

Thelohania sp. Kellen, Chapman, Clark & Lindegren, 1965, J. Invertebr. Pathol., 7, 163.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Host and Site: [DIPTERA-CULICIDAE] *Aedes increpitus* Dyar, larva; oenocyte.
Developmental Stages: Sporulation stages in male larva only.
Spore: 6.44 x 4.90 µm.
Locality: U.S.A. (California).

Amblyospora sp. H. & O., 1975

Thelohania sp. Chapman, Gorham & Fukuda, 1973, Mosq. News, 33, 465-466 [*fide* H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Amblyospora sp. H. & O., 1975, *loc. cit.*
Host: [DIPTERA-CULICIDAE] *Aedes pullatus* (Coquillett).
Descriptive Data: Not on hand.
Locality: U.S.A. (Alaska).

Amblyospora sp. H. & O., 1975

Thelohania sp. Chapman, Gorham & Fukuda, 1973, Mosq. News, 33, 465-466 [*fide* H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Amblyospora sp. H. & O., 1975, *loc. cit.*
Host: [DIPTERA-CULICIDAE] *Aedes punctor* (Kirby).
Descriptive Data: Not on hand.
Locality: U.S.A. (Alaska).

Amblyospora sp. H. & O., 1975

Thelohania sp. Chapman, Gorham & Fukuda, 1973, Mosq. News, 33, 465-466 [*fide* H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Amblyospora sp. H. & O., 1975 *loc. cit.*
Host: [DIPTERA-CULICIDAE] *Aedes riparius* Dyar & Knab.
Descriptive Data: Not on hand.
Locality: U.S.A. (Alaska).

Abmlyospora sp. H. & O., 1975

Thelohania sp. Kellen, Chapman, Clark & Lindegren, 1966, J. Invertebr. Pathol., 8, 356.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Host and Site: [DIPTERA-CULICIDAE] *Aedes sollicitans* (Walker), larva; fat body.
Developmental Stages: No data.
Spore: 5.96 x 3.03 µm.
Locality: U.S.A. (Louisiana).
Remarks: Descriptive data from Chapman *et al.* (1966).

Amblyospora sp. H. & O., 1975

Thelohania sp. Chapman, Woodward, Kellen & Clark, 1966, J. Invertebr. Pathol., 8, 453.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Host and Site: [DIPTERA-CULICIDAE] *Aedes sticticus* (Meigen), larva; oenocyte.
Developmental Stages: Seen in male only.
Spore: 6.96 x 4.71 µm.
Locality: U.S.A. (Louisiana).

Amblyospora sp. H. & O., 1975

Thelohania sp. Franz & Hagmann, 1962, Mosq. News, 22, 302.
Thelohania nr. *opacita* Anderson, 1968, J. Invertebr. Pathol., 11, 442, Figs. 29-34.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Host and Site: [DIPTERA-CULICIDAE] *Aedes stimulans* (Walker), larva; fat body.
Lesion: Fat body lumpy and white or body of larva opaque green except for head capsule and breathing tubes. In late stages the body disintegrates and the larva becomes a sac of spores.
Descriptive Stages: No data.
Sporulation Stages: Octosporous.
Spore: Fresh, 7.2 x 3.9 µm; stained, 5.9 x 4.6 µm [Anderson].
Locality: U.S.A. (New Jersey and Connecticut).

Amblyospora sp. H. & O., 1975

Thelohania sp. Kellen, Chapman, Clark & Lindegren, 1966, J. Invertebr. Pathol., 8, 356. Chapman, Woodward, Kellen & Clark, 1966, J. Invertebr. Pathol., 8, 453.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Host and Site: [DIPTERA-CULICIDAE] *Aedes taeniurhynchus* (Weidemann), larva; fat body.
Developmental Stages: No data.
Spore: 5.13 x 2.85 µm.
Locality: U.S.A. (Louisiana).
Remarks: Descriptive data from Chapman *et al.*

Amblyospora sp. H. & O., 1975

Thelohania sp. Kellen, Chapman, Clark & Lindegren, 1965, J. Invertebr. Pathol., 7, 163.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Host and Site: [DIPTERA-CULICIDAE] *Aedes ventrovittus* Dyar.
Developmental Stages: Sporulation stages seen in male larva only.

Spore: 6.48 x 4.47 μm.
Locality: U.S.A. (California).

Amblyospora sp. H. & O., 1975
Thelohania opacita. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 113.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull. 1530, 44.
Host: [DIPTERA-CULICIDAE] *Aedes vexans* (Meigen).
Developmental Stages: No data.
Locality: Czechoslovakia.

Amblyospora sp. H. & O., 1975
Thelohania opacita. Laird, 1956, Bull. Roy. Soc. N. Z., 6 [*fide* H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44].
Amblyospora sp. H. & O., 1975, *loc. cit.*
Host: [DIPTERA-CULICIDAE] *Culex annulirostris* Skuse.
Descriptive Data: Not on hand.
Locality: South Pacific.

Amblyospora sp. H. & O., 1975
Thelohania sp. Chapman, Clark, Peterson & Woodward, 1969, Proc. N. J. Mosq. Exterm. Assoc., 56, 205.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Host: [DIPTERA-CULICIDAE] *Culex peccator* Dyar & Knab.
Descriptive Data: None
Locality: U.S.A. (Louisiana).

Amblyospora sp. H. & O., 1975
Thelohania sp. Kellen, Chapman, Clark & Lindegren, 1965, J. Invertebr. Pathol., 7, 163.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Host and Site: [DIPTERA-CULICIDAE] *Culex peus* Speiser, larva; fat body(?).
Developmental Stages: No data.
Spore: 5.43 x 4.00 μm.
Locality: U.S.A. (Louisiana).

Amblyospora sp. H. & O., 1975
Thelohania sp. Kellen, Chapman, Clark & Lindegren, 1966, J. Invertebr. Pathol., 8, 356.
Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.
Host: [DIPTERA-CULICIDAE] *Culex salinarius* Coquillett.
Descriptive Data: None.
Locality: U.S.A. (Louisiana).

Amblyospora sp. H. & O., 1975

Thelohania sp. Bresslau *in* Bresslau & Buschkiel, 1919, Biol. Zentralbl., 39, 327. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 158. Kudo, 1960, AIBS (Am. Inst. Biol. Sci.) Tech. Rep., pp. 52.

Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.

Host and Site: [DIPTERA-CULICIDAE] *Culiseta (Theobalida) annulata*, larva; body completely filled parasites.

Developmental Stages: "All developmental stages" mentioned but not described, excepting that beautiful chromosomes were present in the nuclei of sporulation stages.

Spore: No data.

Locality: Germany.

Amblyospora sp. H. & O., 1975

Thelohania sp. Tsai, Grundmann & Rees, 1969, Mosq. News, 29, 102-110 [*fide* H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 45.].

Amblyospora sp. H. & O., 1975 *loc. cit.*

Host: [DIPTERA-CULICIDAE] *Culiseta impatiens* (Walker).

Other Data: Not on hand.

Amblyospora sp. H. & O., 1975

Thelohania sp. Kellen, Chapman, Clark & Lindegren, 1965, J. Invertebr. Pathol., 7, 163.

Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 45.

Host and Site: [DIPTERA-CULICIDAE] *Culiseta particeps* (Adams), larva; fat body.

Developmental Stages: No data.

Spore: 6.35 x 4.27 μm.

Locality: U.S.A. (California).

Amblyospora sp. H. & O., 1975

Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 45.

Host: [DIPTERA-CULICIDAE] *Manosonia dyari* Belkin, Heinemann & Page.

Other Data: None.

Amblyospora sp. H. & O., 1975

Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 45

Host: [DIPTERA-CULICIDAE] *Mansonia leberi* Boreham.

Other Data: None.

Amblyospora sp. H. & O., 1975

Stempellia sp. Chapman, Woodward & Peterson, 1967, Proc. N. J. Mosq. Exterm. Assoc., 54, 56.

Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 44.

Host: [DIPTERA-CULICIDAE] *Mansonia perturbans* = *Coquillettidia perturbans* (Walker), according to Hazard and Oldacre, 1975.

Descriptive Data: None.

Locality: U.S.A. (Louisiana).

Amblyospora sp. H. & O., 1975

Thelohania sp. Chapman, Woodward, Kellen & Clark, 1966, J. Invertebr. Pathol., 8, 453.

Amblyospora sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 45.

Host and Site: [DIPTERA-CULICIDAE] *Psorophora confinnis* (Lynch Arribalzaga), larva; fat body.

Developmental Stages: No data.

Spore: 5.29 x 3.61 µm.

Genus *Chapmanium* H. & O., 1975

Chapmanium cirritus H. & O., 1975

Thelohania sp. Chapman, Clark, Peterson & Woodward, 1969, Proc. N. J. Mosq. Exterm. Assoc., 56, 204, 206.

Chapmanium cirritus H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 46, Figs. 37-40.

Host and Site: [DIPTERA-CHIRONOMIDAE] *Corethrella brakeleyi* (Coquillett), larva; adipose tissue.

Vegetative Stages: No data.

Sporulation Stages: Pansporoblast fusiform. Sporogony by endogenous budding, accompanied by formation of many filaments that connect the spores to the pansporoblastic membrane. Only the octosporous sequence known.

Spore: Live, 2.92-3.80 x 1.33-1.91 µm. Exospore thin. Polar filament with 6-1/2 coils, 4-1/2 composing the thick proximal portion.

Remarks: Type species by original designation.

Chapmanium macrocystis (Gurley, 1893) H. & O., 1975

Thelohania macrocystis Gurley, 1893, Bull. U. S. Fish Com. for 1891, 11, 410, Pl. 12-Fig. 3. Kudo, 1924, Ill. Biol. Monogr. 9(2/3), 136, Figs. 446-448.
Chapmanium macrocystis (Gurley, 1893) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 47 [see this article for fuller synonymy].
Host and Site: [DECAPODA] The shrimp *Palaemonetes varians*; muscle.
Vegetative Stages: No data.
Sporulation Stages: Within an elongate fusiform sporophorous vesicle 8 spores develop.
Spore: Pyriform.
Locality: Italy (vicinity of Verona).
Remarks: Gurley, taking his data from a paper by Garbini (1891) [unavailable to me], named the species in 1893 and described it more fully in 1894. Kudo (1924) called this "a doubtful form." Hazard and Oldacre placed it only "tentatively" in genus *Chapmanium*.

Chapmanium nepae (Lipa, 1966) H. & O., 1975

Thelohania nepae Lipa, 1966, J. Invertebr. Pathol., 8, 163, Figs. 5-7.
Chapmanium nepae (Lipa, 1966) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 48.
Host and Site: [HEMIPTERA] *Nepa cinerea* L., adult; fat body and midgut.
Vegetative Stages: Meronts spherical, 2-4 μm, uni- or binucleate.
Sporulation Stages: Sporogony results in 8 sporoblasts within an ellipsoidal pansporoblast. The sporoblasts transform into 8 spores.
Spore: Slightly elongated, 2-3 x 1.4-1.8 μm in Giemsa smears.
Locality: Poland.
Remarks: One of two infected host individuals contained also *Nosema nepae* Poisson, 1928.

Genus *Cryptosporina* Hazard & Oldacre, 1975

Cryptosporina brachyfila H. & O., 1975

Crytosporina brachyfila H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 50, Figs. 41-43.
Host and Site: [ARACHNIDA] The water mite *Piona* sp.; adipose tissue.
Vegetative Stages: No data.
Sporulation Stages: Only an octosporous sequence known. Sporogony accompanied by formation of many dark amber particles that obscure the spore in fresh preparations. Pansporoblastic membrane very persistent.

Spore: Uninucleate, with thin and rugose wall, 1.80-1.91 x 0.53-0.80 (av. 1.86 x 0.71) µm (fixed); polar filament with no more than 3 coils, uniform in diameter.
Locality: U.S.A. (Florida).
Remarks: Type species by monotypy.

Genus *Heterosporis* Schubert, 1969

Heterosporis finki Schubert, 1969

Heterosporis finki Schubert, 1969, Z. Parasitenkd., 32, 59, Figs. 1-12. Schubert, 1969, *ibid.*, 80, Figs. 1-10.
Host and Site: [PISCES] *Pterophyllum scalare;* connective tissue around oesophagus.
Lesion: Small lumps in the oesophagus.
Vegetative Stages: No data.
Sporulation Stages: Usually 8 spores, sometimes 16 smaller ones, develop within a pansporoblastic membrane. Many pansporoblasts develop within a host cell. Infected and hypertrophied host cell reaches 300 µm in diameter and has a wall 2-3 µm thick. The wall may rupture and liberate spores into the connective tissue.
Spore: Elliptical, mostly 7-9 x 2-3 µm, small ones 3 x 1.5 µm.
Locality: Germany (host found in aquarium, origin unknown).
Remarks: Type species by monotypy.

Genus *Hyalinocysta* Hazard & Oldacre, 1975

Hyalinocysta chapmani H. & O., 1975

Hyalinocysta chapmani H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 52, Figs. 44-47.
Host and Site: [DIPTERA-CULICIDAE] *Culiseta melanura* Coquillett, larva; adipose tissue.
Vegetative Stages: No data.
Sporulation Stages: Only the octosporous sequence known. Pansporoblasts oval, void of metabolic products.
Spore: Pyriform, with thin mucous envelope, 4.34-4.76 x 2.38 2.80 (av. 4.41 x 2.62) µm preserved; polar filament with 7-8 coils, the distal 3-1/2 coils being markedly reduced in diameter. Polaroplast with tightly compressed lamellae anteriorly and expanded sacs posteriorly.
Locality: U.S.A. (Louisiana).
Remarks: Type species by monotypy.

Hyalinocysta sp. Hazard & Chapman

Thelohania barbata Weiser, 1969 [*nomen nudum*] "Atlas of Insect Diseases" [*fide* Hazard, personal communication]. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 94. Weiser, 1971, J. Protozool., 18(Suppl.), 47.
Hyalinocysta sp. H. & C., W H O Bull., in press.

Host and Site: [DIPTERA-CULICIDAE] *Aedes vexans* (Meigen) and *A. cantans* (Meigen), larva; fat body.
Sporulation Stages: Pansporoblast oval, containing spores in a dense gelatinous mass in regular distances and a dense tubular system; size of pansporoblast increasing 8-fold in water.
Spore: With 4 root-like flat filaments, 10-15 x 0.5-1 µm, arising at each end. These filaments, seen on dry smears but not stainable with Giemsa, are coiled in the gelatinous mass.
Locality: Czechoslovakia.
Remarks: Hazard and Oldacre said that the name *Thelohania barbata* is a *nomen nudum*, originally published without a description. Although there was a description in 1971, the name remains a *nomen nudum* because there was no list of characters purporting to distinguish the taxon.

Genus *Inodosporus* Overstreet & Weidner, 1974

Inodosporus spraguei O. & W., 1974

Indosporus spraguei O. & W., 1974, Z. Parasitenkd., 44, 169, Figs. 1-19. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 56.
Host and Site: [DECAPODA] The grass shrimp *Palaemonetes pugio* Holthius (type host) and *P. kadiakensis*; abdominal muscles.
Lesion: "Infects each muscle fiber completely until filaments are destroyed, and infections are spread throughout the animal until most fibers are infected" [O. & W.].
Vegetative Stages: The nuclei are diplocarya.
Sporulation Stages: When sporoblasts are being differentiated within the pansporoblasts, a network of small membranous channels organizes near them and forms an elaborate canal system that is continuous with the pansporoblastic membrane and from which spore tails arise. Pansporoblastic membrane very persistent.
Spore: Pyriform, 2.0-3.7 x 1.7-2.5 µm, 2.9 x 2.0 µm average. Uninucleate. Polar filament uniformly thin, 35-50 (av. 37.0) µm long. Exospore prolonged posteriorly into 3 (rarely 4) tails 17-33 µm long and anteriorly into 1 appendage that is about 2-7 µm long and with 2 branches.
Locality: U.S.A. (type locality Davis Bayou, Ocean Springs, Mississippi; also found in Texas).
Remarks: Type species by original designation.

Inodosporus sp. Sprague, *hoc loco*

Orthothelohania octospora (Henneguy, 1892) Codreanu & Balcescu-Codreanu [*partim*], 1974, *in* "Proceedings of the Third International Congress of Parasitology," 1, 16.
Orthothelohania sp. [presumably *octospora*] Codreanu, Codreanu-Balcescu & Porchet-Hennéré, 1974, C. R. Acad. Sci., 279, 2049.
Thelohania sp. Codreanu-Balcescu, Codreanu & Porchet-Hennéré, 1975, J. Protozool., 22, 78A.

[*non*] *Thelohania octospora* Henneguy, 1892. Goodrich, 1920, Arch Zool. Exp. Gén. Notes Rev., 59, 17, Figs. 1, 2. Kudo [*partim*], 1924, Ill. Biol. Monogr., 9(2/3), 134, Fig. 443. Codreanu, 1966, *in* "Proceedings of the First International Congress of Parasitology" (A. Corradetti, ed.), p. 602. Codreanu & Balcescu-Codreanu, 1974, *in* "Proceedings of the Third International Congress of Parasitology," 1, 15.

Host and Site: [DECAPODA] *Palaemon serratus* [Goodrich. Codreanu & Balcescu-Codreanu]. *P. elegans* Rathke, 1837 [Codreanu]. Muscles.

Vegetative Stages: No data.

Sporulation Stages: Octosporous. Sporont with diplocaryon; numerous coarse secretion granules appear within the pansporoblastic membrane during sporogony, later becoming tubular and forming tails on the spores.

Spore: Most fresh spores 3 µm, macrospores 5-6 µm, each with 3 tails about 20 µm long [Goodrich] or 20-22 µm long [C., C.-B. & P.-H., 1974].

Locality: France (Le Croisic, Roscoff). England (Plymouth). Roumania (Black Sea).

Remarks: Vivares (1975) produced evidence that *T. octospora* does not have tails on its spores. Therefore, this tailed species (possibly 2) is regarded as distinct and treated as an unnamed species of *Inodosporus*, a genus with tailed spores. See "Remarks" under *Thelohania octospora*.

Genus *Parathelohania* Codreanu, 1966

Parathelohania legeri (Hesse, 1904) Codreanu, 1966

Thelohania legeri Hesse, 1904, C. R. Soc. Biol., 57, 570. Hesse, 1904, *ibid.*, 571, Figs. 1-10. Kudo [*partim*], 1924, Arch. Protistenkd., 49, 147. Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 259.

Sarcocystis anophelis Missiroli, 1928, Riv. Malariol., 7, 1-3 [*fide* Weiser, 1961, Monogr. Angew. Entomol., 17, 117].

Toxoglugea missiroli Weiser, 1961, *ibid.*, Fig. 15 - pp. 101.

Parathelohania legeri (Hesse, 1904) Codreanu, 1966, *in* "Proceedings of the First International Congress of Parasitology" (A. Corradetti, ed.), pp. 602. Hazard & Anthony, 1974, U. S. Dep. Agric. Tech. Bull., 1505, 8. Hazard & Oldacre, 1975, *ibid.*, 1530, 70 [see this reference for more extensive synonymy].

Host and Site: [DIPTERA-CULICIDAE] *Anopheles maculipennis* Meigen; adipose tissue and oenocytes in male, oenocytes and ovaries in female [H. & A.].

Vegetatives Stages: In larva, rounded meronts, 3-4 µm in diameter, undergo binary fission. Sometimes delayed cytoplasmic division results in short chains of 3 individuals [Hesse].

Sporulation Stages: Sporonts at first oval, 9-10 x 4-6 µm; after 3 nuclear divisions, 8 sporoblasts are formed and these develop into a group of 8 spores [Hesse].
Spore: In larva ovoid, after fixation one pole deformed and flattened, generally 8 x 4 µm (fresh) but sometimes only 6 x 3 µm; macrospores up to 12 x 5 µm; polar filament about 50 µm [Hesse]. In adult female bow-shaped, 4-5 x 1.5 µm, with vacuole in either end [Weiser].
Locality: France, Italy, Czechoslovakia.
Remarks: Type species by monotypy. Numerous authors have reported microsporidia in various mosquitoes that they identified as *Thelohania legeri*. Apparently, Hazard and Oldacre feel the most of these reports (including Hazard and Weiser, 1968) confused this with other species. The spore dimensions reported by Weiser seem to be appreciably smaller than those given in the original description by Hesse.

Parathelohania africana Hazard & Anthony, 1974

Parathelohania africana H. & A., 1974, U. S. Dep. Agric. Tech. Bull., 1505, 20, Figs. 1C, 8, 9. Hazard & Oldacre, 1975, *ibid.*, 1530, 59.
Host and Site: [DIPTERA-CULICIDAE] *Anopheles gambiae* Giles; adipose tissue and oenocytes of males, oenocytes and ovaries of females.
Vegetative Stages: "Meronts and sporonts are similar to those of *P. anophelis*" [H. & A.].
Sporulation Stages: "The sporonts of all *Parathelohania* species in male larvae are similar ..." [H. & A.]. No data regarding development in adult female.
Spore: In a male larvae oval, with several short and indistinct ridges on posterior end; polar filament with 6 coils, the first three of which are thicker than the others; size (fresh) 3.7 x 2.3 µm. In adult females elongate, slightly bent, narrowed at one end which often contains a vacuole, 4.8 x 2.0 µm.
Locality: Nigeria.

Parathelohania anomala (Sen, 1941) H. & A., 1974

Thelohania anomala Sen, 1941, J. Malar. Inst. India, 4, 258 [*fide* H. & A., 1974, U. S. Dep. Agric. Tech. Bull., 1505, 18]. Sen, 1943, Proc. Indian Sci. Congr., 29, 147.
Parathelohania anomala (Sen, 1941) H. & A., 1974, *loc. cit.* Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 60.
Host and Site: [DIPTERA-CULICIDAE] *Anopheles ramsayi* Covell, female larva; oenocytes.
Vegetative Stages: No data.
Sporulation Stages: Eight to 12 sporoblasts, then 8-12 spores formed within a thin membrane (the cell membrane of an oenocyte, according to Hazard and Anthony).

Spore: Fresh from female larva, 5.1-6.1 x 2.0-2.1 μm.
Locality: India.
Remarks: Sen reported this species as new also in 1943. His paper published in 1941 is cited from Hazard and Anthony. These authors think their placement of this species in Genus *Parathelohania* needs to be supported with information on spores from the male larva.

Parathelohania anophelis (Kudo, 1924) H. & A., 1974

Nosema anophelis Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 110, Figs. 728-730. Kudo, 1925, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I Orig., 96, 434, Figs. 26-43.
Parathelohania anophelis (Kudo, 1924) H. & A., 1974, U. S. Dep. Agric. Tech. Bull., 1505, 10, Figs. 1A, 2, 3. Hazard & Oldacre, 1975, *ibid.*, 1530, 60, Figs. 51-57 [see this reference for more extensive synonymy].
Host and Site: [DIPTERA-CULICIDAE] *Anopheles quadrimaculatus* Say; adipose tissue and oenocytes of males, oenocytes and ovaries of females.
Vegetative Stages: In male larvae, meronts and similar to those in *Thelohania illinoisensis* Kudo, 1921 [H. & A.]. In female(?) larva, binary fission [Kudo (1925)].
Sporulation Stages: In male larva, sporonts octosporous, forming 8 spores in a subpersistent membrane [H. & A.]. In female, sporont develops into plasmodium with 8-25 nuclei. The plasmodium undergoes sporogony to produce sporoblasts that transform into spores not enclosed in a membrane [H. & A.].
Spore: In male larva, elongate with moderately constricted and truncate posterior end. Four prominent ridges run from the middle to the posterior end where they terminate at the corners of a 4-sided ridge that surrounds a depression [H. & A.]; size 4.0-5.5 x 2.5-3.6 μm (fresh) and 3.6 x 2.1 (fixed) [Hazard & Weiser (1968)]. In female, spores oblong with one end slightly narrower than the other and sides often asymmetrical (one side concave and the other convex); often with a vacuole in one end; with thin wall; fresh spores 4.7-5.8 x 2.3-3.2 μm [Kudo (1925)], 4.5 x 2.2 μm [H. & A.].
Locality: U.S.A. (Georgia, New York, Louisiana, Florida).
Remarks: The name *Nosema anophelis* was established by Kudo (1924) in his monograph before the original descriptions, which was delayed in publication, appeared in 1925. When Kudo described this species from 2 larvae and 1 adult female, he described only spores characteristic of the stages in females although he saw also "scattered spores of *T. legeri*" in one of the larvae ("Host no. 1"). Perhaps we can assume the other larva ("Host no. 2") was female but it is difficult to account for 2 kinds of spores in "Host no. 1." Apparently, the spores which Hazard and Anthony described in male larvae are the same as those that Hazard and Weiser (1968) formerly identified as

Thelohania legeri. Fox and Weiser (1959) considered *N. anophelis* Kudo to be a junior synonym of *N. stegomyiae* Marchoux, Salimbeni & Simond, 1903.

Parathelohania barra (Pillai, 1968) Hazard & Oldacre, 1975

Thelohania barra Pillai, 1968, Z. Angew. Entomol., 62, 396, Figs. 1-8.
Parathelohania barra (Pillai, 1968) H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 65.
Host and Site: [DIPTERA-CULICIDAE] *Aedes (Halaedes) australis* Erichson, larva; fat body.
Lesion: Infected host has a mottled appearance.
Vegetative Stages: No data.
Sporulation Stages: Spores vary in size and number within the pansporoblastic membrane. "Microspores" usually occur 8 within a membrane. "Normal spores" usually occur 4 within a membrane, sometimes 8. "Teratospores" usually occur 1 or 2 within a membrane. The different types may occur in various combinations of type and number.
Spore: All types morphologically similar, being barrel-shaped. When stained, one end has a clear area. "Microspores," 3.77 x 2.62 µm. "Normal spores," 5.73 x 3.64 µm. "Teratospores," 7.80 x 5.09 µm. (Dimensions of stained spores.)
Locality: New Zealand.
Remarks: The clear area in the spore was said to be in the anterior end but it was more likely the space that is characteristically present in the posterior end of *Parathelohania* spores.

Parathelohania chagrasenis H. & O., 1975

Parathelohania chagrasenis H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 65, Figs. 58-61.
Host and Site: [DIPTERA-CULICIDAE] *Aedeomyia squamipennis* (Lynch Arribalzaga), larva; adipose tissue.
Vegetative Stages: No data.
Sporulation Stages: Only the octosporous sequence in larva is known. Sporogony accompanied by secretion of granules which clump to form large dense masses within the pansporoblastic membrane, and by formation of tubular structures. Granules disappear and tubules persist.
Spore: With pronounced posterior constriction and prominent posterior ridges; polar filament with 6 coils, the thick proximal portion having 2 coils.
Locality: Panama Canal Zone.

Parathelohania illinoisensis (Kudo, 1921) Hazard & Anthony, 1974

Thelohania illinoisensis Kudo, 1921, J. Morphol., 35, 167, Figs. 61-74.

Parathelohania illinoisensis (Kudo, 1921) H. & A., 1974, U. S. Dep. Agric. Tech. Bull., 1505, 16, Fig. 7. Hazard & Oldacre, 1975, *ibid.*, 1530, 68, Fig. 62 [see this paper for more extensive synonymy].

[*non*] *Thelohania legeri* Hesse, 1904, C. R. Soc. Biol., 57, 570. Kudo, 1924, Arch. Protistenkd., 49, 157.

Host and Site: [DIPTERA-CULICIDAE] *Anopheles punctipennis* (Say); adipose tissue and oenocytes in males, oenocytes and ovaries in females.

Vegetative Stages: No data with the original description. In 1924, Kudo gave a detailed description based on a mixture of species and it is impossible to determine which part of the description applies to this species.

Sporulation Stages: Sporont octosporous [Kudo].

Spore: In male larvae, fresh spores are oval with equally rounded ends; one end of contents narrow and truncate and the other rounded; 4.75-6 x 3-4 μm [Kudo (1921)]. Fresh, 4.94 x 3.18 μm [Chapman *et al.* (1966)]. In adult female unknown.

Locality: U.S.A. (Illinois, Louisiana, Connecticut). Canada (Québec).

Remarks: Kudo (1921) originally described this species very briefly and distinguished it with some hesitation from *P. legeri*. Later (1924), he synonymized these two species and all later authors have followed him in this view until Hazard and Anthony separated them again.

Parathelohania indica (Kudo, 1929) H. & A., 1974

Thelohania indica Kudo, 1929, Arch. Protistenkd., 67, 3, Figs. 19-50.

Parathelohania indica (Kudo, 1929) H. & A., 1974, U. S. Dep. Agric. Tech. Bull., 1505, 19. Hazard & Oldacre, 1975, *ibid.*, 1530, 69 [see this reference for more extensive synonymy].

Host and Site: [DIPTERA-CULICIDAE] *Anopheles hyrcanus* (Pallas), larva; adipose tissue. (Parasite not known in adult.)

Vegetative Stages: Elongated bodies containing 4-8 nuclei divide into 2-4 binucleate schizonts. The nuclei of the binucleate forms fuse to form sporonts.

Sporulation Stages: The sporont nucleus divide 3 times and 8 sporoblasts are formed. [?] "In each sporoblast, the single nucleus divides into two masses. One of them remains as a single nucleus of the sporoplasm, while the other disintegrates and produces the polar filament" [Kudo].

Spore: Unstained spores in sections ellipsoidal with equally rounded ends, 4-5.2 x 2.4-2.8 μm.

Locality: India (Bengal?).

Remarks: Weiser (1961) treated this as a junior synonym of *Thelohania obesa* Kudo, 1924, [*Parathelohania obesa*].

Parathelohania obesa (Kudo, 1924) H. & A., 1974

Thelohania obesa Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 161, Figs. 731-737. Kudo, 1925, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I Orig., 96, 432, Figs. 2-11.
Parathelohania obesa (Kudo, 1924) H. & A., 1974, U. S. Dep. Agric. Tech. Bull., 1505, 14, Figs. 1B, 5. Hazard & Oldacre, 1975, *ibid.*, 1530, 71, Figs. 63-67 [see this reference for more extensive synonymy].
Host and Site: [DIPTERA-CULICIDAE] *Anopheles quadrimaculatus* Say [type host], also *A. crucians* Wiedemann [H. & A.]; fat body of larva [Kudo], oenocytes and ovaries of female [H. & A.].
Vegetative Stages: In meronts, invade blood cells in early instar larvae where they reproduce and form sporonts that migrate to the fat bodies [H. & A.].
Sporulation Stages: In male larva, uninucleate sporont undergoes 3 nuclear divisions, producing 8 sporoblasts and finally 8 spores. During development the sporont has many dense granules that stain intensely red in Giemsa smears [Kudo (1925); H. & A.].
Locality: U.S.A. (Georgia, New York, Pennsylvania, Florida, Louisiana).
Remarks: The name was effectively published by Kudo (1924) in his monograph while publication of the original description, then in press, was delayed until 1925. Weiser (1961) treated *Thelohania obscura* Kudo, 1929, and *T. indica* Kudo, 1929, as synonyms of *T. obesa* but Hazard and Anthony have separated these three again.

Parathelohania obscura (Kudo, 1929) H. & A., 1974

Thelohania obscura Kudo, 1929, Arch. Protistenkd., 67, 4, Figs. 51-61. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 111.
Parathelohania obscura (Kudo, 1929) H. & A., 1974, U. S. Dep. Agric. Tech. Bull., 1505, 19. Hazard & Oldacre, 1975, *ibid.*, 1530, 75 [see this reference for more extensive synonymy].
Host and Site: [DIPTERA-CULICIDAE] *Anopheles funestus (A. varuna* Iyengar), larva; site not determined.
Vegetative Stages: No data.
Sporulation Stages: Octosporoblastic.
Spore: "When viewed in water after decolorization," broadly oblong, 4.5-5 x 3-3.5 µm. Within the membrane is a rounded mass of protoplasm with a knob on one end and a clear space at the other.
Locality: India (Bengal?).
Remarks: Weiser treated this as a junior synonym of *Thelohania obesa* Kudo, 1924, [*Parathelohania obesa*].

Parathelohania octolangella H. & A., 1974

Parathelohania octolangella H. & A., 1974, U. S. Dep. Agric. Tech. Bull., 1505, 22, Figs. 1D, 10, 11. Hazard & Oldacre, 1975, *ibid.*, 1530, 75, Figs. 68-70.

Host and Site: [DIPTERA-CULICIDAE] *Anopheles pretoriensis* (Theobald); adipose tissue and oenocytes in males, oenocytes and ovaries in females.

Vegetative Stages: "Meronts and sporonts are similar to those of *P. anophelis*" [H. & A.].

Sporulation Stages: "The sporonts of all *Parathelohania* species are similar ..." [H. & A.]. No data on development in adult female.

Spore: In male larvae, spores are pointed at the posterior end; prominent ridges run nearly full length and terminate at the pointed end; polar filament coiled 8 times, the first 3 coils thicker than the remainder; size (fresh) 6.0 x 2.6 µm. In the adult female, spores are elongate, attenuated to a very narrow anterior end, curved (sometimes nearly "U"-shaped) and have no visible vacuole in life; size (fresh) 5.5 x 1.5 µm.

Locality: Nigeria.

Parathelohania periculosa (Kellen & Wills, 1962) H. & A., 1974

Thelohania periculosa K. & W., 1962, J. Insect Pathol., 4, 54, Figs. 8, 52-57.

Nosema chapmani Kellen, Clark & Lindegren, 1967, J. Invertebr. Pathol., 9, 20, Figs. 1-40.

Parathelohania periculosa (K. & W., 1962) H. & A., 1974, U. S. Dep. Agric. Tech. Bull., 1505, 19. Hazard & Oldacre, 1975, *ibid.*, 1530, 77.

Host and Site: [DIPTERA-CULICIDAE] *Anopheles franciscanus* McCracken; oenocytes and adipose tissue of male larvae, oenocytes of adult females [H. & A.].

Lesion: Infected area, seen in ventral view of larva, snowy-white.

Vegetative Stages: In larva, concerning some or all of 8 species described by Kellen and Wills, the authors said they saw uninucleate and binucleate, rarely quadrinucleate, schizonts. In adult, binary fission.

Sporulation Stages: In larva, sporont usually produced 8, sometimes 4, spores. In adult, "the nuclei of the diplokarya fused early in the formulation of sporoblasts, and that twin nuclei were acquired secondarily as sporoblast matured. Finally, spores contained a single compact nucleus" [K., C. & L.].

Spore: In larva, 4.71 x 2.62 µm (fresh), 3.81 x 2.44 µm (stained). In adult, 5.54 x 1.73 µm (fresh), 5.78 x 1.48 µm (stained).

Locality: U.S.A. (California).

Parathelohania sp. Hazard & Oldacre, 1975

Parathelohania sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 78.
Host: [DIPTERA-CULICIDAE] *Anopheles albimanus* Wiedemann.
Other Data: None.

Parathelohania sp. H. & O., 1975

Parathelohania sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 78.
[*non*] *Thelohania legeri* Hesse. Kudo [*partim*], 1929, Arch. Protistenkd., 67, 5, Figs. 1-18.
Host and Site: [DIPTERA-CULICIDAE] *Anopheles barbirostris* Vander-Wulp, larva; fat body.
Developmental Stages: Kudo have a brief description is a mixture of data from 5 host species.
Locality: India.

Parathelohania sp. H. & O., 1975

Parathelohania sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 78.
[*non*] *Thelohania legeri* Hesse. Chapman, Woodward, Kellen & Clark, 1966, J. Invertebr. Pathol., 8, 453.
Host and Site: [DIPTERA-CULICIDAE] *Anopheles bradleyi* King, male larvae; fat body.
Developmental Stages: No data.
Spore: 5.04 x 3.22 μm.
Locality: U.S.A. (Louisiana).

Parathelohania sp. H. & O., 1975

Parathelohania sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 78.
Host: [DIPTERA-CULICIDAE] *Anopheles funestus* Giles.
Other Data: None.

Parathelohania sp. H. & O., 1975

Parathelohania sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 78.
Host: [DIPTERA-CULICIDAE] *Anopheles nili* (Theobald).
Other Data: None.

Parathelohania sp. H. & O., 1975

Parathelohania sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 78.
[*non*] *Thelohania legeri* Hesse, *sensu* Tour, Rioux & Croset, 1971, Ann. Parasitol. Hum. Comp., 46, 208, Figs. 2, 3.
Host and Site: [DIPTERA-CULICIDAE] *Anopheles labranchiae atroparvus* Van Thiel, larva; fat body.
Development: Figure 3 shows spores in groups of 8.

Spore: Figure 3 shows spores with the "bottle shape" that is characteristic of the genus.
Locality: France (south).

Parathelohania sp. H. & O., 1975

Parathelohania sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 78.
Host: [DIPTERA-CULICIDAE] *Anopheles pharoensis* Theobald.
Other Data: None.

Parathelohania sp. H. & O., 1975

Parathelohania sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 78.
[*non*] *Thelohania legeri* Hesse, *sensu* Camey-Pacheco, 1968, Rev. Univ. San Carlos, 67 [*fide* H. & O., *loc. cit.*].
Host: [DIPTERA-CULICIDAE] *Anopheles pseudopunctipennis pseudopunctipennis* Theobald.
Other Data: None on hand.

Parathelohania sp. H. & O., 1975

Parathelohania sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 78.
[*non*] *Thelohania legeri* Hesse. Kudo [*partim*], 1929, Arch. Protistenkd., 67, 5, Figs. 1-18.
Host and Site: [DIPTERA-CULICIDAE] *Anopheles subpictus* Grassi, larva; fat body.
Developmental Stages: Kudo gave a brief description this is a mixture of data from 5 different host species.
Locality: India.

Parathelohania sp. H. & O., 1975

Parathelohania sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 78.
Host: [DIPTERA-CULICIDAE] *Anopheles triannulatus* (Neiva & Pinto).
Other Data: None.

Parathelohania sp. H. & O., 1975

Parathelohania sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 78.
[*non*] *Thelohania legeri* Hesse, *sensu* Sen, 1941 [*fide* H. & O., *ibid.*,].
Host: [DIPTERA-CULICIDAE] *Anopheles vagus* Dönitz, larva.
Descriptive Data: None on hand.
Locality: India.

Parathelohania sp. H. & O., 1975

Thelohania sp. Laird, 1961, J. Insect Pathol., 3, 252.
Parathelohania sp. H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 78.

Host: [DIPTERA-CULICIDAE] *Anopheles walkeri* Theobald, larva.
Descriptive Data: None.
Locality: U.S.A. (Minnesota).

Genus *Pegmatheca* Hazard & Oldacre, 1975

Pegmatheca simulii H. & O., 1975

Pegmatheca simulii H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 79, Figs. 77-81.
Host and Site: [DIPTERA-SIMULIIDAE] *Simulium tuberosum* (Lindstrom), larva; adipose tissue.
Vegetative Stages: Multinucleate meronts give rise to several sporoblasts.
Sporulation Stages: Only an octosporous sequence known. Several (4-16) pansporoblasts arising from 1 meront remain attached together by thin strands of protoplasm. Sporogony accompanied by secretion of small granules.
Spore: (Living) oval, without vacuole, 3.04-3.72 x 1.92-2.48 µm; polar filament uniform, with 5 coils.
Locality: U.S.A. (Florida)
Remarks: Type species by monotypy.

Genus *Pilosporella* Hazard & Oldacre, 1975

Pilosporella fishi H. & O., 1975

Pilosporella fishi H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 85, Figs. 74-76.
Host and Site: [DIPTERA-CULICIDAE] *Wyeomyia vanduzeei* Dyar & Knab, larva; adipose tissue.
Vegetative Stages: No data.
Sporulation Stages: Sporogony in the octosporous sequence accompanied by formation of many granules that become replaced by microtubules.
Spore: Subspherical, with small vacuole, 2.33-3.13 µm, average 2.92 µm (living); polar filament uniform, with 6 coils. Isolated spores suspected to belonging to another sequence were pyriform, elongate, 3.18-5.14 x 1.38-1.64 µm.
Locality: U.S.A. (Florida).
Remarks: Type species by original designation.

Pilstophorella chapmani H. & O., 1975

Pilosporella chapmani H. & O., 1975, U. S. Dep. Agric. Tech. Bull. 1530, 84, Figs. 71-73.
Host and Site: [DIPTERA-CULICIDAE] *Aedes triseriatus* (Say), larva; adipose tissue.
Vegetative Stages: No data.
Sporulation Stages: Only the octosporous sequence known. Sporogony accompanied by formation of few granules and many microtubules. Pansporoblastic membrane fragile.

Spore: Spherical, 2.8 μm (life), with thin endospore and relatively thick exospore; wall unornamented; mucous envelope absent; polaroplast made of indistinct and widely separated lamellae; polar filament with about 4 coils, uniform in diameter.
Locality: U.S.A. (Louisiana).

Genus *Systenostrema* H. & O., 1975

Systenostrema tabani H. & O., 1975

Systenostrema tabani, H. & O., 1975, U. S. Dep. Agric. Tech. Bull., 1530, 87, Figs. 82-85.
Host and Site: [DIPTERA-BRACHYCERA] *Tabanus lineola* Fabricius, larva; adipose tissue.
Vegetative Stages: No data.
Sporulation Stages: Only an octosporous sequence known. Sporogony accompanied by secretion of granules later replaced by microtubules.
Spore: Ovoid, 3.13-3.45 x 1.91-2.17 (av. 3.32 x 2.08) μm (living). Polar filament with 14-16 coils, the 6 proximal ones thick and the rest reduced in diameter.
Locality: U.S.A. (Florida).
Remarks: Type species by monotypy.

Genus *Toxoglugea* Léger & Hesse, 1924

Toxoglugea vibrio (L. & H., 1922) L. & H., 1924

Toxonema vibrio L. & H., 1922, C. R. Acad. Sci., 174, 328, Fig. 12. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 187, Fig. 666.
Toxoglugea vibrio (L. & H., 1922) L. & H., 1924, Trav. Lab. Hydrobiol. Pisc. Univ. Grenoble, 14, 54, Fig. 12. Weiser, 1961, Monogr. Angew. Entomol., 17, 122.
Toxospora vibrio (L. & H., 1922) Kudo, 1925, Science, 61, 366.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Ceratopogon* sp., larva; fat body.
Vegetative Stages: No data.
Sporulation Stages: Spherical masses with 8 spores, indicating origin from octosporous pansporoblasts, were seen. Spores most often seen, in immense numbers, diffuse in the fat tissue of the host.
Spore: Minute rod, curved in a semicircle, 3.5 μm long (supposing it were unrolled) and 0.3 μm broad, the ends 2 μm apart. The spore a little twisted, the 2 ends being not in the same plane.
Locality: France (Montessaux).
Remarks: Type species by monotypy. It should be noted that the bent spore, having its two ends in different planes, is actually a spiral, only quantitatively different from that in *Spiroglugea*. When Kudo (1925) proposed the replacement name

Toxospora, he did not mention the specific name *vibrio* but the new name combination, *Toxospora vibrio*, is attributable to him because the new generic name became automatically applicable to the type species.

Toxoglugea bacilliformis (L. & H., 1922)
Coste-Mathiez & Tuzet, manuscript

Mrazekia bacilliformis L. & H., 1922, C. R. Acad. Sci., 174, 327, Fig. 3. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 184, Fig. 657.

Bacillidium bacilliforme (L. & H., 1922) Jírovec, 1940, Zool. Anz., 130, 125, Fig. 2. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1068. Weiser, 1961, Monogr. Angew. Entomol., 17, 121.

Host and Site: [DIPTERA-CHIRONOMIDAE] *Orthocladius* sp., larva; fat body [L. & H.]. *Endochironomus juncicola* Kieff [Jírovec]. *Endochironomus junicola* Th. and *Camptochironomus* sp. [Weiser].

Vegetative Stages: Schizogony with uninucleate stages in chains [L. & H.].

Sporulation Stages: Pansporoblasts octosporous, at first spherical then cut into a rosette [L. & H.]. An uninucleate stage develops into a plasmodium (pansporoblast); sporogony results in 8 sporoblasts within a pansporoblastic membrane and these transform into 8 spores [Jírovec].

Spore: 5 x 0.8 μm (L. & H.]. Usually rod-shaped with rounded ends, 5-7 x 1.2-1.5 μm; often stained have vacuole at either end and 2 nuclei (clearly seen in Feulgen preparations) in the middle [Jírovec].

Locality: France (vicinity of Grenoble) [L. & H.]. Czechoslovakia (vicinity of Blatna) [Jírovec], (vicinity of Chotěboř) [Weiser).

Remarks: The presumed identity of the species studied very briefly by Léger and Hesse and that studied in more detail by Jírovec needs confirmation, since there are certain discrepencies in the descriptions. Production of cylindrical spores within a pansporoblastic membrane and the apparent lack of a manubrium in the spore are characters of *Toxoglugea*, not of *Mrazekia*.

Toxoglugea calliphorae Weiser, 1961

Toxoglugea sp. Fantham & Porter [*partim*], 1958, Proc. Zool. Soc. Lond., 130, 159.

Toxoglugea calliphorae Weiser, 1961, Monogr. Angew. Entomol., 17, 63.

Host and Site: [DIPTERA-BRACHYCERA] *Calliphora erythrocephala* Meig. and *C. vomitoria* L., all stages. Malpighian tubules were the most heavily infected organs but fat bodies were also infected. Experimentally in [COLEOPTERA] *Tenebrio molitor* L., fat body and Malpighian tubules.

Vegetative Stages: No data.

Sporulation Stages: A few octosporous cysts were seen in the fat body.

Spore: Horeshoe-shaped, often showing no internal structure but sometimes with a clear area in one end (fresh). Methyl green demonstrated 2 nuclei in tandem. Dimensions, 4.3-5 x 0.7-1.0 μm.

Locality: Canada and England.

Remarks: Fantham and Porter reported morphologically identical forms in these flies and in *Aphis rumicis*. Weiser separated them into 2 species, this and *T. fanthami*. The generic characters of *Toxoglugea* are not well known but it is doubtful that the binucleate condition of the spore is one of them.

Toxoglugea chironomi (Debaisieux, 1931) Jírovec, 1936

Toxonema chironomi Debaisieux, 1931, C. R. Soc. Biol., 107, 913, Figs. 1, 2.

Toxoglugea chironomi Debaisieux, 1931, Jírovec, 1936, Věstn. Česk. Spol. Zool., 4, 63. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1069. Weiser, 1961, Monogr. Angew. Entomol., 17, 122.

Host and Site: [DIPTERA-CHIRONOMIDAE] *Chironomus* sp., larva; fat body (?).

Vegetative Stages: No data.

Sporulation Stages: Sporogonial stages with 4, then 8 (more or less) spherical sporoblasts were seen. Sporoblasts elongate, forming regular bundles, then developing into 8 elongated, curved spores in compact, tangled masses.

Spore: Slender, elongated, generally very curved, 6-7 x 3-4 μm, with a well-formed vacuole at one pole and a smaller one at the other. Very numerous macrospores and some aberrant, oval or bacilliform spores were encountered.

Locality: Belgium (vicinity of Louvain).

Toxoglugea chloroperlae Weiser, 1946

Toxoglugea chloroperlae Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 247, Fig. la-s. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae 18, 29, Table 4-p, r. Weiser, 1961, Monogr. Angew. Entomol., 17, 52, Figs. 27, 28.

Host and Site: [PLECOPTERA] *Chloroperla* sp., larva; fat body.

Vegetative Stages: A first schizogony starts with a round uninucleate stage that develops into a 4-nucleate stage. This breaks up into uninucleate merozoites. The latter grow into short threads of second schizonts. From the 4-nucleate stage a chain of diplocarya develops. These separate and undergo "die grossen Mitosen" [Weiser (1961)].

Sporulation Stages: During sporogony, small, round 8-nucleate plasmodia arise. These produce 8 finger-like sporoblasts that then develop into spores. Young spores lie 4 and 4 crosswise on one another in the form of a closed fist. Pansporoblasts are 3-4 μm in diameter but become 6 μm when they release the spores.

Spore: Young spores semicircular, 3 x 1 μm. Mature spores, freed from the pansporoblast, 2 x 0.2-0.5 μm. Uninucleate.
Locality: Czechoslovakia (near Chotěboř).
Remarks: Most of the data taken from Weiser's (1961) monograph, since the original paper is in Czech. In 1947, Weiser gave the date for the name as 1945.

Toxoglugea fanthami Weiser, 1961

Toxoglugea sp. Fantham & Porter [*partim*], 1958, Proc. Zool. Soc. Lond., 130, 159, Figs. 15-20. Weiser, 1961, Monogr. Angew. Entomol., 17, 63.
Toxoglugea fanthami Weiser, 1961, *loc. cit.*
Host and Site: [HOMOPTERA] The bean aphid, *Aphis rumicis* L. Malpighian tubules were the most heavily infected organs but fat bodies were also infected.
Vegetative Stages: No data.
Sporulation Stages: A few octosporous cysts were seen in the fat body.
Spore: Horseshoe-shaped, often showing no internal structure but sometimes with a clear area in one end (fresh). Methyl green demonstrated 2 nuclei in tandem. Dimensions, 4.3-5 x 0.7-1.0 μm.
Locality: Canada.
Remarks: Fantham and Porter reported morphologically identical forms in *Aphis* and 2 species of *Calliphora*. Weiser separated them into 2 species, this and *T. calliphorae*. The generic characters of *Toxoglugea* are not well known but it is doubtful that the binucleate condition of the spore is one of them.

Toxoglugea gerridis Poisson, 1941

Toxoglugea gerridis Poisson, 1941, Arch. Zool. Exp. Gén., 82, 31, Figs. 2, 3. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1069. Weiser, 1961. Monogr. Angew. Entomol., 17, 61.
Host and Site: [HETEROPTERA] *Aquarius najas* De Geer; fat body.
Vegetative Stages: Small schizonts, 1.5-2 μm, undergo binary fission while localized in the general vicinity of the hypertrophied nucleus of the infect cell. In another series, larger schizonts are elongated, up to 15 μm, and often multinucleate.
Sporulation Stages: A stage with paired nuclei probably represents the zygote. Most sporonts evolve into pansporoblasts with 8 elements. These produce cysts containing 8 spores. There is also a monosporous development, producing either macrospores or spores like those in the octosporous cysts.
Spore: Microspores generally curved, 4.5 x 0.8 μm, the ends separated by about 3 μm and not in the same plane. Macrospores less curved, reach 7-8 μm.
Locality: France (Pyrénées-Orientales).

Remarks: Since the ends of the curved spore are not in the same plane, the spore is spirally curved, a character said to distinguish genus *Spiroglugea*.

Toxoglugea mercieri (Poisson, 1924) Jírovec, 1936

Toxonema mercieri Poisson, 1924, C. R. Acad. Sci., 178, 665, 666, Figs. 1-12.

Toxoglugea mercieri (Poisson, 1924) Jírovec, 1936, Věstn. Česk. Spol. Zool., 4, 63. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1069. Weiser, 1961, Monogr. Angew. Entomol., 17, 61.

Host and Site: [HETEROPTERA] *Notonecta viridis* Delc.; fat body.

Vegetative Stages: Small amoeboid forms, 2-4 μm, undergo binary fission.

Sporulation Stages: Uninucleate sporont, 5-7 μm, undergoes nuclear division to make pansporoblast in which 8 sporoblast develop. The sporoblasts transform into 8 spores within a pansporoblastic membrane.

Spore: Comma-shaped, 6 x 4.5 μm (fresh) and 4.5-5 x 1.5 μm (fixed); distance between poles 3 μm.

Locality: France.

Remarks: Poisson described spore development similar to that in myxosporidia, involving 2 valve nuclei, 1 capsule nucleus and 2 sporoplasm nuclei. This is now unacceptable

Toxoglugea octospora (Léger & Hesse, 1922) comb. n.

Spironema octospora L. & H., 1922, C. R. Acad. Sci., 174, 328, Fig. 11. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 187, Fig. 665.

Spiroglugea octospora (L. & H., 1922) L. & H., 1924, Trav. Lab. Hydrobiol. Pisc. Univ. Grenoble, 14, 53, Fig. 11. Weiser, 1961, Monogr. Angew. Entomol., 17, 123.

Spirospora octospora (L. & H., 1922) Kudo, 1925, Science, 61, 366.

Spirillonema octospora (L. & H., 1922) Wenyon, 1926, "Protozoology," 1, 747.

Host and Site: [DIPTERA-CHIRONOMIDAE] *Ceratopogon* sp., larva; fat body.

Vegetative Stages: No data.

Sporulation Stages: Pansporoblasts octosporous, often very numerous, in the hypertrophied host cell. Spores remain for some time grouped in ovoid bundles of 8 elements twisted like the carpels of *Spirea*.

Spore: Spirilliform, 8-8.5 x 1 μm, with vacuole at posterior end. Filament up to 100 μm long.

Locality: France (Montessaux).

Remarks: Type species of Genus *Spiroglugea* L. & H., 1924 (= *Spironema* L. & H., 1922), by monotypy. It is noted that the type species of *Toxoglugea, T. vibrio,* is also spirally coiled but is more compressed along the axis of the spiral, these two species differing essentially in tightness of the spiral. To avoid the difficulty of distinguishing genera on the basis of purely quantitative differences, these two genera are here combined in Genus *Toxoglugea*. When Kudo (1925) proposed the replacement name *Spirospora* he did not mention the specific name *octospora* but the new name combination *Spirospora octospora* is attributable to him because the new generic name became automatically applicable to the type species.

Toxoglugea porterae (Weiser, 1961) comb. n.

Spiroglugea sp. Fantham & Porter, 1958, Proc. Zool. Soc. Lond., 130, 160, Figs. 21-24.
Spiroglugea porterae Weiser, 1961, Monogr. Angew. Entomol., 17, 130.
Host and Site: [DIPTERA-BRACHYCERA] *Calliphora erythrocephala* Meig. and *C. vomitoria* L., all stages; Malpighian tubules, fat body, gut.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Tubular, slightly spirally curved, with rounded ends, almost uniform in diameter, with clear area in either end; "and on a few occasions, two minute, oval nuclei, arranged parallel, were found" [F. & P]. Spores from *C. vomitoria* were 12-13.5 x 1.0-1.5 µm and those from *C. erythrocephala* were 12-13.5 x 1.5 µm.
Remarks: This poorly known species (known only from a brief description by Fantham and Porter) is transferred to Genus *Toxoglugea* along with the type species of *Spiroglugea*. Presumably it is one of the PANSPOROBLASTINA, although we have no data on the sporulation stages and the supposed binucleate condition of the spore suggests otherwise. More information is needed to permit generic assignment of this species with confidence.

Toxoglugea tetraspora (Léger & Hesse, 1922)
Coste-Mathiez & Tuzet, manuscript

Mrazekia tetraspora L. & H., 1922, C. R. Acad. Sci., 174, 327, Fig. 10. Léger & Hesse, 1924, Trav. Lab. Hydrobiol. Pisc. Univ. Grenoble, 14, 52, Fig. 10. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 184, Fig. 656.
Bacillidium tetrasporum (L. & H., 1922), Jírovec, 1936, Arch. Protistenkd., 87, 318. Weiser, 1961, Monogr. Angew Entomol. 17, 122.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Tanytarsus* sp., larva; fat body.

Vegetative Stages: No data.
Sporulation Stages: Pansporoblasts tetrasporous; spores at first grouped in bunches of 4 become rapidly dispersed in the adipose tissue of the host.
Spore: Straight or slightly curved rods, 6.5 x 0.8 µm, with hyalin prolongation (1.2 µm) at posterior end.
Locality: France (vicinity of Grenoble).
Remarks: This is an aberrant member of the genus, being (like *Gurleya*) tetrasporous.

Family GURLEYIDAE fam. n.

Genus *Gurleya* Doflein, 1898

Gurleya tetraspora Doflein, 1898

Gurleya tetraspora Doflein, 1898, Zool. Jahrb. Abt. Anat., 11, 291, Figs. 146-153. Auerbach, 1910, "Die Cnidosporidien," 198, Fig. 82. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 128, Figs. 357-364. Jírovec, 1942, Zool. Anz., 140, 129, Fig. 1. Jírovec, 1942, Věstn. Král. Česke Spol. NAUK Trída Mat. Přírodověd. 1942, 2, Fig. 2. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 22. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1061.
Host and Site: [CLADOCERA] *Daphnia maxinna* [type] and *Moina rectirostris;* hypodermis.
Vegetative Stages: No data.
Sporulation Stages: Pansporoblast produces 4 sporoblasts that develop into 4 spores within a membrane.
Spore: Rounded at one pole and slightly pointed at the other [Doflein, Jírovec]; 2.8-3 x 1.4-1.6 µm [Jírovec]; surface covered with fine longitudinal grooves [Doflein].
Locality: Germany (vicinity of Munich) [Doflein]. Czechoslovakia (vicinity of Lnáře) [Jírovec].
Remarks: Type species by monotypy. Unfortunately, descriptions by both authors are brief. Certain discrepencies (different hosts; Jírovec questions identity of host examined by Doflein; striations reported on spores by only one author; spore measurements given by only one author) make it doubtful that the two authors observed the same species.

Gurleya aeschnae Fantham, Porter & Richardson, 1941

Gurleya aeschnae F., P. & R., 1941, Parasitology, 33, 195, Figs. 53-59. Thomson, 1960, J. Insect Pathol., 2, 356. Weiser, 1961, Monogr. Angew. Entomol., 17, 54.
Host and Site: [ODONATA] The dragonfly *Aeschna grandis*, nymph; "probably oenocystes, at the surface of the fat body" [F., P. & R.]
Lesion: Infected cells denser and whiter than normal cells.
Vegetative Stages: Uninucleate cell reproduces repeatedly by binary fission.

Sporulation Stages: Final products of binary fission are sporonts. Sporont undergoes 2 divisions and produces 4 uninucleate sporoblasts within the pansporoblastic membrane. The sporoblasts develop into spores.
Spore: Ovoid to pyriform, 5.5-5.6 x 3-4.1 μm, with posterior vacuole.
Locality: Canada (Québec).

Gurleya chironomi Loubes & Maurand, 1975
Gurleya chironomi L. & M., 1975, Protistologica, 11, 233, Figs. 1-6.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Orthocladius* sp., larva; fat body.
Vegetative Stages: Schizonts, always uninucleate, rarely seen.
Sporulation Stages: Sporont arises by transformation of a schizont; the hyaloplasm retracts to the interior of the membrane and the cytoplasmic mass differentiates a new unit membrane, the old one becoming the pansporoblastic membrane. Sporogony results in 4 sporoblasts that develop into spores.
Spore: Ovoid, having an average length of 5.5 μm and a breadth about half the length when fresh.
Locality: France (near Montpellier).
Remarks: The description of the species involved an excellent electron microscope study that demonstrated many morphological details, especially of the sporont and later stages.

Gurleya dispersa Codreanu, 1957.
Gurleya dispersa Codreanu, 1957, Ann. Sci. Nat. Zool., 19, 364, Figs. 2f-h, 4a-f, Pl. I-fig. 2.
Host and Site: [PHYLLOPODA] The brine shrimp *Artemia salina* (L.); in the cells "adipo-phagocytaires" disseminated in the blood sinuses of the thorax and its appendages.
Lesion: The host individual became rose color.
Vegetative Stages: Schizonts 2.3-3 μm with punctiform nuclei.
Sporulation Stages: Spores develop in tetrads, showing diverse arrangements within a fine common membrane. Sometimes only 2 spores, macrospores, develop within the pansporoblast.
Spore: Pyriform, 5-5.9 μm long (*in vivo*), with a single central nucleus shown in Feulgen preparations.
Locality: Roumania (Tékirghiol).
Remarks: There is massive destruction of infected host cells.

Gurleya elegans (Lemmerman, 1900) Vávra, comb. n.
Marssoniella elegans Lemmerman, 1900, Ber. Dtsch. Bot. Ges., 18, 273. Komárek & Vávra, 1967, J. Protozool., 14(Suppl.), 36.
Gurleya sp. Vávra, 1963, Acta Protozool., 1, 153, Figs. 1, 2.
Gurleya marssoniella Vávra *in* Komárek & Vávra, 1968, Arch. Protistenkd., 111, 13.
Host and Site: [COPEPODA] *Cyclops vicinus* and *C. strenuus*; oocytes.

Developmental Stages: Clusters of 4, rarely 8, spores are found; spores embedded in mucus with posterior ends toward center of colony and connected by thin fibers; mucus swells in water and colony has stellate appearance [K. & V.]. Cells light blue-green, 4-16 united in radially bunched colonies [Lemmerman].

Spore: Pyriform, 5-6 x 1.3-5 μm [Lemmerman]. Drop-shaped, 5-7 μm [K. & V.].

Locality: Wide spread in the north temperate zone.

Remarks: Type species of *Marssoniella,* which now becomes a subjective synonym of *Gurleya.* The name *Gurleya marssoniella* Vávra was first used by Komárek and Vávra (1968), who cited an in-press paper by Vávra that never appeared. The specific name *elegans* Lemmerman, 1900, has priority over *marssoniella* Vávra, 1968. Vávra (personal communication) has concluded that the correct name is *Gurleya elegans.* This species has little resemblance to the type species of *Gurleya, G. tetraspora,* excepting that it is usually tetrasporous. Probably it belongs in a different genus, in which case the correct name for this microsporidian is its original name *Marssoniella elegans.*

Gurleya legeri Hesse, 1903

Gurleya legeri Hesse, 1903, C. R. Soc. Biol., 55, 495. [?] Mackinnon, 1911, Parasitology, 4, 28. Weiser, 1961, Monogr. Angew. Entomol., 17, 47.

Host and Site: [EPHEMEROPTERA] *Ephemerella ignita* Poda, larva; fat body, connective tissue and muscle [Hesse], *E. lepnevae* Tsch. [Weiser]. [TRICHOPTERA] Caddis fly larvae; fat body [Mackinnon].

Lesion: Infection begins in the body and, when intense, causes degeneration of the body and transformation of it into a white mass made up almost entirely of spores. The thorax of the larva becomes deformed.

Vegetative Stages: Uninucleate and binucleate schizonts give rise to uninucleate sporonts [Weiser].

Sporulation Stages: Pansporoblasts with microspores predominant. These are elliposidal, 8.5-11 x 5 μm, with spores usually in two rows, rarely in one row. Pansporoblasts with macrospores spherical, 5-8 μm, or ovoidal, 8 x 6 μm; 2 or 3 macrospores occur in them. Some pansporoblasts contain 1 macrospore and 1-2 microspores [Hesse]. Pansporoblasts 8 x 5 - 11 x 6 μm; spores in 2 superimposed rows, usually with those in the 2 rows pointing in opposite directions but sometimes in same direction. Sometimes only 3 relatively large spores present [Mackinnon].

Spore: Spores ovoidal, 4-5 x 2.5 and 5-6 x 3-4 μm [Hesse]. Pear-shaped, 4-5 x 2.5-3 μm [Mackinnon]. Polar filament about 25 μm [both authors].

Locality: France (Haute-Saône) [Hesse]. Scotland (Aberdeen) [Mackinnon]. U.S.S.R. (Kaukasus) [Weiser].
Remarks: Unfortunately, Hesse did not give any illustrations. Weiser expressed doubt that the species reported by Mackinnon is *G. legeri*.

Gurleya linearis Codreanu, 1968

Gurleya linearis Codreanu, 1968, Ann. Stn. Biol. Besse-en-Chandesse, 3, 271.
Host and Site: [EPHEMEROPTERA] *Ephemera danica*, nymph; fat body.
Vegetative Stages: No data.
Sporulation Stages: Spores produced in linear arrangement.
Spore: Conical, 4-5 x 2 μm, with distinct basal vacuole and discharging a filament 14-18 μm.
Locality: Roumania.
Remarks: The very brief description does not include a statement purporting to give characters differentiating the taxon ["International Code of Zoological Nomenclature," Art. 13a (see Stoll, 1961)]. Therefore, *G. linearis* is a *nomen nudum*.

Gurleya miyairii (Kudo, 1924) Sprague, 1970

Thelohania sp. Miyairi, 1909, "A Guide to the Study of Parasitic Protozoa," pp. 139 [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 182].
Cocconema miyairii Kudo, 1924, *loc. cit.*
Gurleya miyairii (Kudo, 1924) Sprague, 1970, *in* "Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), p. 425.
Host and Site: [DECAPODA] The shrimp *Atyephira* spp.; muscles.
Vegetative Stages: No data.
Sporulation Stages: Tetrasporoblastic.
Locality: Japan (Fukuoka).
Remarks: The descriptive data are taken from Kudo's (1924) monograph, since the original publication is unavailable. After Weiser (1961, Monogr. Angew. Entomol., 17, 36) suppressed the Genus *Cocconema* (a preoccupied name replaced by *Coccospora* Kudo, 1925) by transferring its type species to *Nosema*, this species had to be reassigned. Because it was said to be tetrasporoblastic Sprague placed it in *Gurleya*.

Gurleya nova Hovasse, 1950

Gurleya nova Hovasse, 1950, Bull. Inst. Océanog. (Monaco), 962, 8, Fig. 5.
Host and Site: [CILIOPHORA] Hyperparasite of the ciliate protozoan *Spirobutschliella chattoni* Hovasse, in the gut of the marine annelid *Potamoceros triqueter;* in cytoplasm or macronucleus.
Vegetative Stages: Amoeboid stages divide.

Sporulation Stages: Some stages divide into bi- and tetranucleate elements. Then the cytoplasm cuts into digitations, usually 4 in number, each of which develops into a spore.
Spore: Shape and size not mentioned but figure shows that the normal spore is egg-shaped and about 5.3 x 4.6 µm, with conspicuous posterior vacuole. Young spores show a longitudinal rod, presumed to be the base of the polar filament.
Locality: France (Mediterranean coast).
Remarks: The description is not adequate for correct generic determination. No mention is made of a pansporoblastic membrane, an essential character of *Gurleya*.

Gurleya richardi Cépède, 1911

Gurleya richardi Cépède, 1911, Ann. Biol. Lacust., 5, 27, Figs. 1-14 [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 130, Figs. 383-392, 753].
Host and Site: [COPEPODA] *Diaptomus castor*, a female; muscle (?).
Lesion: The parasite occupied the entire posterior region of the cephalothorax, which was chalky-white.
Vegetative Stages: Some "schizonts" were reported.
Sporulation Stages: Spores in groups of 4 within a pansporoblastic membrane. Some pansporoblasts contained macrospores and others microspores.
Spore: Macrospores, 5.5-6 x 2.8 µm. Microspores, 4-4.5 long with filament 45 µm.
Locality: France (Wimeraux).
Remarks: Possibly the microspores and macrospores represented two species.

Gurleya secalisae Thomson, 1960

Gurleya sp. Gibbs, 1953, Parasitology, 43, 143, Figs. 1-15
Gurleya secalisae Thomson, 1960, J. Insect Pathol., 2, 356. Weiser, 1961, Monogr. Angew. Entomol., 17, 92.
Host and Site: [LEPIDOPTERA] *Trachea secalis*; lower portion of gut.
Lesion: Involved area becomes white and opaque.
Vegetative Stages: Merogony by binary fission.
Sporulation Stages: Sporont undergoes two nuclear division and cytoplasmic division follows, with four sporoblast radiating symmetrically outward and nuclei located at outer extremities. No pansporoblastic membrane seen after dry fixation and Leishman's staining. Wet fixation and staining reveals that, during all stages in sporogony, "the body is invested in a tough ectoplasmic pellicle" [Gibbs].
Spore: Ovoid, 3.5 x 2 µm. Some macrospores, 6 x 3 µm, occur.
Locality: South Africa (vicinity of Cape Town).

Gurleya sokolovi Issi & Lipa, 1968

Gurleya sokolovi I. & L., 1968, J. Invertebr. Pathol., 10, 165, Figs. 1-38.
Host and Site: [ARACHNIDA] The water mite *Limnochares aquatica* (L.); hemocytes and adipose tissue, nerves.
Lesion: No data.
Vegetative Stages: Merogony binary fission ("mature schizonts are binucleated").
Sporulation Stages: Binucleate schizonts sometimes, instead of dividing, develop into plasmodia with 8 nuclei. These produce 8 sporoblasts within a pansporoblastic membrane. Only 4 sporoblasts develop into spores, while the other 4 degenerate.
Spore: Pyriform, with depression in broad end, 6.9 x 3.5 µm (fresh) and 4.5-6.6 x 1.9-3.2 µm (stained).
Locality: U.S.S.R. (vicinity of Peterhoff).
Remarks: Because of the peculiarities of this species (particularly the manner of sporulation), a new genus should probably be erected for it.

Gurleya sp. Hunter, 1968

Gurleya sp. Hunter, 1968, J. Invertebr. Pathol., 10, 387.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Chironomus californicus*, larva, pupa, adult.
Locality: U.S.A. (southern California)
Remarks: No descriptive data were given. The author found "an undescribed species of *Gurleya*" and gave results of field and laboratory studies on effect of the parasite on host populations.

Gurleya sp. Lom & Vávra, 1963

Gurleya sp. L. & V., 1963, Věstn. Česk. Spol. Zool., 27, 5, Fig. 3.
Host: [COPEPODA] *Cyclops* sp.
Vegetative Stages: No data.
Sporulation Stages: Figure 3 shows a cluster of 4 spores and a cluster of 8 spores. The spores, embedded in a thick mass of mucus that has swollen in water, are in stellate arrangement with their broad ends together.
Spore: Elongate, rounded posteriorly and tapering gradually to a bluntly pointed anterior end [as seen in Fig. 3].
Locality: Czechoslovakia.

Gurleya sp. Maurand, Fize, Michel & Fenwick, 1972

Gurleya sp. M., F., M. & F., 1972, Bull. Soc. Zool. Fr., 97, 712, Pl. 2-fig. 5, Pl. 2-figs. 1, 2.
Host and Site: [COPEPODA] *Macrocyclops albidus;* site not mentioned.
Vegetative Stages: No data.

Sporulation Stages: About 85% of the pansporoblasts produce 4 normal spores each. These spores lie with like ends together in a cone. Some produce 8 or 12 normal spores. About 5% of the pansporoblasts are teratological, containing 1 or more giant spores and, usually, some normal spores.
Spores: Elongate-pyriform (according to figures) and normally 4.7 x 2.4 µm. Polaroplast composed of about 20 large and almost spherical masses situated next to the elongated basal part of the polar filament.
Locality: France (Issanka).
Remarks: The authors distinguished *Gurleya* and *Pyrotheca* by the size of the spores but did not specify the characteristic size for either genus. The assignment of the present species to *Gurleya* must be regarded as provisional.

Genus *Pyrotheca* Hesse, 1935

Pyrotheca cyclopis (Leblanc, 1930) Poisson, 1953
Gurleya cyclopis Leblanc, 1930, Ann. Soc. Sci. Bruxelles (Ser. B), 59, 272, Figs. 1-5. Jírovec, 1936, Věstn. Česk. Spol. Zool., 4, 61.
Pyrotheca incurvata Hesse, 1935, Arch. Zool. Exp. Gén., 75, 652, Figs. 1-7. Jírovec, 1936, Věstn. Česk. Spol. Zool., 4, 62. Fantham & Porter, 1958, Proc. Zool. Soc. Lond., 130, 157, Figs. 1-9.
Pyrotheca cyclopis (Leblanc, 1930) Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1061.
[*non*] *Microsporidia incurvata* Moniez, 1887, C. R. Acad. Sci., 104, 185. Fantham & Porter, 1958, *loc. cit.*
Host and Site: [COPEPODA] *Megacyclops viridis* Jurine; fat body, hemocoel and, perhaps, reproductive organs [Hesse]. *Cyclops albidis* [Leblanc]. *Cyclops viridis* and *Diaptomus* sp. [F. & P.]. [CLADOCERA] *Daphnia* spp. [F. & P.].
Lesion: Infected animal chalky-white [Hesse]. It is transformed into a small sachet of spores [Leblanc].
Vegetative Stages: No data.
Sporulation Stages: Sporoblasts short, thicker than spore, uninucleate [Hesse]. Spores in groups of 4, lying side by side with like ends together [Leblanc, Hesse]. Bundle of spores not covered by a membrane proper [Leblanc].
Spore: Shaped like a powder flask, with posterior end inflated and anterior end pointed and curved; with large polaroplast ("capsule") occupying the anterior two-thirds and showing conspicuously the basal part of the polar filament running lengthwise through it; with posterior vacuole, 14 x 3 µm; polar filament 130 µm [Hesse]. Fresh spores 16.5 x 3 µm; polar filament 30 µm [Leblanc]. Spores 11.1-16.3 x 2.2-4.4 µm, with polar filament up to 125 µm [F. & P.].

Locality: Belgium (Louvain) [Leblanc]. France (Haute-Sâone) [Hesse]. England and Canada [F. & P.].

Remarks: Type species by monotypy. Jírovec said that *Pyrotheca incurvata* Hesse, 1935, is identical with *Gurleya cyclopis* Leblanc, 1930, but did nothing about the problem on nomenclature arising from this supposed identity. Weiser (1947) evidently regarded the latter name as a junior synonym of the former, since he included only *Gurleya cyclopis* Leblanc in list of species. Apparently, Poisson was the first author who definitely accepted *Pyrotheca* as a distinct genus while, at the same time, accepting Jírovec's statement about the identity of the two species mentioned above. Whether a pansporoblastic membrane is absent, as Leblanc's remark seems to indicate, needs further clarification. Considering differences in host and spore length, the two species may be actually distinct but, apparently, congeneric.

Pyrotheca cuneiformis Maurand, Fize, Michel & Fenwick, 1972

Pyrotheca cuneiformis M., F., M. & F., 1972, Bull. Soc. Zool. Fr., 97, 714, Pl. 2-figs. 1-3.

Host and Site: [COPEPODA] *Macrocyclops albidus;* adipose tissue.

Vegetative Stages: No data.

Sporulation Stages: Pansporoblast produces a variable number of sporoblasts (15, 16, 17, 18, 19, 21, mostly 16) in rosette formation.

Spore: Cuneiform, straight, 9.75 x 3 μm.

Locality: France (near Montpellier).

Remarks: The large number of sporoblasts produced by the sporont emphasizes the need for arriving at an adequate characterization of the Genus *Pyrotheca.*

Pyrotheca virgula (Moniez, 1887) Hesse, 1935

Microsporidia virgula Moniez, 1887, C. R. Acad. Sci., 104, 1313.

Glugea virgula (Moniez) Pfeiffer, 1895, "Die Protozoen als Krankheitserreger," p. 64 [*fide* Kudo, 1924, Ill. Biol. Mongr. 9(2/3), 133]

Plistophora virgula (Moniez, 1887) Labbé, 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 110.

Thelohania virgula (Moniez, 1887) Kudo, 1921, J. Parasitol., 7, 141. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 133, Fig. 440.

Pyrotheca virgula (Moniez, 1887) Hesse, 1935, Arch. Zool. Exp. Gén., 75, 660.

Host and Site: [COPEPODA] *Cyclops gigas* and *Cyclops* sp.; fat body and body cavity [Labbé].

Vegetative Stages: No data.

Sporulation Stages: "Ordinairement(?) 8 sp. groupées en étoile dans chaque sporoblaste" [Labbé].

Spore: Comma-shaped, sharply pointed at one end, with a vacuole in other end, 8 x 3 µm [Labbé].
Locality: France (Lille). Germany (Weimar).
Remarks: The classification of the latest reviser is accepted without any conviction as to its correctness. Labbé, Kudo (1924), and Hesse all indicated that Moniez originally placed this species in the Genus *Nosema* but I cannot verify this. Weiser (1947, Acta Soc. Sci. Nat. Moravicae, 18, 25) incorrectly attributed the original name to Pfeiffer, 1895.

Pyrotheca sp. Maurand, Fize, Michel & Fenwick, 1972

Pyrotheca sp. M., F., M. & F., 1972, Bull. Soc. Zool. Fr., 97, 713, Pl. 2-Fig. 4.
Host and Site: [COPEPODA] *Macrocyclops albidus;* site not mentioned.
Vegetative Stages: No data.
Sporulation Stages: Tetrasporous. Spores separated by an abundant mucus.
Spore: In fresh smears 16 x 3 µm, curved in the form of a cat's fang. Electron microscopy shows polaroplast like that of *Gurleya* sp. studied at the same time. Polar filament with 12 coils, corresponding to a length of 100 µm.
Locality: France (Issanka).
Remarks: These authors pointed out that this is very much like the type species in size and shape of the spore. The similarity of the internal structure of this and the *Gurleya* sp. emphasizes the problem of distinguishing these two genera.

Genus *Stempellia* Léger & Hesse, 1910

Stempellia mutabilis Léger & Hesse, 1910

Stempellia mutabilis Léger & Hesse, 1910, C. R. Acad. Sci., 150, 412. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 163. Weiser, 1961, Monogr. Angew. Entomol., 17, 50. Codreanu, 1968, Ann. Stn. Biol. Besse-en-Chandesse, 3, 271. Issi, 1968, Acta Protozool., 6, 350. Desportes, 1976, Protistologica, 12, 121-150, Figs. 1-57.
Host and Site: [EPHEMEROPTERA] *Ephemera vulgata* L., larva; exclusively in fat body.
Lesion: Appears, at the end of the development, in the form of spherical or oval cysts disseminated in the adipose tissue and around which the sparse cells react in forming a very thick connective envelope. Cysts vary in size but often reach 120 µm. In each cyst are numerous parasites, mostly in the stage of "sporonts" in different stages of their development. Finally, the cysts may fall into the body cavity. On superficial examination, one might take them for large *Glugea* in which the spores become grouped in different

ways; but a more attentive observation shows, among the "sporonts" with their different groupings of spores, some vegetative stages having contours visible with difficulty and a number of degenerated nuclei of the fat cells destroyed by the parasite [L. & H.]. The cyst [apparently a group of infected fat cells] is limited externally by an envelope with 1-3 layers derived from hemocytes [Desportes].

Vegetative Stages: Contours visible with difficulty [L. & H.]. "Trophozoites" uninucleate or binucleate (sometimes with a typical diplocaryon), surrounded by a membrane from which numerous bridges extend into the host cell cytoplasm and also to other "trophozoites", the bridges resemble the ergastoplasmic reticulum of the host cell. "Trophozoites" transform into sporonts.

Sporulation Stages: "Ces sporontes présentent cette particularité extrêmement remarquable d'évoluer, les uns vers le type octosporé (*Thelohania*), les autres (en nombre à peu près égal aux précédents) vers le type tétrasporé (*Gurleya*), d'autres enfin, plus rares, vers le type disporé (*Perezia*), ou monosporé (*Nosema*)" [L. & H.]. Two distinct sequences occur, one microsporous (producing 8 microspores) and the other macrosporous (producing 4 macrospores). The former takes place within a parasitophorous vacuole that is bounded by a membrane derived from that which was connected by bridges to the host cell endoplasmic reticulum; the latter involves differentiation of a typical pansporoblastic membrane inside of which the 4 macrospores are produced; sometimes there is anomalous production of 1 or 2 giant spores [Desportes].

Spore: Size varies from 2-6 μm, the isolated ones being the largest; those in groups of 4 ("le type *Gurleya*") are pyriform, the others generally ovoid [L. & H.]. Most are pyriform, a little more than 3 μm, grouped by 8; those in groups of 4 are 4-5 μm and those in groups of 2 may reach 6-7 μm [Codreanu]. Microspores generally oblong, sometimes pyriform, 3 x 1.3 μm, with 6-7 coils in the polar filament. Macrospores 6 x 1.9-2 μm, with 12-14 coils in the polar filament [Desportes].

Locality: France.

Remarks: Type species by monotypy. Desportes (using electron microscopy) confirmed the observations of Léger and Hesse, giving also many other details of the morphology and life cycle. She discussed the significance of the polymorphism, admitting that it might represent 2 or more species, but tentatively accepted the idea that only 1 species was represented. In a footnote (P. 148) added while the article was in press, however, she said that she has found new eivdence that causes her now to consider the first interpretation.

Stempellia sp. Vávra, 1972

Stempellia sp. Vávra, 1972, J. Microsc. (Paris), 14, 358, Pl. 1.
Host and Site: [COPEPODA] *Cyclops strenuus;* ovary.
Spore: Polysaccharides were demonstrated in the anchoring disc and the polar filament.
Locality: Czechoslovakia.
Remarks: No descriptive data were given excepting the distribution of polysaccharides in the spore as demonstrated by a cytochemical study involving electron microscopy.

Family TELOMYXDAE Léger & Hesse, 1910
Genus *Telomyxa* Léger & Hesse, 1910

Telomyxa glugeiformis Léger & Hesse, 1910

Telomyxa glugeiformis L. & H., 1910, C. R. Acad. Sci., 150, 413. Léger & Hesse, 1922, C. R. Acad. Sci., 174, 329, Figs. 8, 9. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 188, Fig. 667. Weiser, 1961, Monogr. Angew. Entomol., 17, 51. Codreanu, 1961, C. R. Acad. Sci., 253, 1613, Figs. 1-7. Codreanu, 1963, Prog. Protozool. Proc. Int. Congr. Protozool., 1, 82, Figs. 1-7. Codreanu & Vávra, 1970, J. Protozool., 17, 374, Figs. 1-27.
Host and Site: [EPHEMEROPTERA] *Ephemera vulgata* L., larva; fat body [L. & H.].
Vegetative Stages: No data.
Sporulation Stages: Sporont divides into 2 uninucleate sporoblasts within a pansporoblastic membrane. Sporoblasts develop into spores that remain glued together as diplospores [C. & V.].
Spore: "Slightly pyriform," about 4 x 2.5 µm [calculated from figures given by C. & V.]. Diplospore elliptical, 5.8-6.0 x 3.9-4.2 µm [C. & V.].
Locality: France [L. & H.; C. & V.]. Roumania [Codreanu].
Remarks: Type species by monotypy.

Telomyxa campanellae (Kruger, 1956) comb. n.

Glugea campanellae Kruger, 1956, Zool. Anz., 156, 128, Figs. 1-3.
Host and Site: [CILIOPHORA] The free-living peritrichous ciliate *Campanella umbellaria*. In cytoplasm(?).
Vegetative Stages: No data.
Sporulation Stages: Two spores arise within a pansporoblast and remain side-by-side in pairs, like ends usually together.
Spore: Elongate-ovoidal (judging from figures) and 7 x 3.3 µm. With large anterior clear area, middle darker zone and posterior sickle-shaped clear area. Base of polar filament, starting at anterior end, passes posterior and coils around the middle zone. Nucleus, demonstrated with Feulgen, as well as other methods, usually single; sometimes two nuclei present. Polar filament came only partly out when pressure was applied to spore.

Locality: West Germany. (A watering place for cattle near Munster. The parasite found sporadically.)
Remarks: This species certainly does not belong to the genus *Glugea*. The only genus it seems to resemble is *Telomyxa*.

Telomyxa muscarum Weiser, 1961

Telomyxa sp. Fantham & Porter, 1958, Proc. Zool. Soc. Lond., 130, 160, Figs. 25-34.
Telomyxa muscarum Weiser, 1961, Monogr. Angew. Entomol., 17, 131.
Host and Site: [DIPTERA-BRACHYCERA] *Musca domestica*, *Calliphora erythrocephala*, and *C. vomitoria*, larva; Malpighian tubules, hemocoel, and fat bodies.
Vegetative Stages: No data.
Sporulation Stages: "The few sporonts of *Telomyxa* sp. that we have observed were all at the same stage of development, rudiments of four spores only being present" [F. & P.].
Spore: [diplospore] Oval, 3-4.5 x 2-3.8 μm, the dimensions varying slightly according to the host and its stage of development.
Locality: Canada. England (London).
Remarks: Known only from a brief description by Fantham and Porter. That description contains a large subjective element (if it actually pertains to a microsporidium) that is not repeated here.

Telomyxa trichopterae (Weiser, 1946) comb. n.

Perezia trichopterae Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 256, Fig. 8. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 32.
Glugea trichopterae (Weiser, 1946) Thomson, 1960, J. Insect Pathol., 2, 355. Weiser, 1961, Monogr. Angew. Entomol., 17, 71.
Host and Site: [TRICHOPTERA] *Plectrocnemia geniculata*, larva; fat body.
Lesion: Infected fat body chalky-white and opaque.
Vegetative Stages: Small paucinucleate plasmodia.
Sporulation Stages: "In der Sporogony bilden sich je zwei Sporen in einem Pansporoblasten. Die zwei Sporen bleiben, durch die Plasmareste aneinandergeklebt, lang zusammen" [Weiser (1961)].
Spores: Egg-shaped, 3.5-4 x 2 μm; macrospores, 6 x 3 μm; polar filament 200-340 μm.
Locality: Czechoslovakia (near Chotěboř).
Remarks: Thomson transferred this species to *Glugea* in 1960, incorrectly attributing the transfer to Weiser, 1958, who had declared *Perezia* to be a junior synonym of *Glugea*. However, this species certainly does not belong in *Glugea* because it has no resemblance to typical members of this genus. The description of the sporogony which Weiser (1961) gave fits

only one genus, *Telomyxa* Léger & Hesse, 1910. Therefore, the species if provisionally transferred to *Telomyxa*.

Family TUZETIIDAE Sprague, Tuzet & Maurand [Established in the "Classification"]

Genus *Tuzetia* Maurand, Fize, Fenwick & Michel, 1971

Tuzetia infirma (Kudo, 1921) M., F., F. & M., 1971

Nosema infirmum Kudo, 1921, J. Parasitol., 7, 138, Figs. 8-17. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 108, Figs. 206-210.

Tuzetia infirmum (Kudo, 1921) M., F., F. & M., 1971, Protistologica, 7, 231, Figs. 1-7.

Host and Site: [COPEPODA] *Cyclops albidus;* fat body, reproductive organs and muscles [Kudo (1921)]. *Macrocyclops fuscus* (Jurine, 1820); ovary [M., F., F. & M.].

Vegetative Stages: Young schizont spherical with a single nucleus. Developments into plasmodium with as many as 6 nuclei. "The ultimate products seem to be uninucleate rounded sporonts" [Kudo (1921)]. Schizonts 2.6 μm with a large nucleus 2 μm [M., F., F. & M.].

Sporulation Stages: "Each sporont develops into a single spore ..." [Kudo (1921)]. A schizont develops into a sporogonial plasmodium with 3-6 nuclei. In subsequent development, there is differentation of sporoblast membranes and pansporoblastic membrane. The latter divides during sporogony so that each sporoblast receives its individual sachet from the pansporoblastic membrane [M., F., F. & M.].

Spore: Fresh spore pyriform with a posterior end pointed, 5.6-6.4 x 3 μm, polar filament 90-115 μm [Kudo (1921)]. Pyriform, with posterior protuberance, about 6 x 3 μm, with polar filament wound 16 times in a 2.5 μm spiral, uninucleate [M., F., F. & M.].

Locality: U.S.A. (New York) and France (Alès, Gard).

Tuzetia entericola Codreanu & Codreanu-Balcescu, 1975

Tuzetia entericola C. & C.-B. [*nomen nudum*], 1975, J. Protozool., 22, 78A.

Host and Site: [EPHEMEROPTERA] *Rhithrogena semicolorata* (Curtis), nymph; in cells of hindgut near Malpighian tubules.

Developmental Stages: No data.

Spore: Ellipsoidal, 6-7 μm.

Locality: Roumania.

Remarks: The brief description was not accompanied by a list of characters purporting to differentiate the taxon.

Tuzetia lipotropha Codreanu & Codreanu-Balcescu, 1975

Tuzetia lipotropha C. & C.-B. [*nomen nudum*] 1975, J. Protozool., 22, 78A.

Host and Site: [EPHEMEROPTERA] *Rhithrogena semicolorata* (Curtis), nymph; fat body.
Vegetative Stages: No data.
Sporulation Stages: Sporoblast surrounded by a matrix of secretion limited by a unit membrane and produces a network of threads radiating to the mature spores.
Spore: Ovoid, about 6 μm. Polar filament 150 μm.
Locality: Roumania.
Remarks: The brief description was not accompanied by a list of characters purporting to differentiate the taxon.

Tuzetia sp. Maurand, Fize, Michel & Fenwick, 1972

Tuzetia sp. M., F., M. & F., 1972, Bull. Soc. Zool. Fr., 97, 710, Pl. 1-Fig. 1, Pl. 2-Fig. 6.
Host and Site: [COPEPODA] *Macrocyclops albidus;* site not mentioned.
Vegetative Stages: No data.
Sporulation Stages: The sporont produces many sporoblasts, each with its pansporoblastic membrane. Between the latter and the exospore is an electron-dense trilaminate membrane not seen in *T. infirma*.
Spore: Ovoid, 5 x 2.5 μm, uninucleate.
Locality: France (Issanka).

Suborder APANSPOROBLASTINA Tuzet, Maurand, Fize, Michel & Fenwick, 1971

Family GLUGEIDAE Thélohan, 1892

Genus *Glugea* T., 1891

Glugea anomala (Moniez, 1887) Gurley, 1893

Nosema anomala Moniez, 1887, C. R. Acad. Sci., 104, 1312. Lom & Weiser, 1969, Folia Parasitol. (Prague), 16, 199, Pls. 3, 4.
Nosema anomalum Moniez, 1887, Labbé, 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 105, Fig. 183. Stempell, 1904, Arch. Protistenkd., 4, 1, Figs. 1-147.
Glugea microspora Thélohan, 1891, C. R. Soc. Biol., 112, 170. Thélohan, 1892, Bull. Soc. Philom., Paris, 4, 174. Thélohan, 1895, Bull. Sci. Fr. Belg., 26, 356, Figs. 138-142.
Glugea anomala (Moniez, 1887) Gurley, 1893, Bull. U. S. Fish. Com. for 1891, 11, 409. Gurley, 1894, Rep. U. S. Fish Com. for 1892, 26, 192. Woodcock, 1904, Trans. Liverpool Biol. Soc., 18, 138, Fig. 7c. Weissenberg, 1911, Sitzungsber. Ges. Naturf. Freunde, Berlin, 8, 344. Weissenberg, 1914, Proc. Int. Congr. Zool., 9, 380, Fig. 1. Debaisieux, 1920, Cellule, 30, 217, Figs. 1-53. Weissenberg, 1921, Arch. Protistenkd., 42, 400, Figs. 1-8. Weissenberg, 1922, Verh. Dtsch. Zool. Ges., 27, 41. Kudo, 1924, Ill. Biol. Monogr. 9(2/3), 110, Figs. 219-264, 761. Weissenberg, 1952, Proc. Soc. Protozool., 3, abstr. 5. Doflein-Reichenow, 1953, "Lehrbuch der Protzoenkunde,"

6th ed., pp. 1016, Figs. 127-130. Weissenberg, 1967, J. Protozool., 14(Suppl.), 28. Weissenberg, 1968, J. Protozool., 15, 44, Figs. 1-9. Weissenberg, 1970, J. Parasitol., 56, 363.

Glugea (Nosema) anomala (Moniez) (Gurley, 1893) Poisson, 1953, "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1060, Fig. 810.

Host and Site: [PISCES] "Epinoche" [Moniez, Thélohan (1891)]. "Epinoche" and "epinochette" [Thélohan (1892)]. *Gasterosteus aculeatus*, *G. pungitius* and *Gobius minutus* [Thélohan (1895)].

Lesion: The "*Glugea*-cyst" of this species is the classic example of the cell hypertrophy tumor or xenoma. It may reach 3-4 mm in diameter. Its nucleus becomes hypertrophied, lobed and branched; then the nucleus undergoes amitotic division.

Vegetative Stages: Cylindrical forms in the xenoma undergo binary and multiple fission. At first this occurs throughout the xenoma but later becomes restricted to an outer zone. Certain plasmodia become surrounded by vacuoles and divide into uninucleate "vacuole cells" or sporonts.

Sporulation Stages: Each sporont divides into 2 sporoblasts and these develop into spores.

Spore: Size, 3-3.5 x 1.5 μm [Moniez]; 4-4.5 x 3, filament 30-35 μm [Thélohan (1895)].

Locality: Europe (many localities).

Remarks: Type species by monotypy. Weissenberg (1968) gave a detailed account of the lesion.

Glugea acerinae Jírovec, 1930

Glugea acerinae Jírovec, 1930, Arch. Protistenkd., 72, 198, Figs. 1-8, Pls. 15, 16.

Host and Site: [PISCES] *Acerina cernua;* gut wall.

Cyst: Young xenoma 20-30 μm, older one 40-60 μm, ripe cysts 200-350 μm; wall 0.2-0.5 μ thick, covered with a connective tissue capsule; nucleus, hypertrophied but not divided, degenerates.

Vegetative Stages: Plasmodia in form of branched cylinders, resembling mycelia of fungi. These break up into chains, primary cylinders, which fuze in pairs (without nuclear fusion) to make secondary cylinders. The cylinders then break up into binucleate cells.

Sporulation Stages: The binucleate cells from the cylinders divide into uninucleate cells and these develop into spores.

Spore: 3.5-4.5 x 2.5-3μm, with anterior and posterior vacuoles; uninucleate (confirmed by Jírovec with Feulgen preparations in 1930 and 1932).

Glugea acuta Thélohan, 1895

Glugea acuta Thélohan, 1895, Bull. Sci. Fr. Belg., 26, 358, Fig. 132. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 115, Fig. 269. Weiser, 1947, Acta. Soc. Sci. Nat Moravicae, 18, 48.
Nosema acutum (Thélohan, 1895) Labbé, 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 106.
Host and Site: [PISCES] *Syngnathus acus* and *Entelurus aequoreus;* connective tissue of muscle of dorsal fin.
Developmental Stages: No data.
Spore: Ovoid, with one end inflated and the other pointed, 5 x 3-3.5 μm.
Locality: France.

Glugea branchialis (Nemeczek, 1911) comb. n.

Nosema branchiale Nemeczek, 1911, Arch. Protistenkd., 22, 163, Fig. 19. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 101, Figs. 149, 762. Bazikalova, 1932, Fisheries Sci. Inv. in Murmansk, pp. 136-153 [In Russian. *Fide* Kabata, 1959, Parasitology, 49, 309, Fig. 1]. Dogiel, 1936, Ann. Leningr. Univ. no. 7, Biol. Ser., Probl. Ecol. Parasitol., pp. 122-133 [In Russian. *fide* Kabata, *loc. cit.*]. Fantham, Porter & Richardson, 1941, Parasitology, 33, 191, Figs. 19-28. Shulman & Shulman-Albova, 1953, "Parasites of Fishes of the White Sea" [*fide* Kabata, *loc. cit.*]. Kabata, *loc. cit.*
Host and Site: [PISCES] The haddock *Gadus aeglefinus* L.; gill filaments [Nemeczek, Kabata]. Similar or identical species on gill filaments of cod *Gadus callarias* L. [Bacikalova; Dogiel; F. P. & R.], *G. morhua marsialbi* Derjungin [S. & S.].
Lesion: Cyst whitish-gray, spherical, 0.2-0.5 mm; one cysts was ovoid and 1 mm long; in sections "Die Cysten Zeigten ein durch dunklere Färbung differenziertes Ektoplasma, an welchem jedoch keine fibrilläre struckture wie bei *Nosema anomalum* wahrgenommen wurde" [Nemeczek]. Fantham *et al.* found only 1 cyst, about 1 mm in diameter. When attempting to remove the cyst, it ruptured and a milky fluid came out.
Vegetative Stages: No data in the original description. Fantham *et al.* reported binary fission, "with or without complete separation of the meronts," producing clusters of chains of uninucleate cells.
Sporulation Stages: Nemeczek said only that a pansporoblastic membrane was absent. Fantham *et al.* regarded the species as monosporous.
Spore: Egg-shaped with distinct vacuole, 6.3 x 3.5 μm (fresh) [Nemeczek]. Kabata tabulated the sizes given by different authors.
Locality: Originally found in market fish in Austria (Vienna); Kabata reviewed the locality records and concluded "it can be assumed that *N. branchiale* is boreo-arctic in distribution."

Remarks: Kudo said, concerning Nemeczek's observations, "since he compares the 'cyst' with that of *Glugea anomala*, he may have had a species of *Glugea* although he designated it as a *Nosema*." It should be noted, however, that Nemeczek did not recognize the Genus *Glugea* but followed Labbé (1899) in treating its type species as *Nosema*, *N. anomalum*. Thus, Kudo overlooked the fact that Nemeczek not only compared the cyst of *N. branchiale* with that of *G. anomala* but actually treated these two species as congeneric. Therefore, lacking contradictory evidence, those of us who believe that *Glugea* is distinct from *Nosema* are compelled to consider *N. branchiale* as a species of *Glugea*. Fantham *et al.* concluded that they studied the same species and that it was correctly assigned to *Nosema*, "since one sporoblast gives rise to a single spore." They also said they found "some of the schizogonic stages which establish the parasite as a species of *Nosema*." The first of these statements is meaningless in this context, since one sporoblast in any species gives rise to a single spore. They probably meant "sporont," but it is now generally believed that the sporont in both *Nosema* and *Glugea* gives rise to 2 spores. As to the "schizogonie" stages described and figured, they do not show the double nucleus characteristic of *Nosema*. In any case, the observations of these authors were superficial and in some instances (especially in the description of a spore developing as in myxosporidia) plainly inaccurate; they provide no evidence that this species is a *Nosema*. Kabata accepted the falacious reasoning of Fantham *et al.* that this is a *Nosema* because "one spore is formed by each sporoblast." Kabata pointed out that spore dimensions given by different authors seem to fall into two size groups and mentioned the possibility that more than one species has been described as *N. branchiale*. I note, however, that the authors who gave the larger measurements studied living spores and the others studied preserved ones. Perhaps this could explain the two barely distinct size groups.

Glugea bychowskyi Gasimagomedov & Issi, 1970

Glugea bychowskyi G. & I., 1970, Zool. Zh., 49, 1122, Figs. 5-9.
Host and Site: [PISCES] Volga herring *Alosa kessleri volgensis* (Berg); intestinal walls and testes.
Lesion: No data.
Vegetative Stages: No data.
Sporulation Stages: "In smears of the intestine and the testes many spores clung together by 2, which indicates belonging of the microsporidian to the genus *Glugea*."
Spore: Pyriform, 3.6 x 1.8 μm (in glycerine-gelatin).
Locality: Caspian by Tyulen Island.
Remarks: More data are needed to substantiate the generic determination.

Glugea caulleryi Van den Berghe, 1940

Glugea microspora Van den Berghe, 1939, J. Parasitol., 25, (Suppl.), 21.
[*non*] *Glugea microspora* Thélohan, 1891, C. R. Soc. Biol., 112, 170. Thélohan, 1892, Bull. Soc. Philom. Paris, 4, 173.
Glugea caulleryi Van den Berghe, 1940, J. Parasitol., 26, 238.
Host and Site: [PISCES] *Ammodytes lanceolatus;* liver.
Cyst: Spherical encysted masses.
Vegetative Stages: No data.
Sporulation Stages: No data.
Locality: France (Wimereux).
Remarks: In addition to "encysted masses" there was generalized invasion of the liver. The very brief description does not substantiate the generic determination.

Glugea cordis Thélohan, 1895

Glugea cordis Thélohan, 1895, Bull. Sci. Fr. Belg., 26, 358, Fig. 130. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 116, Fig. 270. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 47.
Nosema cordis (Thélohan, 1895) Labbé, 1899, *in* "Das Tierreich" (O. Butschli, ed.), 5, 106.
Host and Site: [PISCES] *Alosa sardina;* connective tissue and may be muscle fibers of heart.
Lesion: Irregular white spots covered the anterior surface of the ventricle.
Developmental Stages: No data.
Spore: Ovoid, the small end very pointed, 3-3.5 x 2 μm.
Locality: France (Marsielle).

Glugea cotti (Chatton & Courrier, 1923) comb. n.

Nosema cotti C. & C., 1923, C. R. Soc. Biol., 89, 579, Figs. 1-3.
Host and Site: [PISCES] *Cottus bubalis;* testis.
Lesion: The cyst situated in a lacuna resulting from testicular necrosis. The cyst ("complexe xéno-parasitaire" or xenoma) white, subspherical, up to 700 μm in diameter, consisting of 4 zones: an outer brush border 10-15 μm thick with a layer of basal granules. Next, a clear zone of dense cytoplasm 10-20 μm thick. Third, a zone containing many chromatic granules very irregular in size and shape [host cell nuclei?]. Finally, the central region is filled with spores and developmental stages of the parasite. In addition, some parasites infiltrated the host tissue and became surrounded by a fibrous layer of host tissue.
Vegetative Stages: No data.
Sporulation Stages: Each spore is formed from an isolated sporoblast. Spores not grouped in definite masses.
Spore: Ovoidal, 8-10 μm.
Locality: France (Roscoff).

Remarks: Neither the type of sporulation, said by the authors to characterize *Nosema*, nor any other known character, excludes this species from Genus *Glugea*. On the contrary, the structure of the cysts is like that of *Glugea*. These considerations, reinforced by the fact that the presence of a typical *Nosema* in fish has not been clearly demonstrated, justifies transferring this species to *Glugea*. Chatton (1920, C. R. Acad. Sci., 171, 55) introduced the term "complexe xéno-parasitaire" for a mesozoan(?) parasite, *Neresheimeria catenata* and, at the same time, pointed out its applicability to microsporidia such as *Mrazekia*.

Glugea depressa Thélohan, 1895

Glugea depressa Thélohan, 1895, Bull. Sci. Fr. Belg., 26, 360, Fig. 129. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 116, Fig. 271. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae 18, 48.
Nosema depressum (Thélohan, 1895) Labbé, 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 106.
Host and Site: [PISCES] *Julis vulgaris;* liver.
Lesion: Very small white spots appear on surface of the liver.
Developmental Stages: No data.
Spore: Long ovoid, 4.5-5 x 1.5-2 µm.
Locality: France (Marseille).

Glugea destruens Thélohan, 1891

Glugea destruens Thélohan, 1891, C. R. Acad. Sci., 112, 168 [Labbé, 1899, "Das Tierreich" (O. Bütschli, ed.), 5, 105]. Thélohan, 1892, Bull. Soc. Philom. Paris, 4, 174. Gurley, 1893, Bull. U. S. Fish. Com. for 1891, 11, 409. Gurley, 1894, Rep. U. S. Fish. Com. for 1892, 26, 191. Thélohan, 1895, Bull. Sci. Fr. Belg., 26, 357, Figs. 120-122. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 114, Figs. 265-267. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 46. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1060.
Nosema destruens (Thélohan, 1891) Labbé, 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 105.
Host and Site: [PISCES] *Callionymus lyra;* muscles.
Developmental Stages: No data.
Spore: 3-3.5 x 2-2.5 µm.
Locality: France (Concarneau, Roscoff).

Glugea dogieli Gasimagomedov & Issi, 1970

[?] *Glugea lucioperca*e Dogiel & Bychowsky, 1939 [*fide* G. & I., 1970, Zool. Zh., 49, 1121, Figs. 1-4].
Glugea dogieli G. & I., 1970, *loc. cit.*
Host and Site: [PISCES] The pikeperch *Lucioperca lucioperca* L.; intestinal wall.

Cyst: Round, somewhat drawn-out, up to 200-250 μm, surrounded with a connective tissue wall and layer of modified host cells; wall reaches 10 μm in thickness. In center are clumps of chromatin (probably remnants of host cell nucleus) surrounded by light zone. Cysts usually arranged in groups of 2-6 and sometimes combined with another.

Vegetative Stages: No data.

Sporulation Stages: "With extraction from the cyst the spores cling together by twos, which is characteristic of the genus *Glugea*" [G. & I.]

Spore: Elongate-oval with narrowed anterior end, 3.6-4.8 x 2.4-2.7 μm.

Remarks: The authors apparently treated this species as partly identical with *Glugea luciopercae* D. & B., 1939, because the description of its spores fit that given for the latter species by Shulman. Shulman (1962) said the spores are elongatedly oval with somewhat tapering poles and 3.8-5 x 1.8-2.5 μm., while the original authors said they are oval, rather pyriform and not over 3 μm. This complete lack of overlapping in spore measurements given by the different authors is consistent with the idea that they were dealing with completely (not in part) distinct species. An alternative possibility (if not probability) is that the original authors gave grossly inaccurate measurements and that *G. dogieli* G. & I., 1970, is identical with *G. lupiopercae* D. & B., 1939. In the latter case, the new name would have to be abandoned as a junior synonym.

Glugea fennica (Lom & Weiser, 1969) comb. n.

Nosema fennica L. & W., 1969, Folia Parasitol. (Prague), 16, 194, Fig. 1, Pl. I, III. [*fennicum*].

Host and Site: [PISCES] The European catfish *Silurus glanis* L.; subcutaneous tissue.

Lesion: "The surface and the fins of the infected fish were dotted with numerous oval cysts measuring up to 2.5 mm, which were clearly visible because of their whitish color." Cyst wall up to 30 μm, usually 3-5 μm, in "breadth" (thickness ?). Compressed and altered fragments of the host-cell nuclei visible under the cyst wall. Vegetative stages occur in a peripheral zone and spores fill the central part. When cysts rupture the parasites are phagocytized; these phagocytes containing parasites are also packed under the epidermis.

Vegetative Stages: First and second schizogonies involve respectively spherical and cylindrical plasmodia in the peripheral region of the cyst contents.

Sporulation Stages: Sporont undergoes binary fission to produce 2 sporoblasts. A vacuole characterizes the sporogony stages.

Spore: Long-oval, 6.8-8.1 x 2.5-3 μm (fresh), uninucleate; posterior vacuole occupies one-half to two-thirds of the spore.

Locality: Finland (Helsinki).
Remarks: As Weissenberg (1970) said, "I cannot see that the general course of development in *Nosema fennica* shows essential differences from the findings in *Glugea anomala.*" This species is clearly congeneric with *Glugea anomala,* type species, but it was placed in Genus *Nosema* because the authors considered *Glugea* Thélohan, 1891, to be a junior synonym of *Nosema* Naegeli, 1857. More recently, however, Cali (1971) has shown that a double nucleus in the spore (and other stages) is an essential character of *Nosema.* Sprague and Vernick (1971) then pointed out that this character (regardless of certain debated ones) clearly distinguishes *Nosema* from *Glugea* (which has uninucleate spores). Therefore, the present species belongs in Genus *Glugea.*

Glugea gasterostei Voronin, 1974

Glugea gasterostei Voronin, 1974, Acta Protozool., 13, 212, Fig. 1n-p, Pl. 1-Fig. 2.
Host and Site: [PISCES] *Gasterosteus aculeatus;* mesentery.
Lesion: Yellowish-white cysts were 3 x 4 mm.
Spore: Elongate-oval, 5.5 (4.9-6.0) x 2.6 (2.1-2.8) μm. Posterior vacuole occupied one-half to two-thirds of spore. Size after Bouin fixation 4.1 (3.8-4.4) x 1.9 (1.7-2.1) μm.
Locality: Finnish Bay.
Remarks: Data taken from a very brief English summary of a paper in Russian.

Glugea hertwigii Weissenberg, 1911

Glugea hertwigii Weissenberg, 1911, Sitzungsber. Ger. Naturf. Freunde Berlin, 8, 344.
Glugea hertwigi. Weissenberg, 1913, Arch. Microsc. Anat., 82, 81-163, Pl. IV-figs. 1, 2, 5, Pl. VI-figs. 25-27, Pl. VII-figs. 28-35. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 123, Figs. 318-335, 767. [?] Bond, 1938, Trans. Am. Microsc. Soc., 57, 120. Dechtiar, 1965, Can. Fish Cult., 34, 35, Figs. 1-2. Lom & Weiser, 1972, Folia Parasitol. (Prague), 19, 360, Pl. 1-Fig. 1. Weidner, 1973, Biol. Bull., 145, 459.
Glugea sp. Schrader, 1921, J. Parasitol., 7, 151, 1 pl.
Gluegea stephani. Mavor, 1915, Ann. Rep. Dep. Mar. Fish., Contrib. Can. Biol. Session paper 39b, 25-38, 1 pl. [*fide* Kudo, *loc. cit.*].
Host and Site: [PISCES] The smelt *Osmerus eperlanus,* type host [Weissenberg]; *O. mordax* (Mitchell) [various authors]. [?] *Fundulus heteroclitus* Lin. [Bond]. Mainly in the intestine but also in other organs of the fish. [AMPHIPODA] "gammaridean amphipods" [Weidner].
Lesion: The cyst is a typical *Glugea* xenoma, as much as 3 μm in diameter. Numerous cysts may form a lesion involving the whole intestine.

Vegetative Stages: Development typical of *Glugea* was described in detail by Weissenberg.
Sporulation Stages: Development typical of *Glugea* was described in detail by Weissenberg.
Spore: Elongated pyriform, with large posterior vacuole when fresh 4.6-5.4 x 23 μm; polar filament 100 μm; surface finely wrinkled into short irregular folds [L. & W.].
Locality: Originally found in Germany, later found in fresh and salt water habitats in numerous localities. "*Glugea hertwigi* is a holartic species" [Dechtiar].
Remarks: In 1911, Weissenberg spelled the specific name *hertwigii* but in 1913 he changed this to *hertwigi*. Later authors have followed the second spelling. The change was an unjustified emendation, since the original spelling satisfies the requirements of the "International Rules of Zoological Nomenclature"; it is required that a species name derived from the name of a man end in -*i* (Art. 31) but it is only recommended that -*i* instead of -*ii* be added in the formation of the species-group name (Recommendation D-III). Therefore, the original spelling is to be retained as the "correct original spelling" (Art. 32).

Glugea intestinalis Chen, 1956

Glugea intestinalis Chen, 1956, Acta Hydrobiol. Sinica 1956(1), 41, Figs. 39-43.
Host and Site: [PISCES] *Mylopharyngodon piceus;* mucosa of small intestine.
Cyst: No data.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Ovate, 6.2 x 3.6 μm, with a rounded nucleus.
Locality: China.
Remarks: The description, very brief, does not substantiate the generic determination. Furthermore, the name is a *nomen nudum* because it fails to satisfy the conditions of Article 13 ["International Rules of Zoological Nomenclature" (see Stoll, 1961)].

Glugea luciopercae Dogiel & Bychowsky, 1939

Glugea luciopercae D. & B., 1939 [*fide* Gasimagomedov & Issi, 1970, Zool. Zh., 49, 1120.
[?] *Glugea dogieli* G. & I., 1970, *ibid.*, 1121, Figs. 1-4.
Host and Site: [PISCES] The pike perch *Lucioperca lucioperca* L.; intestine and [?] the Caspian herring *Clupeonella delicatula caspia* Swetidov.
Xenoma: No data available.
Vegetative Stages: No data available.
Sporulation Stages: No data available.
Spore: Oval, rather pyriform, not over 3 μm.

Locality: Caspian Sea.
Remarks: The authors listed Caspian herring as a second host but the meager data do not substantiate the identity of the species in the two hosts. That one in the Caspian herring [studied also by Shulman (1962)] may be a distinct, unnamed species. Shulman added also the Volga herring to the list of presumed hosts. Gasimagomedov and Issi (1970), studying *Glugea* spp., in various fish concluded that *G. lucipercae* was an aggretate of species. Then, after adding parasites of three gobies to the aggregate, they distinguished and described three new species, *G. dogieli, G. bychowskyi,* and *G. shulmani,* treating each (with questionable justification) as identical in part with *G. luciopercae* D. & B., 1939. They did not specify which part of the aggregate remains as *G. luciopercae;* although this name, by the Law of Priority, is the valid name for a species in *Lucioperca.* Whether *G. dogieli,* in the same host, represents a distinct species is problematical (see "Remarks" under *G. dogieli*). The publication by Dogiel and Bychowsky (1939) was not available.

Glugea machari (Jírovec, 1934) comb. n.

Octosporea machari Jírovec, 1934, Zool. Anz., 20, 61, Figs. 1, 2.
Host and Site: [PISCES] *Dentex vulgaris (D. dentex);* superficial part of liver.
Cyst: Small ones roundish, large ones usually oval, 300-400 x 250-280 μm; with thick wall, 7-15 μm, consisting of an inner layer belonging to the parasitized host cell and an outer zone of connective tissue cells.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spores: Long, slightly bent, sometimes small rods or oval forms, with both poles rounded and containing each a vacuole, 3-4.5 x 0.8-1.5 μm, with a single nucleus (Feulgen preparations).
Locality: Andria (Rab Island).
Remarks: This species was originally placed in Genus *Octosporea* Flu, 1911, only because its spores are rather long in relation to breadth and are slightly bent, this being similar to the shape of the spore in the type species of *Octosporea.* However, unlike *Octosporea* but like *Glugea* the spores are uninucleate. In this and in every other known respect this is a typical *Glugea,* the particular spore shape being merely a character of this species and showing an incidental resemblance to that seen in some species of some other genera. Pending further data, it probably should be provisionally treated as a species of *Glugea.*

Glugea pseudotumefaciens Pflugfelder, 1952

Glugea pseudotumefaciens Pflugfelder, 1952, Aquarien Terrarien, 5, 132, Figs. 1-6.

Host and Site: [PISCES] *Brachydanio rerio;* ovary, liver, kidney, spleen, eye, central nervous system. Experimental infections in *Xiphophorus, Lebistes, Gambusia, Platypoecilus, Brachydanio, Mollienisia,* and *Colisa.*
Vegetative Stages: Uninucleate amoeboid germs in the cytoplasm of connective tissue cells grow into plasmodia that undergo multiple fission. The products develop into rod-forms which divide into binucleate "pansporoblasts."
Sporulation Stages: The binucleate "pansporoblasts" produce 2 spores.
Spore: Oval.
Remarks: The description and the figures do not fit the genus *Glugea* well; perhaps they are not very accurate.

Glugea punctifera Thélohan, 1895

Glugea punctifera Thélohan, 1895, Bull. Sci. Fr. Belg., 26, 105, Figs. 118, 119. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 115, Figs. 272, 273. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 47. Akhmerov, 1951, Izv. Tikhookean, Nauch. I-ssled. Inst. Rÿb. Khoz. Okeanogr., Valdivostok, 30, 99-104 [*fide* Sindermann, 1970, "Principal Diseases of Marine Fish and Shellfish,"
Nosema punctiferum (Thélohan, 1895) Labbé, 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 105.
Host and Site; [PISCES] *Gadus pollachius;* muscles of eye. *Theragra chalcogramma* (muscle) and "cod" [Akhmerov].
Developmental Stages: No data.
Spore: Ovoidal, as in *G. anomala* but slightly larger, 4-5 x 3 µm.
Locality: France (Concarneau) [Thélohan]. Okhotsk and Japan Seas [Akhmerov].

Glugea shulmani Gasimagomedov & Issi, 1970

[?] *Glugea luciopercae* Dogiel & Bychowsky [*partim*], 1939, [*fide* Gasimagomedov & Issi, 1970, Zool. Zh., 49, 1122].
Glugea shulmani G. & I., 1970, *loc. cit* Figs. 10-12.
Host and Site: [PISCES] The Hycranian goby *Neogobius caspius* (Eichwald), the Caspian sand goby *N. fluviatilis pallasi* (Berg), and the Caspian round goby *N. melanostomus affinus* (Eichwald); intestinal wall.
Cyst: Very small, 18-80 µm, with wall 2.5-5 µm thick; no evident host reaction around it; host cell nucleus becomes hypertrophied and lobed, eventually losing its chromatin and becoming a structureless mass 25 µm in diameter.
Vegetative Stages: "Ribbon-like schizonts."
Sporulation Stages: Spores arranged in groups within the cyst, each group containing spores of the same maturity. In smears many spores cling in twos.
Spore: Ovate or pyriform, 2.2-2.4 x 1.2-1.6 µm in glycerine-gelatin and 2.4 x 1.2 µm after fixation.

Locality: Southern Caspian (region of Samur-Kayakent, vicinity of Bekdash).

Remarks: The authors considered this to be in part identical with *G. luciopercae* D. & B., 1939, the only evident reason being a general similarity in size and shape of spores. With no more evidence, the presumed partical identity is highly questionable.

Glugea stephani (Hagenmüller, 1899) Woodcock, 1904

Nosema stephani Hagenmüller, 1899, C. R. Acad. Sci., 129, 836.

"sporozoon parasite" Johnstone, 1901, Trans. Liverpool Biol. Soc., 15, 184, Figs. 1-4.

"protozoon" Linton, 1901, Bull. U. S. Fish. Com. for 1899, 19, 487, Pl. 1-Fig. 4.

Glugea stephani (Hagenmuller, 1899) Woodcock, 1904, Trans. Liverpool Biol. Soc., 18, 127, Figs. 1-7. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 121, Figs. 314-316, 759. Fantham, Porter & Richardson, 1941, Parasitology, 33, 195. Reichenow, 1953, *in* "Lehrbuch der Protozoenkunde" (F. Doflein & E. Reichenow, eds.), 1018. Stunkard & Lux, 1965, Biol. Bull., 129, 373, Figs. 1-7. Stunkard, 1969, J. Fish. Res. Bd. Can., 26, 733. Jensen & Wellings, 1972, J. Protozool., 19, 297, Figs. 1-23. Weidner, 1973, Biol. Bull., 145, 459.

Glugea hertwigi. Wellings, Ashley & McArn, 1969, J. Fish. Res. Bd. Can., 26, 2216, Figs. 1-6.

Glugea sp. Youssef & Hammond, 1972, J. Protozool., 19(Suppl.), 16. Olson & Pratt, 1973, Trans. Am. Fish. Soc., 102, 410.

Glugea (Nosema) stephani (Hagenmüller, 1899). McVicar, 1975, J. Fish Biol., 7, 611, Figs. 1-3.

Host and Site: [PISCES] *Pleuronectes platessa (= Flesus passer* Moreau); muscles and connective tissue of entire gut wall and under peritoneum of liver [Hagenmüller]. Also in *P. flesus* and *Pseudopleuronectes americanus* [Woodcock]. *Limanda ferruginea* [F., P. & R.]. *Pleuronectes limanda* [Reichenow]. *Platichthys stellatus* [J. & W.]. *Parophrys vetulus* [W., A. & M.; Y. & H.; O. & P.]. [AMPHIPODA] "gammaridean amphipods," experimental infection [Weidner].

Lesion: Johnstone found that the heavily infected intestine "was thickened, and had the appearance of a ripe ovary," the surface being studded with closely packed white cysts. Cysts about 1 mm in diameter; parasites also diffusely infiltrated in tissue [Hagenmuller]. Average diameter of cysts 0.6 mm [Johnstone]. Masses of parasites in diffuse infiltration form pseudocysts [Woodcock].

Vegetative Stages: Occur in the outer layer of the cyst contents [Woodcock]. Immature stages in peripheral part of cyst [J. & W.].

Sporulation Stages: Occur in inner zone of cyst, central part of cyst being filled with ripe spores [Woodcock].

Spore: Oval, up to 5 µm [Johnstone]. Oblong-ovate, 3 x 1.5 µm [Linton]. Oblong-ovate, 3 x 1.5-1.75 µm [Woodcock]. Mature spore 5 x 2 µm [J. & W.].
Locality: France, England, U.S.A., Canada.
Remarks: Jensen and Wellings studied the polar filament and its development with the electron microscope. See Stunkard for a good review of the literature.

Glugea tisae (Lom & Weiser, 1969) comb. n.

Nosema tisae L. & W., 1969, Folia Parasitol. (Prague), 16, 197, Fig. 2, Pl. II.
[?] *Plistophora siluri* Gasimagomedov & Issi, 1970, Zool. Zh., 49, 1118, Fig. 1.
Host and Site: [PISCES] The European catfish *Siluris glanis* L.; submucosa of gut.
Vegetative Stages: No data.
Sporulation Stages: "The inside of the cyst was divided into a number of compartments [sporogony vacuoles?] by extremely thin membranes. The spores in the different compartments were at different stages of maturity, one containing only ripe spores, the other sporoblasts" [L. & W.].
Spore: 4-5 x 2.2-2.6 µm (fresh), uninucleate.
Locality: Hungary (Tiza River).
Remarks: This species apparently was placed in Genus *Nosema* Naegeli, 1857, rather than *Glugea* Thêlohan, 1891, only because the authors regarded these names as synonyms. However, Sprague and Vernick (1971) have pointed that these genera are distinct because a single nucleus in the spore characterizes *Glugea*, while Cali (1971) has shown that a double nucleus is an essential character of *Nosema*. *Plistophora siluri* G. & I., 1970, is said to have binucleate spores, characteristic of neither *Pleistophora* nor *Glugea*. It is said to have pansporoblasts [the "compartments" in *G. tisae?*] characteristic of *Pleistophora* but not of *Glugea*. Thus, there is no satisfactory generic assignment for this species. Nevertheless, in all respects, excepting the number of nuclei (which can easily be miscounted) in the spore and the presence of "pansporoblasts" ["compartments"?], it appears to be identical with *Glugea tisae*. Data on *Plistophora siluri* were taken partly from a translation in English, by Robert M. Howland, of the article by Gasimagomedov and Issi in Russian.

Glugea weissenbergi Sprague & Vernick, 1968

Glugea weissenbergi S. & V., 1968, J. Protozool., 15, 557, Figs. 1-52. Erickson, Vernick & Sprague, 1968, J. Protozool., 15, 758, Figs. 1-3. Vernick, Sprague & Lloyd, 1969, J. Protozool., 16, 50, Figs. 1-3. Erickson & Blanquet, 1969, J. Invertebr. Pathol., 14, 358, Figs. 1-3. Vernick, Tousimis & Sprague, 1969, Annu. Proc. EMSA (Electron Microscopic Soc. of America), 27, 238-239, Figs. 1, 2. Lom & Weiser, 1972, Folia Parasitol. (Prague), 19, 360, Pl. 1-Fig. 1.

Host and Site: [PISCES] The 4-spined stickleback *Apeltes quadracus* (Mitchill). Usually under the visceral or parietal peritenoum. Often subcutaneous.

Cyst (xenoma): Highly variable in size, up to 6 mm in diameter. Structure as in *G. anomala*.

Vegetative Stages: Cylindrical forms undergo binary and multiple fission.

Sporulation Stages: Plasmodia become surrounded by vacuoles and undergo plasmotony to produce vacuole cells or sporonts. During plasmotony, the nuclei appear double (diplocarya?) but as this process terminates the double nucleus fuses (autogamy). Thus, the sporont is a zygote. Each sporont divides to produce 2 sporoblasts and these transform into spores.

Spore: Ellipsoidal or ovoidal, 6.5 x 3 μm when fresh. Many amomalous forms produced. Polar filament 175 μm.

Locality: U.S.A. (Solomons Island, Maryland).

Remarks: The authors expressed some highly speculative ideas about the very early vegetative stages which are not repeated here because they lack confirmation. They also expressed some unorthodox ideas about the nature of the sporoplasm and these cannot be reconciled with what is now known about sporoplasms. When describing this species they advanced one of several hypotheses about the origin and development of the polar filament. The essential feature of the latter hypothesis is that the isthmus, which temporarily connects the daughter nuclei while the sporont divides, forms the basis of the polar filament. Later (1969), they held that this nuclear isthmus is only the primordium and that a second essential component of the filament is a membranous covering supplied by the Golgi apparatus.

Glugea sp. Bogdanova, 1961

Glugea sp. Bogdanova, 1961, Tr. Soveshch. Ikhtiol. Kom. Akad. NAUK SSSR, 10, 169-177 [*fide* Suppl. 16 Med. Vet. Zool.]

Host and Site: [PISCES] *Abramis ballerus;* wall of intestine.

Descriptive Data: None available.

Locality: U.S.S.R. (Volga).

Glugea sp. Pfeiffer, 1895

Glugea sp. Pfeiffer, 1895, "Protoz. Krankh., suppl." p. 38 [*fide* Labbé, 1898, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 106.]

Nosema sp. Labbé, 1895, *loc. cit.*

Host: [PISCES] *Leuciscus phoxinus* L.

Developmental Stages: No data.

Locality: Germany.

Glugea sp. Sano, 1970

Glugea sp. Sano, 1969 [1970] *in* Putz & McLaughlin, 1970, *in* "Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), p. 131.
Host: [PISCES] *Plecoglossus altiveriu.*
Descriptive Data: None.
Locality: Japan.

Genus *Encephalitozoon* Levaditi, Nicolau & Schoen, 1923

Encephalitozoon cuniculi L., N. & S., 1923

"microorganisms" Wright & Craighead, 1922, J. Exp. Med., 36, 137, Figs. 1-4.
Encephalitozoon cuniculi L., N. & S., 1923, C. R. Acad. Sci., 177, 987. Levaditi, Nicolau & Schoen, 1923, C. R. Soc. Biol., 89, 984. Levaditi, Nicolau & Schoen, 1923, *ibid.*, 1157, Figs. 1-4. Cali, 1971, Proc. IV Int. Colloq. Insect Pathol., 1970, 434, Fig. Nc 1. Sprague & Vernick, 1971, J. Protozool., 18, 560, Figs. 1-7. Anver, King & Hunt, 1972, Vet. Pathol., 9, 475, Figs. 1-4.
Encephalitozoon rabiei Manouelian & Viala, 1924, Ann. Inst. Pasteur (Paris), 38, 258, Pls. 3-6.
Glugea lyssae L., N. & S., 1924, C. R. Soc. Biol., 90, 402. Levaditi, Nicolau & Schoen, 1926, Ann. Inst. Pasteur (Paris), 40, 995.
Glugea rabiae L., N. & S., 1926, *ibid.*, 993.
[?] *Encephalitozoon negrii* Manouelian & Viala, 1927, C. R. Acad. Sci., 184, 630.
Encephalitozoon muris Garnham & Roe, 1954, Trans. R. Soc. Trop. Med. Hyg., 48, 1.
Nosema cuniculi (L., N. & S., 1923) Weiser, 1964, Parasitology, 54, 750. Lainson, Garnham, Killick-Kendrick & Bird, 1964, Br. Med. J., 2, 472 + 1 pl., Figs. 1-13. Petri, 1969, Acta Path. Microbiol. Scand., 204(Suppl.), 1, Figs. 1-32.
"Microsporidian" Nelson, 1962, Proc. Soc. Exp. Biol. Med., 109, 714, Fig. 1.
Nosema muris Weiser, 1965, J. Protozool., 12, 78, Figs. 1-7.
Host and Site: [MAMMALIA-RODENTIA, CARNIVORA, other?] Originally found in brain of laboratory rabbits. Later found by the original authors and many others to be very common in laboratory mice as well as rabbits. Meiser *et al.* (1971) found it in hamsters Vávra *et al.* (1971) found similar parasites in different carnivores. See p. 385 for other host names.
Lesion: The lesion has many manifestations [see Petri (1969)].
Vegetative Stages: Binary fission in 2 cycles, with tendency to formation of short chains in the second [Vávra *et al.* (1972)].
Sporulation Stages: Disporous [Cali (1971), Sprague & Vernick (1971), Vávra *et al.* (1972)].

Spore: 1-2 μm [L., N. & S. (1923)]; 2.5 x 0.5-1 μm [L., N. & S. (1924)]; 2.5 x 1.5 μm [Sprague (1974)]. Uninucleate [Cali (1971); Sprague & Vernick (1971); Vávra *et al.* (1972)].
Locality: Cosmopolitan, originally discovered in France.
Remarks: A voluminous literature on this species has developed. Petri made a complete review in 1969. Matsubayashi *et al.*, (1959) reported "*Encephalitozoon*-like organisms" in man and Khanna and Iyer (1971) reported *Nosema cuniculi* in a goat, but the identifications are not well substantiated. Cali (1971) restored the Genus *Encephalitozoon*. Sprague and Vernick (1971) reviewed the ultrastructural studies and considered the taxonomy of this and some other disporous species. Vávra *et al.* (1972) reviewed the tissue culture work.

Encephalitozoon sp. Kemp & Kluge, 1975

Encephalitozoon sp. K. & K., 1975, J. Protozool., 22, 489.
Host and Site: [AVES] The blud-masked lovebird *Agapornis personata;* epithelial cells and renal tubules, bile duct and intestine, and in liver cells.
Lesion: "Focal hepatic necrosis occurred around clusters of the organism but inflammation was minimal or absent in the other tissues."
Vegetative Stages: No data.
Sporulation Stages: "Organisms" [evidently spores] were contained in cytoplasmic vacuoles in the intestinal epithelium.
Spore: ["The organism"] Round or elliptical, 1-2 μm; with light area in one end when stained with hematoxylin. Electron microscopy showed a very thin exospore, a moderately thin endospore, a coiled polar filament with 3-4 turns, and an indistinctly visible polaroplast.
Locality: U.S.A. (Iowa).
Remarks: The data are too few to permit generic determination.

Genus *Spraguea* Weissenberg, 1976

Spraguea lophii (Doflein, 1898) Weissenberg, 1976

Glugea lophii Doflein, 1898, Zool. Jahr. Abt. Anat., 11, 290, Figs. 15, 16, 121-133, Pl. 24-1, 2. Mrázek, 1899, Sitzungsber. Bohm. Ges. Wiss Math-naturwiss. Cl., 1899, 1, Figs. 1-11. Weissenberg, 1909, Sitzungsber. Ges. Naturf. Freunde. Berlin, 1909, No. 9, 557, Figs 1-5. Weissenberg, 1911, *ibid.*, 1911, No. 3, 149. Weissenberg, 1911, Arch. Mikrosk. Anat., 78, 383, Figs. 1-10.
Nosema lophii (Doflein, 1898) Pace, 1908, Z. Hyg. Infektionskr., 60, 67, Figs. 6-8. Weissenberg, 1911, Sitzungsber. Ges. Naturf. Freunde. Berlin, 1911, No. 8, 344. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 80, Figs. 72-84, 758. Weissenberg, 1952, Proc. Soc. Protozool., 3, 2. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1059, Fig. 809. Weissenberg, 1970, J. Parasitol., 56, 364. Weidner & Trager,

1970, Biol. Bull., 139, 443. Weidner, 1971, Am. Soc. Parasitol., 46th Annu. Mtg., Univ. Calif., Los Angeles, 26. Lom & Weiser, 1972, Folia Parasitol. (Prague), 19, 360, Pl. 1-Fig. 3.

"Microsporidian" Jakowska & Nigrelli, 1959, J. Protozool., 6 (Suppl.), 7. Jakowska, 1964, An. 2nd Congr. Lat-Am. Zool., 1, 265, Figs. 1-12. Jakowska, 1966, Trans. Am. Microsc. Soc., 85, 161.

Spraguea lophii (Doflein, 1898) Weissenberg, 1976 Comp. Pathobiol. I, Biology of the Microsporidia, p. 216.

Host and Site: [PISCES] *Lophius piscatorius, L. budegassa,* and *L. americanus;* cranial and spinal ganglia.

Lesion: Groups of the hypertrophied ganglion cells form a tumor of irregular form that resembles a bunch of grapes. Colonies of the parasite form only in the cytoplasmic zone of the host cell where the invasion originally started, although the whole cell becomes hypertrophied.

Vegetative Stages: Multiplication by binary fission and multiple fission of chain-forms. Groups of multiplying schizonts are localized in a median layer of the colony.

Sporulation Stages: Products of schizogony transform directly into spores. Sporoblasts uninucleate.

Spore: Oval, often bent, somewhat bean-shaped, 3.5 x 1.5 μm [Doflein]. Mostly oval in younger cysts and cylindrical in older ones [Weissenberg]. Uninucleate [W. & T.]. Surface with fine network of meandering folds [L. & W.].

Locality: Italy (Naples). France (Banyuls). U.S.A. (New York). South America (Brazil).

Remarks: Type species by monotypy.

Family UNIKARYONIDAE fam. n.

Genus *Unikaryon* Canning, Lai & Lie, 1974

Unikaryon pyriformis C., L. & L., 1974

Unikaryon pyriformis C., L. & L., 1974, J. Protozool., 21, 21, Figs. 1-15.

Host and Site: [TREMATODA] Hyperparasite of *Echinoparyphium dunni* Lie & Umathevy and *Echinostoma audyi* L. & U., in the aquatic snail *Lymnaea rubiginosa* (Michelin); rediae and cercariae, thoughout the parenchyma tissue.

Lesion: Infected rediae distorted and opague; some were bloated and some were smaller than usual; in heavy infections, the entire parenchyma was replaced by masses of spores.

Vegetative Stages: Forms with unpaired nuclei reproduce by binary fission.

Sporulation Stages: Sporont divides into 2 sporoblasts each with an unpaired nucleus. These mature into spores.

Spore: Pyriform, uninucleate, 3.8 x 2.7 μm (fresh), filament up to 150 μm.

Locality: West Malaysia (Negri Sembilan).
Remarks: Type species by monotypy.

Unikaryon legeri (Dollfus, 1912) Canning & Nicholas, 1974

"Glugeidees" Giard, 1897, C. R. Soc. Biol., 4, 957.
Pleistophora sp. Léger, 1897, C. R. Soc. Biol., 4, 957.
Nosema legeri Dollfus, 1912, Mem. Soc. Zool. Fr., 25, 129, Figs. 7, 8. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 102, Fig. 150. Dollfus, 1946, *in* "Encyclopedie Biologique" (P. Lechevalier, ed.), p. 17, Figs. 4-6.
Unikaryon legeri (Dollfus, 1912) C. & N., 1974, J. Invertebr. Pathol., 23, 93, Figs. 1-22.
Host and Site: [TREMATODA] *Brachycoelium* sp. in *Donax trunculus* L., *Tellina fabula* Gronov, *T. tenuis* Da Costa, *T. solidula* Pult; parenchyma [Giard, Léger]. Metacercariae of *Gymnophallus somateriae* Levinsen var. *strigatus* Lebour in *Donax vittatus* Da Costa [Dollfus]. *Meigymnophallus minutus* (Cobold, 1859) in *Cardium edule* [C. & N.].
Vegetative Stages: Binary and multiple fission [Dollfus]. Binary fission [C. & N.].
Sporulation Stages: Spores developed in spherical masses, 15-20 µm in diameter, containing a variable number of spores and surrounded by a very fragile membrane [Léger]. Spores not grouped within a cystic envelope but diffuse [Dollfus]. Disporous [C. & N.].
Spore: Ovoid, 5 x 2.5 µm, with posterior vacuole [Léger, Dofflus]. Dimensions 2.5 x 1.5 µm (Dollfus material); 3.03 x 1.76 µm (fresh) and 2.9 x 1.66 µm (Giemsa stained); uninucleate [C. & N.].
Locality: France.
Remarks: Because of the discrepancies in observations of Léger and Dollfus, it is uncertain that they saw the same microsporidian species. Therefore, the observations of Léger (and Giard) are included in this summary only provisionally. Canning and Nicholas cited Bowers and James (1967) as authorities for regarding all the trematodes in these studies as *Meigymnophallus minutus* (Cobold, 1859). Canning and Nicholas borrowed a type slide from Dollfus and found the spore measurements to be considerably smaller than those given in the original description.

Genus *Nosemoides* Vinckier, 1975

Nosemoides vivieri (Vinckier, Devauchelle & Prensier, 1970) Vinckier, 1975

Nosema vivieri V., D. & P., 1970, C. R. Acad. Sci., 270, 821, Figs. 1-5. Vinckier, Devauchelle & Prensier, 1971, Protistologica, 7, 273, Figs. 1-18. Vinckier, 1970, SIP (Soc. Invertebr. Pathol.) Newsltr., 3(3), 23. Vinckier, 1971, J. Protozool., 18(Suppl.), 52.

Nosemoides vivieri (V., D. & P., 1970) Vinckier, 1975, J. Protozool. 22, 170, Figs. 1-36.
Host and Site: [GREGARINIDA] A monocystid gregarine in a nemertean; cytoplasm.
Vegetative Stages: Uninucleate cells occur.
Sporulation Stages: Sporogonial plasmodium divides in rosette formation to produce several sporoblasts.
Spores: Macrospores, 6.0 x 0.7 μm. Microspores, 2.7 x 1.2 μm. Uninucleate.
Locality: France (Wimereux).
Remarks: The authors published two electron microscope studies (1970, 1971).

Genus *Perezia* Lêger & Duboscq, 1909

Perezia lankesteriae L. & D., 1909

Perezia lankesteriae L. & D., 1909, Arch. Zool. Exp. Gên. Notes Rev., Ser. 5, 1, 89, Fig. 1. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 125, Figs. 336, 337. Youssef, 1974, J. Invertebr. Pathol., 24, 289.
Glugea (Perezia) lankesteriae (L. & D., 1909) Reichenow, 1932, *in* "Tierwelt der Nord- und Ostsee" (Grimpe & Wagler, eds.), Vol. 21(II), p. 79. Doflein & Reichenow, 1953, *in* "Lehrbuch der Protozoenkunde," 6th ed., p. 1021.
Nosema lankesteria (L. & D., 1909) Sprague & Vernick, 1971, J. Protozool., 18, 568.
Host and Site: [GREGARINIDA] *Lankesteria ascidiae* Lankester in the stomach of the tunicate *Ciona intestinalis;* cytoplasm.
Vegetative Stages: They begin with a small uninucleate body. This develops into a plasmodium with up to 10-12 nuclei. The plasmodium breaks up into uninucleate elements [sporonts], each of which is to become a disporous "pansporoblast."
Sporulation Stages: Each "pansporoblast" divides into 2 products, each of which becomes a spore. Usually the division products remain joined until they become essentially mature spores and then separate; sometimes they do not separate completely but remain as double spores. Sometimes a "pansporoblast" produces a single spore, a very long one having the value of 2 spores.
Spore: Ovoid, 2.5 μm long. Large spores (each the single product of a "pansporoblast") 7-8 μm.
Locality: France (Sete).
Remarks: Type species of *Perezia* L. & D., 1909. The authors described a multinucleate condition of the spore (as in myxosporidia) but this part of the description can be unhesitatingly rejected. It is particularly noteworthy that the initial cell in the sporulation sequence (sporont) was said

to be uninucleate and that no evidence for the presence of a diplocaryon in any stage was presented. Because of this supposed nuclear condition (which Youssef, as well as Sprague and Vernick, overlooked), Youssef's resurrection of the Genus *Perezia* can be justified. I do not believe it is justified for the reasons given by Youssef, that the Genus *Nosema* is "monosporous" and that *Perezia* is needed to contain disporous species. It is not clear what Youssef means by the ambiguous term "monosporous." The only rational meaning of "monosporous" that can be found in the literature is the meaning originally attributed to it by Pêrez (1905) who coined the term. Pêrez simply referred to the fact that spores developed in isolation.

Family COUGOURDELLIDAE Poisson, 1953
Genus *Cougourdella* Hesse, 1935

Cougourdella magna Hesse, 1935

Cougourdella magna Hesse, 1935, Arch. Zool. Exp. Gén., 75, 655, Figs. 8-14.

Host and Site: [COPEPODA] *Megacyclops viridis* Jurine; hemocoele and fat body.

Lesion: Infected host individual milky-white and small in size, with body packed full of spores.

Vegetative Stages: No data.

Sporulation Stages: Sporoblasts grouped in pairs. At maturity spores become separated and disseminated in the parasitized tissue where they appear to be formed in isolation "comme chez *Nosema.*"

Spore: Lageniform, with inflated posterior end and a cylindrical neck. Length about 18 μm, neck about 2 μm wide and inflated end about 3 μm wide. Polar filament 110 μm. "Un germe mono-ou binucléé ou deux germes monoculéés."

Locality: France (Côte-d'Or).

Remarks: Type species by monotypy. The author described nuclear changes within the developing spore similar to those that occur in myxosporidia but this description is not acceptable. The "germ" mentioned by the author was an inclusion in the posterior vacuole of the spore and cannot be accepted as the sporoplasm. Therefore, the number of nuclei present in unknown.

Cougourdella polycentropi Weiser, 1965

Cougourdella polycentropi Weiser, 1965, Zool. Anz., 175, 229, Fig. 2.

Host and Site: [TRICHOPTERA] *Polycentropus flavomaculatus* Pict., larva; fat body.

Lesion: Infected fat bodies are swollen and appear porcelain-white through the skin.

Vegetative Stages: Round or oval, 4-5 x 2-3 μm, with 1 or 2 nuclei, mostly 1 because nuclear division is followed by cytoplasmic division.

Sporulation Stages: Stages at first oval become wedge-shaped. In the broad posterior end is a protoplasmic mass with an oval nucleus and a vacuole.
Spore: Rod-shaped with spherical thickening at end, 5.2-7 x 1.4-1.8 μm, average 6 x 1.5 μm; after hydrolysis with HCL and staining with Giemsa, there is always 1 nucleus.

Cougourdella pusilla Hesse, 1935

Cougourdella pusilla Hesse, 1935, Arch. Zool Exp. Gén., 75, 660, Figs. 16, 17.
Host and Site: [COPEPODA] *Megacyclops viridis* Jurine; hemocoele and fat body.
Lesion: No data.
Vegetative Stages: No data.
Sporulation Stages: "La sporulation est ici du type monosporé, comme chez *Nosema.*"
Spore: Langeniform, not over 6 μm long, inflated part 1.5 μm wide and neck 0.5 μm wide.
Locality: France (Haute-Saône).

Cougourdella rhyacophilae Baudoin, 1969

Cougourdella rhyacophilae Baudoin, 1969, Protistologica, 5, 444, Fig. 11.
Host and Site: [TRICHOPTERA] *Rhyacophila obliterata* McL., larva; site not given.
Lesion: No data.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spores: Claviform, 6.3 x 2.7 μm.
Locality: France (in the Couze Pavin at Besse).

Family CAUDOSPORIDAE Weiser, 1958

Genus *Caudospora* Weiser, 1946

Caudospora simulii Weiser, 1946

Glugea polymorphora "form 1" Strickland, 1911, Biol. Bull., 21, 321, 328, Fig. 14.
Caudospora simulii Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 262, Fig. 11. Weiser, 1947, Ann. Parasitol. Hum. Comp., 22, 11, 4 pls. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 44. Weiser, 1961, Monogr. Angew. Entomol., 17, 127, Figs. 58, 59. Doby, Vávra, Weiser & Beaucournu-Saguez, 1965, Bull. Soc. Zool. Fr., 90, 393, Figs. 1-36, Pl. 1. Vávra, 1968, Folia Parasitol. (Prague), 15, 1, Pls. 1-6. Jamnback, 1970, J. Invertebr. Pathol., 16, 5, Fig. 4. Frost, 1970, Can. J. Zool., 48, 890. Frost & Nolan, 1972, Can. J. Zool., 50, 1364, Figs. 1-3.
Host and Site: [DIPTERA-SIMULIIDAE] *Simulium hirtipes* [Strickland]; *Simulium* sp., larva; fat body [Weiser (1946)];

Simulium latipes Meig. [Weiser (1961); D., V., W. & B; Vávra (1968)]; *Prosimulium* sp. [Frost]; *P. fuscum, P. magnum, P. mixtum,* and *P. multidentatum* [Jamnback].

Lesion: Abdomen of host greatly distended [Strickland].

Vegetative Stages: Yound schizont round, 4-6 µm, with compact nucleus. Nucleus and cytoplasm divide simultaneously, no multinucleate stage developing [Weiser (1961)].

Sporulation Stages: First stage a cell with a vesicular nucleus. First nuclear division exhibits many long chromosomes. Successive nuclear divisions result in plasmodium with as many as 9 [D., V., W. & B] or 15 [Weiser (1947)] diplocarya. Plasmodium dissociates into binucleate sporoblasts, Dobey *et al.* finding 8 sporoblasts being produced in rosette formation.

Spore: Endospore oval, 5 x 2.5 µm [Weiser (1961)]. Exospore extended into a long, posterior cauda (14, sometimes 20-24 µm) 2 shorter anterior projections and 2 broad lateral alae. Sporoplasm binucleate.

Locality: U.S.A. (Massachusetts) [Strickland]; Czechoslovakia (near Chateboř) [Weiser]; Canada, U.S.A. (California), France [D., V., W. & B]; France [Vávra]; Newfoundland [Frost]; U.S.A. (New York) [Jamnback].

Remarks: Type species by monotypy. Weiser also listed the genus and species as new in 1947. In 1961, he explained that a manuscript submitted for publication in 1945 was lost for a while and then appeared in print in 1947. Meantime, he submitted another paper in 1946. Thus, the actual data of publication was 1946, although the dates 1945 and 1947 have also been used in the literature. Weiser thought the anterior projections on the spore were 2 polar filaments until he and his associates, Doby *et al.* (1965), determined their true nature in a new light microscope study. Vávra (1968) made an electron microscope study of sporogony stages and spores.

Caudospora alaskensis Jamnback, 1970

Glugea polymorpha form 3 Strickland 1911, Biol. Bull., 21, 321, 328, Fig. 16.

Caudospora alaskensis Jamnback, 1970, J. Invertebr. Pathol., 16, 6, Fig. 1.

Host and Site: [DIPTERA-SIMULIIDAE] *Prosimulium alpestre,* larva; fat body [Jamnback]; *Simulium* sp. [Strickland].

Lesion: Hypertrophied cells cause great distention of host abdomen [Strickland].

Vegetative Stages: Schizonts commonly binucleate, sometimes 4- or 8-nucleate.

Sporulation Stages: Plasmodium in 4- or 8-nucleate stage divides into uninucleate[?] sporoblasts, "sometimes in pairs with nuclei at opposite ends" [Jamnback].

Spore: "Long subelliptical to long oval" [Jamnback], 5.1 x 3.2 μm. Cauda rudimentary, 0.5-1.5 μm, sometimes appearing as a flattened disc. Without visible exospore.
Locality: U.S.A. [Alaska (Jamnback), Massachusetts (Strickland)].
Remarks: Further study is needed to confirm the generic determination, since the mode of sporulation and the morphology of the spore are not clearly typical of *Caudospora*.

Caudospora nasiae Jamnback, 1970

Caudospora nasiae Jamnback, 1970, J. Invertebr. Pathol., 16, 8, Fig. 3.
Host and Site: [DIPTERA-SIMULIIDAE] *Simulium andersi*, larva; fat body.
Lesion: No data.
Vegetative Stages: Rounded stages with 2-16 compact nuclei were seen.
Sporulation Stages: Plasmodium divided, usually in 8-nucleate stages, to give uninucleate[?] sporoblasts.
Spore: Long oval, usually truncate at the anterior end, 4.2 x 2.8 μm. Cauda 6.7-11.1 μm. Exospore thin, irregular, without alae.
Locality: Ghana.

Caudospora pennsylvanica Beaudoin & Wills, 1965

Caudospora pennsylvanica B. & W., 1965, J. Invertebr. Pathol., 7, 152, Figs. 1-8. Jamnback, 1970, J. Invertebr. Pathol., 16, 8, Fig. 5.
Host and Site: [DIPTERA-SIMULIIDAE] *Prosimulium magnum* Dyar & Shannon, larva [presumably in fat body].
Lesion: No data.
Vegetative Stages: Only an uninucleate stage seen.
Sporulation Stages: A sporont with diplocaryon develops into plasmodium with 8 (usually) or 16 (sometimes) diplocarya. Nuclei move to periphery and plasmodium divides into 8 binucleate sporoblasts. Nuclei fuse in late sporoblast [?].
Spore: Egg-shaped, 5.33 x 3.20 μm, with cauda 23.47 μm.
Locality: U.S.A. (Pennsylvania).

Caudospora polymorpha (Strickland, 1911) Maurand, 1975

Glugea polymorpha "form 2" Strickland, 1911, Biol. Bull., 21, 321.
Caudospora brevicauda Jamnback, 1970, J. Invertebr. Pathol., 16, 7, Fig. 2. Frost & Nolan, 1972, Can. J. Zool., 50, 1363, Fig. 4.
Caudospora polymorpha (Strickland, 1911) Maurand, 1975, Ann. Parasitol. Hum. Comp., 50, 379.

Host and Site: [DIPTERA-SIMULIIDAE] *Cnephia mutata*, larva; fat body [Jamnback]; *Simulium* sp. [Strickland], possibly = *C. mutata* [Jamnback]; *C. mutata* [F. & N.].

Lesion: Abodomen of host distended [Strickland].

Vegetative Stages: Stages with 2, 4, 8, and 12 compact nuclei seen. Diplocarya not seen.

Sporulation Stages: "Sporonts" develop to 4- or 8-nucleate plasmodium which divided. "Sporoblasts often separated in pairs attached at the posterior ends" [Jamnback], uninucleate [?].

Spore: "Long subelliptical to long oval" [Jamnback], 5.1 x 3.2 μm. Cauda 5.6-10 μm, being about 1.5 times as long as the spore. Exospore with irregularities but without alae; with 2 distinct, thickened transverse bands. Polar filament 50-60 μm long.

Locality: U.S.A. [Massachusetts, New York (Strickland, Jamnback)]; Newfoundland [F. & N.].

Remarks: Strickland (1911) proposed the name *Glugea polymorpha* for 3 forms with appendages on the spores and 1 without appendages, which he thought were different species but which, in deference to the opinion of G. N. Calkins, he treated as one. Later authors rediscovered the first 3 forms, which clearly did not belong to Genus *Glugea*, and gave the following names: Form 1, with long tail on the spore, became *C. simulii* Weiser, 1946 (type species). Form 2, with short tail, became *C. brevicauda* Jamnback, 1970. Form 3, with a disc-shaped appendage, became *C. alaskensis* Jamnback, 1970. Form 4 (evidently) is, according to Weiser (1961), *Pleistophora simulii* (Lutz & Splendore, 1908). The name *polymorpha* was incorrectly treated by Jamnback as a *nomen oblitum*, although, according to the Rule of Priority, it should have been conserved for one of the original forms. Since it was not conserved, it must be restored. Dr. Curtis Sabrosky, member of the Editorial Committee of the International Code of Zoological Nomenclature, has advised me that the form represented by the designated holotype, or a subsequently selected lectotype, or neotype becomes *Caudospora polymorpha*. There is no record of the existence of any type designations for the forms of *Glugea polymorpha* Strickland, 1911. Therefore, according to Article 74(b) of the Code [Stoll (1961)], I designate Strickland's Fig. 15 (Biol. Bull., 21, Pl. V opposite pp. 338, 1911), representing form 2, as lectotype. For this reason the new name combination is used above. (After this manuscript was submitted for publication, a paper by J. Maurand, 1975, came to my attention, necessitating the following explanation: On 14 February 1974, I sent to Dr. Maurand a xerox copy of my entry on this species. At that time the entry indicated the name combination as new and included verbatim the remarks in this paragraph above. Now, having learned that Maurand has already published my ideas on the nomenclature of this species without acknowledging their source, it becomes necessary to attribute the new name combination to Maurand, 1975).

Caudospora sp. Frost & Nolan, 1972

Caudospora sp. F. & N., 1972, Can. J. Zool., 50, Pl. 1-Figs. 5, 6.
Host and Site: [DIPTERA-SIMULIIDAE] *Cnephia mutata*, larva; fat body.
Lesion: Abdomen of host conspicuously white.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: 3.75-6.12 x 1.75-2.87 μm with cauda 0.75-1.85 μm. "SEM preparations ... indicated that the cauda is enclosed in a membrane which extends from the spore body." No transverse bands.
Locality: Canada (Churchill Falls, Labrador).
Remarks: While the authors apparently included this in their title as one of several *Caudospora* spp., they also remarked that its characters might permit its placement in Genus *Weiseria*.

Caudospora sp. Steinhaus, 1951

Caudospora sp. Steinhaus, 1951, Hilgardia, 20, 658. Davies, 1957, Emtol. Soc. Ont. Annu. Rep., 87, 79. Davies, 1958, Proc. Int. Congr. Zool., 15, 660.
Host: [DIPTERA-SIMULIIDAE] *Prosimulium hirtipes* (Fries), larva.
Descriptive Data: None.
Locality: Canada (Ontario).

Genus *Octosporea* Flu, 1911

Octosporea muscaedomesticae Flu, 1911

Octosporea muscaedomesticae Flu, 1911, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I Orig., 57, 524, Figs. 77-97. Chatton & Krempf, 1911, Bull. Soc. Zool. Fr., 36, 172, Figs. la-b, 2a-o. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 185, Figs. 658-663. Thomson, 1935, Trans. R. Soc. Trop. Med. Hyg., 29, 6. Porter, 1953, Proc. Zool. Soc. Lond., 123, 253-257 [*fide* Kramer, 1964, J. Insect Pathol., 6, 342]. Fantham & Porter, 1958, Proc. Zool. Soc. Lond., 130, 158, Figs. 10-14. Laird, 1959, Can. J. Zool., 37, 467-468 [*fide* Kramer, 1964, J. Insect Pathol., 6, 342]. Weiser, 1961, Monogr. Angew. Entomol., 17, 129. Kramer, 1964, J. Insect Pathol., 6, 331, Figs. 1-18. Kramer, 1972, J. N. Y. Entomol. Soc., 80, 125, Figs. 1-2. Kramer, 1973 *ibid.*, 81, 50, Figs. 1-5. Kramer, 1973, Z. Parasitenkd., 41, 61, Fig. 1. Ormières, Baudoin, Brugerolle & Pralavorio, 1976, J. Protozool., 23, 320.

?Microsporidies Cardamatis, 1912, Zentralbl. Bakteriol. Parasitenkd. Inkeftionskr. Hyg. Abt. I Orig., 65, 77-79, 1 pl. [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 185],
Microsporidium sp. Cardamatis, 1912, *loc. cit.* [*fide* Weiser, 1961, Monogr. Angew. Entomol., 17, 129].
[?] *Thelohania ovata* Dunkerly, 1912. Weiser, *loc. cit.*
Octosporea sp. Thomson, 1935, Trans. R. Soc. Trop. Med. Hyg., 29, 6.

Host and Site: [DIPTERA-BRACHYCERA] *Musca domestica* L., larva; epithelium of gut and Malpighian tubules and in yolk of egg [Flu]. *Drosophila confusa* Staegar and *D. plurilineata* Villeneuve; epithelium of gut [C. & K.]. *Musca sorbens* Wiedemann; gut [Thomson]. *Musca domestica, Calliphora vomitoria* (L.), and *C. erythrocephala;* gut, Malpighian tubules and body [F. & P.]. *Musca domestica* L.; Malpighian tubules and fat body [Laird]. *Musca domestica* L.; gut, Malpighian tubules [Weiser]. *Musca domestica* L., *Phormia regina* (Meigen), *Cochliomyia macellaria* (Fabricius), *Pollenia rudis* (Fabricius), *Phaenicia sericata* (Meigen), and (experimentally) in *Drosophila melanogaster,* adults; gut [Kramer (1964)]. Experimentally in *Musca autumnalis, Muscina stabulans, Sarcophaga bullata, Hylemya antiqua, Phormia regina,* larva and pupa [Kramer (1973)]. *Ceratitis capitata* [Ormières *et al.*]. *Homalomyia scalaris;* rectum [Dunkerly].

Lesion: Infected gut white and swollen [Kramer (1973)]. Infected epithelial cells become packed with parasites, greatly hypertrophied and finally disintegrated, with large areas of the epithelium becoming disorganized; the host often dies [Kramer (1966)].

Vegetative Stages: Multiple fission results eventually in binucleate forms. Diplocarya fuse to produce sporont [Kramer (1964)].

Sporulation Stages: The sporont develops into a plasmodium with (usually) 16 nuclei. Protrusions of the cytoplasm each containing a pair of nuclei develop; these elongate and separate to produce 8 free, binucleate sporoblasts. Rarely sporonts produce 4 or 16 sporoblasts [Kramer (1964)]. Ormières *et al.*, using electron microscopy, demonstrated a delicate pansporoblastic membrane enclosing sporulation stages. E. I. Hazard (personal communication) studying *O. muscaedomesticae* from its type host by means of electron microscopy, confirmed the results of Ormières *et al.*

Spore: (Fresh) Ovocylindrical, straight or slightly curved, 3.84-9.23 x 1.6-3.2 µm; about 75% are 5.4-7.38 x 1.8-2.4 µm. When stained, 75% are 4.7-5.75 x 1.3-1.7 µm [Kramer (1964)].
Locality: Dutch East Indies (Surinam) [Flu]. France (Paris) [C. & K.]. Nyasaland [Thomson]. England (London) [Porter]. Canada (Montreal) [F. & P.]. Canada (P. Q.) [Laird]. Czechoslovakia (Prague) and U.S.S.R. (Kiev) [Weiser]. U.S.A. (Illinois) [Kramer].
Remarks: Type species by monotypy. Flu considered this parasite to be a schizogregarine. Weiser suggested that the parasite reported by Fantham and Porter had a spore size (5.6-6 x 2-3 µm) more characteristic of *Thelohania*. This species is a borderline form that could be assigned to the PANSPOROBLASTINA. The pansporoblastic membrane may be considered vestigial, since it is very delicate and does not become an effective sporophorous vesicle. Therefore, the species is placed with the APANSPOROBLASTINA, in which it fits well in other respects.

Octosporea bayeri Jírovec, 1936

Octosporea bayeri Jírovec, 1936, Zool. Anz., 116, 138, Fig. 2. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 22.
Host and Site: [CLADOCERA] *Daphnia magna;* fat body.
Lesion: Body of infected animal opaque. Infected cell hypertrophied.
Developing Stages: A cell containing young stages, binucleate (diplocaryotic?) cells, was illustrated.
Spore: Falciform, bent, binucleate in Feulgen preparations, with vacuole at end, with variable size, 5.5-9 x 1.5-2.5 (av. 7 x 2) µm.
Locality: Czechoslovakia (near Lednice, Mähren).
Remarks: This species was assigned to the Genus *Octosporea* because of its falciform spore.

Octosporea carlochagasi Kramer, 1972

Trypanosoma cruzi Chagas [*partim*], 1909, Mem. Inst. Oswaldo Cruz Rio de Janeiro, 1, 159-218 [*fide* Kramer, 1972, Z. Parasitenkd., 39, 224].
Octosporea carloschagasi Kramer, 1972, *ibid.*, 221, Figs. 1-9.
Host and Site: [HEMIPTERA] *Panstrongylus megistus;* midgut.
Vegetative Stages: Quadrinucleate schizonts were illustrated.
Sporulation Stages: Octosporoblastic; sporogonial plasmodium passes through a rosette stage and divides into 8 sporoblasts. These develop into 8 spores.

Spore: Elongate, curved, 5-6 x 1.5-2 μm [description taken from figures of Giemsa stained material].
Locality: Brazil.

Octosporea chironomi Weiser, 1943

Octosporea chironomi Weiser, 1943, Zool. Anz., 141, 260, Fig. 3. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 41. Weiser, 1961, Monogr. Angew. Entomol., 17, 121.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Camptochironomus tentans*, larva; body cavity, general infection [Weiser (1943)], fat body [Weiser (1961)].
Vegetative Stages: Uninucleate stages develop, through stages with 2, 4 or more nuclei, into plasmodia that undergo merogony. This cycle may be repeated.
Sporulation Stages: Some products of merogony may become diplocarya. These develop into plasmodia with 8-60 or more nuclei. From these often develop small clumps of sporoblasts arranged in rosette formation as in *O. muscaedomesticae*. At other times, the large plasmodia remain intact while large numbers of spores develop within; then the delicate pansporoblastic membrane disappears and the spores lie assembled in clumps.
Spore: Rod-shaped, slightly bent, somewhat broader at one end, 2.5-4.5 x 0.8-1.4 μm; in life, a large vacuole appears at the posterior end; after Giemsa, one appears at the other end. A weak Feulgen reaction showed a single nucleus.
Locality: Germany (vicinity of Plön).
Remarks: The tendency of the spores developing from the large "plasmodia" to lie in small clumps suggest that the "pansporoblastic membrane" may be a host cell membrane enclosing many small plasmodia. The single nucleus in the spore is not characteristic of *Octosporea*, but it is noted the nucleus was not clearly demonstrated and could be double. The generic determination needs to be confirmed.

Octosporea effeminans Bulnheim & Vávra, 1968

"Mikrosporidien" Bulnheim, 1966, Naturwissenschaften, 53, 709. Bulnheim, 1967, Verh. Dtsch. Zool. Ges., 30, 433, Fig. 1.
Octosporea effeminans B. & V., 1968, J. Parasitol., 54, 241, Figs. 1-14. Bulnheim, 1969, Verh. Dtsch. Zool. Ges., 32, 251, Fig. 4.
Host and Site: [AMPHIPODA] *Gammarus duebeni*, female only; ovarian tissue.
Lesion: No pathogenic effect, although it influences sex of offspring of infected individual.
Vegetative Stages: In a first schizogony, small plasmodia with 3-8 nuclei undergo multiple fission to produce uninucleate merozoites. In a second schizogony, there are ribbon-like stages with usually 4 nuclei in a row. These divide into diplocaryotic cells.

Sporulation Stages: Diplokaryotic cells multiple in the ooplasm. These develop into spores or divide again to produce 2 spores. Unlike *Octosporea gammari*, which undergoes sporogony to produce clusters of finger-like sporoblasts, this species "has a simpler life cycle resembling the developmental pattern in the genus *Nosema*" [B. & V.].

Spore: Cylindrical, sometimes arched, 4-10 x 1.5-2.5 (av. 5 x 1.5 μm *in vivo*. With large pasterior vacuole and a smaller polaroplast. Binucleate. Polar filament, partially everted, 15 μm.

Locality: Germany (Cuxhaven).

Remarks: Bulnheim (1969) has made a special analysis of the role of *O. effeminans* as a sex regulating factor. This parasite appears to be intermediate between typical *Octosporea* and typical *Nosema*, a matter that raises taxonomic questions that need further consideration.

Octosporea corethrae (Lutz & Splendore, 1908) Weiser, 1961

Nosema corethrae L. & S., 1908, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 46, 315, Fig. 30.

Thelohania braziliensis Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 147, Fig. 508.

Octosporea corethrae (L. & S., 1908) Weiser, 1961, Monogr. Angew. Entomol., 17, 117.

Host and Site: [DIPTERA-CHAOBORIDAE] *Corethra* sp., larva; inside the body, site not specifically mentioned.

Lesion: In the hyaline larvae, white spots, masses of cysts, were visible to the unaided eye.

Vegetative Stages: No data.

Sporulation Stages: Cysts always contained 8 spores.

Spore: Elongate-pyriform-cylindrical, bent, with posterior vacuole 5.5-7.5 x 1.5-2 μm.

Locality: Brazil.

Remarks: I doubt that this species is congeneric with *Octosporea muscaedomesticae* Flu. However, I have no strong convictions about the matter and do not want to risk introducing new problems by suggesting a change in classification.

Octosporea ephestiae (Mattes, 1928) Weiser, 1961

Thelohania ephestiae Mattes, 1928, Z. Wiss. Zool., 132, 526, Pls. 9-12. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 94.

Octosporea ephestiae (Mattes, 1928) Weiser, 1961, Monogr. Angew. Entomol., 17, 98.

Host and Site: [LEPIDOPTERA] The meal moth *Ephestia kuehniella* Zeller, larva; fat body.

Lesion: No grossly visible signs. Parasites form colonies in fat body with some hypertrophy of parts containing large spore colonies.

Vegetative Stages: Some small fusiform cells with diplocarya were seen and these were thought to correspond to the planonts of Stempell. Small uninucleate cells were the beginning stages for binary or multiple fission. The end product was uninucleate cells.
Sporulation Stages: Binucleate stage thought to develop into octosporous pansporoblast. Pansporoblastic membrane very delicate.
Spore: Long oval, 4.7 x 1.7 µm (living); 4.0 x 1.1 µm (stained). Binucleate.
Locality: Germany (near Marburg).
Remarks: Hazard and Oldacre say that this species does not belong in the THELOHANIIDAE. Because of the length-breadth relationship of the spores, Weiser (1961) transferred this species to Genus *Octosporea*. The binucleate condition of the spore is also characteristic of *Octosporea* and excludes this species from *Thelohania*.

Octosporea gammari Ryckeghem, 1930

Octosporea gammari Ryckeghem, 1930, Cellule, 39, 412, Figs. 22-24.
Host and Site: [AMPHIPODA] *Gammarus pulex* L.; in the region of the digestive tube.
Developing Stages: Most of the parasites were subspherical, 1-2 µm and binucleate [Ryckeghem]. Sporogonial plasmodium produces large (10 µm) cluster of finger-like sporoblasts [Bulnheim & Vávra (1968), observed on material studied by Jírovec (1943)].
Spore: Generally, bacilliform, often curved, about 6 x 2 µm when fresh, with large posterior vacuole and a typical "organe polaire" at anterior end, binucleate; form highly irregular, with often inflation of the posterior end, or an extension of the anterior end or markedly curved [Ryckeghem]. In fixed and stained material, 4 x 1-1.2 µm, curved, binucleate [Jírovec].
Locality: Belgium (Louvain). Czechoslovakia (Prague).

Octosporea intestinalis Codreanu & Codreanu-Balcescu, 1975

Octosporea intestinalis C. & C-B [*nomen nudum*], 1975, J. Protozool., 22, 78A.
Host and Site: [EPHEMEROPTERA] *Rhithrogena semicolorata* (Curtis), nymph; mesenteron.
Developmental Stages: No data.
Spore: Tubular, up to 6 µm long.
Locality: Roumania.
Remarks: The brief description was not accompanied by a list of characters purporting to differentiate the taxon.

Octosporea monospora Chatton & Krempf, 1911

Octosporea monospora C. & K., 1911, Bull. Soc. Zool. Fr., 36, 176, Figs. 1c, 2p. Brug, 1914, Arch. Protistenkd., 35, 127, Figs. 1-65.

Host and Site: [DIPTERA-BRACHYCERA] *Drosophila confusa* Staeger [type host] and *D. plurilineata* Villen., adult; epithelial cells of midgut. *Homalomyia scalaris*, larva; gut epithelium [Brug].

Lesion: Masses of parasites fall into the lumen of the gut.

Vegetative Stages: Binary of multiple fission results eventually in "sporont" [Brug].

Sporulation Stages: One "pansporoblast" produces 1 spore [C. & K.]. One "sporont" produces 1 spore [Brug]. Sporoblast binucleate.

Spore: Curved in crescent, 4-5 x 1 μm.

Locality: France (Paris) [C. & K.]. Holland [Brug].

Remarks: Chatton and Krempf found spores of *O. muscaedomesticae*, in the same host, to be slightly curved and 4-6 x 1 μm. This description may not be significantly different from that of *O. monospora*. The only significant difference is in the supposed number of spores produced by the "pansporoblast" or "sporont." Perhaps this difference was only apparent rather than real; since it seems possible that the authors observed some hosts in which the clusters of 8 spores had all separated so that all spores were single. Brug found "multinucleate meronts" (his Fig. 14) dividing to produce "sporonts" that become spores and concluded that the species is "monosporous." He could just as well have called these products "sporoblasts" and then he would have had to call the species "polysporous." A very puzzling fact is that Brug seems to have seen no diplocarya. This species remains enigmatic.

Octosporea simulii Debaisieux, 1926

Octosporea simulii Debaisieux, 1926, Ann. Soc. Sci. Bruxelles, 46, 594, Figs. 1-4. Weiser, 1961, Monogr. Angew. Entomol., 17, 127.

Host and Site: [DIPTERA-SIMULIIDAE] *Simulium* sp., larva; small cysts adhere to the midgut near the attachment of the Malpighian tubules.

Vegetative Stages: Involves formation of stages with diplocarya.

Sporulation Stages: Isolated stages with diplocarya transform directly into spores.

Spore: Rod-shaped, slightly bent, 7.5 x 2-3 μm, binucleate, with clear area in each end. Polar filament 40 μm (only 1 was seen).

Locality: Belgium (Louvain).

Octosporea viridanae Weiser, 1956

Octosporea viridanae Weiser, 1956, Česk. Parasitol., 3, 204-205 [*fide* Weiser, 1961, Monogr. Angew. Entomol., 17, 99]. Weiser, *loc. cit.*, Fig. 46.

Host and Site: [LEPIDOPTERA] *Tortrix viridana* L., larva; fat body.

Vegetative Stages: In a first schizogony, 2-4 nucleate schizonts divide. The products grow and 8 or more nuclei produce diplocarya in a row.

Sporulation Stages: In sporogony all stages are binucleate. "Sporonte teîlen sich noch vor ihrer völlig Reifung."

Spore: Rod-shaped, 6.5-8 x 1.7-2 µm, binucleate.

Locality: Czechoslovakia.

Octosporea sp. Issi & Lipa, 1968

Octosporea sp. I. & L., 1968, Acta Protozool., 6, 284.

Host and Site: [DIPTERA-BRACHYCERA] The onion fly *Hylemya antiqua* Meigen; "the tissues of the dead pupae and adult flies, closed inside puparia, were completely destroyed by a microsporidian."

Vegetative Stages: No data.

Sporulation Stages: No data.

Spore: Greatly elongated, 3.7 x 0.6 µm.

Locality: U.S.S.R. (Sverdlovsk region, Ural).

Remarks: The authors stated that Evlakhova and Shvestova reported finding this parasite in 1965.

Octosporea sp. Pavan, Perondini & Picard, 1969

[?] "a protozoan" Diaz & Pavan [*partim*], 1965, Proc. Natl. Acad. Sci. U.S.A., 54, 1321.

[?] "a microsporidian" Pavan & Peronidini [*partim*], 1966, Genetics, 54, 353.

[?]"microsporidian" Pavan & Basil [*partim*], 1966, Science, 151, 1556.

[?] "microsporidia" Pavan & Da Cunha [*partim*], 1968, "Proceedings of the International Seminar on the Chromosomes--its Structure and Function" (A. K. Sharma and A. Sharma, eds.), p. 184.

Octospora sp., P., P. & P., 1969, Chromosoma, 28, 330, Figs. 2. Pavan, Biesel, Riess & Wertz, 1971, Stud. Genet., 6, 243.

Host and Site: [DIPTERA-SCIARIDAE] *Sciara ocellaris*, larva; mainly intestine, sometimes salivary gland. *Rhynchosciara angelae* larva and adult [P., B., R. & W.].

Lesion: [Xenoma] The infected cell becomes "a unicellular tumor that has its own pattern of development" [P., B., R. & W.].

Vegetative Stages: No data.

Sporulation Stages: No data.

Spore: Elliptical, about 7 x 3 µm [D. & P.]. About 8-12 x 2-2.5 µm [estimated from Fig. 2 of Pavan *et al.* (1969)].

Locality: U.S.A. (Tennessee) [P., P. & P.]. Brazil (São Paulo) [P., B., R. & W.].

Remarks: Pavan and associates wrote several papers in which they reported two species of microsporidia, one of which they assigned to Genus *Thelohania* and the other to *Octosporea*. They gave no clues as to whether they were always working with the same two species. Therefore, it is assumed that the *Octosporea* in *Sciara* and that in *Rhynchosciara* are the same. It is of interest that these authors independently developed a concept of the unicellular tumor that is quite similar to the concept made well known in numerous publications of Weissenberg.

Genus *Weiseria* Doby & Saguez, 1964

Weiseria laurenti D. & S., 1964

Weiseria laurenti D. & S., 1964, C. R. Acad. Sci., 259, 3614, Figs. 1-5. Doby & Saguez, 1964, Bull. Soc. Zool. Fr., 89, 777, Figs. 1-48, Pl. figs. 1-11.

Host and Site: [DIPTERA-SIMULIIDAE] *Prosimulium inflatum* Davies, 1957, larva; fat body.

Vegetative Stages: Small plasmodia, uninucleate forms and diplokaryotic cells were seen.

Sporulation Stages: Sporogonial plasmodium divides radially into 16 or more binucleate sporoblasts that separate and develop into spores.

Spore: Ornamented with some crests that give rise posteriorly to some thin ridges subtending a membrane. Length when fresh 3.74-4.5 μm (av. 4 μm) excluding ornamentation and 5-5.25 μm including ornamentation. Binucleate. Polar filament 30-47 μm, average 38 μm.

Locality: France (Haute-Savoie).

Remarks: Type species by monotypy. After establishing the genus and species in 1964, the authors gave a more detailed description in the same year.

Weiseria sommermanae Jamnback, 1970

Weiseria sommermanae Jamnback, 1970, J. Invertebr. Pathol., 16, 11, Figs. 8-19.

Host and Site: [DIPTERA-SIMULIIDAE] *Gymnopais* sp., larva; site not mentioned.

Vegetative Stages: Multiple fission of plasmodia with paired nuclei (diplokarya).

Sporulation Stages: Multiple fission to produce uninucleate sporoblasts that transform into binucleate spores.

Spore: Bell-shaped, 5.4 x 4.1 μm. Uninucleate (p. 11). Binucleate (p. 12).

Locality: Alaska.

Remarks: The description is confused. Perhaps "schizogony" and "sporogony" were transposed.

Weiseria sp. Lom & Weiser, 1972

Weiseria sp. L. & W., 1972, Folia Parasitol. (Prague), 19, 362, Pl. 6.

Host and Site: [EPHEMEROPTERA] *Ephemerella ignita*.

Descriptive Data: "Elongated sausage-shaped spores with deformations revealing a rather plastic interior spore layer. Surface smooth, one longitudinal suture ending in a polar field is limited by other sutures branching from the longitudinal row" [description from SEM study].

Family NOSEMATIDAE Labbé, 1899

Genus *Nosema* Naegeli, 1857

Nosema bombycis Naegeli, 1857

Nosema bombycis Naegeli, 1857, Bot. Ztg., 15, 760. Labbé, 1899, in "Das Tierreich" (O. Butschli, ed.), 5, 106. Pérez, 1905, Bull. Sta. Biol. d'Arcachon, 8, 30. Stempell, 1909, Arch. Protistenkd., 16, 281, Figs. 1-128. Kudo, 1913, Zool. Anz., 41, 368, Figs. 1-4. Kudo, 1916, Bull. Seric. Exp. Stn. (Tokyo), 1, 31, Figs. 1-92. Kudo, 1918, J. Parasitol., 4, 142. Foa, 1924, Boll. Lab. Zool. Portici, 17, 147, Figs. A-D. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 69, Figs. 1-39, 757, textfigs. B2, D. Paillot, 1928, C. R. Soc. Biol., 99, 81, Figs. 1-16. Paillot, 1930, "Traité des Maladies du Ver à Soie," p. 110, Figs. 1-57. Ohshima, 1935, Zool. Mag. (Tokyo), 47 607, Figs. 1-8, Pls. 1-3. Ohshima, 1937, Parasitology, 29, 220. Kudo & DeCoursey, 1940, J. Parasitol., 26, 123. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 34. Machay, 1954, Folia Entomol. Hung., 7, 160. Machay, 1957, *ibid.*, 10, 359. Veber, 1958, Trans. 1st Conf. Insect Pathol. Control, 1958, 301. Thomson, 1960, J. Insect Pathol., 2, 348. Weiser, 1960, Monogr. Angew. Entomol., 17, 77. Veber & Jasič, 1961, J. Insect Pathol., 3, 103. Ishihara, 1963, J. Insect Pathol., 5, 131. Ishihara, 1967, J. Protozool., 14, 29. Ishihara, 1968, J. Invertebr. Pathol., 11, 328, Figs. 1-7. Ishihara & Hayashi, 1968, *ibid.*, 377, Figs. 1-7. Ishihara, 1968, J. Invertebr. Pathol., 12, 245, Figs. 1-19. Ishihara, 1969, *ibid.*, 14, 316, Figs. 1-14. Weiser 1970, SIP (Soc. Invertebr. Pathol.) Newsl., 2, 10. Ishihara, 1970, Bull. Coll. Agric. Vet. Med. Nihon Univ., 27, 84, Figs. 1-11. Cali, 1971, Proc. IVth Int. Colloq. Insect Pathol., 1970, 431, Figs. 1-4. Lom & Weiser, 1972, Folia Parasitol. (Prague), 19, 360, Pl. 2-Fig. 1. Ohshima, 1973, Annot. Zool. Jap., 46, 30, Figs. 1-39. Takizawa, Vivier & Petitprez, 1973, C. R. Acad. Sci., 277, 1769, Figs. 1-3.

Panhistophyton ovatum Lebert, 1858, Berlin Ent. Z., 2, 149-186. [*fide* Labbé, 1899, in "Das Tierreich" (O. Bütschli, ed.), 5, p. 107].

Microsporidium bombycis. Balbiani, 1884, "Lecons sur les Sporozoaires," p. 184.
Glugea bombycis (Naegeli, 1857) Thélohan, 1895, Bull. Sci. Fr. Belg., 26, 357.
Nosema bombycis Naegeli, 1857, *bombycis* Filatova, 1942, Zool. Zh., 21, 25. Filatova, 1947, Bull. Soc. Nat. Moscou, S. Biol., 52, 5.
Nosema bombycis Naegeli, 1857, *antheraeae* Filatova, 1942, *loc. cit.*
[?] *Nosema* sp. Finlayson & Walters, 1957, Nature (Lond.), 180, 713. Walters, 1958, Parasitology, 48, 113.

Host and Site [LEPIDOPTERA] *Bombyx mori* L. [type host], all stages: infection starts in midgut of larva and becomes generalized. Also *Arctia caja* L. [Stempell, Machay (1957)] *Margaronia pyloalis* Wlk., *Chilo simplex* (Butl.) [*Ohshima* (1935) *fide* Weiser (1961)]; *Hyphantria cunea* [K. & D., Machay (1957)]; *Malacosoma neustria* L., *Gastropacha quercifolia* [Veber Machav (1957)]; *Thaumetopoea processionea, Pieris brassicae* [Veber]; *Lithosa complana, Callimorpha quadripunctata, Eriogaster lanestris, Lasiocampa trifolii, L. quercus, Stilpnotia salicis, Lymantria dispar, Orgya antiqua, Sauturina pyri, S. pavonia, Amorpha populi, Sphinx ligustri, Dicanura vinula, Catocala elocacta, C. nupta, Calamia virens, Phytomerta gamma, Acronycta aceris* [Machay]; *Hyalophora (Platysamia) cecropia* and experimentally in *Antheraea polyphemus, A. pernyi, Cerura vinula, Selinia bilunaria, Sphinx ligustri, Vanessa io* and [DIPTERA] *Calliphora erythrocephala* [F. & W.].

Lesion: Heavily infected organs hypertrophied, distorted, milky-white; larva may not grow normally; brown or black spots appear on surface of body.

Vegetative Stages: Infection begins when the germ (or sporoplasm) is injected into the host tissue by the evaginating polar filament [Ohshima (1937), Ishihara (1968)]. The parasite grows and undergoes several binary fission; secondary infective forms leave the host cell to infect new cells [Ishihara (1969)]. According to Weiser (1970), "there are two schizogonial cycles, the first with micronuclear and the second with macronuclear stages, not more than four nuclei in one schizont." Finally, fusiform sporonts are formed [Foa, Ishihara (1969), Cali, Ohshima (1973)]. Ohshima postulated a sexual process during the early vegetative phase and Weiser (1970) said that it occurs to produce the sporont. Most authors have not found a sexual process. Cali found only diplocarya while many authors have found single nuclei in some stages.

Sporulation Stages: Monosporous, the products of the last binary fission developing in isolation into spores [Pérez]. Disporous, the sporont dividing into 2 sporoblasts [Foa, Weiser, Cali, Ohshima (1973)]. Ishihara (1969) said, "*Nosema* can produce two spores from one sporont." Many authors have said that one sporont produces one spore; apparently, these authors use "sporont" for the product of the last cell division rather than for the cell that undergoes the final division.

Spore: Oval, binucleate, 3-4 x 1.5-2 μm, with "a coarse pattern of broad irregular flat wrinkles" [L. & W., SEM]; polar filament up to 98 μm [Kudo (1924)].

Locality: Cosmopolitan.

Remarks: Type species by monotypy. Several microsporidia in other hosts are similar to *Nosema bombycis* in *Bombyx mori*. Filatova (1942) has recognized subspecies but no later author seems to have followed him. Nordin and Maddox (1974) could not distinguish the following species from *N. bombycis: N. invadens* Kellen & Lindegren, 1973; *N. polyvora* Blunk, 1952; *N. mesnili* (Paillot, 1918); *N. perezioides* Huger, 1960; *N. fumiferanae* (Thomson, 1955); *N. disstriae* (Thomson, 1959); *N. trichoplusiae* Tanabe & Tamashiro, 1967; *Nosema* sp. Nordin & Maddox, 1974. However, they did not unambiguously synonomize these species. Weiser [1971, SIP (Soc. Invertebr. Pathol.) Newsl., 3, 25] said that one of these, *N. mesnili*, is identical with 5 other species but did not list the other species. Future investigators will have to decide how all these nominal species and subspecies relate to one another. If all should prove to be synonyms, then they will all take the oldest name, *Nosema bombycis*. There is a voluminous literature on *N. bombycis*. No attempt has been made to cover all of it. It is interesting to note that *N. bombycis* is "monosporous" in the sense that the spores develop in isolation (the original meaning of "monosporous" when coined by Perez) and "disporous" in the sense that each sporont produces 2 spores. When this is understood there need be no further argument about whether *Nosema* is "monosporous" or "disporous." Finlayson and Walters worked with *Nosema* sp.; Walters (1958) found that the same species "shows most similarities to *N. bombycis* ...but one difference stands out, namely that the spores of the present species are longer and narrower than those of *N. bombycis*." The wide range of spore dimension and the host range suggest that these authors worked with several species, including *N. bombycis*.

Nosema acridophagus Henry, 1967

Nosema acridophagus Henry, 1967, J. Invertebr. Pathol., 9, 331, Figs. 1-24. Henry, 1969, J. Insect Physiol., 15, 391, Figs. 1-7.

Host and Site: [ORTHOPTERA] Natural infection in *Schistocerca americana*; experimental infection in *Melanoplus sanguinipes*, *M. bivittatus*, *M. differentialis*; midgut, gastric caeca, gonads, fat bodies, pericardial tissues, tissues associated with the nervous system.

Lesion: "Tumorlike growths, probably a type of 'inflammatory nodule' or 'giant cell' has gross appearance of isolated darkened spot." Later, a pigmented and encapsulated nodule about 5 mm in diameter.

Vegetative Stages: First stage a binucleate amoebula. Very early, uninucleate stages occur; later, binucleate forms are most abundant. Quadrinucleate forms are common.
Sporulation Stages: Seems to be initiated by appearance of binucleate forms with large, hemispherical nuclei. These appear to produce uninucleate sporonts. The latter become binucleate, sometimes quadrinucleate "sporoblasts" (with nuclei arranged linearly) and transform into spores.
Spore: Ovoid, 4.1 x 2.6 μm (fresh).
Locality: U.S.A. (Georgia).
Remarks: The author does not say how sporonts become sporoblasts but the presence of quadrinucleate forms with nuclei in linear arrangement suggests that a binucleate sporont becomes quadrinucleate and then divides to produce 2 binucleate sporoblasts.

Nosema aeschnae (Fantham, Porter & Richardson, 1941) Weiser, 1961

Perezia aeschnae F., P. & R., 1941, Parasitology, 33, 195, Figs. 43-52.
Glugea aeschnae (F., P. & R., 1941) Thomson, 1960, J. Insect Pathol., 2, 354.
Nosema aeschnae (F., P. & R., 1941) Weiser, 1961, Monogr. Angew. Entomol., 17, 53.
Host and Site: [ODONATA] The dragonfly *Aeschna grandis*, nymph; fat body.
Lesion: Infected cells chalky-white but not hypertrophied.
Vegetative Stages: Individuals with a pair of nuclei develop into chains of several binucleate individuals. The chains break up and "sporogony ensues after a period of growth and elongation of the individuals" [F., P. & R.].
Sporulation Stages: The elongated individual, sporont, undergoes binary fission to produce 2 binucleate sporoblasts, each of which develops into a binucleate spore.
Spore: Egg-shaped, 5.9-7.4 x 3.3-4.6 μm, binucleate; polar filament up to 80 μm.
Remarks: Thomson incorrectly attributed the combination *Glugea aeschnae* to Weiser.

Nosema algerae Vávra & Undeen, 1970

Nosema sp. Alger & Undeen, 1970, J. Invertebr. Pathol., 15, 321. Hazard & Lofgren, 1971, *ibid.*, 18, 16, Figs. 1-6. Hazard, 1971, Proc. IV Int. Colloq. Insect Pathol., 1970, 267. Savage & Lowe, 1971, *ibid.*, 272.
Nosema algerae V. & U., 1970, J. Protozool., 17, 240, Figs. 1-26. Canning & Hulls, 1970, *ibid.*, 531. Undeen, 1972, SIP (Soc. Invertebr. Pathol.) Newsl. 4, 20. Ward & Savage, 1972, Proc. Helminthol. Soc. Wash., 39, 434. Undeen & Maddox, 1973, J. Invertebr. Pathol., 22, 258. Canning & Sinden, 1973, Protisto-

logica, 9, 405, Figs. 1-14. Undeen & Alger, 1975, J. Invertebr. Pathol., 25, 19-24. Undeen, 1975, J. Protozool., 22, 107, Figs. 1-15.

[*non*] *Nosema stegomyiae* Marchoux, Salimbeni & Simond, 1903. Fox & Weiser [*partim*], 1959, J. Parasitol., 45, 21, Figs. 1-6. Thomson [*partim*], 1960, J. Insect Pathol., 2, 352. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 108, Fig. 48. Anthony, Savage & Weidhass, 1972, Proc. Helminthol. Soc. Wash., 39, 428. Ward & Savage, 1972, *ibid.*, 434.

Host and Site: [DIPTERA-CULICIDAE] *Anopheles stephensi* [type host], larva and adult; many tissues. Also *A. gambiae*, *A. melas*, *A. albimanus*, *A. quadrimaculatus*, *A. balbacensis*, *Aedes aegypti*, *Culex pipiens*, *C. quinquefasciatus*, *C. salinarius*. In addition, Undeen and Maddox (1973) produced infection in insects of 6 different orders and in crayfish by injecting spores into them. Undeen cultured *N. algerae* in pig kidney cells.

Vegetative Stages: Reproduction by binary fission of diplocaryotic cells.

Sporulation Stages: A binucleate (diplokaryotic), elongate sporont divides into 2 binucleate sporoblasts that transform into spores.

Spore: Ovoid, one end more pointed, 3.65-5.36 x 2.29-3.90 μm; binucleate.

Locality: U.S.A. (Illinois, Washington, D. C.); Tanzania; Liberia.

Nosema apis Zander, 1909

Nosema apis Zander, 1909, Leipzig. Bienenztg., 24, 147-150, 164-166 [*fide* Thomson, 1960, J. Insect Pathol., 2, 347, 385]. Fantham & Porter, 1912, Ann. Trop. Med. Parasitol., 6, 163, Figs. 1-56. Fantham & Porter, 1913, *ibid.*, 7, 569. Kudo, 1920, J. Parasitol., 7, 85, Figs. 1-14. Trappman, 1923, Arch. Bienenk., 5, 221, Figs. 1-13. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 90, Figs. 114-118, text figs. B4, 7. Bailey, 1955, Parasitology, 45, 86, Pl. 4. Thomson, 1960, *loc. cit.* Kramer, 1960, J. Insect Pathol., 2, 433, Fig. 10. Weiser, 1961, Monogr. Angew. Entomol., 17, 64, Fig. 32. Codreanu, Popa & Vioculescu, 1965, Bull. Apicult., 8, 5, Figs. 1-7. Gray, Cali & Briggs, 1969, J. Invertebr. Pathol., 14, 391, Figs. 1-15. Wildführ & Fritsch, 1969, Angew. Parasitol., 10, 39, Figs. 1-18. Cali, 1971, Proc. IVth Int. Colloq. Insect Pathol., 1970, 431, Figs. Na1, Na2, Na3, Na4. Youssef & Hammond, 1971, Tissue Cell, 3, 283, Figs. 1-20. Liu, 1973, J. Invertebr. Pathol., 22, 364, Figs. 1-5. Liu & Liu, 1974, J. Morphol., 143, 337, Figs. 1, 5, 8.

Nosema bombi Fantham & Porter, 1914, Ann. Trop. Med. Parasitol., 8, 623, Figs. 1-42. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 103, Figs. 158-177. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 29. Thomson, 1960, J. Insect Pathol., 2, 348.

Host and Site: [HYMENOPTERA] The honey bee *Apis mellifica* [type host], adult; in midgut and Malpighian tubules. Also, experimental infection in: [HYMENOPTERA] *Bombus terrestris, B. lapidarius, B. hortorum, B. venustus, B. latreillelus,* mason bees, *Vespa germanica;* [LEPIDOPTERA] *Pieris brassicae, Callimorpha jacobeae, Abraxas grossulariata;* [DIPTERA] *Calliphora erythrocephala, Tipula oleracea, Melophagus ovinus* [F. & P. (1913)]. Fantham and Porter (1914) reported *N. bombi* in the following additional hosts: [HYMENOPTERA] *Bombus agrorum, B. sylvarium, Apis florea.*

Lesion: Infected gut becomes swollen and milky-white.

Vegetative Stages: Spore hatches by ejecting binucleate sporoplasm through polar filament [Kramer (1960)]. Germ injected into cell via hollow polar filament [Bailey]. Binucleate "planont," injected into host cell by everting polar filament, undergoes schizogony; incomplete separation of daughter cells results in formation of long chains from which individual binucleate schizonts break off. The process is repeated to produce a second schizogonic chain characterized by more chromophilic nuclei; these are most commonly tetranucleate stages; a final division produces binucleate cells, the nuclei being in the form of diplocarya [Gray *et al.*].

Sporulation Stages: A cell (sporont) with a diplocaryon elongates, acquires a thickened membrane, undergoes binary fission and produces two sporoblasts, each with a diplocaryon. Each sporoblast transforms into a spore [Cali]. As early as 1923, Trappman found that one binucleate sporont produces two binucleate sporoblasts.

Spore: Oval, 5 x 2.8 µm [Zander, *fide* Kudo (1924)]. 4.6-6.4 x 2.5-3.4 µm; polar filament 230-280 µm [Kudo (1920)]. Spore binucleate [several authors].

Locality: Cosmopolitan.

Remarks: There is a voluminous literature relating to this species. Kudo (1924) summarized the early literature. Much of that which came later was devoted to practical aspects of bee culture and is not considered here. Rather recently there have been several electron microscope studies [Codreanu *et al.*(1965), Wildführ and Fritsch (1969), Cali (1971), Youssef and Hammond (1971), Liu (1973)].

Nosema aporivora Veber, 1957

Nosema sp. Lipa, 1957, Wiad. Parazytol., 3, 461.

Nosema aporivora Veber, 1957, Věstn. Česk. Spol. Zool., 21, 187, Figs. 1, 2. Lipa, 1957, Acta Parasitol. Pol., 5, 562. Thomson, 1960, J. Insect Pathol., 2 347. Weiser, 1961, Monogr. Angew. Entomol., 17, 80.

Nosema aporiae Lipa, 1957, Acta Parasitol. Pol., 5, 559, Figs. 1-29 + Pl. 1. Thomson, 1960, *loc. cit.* Lipa, 1963, Pr. Nauk. Inst. Ochr. Rosl. Warsz., 5, 112.

Host and Site: [LEPIDOPTERA] *Aporia crataegi* L., larva; muscles, midgut, epithelium, silk glands, and fat body [Veber]. Mainly silk glands, also muscles, Malpighian tubules, nervous system, and fat body on gut in case of strong invasion [Lipa].
Lesion: Infected silk glands are hypertrophied and dull white. Viewed with low magnification they are black.
Vegetative Stages: "Planonts" thought to divide before penetrating cell. After cell invasion binary fission leads to diplocarya. A nucleus may divide twice to produce a plasmodium that produces 4 new schizonts [Lipa].
Sporulation Stages: "As a rule two sporonts develop from one schizont. A sporont passes through the sporoblastic stage and develops into a spore" [Lipa].
Spore: Oval, 4-5 x 2 μm [Veber]. 2.5-7.5 x 0.90-2.64 μm [Lipa].
Remarks: Although Lipa gave a list of biological and morphological characters to distinguish *N. aporiae* from *N. aporivora*, Weiser combined these species. I follow Weiser, the last reviser, simply because I see no compelling reason to do otherwise.

Nosema artemiae (Codreanu, 1957) comb. n.

Glugea artemiae Codreanu, 1957, Ann. Sci. Nat. Zool., 19, 562, Figs. 1a-d, 2c-e, 3, Pl. 1-Fig. 1.
Host and Site: [PHYLLOPODA] The brine shrimp *Artemia salina* (L.); principally in the muscles but also in adipo-phagocytic cells, maxillary gland, nerve chain, the hypodermis, and the swimming organs.
Lesion: Massive infection causes deformity of host. Host cell frequently hypertrophied with giant nucleus.
Vegetative Stages: Small schizonts with 1 or 2 nuclei undergo binary fission.
Sporulation Stages: Elongated forms divide into 2 binucleate sporoblasts.
Spore: Slightly refringent, oval, variable in size, 4.2-5.9 μm, with a crescentic posterior vacuole (fresh). Two nuclei demonstrated with the Feulgen technique. Polar filament 54-75 μm.
Locality: Roumania (Tékirghiol).
Remarks: This species was assigned to the Genus *Glugea* because it is disporous and causes hypertrophy of the host cell with production of a giant nucleus. The binucleate condition, however, excludes this species from *Glugea*. This condition and the disporous nature are now known to be essential characters of *Nosema*, to which genus it is now provisionally transferred. *Nosema* already contains many species that cause hypertrophy of the host cell. This character needs to be evaluated at another time when a revision of the genus is undertaken.

Nosema astyrae Lutz & Splendore, 1903

Nosema astyrae L. & S., 1903, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I, Orig., 33, 154, Fig. 2. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 83, Fig. 88. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 34. Weiser [*partim*], 1961, Monogr. Angew. Entomol. 17, 81.

Host and Site: [LEPIDOPTERA] *Brassolis astyra* Bodt., larva; site not mentioned.

Vegetative Stages: No data.

Sporulation Stages: No data.

Spore: Ovoid, 4-4.5 x 2.5-3 µm.

Locality: Brazil (near São Paulo).

Remarks: This species was so poorly described that its validity cannot be judged. Weiser (1961) synonomized several species with this one for reasons which he did not state. I feel it would be less confusing to keep it separate until we have more information.

Nosema auriflammae L. & S., 1908

Nosema auriflammae L. & S., 1908, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 46, 314, Fig. 38. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 86, Fig. 100.

Nosema astyrae L. & S., 1903, Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 81.

Host and Site: [LEPIDOPTERA] *Scea auriflamma*, imago. Site not mentioned but found in a state of diffuse inflitration.

Vegetative Stages: No data.

Sporulation Stages: No data.

Spore: Regularly oval, without perceptible vacuole, 3.5-5 x 1.7-2.5 µm.

Remarks: Weiser, for reasons not clear, treated this as a synonym of *N. astyrae* L. & S., 1903. I note, however, that both he and Kudo gave the wrong dimensions for the spore of *N. auriflammae*. Apparently, they mistakenly copied for this species the dimensions of the spore of the species which Lutz and Splendore listed immediately below it, *N. mystacis*.

Nosema baetis Kudo, 1921

Nosema baetis Kudo, 1921, J. Morphol., 35, 171, Figs. 75-117. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 108, Figs. 188-205, 772-774. Weiser, 1946, Věstn. Cesk. Spol. Zool., 10, 248, Fig. 2. Weiser, 1956, Česk. Parasitol., 3, 196, Fig. 2. Weiser, 1961, Monogr. Angew. Entomol., 17, 45, Fig. 22.

Host and Site: [EPHEMEROPTERA] *Baetis* sp. (?)nymph; fat body [Kudo]. *Cloeon dipterum* Bengtss., *C. rufulum* Mül., *Caenis macrura* Steph., *Centroptilum luteolum* Mül., and *Ecdyonurus venosus* Fabr. [Weiser (1961)].

Lesion: Thorax of host whitish opaque and distended. Associated muscle tissue atrophied.

Vegetative Stages: Resemble those of *N. bombycis*. Multiplication by repeated binary fission; no multiple fission seen.
Sporulation Stages: As a result of the binary fission, "the host cells are filled with the schizonts which now become the sporonts." These transform into spores [Kudo (1924)].
Spore: Elongated oval, 3-4 x 1.5-2.5 µm. Filament 94-135 µm.
Locality: U.S.A. (Urbana, Illinois) [Kudo]. Czechoslovakia [Weiser].
Remarks: The generic determination needs to be confirmed, for neither the text nor the illustrations accompanying the description make it clear that the sporulation stages are binucleate.

Nosema bialoviesianae Lipa, 1966

Nosema bialoviesianae Lipa, 1966, J. Invertebr. Pathol., 8, 162, Fig. 4.
Host and Site: [HEMIPTERA] *Nepa cinerea* L., adult; midgut epithelium.
Lesion: No data.
Vegetative Stages: Meronts 2-5 µm, uni-or binucleate.
Sporulation Stages: Sporonts elongated, 3-4 µm.
Spore: Oval, 2.8-3.3 x 1.9-2.2 µm.
Locality: Poland.

Nosema bibionis Stammer, 1956

Nosema bibionis Stammer, 1956, Proc. Int. Congr. Zool., 14, 352, Fig. 4. Weiser, 1961, Monogr. Angew. Entomol., 17, 107.
Host and Site: [DIPTERA-BIBIONIDAE] *Bibio varipes* Meigen, larva; "Hautfettkörperläppchen" lying between the muscles.
Vegetative Stages: No data.
Sporulation Stages: Thought to be monosporous because only single spores were seen.
Spore: Egg-shaped, 3.5-5 x 2.5-4 µm.
Locality: Germany (vicinity of Erlangen).
Remarks: Probably the name is a *nomen nudum* because it was not "accompanied by a statement that purports to give characters differentiating the taxon" [Art. 13, "International Code of Zoological Nomenclature," see Stoll (1961)].

Nosema binucleatum Weissenberg, 1926

Nosema binucleatum Weissenberg, 1926, Arch. Protistenkd., 54, 431, Figs. 2-30. Weiser, 1961, Monogr. Angew. Entomol., 17, 106.
Host and Site: [DIPTERA-TIPULIDAE] The crane fly *Tipula gigantea*, larva; intercellular in the ground substance of the tunica elastico-muscularis of the midgut. Found also in one specimen of *T. lateralis*.

Lesion: Cysts of various sizes, generally 40-120 µm in diameter but rarely 170 x 170 or 230 x 200 µm. Cysts often numerous, sometimes well over 1,000 present on the outside of the gut. Infection rarely evident from external observation. Sometimes, between the gills, the cysts were visible through the skin as white points.
Vegetative Stages: All stages with diplocarya. In young cysts, chains of cells arose during schizogony and in older cysts rosettes were formed.
Sporulation Stages: Both the chains and the rosettes produced binucleate sporoblasts and these transformed into binucleate spores, the former producing larger spores and the latter producing smaller ones.
Spores: Long ovoidal, 4.35-6.75 x 2.6-2.85 µm.
Locality: Switzerland (near Locarno). Czechoslovakia (different localities).
Remarks: Weissenberg called particular attention to the uniqueness of the supposed intercellular development of the parasite. The generic assignment is questionable. If, as the author thought, the rosettes were producing sporoblasts, this parasite is more like *Octosporea* than *Nosema*.

Nosema bryozoides (Korotneff, 1892) Labbé, 1899

Myxosporidium bryozoides Korotneff, 1892, Z. Wiss. Zool., 53, 591, Figs. 1-12.
Glugea bryozoides (Korotneff, 1892) Thélohan, 1895, Bull. Sci. Fr. Belg., 26, 359.
Nosema bryozoides (Korotneff, 1892) Labbé, 1899, in "Das Tierreich" (O. Bütschli, ed.), 5, 106. Braem, 1911, Trav. Soc. Imp. Nat. St. Petersbg., 42, 1-35, 21 textfigs [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 77]. Schröder, 1914, Zool. Anz., 43, 320, Figs. 1, 2. Kudo, 1924, *loc. cit.*, Figs. 40-60.
Host and Site: [BRYOZOA] Freshwater bryozoa *Alcyonella fungosa* [Korotneff], *Plumatella funogosa* Pallas and *P. repens* L. [Schröder]; testicular cells and body cavity.
Lesion: Infected host cells become hypertrophied and their nuclei proliferate amitotically [Schröder], forming cell hypertrophy tumors. These xenomas, 20-200 µm in diameter, may fill the body cavity.
Vegetative Stages: Merogony as in other *Nosema* spp. [Schröder].
Sporulation Stages: Sporogony as in other *Nosema* spp. [Schröder].
Spore: Ellipsoidal, 7 x 4 µm, binucleate [Schröder].
Locality: U.S.S.R.(near Moskow) [Korotneff]. Germany (Schleswig-Holstem) [Schröder]. Turkestan [Braem *fide* Schröder].
Remarks: Apparently, *Plumatella fungosa* and *Alcyonella fugosa* are the same according to Kudo. The paper by Braem not seen. Authors before Schröder considered the hypertrophied host cell to be a "myxosporidium."

Nosema cacoeciae Weiser, 1956

Nosema cacoeciae Weiser, 1956, Z. Pflanzenkr. Pflanzenpathol. Pflanzenschutz, 63, 196. Weiser, 1961, Monogr. Angew. Entomol., 17, 84.

Host and Site: [LEPIDOPTERA] The European fir budworm *Cacoecia murinana* Hüb., larva; fat body.

Vegetative Stages: Schizonts roundish, 2-3.5 μm.

Sporulation Stages: Sporogony makes elongated stages with large double nuclei and these make spores.

Spore: Oval, with broadly rounded ends and a vacuole in the anterior end; 2-2.6 x 1.5 μm; binucleate.

Locality: Czechoslovakia (middle Slovakia).

Remarks: This briefly described species was said to be "eine typische *Nosema* mit meist nur zweikernigen Stadien."

Nosema cactoblastis Fantham, 1939

Nosema cactoblastis Fantham, 1939, Proc. Zool. Soc. Lond., 108, 692, Figs. 1-29, 43, 47-49. Weiser, 1961, Monogr. Angew. Entomol., 17, 83.

Host and Site: [LEPIDOPTERA] *Cactoblastis cactorum* Berg.; epithelium of midgut and Malpighian tubules, body fluids of larva, body fluids of pupa and in pupal case, unidentified contents of thorax and abdomen (especially) of adults.

Vegetative Stages: Merogony by binary and multiple fission.

Sporulation Stages: No reliable data.

Spore: Oval, 4-6 x 1.2-2.2 μm, binucleate.

Locality: South Africa.

Remarks: An unacceptable account of spore development like that in myxosporidia was given. All evidence indicates that this is a typical *Nosema*.

Nosema cactorum Fantham, 1939

Nosema cactorum Fantham, 1939, Proc. Zool. Soc. Lond., 108, 694, Figs. 30-42, 44, 46, 50-52. Weiser, 1961, Monogr. Angew. Entomol., 17, 84.

Host and Site: [LEPIDOPTERA] *Cactoblastis* sp.; epithelium of midgut and Malpighian tubules and body fluid of larva, body fluid of pupa and pupal case, unidentified contents of thorax and abdomen (especially) of adult.

Vegetative Stages: Merogony by binary or multiple fission.

Sporulation Stages: Sporogony results in binucleate sporoblasts.

Spore: Oval, 4.5-7.2 x 2-3.5 μm, binucleate.

Locality: South Africa.

Remarks: An unacceptable account of spore development like that in myxosporidia was given. All evidence indicates that this is a typical *Nosema*.

Nosema caeculiae Lutz & Splendore, 1904

Nosema caeculiae L. & S., 1904, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I, Orig., 36, 646, Fig. 16. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 85.

Nosema astyrae L. & S., 1903. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 81

Host and Site: [LEPIDOPTERA] *Caeculia* spp. (2); no other data.

Vegetative Stages: No data.

Sporulation Stages: No data.

Spore: Regularly elongate-ovoid, 5-6 x 2-2.5 µm, often with a vacuole.

Locality: Brazil (near São Paulo).

Remarks: This is a very poorly described species. Weiser treated it, for reasons not clear, as identical with *N. astyrae* L. & S., 1903. Perhaps some confusion can be avoided by listing it separately until we obtain further information.

Nosema campoletidis Brooks & Cranford, 1972

Nosema campoletidis B. & C., 1972, J. Invertebr. Pathol., 20, 77, Figs. 4-16. McNeil & Brooks, 1974, Entomophaga, 19, 195, Fig. 2.

Host and Site: [HYMENOPTERA] *Campoletis sonorensis (= C. peridistinctus)* [type host] and *Cactolaccus aeneoviridis* (Girault), all stages; generalized infection. *Spilochalcis side* (Walker), adult; midgut, development of microsporidian incomplete.

Vegetative Stages: Most forms have one diplocaryon. Some have two diplocarya and forms with four diplocarya rarely occurred.

Sporulation Stages: Sporogony apparently initiated by nuclear fusion. Sporoblast binucleate.

Spore: Ovocylindrical, 3.1-6.2 x 4-2.4 (av. 4.25 x 1.78) µm (fresh).

Locality: U.S.A. (North Carolina).

Nosema cannae Schwarz, 1929

Nosema cannae Schwarz, 1929, Z. Morphol. Oekol. Tiere, 13, 695, Fig. 7, Pl.8-Fig. 8. Weiser, 1961, Monogr. Angew. Entomol., 17, 83.

Host and Site: [LEPIDOPTERA] *Nonagria cannae,* larva; site not mentioned.

Vegetative Stages: Binucleate schizonts observed.

Sporulation Stages: No data.

Spore: Shows "typical structure," binucleate (?), substantially smaller than that of *N. nonagriae.*

Locality: Germany (Breslau).

Remarks: Although this is an incompletely described species, there is no reason to doubt that it is a *Nosema.*

Nosema cardiochilis Brooks & Cranford, 1972

Nosema cardiochilns B. & C., 1972, J. Invertebr. Pathol., 20, 86, Figs. 17-27.
Host and Site: [HYMENOPTERA] *Cardiochiles nigroceps*, all stages; infection generalized.
Vegetative Stages: Uninucleate schizonts common, binucleate forms (with diplocarya) predominant, tetranucleate forms common.
Sporulation Stages: Sporoblasts fusiform, solitary, binucleate.
Spore: Ovocylindrical, 3.6-6 x 1.4-2.4 μm (av. 4.78 x 1.75 μm) (fresh).
Locality: U.S.A. (North Carolina).

Nosema carpocapsae Paillot, 1938

Nosema carpocapsae Paillot, 1938, C. R. Soc. Biol., 127, 1138. Paillot, 1939, Ann. Epiphyt. Phytogenet., 5, 209, Figs. 1-9. Weiser, 1961, Monogr. Angew. Entomol., 17, 89, Fig. 41. Lipa, 1963, Pr. Nauk. Inst. Ochr. Rosl. Warsz., 5, 116, Figs. 1-13. Issi & Lipa, 1968, Acta Protozool., 6, 283, Pl. 1-Fig. 3.
Host and Site: [LEPIDOPTERA] The codling moth *Carpocapsa pomonella* L., larva; in silk glands, Malpighian tubules, fat cells, muscles, oenocytes, pericardial cells, epidermal cells, sex organs, gut. Also in *Carpocapsa pyrivora* Danil [I. & L.].
Lesion: Not remarkable. Nuclei of infected cells appear normal but cytoplasm vacuolated and more or less hypertrophied.
Vegetative Stages: Usually small round cells with 1 or 2 nuclei. Short chains of cells and multinucleate cells exceptional.
Sporulation Stages: Fusiform cells with 1 or 2 nuclei produce 1 or 2 binucleate sporoblasts and these transform into spores.
Spore: Ovoid, 4 x 2 μm, binucleate.
Locality: France (near Lyon). U.S.S.R. (Krasnodar Country).
Remarks: Paillot gave the same data in 1939 and, in addition, included figures.

Nosema cerasivoranae Thomson, 1960

Nosema cerasivoranae Thomson, 1960, Can. J. Zool., 38, 643, Fig. 1. Thomson, 1960, J. Insect Pathol., 2, 349. Weiser, 1961, Monogr. Angew. Entomol., 17, 89. Smirnoff, 1965, Ann. Entomol. Soc. Que., 10, 121, Fig. 1B & D. Amargier & Smirnoff, 1974, Entomophaga, 19, 136, Figs. 1, 2.
Host and Site: [LEPIDOPTERA] *Archips cerasivorand* (Fitch), larva; mainly in Malpighian tubules and silk glands but also in muscles, midgut, fat body, and epidermis. Experimental host: Spruce budworm *Chroistoneura fumiferana* (Clemens) [Smirnoff].
Vegetative Stages: Small meronts with paired nuclei undergo binary fission or small plasmodia with as many as 6 pairs of nuclei undergo multiple fission.
Sporulation Stages: "Sporonts [apparently sporoblasts] which arise from large binucleate schizonts" transform into spores [Thomson].

Spore: Elongated oval, 4.1 x 1.9 µm (av. of 50 spores in water).
Locality: Canada. Described from various parts of Ontario and later [Smirnoff] found near Plessisville, Québec.

Nosema cheisini Weiser, 1963

Nosema cheisini Weiser, 1963, Zool. Anz., 170, 228, Fig. 2i-l.
Host and Site: [DIPTERA-CHRIONOMIDAE] *Prodiamessa olivacea* and *Ablabechnia lentiginosa;* fat body.
Vegetative Stages: Uni- or binucleate schizonts, mostly oval or roundish with broad nuclei.
Sporulation Stages: Uninucleate sporonts, at first the same form and size as the schizonts (broad oval, 8-9 µm long) develop into sporoblasts (5 x 10 µm) with a broad nucleus in the center. Spores lie in masses but are always single.
Spore: Oval, 8.5-9 x 4 µm in life and 8 x 3-4 µm after fixation.
Locality: Czechoslovakia (near Bilek).
Remarks: Uninucleate sporulation stages are not characteristic of *Nosema*. Further study is needed to confirm the morphology of the parasite and the generic determination.

Nosema chironomi Lutz & Splendore, 1908

Nosema chironomi L. & S., 1908, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 46, 314, Fig. 35. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 87, Fig. 103. Weiser, 1961, Monogr. Angew. Entomol., 17, 117.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Chironomus* sp., larva; epithelium of hind gut.
Vegetative Stages: No data.
Sporulation Stages: Spores diffusely scattered.
Spore: Pyriform, 2-3 x 1.5-2 µm, with posterior vacuole.
Locality: Brazil.

Nosema ciliata (Mrázek, 1897) Kudo, 1924

Myxocystis ciliata Mrázek, 1897, Sitzungsber. Böhm. Ges. Wiss. Mathnaturwiss. Cl., 18, 4, Figs. 1-7. Mrázek, 1910, Arch. Protistenkd., 18, 245, text figs. 1-5, Pl. 14, Figs. 1 and 3.
Nosema ciliata (Mrázek, 1897) Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 78, Figs. 61-63.
Host and Site: [OLIGOCHAETA] *Limnodrilus claparedianus* R.; lymphocytes.
Lesion (xenoma): Infected lymphocyte spherical or ellipsoidal, 50-100 µm, often covered with fine projections. Host cell nuclei vary in number and form.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Oval, 4 µm long.
Locality: Czechoslovakia.

Remarks: Type species of *Myxocystis* by monotypy. Mrázek at first (1897) thought the cyst was the parasite but later (1910) decided it was the infected lymphocyte. Kudo then transferred the species to *Nosema* without giving reasons why it should go into this genus rather than some other. Whether it belongs in *Nosema* is quite uncertain but we do not have a compelling reason either to remove it from this genus or to assign it to another. It is interesting to note, however, that one of the possible alternatives to keeping it in *Nosema* is to restore *Myxocystis*.

Nosema coccinellae Lipa, 1968

Nosema coccinellae Lipa [*nomen nudum*] *in* Lipa & Semjanov, 1967, Entomol. Obozr., 46, 76, 79. Lipa, 1968, Acta Protozool., 5, 369, Figs. 1-8.
Host and Site: [COLEOPTERA] *Coccinella septempunctata* L., *Hippodamia tredecimpunctata* (L.), and *Myrrha octodecimguttata* (L.); midgut epithelium, Malpighian tubules, gonads, nerves, and muscles.
Vegetative Stages: Only uni- and binucleate forms seen.
Sporulation Stages: "Each sporont[?] gives rise to one spore that characterizes the genus *Nosema*" [Lipa (1968)].
Spore: Ellipsoidal, 4.4-6.7 x 2.3-3.4 µm (fresh). Polar filament up to 170 µm.
Locality: Poland (various localities); U.S.S.R. (Leningrad region).
Remarks: Although the paper by Lipa and Semjanov was in Russian, it does not appear that the taxon was properly established in 1967.

Nosema coliadis Jauch & Jauch, 1948

Nosema coliadis J. & J., 1948, An. Soc. Cient. Argent., 145, 307, Pls. 1-4. Weiser, 1961, Monogr. Angew. Entomol., 17, 91.
Host and Site: [LEPIDOPTERA] *Colias lesbia*, larva; epithelium of midgut.
Vegetative Stages: Small forms multiply by binary fission and produce sporonts.
Sporulation Stages: Sporont said to transform directly into a single spore.
Spore: Oval with equally rounded ends, 4.2-5.6 x 1.4-2.8 µm (fresh). The Feulgen method revealed two nuclei. Giemsa shows girdle-shaped sporoplasm. Polar filament 48 µm.
Locality: Argentia (near Buenos Aires and Santa Fe).

Nosema connori Sprague, 1974

Nosema sp. Margelith, Strano, Chandra, Neafie, Blum & McCully, 1973, Arch. Pathol., 95, 145, Figs. 1-10.
Nosema connori Sprague, 1974, Trans. Am. Microsc. Soc., 93, 400.

Host and Site: [MAMMALIA-PRIMATES] *Homo sapiens;* infection disseminated with involvement of myocardium, diaphram, liver, adrenals, gastrointestinal tract.
Development Stages: No data.
Spore: 4-4.5 x 2-2.5 μm, binucleate.
Locality: U.S.A. (Washington, D. C.).
Remarks: This species, excluded from the genus *Encephalitozoon* by the presence of a diplocaryotic spore, was kept provisionally in genus *Nosema.* It probably will have to be transferred to another genus after we have sufficient data.

Nosema cossi Schwarz, 1929

Nosema cossi Schwarz, 1929, Z. Morphol. Oekol. Tiere, 13, 697, Fig. 21, Pl. 8-Fig. 13. Weiser, 1961, Monogr. Angew. Entomol., 17, 83.
Host and Site: [LEPIDOPTERA] *Cossus cossus* L., larva; mainly in gut epithelium.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Appears almost round in sections, smaller than that of *N. nonagriae* but its structure is not substantially different.
Locality: Germany (Breslau).
Remarks: This is a very incompletely described species but there appears to be no reason to doubt the author's opinion that it is a species of *Nosema.*

Nosema crataeganae Weiser, 1961

Nosema crataeganae Weiser, 1961, Monogr. Angew. Entomol., 17, 88.
Host and Site: [LEPIDOPTERA] *Cacoecia crataegana* Hbn.; fat body.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Ovoidal, 4.5-5.3 x 2.8-3.2 μm.
Locality: Czechoslovakia (near Litovel).
Remarks: The report cited above may be the original description of the species, since it is not accompanied by a citation of previous literature. It is also not accompanied by an statement that the species is new or by a statement purporting to differentiate the taxon. The name may be a *nomen nudum.*

Nosema ctenocephali Kudo, 1924

Nosema pulicis Korke, 1916, Indian J. Med. Res., 3, 725, Figs. 1-73.
Nosema ctenocephali Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 105, Figs. 178-182. Thomson, 1960, J. Insect Pathol., 2, 349.
[*non*] *Nosema pulicis* Nöller, 1912, Berl. Klin. Woch., 49, 525 [*fide* Weiser, 1961, Monogr. Angew. Entomol., 17, 131].
Host and Site: [SIPHONAPTERA] "The dog flea *Ctenocephalus felis* [probably *C. canis*] collected from a half bred spaniel," larva; the entire digestive tract.
Lesion: Infected larvae dark and mottled.

Vegetative Stages: Uninucleate or binucleate amoebula seen at distal end of everted polar filament. The uninucleate amoebula is called the planont; it divides by binary fission. The mobile planont enters a host cell and becomes a meront. Merogony by binary and multiple fission.
Sporulation Stages: Thought to be as described by Stempell (1909) for *N. bombycis*.
Spore: Oval, up to 1.5 µm; polar filament 24 µ average.
Remarks: Weiser (1957, 1961) treated this species as identical with *Nosema pulicis* Nöller. However, Kudo (1924) has given convincing reasons for temporarily considering these two species distinct.

Nosema culicis Bresslau, 1919

Nosema culicis Bresslau *in* Bresslau & Buschkiel, 1919, Biol. Zentralbl., 39, 327, Fig. 1. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 107, Fig. 187. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 36. Kudo, 1960, AIBS (Am. Inst. Biol. Sci.) Tech. Rep., p. 51. Canning & Hulls, 1970, J. Protozool., 17, 537.
Host: [DIPTERA-CULICIDAE] *Culex pipiens*, larva.
Developmental Stages: No data.
Spore: In smear preparation 4.5-5.5 x 1.8-2.4 µm, one end truncate and the other broadly rounded.
Locality: Germany.
Remarks: The truncate end of the spore is puzzling. This condition suggests the spore shape seen in *Parathelohania*, known only in *Anopheles* spp.

Nosema cuneatum Henry, 1971

Nosema cuneatum Henry, 1971, J. Invertebr. Pathol., 17, 164, Figs. 1-19.
Host and Site: [ORTHOPTERA] The grasshopper *Melanoplus confusus*; in pericardium, fat body, gonads, tracheal matrix, midgut epithelium, Malpighian tubules, and neural tissues. Transmitted experimentally in *M. sanguinipes*, *M. bivittatus*, *M. femurrubrum*, *M. differentialis*, *M. infantilis*, and *Schistocerca americana*.
Vegetative Stages: Uninucleate, binucleate, and quadrinucleate schizonts observed. These eventually give rise to diplocarya.
Sporulation Stages: Diplocarya transform directly into binucleate sporonts. Sporont divides into two binucleate sporoblasts and these transform into spores.
Spore: Oval to cuneate, 4.8 x 3.4 µm (fresh). Megaspores common, 6.5 x 5.0 µm. Polar filament as much as 110 µm; those of megaspores as much as 225 µm.
Locality: U.S.A. (vicinity of Bozeman, Montana).

Nosema curvidentis Weiser, 1961

Nosema curvidentis Weiser, 1961, J. Insect Pathol., 3, 325, Figs. 1-3. Weiser, 1961, Monogr. Angew. Entomol., 17, 69.

Host and Site: [COLEOPTERA] The bark beetle *Pityocteines curvidens*, adult; fat body and, in some cases, connective tissue.

Vegetative Stages: "Round stages containing 2 to 4 nuclei during first schizogony and very short uni- or binucleated ovoidal stages of the second schizogony. From binucleated schizonts (diplokarya) uninucleated sporonts are formed."

Sporulation Stages: From the sporont spores are formed.

Spore: Elongated ovoid, sometimes slightly reniform, with broad ends; 2.5-3.6 x 1.5-1.8 µm (life), most spores 2.5 x 1.5 µm; binucleate.

Locality: Czechoslovakia (near Banska Stiavnica).

Remarks: In 1968, Weiser saw a "microsporidian, probably identical with *Nosema curvidentis*" in *Scolytus scolytus* but this more likely was *N. scolyti* Lipa, 1968.

Nosema cynaea Krall, 1951

Nosema cynaea Krall [*nomen nudum*], 1951, Iowa State J. Sci., 25, 276-277.

Host and Site: [COLEOPTERA] *Cynaeus angustus* Lec., larva, pupa, adult; mostly in fat body and hemocytes but also in germaria of adult females.

Lesion: Macroscopic signs of infection were a milky-white opacity, black spots and distortion of the integument. The nuclei of infected host cells "became distorted, eccentric and assumed a shapeless mass."

Developmental Stages: No data.

Spore: No data.

Locality: U.S.A. (Iowa).

Remarks: The paper by Krall seems to be an extract from a thesis in which more details were probably given.

Nosema dendroctoni Weiser, 1970

Nosema dendroctoni Weiser, 1970, J. Invertebr. Pathol., 16, 436, Fig. 2C and D.

Host and Site: [COLEOPTERA] The Douglas fir beetle *Dendroctonus pseudotsugae*, larva and adult; Malpighian tubules, fat body, and some muscles.

Vegetative Stages: Schizonts with 1 or 2 nuclei and merozoites with 1 nucleus occur.

Sporulation Stages: No data.

Spores: Oval to reinform, 2-3 x 1-2 µm (av. 2.7 x 1.4 µm); uninucleate.

Locality: Canada (Haney).

Remarks: The uninucleate condition of the spore needs confirmation, since *Nosema* has binucleate spores.

Nosema destructor Steinhaus & Hughes, 1949

"Microsporidian" Allen & Brunson, 1945, J. Econ. Entomol., 38, 393. McCoy, 1947, J. N. Y. Entomol. Soc. 55, 51.
Nosema sp. Allen & Brunson, 1947, Science (Wash. D. C.), 105, 394. Abdel-Malek & Steinhaus, 1948, J. Parasitol., 34, 452. Allen, 1954, Ann. Entomol. Soc. Am., 47, 407.
Nosema destructor S. & H., 1949, J. Parasitol., 35, 67, Fig. 1. Weiser, 1961, Monogr. Angew. Entomol., 17, 82.
Host and Site: [LEPIDOPTERA] The potato tuberworm *Gnorimoschema operculella* (Zeller) [S. & H.]; all stages [Allen (1954)]. In the tuberworm larvae, spores have been found in hemolymph, silk gland, Malpighian tubules, midgut, muscle [Allen (1954)]. Fortuitously in *Macrocentrus ancylivorus* Rohwer [HYMENOPTERA], parasite of the potato tuberworm [McCoy]. In the following insects experimentally; *Colias philodice eurytheme* Bdvl., *Phryganidia californica* Pack., *Danaus plexippus* Linn., *Laphygma exigua* Hbn., *Perisierola emigrata* Roh., *Cremastus flavoorbitalis* Cameron, *Pieris rapae* (Linn.), *Carpocapsa pomonella.*
Vegetative Stages: Binary, rarely multiple, fission of stages with paired nuclei.
Sporulation Stages: Most sporonts seen were binucleate. Rare tetranucleate forms, presumed to indicate occurrence of division to produce 2 sporoblasts, were seen.
Spore: Elliptical (according to figures); 3.00-4.75 x 2.25-3.00 µm (av. 4.0 x 2.8 µm); macrospores 6.00 x 2.81 µm; binucleate.
Locality: U.S.A. (New Jersey, California).

Nosema diplostomi Shigina & Grobov, 1972

Nosema diplostomi S. & G. [*nomen nudum*], 1971, Shigina, 1971, Works K. I. Skryabinia Inst. Helminthol., 18, 289. Shigina, 1971, Proc. Congr. Vet. Students, Moscow, 1971, 56.
Nosema diplostomi S. & G., 1972, Parasitology, 6, 469, Figs. 1-3. Shigina, 1972, Bull. K. I. Skryabina Inst. Helminthol., 7, 59-61. Shigina, 1972, *ibid.*, 8, 75.
Host and Site: [TREMATODA] *Diplostomum spathaceum;* metacerariae in the crystalline lens of several species of fish.
Spore: 3.5 x 1.8 µm.
Locality: U.S.S.R.
Remarks: Shigina apparently anticipated that the description of the species would appear in print before his papers in 1971, thus he employed the name as *nomen nudum.* This species is annotated only very briefly here because the relevant literature is in Russian. It is noteworthy that when the authors described this species they summarized in tabular form all the species of *Nosema* reported in trematodes.

Nosema disstriae (Thomson, 1959) Nordin & Maddox, 1974

Perezia disstriae Thomson, 1959, Can. J. Zool., 37, 221, Fig. 1

Glugea disstriae (Thomson, 1959) Thomson, 1960, J. Insect Pathol., 2, 354, Sohi, 1971, SIP (Soc. Invertebr. Pathol.) Newsl., 3, 23. Sohi & Wilson, 1971, *ibid*., 23.
Nosema disstriae (Thomson, 1959) N. & M., 1974, J. Invertebr. Pathol., 24, 2.
Host and Site: [LEPIDOPTERA] The forest tent caterpillar, *Malacosoma disstria* Hbn., larva; primarily in silk glands and midgut epithelium; light infections also in basement membrane of gut, Malpighian tubules, epidermis, fat body, and tracheae.
Vegetative Stages: The earliest stage was a small schizont, about 1.5 μm, with a large diplocaryon. Reproduction by binary (usually) or multiple fission, always resulting in binucleate merozoites. No uninucleate stages seen.
Sporulation Stages: A binucleate sporont divides into 2 binucleate sporoblasts. Sometimes a diplocaryon divides during sporogony to give 4 nuclei in a sporoblast. "Apparently, the nuclei fuse, as the mature spore contains only a single, indistinctly shaped nucleus" [Thomson (1959)].
Spore: Ellipsoidal [according to figures], 4-5 x 2 μm (living). [Probably binucleate, although the nuclei were thought to fuse.]
Remarks: Thomson (1960) incorrectly attributed the name combination *Glugea disstriae* to Weiser, 1958. In that year, Weiser declared that *Perezia* Léger & Duboscq, 1909, is a junior synonym of *Glugea* Thélohan, 1891, without mentioning any species. Therefore, Weiser can be held responsible only for transferring the type species of *Perezia* to the Genus *Glugea*. Thomson (1960) was actually responsible for the change that he attributed to Weiser, for he first used the new combination. The present species is clearly a species of *Nosema*, not *Glugea*. Sohi (1971) grew this species in hemocyte cultures of the host, demonstrating "for the first time the propagation of an insect microsporidian in an established insect cell line." Nordin and Maddox attributed the name combination *Nosema disstriae* to Weiser (1961) but I am unable to find this name in Weiser's monograph. Nordin and Maddox were unable to distinguish this from 8 other species of *Nosema*, including *N. bombycis*, in Lepidoptera. Perhaps all these species are identical, in which case they would all take the oldest name, *N. bombycis* Naegeli, 1857.

Nosema dollfusi Sprague, 1964

Nosema dollfusi Sprague, 1964, J. Protozool., 11, 381, Figs. 1-19.
Host and Site: [TREMATODA] *Bucephalus cuculus* McCrady, sporocysts in *Crassostrea virginica* (Gmelin); parenchyma and germ balls.
Vegetative Stages: Data very incomplete. Apparently, stages with double(?) nuclei undergo binary fission.
Sporulation Stages: Sporogony not observed. Sporoblasts with double nuclei transform into spores.

Spore: Elongate-ovoidal, about 3 x 1.7 μm (stained), binucleate; polar cap eccentric.
Locality: U.S.A. (Maryland).

Nosema echinostomi Brumpt, 1922

Nosema echinostomi Brumpt, 1922, "Précis de Parasitologie," p. 336. Dollfus, 1946, *in* "Parasites (animaux et vegetaux) des Helminthes" (P. Lechevalier, ed.), p. 26. Voronin, 1974, Parasitologiya (Leningr.), 8, 359-364, Figs. 23-26.
Microsporidium echinostomi (Brumpt, 1922) Canning, 1975, C I H Misc. Publ., 2, 12.
Host and Site: [TREMATODA] Hyperparasite of echinostome rediae, cerceriae and metacercariae in the snail *Lymnaea limosa* L. [Brumpt].
Lesion: Infected rediae lost their normal yellow color and became white.
Vegetative and Sporulation Stages: No data.
Spore: Ellipsoidal, 5 μm long [Dollfus]. Binucleate, 4.3-5.2 x 2.6-3.0 (av. 4.7 x 2.8) μm when fresh and 3.9-4.4 x 2.7-3.0 (av. 4.2 x 2.8) μm after Giemsa staining [Voronin].
Locality: France (near Paris). U.S.S.R. (Moscow).
Remarks: Named without description by Brumpt and briefly described by Dollfus from data supplied by Brumpt. The original description gave no data in support of the generic determination but the data by Voronin, particularly the binucleate condition of the spore, tend to support it.

Nosema ephialtis Lutz & Splendore, 1908

Nosema ephialtis L. & S., 1908, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 46, 315, Fig. 31(?). Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 88, Fig. 104.
Nosema astyrae L. & S., 1903, Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 81.
Host and Site: [LEPIDOPTERA] *Ephialtis angulosa*, imago; site not mentioned by spore said to be diffusely distributed.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Ovoid and ovocylindrical, without clear vacuole, 3.5-5.5 x about 2 μm.
Locality: Brazil (Petropolis).
Remarks: Like all the species reported by Lutz and Splendore, this was poorly described. Weiser, for reasons not clear, treated this as identical with *N. astyrae* L. & S., 1903. I think it would be less confusing to keep it distinct until we have more information.

Nosema erippi L. & S., 1903

Nosema erippi L. & S., 1903, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I, Orig., 33, 155, Fig. 7. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 85, Fig. 95. Weiser, 1961, Monogr. Angew. Entomol., 17, 81.

Host and Site: [LEPIDOPTERA] *Danais erippus* L. and *D. gilippus* L., larva; site not mentioned.

Vegetative Stages: No data.

Sporulation Stages: No data.

Spore: Polymorphic, irregularly egg-shaped or cylindrical, 3-3.5 x 1.5-2.5 µm.

Locality: Brazil (near São Paulo).

Remarks: This species was so poorly described that its validity cannot be judged. Weiser synonomized several species with this one for reasons not stated. I feel it would be less confusing to keep it separate until we have more information.

Nosema eubules L. & S., 1903

Nosema eubules L. & S., 1903, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I, Orig., 33, 155, Fig. 12. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 84, Fig. 93.

Nosema heliothidis L. & S., 1904, Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 78.

Host and Site: [LEPIDOPTERA] *Catopsilia eubule*, adult; site not mentioned.

Vegetative Stages: No data.

Sporulation Stages: No data.

Spore: Polymorphic, ovoidal, cylindrical, pyriform, 2-5 x 1-2.5 µm.

Locality: Brazil (near São Paulo).

Remarks: This species was so poorly described that its validity cannot be judged. Weiser treated it as a junior synonym of *Nosema helothidis* L. & S., 1904, for which he mistakenly gave the date 1903. If these two names are synonyms, we must keep the older name, *N. eubules*. I think confusion can be avoided by keeping these species separate until we learn more about *N. eubules*.

Nosema eurytremae Canning, 1972

Glugea sp. or *Perezia* sp. Canning & Basch, 1965, Excerpta Med. Int. Congr. Ser., 91, 71.

Perezia helminthorum Canning & Basch, 1968, Parasitology, 58, 341, Figs. 1-11. Lie & Basch, 1970, South-East Asia J. Trop. Med. Publ. Hlth., 1, 419. Basch, 1971, *ibid.*, 2 381, Figs. 1-7.

Nosema eurytremae Canning, 1972, J. Invertebr. Pathol., 20, 371. Lie & Nasemary, 1973, Z. Parasitenkd., 41, 109, Figs. 1-2. Canning, Lai & Lie, 1974. J. Protozool., 21, 20, Fig. 28. Colley, Lie, Zaman & Canning, 1975, J. Invertebr. Pathol., 26, 11, Figs. 1-29.

Host and Site: [TREMATODA] *Eurytrema pancreaticum* Janson, sporocysts (in wall) and cercariae in the land snail *Bradybaena similaris* Ferussac, metacercariae in the grasshopper *Concephalus maculatus; Postharmostomum gallinum* Wittenberg, sporocysts, cercariae and metacercariae (in parenchyma) in the snail [C. & B.(1968)]. *Trichobilharzia brevis* Basch, *Schistosoma spindale* Montgomery, "various species of trematode larvae producing paramphistomid xiphidio-cercariae" and (experimental) in *Fasciola gigantea* Cobbold, all in freshwater snails [L. & B.]. (Experimental) *Fasciola hepatica* rediae in the freshwater snail *Lymnaea truncatula* [C., L. & L.]. Rediae of *Echinostoma malayanum* Leiper, larvae of *Echinoparyphium dunni* Lie & Umathevy, (experimental) larvae of *Echinostoma audyi* and *E. ilocanum* [L. & N.]. [OLIGOCHAETA] *Chaetogaster* sp. [L. & B.]. [MOLLUSCA] *Indoplanorbis exustus* (Deshayes) [Basch]. [DIPTERA-CULICADAE] (experimental) Larvae of *Aedes aegypti, A. albopictus,* and *A. togoi* [L. & N.].

Vegetative Stages: "Division of binucleate or tetranucleate round schizonts 6 μm or 2.5 μm in diameter. Nuclear division immediately restores the paired nuclear condition"[C. & B.].

Sporulation Stages: "Spindle-shaped sporonts 7.8 μm x 1.5 μm. Sporoblasts 4 μm x 1.5 μm" [C. & B.]. Disporous.

Spore: 3.5 x 2 μm fresh, ovoid, without clear vacuole when fresh, binucleate. Polar filament up to 75 μm.

Locality: West Malaysia.

Remarks: When Canning transferred this species to the Genus *Nosema,* it was necessary to create a new specific name to avoid creating a homonym of *Nosema helminthorum* Moniez, 1887.

Nosema exigua Codreanu, 1957

Nosema exigua Codreanu, 1957, Ann. Sci. Nat. Zool., 19, 561, Figs. 1h, 2a and b.

Host and Site: [PHYLLOPODA] The brine shrimp *Artemia salina* (L.); intestinal epithelium.

Vegetative Stages: Schizonts have feeble power of multiplication, being limited to a few intestinal cells.

Sporulation Stages: Spores develop in isolation in minute cytoplasmic alveoli toward the apical pole of the digestive cell.

Spore: Slightly refringent, irregularly ovoid, 2.6-3.2 μm long, with a large posterior vacuole (fresh). After iron hematoxylin, there is a black equatorial region and a large clear space at either pole. After the Feulgen reaction, a red nucleus, sometimes double, appears in the center.

Locality: Roumania (Tékirghiol).

Remarks: There is no appreciable hypertrophy of the host cell.

Nosema frenzelinae Léger & Duboscq, 1909

Nosema frenzelinae L. & D., 1909, C. R. Acad. Sci., 148, 733. Léger & Duboscq, 1909, Arch. Protistenkd., 17, 118, Figs. 32, 33. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 89, Figs. 107-113.

Host and Site: [GREGARINIDA] Hyperparasite of *Cephaloidophora conformis* (Diesing) in the crab *Pachygrapsus marmoratus* Fabricius, in cytoplasm.

Vegetative Stages: Small, uninucleate stages multiply by binary fission and form colonies in the host gregarine.

Sporulation Stages: At the end of the development (fission period) each element becomes the starting point for a spore. Isolated spores produced.

Spore: Average length, 2.8 µm. Polar filament, 25 µm.

Locality: France (at Cavaliere on the Mediterranean coast).

Remarks: The name was published twice in 1909 as new, first(?) in *C. R. Acad. Sci.* and later(?) in *Arch. Protistenkd.* Several "nuclei" were observed in the spore (as in mysoxporidian spores) but these can not all be accepted as nuclei. This species was said to be "monosporous" while *Perezia lankesteriae* was said to be "disporous." In both cases, each of two cells resulting from a final binary fission developed into a spore. The only discernible difference between "monosporous" and "disporous," as represented in these species, is that in the one case the two sporoblasts separated early and developed in isolation, while in the other case they remained together and developed in pairs until they were almost mature. According to modern condepts, both of these species are "disporous."

Nosema fumiferanae (Thomson, 1955) Wilson, 1972

Perezia fumiferanae Thomson, 1955, J. Parasitol., 41, 416, Pls. 1, 2. Thomson, 1958, Can. Entomol., 90, 694, Figs. 1-4. Thomson, 1958, Can. J. Zool., 36, 499. Thomson, 1959, Can. J. Zool., 37, 217, Figs. 1-3.

Glugea fumiferanae (Thomson, 1955) Thomson, 1960, J. Insect Pathol., 2, 354. Weiser, 1960, Monogr. Angew. Entomol., 17, 91. Ishihara, 1967, Can. J. Microbiol., 13, 1321, Figs. 1-5.

Nosema fumiferanae (Thomson, 1955) Wilson, 1972, Thesis, Cornell Univ. [*fide* Percy, 1973, Can. J. Zool., 51, 554]. Percy, 1973 *ibid.*, 553, Figs. 1-7. Nordin & Maddox, 1974, J. Invertebr. Pathol., 24, 3. Wilson, 1974, Can. J. Zool., 52, 993.

Nosema (Perezia) fumiferanae (Thomson, 1955) Wilson, 1974, *ibid.*, 59.

Host and Site: [LEPIDOPTERA] *Choristoneura fumiferana* (Clem.), larva; midgut principally but also fat body, silk gland, epidermis, gonad, hindgut, and nerve tissue. *Choristoneura pinus* Free [Thomson (1959)]. Experimentally in *Archipes cerasivorana* and *A. fervidana* [Thomson (1960)].

Vegetative Stages: All forms have 2 or more nuclei. The most common method of multiplication is binary fission. Sometimes short chains form. Multiple fission or budding of small plasmodia with as many as 12 paired nuclei occurs.
Sporulation Stages: Elongated sporont divides into 2 binucleate sporoblasts which transform into spore.
Spore: Variable in shape, usually with straight sides but sometimes curved or ovoid. Size when living, 3-5 x 2 μm. Polar filament 65-105 μm.
Locality: Canada (Ontaria).
Remarks: Nordin and Maddox could not distinguish this from 8 other species of *Nosema* in Lepidoptera. These included *N. bombycis*, type species. Thus, this may be *N. bombycis*.

Nosema gammari Ryckeghem, 1930

[?] *Nosema* sp. Goodrich, 1928, Q. J. Microsc. Sci., 72, 327.
Nosema(?) gammari Ryckeghem, 1930, Cellule, 39, 411, Fig. 21.
Host and Site: [AMPHIPODA] *Gammarus pulex* L.; tissues around and between muscles and sometimes the periphery of the muscles.
Vegetative Stages: No data.
Sporulation Stages: Spores not seen in any regular arrangement.
Spore: As seen in sections, oval, 1.5 x 3.4 μm, with a large and a small vacuole.
Locality: Belgium (Louvaine).
Remarks: It is impossible to judge whether this is a *Nosema*, but there is no evident reason to exclude it from this genus.

Nosema gasti (McLaughlin, 1969) Streett, Sprague & Harman, 1975

Plistophora sp. Ignoffo & Garcia, 1965, J. Invertebr. Pathol., 7, 262.
Nosema sp. McLaughlin, 1966, J. Econ. Entomol., 59, 401.
"microsporidian" McLaughlin, Daum & Bell, 1968, J. Invertebr. Pathol., 12, 168.
Glugea gasti McLaughlin, 1969, J. Protozool., 16, 84, Figs. 1-33. McLaughlin, Cleveland, Daum & Bell, 1969, J. Invertebr. Pathol., 13, 429. McLaughlin & Bell, 1970, *ibid.*, 16, 84. Bell & McGovern, 1975, *ibid.*, 25, 133.
Nosema gasti (McLaughlin, 1969) Streett, Sprague & Harman, 1975, Chesapeake Sci., 16, 32, Figs. 1, 2.
Host and Site: [COLEOPTERA] The boll weevil *Anthonomus grandis* Boheman, larva and adult; infection first in midgut and later generalized. Experimental hosts: [LEPIDOPTERA] *Pectinophora gossypiella* (Sanders); *Heliothis zea* (Boddie), larva; *H. virescens* (F.), larva [McLaughlin (1969)]. [HYMENOPTERA] *Bracon mellitor* [B. & M.].

Vegetative Stages: Emerged sporoplasm binucleate. It enters a first schizogony by dividing into uninucleate forms. This type of fission repeats. In a second schizogony, tetranucleate (rarely octonucleate) forms divide into binucleate forms. The final stage, a diplocaryon cell.
Sporulation Stages: Nuclei of a diplocaryon fuse and then undergo 2 divisions. One cytoplasmic division produces 2 binucleate sporoblasts which transform into spores.
Spore: Ovoidal or bean-shaped, 4.16 x 2.29 μm, average, in larvae and 4.34 x 2.3 μm, average, in adults (fresh).
Locality: U.S.A. (laboratory stocks of insects from Texas and different localities in Mexico).

Nosema gastroideae Houstounský & Weiser, 1973

Nosema gastroideae H. & W., 1973, Acta. Entomol. Bohemoslav., 70, 345, Fig. 1 + 2 pls.
Host and Site: [COLEOPTERA] *Gastroidea polygoni,* all stages; in most tissues, the striated muscles being favored. Experimental host *Leptinotarsa decemlineata.*
Vegetative Stages: Mostly uninucleate. Binucleate forms divide into uninucleate merozoites. The latter develop into ribbon-like forms with two or more nuclei. Each nucleus divides into a diplocaryon. The elongated stage divides to produce uninucleated sporonts.
Sporulation Stages: The uninucleated "sporonts" mature into spores.
Spore: Broad-oval, 3.0-4.8 x 2.5-3 μm (av. 3.8 x 2.8 μm), uninucleate. Polar filament 25-30 μm.
Locality: Czechoslovakia (Hostivice).
Remarks: The uninucleate condition of the sporulation stages is not characteristic of *Nosema.* Possibly suitable methods would reveal a binucleate condition.

Nosema gibbsi (Thomson, 1960) Weiser, 1961

Perezia sp. Gibbs, 1956, Parasitology, 46, 48, Figs. 1-15.
Glugea gibbsi Thomson, 1960, J. Insect Pathol., 2, 354.
Nosema gibbsi (Thomson, 1960) Weiser, 1961, Monogr. Angew. Entomol., 17, 70.
Host and Site: [COLEOPTERA] *Gonocephalum arenarium,* adult; fat body.
Vegetative Stages: Merogony by binary fission. Early uninucleate forms 2.5 μm. Binucleate and quadrinucleate forms very common. "Meronts increase in size until they measure about 4.2 μ in diameter (dry fixed) and become pansporoblasts" [Gibbs].
Sporulation Stages: The "pansporoblast" undergoes nuclear division and produces 2 binucleate sporoblasts which separate to form 2 binucleate spores.

Spore: Gibbs did not give the size and shape of the spore but Weiser judged from the figures that they are egg-shaped and 3-4 x 2 µm. Polar filament up to 100 µm. When the filament everts a binucleate sporoplasm appears at its end.
Locality: South Africa.
Remarks: The author shows a quadrinucleate stage during the transformation of sporoblast into spore but it is highly probable that no such stage occurs in this part of the cycle. This study by Gibbs is one of the first to reveal a modern concept of the function of the polar filament. Both Thomson and Weiser employed a method of citation which incorrectly indicated that Gibbs was author of the specific name.

Nosema glossiphoniae Schröder, 1914

Nosema glossiphoniae Schröder, 1914, Zool. Anz., 43, 322, Fig. 3. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 103, Figs. 154-157.
Host and Site: [HIRUDINEA] The leech *Glossiphonia complanata* L.; muscle cells.
Lesion: A particular spot in the posterior region of the body had a white appearance. Infected cells appeared as tubes filled with spores.
Vegetative Stages: No data.
Sporulation Stages: Only spores seen.
Spore: Ellipsoidal, usually 4 x 2.5 µm, sometimes 6 x 3 µm, binucleate.
Locality: Germany (Heidelberg).

Nosema halesidotidis Lutz & Splendore, 1904

Nosema halestidotidis L. & S., 1904, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I, Orig., 36, 645, 648, Fig. 15. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 85.
Nosema erippi L. & S., 1903, Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 81.
Host and Site: [LEPIDOPTERA] *Halesidotis* sp.; site not mentioned.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Said to be similar to that of *N. lophocampae*. Figures show ovoid spores that are, according to calculations, about 5 x 2.5 µm.
Locality: Brazil (near São Paulo).
Remarks: This is a very poorly described species. Weiser, for reasons not clear, treated this as a synonym of *N. erippi* L. & S., 1903, but confusion might be avoided by treating it as a separate species until we get more information.

Nosema heliothidis L. & S., 1904

Nosema heliotidis L. & S., 1904, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I, Orig., 36, 645. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 85.

Nosema armigerae L. & S., 1904, *ibid.*, 648, Fig. 14.
Nosema heliothidis L. & S., 1904. Kramer, 1959, J. Insect Pathol., 1, 297, Figs. 1-18. Thomson, 1960, *ibid.*, 2, 349. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 78. Lipa, 1968, Pol. Pismo Entomol., 38, 612, Figs. 1, 2, 13-15. Lipa, 1968, Acta Protozool., 6, 273, Figs. 1-12. Brooks, 1968, J. Invertebr. Pathol., 11, 511, Figs. 1-14. Brooks, 1969, SIP (Soc. Invertebr. Pathol.) Newsl., 2, 26. Lom & Weiser, 1972, Folia Parasitol. (Prague), 19, 361, Pl. 3, Fig. 3. Brooks & Cranford, 1972, J. Invertebr. Pathol., 20, 80, Figs. 1-3. Brooks, 1973, Misc. Publ. Entomol. Soc. Amer., 9, 105, Figs. 1-3. McNeil & Brooks, 1974, Entomophaga, 19, 195, Fig. 1. Gaugler & Brooks, 1975, J. Invertebr. Pathol., 26, 57.
Host and Site: [LEPIDOPTERA] *Heliothis armigera* (Hübner) = *H. zea* (Boddie), larva [L. & S.]. *Heliothis virescens* (Fabricius), imago; gut [Kramer]. General infection; midgut epithelium, trachael matirx, salivary glands, muscles, fat body, hypodermis, hemocytes, gonads [Lipa]. Also Malpighian tubules and eggs of *Heliothis virescens* [Brooks (1969)]. [HYMENOPTERA] *Campoletis sonorensis*, larval stages parasitic on *Heliothis zea* [Brooks (1973)].
Lesion: The parasite strikingly destructive to host tissue. Midgut epithelium and salivary gland completely destroyed [Lipa].
Vegetative stages: Binucleate and tetranucleate forms, undergoing binary fission to produce binucleate forms, were seen.
Sporulation Stages: Some products of schizogony are binucleate sporoblasts that develop into spores [Kramer].
Spore: Elongate-ovoid, 2.5-5.5 x 1.7-2 µm [L. & S.]. Ovoidal, 2.5-5.5 x 2.0-3.5 µm, typically 4.5-5.5 x 3.0-5.5 µm (stained) [Kramer]. Dimensions 2.8-5.0 x 2.0-3.0 µm (stained) and 3.3-6.0 x 2.5-3.5 µm (fresh) [Lipa]. In *Heliothis zea* from North Carolina, spores were 3.30-4.85 x 1.70-2.55 µm; in the same host from Georgia, they were 2.85-6.55 x 1.25-2.75 µm [Brooks (1968)]. Larger in the hymenopterous host than in the lepidopteran host [Brooks (1973)].
Locality: Brazil and U.S.A. (widespread).

Nosema helminthorum Moniez, 1887

Nosema helminthorum Moniez, 1887, C. R. Acad. Sci., 104, 1312. Dissanaike, 1955, Nature (Lond.), 175, 1002, Fig. 1. Dissanaike, 1955, Trans. R. Soc. Trop. Med. Hyg., 49, 294. Dissanaike, 1957, J. Helminthol., 31, 47. Dissanaike, 1957, Parasitology, 47, 335, Figs. 1-39. Dissanaike, 1958, Exp. Parasitol., 7, 306. Shigina, 1972, Bull. K. I. Skryabina Inst. Helminthol., 8, 73.
Plistophora helminthophthora (Keferstein, 1861) Labbé [*partim*], 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 111.

Gen. incert. *helminthophthorum* (Keferstein, 1862) Kudo [*partim*], 1924, Ill. Biol. Monogr., 9(2/3), 196.
Nosema bischoffi Weiser, 1951, Věstn. Česk. Spol. Zool., 15, 80, Fig. 1.
Host and Site: [CESTODA] Hyperparasite of the cestodes *Moniezia expansa* (Rudolphi), *M. benedeni* (Moniez) in sheep, *Monezia* sp, in buffalo, *Hymenolepis bacillaris* [Dissanaike (1957)]; in parenchyma, genital organs and ovules [Labbé]. Experimental infections of *Hymenolepis nana* in rats and mice, *Taenia saginata* in man and [ARACHNIDA] oribatid mites *Ceratoppia bipilis* and *Xenillus tegeocranus*, the last two in midgut and ceca [Dissanaike (1958)].
Lesion: Irregularly scattered white spots, 0.5-3.0 mm, resembling mould [Weiser].
Vegetative Stages: A first phase schizogony involves binary fission and multiple fission of spherical or cylindrical plasmodia, all with rather large and unpaired nuclei. A secondary schizogony involves fusiform schizonts that form chains of diplokaryotic cells [Dissanaike (1957)].
Sporulation Stages: Some cells of the secondary schizogony, called "sporonts" (sporoblasts) transform into spores. Autogamy thought to occur at some stage [Dissanaike (1957)].
Spore: Egg-shaped, when fresh, 5.81-6.8 x 3.25 μm (av. 6.25 x 3.5 μm), with posterior vacuole. Smaller when crowded, being 5.25 x 3.2 μm in two different worms. Double spores, with posterior ends joined together, sometimes seen [Dissanaike (1957)].
Locality: Germany [Moniez], France [Labbé], England and Pakistan [Dissanaike], Jugoslavia [Weiser], and U.S.S.R. [Shigina].
Remarks: According to Jones, 1943, *Mucor helminthophthorus* Keferstein, 1861, (transferred to *Plistophora* by Labbé, 1899) is actually a fungus.

Nosema herpobdellae Conent, 1931

Nosema herbobdellae Conent, 1931, Ann. Soc. Sci. Bruxelles, 51, 170.
Host and Site: [HIRUDINEA] The leech *Herpobdella octoculata* L.; connective tissue in region of digestive tube.
Lesion: Large white, several millimeters in diameter, were contained ordinarily in the posterior two-thirds of the body.
Vegetative Stages: Many stages, such as diplocarya and copulae, were seen but not described.
Sporulation Stages: No specific data. Spores not grouped in masses.
Spore: Oval, with vacuole in each end, 6 x 3 μm average, rarely 10 x 3.5-4 μm.
Locality: Belgium (Louvaine).

Remarks: The only basis for assigning this species to the Genus *Nosema* was that the spores were never united in groups. That assignment needs confirmation.

Nosema heterosporum Kellen & Lindegren, 1969

Nosema heterosporum K. & L., 1969, J. Invertebr. Pathol., 14, 329, Figs. 1-83.

Host and Site: [LEPIDOPTERA] The Indian meal moth *Plodia interpunctella* (Hübner), all stages; primarily wall of midgut and fat body but also silk and salivary glands and muscle. Transmitted experimentally to *Galleria mellonella* and *Paramyelois transitella*.

Vegetative Stages: Schizonts small uninucleate forms or spherical plasmodia with 16 nuclei or "chain schizonts" with 4-10 nuclei.

Sporulation Stages: Figures show fusiform sporonts with 1-2 nuclei or "aberrant" forms with as many as 8 nuclei.

Spore: [Elliptical, cylindrical, fusiform] 5.46 x 1.99 μm (fresh). 4.95 x 2.08 μm (Giemsa). Macrospores as much as 16 x 3.5 μm. Figures of Feulgen preparations show a pair of nuclei in a "typical spore" and 2 pairs in a macrospore. Extruded sporoplasm binucleate.

Locality: U.S.A. (Sacramento, California).

Nosema hippodamiae Lipa & Steinhaus, 1959

Nosema hippodamiae L. & S., 1959, J. Insect Pathol., 1, 304, Figs. 1-11.

Host and Site: [COLEOPTERA] The convergent ladybird beetle *Hypodamia convergens* Guérin, pupa and adult; primarily in midgut and fat body but in other tissues when infeciton is heavy.

Vegetative Stages: Schizogony is represented by paucinucleate stages and ends in diplocarya.

Sporulation Stages: The diplocarya go into sporogony.

Spore: Ovoid, 3.3-5.4 x 2.2-2.7 μm, mostly 3.8-4.4 μm long; show a nucleus when young.

Locality: U.S.A. (near Linden and Patterson, California).

Remarks: Weiser's (1961) summary of the development is presented here. It differs slightly from the original but is more succinct and, probably, more accurate in its interpretation. The supposed presence of a single nucleus in the spore needs to be confirmed, since this is not a character of *Nosema*.

Nosema hydraeciae Issi & Tkach, 1968

Nosema hydraeciae I. & T. [*nomen nudum*], 1968, Int. Congr. Entomol., 13, [Abstr. pap.].

Host and Site: [LEPIDOPTERA] *Hydraecia micacea*, larva. Transovarian transmission was mentioned.

Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: No data.
Locality: U.S.S.R. (Leningrad).
Remarks: The name was published in a very brief note which contained some information about the host but essentially none about the parasite.

Nosema hydriae Lutz & Splendore, 1904

Nosema hydriae L. & S., 1904, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I, Orig., 36, 646, Fig. 26. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 34. Weiser, 1961, Monogr. Angew. Entomol., 17, 81.
Nosema hydriae β L. & S., 1908, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I, Orig., 46, 314, Fig. 39. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 86.
Nosema hydrae γ L. & S., 1908, *ibid.*, 315. Kudo, 1924, *loc. cit.*
Nosema hydrae α L. & S., 1904, Kudo, 1924, *ibid.*, 85, Fig. 97.
Nosema junonis β L. & S., 1904, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. I, Orig., 36, 645, Fig. 13.
Host and Site: [LEPIDOPTERA] *Hydria* sp. and *Dione juno*. Site?
Vegetative Stages: No data.
Sporulation Stages: No data.
Spores: Bacilliform, often elliptical in cross section, 4-5.5 x 1.-15 μm. A β form, with spores 3.5-5.5 x 2-3 μm, and a γ form, with spores somewhat smaller in cross section, were found in 1908. Spores in *Dione*, 3.5-4.5 x 1.7-2 μm.
Locality: Brazil (The first form from Petropolis and the other two from the Amazon region).
Remarks: I have followed Weiser in treating *Nosema junonis* β as a synonym of *N. hydriae*, since it seems to be distinct from *N. junonis* α.

Nosema hyperae (Youssef, 1974) comb. n.

Perezia hyperae Youssef, 1974, J. Invertebr. Pathol., 24, 282, Figs. 1-11.
Host and Site: [COLEOPTERA] The alfalfa weevil *Hypera postica*; Malpighian tubules (primarily), fat body, trachael cells, abdominal nerve cord, abdominal muscle, and integumental epidermal cells of larva and gonads of adults.
Lesion: In larve with late infections, the body had abnormal bulges. Infected tissues were largely replaced by spores and were opaque. Cells did not show hypertrophy.
Vegetative Stages: Reproduction by binary fission. All stages with diplokarya.
Sporulation Stages: "First stage of sporogony initiated by diplokaryotic sporonts. Fusion followed by two divisions of sporont diplokaryon resulting in formation of two sporoblasts." Sporoblast transforms into spore.

Spore: In saline, 3.1 x 1.7 µm (average); with diplocaryon; polar filament 40-50 µm.
Locality: U.S.A. (Utah).
Remarks: The generic characters of this species correspond exactly with those of *Nosema* as revealed by Cali's (1971) study of the type species, *N. bombycis*.

Insisting that *Nosema* is basically monosporous, Youssef resurrected *Perezia*, which is disporous [and which was suppressed by Sprague and Vernick (1971) as a synonym of *Nosema*], to include this species. Sprague and Vernick, and now Youssef, were preoccupied with the disporous nature of *Perezia lankesteriae* (type species) and did not give proper consideration to the nucleus of that species as described by Léger and Duboscq (1909). These authors reported uninucleate vegetative stages, plasmodia with up to 10-12 nuclei, uninucleate elements that become disporous "pansporoblasts," and multinucleate spores (presumably thought to have nuclei similar to those of myxosporidia, clearly an unacceptable notion). Thus, all the data we have, whether reliable or not, indicate that *Perezia* has only unpaired nuclei, no known diplocarya. It does not seem justified to place in Genus *Perezia* a species with diplocarya in all known sta es (excepting the zygote).

Youssef expressed a need "to account for those species of microsporidians which are basically [usually ?] monosporous but occasionally disporous, and those that are never disporous" [presumably, always monosporous]. This is an involved subject which requires a lengthy discussion at a more appropriate time. I think it is fair to say, however, that almost every author who called a species "monosporous" was simply using a convenient word to express the fact that he saw only isolated spores but did not necessarily know how they came to be isolated. Pérez (1905), who coined the term simply referred to spores that develop in isolation rather than in groups surrounded by a membrane. When Léger and Duboscq (1909) coined the term "disporous" they used it for a condition in *Perezia lankesteriae* in which the products of a final binary fission remain united during most of the period of transformation into spores. The strong modern tendency is to call any species "disporous" when the evidence indicates that the products of a final binary fission (of a cell generally called "sporont") develop into 2 spores, regardless of how long they remain united (extreme examples being species of *Nosema* and *Telomyxa*).

It is not at all clear what concepts Youssef had in mind when he spoke of species that "are basically monosporous but occasionally disporous, and those that are never disporous." At any rate, *Perezia* probably should be resurrected, but not for the reason given by Youssef.

Nosema infesta Hall, 1952

Nosema infesta Hall, 1952, J. Parasitol., 38, 487, Figs. 1, 2. Hall, 1954, Hilgardia, 22, 537. Weiser, 1961, Monogr. Angew. Entomol., 17, 82.

Host and Site: [LEPIDOPTERA] The fawn-colored lawn moth *Crambus bonifatelis* (Hulst) [type host], larva and pupa, and the fiery skipper *Hylephila phylaeus* Drury, larva. Experimentally in: the California oakworm *Phryganidia californica* Packard, alfalfa caterpillar *Colias philodice eurytheme* Boisduval, cabbageworm *Pieris rapae* (Linnaeus), malva butterfly *Vanessa carye* (Hübner), buckeye caterpillar *Junonia coenia* Hübner, salt marsh caterpillar *Estigmene acraea* (Drury), potato tuberworm *Gnorimoschema operculella* (Zeller), beet webworm *Loxostege sticticalis* (Linnaeus), granulate cutworm *Feltia subterranea* (Fabricius), beet armyworm *Laphygma exigua* (Hübner), armyworm *Cirphis unipunctata* (Hayworth), *Heliothis phloxophaga* [Hall (1954)]. Mainly in fat body.

Vegetative Stages: Emerged sporoplasm uninucleate. Most schizonts binucleate; forms with 1, 3, or 4 nuclei common; forms with 6 or 8 nuclei rare. Binary fission of binucleate and tetranucleate forms seen. Budding of the multinucleate forms reported.

Sporulation Stages: Sporont elongate, 5-10 x 3-5 µm, with 2 or 4 nuclei.

Spore: 5-8 x 2-3 µm; polar filament up to 120 µm.

Locality: U.S.A. (California).

Remarks: Hall (1954) performed a number of laboratory and field infection experiments using spores that had been held under various conditions.

Nosema invadens Kellen & Lindegren, 1973

Nosema invadens K. & L., 1973, J. Invertebr. Pathol., 21, 293, Figs. 1-58. Nordin & Maddox, 1974, *ibid.*, 24, 3.

Host and Site: [LEPIDOPTERA] The raisin moth *Cadra figulilella* and the almond moth *Cadra cautella*, all stages; at first in midgut and Malpighian tubules but later in most other tissues. Experimentally transmitted to larvae of *Galleria mellonella* (L.), *Plodia interpunctella* (Hübner), *Ephestia elutella* (Hübner), and *Paramyelois transitella* (Walker).

Vegetative Stages: Reproduction by binary fission. A first schizogony involves forms with compact nuclei and a second schizogony involves forms with vesicular nuclei.

Sporulation Stages: Sporont divides into 2 binucleate sporoblasts that transform into spores.

Spore: Fresh spores 4.37 x 1.80 µm.

Locality: U.S.A. (California).

Remarks: Nordin and Maddox could not distinguish this from the type species, *N. bombycis*, and several other species.

Nosema juli Wilson, 1971

Nosema juli Wilson, 1971, Can. J. Zool., 49, 1279, Figs. 1, 2.

Host and Site: [MYRIAPODA] The millipede *Diploiulus londinensis caeruleocinctus* (Wood); initially in fat body, with subsequent development in muscles and connective tissues.

Vegetative Stages: Merogony generally by binary fission of uninucleate or binucleate forms. Rarely short chains of 3 individuals were seen. Ther terminal stage, a **diplokaryon.**

Sporulation: The **diplokaryon** nuclei appeared to fuse to produce a sporont. The sporont appeared to produce either 1 or 2 binucleate sporoblasts which transformed into spores.

Spore: Ovoidal, 5.5 x 2.8 μm (fresh). Everted filament 81-153 μm, 110 average, sometimes with a binucleate sporoplasm at the end.

Locality: U.S.A. (vicinity of Ithaca, New York).

Nosema junonis Lutz & Splendore, 1903

Nosema junonis L. & S. [*partim*, the long spores], 1903, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 33, 154, 155, Fig. 9. Kudo [*partim* α], 1924, Ill. Biol. Monogr., 9(2/3), 84, Fig. 80.

Nosema junonis α L. & S., 1904, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 36, 645. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 34. Weiser, 1961, Monogr. Angew. Entomol., 17, 88.

Host and Site: [LEPIDOPTERA] *Dione juno* and (experimentally) *Papilio pompejus*, larva; site not mentioned.

Vegetative Stages: No data.

Sporulation Stages: No data.

Spore: Cylindrical, up to 8 x 2 μm.

Locality: Brazil (near São Paulo).

Remarks: In both 1903 and 1904 Lutz and Splendone described cylindrical spores and ovoid spores. In 1904 they treated these and two distinct species ("zwei vershiedene *Nosema*-arten"), designating the long spores as *Nosema junonis* α and the ovoid ones as *Nosema junonis* β. Weiser (1961) considered the latter to be identical with *N. hydriae* L. & S., 1904, an opinion that I have followed for lack of a better alternative.

Nosema kingi Kramer, 1964

Nosema sp. Burnett & King, 1962, J. Insect Pathol., 4, 111, Figs. 1-4.

Nosema kingi Kramer, 1964, J. Insect Pathol., 6, 491, Figs. 1-14.

Host and Site: [DIPTERA-BRACHYCERA] *Drosophila willistoni* Sturtevant. In lightly infected adults, the parasite is generally found only in the fat body; in advanced infections, it invades many tissues. Found also in fat bodies of larva and pupa.

Vegetative Stages: Ejected sporoplasm *in vitro* spherical, 2 μm. with compact and rounded nuclei. The smallest schizonts found in fat body indistinguishable from ejected sporoplasms.

Binucleate forms become quadrinucleate, divide into binucleate forms, and the process is repeated. The terminal product is the diplocaryon of Debaisieux. The nuclei of the diplocaryon are thought to fuse, resulting in an uninucleate sporont.
Sporulation Stages: The nucleus of the sporont divides to make a binucleate sporoblast and the latter transforms into a spore
Spore: Ovoidal, 4.31-2.57 µm (fresh), filament 75-95 µm.
Locality: U.S.A., infected flies obtained from Prof. D. F. Poulson of Yale University.
Remarks: Convincing evidence for fusion of nuclei to produce a sporont is not presented. The sporulation sequence was followed with difficulty and could have been inaccurately interpreted.

Nosema kovacevici Purrini & Weiser, 1975

Nosema kovacevici P. & W., 1975, Anz. Schädlingskd. Pflanzen-Umweltischutz., 48, 11-17, Figs. 1-2.
Host: [LEPIDOPTERA] *Euproctis chrysorrhoea,* pupa.
Vegetative Stages: Schizonts with no more than 4 nuclei divide into binucleate cells.
Sporulation Stage: Binucleate stages develop into spores.
Spore: Long-oval, highly variable in length, 2.5 x 2.3 - 6 x 2 µm, mostly 5 x 2 µm; binucleate.
Locality: Yugoslavia (Kosovo).

Nosema kozhovi Lipa, 1967

Nosema kozohovi Lipa, 1967, Acta Protozool., 5, 93, Figs. 1-4.
Host and Site: [AMPHIPODA] *Brandtia lata lata* (Dybowski), general infection, especially gut epithelium.
Vegetative Stages: Schizonts uni- and binucleate up to 5 µm.
Sporulation Stages: "Sporonts" elongate, up to 6 µm, binucleate; give rise to 1 spore.
Spore: Oval, 3.3-3.9 x 2.1-2.2 µm (living); 2.5-4.0 x 1.8-2.1 µm (stained).
Locality: U.S.S.R. (Lake Baical near Bolshiye Koty).

Nosema laphygmae Weiser, 1959

Nosema laphygmae Weiser, 1959, J. Insect Pathol., 1, 52, Figs. 1-4. Weiser, 1961, Monogr. Angew. Entomol., 17, 88.
Host and Site: [LEPIDOPTERA] The fall armyworm *Laphygma frugiperda* (Smith), adult; fat body.
Vegetative Stages: Uninucleate oval schizonts with large nuclei, 3 x 6 µm [Weiser (1961)].
Sporulation Stages: Only sporoblasts and spores were seen [Weiser (1959)].
Spore: Normally, 4.0-5.0 x 1.5-2.2 µm or 4.5 x 2.0 µm [Weiser (1959)]; 3.9-5.2 x 1.5-2 µm [Weiser (1961)]. Macrospores, 8-9 x 2-2.5 µm.
Locality: Venezeula (Caracas).

Remarks: Weiser (1959), using this species, made one of the pioneering electron microscope studies on microsporidia.

Nosema lepiduri Vávra, 1960

"Nosema lepiduri Vávra, 1958 (im Druck)," Vávra, 1959, Věstn. Česk. Spol. Zool., 23, 347, 2 figs.

Nosema lepiduri Vávra, 1960, J. Protozool., 7, 36, Figs. 1-7.

Host and Site: [PHYLLOPODA] *Lepidurus apus* L., connective tissue cells of appendages, carapace and head; also, fat cells.

Vegetative Stages: Oval schizonts of "first schizogony" undergo multiple fission. Larger, ribbon-like plasmodia, sometimes with diplocarya, undergo the "second schizogony." "After this period autogamy obviously takes place and the formation of sporonts begins."

Sporulation Stages: Sporont (presumably sporoblast) oval, 4.2 x 2.8 μm, with elongated central nucleus. "Sporont" transforms into spore.

Spore: Oval, 4.2 x 2.3-2.4 μm (fresh), with "fairly large elongated nucleus" (Feulgen).

Locality: Czechoslovakia (near Prague).

Remarks: When Vávra (1959) mentioned *"Nosema lepiduri* Vávra, 1958 (im Druck)," he evidently anticipated early publication of both his 1959 paper and the description of the new species that did not appear until 1960. The name was, therefore, published as a *nomen nudum* in 1959 and became available after it satisfied the appropriate provisions of the Code in 1960. A single nucleus is not characteristic of *Nosema*. Perhaps the "elongated" nucleus was actually double.

Nosema leptinotarsae Lipa, 1968

Nosema leptinotarsae Lipa, 1968, J. Invertebr. Pathol., 10, 111, Figs. 1-8.

Host and Site: [COLEOPTERA] The Colorado potato beetle *Leptinotarsa decemlineata* (Say); blood.

Vegetative Stages: Uni- and binucleate schizonts were observed.

Sporulation Stages: "Sporonts" [sporoblasts] elongated, 3-6 μm. Each "sporont" produces 1 spore.

Spore: Oval to ellipsoidal, 2-5 x 1.9-3.3 μm.

Locality: U.S.S.R. (near Nesterov and Obrushion, Lvov region).

Nosema leptocordis Lipa, 1966

Nosema leptocordis Lipa, 1966, J. Invertebr. Pathol., 8, 250, Fig. 1.

Host and Site: [HETEROPTERA] *Leptocoris trivittatus* (Say), adult; midgut epithelium.

Vegetative Stages: Schizonts, 2-4 μm in diameter and with 1 or 2 nuclei were seen.

Sporulation Stages: "Sporonts" [sporoblasts], 4 x 2 μm.

Spore: Elongated, 2.1 x 1.1 - 3.5 x 1.5 µm. Polar filament 30 µm.
Locality: U.S.A. (Salt Lake City).

Nosema lepturae Lipa, 1968

Nosema lepturae Lipa, 1968, Acta Protozool., 5, 269, Figs. 1-6.
Host and Site: [COLEOPTERA] *Leptura rubra* L., adult; general infection, especially trachael matrix, fat body, and midgut epithelium.
Vegetative Stages: Spherical, 2.5 µm with 1-2 nuclei.
Sporulation Stages: "Sporont" elongated, 3-6 µ, producing 1 spore.
Spore: Ovoidal or ellipsoidal and rather uniform in size, 4.6-6.1 x 2.2-3.5 µm (fresh). Polar filament 117 µm maximum.
Locality: Poland (Bialowieza National Park).
Remarks: The cell transforming directly into a spore should be called a "sporoblast," since the applicability of "sporont" for this stage is highly questionable.

Nosema locustae Canning, 1953

Nosema sp. Steinhaus, 1951, Hildgardia, 20, 642.
Nosema locustae Canning, 1953, Parasitology, 43, 287, Figs. 1-20. Huger, 1960, J. Insect Pathol., 2, 84, Figs. 1-15. Weiser, 1961, Monogr. Angew. Entomol., 17, 58. Canning, 1962, J. Insect Pathol., 4, 237, Figs. 1-16. Canning, 1962, *ibid.*, 248. Issi & Lipa, 1968, Acta Protozool., 6, 283. Henry, 1971, J. Invertebr. Pathol., 18, 389. Henry & Oma, 1974, *ibid.*, 23, 371.
Host and Site: [ORTHOPTERA] *Locusta migratoria* (Reiche & Fairmaire) [type host]; fat body. Also: *Melanoplus bivittatus* (Say), *M. mexicanus* (Saussure), *M. dawsoni* (Scudder), *Dissosteira carolina*, *Schistocerca gregaria* (Forskal), *Camnula pellucida* [Canning (1962)]; *Chorithippus albomarginatus* De Geer [I. & L.]; *Melanoplus sanguinipes*, *M. gladstoni*, *M. infantilis*, *M. packardii*, *Phoetatiotes nebrascensis*, *Opeia obscura*, *Amphitornus coloradus*, *Ageneotettix d. deorum*, *Phlibostroma quadrimaculatum*, *Trachyrhacyhs k. kiowa*, *Arphia p. pseudonietana*, *Encoptolophus sordidus costalis*, *Trimeroptropus campestris*, *Hesperotettix v. viridis*, *Hypochlora alba* [Henry (1971)]; *Cordillacris o. occipitalis*, *Drepanopterna femoratum*, *Aulocara elliotti*, *Melanoplus keeleri luridus*, *M. o. occidentalis*, *M. foedus*, *Metator pardalinus*, *Spharagemon equale* [H. & O.].
Vegetative Stages: Schizont with 1-4 nuclei seen. Division produces uninucleate cells.
Sporulation Stages: "Sporont" uninucleate at first. Its nucleus divides and it develops into spore.
Spore: Oval, variable in size; most are 4-6.5 x 2.5-3.5 µm, but a few are as small as 3 x 1.5 µm and a few as large as 7 x 3.5 µm (fresh), binucleate [Canning (1962)].

Locality: England (London), U.S.A. (many localities), U.S.S.R. (Siberia).

Remarks: Huger used this species in carrying out one of the earliest and most important electron microscope studies made on microsporidia.

Nosema lophocampae Lutz & Splendore, 1903

Nosema lophocampae L. & S., 1903, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 33, 154, Fig. 5. Kudo, 1924 Ill. Biol. Monogr., 9(2/3), 85, Fig. 94.

Nosema erippe L. & S., 1903, Weiser [*partim*], 1947, Acta Soc. Sci. Nat. Moravicae, 18, 33. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 81.

Host and Site: [LEPIDOPTERA] *Lophocampa flavostica,* larva; site not mentioned.

Vegetative Stages: No data.

Sporulation Stages: No data.

Spores: 3.5-4 x 1-2 μm.

Locality: Brazil (São Paulo).

Remarks: This species was so poorly described that we cannot judge its validity. Weiser, for reasons not clear, treated this as identical with *N. erippi* L. & S., 1903. Perhaps confusion will be avoided if we keep separate the species of Lutz and Splendore until there are compelling reasons to do otherwise.

Nosema lotmarae Weiser, 1961, emend.

Nosema sp. Lotmar, 1941, Mitt. Schweiz. Entomol. Ges., 81, 361, Figs. 1-3.

Nosema lotmaris Weiser, 1961, Monogr. Angew. Entomol., 17, 87.

Host and Site: [LEPIDOPTERA] The clothes moth *Tineola bisselliella,* larva, pupa, and adult; mainly in Malpighian tubules but also in silk glands.

Vegetative Stages: Schizont with few nuclei [Weiser].

Sporulation Stages: Sporoblast oval, 4 x 2.5 μm [Weiser].

Spore: Long oval, 3.5-4 x 1.5-2 μm in sections; with anterior and posterior vacuoles; polar filament up to 75 μm.

Locality: Switzerland [Lotmar]. Czechoslovakia [Weiser].

Remarks: Evidently, Ruth Lotmar is the name of a woman. "A species group name, if formed for a modern personal name, must end ... in -ae if a woman ..." [Art. 31 of the Code (see Stoll, 1961)].

Nosema lutzi Kudo, 1929

Nosema stegomyiae Lutz & Splendore, 1908, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 46, 315. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 88. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 39. Fox & Weiser [*partim*], 1959, J. Parasitol., 45, 21. Kudo, 1960, AIBS (Am. Inst. Biol. Sci.) Tech. Rep., p. 51. Thomson [*partim*], 1960, J. Insect Pathol., 2, 352. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 108.

[*non*] *Nosema stegomyiae* Marchoux, Salimbeni & Simond, 1903, Ann. Inst. Pasteur (Paris), 17, 714 [*fide* Kudo, 1924, Ill. Biol. Monongr., 9(2/3), 169, 206, Figs. 601-607].

[*non*] *Nosema stegomyiae* Simond, 1903, C. R. Soc. Biol., 55, 1335, Figs. 1-9.

Nosema lutzi Kudo, 1929, Arch. Protistenkd., 67, 5. Canning & Hulls, 1970, J. Protozool., 17, 538.

Host and Site: [DIPTERA-CULICIDAE] *Aedes aegypti (= Stegomyia fasciata = Aedes calopus)*, adult; in gut.

Developing Stages: Found scattered in gut or in multisporous cysts.

Spore: Ovoid or pyriform, 3.5-7 x 2-2.5 μm.

Locality: Brazil.

Remarks: Presence of spores in cysts is not characteristic of *Nosema* but Fox and Weiser regarded the "cysts" as pseudocysts.

Nosema lymantriae Weiser, 1957

Nosema lymantriae Weiser, 1957, Věstn. Česk. Spol. Zool., 21, 67, Figs. 1-3, Pl. 1. Weiser, 1957, Z. Angew. Entomol., 40, 510, Figs. 1, 2. Weiser, 1961, Monogr. Angew. Entomol., 17, 85. Issi & Lipa, 1968, Acta Protozool., 6, 284, 285, Pls. 1-3. Lom & Weiser, 1972, Folia Parasitol., 19, 361, Pl. 3-Fig. 4.

Host and Site: [LEPIDOPTERA] *Lymantria dispar* L., larva; fat body and silk gland. Experimentally in *Euproctis chrysorrhoea* L. [Weiser]. Found naturally occurring in these hosts by Issi and Lipa (1968).

Vegetative Stages: From meronts band-form stages develop. These eventually divide into cells with diplocarya.

Sporulation Stages: From binucleate merozoites binucleate sporoblasts and spores develop [Weiser (1957)].

Spore: Fusiform, 5-6 x 2-2.5 μm, rarely 4.5 x 1.6 μm, with smooth surface [SEM] and thin wall. Polar filament up to 125 μm.

Locality: Czechoslovakia (Beňedík) and Jugoslavia (middle Serbia) [Weiser]. U.S.S.R. (Carpathian and Sverdlovsk regions) [I. & L.].

Nosema lysimniae Lutz & Splendore, 1903

Nosema lysimniae L. & S., 1903, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 33, 154, Fig. 10. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 84, Fig. 92.
Host and Site: [LEPIDOPTERA] *Mechanites lysimnia* Fabr., larva; site not mentioned.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Ovoid and pyriform, 4-6 x 2-2.5 µm.
Locality: Brazil (near São Paulo).
Remarks: This species was so poorly described that one cannot judge its validity.

Nosema marionis (Thélohan, 1895) Labbé, 1899

Glugea marionis Thélohan, 1895, Bull. Sci. Fr. Belg., 26, 360, Figs. 14, 15. Georgévitch, 1917, Bull. Soc. Zool. Fr., 42, 106, Figs. 1-4. Wenyon, 1962, "Protozoology," p. 719, Fig. 719D.
Nosema marionis (Thélohan, 1895) Labbé, 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 106. Stempell, 1919, Arch. Protistenkd., 40, 142, Figs. 5, 7, 14, 16, 18-23, 44-45, 47-48, 52, 54, 64, 75, 77-80, 89-90, 110-113. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 79, Figs. 64-71. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1069.
Mariona marionis (Thélohan, 1895) Stempell, 1909, Arch. Protistenkd. 16, 341.
Host and Site: [MYXOSPORIDA] *Ceratomyxa coris* Georgévitch, 1916 [= *Leptotheca coris* Stempell, 1919], a myxosporidian in gall bladder of the fishes *Coris julis* and *C. giofredi;* in cytoplasm of trophozoite.
Vegetative Stages: Like that of *N. bombycis* [Stempell, 1919].
Sporulation Stages: Similar to those of *N. bombycis* [Stempell].
Spore: Very long ovoidal, slightly attenuated anteriorly, 8 x 3 µm [Thélohan]. Largest spores 6-7 µm long and smallest about 1.5 µm long [Stempell].
Locality: France (Marseille, Villefranche).
Remarks: It is interesting to note that Stempell (1919) recognized an intracellular "planont" in this species and earlier (1909) recognized an extracellular "planont" in *N. bombycis*. Georgévitch figured a binucleate germ in the spore of *N. marionis*. Although this latter condition is characteristic of *Nosema,* the "germ" shown by Georgévitch was in the posterior vacuole and, therefore, probably misidentified.

Nosema melolonthae (Krieg, 1955) Huger, 1964

Plistophora melolonthae Krieg, 1955, Zentralbl. Bakteriol. Parasitenk. Infektionskr. Hyg. Abt. II, 108, 538, Figs. 1-6. Thomson, 1960, J. Insect Pathol., 2, 365. Weiser, 1961, Monogr. Angew. Entomol. 17, 70.

Nosema melolonthae (Krieg, 1955) Huger, 1964, Entomophaga Mém. Hors Sér., 2, 83. Kharazi-Pakdel, 1968, Entomophaga, 13, 289, Figs. 1-5. Kharazi-Pakdel, 1971, Proc. IV Int. Colloq. Insect Pathol., 1970, 410.
Host and Site: [COLEOPTERA] *Melolontha melolontha* L., larva; fat body.
Lesion: Infected larva dirty white [Krieg].
Vegetative Stages: Meronts with 1 or 2 (seldom 4) nuclei undergo binary fission.
Sporulation Stages: Schizonts give rise to 1 or 2 nucleate sporonts, each of which "in der Regel" develops into 1 sporoblast [Huger].
Spore: Oval, 4.0-4.5 x 2.5-3.0 μm, with ripples (seen by EM) on the surface; polar filament 150-200 μm [Krieg]. Generally ovoid, 5.72 x 2.87 μm (av., in life); usually binucleate, sometimes with 1 or 3 nuclei, polar filament 125-242 μm (av. 187 μm) [Huger].
Locality: Germany [Krieg, Huger]. France [Huger]. Czechoslovakia [Weiser].
Remarks: Krieg described "pansporoblasts" but Huger called them "pseudopansporoblasts."

Nosema mesnili (Paillot, 1918) Weiser, 1961

Perezia mesnili Paillot, 1918, C. R. Soc. Biol., 81, 67, Figs. 1-32. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 126, Figs. 338-344. Paillot, 1929, Arch. Anat. Microsc., 25, 212, Figs. 1-12. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 35. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1061. Tanada, 1953, Proc. Hawaii. Entomol. Soc., 15, 167, Figs. 1-2. Tanada, 1955, *ibid.*, 609.
Perezia legeri Paillot, 1918, C. R. Soc. Biol., 81, 187, Figs. 1-12. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 127, Figs. 345-356. Paillot, 1929, *loc. cit.* Weiser, 1947, *loc. cit.*
Perezia pieris Paillot, 1924, C. R. Soc. Biol., 90, 1255, Figs. 1-17. Paillot, 1929, *loc. cit.*
Nosema polyvora Blunck, 1952, Trans. IX Int. Congr. Entomol., Amsterdam, 1952, 438, Figs. 1-2. Blunck, 1954, Z. Angew. Entomol., 36, 329. Blunck, Krieg & Scholtyseck, 1959, Z. Pflanzenkr. Pflanzenpathol. Pflanzenschutz., 66, 130, Figs. 1-2, 6, 8. Thomson, 1960, J. Insect Pathol., 2, 351. Lipa, 1963, Pr. Nauk. Inst. Ochr. Rosl. Warsz., 5, 123, Figs. 14-26. Issi, 1963, Tr. Vses. Nauchno-Issled. Inst. Zashch. Rast., 19, 175, Fig. 2. Issi & Maslennikova, 1964, Entomol. Obozr., 43, 117. Issi & Maslennikova, 1966, *ibid.*, 45, 499. Veremtchuk & Issi, 1968, Int. Congr. Entomol., 13, 107 [Abstr. pap.]. Nordin & Maddox, 1974, J. Invertebr. Pathol., 24, 3.
Perezia (Glugea) legeri Paillot, 1918, Blunck *et al.*, 1959, Z. Pflanzenkr. Pflanzenpathol. Pflanzenschutz., 66, 132.
Nosema cf. *legeri* (Paillot, 1918) Blunck *et al.*, 1959, *loc. cit.*
Glugea mesnili (Paillot, 1918) Thomson, 1960, J. Insect Pathol., 2, 355.

Glugea legeri (Paillot, 1918) Thomson, 1960, *loc. cit.*
Glugea pieris (Paillot, 1924) Thomson, 1960, *loc. cit.*
Nosema brassicae Weiser, 1961, Z. Angew. Entomol., 17, 80.
Nosema mesnili (Paillot, 1918) Weiser, 1961, Monogr. Angew. Entomol., 17, 79. Gupta, 1964, Curr. Sci. (Bangalore), 33, 407, Fig. 1. Issi & Chervinskaya, 1969, Zool. Zh., 48, 1140. Hostounský, 1970, Acta Entomol. Bohemoslav., 67, 1, Figs. 1-5. Veremtchuk & Issi, 1970, Parasitologia, 4, 4, Figs. 1, 2. Weiser, 1971, SIP (Soc. Invertebr. Pathol.) Newsl. 3, 25. Lom & Weiser, 1972, Folia Parasitol. (Prague), 19, 361, Pl. 4, Fig. 1.
Nosema pieris (Paillot, 1918) Nordin & Maddox, 1974, J. Invertebr. Pathol., 24, 2.
Host and Site: [LEPIDOPTERA] *Pieris brassicae* L. [Type host. Paillot (1918, 1924) and many later authors]; gut, fat body, and other tissues. *Pieris rapae* [Tanada], *Aporia crataegi* L. [Blunck (1954)]. [HYMENOPTERA] *Apanteles glomeratus* L. [Tanada (1955) and several later authors], *A. rubecula* Marsh [Blunck (1952)]. *Hyposoter ebeninus* (Grav.) and *Pimpla instigator* (F.) [Hostounský (1970)]. [NEMATODA] *Neoaplectana* sp., *N. agriotos* [V. & I (1969, 1970)].
Vegetative Stages: Reproduction by binary fission or by multiple fission of small spherical or chain-form plasmodia. The final stage is a fusiform, binucleate sporont.
Sporulation Stages: The sporont divides into 2 binucleate sporoblasts that transform into spores.
Spore: Ovoid, elongate, 3-4 x 1.5-2 μm, binucleate [Paillot (1918)].
Locality: Cosmopolitan.
Remarks: Weiser (1961) synonymized *Nosema mesnili* (Paillot), *N. polyvora* Blunck and *Perezia pieris* Paillot. Hostounský snyonymized *N. mesnili, N. polyvora* Blunck, and *Perezia legeri* Paillot. Thus, I am treating 4 nominal species as identical. Weiser (1971) said *N. mesnili* is identical with 5 other species which he did not list. Nordin and Maddox could not distinguish *N. mesnili* from 8 other species, including *N. bombycis,* the type species. Possibly many nominal species are actually *N. bombycis*.

Nosema micrattaci Lutz & Splendore, 1904

Nosema micrattaci L. & S., 1904, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 36, 646, Fig. 27. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 86, Fig. 98.
Nosema erippi L. & S., 1903, Weiser [*partim*], 1947, Acta Soc. Sci. Nat. Moravicae, 18, 38. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 81.
Host and Site: [LEPIDOPTERA] *Micrattacus nana;* site not mentioned.
Vegetative Stages: No data.
Sporulation Stages: No data.

Spore: Regularly ovoid or ovocylindrical, 3.5-4 x 1.5-2 µm.
Locality: Brazil (near São Paulo).
Remarks: Weiser, for reasons not clear, treated this species as identical with *N. erippi* L. & S., 1903. I feel it would be less confusing to keep it separate until we have more information.

Nosema murinanae Weiser, 1956

Nosema murinanae Weiser, 1956, Z. Pflanzenkr. Pflanzenpathol. Pflanzenschutz., 63, 196. Weiser, 1961, Monogr. Angew. Entomol., 17, 84.
Host and Site: [LEPIDOPTERA] The European fir budworm *Cacoecia murinana* Hub., larva; fat body.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Broad oval, 5 x 2-2.5 µm, with a vacuole in either end; binucleate.
Locality: Czechoslovakia (middle Slovakia).

Nosema muscularis Weiser, 1957

Nosema muscularis Weiser, 1957, Věstn. Česk. Spol. Zool., 21, 71, Figs. 4, 5, Pl. 2-Fig. 1. Weiser, 1957, Z. Angew. Entomol., 40, 512, Figs. 3-5. Weiser, 1961, Monogr. Angew. Entomol., 17, 86. Lom & Weiser, 1972, Folia Parasitol. (Prague), 19, 361.
Host and Site: [LEPIDOPTERA] *Lymantria dispar* L., larva; muscles of midgut mainly, also tracheae and Malpighian tubules. Experimental infections in *Nygmia phaeorrhoea*, *Hyphantria cunea* [Weiser (1957)] and *Euproctis chrysorrhoea* L. [Weiser (1961)].
Vegetative Stages: Binucleate cells situated near the host-cell nucleus multiply. Two schizogonies recognized [Weiser (1957)].
Sporulation Stages: Sporoblast binucleate.
Spore: Broad ovoidal, 4.8-6 x 3-4 µm, with large posterior vacuole, with very indistinct wrinkles in circular arrangement on surface.
Locality: Czechoslovakia (Benadik).

Nosema mystacis Lutz & Splendore, 1908

Nosema mystacis L. & S., 1908, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 46, 314, Fig. 32. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 87, Fig. 101.
Host and Site: [NEMATODA] *Ascaris mystax;* in gut of cat, in reproductive tubules of 2 females.
Vegetative Stages: No data.
Sporulation Stage: No data.
Spore: Regularly ovoid with posterior vacuole, 4-4.5 x 2-2.5 µm.
Locality: Brazil (São Paulo).

Remarks: Like most of the species reported by Lutz and Splendore, this was poorly described but there are no known data that raise questions about the generic determination.

Nosema nebulellum Weiser, 1961

Nosema sp. Weiser, 1952, Zool. Entomol. Listy, 15, 264, Fig. 3.
Nosema nebulellum Weiser, 1961, Monogr. Angew. Entomol., 17, 84.
Host and Site: [LEPIDOPTERA] The sunflower moth *Homeosoma nebulellum* Hub.; fat body.
Vegetative Stages: Schizonts ovoidal with 4 to many nuclei.
Sporulation Stages: No data.
Spore: Oval, 4.7-5.7 x 3.2-3.4 μm.
Locality: Czechoslovakia (Südslowakei).
Remarks: Descriptive data from Weiser's (1961) monograph, the original paper being unavailable.

Nosema nepae Poisson, 1928

Nosema nepae Poisson, 1928, Arch. Zool. Exp. Gén., 67, 129, Figs. 1-4. Poisson, 1953, *in* "Traité de Zoologie (P. P. Grassé, ed.) 1(2), 1048, Fig. 802. Weiser, 1961, Monogr. Angew. Entomol., 17, 61. Lipa, 1966, J. Invertebr. Pathol., 8, 161, Fig. 3.
Host and Site: [HEMIPTERA] *Nepa cinerea* L.; fat body.
Vegetative Stages: Meronts undergo binary fission.
Sporulation Stages: Sporonts have larger nuclei and darker cytoplasm. These transform into spores.
Spore: Polymorphic, either pyriform or elongated, 5-5.5 x 2.5 μm. Polar filament up to 40 μm.
Locality: France (Banyuls) [Poisson], Poland [Lipa].
Remarks: The development of the spore was said to involve several nuclei as in myxosporidia but we can now be sure this does not occur in microsporidia.

Nosema nonagriae Schwarz, 1929

Nosema nonagriae Schwarz, 1929, Z. Morphol. Oekol. Tiere, 13, 675, Figs. 1-6, 8-17, 22, Pl. 8-figs. 1-7.
Host and Site: [LEPIDOPTERA] *Nonagria typhae*, the type host (p. 694); identical or similar species found also in *N. cannae*, *Sesia vespiformis*, *S. culiciformis*, *S. spheciformis*, larva; infection generalized in gut, Malpighian tubules, muscles, fat body, tracheal tubules, nerves, silk glands.
Vegetative Stages: Binucleate sporoplasm believed to undergo nuclear fusion to produce the only uninucleate stage in the cycle. This is followed by binary fission or by formation of cylindrical plasmodia that undergo multiple fission. Some of the products are sporoblast.
Sporulation Stages: Isolated, binucleate, fusiform sporoblasts transform into spores.

Spores: Oval, about 4.5-5 x 2-2.5 µm (calculated from Fig. 1, p. 677), binucleate; polar filament about 70 µm (calculated from Fig. 22, p. 703).
Locality: Germany (Breslau).

Nosema notabilis Kudo, 1939

Nosema notabilis Kudo, 1939, Anat. Rec., 75, 153. Kudo, 1944, Ill. Biol. Monogr., 20, 4, text figs. 1-7, Pls. 1-12. Lom & Weiser, 1972, Folia Parasitol. (Prague), 19, 360, Pl. 1-fig. 2.
Host and Site: [MYXOSPORIDA] Trophozoite of *Sphaerospora polymorpha* Davis in the urinary bladder of the toad fishes *Opsanus tau* and *O. beta*.
Vegetative Stages: Earliest stage, a binucleate schizont that divides into two uninucleate forms. This division is repeated. In a second phase, binucleate fusiform stages arise and they may appear in short chains.
Sporulation Stages: A final division of a fusiform cell [sporont] produces two binucleate "sporonts" [sporoblasts] which transform into spores.
Spore: Ovoid to ellipsoid, 2.9-4.8 x 1.4-2.5 µm (av. 3.3 x 2 µm) [fresh]. Surface with "very small wart-like structures" [L. & W., SEM]. Binucleate. With band-form sporoplasm and "vacuole" at either end. Polar filament, attached eccentrically, 45-62 µm when fully extruded.
Locality: U.S.A. (Solomons, Maryland, and Englewood, Florida).
Remarks: Although the type species of *Nosema* occurs in insects, this species in myxosporidia appears also to show clearly the essential characters of the genus.

Nosema operophterae Canning, 1960

Nosema operophterae Canning, 1960, J. Parasitol., 46, 755, Figs. 17-21.
Host and Site: [LEPIDOPTERA] The winter moth *Operophtera brumata* (L.), larva and pupa; salivary gland.
Vegetative Stages: Only binucleate and uninucleate schizonts were seen.
Sporulation Stages: Last division of schizonts produces sporonts.
Spore: Cylindrical, 2.5-3.5 x 1-1.3 µm; macrospores 5-7 x 1.0-1.5 µm. "The mature spore has two nuclei ... ." "The spores, at first uninucleate, undergo autogamy so that the mature spore is also uninucleate."

Nosema oryzaephili Burges, Canning & Hurst, 1971

Nosema oryzaephili B., C. & H., 1971, J. Invertebr. Pathol., 17, 419, Figs. 1-42. Burges, Canning & Hulls, 1974, J. Invertebr. Pathol., 23, 135, Figs. 1-4.

Host and Site: [COLEOPTERA] The saw-toothed grain beetle *Oryzaephilus surinamensis;* mainly fat body but also nerve fibers and cells. Also in *Tribolium castaneum.* Experimentally in 4 other species of beetles: *Oryzaephilus mercator, Lasioderma serricorne, Stegobium paniceum,* and *Dermestes maculatus.* Experimentally in 3 species of moths: [LEPIDOPTERA] *Ephestia elutella, E. cautella,* and *E. kuehniella.*
Vegetative Stages: Uni-, bi-, and tetranucleate "meronts"; rarely, forms with 6, 8, or 12 nuclei seen; nuclei mostly appeared as diplocarya.
Sporulation Stages: A sporont divides into 2 sporoblasts. These are at first uninucleate[?] but become binucleate.
Spore: Ovoid, 4.1-4.8 x 2.6-3.3 µm (fresh), binucleate.
Locality: England (Slough, Berks.).

Nosema otiorrhynchi Weiser, 1951

Nosema otiorrhynchi Weiser, 1951, Věstn. Česk. Spol. Zool., 15, 215, Figs. 1-5. Weiser, 1961, Monogr. Angew. Entomol., 17, 67.
Host and Site: [COLEOPTERA] *Otiorrhynchus ligustici* L., adult; Malpighian tubules and, to a limited extent, fat body and muscle.
Vegetative Stages: Uni- and binucleate meronts seen.
Sporulation Stages: No data.
Spores: Elongated, with rounded ends, 3.8-4 x 1.8-2 µm; uninucleate(?); macrospores 6-8 x 2 µm.
Locality: Czechoslovakia (vicinity of Luzce and of Berkovice).
Remarks: Either there are 2 nuclei in the sporulation stages or this species lacks an essential character of Genus *Nosema.*

Nosema parva Moniez, 1887

Nosema parva Moniez, 1887, C. R. Acad. Sci., 104, 1313.
Host: [COPEPODA] *Cyclops* spp.
Developmental Stages: Sporogenic masses relatively voluminous. Among the spores were protoplasmic masses said to have all the characters of *Nosema anomala* Moniez [infected fat bodies?].
Spores: Oval, 3.5 x 2 µm, with clear space at one end.
Locality: France (Lille).
Remarks: There is no basis for judging the accuracy of the generic designation. In the absence of any compelling reason to remove it from *Nosema,* it is left provisionally in this genus.

Nosema pediculusvestimenti (Popow & Manúilowa, 1926) comb. n.

Cocconema pediculis vestimenti P. & M., 1926, Ruskij. Žurn. Trop. Med., 8, 48, Figs. 1-5.

Cocconema pediculus vestimenti P. & M., 1926, *ibid.*, 49.
Cocconema pediculi Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 28.
Nosema pediculi (Weiser, 1947) Weiser, 1961, Monogr. Angew. Entomol., 17, 59.
Host and Site: [ANOPLURA] The body louse *Pediculus vestimenti*; intestinal epithelium and fat body.
Vegetative Stages: Stages with 4-8 nuclei undergo schizogony. Elongated meronts, after a nuclear division to make diplocarya, initiate sporogony.
Sporulation Stages: Each diplocaryon produces a single[?] spore.
Spore: Spherical or subspherical, 3.21-4.28 μm.
Locality: U.S.S.R. (Moscow).
Remarks: Popow and Manuilowa, who used both *pediculis* and *pediculus*, evidently intended the latter, which is the correct spelling of the host name. For reasons not stated, Weiser changed the compound specific name to *pediculi*. If Weiser's change was intended as a correction, it is an unjustified emendation. In either case, it has the status of a new name attributable to Weiser, 1947 [Art. 33 of the Code (see Stoll, 1961)]. There is no evident reason for not accepting Weiser's (1961) view that this is a species of *Nosema* but the combination *Nosema pediculusvestimenti* must be regarded as new.

Nosema perezioides Huger, 1960

Nosema sp. Huger, 1958, Trans. 1st Int. Conf. Insect Pathol. Biol. Control, Praha, 1958, 321, Figs. 1, 2.
Nosema perezioides Huger, 1960, Z. Pflanzenkr. Pflanzenpathol. Pflanzenschutz., 67, 65, Figs. 1-11. Weiser, 1961, Monogr. Angew. Entomol., 17, 79. Issi & Nilova, 1967, Izv. Akad. Nauk Tadzh. SSR Otd. Biol. Nauk., 1, 66. Nordin & Maddox, 1974, J. Invertebr. Pathol., 24, 3.
Host and Site: [LEPIDOPTERA] *Agrotis segutum* (Schiff.), larva; midgut, fat body, Malpighian tubules, tracheae, salivary glands, muscle, epidermia, ganglia, pericardial cells, oenocytes, gonads.
Vegetative Stages: There are 2 schzogonies. Binary fission and multiple fission of plasmodia with as many as 16 nuclei occur. Chains with 4-6, seldom 8, members occurs.
Sporulation Stages: Diplocaryotic cells become quadrinucleate sporonts and these divide into 2 sporoblasts which transform into spores.
Spore: Ovocylindrical, 4.2 x 1.8 μm, binucleate. Polar filament up to 103 μm.
Locality: Germany (Darmstadt).
Remarks: Weiser commented on the similarity of this species to *N. bombycis*. Nordin and Maddox could not distinguish this from *N. bombycis* and 7 other species. Perhaps this species is identical with *N. bombycis*.

Nosema phalerae Issi & Lipa, 1968

Nosema phalerae I. & L., 1968, Acta Protozool., 6, 285.
Host and Site: [LEPIDOPTERA] *Phalera bucephala* L.; fat body.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: 2.2-4.5 x 1.3-2.0 µm. Polar filament 40 µm.
Locality: U.S.S.R. (Cernovcy, Carpathian region).
Remarks: The authors said that this was previously reported as an unidentified microsporidian by Evlakhova and Shvetsova in 1965.

Nosema phyllotretae Weiser, 1961

Nosema sp. Weiser, 1954, Sb. Česk. Acad. Zemed. Ved., 87, 171-174 [*fide* Weiser, 1961, Monogr. Angew. Entomol., 17, 68, Pl. II-fig. 15].
Nosema phyllotretae Weiser, 1961, *loc. cit.*
Host and Site: [COLEOPTERA] *Phyllotreta atra* E. and *P. undulata* Kutsch.; fat body.
Vegetative Stages: No specific data; similar to other forms.
Sporulation Stages: No data.
Spore: Egg-shaped, 4.2-6 x 2-3 µm. Figure 15 shows 2 nuclei.
Locality: England (Rothamsted).
Remarks: Weiser (*loc. cit.*) cited Weiser, 1961, Věstn. Česk. Spol. Zool., 25, in press, for the original description. This paper, unavailable to me, evidently appeared in print after the monograph appeared.

Nosema phryganidiae Lipa & Martignoni, 1960

Nosema phryganidiae L. & M., 1960, J. Insect Pathol., 2, 396, Figs. 1-19. Weiser, 1961, Monogr. Angew. Entomol., 17, 91.
Host and Site: [LEPIDOPTERA] The California oakworm *Phryganidia californica* Packard, immature and mature stages of both sexes. Mainly in fat body; also in silk gland, epidermis, midgut, central nervous system, gonad, Verson's gland, and, occasionally, in tracheal epithelium, Malpighian tubules, and hemocytes. Experimental infection in *Colias philodice eurytheme*.
Lesion: The fat body becomes almost completely destroyed, while other tissues may not show any signs of the infection.
Vegetative Stages: Uninucleate schizonts rare; binucleate forms most common. Tetranucleate forms divide into cells with "twin nuclei." Chains of 4 schizonts are rare.
Sporulation Stages: Sporont elongate, binucleate. "Some sporonts turn directly into sporoblasts, while others may undergo division. In such cases, after previous fusion, the nuclei of the sporont divide, producing four nuclei. The nuclei migrate in pairs to each end of the sporont and ultimately two sporoblasts are produced" [L. & M.]. The sporoblasts transform into spores.

Spore: Mostly ovoidal, some elongated and slightly curved; 3.4-5.9 x 1.0-2.7 μm (av. 4.69 x 2.14 μm). A few large spores about 6.5-9 μm long seen. Polar filament 70-100 μm.
Locality: U.S.A. (California).

Nosema plodiae Kellen & Lindegren, 1968

Nosema plodiae K. & L., 1968, J. Invertebr. Pathol., 11, 104, Figs. 1-54. Kellen & Lindegren, 1970, *ibid.*, 16, 344. Kellen & Lindegren, 1971, J. Stored Prod. Res., 7, 31, Figs. 1-4. Weiser & Hostounský, 1971, J. Protozool., 18(Suppl.), 29. Hostounský & Weiser, 1972, Věstn. Česk. Spol. Zool., 36, 97. Lom & Weiser, 1972, Folia Parasitol. (Prague), 19, 361, Pl. 5-figs. 1, 2. Kucera & Weiser, 1975, J. Invertebr. Pathol., 25, 109, Fig. 2.
Host and Site: [LEPIDOPTERA] The Indian meal moth *Plodia interpunctella* (Hübner) [type host], all stages; many tissues. Also in the navel orangeworm *Paramyelois transitella* (K. & L. (1970)]. Experimentally infected hosts: *Ephestia kuehniella, E. elutella, Galleria mellonella, Pieris brassicae, Barathra brassicae,* and *Carpocapsa pomonella* [W. & H. (1971)]; *Mamestra brassicae* L. [H. & W. (1972)].
Vegetative Stages: Earliest stage an uninucleate "result of planot development" [K. & L.]. Two types of schizogony occur; the first has no more than 2 nuclei, and the second involves plasmodia with as many as 6 diplocarya and results in "twin daughter diplokarya" [sporonts?].
Sporulation Stages: Binucleate sporoblasts [from the "twin daughter diplokarya"?] become binucleate spores.
Spore: 4.09 x 1.89 μm (fresh, mature). 5.11 x 2.58 μm (fresh, immature). 3.43 x 1.61 μm (stained, mature). Polar filament about 80 μm.
Locality: U.S.A. (Fresno County, California).

Nosema polygrammae Hostounský & Weiser, 1975

Nosema polygrammae H. & W., 1975, Věstn. Česk. Spol. Zool., 39, 106, Fig. 1, Pls. IA and IIA.
Host and Site: [COLEOPTERA] *Polygramma undecimlineata* Stal.; gut epithelium. Experimental host *Leptinotarsa decemlineata* (Say).
Vegetative Stages: Mononuclear and binuclear schizonts present.
Sporulation Stages: Sporoblasts, binucleate, develop into spores.
Spore: Broad-oval, binucleate, 4.8 x 2.05 μm when fresh and 4.2 x 1.8 μm on dry smears.
Locality: Cuba.

Nosema pulicis Nöller, 1912

Nosema pulicis Nöller, 1912, Berl. Klin. Woch., 49, 524-525 [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 103, 207]. Kudo, 1924, *idem*, 103, Figs. 151-153. [?]Weiser, 1957, Česk. Parasitol., 4, 358, Fig. 3. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 131.

[*non*] *Nosema pulicis* Korke, 1916, Indian J. Med. Res., 3, 725, Figs. 1-73.

Host and Site: [SIPHONAPTERA] The dog flea *(Ctenocephalus canis)*; epithelium of ventriculus and midgut, Malpighian tubules, fat body, salivary gland, ovary [Nöller]. The Igelfhöhe *Archaeopsylla erinacei;* fat body [Weiser (1957)].

Vegetative Stages: No data.

Sporulation Stages: No data.

Spore: Oval, 2.5-5 x 1.5-2 µm; polar filament 65-85 µm [Nöller]. 2-2.3 x 1-1.5 µm [Weiser].

Locality: Germany (Berlin) [Nöller], Czechoslovakia (vicinity of Prague) [Weiser].

Remarks: The data are inadequate to substantiate the generic determination. Since fleas tend to be host specific and since parasites tend to evolve with their hosts, it seems probable that Weiser observed a distinct species in the hedgehog flea. (The data by Nöller were taken from Kudo's monograph.)

Nosema pyrausta (Paillot, 1927) Weiser, 1961

Perezia pyrausta Paillot, 1927, C. R. Acad. Sci., 185, 673, Figs. 1, 2. Jírovec, 1936, Věstn. Česk. Spol. Zool., 4, 61. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 35.

Perezia pyraustae Paillot, 1928, Int. Corn Borer Invest. Sci. Rep., 1, 78. Kotlan, 1928, *ibid.*, 174. Hall, 1952, J. Parasitol., 38, 48, Figs. 1-28. Kramer, 1959, J. Insect Pathol., 1, 25. Kramer, 1959, Trans. Am. Microsc. Soc., 78, 336, Pls. 1, 2. Kramer, 1959, Entomophaga, 4, 37. Kramer, 1960, Am. Midl. Nat., 64, 485, Figs. 1-6. York, 1961, J. Insect Pathol., 3, 101. Lewis & Lynch, 1969, Proc. North Cent. Branch Entomol. Soc. Am., 24, 84. Lewis & Lynch, 1970, J. Invertebr. Pathol., 15, 43.

[?]*Nosema pyraustae* Kotlan, 1928, Int. Corn Borer Invest. Sci. Rep., 1, 178, Figs. 3, 4.

Glugea pyraustae (Paillot, 1928) Thomson, 1960, J. Insect Pathol., 2, 355.

Nosema pyraustae (Paillot, 1928) Weiser, 1961, Monogr. Angew. Entomol., 17, 88. Wenn, 1965, Acta Zool. Sinica, 17, 67, Figs. 1-32.

Nosema pyrausta (Paillot, 1927) Weiser, 1961, emend. Lewis & Lynch, 1974, J. Invertebr. Pathol., 24, 149.

Host and Site: [LEPIDOPTERA] The European corn borer *Pyrausta nubilalis* (Hbn.) [= *Ostrinia nubilalis* (Hbn.) of some later workers], larva; Malpighian tubules, silk glands [Paillot (1927, 1928)]. Egg, larva, adult [Kramer (1959)]. [HYMENOPTERA] *Chelonus annulipes* Wesmael, *Macrocentrus gifuensis* Ashmead and [DIPTERA-BRANCHYCERA] *Lydella grisescens* Robineau-Desvoidy [York (1961)].
Lesion: No external signs, Malpighian tubules white and hypertrophied.
Vegetative Stages: Binary fission, producing 2 binucleate daughter cells [Paillot (1927), Hall, Kramer (1959), Wenn]. Also multiple fission of spherical plasmodia with as many as 16 nuclei [Kramer, Wenn]. Also budding [Kramer, Wenn]. Also multiple fission of chain forms [Hall, Kramer, Wenn].
Sporulation Stages: Sporont divides into 2 sporoblasts which transform into spores [Paillot, Hall, Kramer, Wenn].
Spore: Ovoidal, 4-4.5 x 2 μm [calculated from Paillot's figures] and binucleate. Size variable, 3.5-6 x 1.8-3 μm (av. 4.5 x 2 μm); anomalous forms common, binucleate becoming uninucleate [Hall]. Typically ovoidal or cylindrical, 3.2-4.7 x 1.2-2 μm (av. 4.2 x 2.1 μm), binucleate [Kramer]. Shape highly variable [Kramer (1960)].
Locality: France, U.S.A. (many localities), China.
Remarks: Thomson incorrectly attributed the combination *Glugea pyraustae* to Weiser (1958). *Nosema pyraustae* Kotlan is not definitely recognizable as a microsporidium.

Nosema sabaunae Lutz & Splendore, 1908

Nosema sabaunae L. & S., 1908, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 46, 314, Fig. 40. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 86, Fig. 99. Weiser, 1961, Monogr. Angew. Entomol., 17, 82.
Host and Site: [LEPIDOPTERA] Unidentified lepidopteran larva; site not mentioned.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Regularly elongate-ovoid and refractive, always with posterior vacuole, 6-7 x 2-2.5 μm.
Locality: Brazil (São Paulo and Sabauna).
Remarks: The spores were said to be sometimes free and sometimes in cysts of inconstant spore number. On page 311, the authors seemed to use the term "cyst" in the sense of a pansporoblastic membrane. Yet, they listed this species with those having "Unbestimmte Sporenzahl in diffuser Verbreitung." It is impossible to decide whether this is a *Nosema*.

Nosema sapidi De Turk, 1940

Nosema sapidi De Turk [*partim*], 1940, Thesis, pp. 21, Figs. 3-13. Sprague, 1970, *in* "A Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), p. 423. Sprague & Couch, 1971, J. Protozool., 18, 530.
Host and Site: [DECAPODA] The crab *Callinectes sapidus* Rathbun; muscles.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spores: Oval, 3.55-2.13 µm.
Locality: U.S.A. (Beaufort, North Carolina).

Nosema schneideri Léger & Hesse, 1910

Nosema schneideri L. & H., 1910, C. R. Acad. Sci., 150, 412. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 101. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 30. Thomson, 1960, J. Insect Pathol., 2, 352. Weiser, 1961, Monogr. Angew. Entomol., 17, 44.
[?]*Nosema ephemerae* α Lutz & Splendore, 1908, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 46, 314, Fig. 36. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 87.
Host and Site: [EPHEMEROPTERA] *Ephemera vulgata* [type host], and *Ephemera* sp. L. & S., 1908. In gut of larva.
Vegetative Stages: Spherical schizonts undergo binary fission [L. & H.].
Sporulation Stages: "Sporontes monospores" [L. & H.]. Spores diffusely disseminated [L. & S.].
Spore: Ovoid, 4 x 2 µm; polar filament 90 µm [L. & H.]. Egg-shaped, 3.5-4 x 2-2.5 µm [L. & S.].
Locality: France. Brazil.

Nosema scolyti Lipa, 1968

Nosema scolyti Lipa, 1968, Acta Protozool., 6, 72, Figs. 11-22.
Host and Site: [COLEOPTERA] *Scolytus ensifer* Eichh., *S. multistriatus* Marsh., *S. pygmaeus* Fabr., *S. scolytus* Fabr.; Malpighian tubules, intestine, hemocytes.
Vegetative Stages: Schizonts oval, up to 8 µm. "Quadrinucleate schizonts have also been observed and some of them appear as short chains" [dividing sporonts?].
Sporulation Stages: "The sporogony is typical of the genus *Nosema* as one spore is produced from each sporont. The latter is slightly elongate and is up to 6 µ long."
Spore: Usually oval but sometimes irregular in shape. Size (fresh) 3.6-6.2 x 2.0-3.3 µm; (stained) 2.7-4.0 x 1.8-3.2 µm.
Locality: Poland (Poznań). U.S.S.R. (Voronezh). Germany (Lepizig).

Nosema serbica Weiser, 1964

Nosema serbica Weiser, 1964, Prog. Protozool. Proc. Int. Congr. Protozool., 1, 497.
Host and Site: [LEPIDOPTERA] The gypsy moth *Lymantria dispar* L., larva, pupa, and adult; gut wall and spreading to the silk gland, fat body, Malpighian tubules, muscles.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Broad oval with rounded ends, 6-8 x 4 μm, binucleate.
Locality: Yugoslavia (Serbia), Bulgaria (vicinity of Varna).

Nosema sesiae Schwarz, 1929

Nosema sesiae Schwarz, 1929, Z. Morphol. Oekol. Tiere, 13, 697, Pl. 8-fig. 12. Weiser, 1961, Monogr. Angew. Entomol., 17, 83.
Host and Site: [LEPIDOPTERA] *Sciapteron tabaniformis* Rott., larva; site not mentioned.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Substantially smaller than that of *N. nonagriae* and almost spherical.
Locality: Germany (Breslau).
Remarks: This is an incompletely described species but there is no reason to doubt that it is a *Nosema*.

Nosema slovaca Weiser & Řeháček, 1975

Nosema slovaca W. & R., 1975, J. Invertebr. Pathol., 26, 411, Fig. 1.
Host and Site: [ARACHNIDA] *Ixodes ricinus;* hemolymph.
Developmental Stages: A few schizonts were present. Binucleate sporoblasts, isolated, were seen.
Spore: Oval, 4 x 1.6 μm, binucleate.
Locality: Czechoslovakia (Slovakia).

Nosema sperchoni Lipa, 1962

Nosema sp. Steinhaus & Lipa *in* Davies, 1960, Proc. Entomol. Soc. Ont., 90, 53. Lipa & Steinhaus, 1962, Acta Parasitol. Pol., 10, 169.
Nosema sperchoni Lipa, 1962, Bull. Acad. Pol. Sci. Ser. Sci. Biol., 10, 435, Figs. 1-7.
Host and Site: [ARACHNIDA] The water mite *Sperchon* sp.; fat body.
Vegetative Stages: Schizonts uninucleate or binucleate.
Sporulation Stages: Sporonts[?] fusiform and elongated, 5-7 x 2-4 μm.
Spore: Oval, 4.5-5.5 x 3.0-3.5 μm, binucleate.
Locality: Canada (Algonquim National Park).

Nosema sphaeromiadis Weiser, 1957

Nosema sphaeromiadis Weiser, 1957, Česk. Parasitol., 4, 357, 358, Figs. 1d, 1e. Weiser, 1960, Monogr. Angew. Entomol., 17, 122.
Host and Site: [DIPTERA-CERATOPOGONIDAE] *Sphaeromias* sp., larva; fat body.
Vegetative Stages: No data.
Sporulation Stages: Spores arise free in host cell, not enclosed in a pansporoblastic membrane.
Spore: Broad oval, 5-6 x 2.5 µm.
Locality: Czechoslovakia (vicinity of Lnář).
Remarks: This species was described very briefly. Figures of spores show only 1 nucleus. Therefore, the generic determination is in doubt.

Nosema sphingidis Brooks, 1970

Nosema sphingidis Brooks, 1970, J. Invertebr. Pathol., 16, 390, Figs. 1-15. Brooks, 1971, *ibid.*, 17, 87.
Host and Site: [LEPIDOPTERA] The tobacco hornworm *Manduca sexta*, larva; primarily in midgut with infection finally becoming general. Experimental infections produced in larvae of *Manduca quinquemaculata*, *Ceratomia catalpae*, *C. amytor*, *Celerio lineata*, *Atreides plebeius*, *Heliothis zea*, *H. virescens*, and *Trichoplusia ni*.
Lesion: There is a severe inflammatory response with nodule formation, first on midgut and later on other organs. Extensive hemocytic infiltration and melanization occur in late stage [Brooks (1971)].
Vegetative Stages: Schizonts with 1-8 nuclei seen, binucleate forms being predominant. Tetranucleate forms probably are the main stage that undergoes binary fission.
Sporulation Stages: Not clearly described. Binucleate sporonts(?) and sporoblasts were seen.
Spore: Ovocylindrical, 3.8-5.4 x 1.9-2.7 µm, av. 4.3 x 2.2 µm (fresh).
Locality: U.S.A. (North Carolina).
Remarks: The author suggested that *M. sexta* May not be the natural host and that the natural infection may have been due to transmission during oviposition by the hymenopterous parasite *Apanteles congregatus*.

Nosema stegomyiae Marchoux, Salimbeni & Simond, 1903

Nosema stegomyiae M., S. & S., 1903, Ann. Inst. Pasteur (Paris), 17, 714 [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 169, 206, Figs. 601-607]. Simond, 1903, C. R. Soc. Biol., 55, 1335, Figs. 1-9. Marchoux & Simond, 1906, Ann. Inst. Pasteur (Paris), 20, 16 [*fide* Kudo, *loc. cit.*]. Fox & Weiser [*partim*], 1959, J. Parasitol., 45, 21. Thomson, 1960, J. Insect Pathol., 2, 352. Weiser [*partim*], 1961, Monogr. Angew. Entomol., 17, 108. Canning & Hulls, 1970, J. Protozool., 17, 538.

[*non*] *Nosema stegomyiae* Lutz & Splendore, 1908, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 46, 315. Kudo, 1924, Ill. Biol. Monogr. 9(2/3), 88. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 39.
Glugea stegomyiae (M., S. & S., 1903) Auerbach, 1910, "Die Cnidosporidien," p. 190.
Pleistophara stegomyiae (M., S. & S., 1903) Chatton, 1911, Bull. Soc. Pathol. Exot., 4, 664 [*fide* Kudo, 1924, *loc. cit.*, 169, 201]. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 39. Kudo, 1960, AIBS (Am. Inst. Biol. Sci.) Tech. Rpt., p. 53.
Host and Site: [DIPTERA-CULICIDAE] *Aedes aegypti (= Stegomyia fasciata),* larva and adult; stomach, esophagus, air sac, coelom, Malpighian tubules, ovary, ovum, thoracic muscles, the large ganglion, and the tracheal epithelium.
Vegetative Stages: The data are fragmentary and confusing.
Sporulation Stages: Spores occur in masses that are colorless or brown.
Spore: Colorless spore reniform or pyriform, 3-5 x 2-3 μm [Simond].
Locality: Brazil (Rio de Janeiro).
Remarks: The masses of spores are probably within pseudocysts (not pansporoblastic membranes) and the brown color on some masses probably represents melanization due to host reaction.

Nosema steinhausi Weiser, 1956

Nosema steinhausi Weiser, 1956, Česk. Parasitol., 3, 187, Figs. 1-4.
Host and Site: [ARACHNIDA] The mite *Tyrophagus noxius,* nymph and adult; lymphocytes and fat cells.
Vegetative Stages: Proliferation by binary fission.
Sporulation Stages: No data.
Spore: Oval to rod-shaped, 2.8 x 1.3 μm (av.) fresh; 0.6-0.8 x 1.2-1.7 μm stained; binucleate.
Locality: Czechoslovakia.

Nosema stricklandi Jírovec, 1943

Nosema stricklandi Jírovec, 1943, Zool. Anz., 142, 177, Fig. 1. Weiser, 1961, Monogr. Angew. Entomol., 17, 123.
Host and Site: [DIPTERA-SIMULIIDAE] *Simulium* larvae; fat body. *Simulium ornatum* Meig. [*fide* Weiser]. Infected cells become hypertrophied.
Vegetative Stages: Although Jírovec gave no data, Weiser said, in schizogony uni- and binucleate stages were seen and from these diplocarya developed.
Sporulation Stages: Spores arise singly from uninucleate sporoblasts.
Spore: Pyriform, 5 x 2.5 μm.
Locality: Czechoslovakia (vicinity of Chotěboř).
Remarks: The supposed uninucleate condition of the sporoblast raises doubts about whether this is a *Nosema*.

Nosema strictum Moniez, 1897

Nosema stricta Moniez, 1897, C. R. Acad. Sci., 104, 1312. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 196.
Nosema strictum Moniez, 1887, emend. Labbé, 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 108.
Host: [DIPTERA-TIPULIDAE] *Pachyrhina pratensis*.
Developmental Stages: No data.
Spore: 5 x 1.5 µm.
Locality: France (Lille).

Nosema strigeoideae Hussey, 1971

Nosema sp. Cort, Hussey & Ameel, 1960, J. Parasitol., 46, 318, Fig. 1.
Nosema strigeoideae Hussey, 1971, J. Protozool., 18, 676, Figs. 1-4. Knapp, Baldwin & Presidente, 1971, J. Parasitol., 58, 1206. Hussey, 1973, J. Invertebr. Pathol., 22, 193.
Host and Site: [TREMATODA] Hyperparasites of larval stages of 12 species of strigeoid trematodes in 10 species of snails: *Diplostomum flexicaudum* (Cort & Brooks, 1928) [type host] in *Stagnicola emarginata angulata* (Sowerby), *S. e. canadensis* (Sowerby), *Lymnaea stagnalis appressa* Say, *L. s. perampla* Walker, and *Fossaria abrussa* (Say); *Cotylurus flabelliformis* (Faust, 1918) in *L. s. appressa* Say and *L. s. perampla* Walker; *Posthodiplostomum minimum* (MacCallum, 1921) in *Physa parkeri* Currier, *P. magnalacustris* Baker and *Physa* sp.; *Uvulifer ambloplites* (Hughes, 1927) in *Heliosoma trivolvis* (Say) and *H. campanulatum smithii* (Baker); *Apatemon* sp. (*Cercaria burti* Miller, 1923) in *Physa* sp. and *H. c. smithii* (Baker); *Cercaria laruei* Cort & Brooks, 1928, in *S. e. angulata* (Sowerby); *C. yogena* Cort & Bracket, 1937, in *S. e. angulata* (Sowerby); *C. dohema* Cort & Bracket, 1937, in *L. s. appressa* Say and *L. s. perampla* Walker; *C. emarginatae* Cort, 1917, in *S. e. angulata* Sowerby; *C. modicella* Cort & Brooks, 1928, in *Fossaria abrussa* (Say); unidentified strigeoid in *S. e. angulata* (Sowerby); unidentified strigeoid in *H. trivolvis* (Say) and *H. c. smithii* Baker [Cort *et al.* (1960)]. Experimentally transmitted to cercariae of *Fasciola hepatica* [Knapp *et al.*]. Wall cells of sporocyst, germinal masses and embryos infected.
Lesion: Wall cells, filled with parasites, protruded into the cavity of the sporocyst. Germinal masses and embryos became bloated. Finally, sporocysts contained only spores, loose cells, masses of disorganized material, and injured embryos. Larva swollen and opaque [Hussey (1971, 1973)].
Vegetative Stages: Small rounded bodies, 2-3.5 µm.
Sporulation Stages: No data.
Spore: Ovoid, 4.7 x 3.1 µm (av.), with vacuole at posterior end, with elongate or double nucleus. Polar filament over 100 µm.
Locality: U.S.A. (Michigan).

Nosema tatrica Weiser, 1956

Nosema tatrica Weiser, 1956, Česk. Parasitol., 3, 193, Figs. 1-5. Weiser, 1961, Monogr. Angew. Entomol., 17, 46, Fig. 24.
Host and Site: [EPHEMEROPTERA] *Ephemerella ignita* Poda, larva; fat body.
Vegetative Stages: Schizonts in diplocaryon stages seen.
Sporulation Stages: Uninucleate "schizonts" develop into sporoblasts.
Spore: Oval, 3.3-3.5 x 1.7-2 µm.
Locality: Czechoslovakia.
Remarks: It is not clear that the sporulation stages are typical for *Nosema*, since they appear to be uninucleate. Weiser pointed out that this species closely resembles *N. baetis* Kudo, 1921, which also may not be a *Nosema*.

Nosema thomsoni Wilson & Burke, 1971

Nosema thomsoni W. & B., 1971, Can. J. Zool., 49, 786, Fig. 1.
Host and Site: [LEPIDOPTERA] *Choristoneura conflictana*, larva; Malpighian tubules, silk gland, gut.
Vegetative Stages: Binary and multiple fission, producing uninucleate forms.
Sporulation Stages: "Sporonts" give rise to binucleate sporoblasts by nuclear division. Sporoblast undergoes nuclear fusion to produce uninucleate spores.
Spore: Ovoidal (according to figures), 2.1-3.1 x 1.1-1.8 µm, av. 2.7 x 1.4 µm (fresh). Uninucleate. Polar filament up to 52 µm.
Locality: Canada (Ontaria).
Remarks: Either the description is inaccurate in some essential details or this is not a *Nosema*. Considering that isolated spores were produced, that *Nosema* is quite common in Lepidoptera, and that the spores were small, it seems probable that some observations were not accurate. Therefore, this species is left provisionally in the Genus *Nosema*.

Nosema tortricis Weiser, 1956

Nosema tortricis Weiser, 1956, Česk. Parasitol., 3, 207-208 [*fide* Weiser, 1961, Monogr. Angew. Entomol., 17, 84]. Issi & Lipa, 1968, Acta Protozool., 6, 286. Lom & Weiser, 1972, Folia Parasitol. (Prague), 19, 361, Pl. 3-fig. 5.
Host and Site: [LEPIDOPTERA] *Tortrix viridana* L., larva; fat body.
Vegetative Stages: First there are short band-form stages with no more than 4 nuclei. A later stage has paired nuclei and from it diplokaryotic cells separate.
Sporulation Stages: No data.
Spore: Long, oval, often slightly bent, binucleate, 3-4 x 1.5 µm. Surface [in SEM] with very course ridges and fine wrinkles.

Locality: Czechoslovakia (Sudmahren) [Weiser]. U.S.S.R. (Cherson) [I. & L.].
Remarks: Descriptive data taken from Weiser's (1961) monograph, since the original paper was not available.

Nosema tracheophilum Cali & Briggs, 1967, emend.

Nosema tracheophila C. & B., 1967, J. Invertebr. Pathol., 9, 515, Figs. 1-7.
Host and Site: [COLEOPTERA] *Coccinella septempunctata* Linnaeus; hemocytes, tracheal epithelium, and connective tissue.
Vegetative Stages: Binucleate sporoplasm divides repeatedly, forming short chains of uninucleate rounded cells. The latter may become 8-nucleate plasmodia.
Sporulation Stages: A stage identified as sporont [probably sporoblast] and which transforms into a spore was observed.
Spore: Oval, 4-5.3 x 2.2-3.1 µm; polar filament 89-178 µm.
Locality: U.S.A. (Ohio?).
Remarks: The authors summarize in tabular form the characters of species of *Nosema* reported in Coleoptera.

Nosema trichoplusiae Tanabe & Tamashiro, 1967

Nosema trichoplusiae T. & T., 1967, J. Invertebr. Pathol., 9, 188, Fig. 1. Nordin & Maddox, 1974, *ibid.*, 24, 63, Fig. 3.
Nosema trichoplusiae hyphantriae Nordin & Maddox, 1972, SIP (Soc. Invertebr. Pathol.) Newsl., 4, 20.
Nosema sp. Nordin & Maddox, 1974, J. Invertebr. Pathol., 24, 1, Figs. 1-15.
Host and Site: [LEPIDOPTERA] *Trichoplusia ni* (Hübner) [type host], larva; midgut, Malpighian tubules, hemocytes, and, eventually, all organs. Experimentally infected hosts: *Cryptophlebia illepida* (Butler) *Anacamptodes fragillaria* (Grossbeck), *Archea tanata* (Linnaeus), *Elydna nonargrica* (Walker), *Otosema odora* (Linnaeus), *Perigea illecta* (Walker), *Plusia chalcites* (Esper), *Pseudaletia unipuncta* (Haworth), *Spodoptera exigua* (Hübner), *S. mauritia acronyctoides* (Guenee), *Pieris rapae* (Linnaeus), *Argius cingulatus* (Fabricius) [T. & T.]. Original host: *Hyphantria cunea;* experimentally infected hosts: *Diacrisia virginica, Estigmene acrea, Hyphantria cunea, Argotis ypsilon, Autographa* sp., *Heliothis zea, Laphygma frugiperda, Plusia* sp., *Pseudaletia unipunctata, Trichoplusia ni* [N. & M.].
Vegetative Stages: Earliest stage uninucleate, later stages with 2 nuclei or with diplocaryotic nuclei. Reproduction by binary fission [T. & T.]. Octonucleate forms and chain-like forms also seen [N. & M.].
Sporulation Stages: Sporont divides into 2 binucleate sporoblasts that transform into spores.

Spore: Typically, oval, sometimes elongate or curved, 3-4 x 1.9-2.1 μm (av., 3.63 x 1.99 μm); fresh spores, described by Tanabe and Tamashiro. Nordin and Maddox found slightly larger dimensions for both *N. trichoplusiae* and *N.* sp.
Locality: U.S.A. (Hawaii and Illinois).
Remarks: Nordin and Maddox at first (1972) regarded *Nosema* sp. as a subspecies of *N. trichoplusiae* but later (1974) decided that these and 7 other species, including *N. bombycis*, are not clearly distinguishable. Perhaps all these species are identical, in which case the correct name for all of them would be *Nosema bombycis* Naegeli.

Nosema tubifici Ryckeghem, 1928

Nosema tubifici Ryckeghem, 1928, Ann. Soc. Sci. Bruxelles, 48, 139. Jírovec, 1940, Arch. Protistenkd., 94, 91.
Host and Site: [OLIGOCHAETA] The oligochaete annelid *Tubifex* sp.; intestinal epithelium.
Vegetative Stages: No data.
Sporulation Stages: Spores probably arise in isolation.
Spore: 2-3 x 1 μm, with anterior and posterior vacuoles.
Locality: Belgium (Louvain).
Remarks: Because of the form of the spores and their diffuse distribution, the species was regarded as probably a *Nosema*. This determination needs confirmation. Meanwhile, there is no compelling reason for not leaving the species provisionally in the Genus *Nosema*.

Nosema typographi Weiser, 1955

Nosema typographi Weiser, 1955, Věstn. Česk. Spol. Zool., 19, 375, Fig. 1 + Pl. 1A. Weiser, 1961, Monogr. Angew. Entomol., 17, 69, Fig. 35.
Host and Site: [COLEOPTERA] The bark beetle *Ips typographus;* fat body.
Vegetative Stages: Round schizonts develop into "hörnchenförmigen" stages that divide into 3 cells.
Sporulation Stages: No data.
Spore: Oval, thick-walled, binucleate, 3.6-5.3 x 2-3.5 μm. Polar filament up to 63 μm.
Locality: Czechoslovakia (Horsovsky Tyn).

Nosema vanillae α Lutz & Splendore, 1903

Nosema vanillae α L. & S., 1903, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 33, 154-155, Fig. 1. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 82, Fig. 85.
Nosema vanillae L. & S., 1903, Weiser [*partim*,α], 1947, Acta Soc. Sci. Nat. Moravicae, 18, 33. Weiser [*partim*,α], 1961, Monogr. Angew. Entomol., 17, 78.
Host: [LEPIDOPTERA] *Dione vanillae,* larva.

Developmental Stages: No data.
Spore: 2.5-2.75 x .85-1.3 µm.
Locality: Brazil (near São Paulo).
Remarks: The spore dimensions actually given by Lutz and Splendore were 2.5-9.75 x .85-1.30, obviously incorrect. The dimensions given above are taken from Kudo who evidently used his judgement in making corrections. They seem to correspond with the 25 sketches of spores shown in Fig. 1. Lutz and Splendore described α, β, and γ forms that they evidently regarded as 3 distinct species ("3 Arten") though Weiser did not treat them as distinct. The illustrations (Figs. 1, 6, and 8) of these 3 kinds appear quite different. For this reason, I feel that they are distinct. If they actually are distinct, they need different names but it seems premature to deal with the nomenclatural problem now.

Nosema vanillae β L. & S., 1903

Nosema vanillae β L. & S., 1903, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 33, 154-155, Fig. 8. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 83, Fig. 86.
Nosema vanillae L. & S., 1903, Weiser [*partim*, β], 1947, Acta Soc. Sci. Nat. Moravicae, 18, 33. Weiser [*partim*, β], 1961, Monogr. Angew. Entomol., 17, 78.
Host: [LEPIDOPTERA] *Dione vanillae*, larva.
Developmental Stages: No data.
Spore: More or less elongate ovoid or cylindrical, 2.5-3.5 x 1-2 µm.
Locality: Brazil (near São Paulo).
Remarks: Weiser considered *N. vanillae* α and β to be identical, but the illustrations shown for them are so different that I chose to treat them as distinct. I feel it is premature to try to deal with the nomenclatural problems.

Nosema vanillae γ L. & S., 1903

Nosema vanillae γ L. & S., 1903, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 33, 154-155, Fig. 6. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 83, Fig. 87.
Nosema astyrae L. & S., 1903. Weiser [*partim*], 1947, Acta Soc. Sci. Nat. Moravicae, 18, 23.
Host: [LEPIDOPTERA] *Dione vanillae*, larva.
Developmental Stages: No data.
Spore: Predominately elongate-cylindrical, 3.5-6 x 2-3 µm.
Locality: Brazil (near São Paulo).
Remarks: Because illustrations of *N. astyrae* and *N. vanillae* γ look quite different, I chose to treat them as distinct.

Nosema vasicola Canning, Lai & Lie, 1974

Nosema vasicola C. L. & L., 1974, J. Protozool., 21, 21, Figs. 16-26, 29, 30.
Host and Site: [TREMATODA] Hyperparasite of *Echinostoma hystricosum* in the aquatic snail *Lymnaea rubiginosa;* in rediae and cercariae, parenchymal tissue.
Lesion: Infected rediae were distorted and opaque; some were bloated but some were smaller than normal. In heavy infections, the entire parenchyma was replaced by masses of spores.
Vegetative Stages: Small cells with unpaired nuclei undergo binary fission.
Sporulation Stages: "Uninucleate sporonts derived from uninucleate schizonts become binucleate and then tetranucleate." This sporont then divides into 2 binucleate sporoblasts with paired nuclei.
Spore: Slender, rounded anteriorly and pointed posteriorly, 3.1 x 1.6 µm (stained); with vacuole in anterior end; slightly constricted in area of vacuole, giving a vase-shaped appearance; 3.1 x 1.6 µm (stained).
Locality: West Malaysia (Negri Sembilan).
Remarks: Presence of diplocarya only in sporulation stages is atypical for *Nosema*.

Nosema veliae Poisson, 1929

Nosema veliae Poisson, 1929, Arch. Zool. Exp. Gén., 69, 55, Figs. 1-24. Weiser, 1961, Monogr. Angew. Entomol., 17, 60.
Host and Site: [HETEROPTERA] *Velia currens* Fab., with formation of peri-intestinal cysts, then progressive and massive infection of the fat cells and of oenocytes, resulting in parasitic castration.
Vegetative Stages: Small (1.5 µm) schizonts and later larger schizonts (2-4 µm) multiply by binary fission.
Sporulation Stages: Sporont thought to arise by autogamy and then transform into spores.
Spore: Polymorphic; those seen at Banyuls were curved and 5.5-7 x 3 µm. Those at Caen were more regularly ovoid. Macrospores 9-11 µm long.
Locality: France (Caen and Banyuls).
Remarks: The author described a process of spore development involving several nuclei as in the myxosporidia. This is certainly incorrect. Because of the poor description, it is impossible to judge whether this is a *Nosema*.

Nosema weiseri Lipa, 1968

Nosema weiseri Lipa, 1968, Acta Protozool., 5, 375, Pls. 1, 2.
Host and Site: [COLEOPTERA] *Rhizopertha dominica* F.; fat body spreading to all parts of the insect body.
Vegetative Stages: Uninucleate and binucleate schizonts, 1.5 - 4 µm, were seen.

Sporulation Stages: "Sporonts" were elongate with 2 nuclei.
Spore: Ellipsoidal, 3-4.1 x 1.9-2.5 µm (fresh). Polar filament 60 µm.
Locality: Poland (Poznań).
Remarks: The author said, "Inasmuch as one spore is produced from each sporont the species being described belongs to the genus *Nosema.*" This is not an adequate diagnosis of *Nosema,* although the meager data presented raise no real question about the accuracy of the generic determination.

Nosema whitei Weiser, 1953

"neosporidian" White, 1923, Anat. Rec., 26, 359.
Nosema whitei Weiser, 1953, Věstn. Česk. Spol. Zool., 17, 205, Fig. 4E. Kramer, 1960, J. Insect Pathol., 2, 433, Figs. 1-8. Weiser, 1961, Monogr. Angew. Entomol., 17, 68. Fisher & Sanborn, 1962, J. Parasitol., 48, 926. Lipa, 1968, Acta Protozool., 5, 376, Figs. 1-4. George, 1971, J. Invertebr. Pathol., 18, 383. Milner, 1972, *ibid.*, 19, 231, Figs. 1-11. Milner, 1972, *ibid.*, 239, Figs. 1-8. Milner, 1972, *ibid.*, 248, Fig. 1. Milner, 1972, *ibid.*, 20, 356.
Nosema buckleyi Dissanaike, 1955, J. Protozool., 2, 155, Figs. 32-34.
Nosema sp. West, 1960, J. Parasitol., 46, 748, Figs. 1-21. Fisher & Sanborn, 1962, Nature (Lond.), 194, 1193. Fisher & Sanborn, 1964, Biol. Bull., 126, 235.
Host and Site: [COLEOPTERA] *Tribolium castaneum* Herbst, larva and pupa; fat body [Weiser. White. Dissanaike. Kramer. Fisher. & Sanborn. George. Milner]. *Tribolium confusum* [White, West, Fisher & Sanborn, Lipa, Milner]. *Tribolium anaphe* [Milner]. *Tenebrio molitor* [Fisher & Sanborn]. *Oryzaephilus surinamensis* [Milner]. [LEPIDOPTERA, experimental *per os*.] *Galleria mellonella, Bombyx mori* [Fisher & Sanborn]. [BLATTARIA, experimental by surgical introduction] *Blaberus craniifera, Byrsotria fumigata, Periplaneta americana* [F. & S.].
Vegetative Stages: Uninucleate and binucleate meronts undergo binary fission [Milner].
Sporulation Stages: Sporogony results in binucleate sporoblasts [Milner].
Spore: Broad oval, 4.5-5 x 2-2.5 µm [Weiser]. Binucleate [Kramer].
Locality: Cosmopolitan.
Remarks: Milner has compared spores from different hosts and found no significant difference. The same author did an electron microscope study. Fisher and Sanborn demonstrated the production of a juvenile hormone by this microsporidium

Nosema xiphidiocercariae Voronin, 1974

Nosema xiphidiocercariae Voronin, 1974, Parazitologiya (Leningr.), 8, 360, Figs. 1-13.

Host and Site: [TREMATODA] Hyperparasite of sporocysts, cercariae and metacercariae of Plagiochiidae in the snail *Lymnaea palustris* Müll.
Vegetative Stages: Early stages with 2 or 4 separate nuclei. Plasmodial stage with few diplocarya produces sporonts with 1 diplocaryon each.
Sporulation Stages: Sporont divides into 2 binucleate sporoblasts that transform into spores.
Spore: Elliptical or ovoidal, sometimes bent, binucleate, 3.8-5.2 x 1.9-2.4 (av., 4.5 x 2.3) μm when fresh. After Giemsa, 4.0 x 2.3 μm.
Locality: U.S.S.R. (Moscow).

Nosema zavreli Weiser, 1946

Nosema zavreli Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 273, 291, Fig. 1. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 39. Thomson, 1960, J. Insect Pathol., 2, 353. Weiser, 1961, Monogr. Angew. Entomol., 17, 117.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Chironomus thumi* L., larva; midgut.
Vegetative Stages: "Schizogony mit Kleinen runden Plasmodien und mit länglichen zweiten Schizonts" [Weiser (1961)].
Sporulation Stages: No data.
Spore: Oval, 3-4 x 2-2.5 μm.
Locality: Czechoslovakia (near Chotěboř).
Remarks: In 1946 (p. 273), Weiser gave 1944 as the date for the establishment of the name of this species. Unfortunately, I do not have access to the 1944 reference. In 1947, he used the date 1945. In 1961, he used 1946, citing the 1946 reference listed above. In absence of information to the contrary, I assume that the date he gave last is correct.

Nosema zwoelferi Weiser, 1957

Nosema zwölferi Weiser, 1957, Z. Angew. Entomol., 41, 243, Fig. 1. Weiser, 1961, Monogr. Angew. Entomol., 17, 87.
Host and Site: [LEPIDOPTERA] *Eriogaster lanestris* L., larva; gut epithelium.
Vegetative Stages: As with *Nosema apis*, the schizonts grow in long chains along the epithelial cells [Weiser (1961)]. Roundish schizonts, after some divisions, produce longish sporoblasts.
Sporulation Stages: Binucleate.
Spore: Broad oval with rounded ends, 4-4.9 x 2-2.5 μm.
Locality: Czechoslovakia.

Nosema sp. Asayama, 1969

Nosema sp. Asayama, 1969, Jap. J. Appl. Entomol. Zool., 13, 26.
Host and Site: [LEPIDOPTERA] The oriental tussock moth *Euproctis subflava* Bremer, larva; site not mentioned.

Lesion: No data.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Elliptical, 7-9 x 1.3-1.6 μm.
Locality: Japan (Aichi Prefecture).

Nosema sp. Banerjee, 1968

Nosema sp. Banerjee, 1968, Ann. Entomol. Soc. Am., 61, 545, Fig. 1.
Host and Site: [LEPIDOPTERA] The sod webworm *Crambus trisectus* (Walker), larva, pupa, adult; fat body, silk gland, Malpighian tubules, midgut, and meconia. Experimental host: *C. teterrellus* (Zincken), larva.
Lesion: Diseased larva becomes flaccid and contracted, with dorsum blackened.
Vegetative Stages: No data.
Sporulation Stages: Spores "develop from a single sporoblast."
Spore: 2.27 x 5.63 μm.
Locality: U.S.A. (Illinois).

Nosema sp. Bucher & Cheng, 1971

Nosema sp. B. & C., 1971, Can. Entomol., 103, 888.
Host and Site: [LEPIDOPTERA] The dark-sided cutworm *Euxoa messoria* (Harris), larva; fat body.
Lesion: No data.
Vegetative Stages: No data.
Sporulation Stages: "Each sporont produces a single oval spore ... ."
Spore: Oval, 5.0 x 2.5 μm.

Nosema sp. Drea, Angalet & Day, 1969

Nosema sp. D., A. & D., 1969, J. Invertebr. Pathol., 13, 303.
Host and Site: [COLEOPTERA] The alfalfa weevil *Hypera postica* (Gyllenhal), adults; testis, ovary, fat body.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Ovoid, 6 x 4.5 μm; polar filament 60-70 μm.
Locality: U.S.A. (New Jersey).

Nosema sp. Ginecinskaja, 1968

Nosema sp. Ginecinskaja, 1968, [*fide* Shigina & Grobov, 1972, Parazitologiya, 6, 469-475].
Host: [TREMATODA] *Xiphidiocercaria* sp. in the snail *Lymnaea stagnalis*.
Locality: U.S.S.R.
Remarks: Data from Shigina and Grobov, 1972, Parazitologiya 6, 469-475 [Russian].

Nosema sp. Ishiwata, 1917

Nosema sp. Ishiwata, 1917, J. Parasitol., 3, 136, Figs. 1-5.
Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 106, Figs. 183-186.
Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 27.
Host: [LEPIDOPTERA] *Attacus cynthia*, larva.
Developmental Stages: No data.
Spore: Ovoid, tapering toward both ends, 3-3.5 x 2 μm; polar filament relatively short and thick.
Locality: Japan (Tokio).
Remarks: The author said this species is closer to *N. bombycis* than to any other.

Nosema sp. Issi & Lipa, 1968

Nosema sp. I. & L., 1968, Acta Protozool., 6, 285.
Host and Site: [LEPIDOPTERA] *Laspeyresia strobilella* L.; no data on site.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Oval, 2.7-4.2 x 1.2-2.2 μm.
Locality: U.S.S.R. (Leningrad and Kirov regions).
Remarks: Although the authors gave no specific data on the life cycle stages, they said, "The type of schizogony and sporogony indicates that this microsporidian belongs to the genus *Nosema* and evidently is a new species."

Nosema sp. I. & L., 1968

Nosema sp., I. & L., 1968, Acta Protozool., 6, 286.
Host and Site: [COLEOPTERA] The spruce beetle *Pissodes piceae*, larva; no data on site.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Elongate, 3.6-5.0 x 2-2.9 μm, binucleate.
Locality: U.S.S.R. (Leningrad).

Nosema sp. Johnson & Brooks, 1968

Nosema sp. J. & B., 1968, J. Elisha Mitchell Sci. Soc., 84, 446.
Host: [AMPHIPODA] The freshwater amphipod, *Crangonyx pseudogracilis*.
Developmental Stages: No data.
Spore: Ovoidal to ovocylindrical, about 11 x 3.4 μm.
Locality: U.S.A. (North Carolina).
Remarks: Considering the unusual size and shape of the spores and the occurrence of this parasite in an amphipod, it is doubtful that this is a *Nosema*.

Nosema sp. Kellen & Lindegren, 1970

Nosema sp. K. & L., 1970, J. Invertebr. Pathol., 16, 344, Fig. 2.
Host and Site: [LEPIDOPTERA] The navel orangeworm *Paramyelois transitella,* larva; fat body. Also, by artificial infection, the Indian meal moth *Plodia interpunctella.*
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: 5.25 x 2.10 µm (fresh). Polar filament about 65 µm.
Locality: U.S.A. (California).

Nosema sp. Lipa, 1963

Nosema sp. Lipa, 1963, Pr. Nauk. Inst. Ochr. Rosl. Warsz., 5, 127, Figs. 27-37.
Host: [LEPIDOPTERA] *Pieris rapae* L.
Vegetative Stages: Reproduction by binary fission.
Sporulation Stages: Binucleate sporoblast develops into spore.
Spore: Oval, binucleate, 4.5-6 x 2.5 µm.
Locality: Poland(?).

Nosema sp. Lipa, 1964

Nosema sp. Lipa, 1964, Entomophaga Mém. Hors Sér., 2, 77, Figs. 1-5.
Host and Site: [LEPIDOPTERA] *Eurpoctis chrysorrhoea* L., larva; mostly in fat body and silk glands but quite often causes general infection.
Vegetative Stages: Uninucleate and binucleate forms seen.
Sporulation Stages: Sporoblasts fusiform and always solitary.
Spore: Shape variable, mostly elongate but also ovoidal or fusiform; 4.5-8.2 x 2.0-3.5 µm, macrospores up to 10 µm (life); binucleate.
Locality: Poland (Poznań).

Nosema sp. Lom, 1972

Nosema sp. Lom, 1972, Z. Parasitenkd., 38, 200, Figs. 1-17.
Host and Site: [PISCES] *Hippocampus erectus;* skin and abdominal cavity.
Lesion: Cysts whitish, up to 1 mm diameter and packed with spores.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Ovoidal, about 6 x 3.2 µm [estimated from Lom's Fig. 1]. Polar filament with 10-12 turns.
Locality: U.S.A. (New York).
Remarks: Considering the typical cyst and the fact that Lom and Weiser (1969) treated *Glugea* as a junior synonym of *Nosema,* this is almost certainly a species of *Glugea* to one who recognizes this genus as valid.

Nosema sp. Lom & Vávra, 1963

Nosema sp. L. & V., 1963, Věstn. Česk. Spol. Zool., 27, 5, Fig. 5.
Host: [COPEPODA] *Cyclops strenuus.*
Developmental Stages: No data.
Spore: Individual spores have mucous covering that swells in water.
Locality: Czechoslovakia.
Remarks: The presence of a mucous coat suggests that this species may not be congeneric with the type species of *Nosema, N. bombycis,* in terrestrial insects.

Nosema sp. Lom & Weiser, 1972

Nosema sp. L. & W., 1972, Folia Parasitol (Prague), 19, 361, Pl. 1-Fig. 4.
Host: [LEPIDOPTERA] *Antherea pernyi.*
Spore: In SEM preparations, "Their surface shows irregular mostly transverse wrinkles."
Locality: Not mentioned.

Nosema sp. L. & W., 1972

Nosema sp. L. & W., 1972, Folia Parasitol. (Prague), 19, 361, Pl. 5-Figs. 3, 4.
Host: [LEPIDOPTERA] *Euproctis chrysorrhoea.*
Spore: "Spores [in SEM] extremely variable in size and shape, similar to *N. plodiae.* Their shape ranges from tiny, stubby spores of about 1.6 x 1 µ to long cigar-shaped spores of 6 x 1.6 µ in size."
Locality: Not mentioned.

Nosema sp. L. & W., 1972

Nosema sp. L. & W., 1972, Folia Parasitol. (Prague), 19, 361, Pl. 1-Fig. 2.
Host: [LEPIDOPTERA] *Pseudoaletia correcta.*
Spore: "Regularly elongated oval shape, surface wrinkled into an irregular network of folds" [in SEM observations].
Locality: Not mentioned.

Nosema sp. Maddox & Luckmann, 1966

Nosema sp. M. & L., 1966, J. Invertebr. Pathol., 8, 543.
Host and Site: [COLEOPTERA] The alfalfa weevil *Hypera postica,* larva; muscle, fat body, salivary glands, tracheal cells.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Fresh spores from larvae reared at 27°C were 4.3-5.7 x 1.9-2.9 µm, av. 4.9 x 2.5 µm. In larvae maintained at 32°C, the spores were larger. Polar filament up to 300 µm.
Locality: U.S.A. (Illinois?).

Nosema sp. Mercier & Poisson, 1926

Nosema α M. & P., 1926, C. R. Acad. Sci., 182, 1576.
Nosema sp. M. & P., 1926. Jírovec, 1936, Věstn. Česk. Spol. Zool., 4, 60.
Host and Site: [MYSIDACEA] *Mysis spiritus* Norm.; muscle.
Lesion: Infected host porcelain-white.
Developmental Stages: Different stages of schizogony and sporogony observed. Isolated "sporonts" give rise to a single spore each.
Spore: Pyriform, 4 x 2 μm.
Locality: France.

Nosema sp. M. & P., 1926

Nosema β M. & P., 1926, C. R. Acad. Sci., 182, 1577.
Nosema sp. M. & P., 1926. Jírovec, 1936, Věstn. Česk. Spol. Zool., 4, 60.
Host and Site: [MYSIDACEA] *Neomysis vulgaris;* muscle.
Developmental Stage: The principal phases of sporogony were observed.
Spore: Cylindrical, slightly curved, rounded at both ends, 9 x 2.5-3 μm.
Locality: France.

Nosema sp. Nordin, 1975

Nosema sp. Nordin, 1975, J. Invertebr. Pathol., 25, 221, Figs. 1-19.
Host and Site: [LEPIDOPTERA] *Malacosoma americanum,* all stages from egg to adult; in yolk of egg and midgut of larva, spreading to other organs and becoming generalized.
Lesion: Hemocytic aggregations surrounding infected fat body cells were occasionally observed.
Vegetative Stages: Binary fission with 2 schizogonic phases, the first with small compact nuclei and the second with diffuse nuclei.
Sporulation Stages: A sporont with a diplocaryon divides into 2 sporoblasts with diplocarya and these transform into spores.
Spores: 2 x 3.4 μm.
Locality: U.S.A. (Kentucky).
Remarks: Nordin considered this species to be one of a complex of species that he and Maddox (1974) found to be morphologically similar to *N. bombycis.* He considered it to be probably identical with *N. disstriae* (Thomson, 1959).

Locality: U.S.A. (Biscayne Bay, Florida).
Remarks: The authors made an electron microscope study which

Nosema sp. Poljansky, 1955

Nosema sp. Poljansky, 1955, Tr. Inst. Zool. Akad. NAUK SSSR, 19 35.
Host: [PISCES] *Mollotus villosus*.
Descriptive Data: None.
Locality: U.S.S.R.

Nosema sp. Streett, Sprague & Harman, 1975

Nosema sp. S., S. & H., 1975, Chesapeake Sci., 16, 32, Figs. 1 and 2.
Host and Site: [COLEOPTERA] The white pine weevil *Pissodes strobi*, larva and adult; mainly in muscles and fat body but also in several other tissues.
Vegetative Stages: Only binucleate meronts seen.
Sporulation Stages: Spores develop in isolation.
Spore: Two size ranges, 3.5-4.2 x 1.8-2.2 and 5.0-6.0 x 1.8-2.5 µm. Binucleate.
Locality: U.S.A. (western Maryland).

Nosema sp. Tanada, 1962

[?] "Microsporidian" Tanada & Chang [*partim*], 1962, J. Insect Pathol., 4, 129.
Nosema sp. Tanada, 1962, J. Insect Pathol., 4, 495.
Host: [LEPIDOPTERA] The armyworm *Pseudaletia unipunctata* (Hayworth), larva, and (experimentally) the alfalfa caterpillar *Colias eurytheme* Boisduval.
Descriptive Data: None.
Locality: U.S.A. (Hawaii).

Nosema sp. Tanada & Beardsley, 1958

Nosema sp. T. & B., 1958, Proc. Hawaii. Entomol. Soc., 15, 411-463 [*fide* Laigo & Tamashiro, 1967, J. Invertebr. Pathol., 9, 547].
Host: [LEPIDOPTERA] The lawn-armyworm *Spodoptera mauritia acronyctoides*, larva.
Descriptive Data: None.
Locality: U.S.A. (Hawaii).

Nosema sp. Walker & Hinsch, 1972

Nosema sp. W. & H., 1972, Z. Parasitenkd., 39, 17, Figs. 1-10.
Host and Site: [DECAPODA] The spider crab, *Libinia dubia* H. M. E.; epithelium of vas deferens.
Vegetative Stages: No data.
Sporulation Stages: Sporont with diplocaryon divides into 2 sporoblasts, each with a diplocaryon. Sporoblast transforms into spore.
Spore: Ovoidal, about 5 x 3 µm in EM sections.
Locality: U.S.A. (Biscayne Bay, Florida).
Remarks: The authors made an electron microscope study which revealed many details of spore development.

Genus *Ameson* gen. n.

Ameson michaelis (Sprague, 1970) comb. n.

Nosema sapidi De Turk [*partim*], 1940, Thesis, Duke Univ., pp. 21, 23, Figs. 14-16.

Nosema sp. Sprague, 1965, J. Protozool., 12, 66, Figs. 1-20. Bond, 1967, Univ. Md. Nat. Resour. Inst. Ref. 67-63. Sprague, Vernick & Lloyd, 1968, J. Invertebr. Pathol., 12, 105, Figs. 1-15. Weidner, 1970, Z. Zellforsch., 105, 33, Figs. 1-19.

Nosema michaelis Sprague, 1970, *in* "A Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), p 422, Fig. 5. Sprague & Couch, 1971, J. Protozool., 18, 530. Weidner, 1972, Z. Parasitenkd., 40, 227, Figs. 1-20. Weidner & Trager, 1973, J. Cell Biol., 57, 586, Figs. 1-6. Dwyer & Weidner, 1973, Z. Zellforsch., 140, 177, Figs. 1-7. Trager, 1974, Science (Wash. D. C.), 183, 271, Fig. 2.

Host and Site: [DECAPODA] The blue crab *Callinectes sapidus;* early stages in hematopoietic organs and sporulation stages in skeletal muscles.

Lesion: Infected muscles opaque-white.

Vegetative Stages: Binary and multiple fission within hematopoietic organs, involving small cylindrical or spherical plasmodia with 4 nuclei; merogony terminated with diplocaryotic cells [Bond]. Occur within the hemocytes in the submucosa of the host midgut [Weidner (1970)].

Sporulation Stages: Sporont a diplocaryotic cell [Bond]. Sporogony involves delayed cytokinesis, resulting in formation of sporoblasts in pairs or chains [Sprague *et al.;* Weidner (1970)]. Probably extracellular in these stages.

Spore: Ovoid, 2.2 x 1.7 µm, when fresh; binucleate; with chromophilic inner zone of polaroplast (originally misidentified as polar filament); covered with fine projections seen with the electron microscope and interpreted by Dwyer and Weidner as microtubules; polar filament ca. 40 µm.

Locality: Atlantic and Gulf coasts of the United States, common and widely distributed.

Remarks: Type species by original designation. Although this species produces isolated and binucleate spores, the polysporoblastic sporogony and the staining properties of the polaroplast clearly exclude it from the Genus *Nosema.*

Ameson nelsoni (Sprague, 1950) comb. n.

Nosema nelsoni Sprague, 1950, Occ. Pap. Mar. Lab. La. St. Univ., 5, 2, Fig. 1. Woodburn, Eldred & Clark, 1957, Fla. Board Conserv. Mar. Res. Lab. Tech. Serv., 21, 11. Hutton, 1964, Trans. Am. Microsc. Soc., 83, 440. Sprague & Vernick, 1969, J. Protozool., 16, 264, Figs. 1-7. Sprague, 1970, *in* "A Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), p. 423, Fig. 6. Sprague & Couch, 1971, J. Protozool., 18, 530.

[?] *Nosema pulvis*. Jones, 1958, A S B (Assoc. Southeast Biol.) Bull., 5, 10.
Host and Site: [DECAPODA] *Penaeus aztecus* Ives [type host]; muscle. *P. duorarum* Burkenroad. *P. setiferus* (L.). Tentatively identified also in *Metapenaeus monoceros* [F. P. Champion (personal communication)], *Solenocera vioscai* and *Xiphopeneus kroyeri* [D. N. Kruse (personal communication)].
Lesion: Infected muscles opaque white.
Vegetative Stages: No data.
Sporulation Stages: Sporogony unknown. Sporoblasts develop into isolated spores.
Spore: Ellipsoidal, 2.5 x 1.5 µm, with polar filament ca. 23 µm. Internal structure, incorrectly interpreted by Sprague (1950), is similar to that of *A. michaelis*, type species, as seen with both light and the electron microscopes.
Locality: Widely distributed along the southern coast of the United States.
Remarks: This species is transferred to *Ameson* primarily on the basis of spore structure, particularly the presence of a siderophile central portion of the polaroplast. Its occurrence in the muscle of a decapod is a smaller consideration.

Ameson pulvis (Pérez, 1905) comb. n.

Nosema pulvis Pérez, 1905, C. R. Soc. Biol., 58, 148. Pérez, 1905, Bull. Sta. Biol. d'Arcathon, 8, 25, Figs. 12, 13. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 88, Fig. 106. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 27. Sprague, 1970, "A Symposium on Diseases of Fishes and Shellfishes" (S. F. Snieszko, ed.), p. 422. Sprague & Couch, 1971, J. Protozool., 18, 530.
Coccospora pulvis (Pérez, 1905) Poisson, 1953. *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1067.
Host and Site: [DECAPODA] *Carcinus maenas;* skeletal muscle.
Lesion: Infected muscle opaque white.
Vegetative Stages: Multiplication said to be by binary fission.
Sporulation Stages: After a certain number of divisions, each element develops in isolation into a spore.
Spore: Ovoid, 1.25 x 1 µm.
Locality: France (Arcachon).
Remarks: This species, not well known, is placed in the Genus *Ameson* because of its great similarity at the light microscope level to the type species.

Genus *Ichthyosporidium* Caullery & Mesnil, 1905

Ichthyosporidium giganteum (Thélohan, 1895) Swarczewsky, 1914

Glugea gigantea Thélohan, 1895, Bull. Sci. Fr. Belg., 26, 359, Figs. 143, 144. Mercier, 1921, C. R. Soc. Biol., 84, 261.

Reichenow, 1932, *in* "Tierwelt der Nord- und Ostsee" (Grimpe & Wagler, eds.) 21(II), 79.
Nosema giganteum (Thélohan, 1895) Labbé, 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 106.
Ishthyosporidium phymogenes C. & M., 1905, C. R. Soc. Biol., 58, 641. Caullery & Mesnil, 1905, Arch. Zool. Exp. Gen., 4, 139, Figs. 117-124.
Plistophora labrorum Le Danois, 1910, Bull. Soc. Sci. Med. Rennes, 19, 211, 2 figs. Reichenow, 1932, *in* "Tierwelt der Nord- und Ostsee" (Grimpe & Wagler, eds.) 21(II), 79.
Pleistophora gigantea (Thélohan, 1895) Swellengrebel, 1911, Amsterdam Versl. Wis. Nat. Afd. K. Akad. Wet., 20, 238, Figs. 1-7. Swellengrebel, *ibid.*, 14, 377, Figs. 1-7. Swellengrebel, 1912, Parasitology, 4, 345, Figs. 1-22, Pls. 7, 8. Sprague & Vernick, 1968, J. Protozool., 15, 662, Figs. 1-3.
Ichthyosporidium giganteum (Thélohan, 1895) Swarczewsky, 1914, Arch. Protistenkd., 33, 51, Figs. 1-47, textfigs. A-E. Weissenberg, 1921, *in* "Handbuch der Pathogene Protozoen" (S. von Prowazek, ed.), 3, 1397, Figs. 1-3, 5-7, 10-13. Kudo, 1966, "Protozoology, 5th ed.," p. 763, Fig. 763.
Thelohania gigantea (Thélohan, 1895) Caullery, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 928.
[?] *Ichthyosporidium* sp. Schwartz, 1963, Prog. Fish-Cult., 25, 181, Figs. 1-5. Sprague, 1966, J. Protozool., 13, 356, Figs. 1-6. Sprague, 1969, Natl. Cancer Inst. Monogr., 31, 237, Figs. 1-11. Sprague & Vernick, 1974, J. Protozool., 21, 667, Figs. 1-11.

Host and Site: [PISCES] *Crenilabrus melops* [Thélohan, C. & M., Le Danois, Swellengrebel, Mercier]; *C. ocellatus* [Swarczewsky]. *Leiostomus xanthurus* [Schwartz]. Connective tissue of abdomen [all authors]. Also liver [Le Danois].

Lesion: This parasite produces a spectacularly large abdominal swelling that is composed of many cysts. The lesion has been described by several authors, the most recent being Sprague (1969) and Sprague and Vernick (1974).

Vegetative Stages: Merogony of 2 types: First, schizogony by repeated binary fission of small chromophilic cells; second, schizogony by repeated binary fission of cells with large nuclei that eventually become diplocarya (Sprague and Hussey, unpublished). Occurs in cytoplasm of connective tissue syncytium (as "amoeboid forms" of previous authors) while portion of the syncytium gradually develops into characteristic cyst.

Sporulation Stages: Probably disporoblastic; sporoblast binucleate.

Spore: Ovoid with anterior end very attenuated, 7-8 x 5 µm [Thélohan]. 4.4-5.6 x 3.4-4.6 µm [Swellengrebel]. Ovoid, mostly 5 x 3, sometimes 7 x 4 µm [Swarczewsky]. Oval, 3 x 2 µm according to statement but 6 x 3 when calculated from figure [Le Danois].

Locality: France (Roscoff) [Thélohan, Le Danois]; (Concarneau) [C. & M.]; (Luc-sur-Mer) [Mercier]. Holland (Swellengrebel). U.S.S.R. (Sevastopol) [Swarczewsky].
Remarks: No later author has found the spore to be quite so pointed or quite so large as Thélohan described it, yet this has not led anyone to believe that he studied a different species. *Ichtyosporidium* sp. Schwartz, having ovoidal spores about 6 x 4 µm, is morphologically indistinguishable from *I. giganteum*. The description given here (from personal observations) of vegetative stages differs sharply from all previous accounts, which have held that the early stages are uni- or multinucleate amoeboid forms.

Ichthyosporidium hertwigi Swarczewsky, 1914

Ichtyhosporidium hertwigi Swarczewsky, 1914, Arch. Protistenkd., 33, 76, Figs. 48-76, textfigs. F-K. Weissenberg, 1921, "Handbuch der Pathogene Protozoen" (S. von Prowazek, ed.), 3, p. 1398, Figs. 3b-d, 4, 13.
Host and Site: [PISCES] *Crenilabrus pavo*; swellings on gills.
Developmental Stages: Essentially as in *I. giganteum*.
Spore: Ovoid, 6 x 4.5 µm.
Locality: U.S.S.R. (Sevastopol).

Family MRAZEKIDAE Léger & Hesse, 1922
Genus *Mrazekia* Léger & Hesse, 1916

Mrazekia argoisi L. & H., 1916

Mrazekia argoisi L. & H., 1916, C. R. Soc. Biol., 79, 347, Figs. 4-6. Léger & Hesse, 1924, Trav. Lab. Hydrobiol. Pisc. Univ. Grenoble, 14, 52. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 182, Figs. 642-644, textfig. B5. Debaisieux, 1931, Cellule, 40, 147, Figs. 1-81.
Bacillidium argoisi (L. & H., 1916) Jírovec, 1936, Arch. Protistenkd., 87, 317. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 26. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1068.
Bacillidium (Mrazekia) argoisi (L. & H., 1916) Jírovec, 1936, *ibid.*, 336, Fig. 8.
Host and Site: [ISOPODA] The isopod *Asellus aquaticus* L.; fat bodies around stomach [L. & H.]. The parasite is intercellular during a large part of its development. In young infections, it is localized near the nerve chain, in the wall of blood sinuses, maybe in the vessels near the hematopoietic organs, sometimes in the undifferentiated cytoplasm of muscle bundles [Debaisieux].
Lesion (xenoma): Infected host cell and its nucleus becomes hypertrophied (Debaisieux).

Vegetative Stages: Earliest stage seen was a diplocaryon, found in a host cell with hypertrophied nucleus. Diplocarya multiply by "cineses associees," giving 2 daughter diplocarya. Multiple, as well as binary, fission may occur but this is uncertain. [Debaisieux].

Sporulation Stages: The diplocaryon of the last generation undergoes nuclear changes not quite clear to become a copula, which transforms into sporoblast and spore [Debaisieux]. Probably disporous.

Spore: Tubular, 17-23 x 3.5 μm; sometimes curved or twisted; aberrant forms ovoid or pyriform; a long manubrium occupies the axial portion and is terminated by a slender filament that coils around it [L. & H.]. Tubular, 13-20 x 3.5-5 μm, with regularly rounded ends [Debaisieux]. Feulgen preparations show 2 unequal nuclei in sporoblast but these appear as a single, spiral nucleus in the mature spore [Jírovec]. Without tail [all authors].

Locality: France (vicinity of Grenoble) [L. & H.]; Belgium (vicinity of Louvain) [Debaisieux].

Remarks: Type species by subsequent designation, Kudo, 1924. Originally described very briefly. Most stages studied in detail by Debaisieux. Jírovec, using material obtained from Debaisieux, studied sporulation stages in detail. Overlooking the fact that this is the type species of *Mrazekia*, he transferred it to the Genus *Bacillidium* Janda, 1928, which, as Sprague (1970) pointed out, is a junior synonym of *Mrazekia* Léger and Hesse, 1916. Therefore, this species must be returned to Genus *Mrazekia*.

Mrazekia brevicauda L. & H., 1916

Mrazekia brevicauda L. & H., 1916, C. R. Soc. Biol., 79, 347, Fig. 2. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 184, Fig. 645. Jírovec, 1936, Arch. Protistenkd., 87, 317. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), p. 1068. Weiser, 1961, Monogr. Angew. Entomol., 17, 122.

Host and Site: [DIPTERA-CHIRONOMIDAE] *Chironomus plumosus* L., larva; fat body [L. & H.]. *C. anthracinus* Zett. [Weiser].

Lesion (xenoma): No specific data.

Vegetative Stages: No data.

Sporulation Stages: No data.

Spore: Rod-shaped, 20-22 x 1.4-1.5 μm, with short tail, 3.5 μm.

Locality: France (vicinity of Grenoble [L. & H.]; Germany (Lake Plön) [Weiser].

Remarks: It is reasonable to suppose that a xenoma was observed, since (at the same time) the authors described the hypertrophied and multinucleate lymphocyte as characteristic of the genus.

Mrazekia caudata L. & H., 1916

Mrazekia caudata L. & H., 1916, C. R. Soc. Biol., 79, 347. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 182, Figs. 647-651. Jírovec, 1936, Arch. Protistenkd., 87, 317. Lom, 1958, Cesk. Parasitol., 5, 147, Figs. 1-35.
Mrazekia (Myxocystis) caudata L. & H., 1916, Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1068.
Host and Site: [OLIGOCHAETA] *Tubifex tubifex* Mull.; lymphocytes in the body cavity [Lom].
Lesion (xenoma): The parasite causes great hypertrophy of the host cell [Lom].
Vegetative Stages: The initial stage is a "planont" [apparently the germ after its emergence from the spore]. The planont divides [by repeated binary fission?] into about 30 meronts, 3-4 µm large [Lom].
Sporulation Stages: "The meront divide into an immense number of smaller (2-2.5 µ, nucleus 1-1.5 µ) meronts, which become sporonts and then spores," in radial arrangement [Lom].
Spore: Long, straight rods, 16-18 x 1.3-1.4 µm, with tapering tail as long as the spore [L. & H.]. Spores 15-16.6 µm long with tail 16-17 µm, the total length being 31-34 µm, and 1.5-2 µm broad; with a single elongated nucleus 5-6 µm.
Locality: France (vicinity of Grenoble) [L. & H.]; Czechoslovakia (vicinity of Prague) [Lom].
Remarks: Whereas Léger and Hesse considered this species to be identical with *Myxocystis* sp. Mrázek, 1910, in *Limnodrilus* [an opinion followed by Kudo (1934)], Jírovec (1936) studied Mrázek's material and found the species in *Limnodrilus* to be distinct and new. Janda (1928), followed by Jírovec (1936), mistook this for the type species of *Mrazekia* and incorrectly regarded the presence of a tail on the spore as an essential character of the genus.

Mrazekia criodrili (Janda, 1928) Sprague, 1970

Bacillidium criodrili Janda, 1928, Arch. Protistenkd., 63, 86, textfigs. 1, 2, Pl. 8. Jírovec, 1936, *ibid.*, 87, 326, textfigs. 5, 6, Pl. 14-figs. 14-17.
Mrazekia criodrili (Janda, 1928) Sprague, 1970, J. Parasitol., 56, Sec. II, Pt. I, 327.
Host and Site: [OLIGOCHAETA] *Criodrilus lacuum;* lymphocytes lying in body cavity and, in later stages, involving the nephridia.
Lesion (xenoma): Hypertrophied lymphocyte covered with a very fine ciliary coat and often quite fine pseudopodia. Its nucleus divides by simple binary fission (amitosis) or through fragmentation into small pieces.
Vegetative Stages: Uninucleate germ enters lymphocyte, divides by binary fission and produces uninucleate meront. After a period of reproduction, meronts give rise to diplocarya and these transform into small, spherical binucleate sporonts [Jírovec].

Sporulation Stages: Sporonts develop into binucleate sporoblasts and these transform into spores [Jírovec].
Spore: Rod-shaped, usually straight, 20-22 x 1.6 µm in life [Janda]; size variable, small spores 15.5-17 x 1.2-1.4 µm, largest ones 24-25 x 1.6 µm, and most 18-20 x 1.4-1.5 µm, posterior end slightly pointed with 2 straight nuclei in tandem, with manubrium but no polar filament [Jírovec].
Locality: Czechoslovakia.
Remarks: Type species of *Bacillidium* Janda, 1928, by monotypy. When Jírovec (1936) transferred the type species of *Mrazekia* L. & H., 1916, *M. argoisi*, to *Bacillidium* these 2 genera became synonyms. So long as the 2 type species are regarded as congeneric they must both take the older generic name, *Mrazekia*. Sprague did not specifically use the combination *Mrazekia criodrili* but he took an equivalent action by declaring *Bacillidium* (of which *criodrili* is the type species) to be a junior synonym of *Mrazekia*.

Mrazekia cyclopis (Vávra, 1962) comb. n.

Bacillidium cyclopis Vávra, 1962, Věstn. Česk. Spol. Zool., 26, 295, Figs. 1-5.
Host and Site: [COPEPODA] *Acanthocyclops americanus* Marsh; fat body. Experimentally, in *A. vernalis*, *Mesocyclops dybowski*, *Diacyclops crassicaudis*, and *Cyclops strenuus*.
Lesion: No data.
Vegetative Stages: Small uninucleate cells develop into multinucleate bodies in ribbon or chain-like formations. The chain break up into individual cells, each with a large nucleus surrounded by a clear area.
Sporulation Stages: Each cell resulting from merogony undergoes binary fission and each of its daughter cell goes through a diplocaryon stage. These 2 cells, sporoblasts, transform into spores.
Spore: Rod-shaped, straight or slightly curved, 7-7.7 x 1.4 µm, binucleate, with manubrium passing through two-thirds of the spore length. "Electron microscopy shows that the manubrium is a thick wall tube with a narrow inside canal, the inner wall of which consists of two concentric lamellae. The whole spore is covered by a thick doublelayer sheath." Some components of the spore were not identified because of problems with fixation.
Locality: Czechoslovakia (vicinity of Sedlice).

Mrazekia hematobia (Jírovec, 1936) comb. n.
Bacillidium hematobium Jírovec, 1936, Arch. Protistenkd., 87 335, Fig. 7c-d, Pl. 15-figs. 20, 21.
Host and Site: [OLIGOCHAETA] *Limnodriulus hoffmeisteri;* free in blood system. (No remnants of infected host cells could be found).
Vegetative Stages: No data.
Sporulation Stages: Spores appear in packets of more than 100 spores.
Spore: Rod-shaped, 16-17 x 1.2-1.4 μm; without tail; with 2 band-shaped nuclei lying close together end-to-end.
Locality: U.S.S.R. (Turkestan).
Remarks: Found on slides provided by Dr. Cernosvitov.

Mrazekia ilyodrili Jírovec, 1936
Myxocystis sp. Mrázek [*partim*], 1910, Arch. Protistenkd., 18, 247, Figs. 4, 5, Pl. 14-figs. 4, 5.
Host and Site: [OLIGOCHAETA] *Ilodrilus (= Potamothrix) moldaviensis;* lymphocytes in body cavity and ovary.
Lesion (xenoma): Hypertrophied host cell multinucleate, with nuclei near periphery and with a fine ciliary border.
Vegetative Stages: Elongated, uninucleate sporoblasts transform into spores lying parallel or in radial arrangement with their tails oriented toward the center of the giant cell.
Spore: 7-9 x 1.5 μm, with tail about 15 μm; the nucleus apparently single[?]; manubrium sometimes visible.
Locality: Czechoslovakia.
Remarks: Described from Mrázek's slides.

Mrazekia jiroveci nom. nov.
Bacillidium limnodrili Jírovec, 1936, Arch. Protistenkd., 87, 334, textfig. 7, Pl. 15-figs. 18, 19.
Host and Site: [OLIGOCHAETA] *Limnodrilus claparedianus;* lymphocytes in seminal vesicle, egg sac, and body cavity.
Lesion (xenoma): Hypertrophied lymphocyte has likewise a hypertrophied nucleus with large nucleolus and sparse chromatin material. Without ciliary coat.
Vegetative Stages: No data.
Sporulation Stages: Sporonts[?], 4-5 μ.
Spore: Rod-shaped, 22-24 x 1.5 μm, without tails; with light area in anterior end thru which manubrium passes; with band form double nucleus.
Locality: Czechoslovakia.
Remarks: Described from Mrázek's slides. Since *Bacillidium* Janda, 1928, is a junior synonym of *Mrazekia* Léger & Hesse, 1916, this species must be transferred to the latter genus. The name then becomes *Mrazekia limnodrili* (Jirovec, 1936), a secondary homonym of *M. limnodrili* Jírovec, 1936, and must be replaced. *Mrazekia jiroveci* nom. nov. is offered as a replacement name.

Mrazekia limnodrili Jírovec, 1936

Myxocystis sp. Mrázek [*partim*], 1910, Arch. Protistenkd., 18, 247, textfigs. 1, 2. Pls. 14-figs. 5, 6 and 15-figs. 14-20.

Mrazekia limnodril: Jírovec, 1936, *Ibid.,* 87, 324, Fig. 4, Pl. 12, Figs. 9, 10.

Host and Site: [OLIGOCHAETA] *Limnodrilus* sp. Mrazek, 1910; lymphocytes in body cavity.

Lesion (xenoma): The originally uninucleate lymphocyte becomes a giant cell with many nuclei concentrated in the middle and with a thick ciliary coat on the surface.

Vegetative Stages: Young, uninucleate parasites with large nucleoli.

Sporulation Stages: No data.

Spore: Rod-shaped, 8-10 x 1.2 μm, with tail about 10-15 μm, apparently uninucleate.

Locality: Czechoslovakia.

Remarks: Described from Mrázek's slides. The spore probably has two nuclei lying so close together that they appeared as one.

Mrazekia lumbriculi Jírovec, 1936

Myxocystis sp. Mrázek [*partim*], 1910, Arch. Protistenkd., 18, 247, Pl. 15-figs. 8-13.

Mrazekia lumbriculi Jírovec, 1936, *Ibid.,* 87, 320, Figs. 1, 2, Pl. 12-figs. 1-5. Puytorac, 1961, C. R. Acad. Sci., 253, 2600, Figs. 1-4. Puytorac, 1962, J. Microscopie (Paris), 1, 39, Pls. 1-3.

Host and Site: [OLIGOCHAETA] *Lumbriculus variegatus;* lymphocytes in the body cavity.

Lesion (xenoma): Giant cell multinucleate and with smooth surface.

Vegetative Stages: These and all other stages binucleate; merogony by binary fission [Jírovec].

Sporulation Stages: Young "sporonts" are round, with two closely associated nuclei. They elongate into sporoblasts which transform into spores [Jírovec]. Spores lie without any order in the host cell.

Spore: Club-shaped tapering posteriorly, 7.5-9 x 1-1.5 μm, with tapering tail 8-11 μm long [Jírovec]. With a pair of elongated nuclei lying close together and end-to-end; manubrium consist of a portion of the filament around which are organized some secondary structures; filament extends posteriorly from manubrium, being straight or bent but not regularly coiled; a polaroplast not recognized but manubrium may play role analogous to it [Puytorac, electron microscope studies].

Locality: Czechoslovakia [Mrázek]. "Differentes stations" [presumably in France. (Puytorac, 1962)].

Remarks: Originally described from Mrázek's slides.

Mrazekia piscicola Cépède, 1924

Mrazekia piscicola Cépède, 1924, Bull. Soc. Zool. Fr., 49, 109, Figs. 1, 2.

Host and Site: [PISCES] *Gadus merlangus* L.; pyloric cecum.
Lesion: No data.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Broadest at anterior-third and tapering slightly posteriorly, about 20 x 6 μm with fine longitudinal striations on surface and with tapering tail about as long as the spore; with a manubrium inside extending nearly to the posterior end and terminating in a fine filament; filament coils around manubrium.
Locality: Unknown. Parasite found in a preserved fish during dissection.
Remarks: This species is unique in being the only *Mrazekia* found in a vertebrate and the only one in a marine host. Considering also the lack of information about the xenoma, the host-parasite relations, and developing stages, the presumed affinity to other species of *Mrazekia* needs confirmation.

Mrazekia stricta Léger & Hesse, 1916

Mrazekia stricta L. & H., 1916, C. R. Soc. Biol., 79, 347, Fig. 3. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 184, Fig. 646.
Bacillidium strictum (L. & H., 1916) Jírovec, 1936, Arch. Protistenkd., 87, 317.
Host and Site: [OLIGOCHAETA] *Lumbriculus variegatus* Mull.; lymphocytes.
Lesion (xenoma): Infected host cell hypertrophied, often more than 100 μm in diameter, and multinucleate.
Vegetative Stages: No specific data.
Sporulation Stages: No specific data.
Spores: Tubular, straight or slightly curved, without tail, 13-14 x 1.8-2 μm.
Locality: France (Dauphiné).
Remarks: Figure 2 on Pl. 1 shows parasites said to be binucleate but the stage is not distinguished.

Mrazekia sp. Jírovec, 1936

Mrazekia sp., Jírovec, 1936, Arch. Protistenkd., 87, 325, Pl. 13-fig. 13.
Host and Site: [OLIGOCHAETA] *Tubifex* sp.; lymphocytes in body cavity, seminal vesicle, and ovary.
Lesion (xenoma): Giant cells 60-150 x 30-100 μm, covered with a fine coat of cilia 5-7 μm long and containing many nuclei 6-8 μm large.
Vegetative Stages: Uni- or binucleate meronts present among nuclei of giant cell.
Sporulation Stages: Spores develop in parallel arrangement in the giant cell.
Spore: 12-13 x 1.2-2.6 μm.
Remarks: Found on Dr. Hahn's slides.

Mrazekia sp. Jírovec, 1936

Mrazekia sp. Jírovec, 1936, Arch. Protistenkd., 87, 326, Pl. 12-fig. 12.
Host and Site: [OLIGOCHAETA] Unidentified tubeficid; lymphocytes in seminal vesicle and egg sac.
Lesion (xenoma): Giant cell with many nuclei concentrated in middle.
Vegetative Stages: No data.
Sporulation Stages: Spores develop in radial arrangement in the giant cell.
Spore: 8-10 x 0.7-0.2 (sic) µm, with tail 12-16 µm.
Locality: Czechoslovakia.
Remarks: Found in Mrázek's slides.

APPENDIX: MICROSPORIDIA UNCLASSIFIED

Collective Group *Microsporidium* Balbiani, 1884

Microsporidium aedis (Kudo, 1930) comb. n.

Nosema aedis Kudo, 1930, Arch. Protistenkd., 69, 23, Figs. 1-67. Jírovec, 1936, Věstn. Česk. Spol. Zool., 4, 60. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 39. Thomson, 1960, J. Insect Pathol., 2, 347. Kudo, 1960, A I B S (Am. Inst. Biol. Sci.) Tech. Rep., p. 51. Weiser, 1961, Monogr. Angew. Entomol., 17, 110. Canning & Hulls, 1970, J. Protozool., 17, 537.
Host and Site: [DIPTERA-CULICIDAE] *Aedes aegypti*, larva; fat body.
Vegetative Stages: Binary fission produces uninucleate forms. Other forms with paired nuclei divide, in radial formation, to produce many (8?) cells with paired nuclei. The nuclei in these cells fuse to form sporonts[?].
Sporulation Stages: The "sporont" transforms into spores.
Spore: Pyriform, 7.5-9 x 4-6 µm (fixed), uninucleate.
Locality: Puerto Rico.
Remarks: The manner of development and the spore morphology exclude this species from the Genus *Nosema*. Kudo repeatedly compared it with *Stempellia magna*. Since it does not seem to belong to any established genus, it is transferred to the collective group *Microsporidium*.

Microsporidium asperospora (Fritsch, 1895) comb. n.

Glugea asperospora Fritsch, 1895, Bull. Ac. Prague, p. 84, Figs. 7, 8 [*fide* Labbé, 1899, "Das Tierreich" 5, 111].
Plistophora asperospora (Fritsch, 1895) Labbé, 1899, *loc. cit.*
Host: [ROTATORIA] *Brachionus urceolaris* (Müll.) and *B. pala* Ehrb.
Descriptive Data: Large, oval or reniform vesicles contain about 30 spores.

Locality: ?
Remarks: The data are not adequate for making a generic determination.

Microsporidium asplanchnae (Fritsch, 1895) comb. n.

Glugea(?) asplanchnae Fritsch, 1895, Bull. Ac. Prague, p. 83, Fig. 6 [*fide* Labbé, 1899, "Das Tierreich" 5, 110].
Plistophora asplanchnae (Fritsch, 1895) Labbé, 1899, *loc. cit*
Gen. incert. *asplanchnae* (Fritsch, 1895) Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 198.
Nosema asplanchnae (Fritsch, 1895) Budde, 1927, Arch. Hydrobiol., 18, 444.
Host: [ROTATORIA] *Asplanchna* sp.
Descriptive Data: Vesicles spherical, spores oval.
Locality: Hungary.
Remarks: The data are not adequate for making a generic determination.

Microsporidium balantidii (Lutz & Splendore, 1908) comb. n.

Nosema balantidii L. & S., 1908, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 46, 315, Fig. 34. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 88, Fig. 105. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 16.
Host and Site: [CILIOPHORA] "Infusorien vom typus der Balantidien," site not stated (cytoplasm?). Ciliate in rectum of the toad *Bufo marinus* and in frogs.
Vegetative Stages: No data.
Sporulation Stages: Spores lay diffuse or in small cysts with numerous or few (4-8) spores.
Spore: Pyriform or egg-shaped with pointed end, 2-5 x 1-3 μm.
Locality: Brazil (toads from Guaratingueta. Frogs near São Paulo.).
Remarks: Unfortunately, Lutz and Splendore placed all microsporidia in Genus *Nosema*. This species with spores in cysts, clearly is not a species of *Nosema* and the data are inadequate for making a generic assignment. Therefore, it is placed provisionally in the collective group *Microsporidium*.

Microsporidium calopterygis (Weiser, 1956) comb. n.

Plistophora calopterygis Weiser, 1956, Cesk. Parasitol., 3, 198, Figs. 3, 4.
Stempellia calopterygis (Weiser, 1956) Weiser, 1961, Monogr. Angew. Entomol., 17, 54, Figs. 29, 30. Issi, 1968, Acta Protozool., 6, 351.
Host and Site: [ODONATA] *Calopteryx virgo* L. and *C.* sp., larva; fat body.
Lesion: Infected fat body visible through the cuticula.
Vegetative Stages: Schizonts with at most 4 nuclei. These break up into merozoites that begin a second schizogony.

Sporulation Stages: Sporogonial plasmodia with 4 and 8 (infrequently an irregular number) nuclei break up into sporoblasts. Pansporoblastic membrane not mentioned.
Spores: Oval, 3.5 x 1.7 μm. Macrospores, 5-8 x 3-4.5 μm.
Locality: The first host in Czechoslovakia (near Chotebor). The second in Jugoslavia (near Sarajewo).
Remarks: Apparently, this species was transferred to the Genus *Stempellia* after the author noted that an inconstant number of spores are produced by a sporogonial plasmodium. This character alone does not make this species congeneric with *S. mutabilis*, and it does not clearly belong to any other established genus. Therefore, it is transferred to the collective group *Microsporidium*.

Microsporidium cernosvitovi (Jírovec, 1935) comb. n.

Nosema cernosvitovi Jírovec, 1935, Věstn. Česk. Spol. Zool., 3, 1, Figs. 1-5. Jírovec, 1936, *ibid.*, 4, 60. Jírovec, 1936, Zool. Anz., 114, 217, Fig. 1.
Host and Site: [OLIGOCHAETA] *Opistocysta flagellum*; gut epithelium.
Lesion: The figures show typically 1 large cyst in each infected cell. Infected cell shows slight hypertrophy of cytoplasm and degeneration(?) of the nucleus.
Development Stages: Development takes place within a round or elliptical cyst, 20-30 μm in diameter and bounded by a membrane, in the host cell cytoplasm. Long band forms break up into uninucleate "sporonts" (sporoblasts) that transform into spores. Number of spores per cyst highly variable, according to the size of the cyst. Most frequently there are 30-40 spores per cyst but the range is 12-60 or more.
Spore: Egg-shaped, 2-3 x 1-1.5 μm (fixed) with anterior and posterior vacuoles. The number of nuclei in the ripe spore could not be determined.
Locality: Argentina (near Loreto, Missiones).
Remarks: Presumably, this species was placed in the Genus *Nosema* because the spores were isolated within the cyst. However, development of the parasite within a cytoplasmic vacuole ("cyst"), presence of a single nucleus in the sporoblast (to mention only some of the most obvious characters) exclude this species from *Nosema*. Since it does not clearly belong to any established genus, it is transferred to the collective group *Microsporidium*. This species was reported also as new in two publications in 1936 (Zool. Anz., 114, 219-220, and Věstn. Česk. Spol. Zool., 4, 6-7).

Microsporidium chaetogastris (Schröder, 1909) comb. n.

Thelohania chaetogastris Schröder, 1909, Arch. Protistenkd., 14, 119, Figs. 1-60. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 147, Figs. 509-518, 777-779. Debaisieux, 1926, Ann. Soc. Sci. Bruxelles, 46, 599.

Host and Site: [OLIGOCHAETA] *Chaetogaster diaphanus* Gruith; numerous large and small spherical structures (cysts) filled the body cavity, some free and some attached to the septa and body wall.

Vegetative Stages: Youngest stages in connective tissue, less often the muscle. These develop into rosary-like chains with usually 2 (seldom 1 or 3) nuclei in each part. The chains with usually 2 (seldom 1 or 3) nuclei in each part. The chains divide into round, binucleate stages. These divide further so that the end product of merogony is an uninucleate, spherical stage about 3 μm in diameter.

Sporulation Stages: The end product of merogony probably develops directly into the uninucleate sporont distinguished by lightly staining cytoplasm. Sporogony involves 3 successive nuclear divisions accompanied by partial cytoplasmic division to form first a dumbbell, then a cross, and lastly a rosette with 8 uninucleate sporoblasts held together by a centrally located residual mass of protoplasm. These separate and become spores. Sporulation occurs within a very delicate pansporoblastic membrane.

Spore: Ellipsoidal, 4 x 3 μm, sometimes there were macrospores 4 and 6 μm.

Locality: Germany (near Heidelberg).

Remarks: There appear to be 2 kinds of "cysts" in which development occurs. One is a small cyst within a host cell that does not alter the host cell nucleus. Such cysts are also free in the body cavity. The other type is a large (up to 100 μm) multinucleate host cell full of parasites in various stages. Nuclear division was said to occur in the sporoblast, giving 2 then more nuclei. Spore development involving several nuclei as in myxosporidia was said to occur but we can now be sure this is incorrect. Debaisieux thought the "sporogony" described was actually "schizogony," that sporogony was absent, and that the "sporoblasts" in the binucleate stages were diplocarya that produced single spores. Neither Schröder nor Debaisieux found this parasite to be like a typical species of *Thelohania*. Therefore, it is now transferred to the collective group *Microsporidium*.

Microsporidium chapmani (Clark & Fukuda, 1971) comb. n.

Plesitophora chapmani C. & F., 1971, J. Invertebr. Pathol., 18, 400.

Host and Site: [DIPTERA-CULICIDAE] *Culex territans* Walker; gastric caeca and midgut. Also in *Culiseta inornata*

(Williston) [*fide* Hazard & Chapman, W H O Bull. (in press)].
Lesion: Thorax and abdomen of infected larva swollen and light color due to accumulation of cysts between the peritrophic membrane and gut wall and in the caeca. In heavily infected larvae, the epithelium of infected areas was largely destroyed.
Vegetative Stages: Merogony by multiple fission of plasmodia with usually no more than 24 nuclei, producing uninucleate forms.
Sporulation Stages: Plasmodia encyst and further nuclear division occurs, while the size of the nucleus decreases. Finally, thick-walled cysts, 10-30 μm in diameter, contain from about 24 to several hundred spores.
Spore: Subspherical, 2.20 x 1.72 μm, uninucleate; polar filament up to 20 μm.
Locality: U.S.A. (Louisiana).
Remarks: The Genus *Pleistophora* quite probably will eventually be broken into several genera, although our knowledge is too limited to permit delineation of those taxa at present. However, it seems safe to conclude that the present species is not congeneric with *P. typicalis* in fish. Of all the established genera it appears to be most like *Hessia* Ormières & Sprague, 1973, which has thick-walled sporocysts and small, subspherical spores with short polar filaments. More information on details of morphology and development are needed before it can be determined whether this is a species of *Hessia*. Therefore, it is transferred provisionally to the collective group *Microsporidium*.

Microsporidium chironomi (Voronin, 1975) comb. n.

Bacillidium chironomi Voronin, 1975, Parasitologiya (Leningr.), 9, 373, Figs. 1-9.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Chironomus dorsalis* Meig., larva; fat body.
Vegetative Stages: Multinucleate schizonts seen.
Sporulation Stages: Sporogonial plasmodium produces a bundle of many spores.
Spore: Rod-shaped, 15 (11-9) x 0.7 (0.6-0.9) μm, binucleate(?).
Locality: U.S.S.R. (northeast).
Remarks: This species must be removed from the genus *Bacillidium*, a junior synonym of *Mrazekia*. Since it does not clearly belong to the latter genus, however, it is placed provisionally in the collective group *Microsporidium*.

Microsporidium cladocera (Pfeiffer, 1895) comb. n.

Glugea cladocera II Pfeiffer, 1895, "Die Protozoen als Krankheitserreger, Nachträge," p. 66 [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 198, 208].

Plistophora coccoidea (Pfeiffer, 1895) Labbé [*partim*], 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 108. Auerbach [*partim*], 1910, "Die Cnidosporidien," p. 194.
Gen. incert. *coccoidea* (Pfeiffer, 1895) Kudo [*partim*], *loc. cit.*
Thelohania cladocera (Pfeiffer, 1895) Jírovec, 1936, Zool. Anz., 116, 137. Jírovec, 1942, Věstn. Král. Česke Spol. Nauk. Třída Mat. Příroověd., 1942, 3. Lom & Vávra, 1963, Věstn. Česk. Spol. Zool., 27, Pl. 1-fig. 1. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull. 1530, 94.
Host and Site: [CLADOCERA] *Daphnia magna* and *Limnetis* sp. [Pfeiffer], *D. magna* and *D. pulex* [Jírovec]. Hypodermal cells.
Vegetative Stages: Developing stages were mentioned by Jírovec (1936).
Sporulation Stages: A small uninucleate sporont develops into a plasmodium that produces sporoblasts. These develop always into 8 spores within the pansporoblast. Spores seem to be held together by mucus, for no pansporoblastic membrane could be seen [Jîrovec (1936)]. Many pansporoblasts(?) with 8 spores, are packed together in the infected cell.
Spore: When alive, pyriform, showing no internal structure, 3-3.5 x 1.5-1.8 µm. Binucleate in Feulgen preparations. Covered with a mucous envelope that swells in water [L. & V.].
Locality: Germany (Griswald, Heidelberg, etc.). Czechoslovakia (Lednice).
Remarks: In 1936, Jírovec said he identified the species he studied with *Glugea acerinae* II Pfeiffer, 1895, but, in 1942, he corrected this to *Glugea cladocera* II Pfeiffer. The binucleate condition of the spore excludes this species from *Thelohania*. Whether there is a pansporoblastic membrane, also an essential character of *Thelohania*, seems to be in doubt. Hazard and Oldacre think this species does not belong on the THELOHANIIDAE. Therefore, this species is transferred to the collective group *Microsporidium*.

Microsporidium cyclopis (Kudo, 1921) comb. n.

Nosema cyclopis Kudo, 1921, J. Parasitol., 7, 137, Figs. 1-7. Weiser, 1945, Acta Soc. Nat. Moravicae, 17, 8, Fig. 3m.
Host and Site: [COPEPODA] *Cyclops fuscus* [type host]; fat body and reproductive organ(?). *Megacyclops viridis* [Weiser].
Lesion: Infected animal opaque white.
Vegetative Stages: Youngest stage rounded and uninucleate. Spherical or elongated plasmodia develop. "The ultimate products seem to be uninucleate rounded sporonts."
Sporulation Stages: "Each sporont develops into a single spore ... ."
Spore: Pyriform, rounded posteriorly, 4.2-4.7 x 2.7-3 µm (fresh). Polar filament, 75-100 µm.
Locality: U.S.A. (New York). Czechoslovakia.

Remarks: The description of developmental stages was given for *Nosema infirmum* with the statement that this species and *N. cyclopsis* are distinguishable only on spore form. This description, involving uninucleate "sporonts," does not fit *Nosema*. This, plus the fact that Maurand *et al.* (1971) created for *N. infirmum* a new genus *(Tuzetia)*, is strong evidence that *N. cyclopsis* is not a *Nosema*. Therefore, this species is transferred to the collective group *Microsporidium*.

Microsporidium danilewskyi (Pfeiffer, 1895) Canning, 1976

"Mikrosporidien" Danilewsky, 1891, Zentralbl. Bakteriol. Parasitenk. 9, 9.
Glugea danilewskyi Pfeiffer, 1895, "Die Protozoen als Krankheitserreger, Nachtrage," p. 45, 73, Figs. 18-23 [*fide* Labbé, 1899, "Das Tierreich," 5 p. 109].
Plistophora danilewskyi (Pfeiffer, 1895) Labbé, 1899, *loc. cit.*
[?] *Glugea encyclometrae* Guyénot & Naville, 1924, Rev. Suisse Zool., 31, 75.
Plistophora (Glugea, Nosema) danilewskyi (Pfeiffer, 1895). Guyénot, Naville & Ponse, 1925, *ibid.*, 417.
[?] *Nosema (Plistophora) encyclometrae* (G. & N., 1924) G., N. & P., 1925, *loc. cit.*
Pleistophora danilewskyi (Pfeiffer, 1895) Canning, 1976.

Host and Site: [REPTILIA] "Eidechen und Schildkröten" [Danilewsky]. Muscles of *Emys orbicularis* (L.); maybe also *Lacerta* sp. and *Chalcides tridactylus* Laur. [Labbé]. *Tropidonotus natrix;* muscle [Debaisieux (1919)]. [AMPHIBIA] "Froschen" [Danilewsky]. *Rana temporaria* [Pfeiffer, *fide* Kudo (1924)]. [TREMATODA] *Encyclometra bolognensis* Baer in the stomach of the snake *Tropidonotus natrix* and *Telorchis ercolanii* Mont. in the intestine of the reptile [G. & N.].

Vegetative Stages: Rarely seen. Forms with 1, 2, and 4 nuclei seen [G. & N. for *G. encyclometrae*.].

Sporulation Stage: Two types described by Guyenot and Naville for *G. encyclometrae*. When developing in cavities, such as excretory canals, certain networks of the parenchyma or in the cuticle, there were sharply delimited masses of sporoblasts enclosed in a common pansporoblastic envelope. When the parasites were intracellular, there was early dissociation of the sporoblasts which resulted in isolated spores.

Spore: Oval or egg-shaped, 3-4 μm long [Danilewsky]. Pyriform or oval, 3-4 μm long [Pfeiffer, *fide* Kudo]. Average 3-4 μm, some 6-7 μm [Debaisieux]. In life, ovoid 3-3.5 μm, with a clear vacuole in either end, polar filament 50-70 μm [G. & N.].

Locality: Poland (Charkow). Italy (Verone, Bologne). Belgium (Louvain). Switzerland (Geneve).

Remarks: Debaisieux and Guyénot and Naville have given complicated, contradictory and somewhat fanciful life-cycle diagrams for *Glugea danilewskyi* that are more confusing than enlightening [see Kudo (1924, pp. 29-31)]; therefore, it is useless to repeat them here. Guyénot and Naville noted a striking similarity in the life cycle and spore dimension (based on a careful morphometric study) between *G. danilewskyi* and *G. encyclometrae* and distinguished these two, with considerable hesitation, after they were unable to infect snakes in some inconclusive experiments. (The snakes died too early in the experiment.) These two nominal species include organisms that are morphologically indistinguishable and of undetermined generic identity. In view of the wide variety of natural hosts, it seems probable that several species may be involved. Because of the general state of confusion that surrounds these species, it is convenient to lump them provisionally in the collective group *Microsporidium*.

Microsporidium debaisieuxi (Jírovec, 1943) comb. n.

Plistophora simulii forms γ, δ, and ε. Debaisieux & Gastaldi, 1919, Cellule, 30, 196, Figs. 61-114.

Plistophora simulii (L. & S., 1908) D. & G., 1919, Kudo [*partim*], 1924, Ill. Biol. Monogr., 9(2/3), 170. Weiser [*partim*], 1947, Acta Soc. Sci. Nat. Moravicae, 18, 42. Thomson [*partim*], 1960, J. Insect Pathol., 2, 366.

[*non*] *Pleistophora* forms α and β [in *Simulium*] L. & S., 1904, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hgy. Abt. I, Orig., 36, 647, Figs. 22, 23.

Plistophora debaisieuxi Jírovec, 1943, Zool. Anz., 142, 177. Weiser, 1961, Monogr. Angew. Entomol., 17, 126. Vávra, 1965, C. R. Acad. Sci., 261, 3468, Figs. 4-8.

Pleistophora debaisieuxi (Jírovec, 1943) Weiser & Žižka, 1974, J. Protozool., 21, 477.

Host and Site: [DIPTERA-SIMULIIDAE] *Simulium maculatum* Meig. [D. & G.], *S. ornatum* [Weiser]. Larva; fat body.

Lesion: "Tumors," single or multiple, rounded, sometimes lobed. Parasite inside shows distinctive pattern [D. & G.].

Vegetative Stages: Rare; a few uninucleate, binucleate, and plasmodial stages seen. Diplocarya common. Karyogamy reported [D. & G.].

Sporulation Stages: Sporogony results in 20-30 sporoblasts arranged more or less in rosette formation [D. & G.]; 16-32, rarely more, sporoblasts formed, without a pansporoblastic membrane [Jírovec]. "The sporont ... grows from a diplokaryon to a multinucleate plasmodium with single nuclei in fingerlike protrusions" [W. & Z.].

Spore: Ovoidal [in illustrations], 6-8 x 3.5-5 μm. Macrospores occur. Uninucleate in Feulgen preparations [Jírovec].

Locality: Belgium (Louvain). Czechoslovakia (near Lnáře and Chotěboř).
Remarks: The type of sporogony (apparently no pansporoblastic membrane) excludes this species from Genus *Pleistophora*. There is no other established genus to which it seemingly belongs. Therefore, it is now placed in the collective group *Microsporidium*. (After this was written, I found that Vávra (Vol. 1 of this series, Chapter on Structure of Microsporidia, Figs. 24, 25, 29) revealed the presence of individual pansporoblastic membranes around the sporoblasts and spores as in *Tuzetia*.)

Microsporidium distomi (L. & S., 1908) Canning, 1975

Nosema distomi L. & S., 1908, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 46, 314, Fig. 33. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 87, Fig. 102.
Microsporidium distomi (L. & S., 1908) Canning, 1975, C I H Misc. Publ., 2, 2.
Host and Site: [TREMATODA] *Distomum lingulata* Rud. (?)in gut of *Bufo marinus*, vitellaria.
Sporulation Stages: Spores lay free or in undertermined number encysted in the vitellaria.
Spore: Regularly ovoid, often with posterior vacuole, 2 x 0.8-1 µm.
Remarks: Lutz and Splendore assigned all species to the Genus *Nosema*. Presence of "encysted" spores strongly suggest that this species belongs to another genus.

Microsporidium elongatum Moniez, 1887

Microsporidia elongata Moniez, 1887, C. R. Acad. Sci., 104, 185.
Microsporidia (Nosema) elongata Moniez, 1887, *ibid.*, 1314.
Plistophora obtusa (Moniez, 1887) Labbé [*partim*], 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 109. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 243.
Nosema elongatum (Moniez, 1887) Jírovec, 1936, Zool. Anz., 116, 136, Fig. 1. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 21.
Host and Site: [CLADOCERA] *Simocephalus vetulus* [Moniez]. *Daphnia magna;* hypodermal cells [Jírovec].
Vegetative Stages: No data.
Sporulation Stages: Spores always single [Jírovec].
Spore: Elliptical, 5 x 2 µm [Moniez]. Elliptical, 4-5 x 1.8-2.8 (4.5-2.4 av.) µm, uninucleate in Feulgen preparations [Jírovec].
Locality: France. Czechoslovakia.
Remarks: Jírovec transferred this species to *Nosema* because he saw only single spores. However, it must be removed from this genus because the spores are uninucleate. It is, therefore, transferred back to *Microsporidium*, considered to be the equivalent of *Microsporidia* Moniez.

Microsporidium ephemerae (Lutz & Splendore, 1908) comb. n.

Nosema ephemerae β L. & S., 1908, Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. I, Orig., 46, 314, Fig. 37. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 87. Weiser, 1961, Monogr. Angew. Entomol., 17, 44.
Host and Site: [EPHEMEROPTERA] *Ephemera* sp, larva; gut.
Vegetative Stages: No data.
Sporulation Stages: Spores either diffuse or in small cysts containing 4 or 8 or an undetermined number.
Spore: Elongate-ovoid [according to figures], 2 x 0.6 μm.
Remarks: The data on host and site are inferred from the context. The occurrence of spores in cysts seem to exclude this species from the Genus *Nosema*. Kudo called attention to its resemblance to *Stempellia mutabilis* Léger and Hesse, 1910, also in *Ephemera*. Since there is no adequate basis for reclassifying this species, it is transferred provisionally to the collective group *Microsporidium*.

Microsporidium eriogastri (Weiser, 1957) comb. n.

Thelohania eriogastri Weiser, 1957, Z. Angew. Entomol., 41, 244, Fig. 2. Weiser, 1961, Monogr. Angew. Entomol., 17, 95. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.
Host and Site: [LEPIDOPTERA] *Eriogaster lanestris* L., larva; hypodermis.
Vegetative Stages: In smears of the tissues were found small binucleate planonts, young schizonts, and stages in schizogony [Weiser (1957)]. Of the vegetative stages only small diplocarya and round uninucleate schizonts are known.
Sporulation Stages: The initial stage is an oval merozoite with dark-staining cytoplasm and large nucleus with chromosomes in form of a net. This undergoes sporogony to produce 8 sporoblasts within a thin pansporoblastic membrane.
Spore: Egg-shaped, with bluntly rounded end and vacuole at each pole. 3.5-4.5 x 2 μm; binucleate.
Locality: Czechoslovakia.
Remarks: Hazard and Oldacre, for reasons not given, think this species does not belong to the THELOHANIIDAE. The binucleate spore excludes it from this family. There seems to be no better alternative to placing it in the collective group *Microsporidium*.

Microsporidium francottei (Léger & Duboscq, 1909) comb. n.

Gurleya francottei L. & D., 1909, Bull. Cl. Sci. Acad. R. Belg., 8, 885-902, fig. [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 129, Figs. 370-382, 776]. Kudo, 1924, *loc. cit.* Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 36. Thomson, 1960, J. Insect Pathol., 2, 356. Weiser, 1961, Monogr. Angew. Entomol., 17, 106.

Pyrotheca francottei (L. & D., 1909) Hesse, 1935, Arch. Zool. Exp. Gén., 75, 660. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1061, Fig. 811.
Host and Site: [DIPTERA-PTYCHOTERIDAE] *Ptychoptera contaminata*, larva; epithelial cells of midgut.
Lesion: The host cell becomes enlarged twice the normal size and the cytoplasm disappears. The nucleus also undergoes hypertrophy and undergoes lysis.
Vegetative Stages: Uninucleate schizonts, 4 μm in diameter, undergo binary fission.
Sporulation Stages: "Pansporoblast" [sporont?] about 6 μm in diameter, with large nucleus, initiates sporogony. The nucleus divides twice, producing 4 nuclei. The plasmodium divides in stellate formation, producing 4 sporoblasts which develop into spores. At first the spores are arranged in the form of a cross with their posterior ends together. No common membrane is present and the spores soon become separated.
Spore: Pyriform, 3 μm.
Locality: Belgium.
Remarks: All descriptive data were taken from Kudo (1924). The lack of a pansporoblastic membrane excludes this species from Genus *Gurleya*. Hesse transferred it to Genus *Pyrotheca* only because the spore is roughly similar in shape to that of *P. incurvata*. It shows no other similarities to *P. incurvata* and most authors have not followed Hesse. Since it does not seem to belong to either *Gurleya* or *Pyrotheca*, it is transferred to the collective group *Microsporidium*.

Microsporidium ghigii (Guyénot & Naville, 1924) comb. n.
Glugea ghigii G. & N., 1924, Rev. Suisse Zool., 31, 96, Figs. 5-6.
Nosema (Plistophora) ghigii (G. & N., 1924) Guyénot, Naville, Ponse, 1925, *ibid.*, 418.
Host and Site: [CESTODA] *Plerocercoides pancerii* Polonio, in subcutaneous connective tissues, muscle, and peritoneum of the snake *Tropidonotus natrix* L., parenchyma and epidermis. [TREMATODA] *Telorchis ercolanii* Mont. in *Tropidonotus natrix* L., parenchyma and epidermis. [REPTILLA] *Tropidonotus natrix* L., in the tissue surrounding the infected cestode.
Vegetative Stages: No data.
Sporulation Stages: A few plasmodia and a few groups of spores apparently enclosed in membranes were seen, the great majority of the spores were isolated.
Spores: 2 x 2.5 μm.
Locality: Italy (Bologne).
Remarks: In the light of modern knowledge, we can say without hesitation that this is not a species of *Glugea*. As the authors themselves indicated, it could possibly be a *Nosema* or a *Pleistophora* but it cannot be assigned to either of these genera with confidence. Therefore, it is placed in the collective group *Microsporidium*.

Microsporidium girardini (Lutz & Splendore, 1903) comb. n.

Nosema girardini L. & S., 1903, Zentralbl. Bakteriol. Parasitenkd. Hyg. Abt. I, Orig., 33, 154, Fig. 4. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 84, Fig. 89.
Host and Site: [PISCES] *Girardinus* sp.; in skin, musculature, and intestinal serosa and mucosa.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Pyriform, 2-2.5 x 1-1.5 µm.
Locality: Brazil (near São Paulo).
Remarks: The shape of the spores and the occurrence of them in a fish suggest that it is highly unlikely that this is a species of *Nosema*. It is, therefore, transferred to the collective group *Microsporidium* pending further information.

Microsporidium giraudi (Léger & Hesse, 1917) comb. n.

Glugea mülleri Pfeiffer [*partim*], 1984, *in* "Correspondezblatter des allgemeinen ärztlichen Vereins von Thüringen," p. 21-22 [*fide* Labbé, 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, p. 109]. Pfeiffer, 1895, "Protoz. Krankh., Suppl.," p. 54-60, 72 [*fide* Labbé, *loc. cit.*]. Debaisieux, 1919, Cellule, 30, Figs. 54-86. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 119, Figs. 296-313.
Plistophora mülleri (Pfeiffer, 1894) Labbé [*partim*], 1899, *loc. cit.* Georgévitch, 1929, Arch. Protistenkd., 65, 148, textfig. 1 + Pls. 4-8. Jírovec, 1943, Priroda (Brno), 35, 152, Fig. 3.
Thelohania giraudi L. & H., 1917, C. R. Soc. Biol., 80, 14, Figs. 519, 752. Poisson, 1953, *in* "Traité de Zoologie (P. P. Grassé, ed.), 1(2), 1063, Fig. 812B. Lipa, 1967, Acta Protozool., 5, 95.
Plistophora blochmanni Zwölfer, 1926, Arch. Protistenkd., 54, 261, Figs. A-F and 1-75. Zwölfer, 1926, *ibid.*, 341, Fig. A. Jírovec, 1936, Věstn. Česk. Spol. Zool., 4, 62.
Stempellia mülleri (Pfeiffer, 1894) Bulnheim, 1971, Arch. Protistenkd., 113, 137, Figs. 1, 2.
Host and Site: [AMPHIPODA] *Gammarus pulex* (L.) [Pfeiffer, L. & H., Zwölfer, Ryckeghem (1930)]. *Gammarus locusta* L. [Debaisieux]. *Niphargus ilidzensis* Schäf. [Georgévitch]. *Gammarus oceanicus* Segerstrale, *G. salinus* Spooner, and (experimentally) in *G. duebeni* Lilljeborg and *G. zaddachi* Sexton [Bulnheim].
Lesion: Forms white stripes in all the muscle bundles of the thorax, abdomen, and appendages [L. & H.]. As many as a dozen white stripes are mainly in the posterior part of the body [Debaisieux]. Mainly longitudinal stripes in the dorsal part of the abdominal segments [Zwölfer]. One or two white longitudinal stripes, situated dorsally or dorsolaterally in the region of the last abdominal segments [Ryckeghem].

Vegetative Stages: Small uninucleate and binucleate cells observed [Zwölfer]. An uninucleate cell develops into a plasmodium that produces binucleate cells (each a "copula") within a common membrane [Debaisieux]. Plasmodia arise and produce cells with diplocarya [Ryckeghem]. A binucleate sporoplasm undergoes autogamy followed by repeated binary fission [Georgévitch].
Sporulation Stages: Spherical vesicles 10-40 µm contain 8-32 spores [Labbé]. A sporont produces cysts containing 4, 8, 16, or 32 spores [L. & H.]. Each "copula," after autogamy, divides into 2 sporoblasts which transform into spores [Debaisieux]. Final product of schizogony, a sporont, develops into a plasmodium that divides into sporoblasts, 40 and upward [Georgévitch]. Variable number of spores, usually 8, contained in a "loge" [Ryckeghem].
Spore: Pyriform, with polar filament 15 µm [Labbé]. Ovoid, 5.5 µm long; polar filament at least 60 µm [L. & H.]. Dimensions 5-6 x 2-3 µm [Debaisieux]. Oval-pyriform, 4.5 x 2.2 µm [Ryckeghem]. Egg-shaped to elliptical, sometimes bean-shaped, 6 x 3 µm [Zwölfer]. Ovoid, 6 x 3 µm [Georgévitch]. Oval, 5-6 x 2-3 µm [Jírovec].
Locality: Germany (Griefswald, etc.), Belgium (Louvain), France (Paris, Grenoble?), Yugoslavia, Czechoslovakia (Prague).
Remarks: I have followed Bulnheim, without strong conviction, in synonymizing some species that have been sometimes treated as distinct. However, I have strong convictions against assigning this species to the Genus *Stempellia*. It is quite relevant to recall that (Art. 61 of the Code) "the standard of reference that determines the application of a scientific name" is the type, in this case *Stempellia mutabilis* Léger & Hesse, 1910, type species of *Stempellia*. Unfortunately, the authors who described this species told us very little about it. They do say that tetrasporous sporonts (producing pyriform spores) and octosporous sporonts (producing ovoid spores) occur in about equal numbers and that monosporous and disporous sporonts occur rarely. Whether there was a pansporoblastic membrane they did not say. Kudo (1924) altered the description significantly when he said, "Each sporont develops into one, two, four or eight sporoblasts and ultimately into one, two, four or eight spores." Later authors have generally followed this misleading version of the original description. Weiser (1961) also deviated significantly from the standard of reference in the following part of his definition of *Stempellia:* "Plasmodien und Pansporoblasten zu 2, 4, 8, 16 oder 32 Gleidern." Bulnheim, following Weiser's definition, transferred to *Stempellia* a species that fits very poorly the description of the type species, a species (a mixture of *Gurleya* sp. and *Thelohania* sp.?) so poorly described in the first place that no other known species can confidently be regarded as congeneric with it. While

I am strongly opposed to transferring this species to *Stempellia,* it does not clearly belong to any other genus. Therefore, I place it in the collective group *Microsporidium.* The specific name *giraudi* Léger & Hesse is used because, as these authors said, the name *Thelohania muelleri* should be reserved for a part of *Glugea muelleri* Pfeiffer that was studied by Stempell (1901, 1902). Pfeiffer's papers were not available. The date 1894 was taken from Labbé, although most authors have used 1895.

Microsporidium haematobium (Jírovec, 1936) comb. n.

Nosema haematobium Jírovec, 1936, Zool. Anz., 114, 219, Fig. 2. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 18.

Host and Site: [OLIGOCHAETA] *Tubifex tubifex;* blood vascular system, especially sinuses around gut.

Lesion: Spore masses in large numbers were on the walls of the blood sinuses and sometimes completely filled the lumen of a sinus.

Development Stages: Besides spores, only a spherical plasmodium of unknown significance was seen. Often spores were in cysts that were very difficult to demonstrate.

Spore: Broad elliptical, 5 x 2.5-3 µm. The number of nuclei could not be determined.

Locality: Czechoslovakia (near Mokropsy).

Remarks: This species was placed provisionally in the Genus *Nosema* but the author said that if the cysts in which spores were sometimes seen were pansporoblastic membranes the species would have to be assigned to the Genus *Plistophora.* Since this species was placed in the Genus *Nosema* with hesitation and only because it does not seem to fit into any other genus, some confusion may be avoided by transferring it to the collective group *Microsporidium.*

Microsporidium holopedii Fritsch & Vávra, 1894

Microsporidium holopedii F. & V., 1894, Arch. Landesdf. Böhmen., 9, 106, Figs. 70, 71 [*fide* Labbé, 1899, *in* "Das Tierreich" (O. Butschli, ed.), 5, 110].

Plistophora holopedii (F. & V., 1894) Labbé, 1899, *loc. cit.*

Gen. incert. *holopedii* (F. & V., 1894) Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 197. [See Kudo for other synonyms.]

Host: [CLADOCERA] *Holopedium gibberum.*

Developmental Stages: Cyst contained ordinarily 8 (sometimes 10) spores [Labbé].

Spore: Pyriform with clear vacuole at one end.

Locality: Hungary.

Microsporidium hyphantriae (Weiser, 1953) comb. n.

Thelohania hyphantriae Weiser, 1953, Věstn. Česk. Spol. Zool., 17, 228. Weiser & Veber, 1957, Z. Angew. Entomol., 40, 55. Thomson, 1960, J. Insect Pathol., 2, 358. Weiser, 1961, Monogr. Angew. Entomol., 17, 93. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.

Host and Site: [LEPIDOPTERA] The fall webworm *Hyphantria cunea* Drury, larva; fat body. Experimental hosts: *Nygmia phaeorrhoea* Don., *Malacosoma neustria* L. and *Hyponomeuta malinella* mentioned by Weiser and Veber in 1957 while *Euproctis chrysorrhoea* L. and *Malacosoma neustrium* L. were mentioned by Weiser in 1961.

Lesion: Only the fat body becomes infected. This is consumed and becomes a spore mass.

Vegetative Stages: Amoeboid planonts with 1 or 2 nuclei described in the lumen of the gut. Binary fission and multiple fission of filiform plasmodia. Diplocarya were common. Some cells with diplocarya underwent autogamy and became initial stages in sporulation.

Sporulation Stages: The initial stage with a large nucleus underwent nuclear division and developed into octonucleate pansporoblast and this produced 8 spores. Before the spores were ripe the pansporoblast broke up and set the spores free. It appeared, also, that single spores developed directly from the uni- and binucleate schizonts.

Spore: Oval, binucleate, 4-5 x 2-3 µm.

Locality: Czechoslovakia (near Surany)

Remarks: Named in 1953 and described fully in 1957. The binucleate condition of the spore excludes this species from Genus *Thelohania*. It is also not completely clear that a pansporoblastic membrane, an essential character of *Thelohania*, is present. Conceivably, this could be a *Nosema* in which configurations suggestive of pansporoblasts were seen. Because of the uncertain status of this species, it is transferred provisionally to the collective group *Microsporidium*.

Microsporidium incurvatum Moniez, 1887

Microsporidia incurvata Moniez, 1887, C. R. Acad. Sci., 104, 185

Microsporidia (Nosema) incurvata (Moniez, 1887) Moniez, 1887, *ibid.*, 1314.

Plistophora obtusa (Moniez, 1887) Labbé [*partim*], 1899, "Das Tierreich" (O. Bütschli, ed.), 5, 109. Kudo [*partim*], 1924, Ill. Biol. Monogr., 9(2/3), 167. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 22.

Host: [CLADOCERA] *Daphnia pulex*.

Spore: The two ends almost equal in size, slightly curved, 5 x 2 µm, with a clear spot.

Locality: France (Lille).

Remarks: This species has not been found again since Labbé lumped several nominal species distinguished by Moniez under *Plistophora* *obtusa* (Moniez). Most of these were later recognized as separate species and there is no reason to doubt that this is also distinct.

Microsporidium ixodis (Weiser, 1957) comb. n.

Nosema ixodis Weiser, 1957, Česk. Parasitol., 4, 357, 358, Fig. 1b, 1c.
Encephalitozoon ixodis (Weiser, 1957) Weiser & Řeháček, 1975, J. Invertebr. Pathol., 26, 411.
Host and Site: [ARACHNIDA] The tick *Ixodes ricinus*, nymph; "in dem Korper."
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Oval, 1.6-2.6 x 1.2-1.4 µm. Uninucleate [W. & R.].
Locality: Czechoslovakia (vicinity of Koloeje).
Remarks: The description was very brief and more data are needed to substantiate the generic determination.

Microsporidium laverani (Caullery & Mesnil, 1899) comb. n.

Glugea laverani C. & M., 1899, C. R. Soc. Biol., 51, 791. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 120. Auerbach, 1910, "Die Cnidosporidien," p. 191.
Plistophora laverani (C. & M., 1899) Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 17.
Host and Site: [POLYCHAETA] The marine worms *Scoloplos muelleri* and *Scolelepis fuliginosa*. "Parasites" [cysts] usually free in body cavity of the former host but sometimes in the tissue. Normally in the epidermis and its derivatives (for example, the nervous system) of the second host; rarely also in body cavity and then surrounded by a coat of phagocytes.
Lesion: Cysts [described as "vegetative stages"] resemble plasmodia with amoeboid prolongations. Very irregular but when filled with spores they condense into large spheres. The external zone does not contain spores. A vesicular nucleus with distinct karyosome is present.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Ellipsoidal, with clear vacuole at one end, 4-4.5 x 1.5-2 µm.
Locality: France (near cape of the Hague).
Remarks: All present knowledge of cysts ("vegetative stages") similar to those in this species indicates that they are infected host cells. With respect to this character, therefore, and the spore shape, the present species fits the Genus *Glugea*. However, these are not compelling reasons to call it a *Glugea* and we have little more pertinent data. Because no species known to have all the essential characters of the Genus *Glugea* has been described in the invertebrates, I cannot accept this

as a species of *Glugea*. Kudo (1924) transferred an apparently very similar species, *Myxocystis ciliata* Mrázek, 1897, to *Nosema* but neither of these two species is known to have characters (such as the diplocaryon) that we now regard as essential characters of *Nosema*. There is no evident reason to call it a *Pleistophora*. The fact is that we do not have enough data to place such species into a modern classification. Therefore, I propose to transfer the present species to the collective group *Microsporidium*.

Microsporidium legeri (Paillot, 1941) comb. n.

Mesnilia legeri Paillot, 1941, C. R. Soc. Biol., 135, 1041. Poisson, 1953, *in*, "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1068.

Stempellia legeri (Paillot, 1941) Weiser, 1961, Monogr. Angew. Entomol., 17, 95. Issi, 1968, Acta Protozool., 6, 350.

Host and Site: [LEPIDOPTERA] *Clysia ambiguella* Hbn., larva; mainly in midgut epithelium but also in silk glands, Malpighian tubules, pericardial cells, oenocytes, muscles, hypodermal cells, fat tissue, reproductive organs, and sex cells.

Vegetative Stages: Reproduction by binary and multiple fission. Plasmodia sausage-shaped or rounded. Binucleate forms, with nuclei like grains of coffee [diplocarya] rare.

Sporulation Stages: "Pansporoblasts" produce a variable number of spores. One sees multisporous masses with 4, 8, 16, 24, and more spores as well as isolated spores. Octosporous masses most common. Pansporoblastic membrane not mentioned.

Spore: Small, 2 x 1 µm, uninucleate.

Locality: France (Saint-Genis-Laval). Czechoslovakia (Bratislava).

Remarks: Type species of *Mesnilia* Paillot, 1941, junior homonym of *Mesnilia* Canu, 1908, Crustacea. Weiser evidently placed this species in Genus *Stempellia* only because the sporogonial plasmodium produces a variable number of spores. This practice has brought together several species that are clearly not congeneric, a fact that becomes apparent when one compares such greatly different species as *S. mutabilis*, *S. legeri*, and *S. magna*. Since this species does not resemble the type of *Stempellia*, *S. mutabilis*, [about equal numbers of groups of 4 (like *Gurleya*) and 8 (like *Thelohania*) spores, rarely 1 or 2 spores] or any other established genus, it is transferred to the collective group *Microsporidium*.

Microsporidium leptophlebiae (Weiser, 1946) comb. n.

Nosema leptophlebiae Weiser, 1946, Věstn. Česk. Spol. Zool., 10, 250, Fig. 3. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 30, Tab. vc. Thomson, 1960, J. Insect Pathol., 2, 350. Weiser, 1961, Monogr. Angew. Entomol., 17, 46.

Host and Site: [EPHEMEROPTERA] *Leptophlebia vespertina* L., larva; chiefly in musculature but in all organs excepting fat body.
Vegetative Stages: "Planonts" are said to penetrate the gut wall, then divide and go via the hemolymph to different organs. Infection is chiefly in the muscle from which schizonts pass to all parts of the body.
Sporulation Stages: No data.
Spore: [Ellipsoidal in the figures] 2-3 x 2 μm, uninucleate.
Locality: Czechoslovakia (near Chotěbǒr).
Remarks: The uninucleate condition of the spore is not characteristic of *Nosema*. Therefore, this species is transferred to the collective group *Microsporidium*.

Microsporidium leydigii (Pfeiffer, 1895) comb. n.

Glugea leydigii Pfeiffer, 1895, "Die Protozoen als Krankheitserreger, Nachträge," p. 83 [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 76].
Host: [COPEPODA] *Cyclops* sp.
Developmental Stages: "Cysts" with spores, rounded or elongated.
Spore: Pyriform, 8 x 5 μm, with clear spot at rounded end.
Locality: Germany (Weimar).
Remarks: Data taken from Kudo (1924). Kudo treated this as a synonym of *Nosema parva* Moniez, 1887. At the same time, he experssed doubt about the accuracy of the generic designation and about the identity of the two species because of the great difference in sizes of their spores. Because it seems unlikely that this could be either *Nosema parva* or a species of *Glugea*, it is transferred to the collective group *Microsporidium*.

Microsporidium longifilum (Hesse, 1905) comb. n.

Nosema longifilum Hesse, 1905, C. R. Assoc. Franc., 33, 918. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 89. Thomson, 1960, J. Insect Pathol., 2, 350. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 29. Weiser, 1961, Monogr. Angew. Entomol., 17, 67.
Glugea longifila (Hesse, 1905) Auerbach, 1910, "Die Cnidosporidien," p. 191.
Host and Site: [COLEOPTERA] *Otiorhynchus fuscipes* Ol.; fat body.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Two kinds, the most numerous being 4-5 x 3 μm; macrospores, 6 x 4 μm, always appear empty, polar filament 85-90 μm.
Locality: France.
Remarks: The parasite forms cysts that fill the body cavity and become encapsulated by host reaction with connective tissue. The original description was not accompanied by figures, although Weiser (1961, p. 62) gave a figure of a spore

without saying where he got it. That figure shows a single nucleus, although *Nosema* has a binucleate spore. Since the available data are not in agreement with the characters of the genus *Nosema*, this species is transferred to the collective group *Microsporidium*.

Microsporidium lunatum (Hazard & Savage, 1970) comb. n.

Stempellia lunata H. & S., 1970, J. Invertebr. Pathol., 15, 49, Figs. 1-15. Hazard & Fukuda, 1974, J. Protozool., 21, 497, Figs. 2, 5, 8, 11, 14.

Host and Site: [DIPTERA-CULICIDAE] *Culex pilosus* (Dyar & Knab), larva; fat body.

Lesion: Infected larva dull white, especially in thorax. Fat body not destroyed.

Vegetative Stages: No data.

Sporulation Stages: Forms with 1, 2, 4, 6 or 8 nuclei present. The plasmodia divide into sporoblasts. These develop into spores. The number of spores produced by a sporont is not mentioned but Figs. 5 and 10 indicate that there are 5 or 6. Judging from the figures, there is no pansporoblastic membrane but as many as 5 spores may be imbedded in a gelatinous capsule.

Spore: Elongate, pyriform, slightly curved, comma-shaped, "U"-shaped or straight; with posterior vacuole; covered with gelatinous capsule; 10.5 x 3.5-5.0 when fresh; polar filament 93-114 µm.

Locality: U.S.A. (Florida).

Remarks: This species shows very little similarity to the type species of *Stempellia, S. mutabilis,* as briefly described by Léger and Hesse, 1910. Since it also does not seem to belong to any other established species, it is transferred to the collective group *Microsporidium*.

Microsporidium magnum (Kudo, 1920) comb. n.

Thelohania magna Kudo, 1920, J. Parasitol., 6, 180, Figs. 1-11. Kudo, 1920, Trans. Ill. State Acad. Sci., 13, 301. Kudo, 1921, J. Morphol., 35, 156, Figs. 1-60. Kudo, 1922, J. Parasitol., 8, 73. Issi, 1968, Acta Protozool., 6, 350.

Stempellia magna (Kudo, 1920) Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 164, Figs. 571-596, 769, 770, textfig. I. Kudo, 1925, Biol. Bull., 48, 112, Figs. 1-3. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 27. Thomson, 1960, J. Insect Pathol., 2, 362. Weiser, 1961, Monogr. Angew. Entomol., 17, 116. Kudo, 1960, J. Insect Pathol., 4, 353. Wills & Beaudoin, 1965, J. Invertebr. Pathol., 7, 13, Figs. 5-8. Bailey, Barnes & Dewey, 1967, Mosq. News, 27, 111, Figs. 1-8. Clark & Fukuda, 1967, J. Invertebr. Pathol., 9, 430. Anderson, 1968, *ibid.*, 11, 453. Simmers, 1974, J. Parasitol., 60, 721. Hazard & Savage, 1970, J. Invertebr. Pathol., 15, 49, Figs. 12, 13. Hazard & Fukuda, 1974, J. Protozool., 21, 497, Figs. 1, 4, 7, 10, 13.

Pyrotheca magna (Kudo, 1920) Hesse, 1935, Arch. Zool. Exp. Gén., 75, 660. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1061.
Host and Site: [DIPTERA-CULICIDAE] *Culex pipiens* [type host], larva; adipose tissue [Kudo (1920)]. *Culex territans* [Kudo (1924, 1925)]. *Culex restuans* [Kudo (1962), W. & B., B. B. & D., Anderson]. *Anopheles stephensi* [B. B. & D]. *Anopheles punctipennis* [Simmers]. *Aedes sierrensis* [C. & F.]. *Culiseta inornata* [Simmers].
Lesion: "The infected larvae were more whitish opaque in color than normal, with more or less distended thorax" [Kudo (1920)]. Nucleus of infected host cell becomes greatly hypertrophied [Kudo (1924)].
Vegetative Stages: In 1921, Kudo described, in *Culex pipiens*, both binary and multiple fission resulting in uninucleated forms. The plasmodial stage in the multiple fission sequence was a rounded form with up to 8 nuclei. Later, 1924 and 1925, he found in *C. territans* oblong schizonts with 3, 4, 5, 6, 7, and 8 nuclei and concluded that the final product of schizogony is binucleate form. The nuclei (of the diplocaryon) fuse to form a sporont.
Sporulation Stages: Kudo (1924) found that in *Culex pipiens* "the sporont produces eight (sometimes four) sporoblasts, which are connected by the central mass of protoplasm for some time after the completion of division." In *C. territans*, he (1925) found that the sporont produces ordinarily 2, frequently 4, less frequently 8 sporoblasts; and quite frequently a single, abnormally large, spore is formed from a sporont. No pansporoblastic membrane was mentioned. The illustrations do not clearly show a pansporoblastic membrane although some of the figures of early sporogony stages suggest that a nonpersistent membrane may be present. E. I. Hazard (personal communication) found no pansporoblastic membrane in electron micrographs in this species in *Culex restuans*.
Spore: Elongated pyriform, often slightly bent, 12.0-16.5 x 4-4.6 μm, uninucleate. Some abnormally large spores are 25 x 10 μm. The anterior half or two-thirds contains a "polar capsule" [polaroplast] that is 7.5 μm long and has transverse lines. Polar filament 350-400 μm.
Locality: U.S.A. (Illinois, Pennsylvania, Virginia, California, Connecticut).
Remarks: This species (possibly more than one, as suggested by different accounts of its development in different host species) may fit Kudo's (1924) characterization of *Stempellia* ("Each sporont developes into one, two, four or eight sporoblasts and ultimately into one, two, four or eight spores") but it does not fit the known characters of the poorly described type species, *S. mutabilis* Léger & Hesse, 1910, (about equal numbers of pyriform spores in groups of 4, like *Gurleya*, and

ovoidal spores in groups of 8, like *Thelohania*, and rarely spores single or paired). Because it fits no established genus, it is now transferred to the collective group *Microsporidium*. At the same time, it is noteworthy that the spore structure is very much like that of *Pyrotheca*.

Microsporidium mesnili (Paillot, 1924) comb. n.

Thelohania mesnili Paillot, 1924, C. R. Soc. Biol., 90, 501, Figs. 1-10. [?]Blunck, 1954, Z. Angew. Entomol., 36, 327, Fig. 1. Weiser, 1961, Monogr. Angew. Entomol., 17, 92. Lipa, 1963, Pr. Nauk. Inst. Ochr. Rosl. Warsz., 5, 131, Figs. 38-48. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.

Host and Site: [LEPIDOPTERA] *Pieris brassicae* L., larva; fat body.

Lesion: Infected cells hypertrophied, white.

Vegetative Stages: The earliest stage has 2 nuclei "disposes generalement en grain de cafe" [diplocaryon]. Reproduction by binary fission, giving 2 diplocaryotic cells.

Sporulation: The first stage [sporont] uninucleate and presumed to be a zygote resulting from autogamy of the diplocaryon. Sporogony results in 8 binucleate sporoblasts that transform into binucleate spores. During sporogony the cytoplasmic division usually does not accompany nuclear division; exceptionally, daughter cells may become isolated before nuclear division is complete. Illustrations by Paillot indicate that a sporophorous vesicle (pansporoblastic membrane) is absent and the author mentions none. Both Blunck and Lipa illustrated a sporophorous vesicle.

Spore: Broad oval, binucleate, 2.5-3.5 x 1.5-2 μm as calculated from illustrations by Paillot. Size, 4-5 x 2.5-3 μm as calculated from illustrations by Blunck.

Locality: France (St. Genis-Laval).

Remarks: The binucleate condition in the sporulation stages and the apparent absence of a pansporoblastic membrane (in the original description) exclude this species from the Genus *Thelohania*. Since it does not clearly fit into any other established genus it is placed in the collective group *Microsporidium*.

Microsporidium micrococcus (Léger & Hesse, 1921) comb. n.

Cocconema micrococcus L. & H., 1921, C. R. Acad. Sci., 173, 1420. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 180, [?]Figs. 639-640. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 40.

Coccospora micrococcus (L. & H., 1921) Kudo, 1925, Science, 61, 1579. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1067.

Nosema micrococcus (L. & H., 1921) Weiser, 1961, Monogr. Angew. Entomol., 17, 117.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Tanypus setiger* Kieffer, larva; fat body.
Vegetative Stages: Schizogonic stages observed.
Sporulation Stages: Spores sometimes joined in twos, at first grouped in a spherical mass of numerous elements and diffusing later into all the fat tissue of the host. Speaking of all species of *Cocconema,* Léger and Hesse (1921, pp. 1421) said that the spores are "toujours protégées par une enveloppe kystique."
Spore: Spherical, 1.8-2 µm.
Locality: France [Grenoble and Montessaux (Haute-Saône)].
Remarks: Type of *Cocconema* by subsequent designation, Kudo (1924). Transferred by implication (but not specifically mentioned) to Genus *Coccospora* by Kudo (1925) when he proposed this generic name as a replacement name. The taxonomic status of this species is enigmatic. It has no distinctive characters to substantiate the genus. Weiser (1961) transferred it to *Nosema* (thus, abolishing the genus) because, presumably, the spores, as in Genus *Nosema,* become diffuse in the tissue. Unlike *Nosema,* however, the spores are at first grouped in a spherical mass. Thus, there is no reason to regard it as a species of *Nosema,* and since there is no basis for assigning it to any other established genus, it is here transferred to the collective group *Microsporidium.* So long as this type species is not in *Coccospora* this genus remains suppressed and no other species can be assigned to it.

Microsporidium milleri (Hazard & Fukuda, 1974) comb. n.

Stempellia milleri H. & F., 1974, J. Protozool., 21, 497, Figs. 3, 6, 9, 12, 15, 16.
Host and Site: [DIPTERA-CULICIDAE] *Culex pipiens quinquefasciatus* Say, larva; blood cells and fat tissue. Experimental hosts are *C. p. pipiens, C. salinarius, C. tarsalis,* and *C. territans.*
Vegetative Stages: Repeated merogony occurs in the hemocytes. Eventually, binucleate, fusiform cells are produced. These are freed by rupture of the host cell and either enter other hemocytes to repeat the merogony or migrate to the fat body to initiate the sporogony sequence.
Sporulation Stages: Some diplocaryotic cells produce binucleate sporoblasts. In others the nuclei fuse, producing uninucleate sporonts that develop into sporogonial plasmodia with 2, 4, 6, 8 or 16 nuclei (most commonly 8). The nuclei migrate toward the surface of the plasmodium and uninucleate sporoblasts, 2, 4, 6, 8 or 16 in number, bud off from the parent body. They are not enclosed in a pansporoblastic membrane.

Spore: There are two types, both pyriform. One is thin-walled, uninucleate, 4.9 x 2.50 µm, with polaroplast partitioned into cell-like compartments, with polar filament uniform in diameter, excepting for tapering tip. The other is thick-walled, binucleate, with more compact polaroplast, with polar filament thick in the proximal half and thin in the distal half.
Locality: U.S.A. (Texas and Louisiana).
Remarks: This species has little resemblance to the type species of *Stempellia, S. mutabilis* Léger & Hesse, 1910. Since it also does not resemble any other established genus, it is transferred to the collective group *Microsporidium*.

Microsporidium moniezi (Jones, 1943) comb. n.

Stempellia moniezi Jones [*nomen nudum*], 1942, J. Parasitol., 28 (Suppl.), 10. Jones, 1943, *ibid.*, 29, 373, Figs. 1-4.
Host and Site: [CESTODA] Hyperparasite of *Hymenolepis anthocephalus* Van Gundy and *Dorchis reynoldsi* Jones in the gut of a shrew *Blarina brevicauda* Say; parenchyma, chiefly near the excretory ducts.
Vegetative Stages: "Meronts, about 2.5-3.0 micra in diameter, are subspherical uninucleate forms occurring in large or small groups resulting from schizogony." At no stage in the life cycle are "cyst walls" developed, although parasites sometimes appear to be in vacuoles.
Sporulation Stages: "Schizogony produces groups of several to many sporonts; each sporont produces one, two, four, or eight spores; spores from octosporous pansporoblast smaller than those from tetrasporous or other sporoblast."
Spore: Ovoid to subcylindrical, 4-5 x 1.5-2.0 µm, with vacuole in either end. Polar filament not demonstrated.
Locality: U.S.A. (Virginia).
Remarks: The "group of meronts (some in division)" shown in the author's Fig. 3 resembles a cross section of a morula-like mass of cells with mitotic figures typical of metazoan cells. These cells do not look like cells of microsporidia. The spores resemble those of microsporidia but the generic identity is quite uncertain. *Stempellia mutabilis* Léger & Hesse, 1910 [type species] was very poorly described; Kudo's (1924) translation of that description (generally followed by later authors) is inaccurate and misleading, and, therefore, the presence of spores in groups of irregular number (1-8) is not a rational basis for assigning a species to *Stempellia*. There is, in fact, no rational basis for assigning any species to this genus. Therefore, this species is transferred to the collective group *Microsporidium*.

Microsporidium mrazeki (Hesse, 1905) comb. n.

Myxocystis mrazeki Hesse, 1905, C. R. Assoc. Franç., 33, 916 Hesse, 1905, C. R. Soc. Biol., 58, 12, 13, 1 fig. [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 182]. Auerbach, 1910, "Die Cnidosporidien," p. 193, Fig. 81.

Mrazekia mrazeki (Hesse, 1905) Kudo, 1924, *loc. cit.*, Figs. 652-655.
Cougourdella mrazeki (Hesse, 1905) Hesse, 1935, Arch. Zool. Exp. Gén., 75, 660. Jírovec, 1936, Arch. Protistenkd., 87, 318. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 21.
Host and Site: [OLIGOCHAETA] *Limnodrilus hoffmeisteri;* epithelium and lumen of gut and body cavity.
Lesion (xenoma): Hypertrophied host cell up to 120 μm in diameter, often with external ciliary processes and with several nuclei.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Usually cylindrical with small neck at anterior end, 9-10 x 1-2 μm. Many irregularly shaped spores seen.
Locality: France (Grenoble).
Remarks: Jírovec suggested that this may be a mixed infection with *Nosema.* Since this species does not have spores that are characteristic of either *Mrazekia* or *Cougourdella,* it is placed in the collective group *Microsporidium.* Hesse gave some of the descriptive detail in a second paper in 1905; since this paper was not available the data were taken from Kudo.

Microsporidium mutabilis (Kudo, 1923) comb. n.
Thelohania mutabilis Kudo, 1923, J. Parasitol., 10, 22, Figs. 1-22. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 160, Figs. 684-687. Weiser, 1961, Monogr. Angew. Entomol., 17, 48. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.
Host and Site: [EPHEMEROPTERA] *Ameletus ludens,* nymph; fat body.
Lesion: A slight opaque discoloration was noticed in the infected area of the body.
Vegetative Stages: Reproduction by repeated binary or multiple fission, producing 2, 4, or 8 cells each time.
Sporulation Stages: "Each schizont grows into a larger body, a sporont, whose nucleus becomes vesicular. The sporont further grows and the nucleus divides three times, forming eight sporoblasts in it. There seems to be considerable variation in the size of the sporonts at the end of sporoblast formation. Occasionally one finds tetrasporoblastic sporonts which undoubtedly give rise to larger sporoblasts, but octosporoblastic sporonts predominate in number over the former." While the description suggests (but does not mention) the presence of pansporoblasts, the figures show nothing resembling pansporoblasts. On the contrary, they show octonucleate chain-like plasmodia and a cluster of binucleate sporoblasts that tend to lie in pairs and are not enclosed by a membrane.
Spore: Oval, elongated ovoid or pyriform, 3.8-5.5 x 2.5-3 μm (fresh). Polar filament 70 μm. "When stained, it becomes clear that the structure of the spore is similar to that of *Nosema baetis.*"
Locality: U.S.A. (Warren, Pennsylvania).
Remarks: The lack of a pansporoblastic membrane excludes this species from the family THELOHANIIDAE. It is transferred to the collective group *Microsporidium* for lack of a better alternative.

Microsporidium necatrix (Kramer, 1965) comb. n.

"Microsporidian" Tanada & Chang, 1962, J. Insect Pathol., 4, 129. Tanada, 1962, *ibid.*, 495. Tanada, 1966, Proc. Hawaii. Entomol. Soc., 19, 302.
Nosema sp. Tanada, 1964, Proc. Hawaii. Entomol. Soc., 18, 435. Fowler & Reeves, 1974, J. Invertebr. Pathol., 23, 63.
Thelohania sp. Tanada, 1964, *loc. cit.*
Nosema necatrix Kramer, 1965, J. Invertebr. Pathol., 7, 117, Figs. 1-21. Nordin & Maddox, 1972 S. I. P. (Soc. Invertebr. Pathol.) Newsl., 4, 20. Fowler & Reeves, 1974, J. Invertebr. Pathol., 23, 3. Fowler & Reeves, 1974, J. Protozool., 21, 538, Fig. 1. Nordin & Maddox, 1974, J. Invertebr. Pathol., 24, 5. Fowler & Reeves, 1975, *ibid.*, 26, 1, Figs. 1-6.
Thelohania diazoma Kramer, 1965, J. Invertebr. Pathol., 7, 117, Figs. 1-21. Fowler & Reeves, 1974, *ibid.*, 23, 63. Fowler & Reeves, 1974, J. Protozool., 21, 538.

Host and Site: [LEPIDOPTERA] *Pseudaletia unipuncta* (Haworth) [type host], larva; hemolymph and fat body [Kramer]. *Colias eurytheme* Boisduval [experimental, Tanada (1962)]. *Hyphantria cunea* [N. & M. (1972, 1974)]. *Heliothis virescens* [F. & R. (1974)].

Vegetative Stages: *Nosema*-like forms: Earliest stages seen were binucleate forms 5 μm in diameter. Later, forms with 1, 2, 4, and 8 nuclei were seen. Nuclei of the 8-nucleate form were more or less square and paired [diplocarya?]. These large schizonts divided to produce forms with "one pair of hemispherical nuclei" [diplocaryon]. The two nuclei of the pair fused to make a sporont with one nucleus. *Thelohania*-like forms: Earliest stages (in hemolymph) spherical, 2.5-3 μm. "Binucleate forms which are probably the terminal schizonts" were 4 μm.

Sporulation Stages: *Nosema*-like forms: The sporont undergoes 2 nuclear divisions followed by a cytoplasmic division to produce 2 binucleate sporoblasts. *Thelohania*-like forms: Uninucleate sporonts develops into octonucleate plasmodium. Cytoplasm condensed around each nucleus to make 8 sporoblasts. Sporont octosporous. "Wall of the sporont very persistent ... ."

Spore: Of the *Nosema*-like form, 5.06-6.05 x 2.32-2.82 μm after staining with Giemsa's solution [Kramer]; surface smooth in SEM [F. & R. (1975)]. Of the *Thelohania*-like form, 2.82-3.98 x 1.74-2.40 μm [Kramer].

Locality: U.S.A. (Illinois and Hawaii).

Remarks: Maddox, in unpublished studies (according to Fowler and Reeves, 1974, *J. Protozool.*, 21, 538), found that this parasite produced only *Nosema*-like forms when its host was cultured at high temperature and mostly *Thelohania*-like forms at low temperature. Fowler and Reeves, themselves, confirmed these results, using for an inoculum an isolate of the *Nosema*-like form. They further found that the two forms gave identical hydrophobic protein spectra in electrophoresis analysis and were forced to conclude the *Nosema necatrix* and

Thelohania diazoma are synonyms. Since these names were published at the same time, neither has priority and the authors were at liberty to choose one of the two names. They chose to retain *Nosema necatrix* Kramer, 1965, and to reject *Thelohania diazoma* Kramer, 1965. This species cannot remain in the Genus *Nosema,* however, because its dimorphism sets it off sharply from the type species, *Nosema bombycis,* and similar species. It appears that *Nosema necatrix* does not belong in any established genus. Therefore, it is transferred provisionally to the collective group *Microsporidium.*

Microsporidium niphargi (Poisson, 1924) comb. n.

Mrazekia niphargi Poisson, 1924, C. R. Acad. Sci., 178, 666, Figs. 16, 17. Jírovec, 1937, Věstn. Česk. Spol. Zool., 4, 63.
Bacillidium niphargi (Poisson, 1924) Jírovec, 1936, Arch. Protistenkd., 87, 318. Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1068.
Host and Site: [AMPHIPODA] The freshwater amphipod *Niphargus stygius* Schiödte.
Vegetative Stages: No data.
Sporulation Stages: "Les pansporeblasts renferment 8 et parfois 16 spores."
Spores: Tubular, 8-9 x 2 μm, without a distinct manubrium.
Locality: France (vicinity of Paris).
Remarks: Production of 8 (sometimes 16) spores within a pansporoblast and apparent absence of a manubrium require removal of this species from Genus *Mrazekia* (synonym *Bacillidium).* The name is, in any case, probably a *nomen nudum* for failure to satisfy Art. 13 of the Code [Stoll (1961)].

Microsporidium obtusum Moniez, 1887

Microsporidia obtusa Moniez, 1887, C. R. Acad. Sci., 104, 185.
Microsporidia (Nosema) obtusa Moniez, 1887, *ibid.,* 1314.
Plistophora obtusa (Moniez, 1887) Labbé [*partim*], 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 109. Kudo [*partim*], 1924, Ill. Biol. Monogr., 9(2/3), 167. Jírovec, 1937, Zool. Anz., 118, 307, Fig. 1. Weiser [*partim*], 1947, Acta Soc. Sci. Nat. Moravicae, 18, 22.
Host and Site: [CLADOCERA] *Simocephalus vetulus* and *Daphnia reticulata* [Moniez]; *D. pulex, D. magna,* and *D. longispina;* in hemolymph [Jírovec].
Lesion: Infected host opaque white [Jírovec].
Vegetative Stages: Largely unknown, although Jírovec once observed rosette-like division of a plasmodium.
Sporulation Stages: The nucleus of an uninucleate sporont divides to produce 2, 4, 6, 16, and more nuclei in the pansporoblast. Always more than 16 spores develop in the pansporoblast. The spores are quite loosely stuck together and soon become free [Jírovec]. Pansporoblastic membrane not mentioned.

Spore: Obtuse, very inflated posteriorly and nearly always showing an asymmetrical clear spot; size up to 4 x 2.5 µm [Moniez]. Pyriform, this shape serving to distinguish this from other species of microsporidia in Cladocera; 3-4 x 1.5-2 µm, with polar filament 20-30 µm.
Locality: France, Czechoslovakia (Lnáre).
Remarks: The authors did not mention a pansporoblastic membrane, while Jírovec's description and figures strongly suggest that there is none. This impression becomes almost a certainty when one notes the strong similarity between the sporogony in this species and that in *Plistophora schäfernai* Jírivec, 1937, [see *Microsporidium schaefernai* (Jírovec)]. Therefore, this species, which seems not to belong to *Pleistophora* or to any other established genus, is returned to the collective group *Microsporidium*. Moniez said maybe he included two species under *M. obtusa*.

Microsporidium orthocladii (Coste-Mathiez & Manier, 1968) comb. n.

Nosema orthocladii C-M. & M., 1968, Bull. Soc. Zool. Fr., 93, 127, Pls. 1, 2, Figs. 1, 2. Fenwick, 1972, Thesis, Acad. Montpellier, Fig. 58.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Orthocladius lignicola* Kieffer, larva; fat body.
Lesion: Cysts white, spherical, up to 200 µm, visible in living host. As many as 55 seen in one larva.
Vegetative Stages: Youngest schizont spherical, 3 µm, with a single large nucleus. Nucleus multiplies, producing plasmodia. Some plasmodia have single nuclei and others have diplocarya. Each diplocaryon and a portion of cytoplasm become isolated to form a sporont.
Sporulation Stages: The sporont produces a sporoblast which transforms into a spore [C-M. & M.]. A sporogonial plasmodium with diplocarya divides in rosette formation to produce binucleate sporoblasts not enclosed in a pansporoblastic membrane [Fenwick].
Spore: Bean-shaped, 5 x 1.8 µm (av., in life). Binucleate.
Locality: France (near Montpellier).
Remarks: The type of sporogony described by Fenwick and the morphology of the spore are not characteristic of *Nosema*. Therefore, I place it provisionally in the collective group *Microsporidium*.

Microsporidium ovatum Moniez, 1887

Microsporidia ovata Moniez, 1887, C. R. Acad. Sci., 104, 185.
Microsporidia (Nosema) ovata Moniez, 1887, *ibid.*, 1314.
Plistophora obtusa (Moniez, 1887) Labbé [*partim*], 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 109. Kudo [*partim*], 1924, Ill. Biol. Monogr., 9(2/3), 167. Weiser [*partim*], 1947, Acta Soc. Sci. Nat. Moravicae, 18, 22.
Host: [CLADOCERA] *Simocephalus vetulus* and *Chydorus sphaericus*.
Developing Stages: No data.

Spore: Perfectly oval, not exceeding 3 μm long, with clear spot rarely visible.
Locality: France.
Remarks: This species has not been found again since Labbé lumped several nominal species distinguished by Moniez under *Plistophora obtusa* (Moniez). Since most of these species have been rediscovered and recognized as separate species, this one, being no longer considered as identical with one of the others, emerges as distinct. Jírovec considered it to be the species most like *Plistophora schaefernai* Jírovec, 1937 (see *Microsporidium schaefernai).*

Microsporidium ovoideum (Thélohan, 1895) comb. n.

Glugea ovoidea Thélohan, 1895, Bull. Sci. Fr. Belg., 26, 357, Fig. 131. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 115, Fig. 268. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 47.
Nosema ovoideum (Thélohan, 1895) Labbé, 1899, *in* "Das Tierreich" (O. Bütschli, ed.), 5, 106. Auerbach, 1910, "Die Cnidosporidien," p. 198. Raabe, 1936, Bull. Inst. Oceanogr. (Monoco), 696, 1, Figs. 1-7.
Host and Site: [PISCES] *Motella tricirrata* and *Cepola rubescens;* [Thélohan]. *Mullus barbatus* L. [Raabe]. Liver.
Lesion: Small white spots, 1-1.5 mm, appear on the surface and in the deep tissues of the liver [Thélohan]. Most of the liver necrotic but some areas contain cysts, spherical or elliptical, 1 mm, formed by hepatic cells that contain the parasites [Raabe].
Vegetative Stages: Youngest stages small, amoeboid, uninucleate forms. There are two binary fissions.
Sporulation Stages: The second fission results in sporoblasts. Sporoblasts (uninucleate in the figures) transforms directly into the spore [Raabe].
Spore: Ovoidal (in figure), 2.5 x 1.5 μm [Thélohan].
Locality: France (first host at Roscoff; other, Marseille and Banyuls) [Thélohan]. France (Monaco) [Raabe].
Remarks: For a half-century this poorly known species alternated between *Glugea* and *Nosema.* The fact is that we do not have enough information to classify it. Although Thélohan assigned it to *Glugea* (where it probably belongs), he gave very little information about it. The only known data that tend to conflict with Thélohan's generic assignment are those of Raabe. Assuming that Thélohan and Raabe worked with only one species (which is quite uncertain), Raabe's data do not clearly place it in either *Nosema* nor *Glugea.* The nuclear pattern appears to be unlike that of *Nosema,* while the cyst and the general mode of development seem to be unlike those of *Glugea.* Raabe's description is rather suggestive of secondary *Glugea* cysts formed by encapsulation of groups of phagocytes containing spores and some other stages of *Glugea.* Considering the inadequacy of the present information, it seems desirable to place this (or these) species in the collective group *Microsporidium.*

Microsporidium peponoides (Schulman, 1962) comb. n.

Plistophora peponoides Schulman, 1962, *in* "Key to Parasites of Freshwater Fish of the U.S.S.R." (E. N. Pavlovskii, ed.), No. 80, 135, Fig. 305.

Host and Site: [PISCES] "The big-mouthed sleeper"; in subcutaneous connective tissue.

Lesion: "Spherical white cyst up to 1 mm in diameter, apparently derived from single host cell, containing large number of pansporoblasts ... ."

Developing Stages: Pansporoblasts containing 8 spores develop within a cyst, apparently a host cell.

Spore: Shaped like a gourd or flask, with markedly tapered anterior end and inflated posterior part; one size, 3.6-4 x 2-2.3 µm.

Locality: U.S.S.R. (Amur River basin).

Remarks: The production of cell hypertrophy tumors containing octosporous pansporoblasts is not characteristic of *Pleistophora,* or any other established genus. Therefore, this species is transferred to the collective group *Microsporidium.*

Microsporidium pimphales (Fantham, Porter & Richardson, 1941) comb. n.

Nosema pimphales F., P. & R., 1941, Parasitology, 33, 188, Figs. 1-18.

Host and Site: [PISCES] *Pimphales promelas;* abdomen.

Lesion: A large cyst greatly distended the abdomen and practically obliterated the body cavity. The intestine was compressed, the pancreas reduced, and veins of the abdominal viscera were congested. "The walls of the cyst or tumor consisted of fibrous connective tissue, surrounding a mass of multiplicative stages and spores of a *Nosema.*

Vegetative Stages: Binary or multiple fission resulting in 2 to 6 or more uninucleate bodies.

Sporulation Stages: "One sporoblast, which is formed by each uninucleate meront, gives rise to one spore, which is characteristic of the genus *Nosema.*" During development of the sporoblast into a spore "nuclear multiplication occurs" and a process of development similar to that in Myxosporidia was described.

Spore: Oval or elliptical, 3.8-4.4 (rarely as much as 5.2) x 1.9-3.3 µm. Binucleate?

Remarks: The description was brief and clearly inaccurate in important details. The generic determination is highly questionable. Perhaps this is a species of *Ichthyosporidium,* since the cyst seems to be the kind that is characteristic of this genus. Because there is no convincing evidence as to its correct generic assignment, it is transferred to the collective group *Microsporidium.*

Microsporidium polygonum (Fritsch, 1895) comb. n.

Glugea(?) polygona Fritsch, 1895, Bull. Ac. Prague, p. 85, Fig. 9 [*fide* Labbé, 1899, "Das Tierreich," 5, 111].
Plistophora polygona (Fritsch, 1895) Labbé, 1899, *loc. cit.*
Nosema polygona (Fritsch, 1895) Budde, 1927, Arch. Hydrobiol., 18, 444.
Host: [ROTATORIA] *Asplanchna* sp.
Descriptive Data: Spores round or polygonal, grouped in masses of 3, 6, 13.
Locality: Hungary.
Remarks: The data are not adequate for making a generic determination.

Microsporidium polysporum (Léger & Hesse, 1921) comb. n.

Cocconema polyspora L. & H., 1921, C. R. Acad. Sci., 173, 1420. Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 180. Weiser, 1947, Acta Soc. Sci. Nat. Moravicae, 18, 41.
Stempellia polyspora (L. & H., 1921) Weiser, 1961, Monogr. Angew. Entomol., 17, 120.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Tanypus* sp., larva; fat body.
Vegetative Stages: No data.
Sporulation Stages: Spores grouped in spherical masses containing a variable but always large number (16, 32, and more).
Spore: 2-3.2 μm.
Locality: France (near Grenoble).
Remarks: Weiser found it necessary to reassign this species after he abolished the Genus *Coccospora* Kudo, 1925 [= *Cocconema* Léger & Hesse, 1921, preoccupied) by transferring the type species to *Nosema*. This species does not belong to *Stempellia* [the type species of which has usually pyriform spores in groups of 4 and oval ones in groups of 8 (rarely 1 or 2)]. However, with our limited information, it fits no better into any other genus (with the possible exception of *Pleistophora)*. Therefore, perhaps, there is no better alternative to transferring it to the collective group *Microsporidium*.

Microsporidium rhionicae (Voronin, 1974) comb. n.

Nosema rhionicae Voronin, 1974, Parazitologiya (Leningr.), 8, 362, Figs. 14-22.
Host and Site: [TREMATODA] Hyperparasite of sporocysts and redia of *Cercaria rhionica* VIII Olener & Dobrovolsky in the mollusc *Melanopsis praemorsa*.
Vegetative Stages: Uninucleate cells undergo binary fission. A final stage has a diplocaryon. The diplocaryotic nuclei undergo autogamy to produce a zygote.
Sporulation Stages: The zygote nucleus divides to produce a binucleate sporont that produces uninucleate spores.

Spore: Ovoidal, 4.0-4.7 x 2.7-3.1 (av., 4.3 x 2.85) μm when fresh. 4.0 x 2.75 μm after Giemsa staining. Uninucleate.
Locality: U.S.S.R. (Moscow).
Remarks: The absence of a diplocaryon from all stages excepting the final product or merogony exclude this species from the Genus *Nosema*.

Microsporidium rubstovi (Issi, 1968) comb. n.

Stempellia rubstovi Issi, 1968, Acta Protozool., 6, 345, Figs. 1-3.
Host and Stie: [DIPTERA-SIMULIIDAE] *Odagmia caucasica* Rubz, larva; salivary gland.
Vegetative Stages: Not mentioned in the English summary of the paper, which is in the Russian language.
Sporulation Stages: A diplocaryotic cell becomes a sporont by nuclear fusion. The sporont produces usually 2, 4, or 8 sporoblasts, rarely 1 or 16 (apparently uninucleate in the figures) and these develop into 1, 2, 4, 8, or 16 spores. It is not clear whether a pansporoblastic membrane is present.
Spore: Broad-oval, 5.4-16.3 x 3.6-8.4 μm, the size being inversely related to the number produced by the sporont.
Remarks: The production of a variable number of spores by a sporont is not a distinguishing character of *Stempellia* or any other microsporidian genus. Since there is no other evident basis for assigning this species to any established genus, it is transferred to the collective group *Microsporidium*.

Microsporidium sauridae (Narasimhamurti & Kalavati, 1972) comb. n.

Nosema sauridae N. & K., 1972, Proc. Indian Acad. Sci., Sect. B, 76, 168, Fig. 2.
Host and Site: [PISCES] The marine fish *Saurida tumbil;* visceral muscle.
Lesion: The cyst showed an outer muscular and an inner connective tissue layer. The latter showed many cells with vacuolated cytoplasm. The infection was very light. There was no apparent injury to the host.
Vegetative Stages: "The earlier stages of schizogony are found within the connective tissue but the more advanced stages appear to be intracellular."
Sporulation Stages: "Uninucleate sporonts are found in the lumen of the cyst. They are pyriform in shape with a large nucleus and measure 2.0 μ x 1.6 μ. The sporonts are usually attached end to end and appear like long chains ... . Each sporoblast gives rise to a single spore ... ."
Spore: Pyriform, 2.3-3.8 x 1.8-2.0 μm, with an anterior vacuole, the sporoplasm occupying the rest of the spore. "Spores stained with Giemsa after an initial hydrolysis of 1 N HCl for 10 minutes at 60°C reveal the presence of the nucleus to one side." Polar filament uniformly thin, 150-180 μm.

Locality: India (Waltair).
Remarks: Although the spores are isolated as in the Genus *Nosema*, the apparent lack of a double nucleus excludes the species from *Nosema*. Since the data do not permit assigning this species to any established genus, it is transferred to the collective group *Microsporidium*.

Microsporidium schaefernai (Jírovec, 1937) comb. n.
Plistophora schafernai Jírovec, 1937, Zool. Anz., 118, 309, Figs. 2, 3a.
Host and Site: [CLADOCERA] *Daphnia pulex*; ovarian cells.
Lesion: Infected individual grayish-green and partly opaque. Infected oocyte shows great hypertrophy of both nucleus and cytoplasm.
Vegetative Stages: No data.
Sporulation Stages: A sporont with a single nucleus develops into a plasmodium that usually has 16 nuclei. The plasmodium then breaks up into sporoblasts which separate and develop into spores. The infected cells rupture and permit the parasites to go into the body cavity and be transported to different parts of the body. In one case, a plasmodium with 20 nuclei were seen. Pansporoblastic membrane absent. Mature spores always isolated.
Spore: Oval, 3.8-4.2 x 1.6-2 (av., 4 x 2) μm, uninucleate in Feulgen preparation. Anomalous macrospores, 7 x 2.5, rare. Polar filament with thick proximal part and thin distal part, 30-40 μm long.
Locality: Czechoslovakia (Lnář).
Remarks: The type of sporogony, especially the absence of a pansporoblastic membrane, excludes this species from Genus *Pleistophora*. Since it does not clearly fit any other established genus, it is transferred to the collective group *Microsporidium*.

Microsporidium schmeilii (Pfeiffer, 1895) comb. n.
Glugea schmeilii Pfeiffer, 1895 [*fide* Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 196].
Plistophora schmeili (Pfeiffer, 1895) Labbé, 1899 *in* "Das Tierreich" (O. Bütschli, ed.), 5, 110.
Genus incert *schmeilii* (Pfeiffer, 1895) Kudo, 1924, *loc. cit.*
Host: [COPEPODA] *Cyclops* sp., *Diaptomus vulgaris* Schmeil *(D. coeruleus)*, *D. salinus* Daday *(D. richardi)*.
Lesion: Body of infected animal gray due to parasitic masses.
Developmental Stages: No data.
Spore: Fusiform or crescentic, size variable, though uniform in one and the same host, 4-8 x 3-6 μm.
Locality: Germany (Halle, Heidelberg, Greiswald, Ludwigshafen).
Remarks: Apparently, this represents more than one species.

Microsporidium scolyti (Weiser, 1968) comb. n.

Plistophora scolyti Weiser [*nomen nudum*], "Nemoci hmyco" [*fide* Weiser, 1968, Folia Parasitol., 15, 12].
Plistophora scolyti Weiser [*partim*], 1968, *loc. cit.*
Stempellia scolyti (Weiser) Lipa, 1968, Acta Protozool., 6, 69.
Host and Site: [COLEOPTERA] *Scolytus scolytus* F. (type host); gut wall [Weiser]. Also in *S. ensifer* Eichh., *S. multistriatus* Marsh, and *S. pygmaeus* Fabr.; gut, Malpighian tubules, hemocytes [Lipa].
Vegetative Stages: "The first schizonts are oval or spherical with dark staining nuclei. They develop into elongated merozoites with 3 or more nuclei, which divide into uninucleate bodies; in their interior two nuclei of the diplokaryon are formed" [Weiser]. "Young schizonts are uninucleate and about 3 μ in diameter ... . Older schizonts are binucleate, tetranucleate or more and ... up to 8 μ in diameter" [Lipa].
Sporulation Stages: Plasmodia with 3-15 nuclei "break into segments with 2-3 nuclei which divide again into elongated oval sporoblasts with one and later two nuclei" [Weiser]. Sporonts produce 4, 6, 8, 16 or more spores [Lipa].
Spore: 4-7 x 2.8-4 μm (av., 5.2 x 3.3 μm) with equal ends; with "a metachromatic granule at one end, a polaroplast at the other and 2 nuclei in the center of the sporoplasm. ...part of the material ... contained spores 6-7 μ long and 3-4 μ broad, in average size 6.8 x 3.8 μ" [Weiser]. Ellipsoidal, 2.7-4 x 1.2-2.2 μm, when fresh and 1.5-2.5 x 1.0-1.5 μm, when stained [Lipa].
Locality: Czechoslovakia (near Polarikovo and St. Maria) [Weiser]. Poland (Poznań), U.S.S.R. (Voronezh), Germany (Leipzig) [Lipa].
Remarks: Differences, especially in spores, reported by Weiser and Lipa raise doubts that these two authors studied the same species. However, these differences can be fairly well reconciled by assuming that Weiser had a mixed infection that included *Nosema scolyti* Lipa, 1968. This species is transferred to the collective group *Microsporidium* because it shows little resemblance to the type species of *Pleistophora* or *Stempellia*.

Microsporidium simulii (Maurand & Manier, 1967) comb. n.

Stempellia simulii M. & M., 1967, J. Protozool., 14(Suppl.), 47. Maurand & Manier, 1967, Protistologica, 3, 448, Fig. 1, Pls. 1, 2. Maurand & Manier, 1968, Ann. Parasitol. Hum. Comp., 43, 81, Figs. 1-3.
Host and Site: [DIPTERA-SIMULIIDAE] *Simulium bezzii*, larva; fat body.
Lesion: The fat body becomes enlarged due to hypertrophy of both nucleus and cytoplasm. The body acquires a syncytial aspect. The nuclei degenerate.

Vegetative Stages: Uninucleate cells undergoing binary fission were illustrated. Diplocaryotic cells (sporonts?) also were demonstrated.
Sporulation Stages: The sporont develops into a sporogonial plasmodium which generally forms 8, 12, or 16 spores.
Spore: Pyriform, 4.5 x 1.75 μm, uninucleate; polar filament about 20 μm. The size does not vary with the number produced in the pansporoblast.
Locality: France (near Montpellier?).
Remarks: This, like the diverse other species that have been assigned to the Genus *Stempellia*, seems to have little resemblance to the type species. Therefore, it is transferred to the collective group *Microsporidium*.

Microsporidium slavinae (Léger & Hesse, 1921) comb. n.

Cocconema slavinae L. & H., 1921, C. R. Acad. Sci., 173, 1420.
Coccospora slavinae (L. & H., 1921) Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1067.
Host and Site: [OLIGOCHAETA] *Slavina appendiculata* Udek.; epithelial cells of intestine.
Lesion: Infected cells often hypertrophied.
Vegetative Stages: "Schizogonie avec stages amaebiformes."
Sporulation Stages: Spores in spherical or ovoid mass composed of numerous elements.
Spore: Spherical, 3 μm.
Locality: France (Montessaux).
Remarks: Kudo (1925, Science, 61) replaced the name *Cocconema* (preoccupied) with the new name *Coccospora* but did not actually use the new name in combination with any specific name. Perhaps, Poisson was first actually to use the combination *Coccospora slavinae*. The Genus *Coccospora* was suppressed by transfer of its type species to another genus. Therefore, *C. slavinae* is transferred to the collective group *Microsporidium*.

Microsporidium spelotremae (Guyénot, Naville & Ponse, 1925) Canning, 1975

Nosema (Plistophora) spelotremae G., N. & P., 1925, Rev. Suisse Zool., 31, 399, Figs. 2, 5, 7.
Nosema spelotremae G., N. & P., 1925. Jírovec, 1936, Vestn. Cesk. Spol. Zool., 4, 60. Stanier, Woodhouse & Griffin, 1968, J. Invertebr. Pathol., 12, 73, Figs. 1-7.
Microsporidium spelotremae (G. N. & P., 1925) Canning, 1975, C I H Misc. Publ., 2, 2.
Host and Site: [TREMATODA] Hyperparasite of *Spelotrema carcini* Lebour in the crab *Carcinus maenas*. Metacercaria, parenchyma, hypodermal cells, vitellaria, and epithelium of excretory tubules.

Lesion: Infected cyst hypertrophied, with thin wall, usually completely filles with spores [Stanier *et al.*].
Vegetative Stages: Not observed, thought by Guyénot *et al.* and by Stanier *et al.* to have occurred before encystment of the cercaria.
Sporulation Stages: Some small elements with granular nucleus were thought to be probably sporonts and a few plasmodia in the parenchyma were thought to be possible pansporoblasts [Guyénot *et al.*]. Spores isolated or grouped in masses.
Spore: Length, 3.5 μm [Guyénot *et al.*]. After fixation, 2.6-3 x 1.3-1.5 μm; polar filament 106 μm [Stanier *et al.*].
Locality: France and England.
Remarks: The generic determination of this species has always been in doubt, although authors have generally accepted the idea that it is a *Nosema*. Electron microscope studies by Stanier *et al.* did not clarify the taxonomic position.

Microsporidium stempelli (Pérez, 1905) comb. n.

Glugea stempelli Pérez, 1905, C. R. Soc. Biol., 58, 151. Pérez, 1905, Bull. Sta. Biol. d'Arcachon, 8, 29, Fig. 14.
Cocconema stempelli (Pérez) Kudo, 1924, Ill. Biol. Monogr., 9(2/3), 181, Fig. 641.
Coccospora stempelli (Pérez, 1905) Poisson, 1953, *in* "Traité de Zoologie" (P. P. Grassé, ed.), 1(2), 1067.
Host and Site: [CIRRIPEDIA] The barnacle *Balanus amaryllis* Darwin; body cavity, especially abundant in region between mantle and testis, also where the female glands are normally located.
Lesion: Connective tissue filled in a massive way with a dense accumulation of cysts, white, spherical, 1-2 mm in diameter. Each cyst enveloped by a thin layer of host connective tissue.
Vegetative Stages: Each cyst with outer protoplasmic layer containing numerous polymorphic and budding nuclei, up to 20 μm long. This was said to be the vegetative part of the parasite.
Sporulation Stages: Small nuclei were said to bud off the large ones, migrate inward in the cyst, surround themselves with cytoplasm and, finally, transform into spores.
Spore: Almost spherical, about 1.5 μm (in sections).
Locality: Gulf of Persia.
Remarks: Pérez first described this species in a preliminary note in 1905. Later in the same year, he described it more fully and illustrated it. This species is similar to *Glugea* in forming a typical xenoma with proliferating host cell nuclei (thought by Pérez, and others at that time, to be vegetative nuclei of the parasite). It does not, however, show any of the life-cycle stages characteristic of *Glugea* (judging both from the description and the figure given by Pérez). Kudo's reason for reassigning it on the basis of spherical spores is no longer tenable because many genera have

spherical spores. Furthermore, the genus to which he assigned it *(Cocconema = Coccospora)* was suppressed by Weiser (1961). This species appears to be close to the BURKEIDAE but, because our knowledge is limited, the best temporary expedient may be to place it in the collective group *Microsporidium*.

Microsporidium tabani (Gingrich, 1965) comb. n.

Thelohania tabani Gingrich, 1965, J. Invertebr. Pathol., 7, 236, Figs. 1-18. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.

Host and Site: [DIPTERA-BRACHYCERA] The black horsefly *Tabanus atratus* Fabricius.

Vegetative Stages: Two schizogonic cycles, both binary fission, described. One involves single nuclei and the other double nuclei.

Sporulation Stages: A sporont with double nucleus is said to undergo autogamy and then sporogony, forming 8 sporoblasts in a cluster. The sporoblasts separate and produce isolated spores. Pansporoblastic membrane absent.

Spore: Elongate-oval to pyriform, 2.83 x 2.02 μm (life). Macrospores, 4.32 x 2.65 μm. Polar filament 34.9 μm.

Locality: U.S.A. (Mississippi).

Remarks: Absence of a pansporoblastic membrane excludes this species from *Thelohania*. Hazard and Oldacre, for reasons not given, think it does not belong in the THELOHANIIDAE. The apparent production of sporoblasts in rosettes of 8 suggest an affinity to *Octosporea,* although the species does not have the narrow spores commonly seen in this genus and the number of nuclei in the spores in unknown. In the absence of a better alternative, this species is transferred provisionally to the collective group *Microsporidium*.

Microsporidium thomsoni (Kramer, 1961) comb. n.

Thelohania thomsoni Kramer, 1961, J. Insect Pathol., 3, 259, Figs. 1-18. Hazard & Oldacre, 1975, U. S. Dep. Agric. Tech. Bull., 1530, 95.

Host and Site: [DIPTERA-BRACHYCERA] *Muscina assimilis* (Fallen), adult; epithelium of chyle stomach and anterior portion of proximal intestine.

Lesion: Not externally visible, infected tissues usually opaque.

Vegetative Stages: Binucleate forms undergo binary of multiple fission to produce more binucleate forms. Autogamy said to occur and give rise to the initial stage in sporogony.

Sporulation Stages: Sporont thought to produce 8 sporoblasts that separate very early, producing single and, occasionally, paired young sporoblasts.

Spore: Ovocylindrical, 2.56-5.45 x 1.28-2.05 µm, about 80% being 3.14-3.72 x 1.28-1.79 µm (in Giemsa smears). Binucleate. Polar filament 60-70 µm.
Locality: U.S.A. (Urbana, Illinois).
Remarks: Hazard and Oldacre, for reasons not stated, think this species does not belong in the THELOHANIIDAE. The binucleate condition of the spore exclude this species from *Thelohania*. Whether it has the pansporoblastic membrane, characteristic of *Thelohania*, is not clear from the text and figures. This may be a species of *Octosporea* but, since there is doubt, it is transferred provisionally to the collective group *Microsporidium*

Microsporidium termitis (Kudo, 1943) comb. n.

Nosema sp. Kudo, 1938, J. Parasitol., 24, 377, Fig. 1.
Nosema termitis Kudo, 1943, J. Morphol. 73, 265, Figs. 1-46. Weiser, 1961, Monogr. Angew. Entomol., 17, 57.
Host and Site: [ISOPTERA] The termite *Reticulitermes flavipes;* midgut epithelium.
Vegetative Stages: Reproduction by binary fission; this stage is very limited.
Sporulation Stages: Certain peculiar "trophozoites" divide into 2 uninucleate cells ("sporonts") that develop directly into spores.
Spore: Elongated-ovoid to ellipsoid, 6-8 x 4-4.7 µm (fresh), and 6-7.5 x 3.6-4.5 µm (stained). Uninucleate. Polar filament up to 100 µm.
Locality: U.S.A. (vicinity of Urbana, Illinois).
Remarks: In 1938, the author suspected the parasite was in the fat body of the host; but in 1943, he decided that the earlier idea was incorrect. It is interesting to note that the author, biased by the view that *Nosema* is "monosporous," treated the product of the last binary division, rather than the cell that divides into those products, as sporonts. Diplocarya were not demonstrated and the evidence (involving Feulgen preparations) that the spores are uninucleate is rather convincing. Therefore, this species is excluded from the Genus *Nosema* and placed provisionally in the collective group *Microsporidium*.

Microsporidium tritoni (Weiser, 1960) Canning, manuscript

Nosema tritoni Weiser, 1960, Věstn. Česk. Spol. Zool., 24, 232, 8 figs.
Host and Site: [AMPHIBIA] *Triturus vulgaris* L., larva; connective tissue, infection appeared as a white swelling anterior to the anus.
Lesion: The cyst was lenticular, about 2 mm long, subcutaneous, with thin and inconspicuous wall.

Vegetative Stages: Only a few uni- or binucleate stages with small massive nuclei could be found.
Sporulation Stages: "Sporont" round to egg-shaped, 5 x 3 µm, with a broad nucleus. Sporoblast elongated, with metachromatic granule in one pole.
Locality: Czechoslovakia (near Chatebor).
Remarks: The apparent presence of a single nucleus in all stages is inconsistent with the characters of the Genus *Nosema*.

Microsporidium tuzetae (Tour, Rioux & Croset, 1971) comb. n.
Stempellia tuzetae T., R. & C., 1971, Ann. Parasitol. Hum. Comb., 46, 216, Figs. 9, 11.
Host: [DIPTERA-CULICIDAE] *Aedes detritus* (Hal.), larva.
Vegetative Stages: Represented by small elements with 2 and 4 nuclei. Larger elements with 1, 2, or 4 nuclei undergo a sexual process.
Sporulation Stages: During sporogony the zygote develops into a plasmodium with 4 or 8 nuclei which divides into sporoblasts. Sporogensis occurs either within the pansporoblastic membrane or after liberation of the sporoblasts.
Spore: "Bacculiform," an inflated posterior part separated from the subcylindrical anterior part by a slight constriction. Size, 7-16 x 3-6 (av., 10.71 x 3.78) µm.
Locality: France (Aiques-Mortes, Gard).
Remarks: This species was assigned to the Genus *Stempellia* because it was thought to possess the principal characters of this genus. Judging from the limited information available, this species does resemble the type species of *Stempellia* more than most of the diverse species that have been assigned to this genus. Since the validity of *Stempellia* is questionable, however, this species is transferred to the collective group *Microsporidium*.

Microsporidium weiseri (Šilhavý, 1960) comb. n.
Stempellia weiseri Silhavý, 1960, Věstn. Česk. Spol. Zool., 24, 50, Figs. 1-12.
Host and Site: [ARACHNIDA] *Opilio parientinus* (De Geer); haemocytes.
Developmental Stages: A small body surrounded by a clear zone develops into a plasmodium that produces 2, 4, 8, or 16 spores. The parasites develop within a vacuole in the cytoplasm of the host cell, although a sporophorous vesicle may be absent. The figures show only 1 plasmodium (or its products) in a host cell.
Spore: Oval, 2.6-3 x 1.3-1.5 µm.
Locality: Czechoslovakia (Trebic).

Remarks: This species was assigned to the Genus *Stempellia* only because the sporogonial plasmodium produces a variable number of spores. It has little resemblance to any of the very diverse species that have been assigned to this genus. Therefore, it is transferred to the collective group *Microsporidium*.

Microsporidium sp. Banerjee, 1968

"microsporidian" sp. Banerjee, 1968, Ann. Entomol. Soc. Am., 61, 545.

Host and Site: [LEPIDOPTERA] The sod webworm *Crambus trisectus* (Walker), larva; midgut. Experimental host, *C. teterrellus* (Zincken), larva.

Lesion: No data.

Vegetative Stages: No data.

Sporulation Stages: "Spores occurred singly, not in packets."

Spore: Size when fresh, 1.51 x 3.11 µm.

Locality: U.S.A. (Illinois).

Remarks: "microsporidia," unidentified, is treated as being identical with *Microsporidium*.

Microsporidium sp. Bell & McGovern, 1975

"microsporidan" B. & M., 1975, J. Invertebr. Pathol., 25, 133.

Host: [COLEOPTERA] The boll weevil *Anthonomus grandis*.

Descriptive Data: None.

Locality: U.S.A. (Mississippi).

Microsporidium sp. Canning, 1975

Nosema sp. Schäller, 1959, Z. Wiss. Zool., 162, 187, Figs. 6-8, 10-19, 22. Schäller, 1960, Urania, 19, 36, Figs. 3-5.

Microsporidium sp. (Schäller, 1959) Canning, 1975, C I H Misc. Publ. 2, 12.

Host and Site: [TREMATODA] Hyperparasite of larval stages of 4 species of trematodes in the digestive gland of the snail *Tropidiscus planorbis* (L.): *Cercaria echinoparyphii recurvati* Mathias, 1926, *Cercaria burti* (Miller, 1923) Cort, 1928, *Cercaria helvetica* V = VII Dubois, 1929, Xiphidiocercariae of the microcotylae group.

Vegetative Stages: No data.

Sporulation Stages: Spores were developed in isolation; pansporoblasts were not present.

Spore: 2.3-3.4 x 1.1-1.5 µm.

Locality: Germany.

Remarks: It is impossible to judge whether the generic determination is correct but there is no evidence to the contrary. I have followed Canning in placing this species in the collective group *Microsporidium* because I see no compelling reason to do otherwise. However, I do not treat *Microsporidium* sp. as a new combination because, since there is no specific name, I take the position that there is no combination.

Microsporidium sp. Canning & Landau, 1971

"microsporidan" C. & L., 1971, Trans. Roy. Soc. Trop. Med. Hyg., 65, 431.
Host and Site: [REPTILIA] *Lacerta muralis;* gut epithelium.
Lesion: "The parasites were seen as foci of spores, lacking a bounding membrane, lying in a vacuole in the host cell. The spores were characteristically positioned close to the host cell nucleus, in the small space between it and the mucus goblet."
Developmental Stages: "not seen but, the occurrence of free spores in the foci rather than tight packed or membrane-bound groups suggest that the genus is *Nosema* or *Glugea* ... ."
Spores: No data.
Locality: France.

Microsporidium sp. Christophers, 1922

"Leishman-Donovan bodies" Adie, 1922, Indian J. Med. Res., 9(3), v.
Nosema adiei Christophers [*nomen nudum*], 1922, *ibid.*, 9(4), v. Shortt & Swaminath, 1924, Indian J. Med. Res., 12, 181, Figs. 1-3. Weiser, 1961, Monogr. Angew. Entomol., 17, 60.
"Parasites" Adie, 1922, Indian J. Med. Res., 10, 236.
Host and Site: [HEMIPTERA] *Cimex rotundatus;* gut, salivary gland, ovary.
Vegetative Stages: "Planonts," 1.6 μm in diameter and with one "mass of chromatin" were seen. Meronts were 3.2 x 2.7 μm and binucleate.
Sporulation Stages: No data, although "aggregates" of spores "unassociated with any evident cell nucleus" were present.
Spore: Elliptical or oval, 3 x 1.7 μm, "with a central dot which may be a deeper blue color or may be red."
Locality: India.
Remarks: "The International Rules of Zoological Nomenclature" [see Stoll (1961)] require that the specific name (from that of Mrs. Adie) end in *-ae*. Christophers proposed the name as a *nomen nudum* in 1922. Adie and, in more detail, Shortt and Swaminath described the parasite. No one made the name available by giving characters purporting to distinguish the taxon. Therefore, it has no standing in nomenclature. For convenience, the parasite is here designated as *Microsporidium* sp. Christophers.

Microsporidium sp. Hall, Stewart, Arakawa & Strong, 1971

"microsporidan" H., S., A. & S., 1971, J. Invertebr. Pathol., 18, 259.
Host and Site: [COLEOPTERA] The dermestid beetle *Trogoderma simplex,* adult(?); site not mentioned.
Lesion: No data.

Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: 6-7 x 3 µm; polar filament 47-53 µm.
Locality: U.S.A. (Sonoma County, California).
Remarks: "species of microsporidan" is treated as being identical with *Microsporidium*.

Microsporidium sp. Herman & Putz, 1970

"A microsporidan" H. & P., 1970, J. Wildl. Dis., 6, 173, Fig. 1.
Host and Site: [PISCES] *Ictalurus punctatus;* ventricle of the heart and intestinal submucosa.
Lesion: Xenoma formed by hypertrophy of both nucleus and cytoplasm of infected cell. Membrane of xenoma thicker in intestine than in heart.
Vegetative Stages: No data.
Sporulation Stages: Sections showed at least 6 spores from a sporont, leading to the conclusion that the parasite belongs either to the Genus *Thelohania* or *Pleistophora*.
Spore: Not described.
Locality: U.S.A. (Maryland).

Microsporidium sp. Hopper, Meyers & Cefalu, 1970

"microsporidia" H., M. & C., 1970, J. Invertebr. Pathol., 16, 376.
Host and Site: [NEMATODA] *Theristus (Daptonema) albigensis;* muscle(?).
Lesion: Microsporidial masses 25-40 x 80-100 µm were present (in 2 host specimens).
Other Data: None.
Locality: Canada (Prince Edward Island).
Remarks: "microsporidia" is treated as being identical with *Microsporidium*.

Microsporidium sp. Issi & Lipa, 1968

"microsporidian" I. & L., 1968, Acta Protozool., 6, 283.
Host and Site: [LEPIDOPTERA] *Argyresthia pygmaella* Hb., larva; site not mentioned.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: (stained) 1.6-2.3 x 1.1-1.3 µm.
Locality: U.S.S.R. (Krasnodar Country).
Remarks: Because the parasite was found in dead larvae its condition did not permit the making of a generic determination.

Microsporidium sp. I. & L., 1968
"unidentified microsporidians" I. & L., 1968, Acta Protozool., 6, 288.
Host and Site: [LEPIDOPTERA] *Panolis flammea* Schiff; site not mentioned.
Other Data: None.
Locality: U.S.S.R.
Remarks: "Unidentified microsporidians" is treated as being identical with *Microsporidium* sp.

Microsporidium sp. I. & L., 1968
"unidentified microsporidians" I. & L., 1968, Acta Protozool., 6, 288.
Host and Site: [LEPIDOPTERA] *Notodonta trepida* Exp.; site not mentioned.
Other Data: None.
Locality: U.S.S.R.
Remarks: "Unidentified microsporidians" is treated as being identical with *Microsporidium* sp.

Microsporidium sp. I. & L., 1968
"unidentified microsporidians" I. & L., 1968, Acta Protozool., 6, 288.
Host and Site: [LEPIDOPTERA] *Dioryctria splendidella* H. & L.; site not mentioned.
Other Data: None.
Locality: U.S.S.R.
Remarks: "Unidentified microsporidians" is treated as being identical with *Microsporidium* sp.

Microsporidium sp. I. & L., 1968
"unidentified microsporidians" I. & L., 1968, Acta Protozool., 6, 288.
Host and Site: [LEPIDOPTERA] *Cheimatobia brumata* L,; site not mentioned.
Other Data: None.
Locality: U.S.S.R.
Remarks: "Unidentified microsporidians" is treated as being identical with *Microsporidium* sp.

Microsporidium sp. I. & L., 1968
"unidentified microsporidians" I. & L., 1968, Acta Protozool., 6, 288.
Host and Site: [COLEOPTERA] *Anisoplia austriaca* Herbst; site not mentioned.
Other Data: None.
Locality: U.S.S.R.
Remarks: "Unidentified microsporidians" is treated as being identical with *Microsporidium* sp.

Microsporidium sp. Keyl, 1960

"Mikrosporidien" Keyl, 1960, Naturwissenschaften, 47, 212.
Host and Site: [DIPTERA-CHIRONOMIDAE] *Chironomus anthracinus*, larva; salivary gland.
Lesion: Infected cells undergo hypertrophy of both nucleus and cytoplasm, with enormous increase in size of the giant chromosomes.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: No data.
Locality: Germany.

Microsporidium sp. Miller, Barrett, Scanlon & Bartnett, 1970

"an unidentified microsporidia" M., B., S. & B., 1970, Proc. Tex. Mosquito Contr. Assoc., 1970, 4.
Host and Site: [DIPTERA-CULICIDAE] *Culex quinquefasciatus* Say, larva; fat body.
Lesion: No data.
Vegetative Stages: No data.
Sporulation Stages: No data.
Spore: Pyriform, about 7 x 3 μm.
Locality: U.S.A. (Houston, Texas).
Remarks: "an unidentified microsporidia" is treated as being identical with *Microsporidium* sp.

Microsporidium sp. Pavan & Basile, 1966

"a protozoan" Diaz & Pavan [*partim*], 1965, Proc. Natl. Acad. Sci. U. S. A., 54, 1321.
"microsporidian" P. & B. [*partim*], 1966, Science (Wash., D. C.), 155, 1556. [?]Pavan & Perondini, 1966, Genetics, 54, 353. Pavan & Da Cunha [*partim*], 1968, *in* "Proceedings of the International Seminar on the Chromosomes--its Structure and Function" (A. K. Sharma & A. Sharma, eds.), p. 184.
Thelohania sp. Pavan, Perondini & Picard, 1969, Chromosoma, 28, 331, Figs. 1, 3, 7, 11. Pavan, Biesele, Riess & Wertz, 1971, Stud. Genet., 6, 243, Fig. 28.
Host and Site: [DIPTERA-SCIARIDAE] *Sciara ocellaris*, larva; most commonly but also in salivary gland, tracheal cells, muscle [P. P. P. (1969)]. [?] *Rhynchosciara angelae*, larva and adult; salivary gland, muscles and fat bodies [P., B., R. & W. (1971)].
Lesion: [Xenoma] The infected cell is "a unicellular tumor that has its own pattern of development." In the fat body, "several cells may fuse, and together with the micro-organisms present, behave as a unit." This is a "syncytial tumor." The chromosomes of the infected host cell are altered [P., B., R. & W. (1971)].

Vegetative Stages: Schizonts with 1 or 2 nuclei were illustrated [P., B., R. & W.].
Sporulation Stages: "Each sporont produces eight sporoblasts and ultimately eight spores" [P., P., & P.]. Spores "normally found in groups of eight attached together" (D. & P.).
Spore: Spherical, about 3 μm, uninucleate [D. & P.]. Ovoidal, about 5-6 x 2.5-3 μm [calculated from figure of Pavan *et al.* (1969)]. An electron micrograph by Pavan *et al.* (1971) shows a spore that is oval in section, with little or no endospore, with thick and irregular exospore, with short polar filament showing 3-4 turns.
Locality: U.S.A. (Tennessee) [P. P. P. (1969)]. Brazil (Sao Paulo) [P., B., R. & W.].
Remarks: Pavan and associates wrote a number of papers in which they reported two microsporidian species, one identified as *Thelohania* sp. and the other *Octosporea* sp. It is impossible to judge from their reports whether they were always dealing with the same two species. In absence of information to the contrary, I assume they reported only one species in each of these two genera. The spores and "sporonts" (sporoblasts) of "*Thelohania* sp." shown in Fig. 1 by Pavan *et al.* (1969) tend to be "attached together" in groups but they are in a rosette or stellate formation with no indication of a pansporoblastic membrane. This character, plus the spore structure, seem to exclude the species from Genus *Thelohania*. It is, therefore, placed in the collective group *Microsporidium*, deemed to be the equivalent of "microsporidian" as used by Pavan and Basile, 1966. It is interesting that Pavan and associates have, like Weissenberg (1968) before them, independently arrived at the concept of the infected cell (the "unicellular tumor") as an example of symbiosis.

Microsporidium sp. Raabe, 1935

Microsporidium sp. Raabe, 1935, Bull. Inst. Océanogr. (Monaco), 665, 1-11, Figs. 1-4.
Host and Site: [PISCES] *Pleuronectes flesus*, in *Lymphocystis* lesions on the skin.
Lesion: A typical *Lymphocystis* lesion was described. The parasite appears in the cytoplasm of the hypertrophied cells of the lesion.
Vegetative Stages: Reproduction of amoboid forms by binary and multiple fission was observed.
Sporulation Stages: The sporogony sequence is initiated by elliptical cells. These develop into plasmodia up to 20 x 12 μm and 2-8 spores form within a membrane. Each sporoblast transforms into a spore.

Spore: Elliptical, with a vacuole in one end or in either end, about 3.3 x 2 μm (calculated from the figures); uninucleate.
Locality: England.

Microsporidium sp. Richards, 1973

"microsporidia" Richards, 1973, J. Parasitol., 59, 111.
Host and Site: [MOLLUSCA] Planorbid snails morphologically similar to *Biomphalaria straminea;* site not mentioned.
Descriptive Data: None.
Locality: Grenada.
Remarks: "microsporidia" is treated as being identical with *Microsporidium* sp.

Microsporidium sp. Siebold & Fussell, 1973

"microsporidian" S. & F., 1973, Lab. Anim. Sci., 23, 117, Figs. 1-3.
Host and Site: [MAMMALIA-PRIMATES] *Callicebus moloch,* jejunal epithelium.
Lesion: "There was total desquamation of the surface epithelium in the portion of jejunum that was examined."
Vegetative Stages: Intracytoplasmic clusters of round bodies were seen.
Sporulation Stages: Mature and developing spores were observed.
Spores: Elliptical, with "2 clear areas separated by a biconcave wall of basophilic material." About 4 μm long [judging from figures]. Polar filament with 7 coils.
Locality: U.S.A. (Louisiana).
Remarks: The authors considered this species to be much like *Encephalitozoon cuniculi* but different in having more coils in the polar filament.

Microsporidium sp. Sprague, *hoc loco*

Bertramia asperospora (Fritsch). Badalamente & Vernick [*partim*], 1973, Arch. Protistenkd., 115, 1, Figs. 5, 6.
Host: [ROTATORIA] *Brachionus plicatilis* Müller.
Vegetative Stages: No data.
Sporulation Stages: A sporogonial plasmodium undergoes multiple fission to produce many sporoblasts that transform into spores.
Spore: Polar filament demonstrated by means of electron microscopy.
Locality: U.S.A. (Maryland).
Remarks: In rotifers containing cysts that appeared to be *Bertramia,* these authors demonstrated microsporidian spores and concluded that *Bertramia* Mesnil & Caullery, 1897, is a microsporidian genus. The authors seem not to have considered the possibility (if not probability) that they were dealing with a mixed infection. Therefore, their conclusion is questionable.

Microsporidium sp. Tanada, 1969

"Microsporidian" Tanada, 1969, J. Invertebr. Pathol., 13, 313.
Host: [LEPIDOPTERA] The alfalfa caterpillar *Colias eurytheme*.
Descriptive Data: None.
Locality: U.S.A. (California).
Remarks: The microsporidian spores were obtained from A. M. Tanabe.

Microsporidium sp. Tanada & Omi, 1974

"Microsporidian infection" T. & O., 1974, J. Invertebr. Pathol., 23, 362.
Host: [LEPIDOPTERA] *Colias eurytheme* and *Trichoplusia ni*, larvae.
Descriptive Data: None.
Locality: U.S.A. (California).