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STUDIES ON MYXOSPORIDIA

A SYNOPSIS OF GENERA AND SPECIES
OF MYXOSPORIDIA

WITH 25 PLATES AND 2 TEXTFIGURES

BY

ROKUSABURO KUDO

Contributions from the
Zoological Laboratory of the University of Illinois
No. 158
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INTRODUCTION

Ten years have elapsed since Auerbach (1910) published *Die Cnidosporidien* in which he gave a synopsis of the genera and species of Myxosporidia known up to that time. During this period new genera and a number of new species have been added to the list of this particular group of parasitic protozoa from the various parts of the world. It is, therefore, desirable to have a complete monographic work including all the forms reported up to the present time.

The main objects of the present paper are: 1) to describe a new genus and a number of new species which have come under the observation of the writer; 2) to collect all the genera and species recorded by various authors; 3) to propose a new classification by which some of the confusion now existing may, probably, be avoided; 4) to show the geographical, zoological and organal distribution in the light of more recent observations; and 5) to present a complete list of the names of the hosts in which Myxosporidia occur.

The writer believes himself to be in possession of as complete references as possible under present conditions. However, he may be unaware of some works which have not reached him owing to the war.

The Myxosporidia recorded by Labbé (1899) are arranged in almost the same order as that author listed them, with some slight change such as placing the type species at the front of each genus or removing a few species to other genera, while those species which have been described since 1898 are arranged chronologically, no matter whether names are given the species or not.

Some of the references are omitted, especially when they can be found in Gurley (1894), Thélohan (1895), Labbé (1899), or Auerbach (1910). The description of each species is given according to the first observer. The observations of subsequent investigators are then mentioned in the second place.

Each species is described according to the following scheme:

1) Specific name
2) Synonyms and literature
3) Habitat, including the locality and the date of observation
4) Vegetative form
5) Spore
6) Remarks

I wish to express my appreciation to Professor Henry B. Ward whose kindness has made the completion of this paper possible.
GENERAL REMARKS ON RECENT OBSERVATIONS

The total number of species of Myxosporidia reported up to date and described in the following pages, excluding 12 ambiguous forms, reaches 237 of which 125 are species which have been observed since 1910.*

The distribution of these new forms is as follows:

- Africa ........................................ 6 species
- Asia .......................................... 23 species
- Australia .................................... 1 species
- Europe ....................................... 31 species
- North America ................................ 63 species
- South America ................................ 1 species

Thus, the majority of the species were observed in other lands than Europe, nearly half being recorded from North American waters. It is not hard to anticipate from the observations made by Awerinzew, Davis, Kudo, Mavor, Johnston and Bancroft, and others, that further investigations on the parasites in the localities where the study of the protozoa under consideration was neglected, will bring out not only new and interesting forms which will be quite different from the comparatively well studied European species, but also many important facts that will clear unknown or doubtful phases concerning the life history and structure of Myxosporidia.

* Three species are included here which have been described (in Nipponese) by Miyairi in 1909.
MYXOSPORIDIA RECORDED IN THE PRESENT PAPER

LIST I

Order MYXOSPORIDIA Butschli
I Suborder EURYSPOREA nom. nov. (see page 56)
I Family CERATOMYXIDAE Doflein

Genus 1 LEPTOTHECA Thélohan [15 species]
1) L. agilis Thélohan (type species)
2) L. elongata Thélohan
3) L. polymorpha (Thél.) Labbé
4) L. parva Thélohan
5) L. renicola Thélohan
6) L. hepseti Thélohan
7) L. perlata (Gurley) Labbé
8) L. sp. Awerinzew
9) L. macrospora Auerbach
10) L. infiformis Auerbach
11) L. longipes Auerbach
12) L. fusiformis Davis
13) L. scissura Davis
14) L. lobosa Davis
15) L. glomerosa Davis

Genus 2 CERATOMYXA Thélohan [35 species]
1) C. arcuata Thélohan (type species)
2) C. sphaerulosa Thélohan
3) C. pallida Thélohan
4) C. globurifera Thélohan
5) C. appendiculata Thélohan
6) C. truncata Thélohan
7) C. reticularis Thélohan
8) C. inaequalis Doflein
9) C. linozpora Doflein
10) C. ramosa Awerinzew
11) C. drepanopsettae Awerinzew
12) C. tylosuri Awerinzew
13) C. (?) sparti Awerinzew
14) C. sp. (?) Awerinzew
15) C. sp. (?) Awerinzew
16) C. acadiensis Mavor

Genus 3 MYXOPROTEUS Doflein [3 species]
1) M. ambiguus (Thélohan) Doflein (type species)
2) M. cordiformis Davis
3) M. cornutus Davis

Genus 4 WARDIA nov. gen. [2 species]
1) W. ovinocua nov. spec. (type species)
2) W. ohimacheri (Gurley) Kudo

Genus 5 MITRASPORIA Fujita emend. Kudo [3 species]
1) M. cyprini Fujita (type species)
2) M. caudata (Parial) Kudo
3) M. elongata nov. spec.
II Suborder SPHAEROSPORA nom. nov. (see page 57)

I Family CHLOROMYXIDAE Thélohan

Genus 1 CHLOROMYXUM Mingazzini [22 species]

1) C. leyi-digi Mingazzini (type species)
2) C. caudatum Thélohan
3) C. quadratum Thélohan
4) C. floviatiile Thélohan
5) C. mucronatum Gurley
6) C. diploxyis (Gurley) Thélohan
7) C. protei Joseph
8) C. truliae Léger
9) C. cristatum Léger
10) C. dubium Auerbach
11) C. leydigi Mingazzini (type species)
12) C. caudatum Thélohan
13) C. mucronatum Gurley
14) C. diploxyis (Gurley)
15) C. protei Joseph
16) C. truliae Léger
17) C. cristatum Léger
18) C. dubium Auerbach
19) C. sp. Auerinzew
20) C. thomali Lebehelter
21) C. koi Fujita
22) C. magnun Auerinzew
23) C. fundulii Hahn
24) C. misgurni Kudo
25) C. fujitai Kudo
26) C. catostomi nov. spec.
27) C. leydigi Mingazzini
28) C. caudatum Thélohan
29) C. mucronatum Gurley
30) C. diploxyis (Gurley)
31) C. protei Joseph
32) C. truliae Léger
33) C. cristatum Léger
34) C. dubium Auerbach

II Family SPHAEROSPORIDAE Davis

Genus 1 SPHAEROSPORA Thélohan [10 species]

1) S. divergens Thélohan (type species)
2) S. elegans Thélohan
3) S. rostrata Thélohan
4) S. masovica Cohn
5) S. platesseae Woodcock
6) S. angulata Fujita
7) S. sp. Davis
8) S. polymorpha Davis
9) S. (?) sp. Southwell et Prashad
10) S. carassii nov. spec.

Genus 2 SINUOLINEA Davis [5 species]

1) S. dimorpha Davis (type species)
2) S. capsularis Davis
3) S. arborescens Davis
4) S. opacita Davis
5) S. brachioophora Davis

III Suborder PLATYSPOREA nom. nov. (see page 57)

I Family MYXIIDAE Thélohan

Genus 1 MYXIDIUM Bütschli [26 species]

1) M. lieberkühni Bütschli (type species)
2) M. incurvatum Thélohan
3) M. sphaericum Thélohan
4) M. histophilum Thélohan
5) M. sp. Gurley
6) M. danileucyski Laveran
7) M. giganteum Doflein
8) M. barbatulae Cépède
9) M. giardi Cépède
10) M. pfeifferi Auerbach
11) M. inflatum Auerbach
12) M. bergense Auerbach
13) M. procerum Auerbach
14) M. mackiei Bosanquet
15) M. macrocapitale Auerbach
16) M. sp. Aierinzew
17) M. depressum Parisi
18) M. ereiforme Parisi
19) M. anguillae Ishii
20) M. sp. Mavor
21) M. gadi Georgévitch
22) M. glutinosum Davis
23) M. phylilium Davis
24) M. striatum Cunha et Fonseca
25) M. kagayamai nov. spec.
26) M. americanum nov. spec.

Genus 2 SPHAEROMYXAXA Thélohan [7 species]

1) M. balbiamii Thélohan (type species)
2) M. immersa (Lutz) Thélohan
3) M. incurvata Doflein
4) M. sabrasi Laveran et Mesnil
5) M. hellandi Auerbach
6) M. exneri Auerinzew
7) M. gasterostei Georgévitch

Genus 3 ZSCHOKKELLA Auerbach [4 species]

1) Z. hildæ Auerbach (type species)
2) Z. nova Klokacewa
3) Z. acheilognathi Kudo
4) Z. globulosa Davis
### STUDIES ON MYXOSPORIDIA—KUDO

#### II Family MYXOSOMATIDAE Poche

**Genus 1 MYXOSOMA** Thelohan  
[3 species]

1. *M. dujardini* Thelohan (type species)
2. *M. (?) lobatum* Nemeczek
3. *M. funduli* Kudo

**Genus 2 LENTOSPIRA** Plehn  
[6 species]

1. *L. cerebralis* (Hofer) Plehn (type species)
2. *L. multiplicata* Reuss
3. *L. encephalina* Mulso
4. *L. asymmetrica* Parisi
5. *L. acuta* (Fujita) Kudo
6. *L. dermatobia* Ishii

#### III Family MYXOBOLIDAE Thelohan

**Genus 1 MYXOBOLUS** Bütschli  
[63 species]

1. *M. mülleri* Bütschli (type species)
2. *M. piriformis* Thelohan
3. *M. unicapstalis* Gurley
4. *M. fuhrmanni* Auerbach
5. *M. oculi-leucisci* Trojan
6. *M. toyamai* Kudo
7. *M. notatus* Mavor
8. *M. sp.* Kudo
9. *M. rohitae* Southwell et Prasad
10. *M. seni* Southwell et Prasad
11. *M. misgurni* nov. spec.
12. *M. jefiferi* Thelohan
13. *M. inaequalis* Gurley
14. *M. dispar* Thelohan
15. *M. ellipsoïdes* Thelohan
16. *M. exigus* Thelohan
17. *M. oviformis* Thelohan
18. *M. hintoni* Gurley
19. *M. globosus* Gurley
20. *M. oblongus* Gurley
21. *M. transovalis* Gurley
22. *M. obscurus* Gurley
23. *M. cycloides* Gurley
24. *M. sphaeralis* Gurley
25. *M. amarus* Cohn
26. *M. sp.* Gurley
27. *M. sp.* Gurley
28. *M. sp.* Gurley
29. *M. cyprini* Dollein
30. *M. neurobius* Schüberg et Schröder
31. *M. aeglephi* Auerbach
32. *M. gigas* Auerbach
33. *M. volgensis* Reuss
34. *M. scardini* Reuss
35. *M. physophilus* Reuss
36. *M. macrocapsularis* Reuss
37. *M. sandrae* Reuss
38. *M. bramae* Reuss
39. *M. cyprincola* Reuss
40. *M. balleri* Reuss
41. *M. squamae* Keysselitz
42. *M. cordis* Keysselitz
43. *M. musculi* Keysselitz
44. *M. sp.* Miyairi
45. *M. sp.* Wegener
46. *M. permagnus* Wegener
47. *M. rotundus* Nemeczek
48. *M. minutus* Nemeczek
49. *M. sp.* Lebzeiter
50. *M. magnus* Awerinzew
51. *M. carassii* Klokacaewa
52. *M. sp.* Southwell
53. *M. funduli* Kudo
54. *M. pleuronectidae* (Hahn)
55. *M. capsulatus* Davis
56. *M. nodularis* Southwell et Prasad
57. *M. kylae* Johnston et Bancroft
58. *M. aureatus* Ward
59. *M. miyairi* nov. spec.
60. *M. koi* nov. spec.
61. *M. orbiculatus* nov. spec.
62. *M. discrepans* nov. spec.
63. *M. mesentericus* nov. spec.

**Genus 2 HENNEGUYA** Thelohan  
[32 species]

1. *H. psorospermica* Thelohan (type species)
2. *H. texta* (Cohn) Labbé
3. *H. minuta* (Cohn) Labbé
4. *H. oviperda* (Cohn) Labbé
5. *H. lobosa* (Cohn) Labbé
6. *H. peri-intestinalis* Cépède
7. *H. media* Thelohan
8. *H. brevis* Thelohan
9. *H. schisura* (Gurley) Labbé
10. *H. crephini* (Gurley) Labbé
11) H. linearis (Gurley) Labbé
12) H. gurleyi Kudo
13) H. strongylura (Gurley) Labbé
14) H. monura (Gurley) Labbé
15) H. kolesnikovi (Gurley) Labbé
16) H. macrura (Gurley) Thélohan
17) H. szchokkei (Gurley) Dollein
18) H. sp. (Gurley) Labbé
19) H. sp. (Gurley) Labbé
20) H. tenuis Vaney et Conte
21) H. müslini Schuberg et Schröder
22) H. legeri Cépède
23) H. acerinae Schröder
24) H. gigantea Nemeczek
25) H. (?) sp. Nemeczek
26) H. gassterostei Parisi
27) H. neapolitana Parisi
28) H. wisconsinensis Mavor
29) H. brachyura Ward
30) H. salminicola Ward
31) H. miyairii nov. spec.
32) H. miclostora nov. spec.

Genus 3 HOFERELLUS Berg
[1 species]
1) H. cyprini Dollein

Appendix: Myxosporidia of unknown genera and species [11 forms]
1) Gen. et spec. incert. Leydig
2) Gen. et spec. incert. Leydig
3) Gen. et spec. incert. Leydig
4) Gen. et spec. incert. Heckel et Kner
5) Gen. et spec. incert. Borne
6) Gen. incert. merlucii Perugia
7) Gen. incert. congri Perugia
8) Gen. et spec. incert. Linton
9) Gen. et spec. incert. Mingazzini
10) Gen. et spec. incert. Nufer
11) Gen. et spec. incert. Mavor
12) Gen. et spec. incert. Mavor
DISTRIBUTION OF MYXOSPORIDIA

A. GEOGRAPHICAL DISTRIBUTION

As will be seen from List III, Myxosporidia are common parasites of fish in various parts of the world.

It is interesting to notice that the same species are found among freshwater or marine fish from waters in widely separated countries. It is possible to think that Myxosporidia in marine fish may be carried into remote waters by the migration of their hosts, while those infecting freshwater fish may be brought from one place to another by the transportation of infected fish for breeding purpose, etc. It should be noted in this connection that no intermediate host has yet been found in relation to myxosporidiosis.

The followings are the common species found in different localities:

Leptotheca parva Thél.
Ceratomyxa sphaerulosa Thél.
C. appendiculata Thél.
C. drepanopsetiae Averinsew
Chloromyxum leydigi Ming.
C. quadratum Thél.
Sphaerospora elegans Thél.
S. divergens Thél.
Myxidium liebberkhii Bütsch.
M. incurvatum Thél.
M. bergense Auerbach.
M. oviforme Parisi
Sphaerospora balbianii Thél.
Myxosoma dujardini Thél.

Marseille, Bergen
Monaco, Roscoff, Bergen
Roscoff, Marseille, Rovigno
Murman coast, Bergen, Woods Hole
Roscoff, Monaco, Napoli, Rovigno, Beaufort
Roscoff, Marseille, Napoli, Beira
Bretagne, Karlsruhe, Lago di Garda
Napoli, Roscoff, Smalfjorden
Lago Maggiore, France, Germany, Lake Mendota, Georgian Bay
Napoli, Monaco, Roscoff, Bergen, Beaufort
Bergen, St. Andrews
Napoli, Norwegian coast
Roscoff, Napoli, Beaufort
France, Germany, Tokio(?)

On the other hand, some species are limited to certain localities. Five species classified in the genus Sinuolinea by Davis are reported only from Beaufort, N. C., U. S. A. The two species of the genus Wardia have been found solely in the state of Illinois, U. S. A.

More detailed data are shown in the following list.

LIST II

ASIÁ

I NIPPON
Myxosporidia of fresh water fish
1) Northern Part (Hokkaïdo)
Sapporo: Mitraspora cyprini Fujita
Chloromyxum koi Fujita
Sphaerospora angulata Fujita
Lentospora acuta (Fujita) Kudo
2) Central part (Hondo)
Tokio: *Miraspora cyprini* Fujita
    *Chloromyxum misgurni* Kudo
    *Chloromyxum fujitai* Kudo
    *Sphaerospora carassii* nov. spec.
    *Myxidium kagayamai* nov. spec.
    *Zschokkella acheilognathi* Kudo
    *Myxosoma dujardini* (?) Thélohan
    *Myxobolus toyamai* Kudo
    *Myxobolus misgurnii*, nov. spec.
    *Myxobolus ko* nov. spec.
Numazu: *Myxidium anguilae* Ishii
    *Lentospora dermatoobia* Ishii

3) Southern part (Kushiu)
Fukuoka: *Myxobolus* sp. Miyairi
    *Myxobolus miyairii* nov. spec.
    *Henneguya miyairii* nov. spec.

II INDIA
A. Myxosporidia of fresh-water fish
Katwan, Mirzapore (U.P.): *Myxobolus* sp. Southwell
Mirpur, Decca district: *Myxobolus rohita* Southwell et Prashad
    *Myxobolus seni* Southwell et Prashad
    *Myxobolus nodularis* Southwell et Prashad
B. Myxosporidian of reptiles
Bombay: *Myxidium mackiei* Bosanquet

III BURMA
In the vicinity of Ruby Mines: *Sphaerospora* sp. Southwell et Prashad

IV KAMTSCHATKA
?*Henneguya salminicola* Ward

AUSTRALIA
Myxosporidian of amphibia
In the vicinity of Sidney: *Myxobolus hylae* Johnston et Bancroft

AFRICA
A. Myxosporidia of fresh-water fish
Nile: *Myxobolus unicapsulatus* Gurley
    *Henneguya strongylura* Gurley
B. Myxosporidia of marine fish

1) Indian Ocean
Algoa Bay: *Chloromyxum magnum* Awerinzew
Beira: *Chloromyxum quadratum* Thélohan
East London: *Chloromyxum magnum* Awerinzew
Lorenço Marques: *Ceratomyxa tylosuri* Awerinzew
    *Ceratomyxa spari* Awerinzew
    *Ceratomyxa sp (?).* Awerinzew
    *Ceratomyxa sp (?).* Awerinzew
    *Sphaeromyxa exneri* Awerinzew

2) South Atlantic Ocean
Lüderitz Bay: *Chloromyxum magnum* Awerinzew
STUDIES ON MYXOSPORIDIA—KUDO

NORTH AMERICA

I United States

A. Myxosporidia of fresh-water fish

1) From Rivers emptying into Atlantic Ocean
   Carlius, Va. (trib. of Potomac River): *Myxobolus transovalis* Gurley
   Columbia, S. C. (Santee River): *Myxobolus globosus* Gurley
   Kinston, N. C. (Neuse River): *Myxobolus globosus* Gurley
   West Falmouth, Mass.: *Myxobolus* sp. Kudo
   Woodbury, N. J. (Delaware River): *Henneguya monura* Gurley

2) From Lakes and Rivers opening into the Gulf of Mexico
   Fox River, trib. Mississippi: *Myxobolus globosus* Gurley
   Lake Mendota, Wis.: *Myxidium lieberkuhni* Bütschli
   Neches River, Palustin, Tex.: *Henneguya macrura* (Gurley) Thélohan
   Storm Lake, Ia.: *Henneguya gurleyi* Kudo
   Stony Creek, Ill.: *Chloromyxum trijugum* nov. spec.
   Homer Park, Ill.: *Henneguya mictospora* nov. spec.
   Salt Fork, Urbana, Ill.: *Wardia ovinocua* nov. gen. nov. spec.
   Crystal Lake, Urbana, Ill.: *Mitraspora elongata* nov. spec.
   3) From the rivers opening into the Great Lakes
      Black River, Ohio: Gen. et spec. incert. Linton
      Put-In-Bay, Ohio: *Myxobolus aureatus* Ward

B. Myxosporidia of marine fish (Atlantic Ocean)

   Beaufort, N. C.: *Leptotheca fusiformis* Davis
   *Leptotheca scissura* Davis
   *Leptotheca lobosa* Davis
   *Leptotheca glomerosa* Davis
   *Ceratomyxa mesospora* Davis
   *Ceratomyxa sphairophora* Davis
   *Ceratomyxa taenia* Davis
   *Ceratomyxa attenuata* Davis
   *Ceratomyxa recurvata* Davis
   *Ceratomyxa lunata* Davis
   *Ceratomyxa abbreviata* Davis
   *Ceratomyxa flagellifera* Davis
   *Ceratomyxa agglomerata* Davis
   *Ceratomyxa amorpha* Davis
   *Ceratomyxa monospora* Davis
   *Ceratomyxa streptospora* Davis
   *Ceratomyxa aggregata* Davis
   *Ceratomyxa undulata* Davis
Ceratomyxa nasicularia Davis
Ceratomyxa spinosa Davis
Myxoproteus cordiformis Davis
Myxoproteus cornutus Davis
Chloromyxum leydigi Mingazzini
Chloromyxum granulosum Davis
Sphaerospora polymorpha Davis
Sinuolinea dimorpha Davis
Sinuolinea capsularis Davis
Sinuolinea arborescens Davis
Sinuolinea opacita Davis
Sinuolinea brachiophora Davis
Myxidium incurvatum Thélohan
Myxidium glutinosum Davis
Myxidium phyllium Davis
Sphaeromyxa babianii Thélohan
Zschokkella globulosa Davis
Myxobolus capsulatus Davis

Woods Hole, Mass: Ceratomyxa aceropetela Awerinzew
Chloromyxum funduli Hahn
Chloromyxum dupeidae Hahn
Myxosoma funduli Kudo
Myxobolus lintoni Gurley
Myxobolus funduli Kudo
Myxobolus pleuronectici Hahn

Locality unrecorded: Henneguya schisura (Gurley) Labbé
C. Myxosporidian of Amphibia

Sycamore, Ill.: Wardia ohlmacheri (Gurley) Kudo

II CANADA

A. Myxosporidia of fresh-water fish

Georgian Bay (south. part): Myxidium lieberkühni Bütschli
Myxobolus notatus Mavor
Gen. et spec. incert. Mavor

B. Myxosporidia of marine fish (Atlantic Ocean)

Passamaquoddy Bay (at or near the mouth of St. Croix
River), New Brunswick: Ceratomyxa acadiensis Mavor
Myxidium bergense Auerbach
M. sp. Mavor
Gen. et spec. incert. Mavor

III ALASKA

Klutina Lake: Chloromyxum wardi nov. spec.
Stickeen River: Henneguya salminicola Ward

SOUTH AMERICA

A. Myxosporidia of fresh-water fish from the waters connected with Atlantic Ocean

Guiana: Myxobolus inaequalis Gurley
Surinam: Myxobolus inaequalis Gurley
Locality?: Henneguya linearis (Gurley) Labbé
STUDIES ON MYXOSPORIDIA—KUDO

B. Myxosporidian of marine fish (Atlantic Ocean)
Rio de Janeiro: Myxidium striatum Cunha et Fonseca
Brasil: Sphaeromyxa imersa (Luts) Thelohan

C. Myxosporidian of Amphibia

EUROPE

ITALY

A. Myxosporidia of fresh-water fish from lakes and rivers opening into Adriatic Sea
Lago di Como: Mitraspore caudata (Parisi) Kudo
Myxidium lieberkühni Bütschli
Lago di Garda: Sphaerospora elegans Thelohan
Heneguya gasterostei Parisi
Lago di Varano: Heneguya minuta (Cohn)
Lago Maggiore: Myxidium lieberkühni Bütschli
Milano: Myxidium lieberkühni Bütschli
Myxobolus pfeifferi Thelohan
Pavia: Myxobolus gigas Auerbach
Myxobolus ellipsoides Thelohan
Heneguya peri-intestinalis Cépède
Ticino River: Heneguya minuta (Cohn)

B. Myxosporidia of marine fish

1) Ligurian Sea
Genova: Chloromyxum leydi Mingazzini
Gen. incert. merluccii Perugia
Gen. incert. congri Perugia

2) Tyrrhenian Sea
Napoli: Leptotheca agilis Thelohan
Leptotheca elongata Thelohan
Ceratomyxa arcuata Thelohan
Ceratomyxa appendiculata Thelohan
Ceratomyxa trunca Thelohan
Ceratomyxa inaequalis Dollein
Ceratomyxa linospora Dollein
Myxoproteus ambiguus (Thél.) Dollein
Chloromyxum leydi Mingazzini
Choromyxum quadratum Thelohan
Sphaerospora divergens Thelohan
Myxidium incurvatum Thelohan
Myxidium giganum Dollein
Myxidium depressum Parisi
Myxidium oviforme Parisi
Sphaeromyxa balbianii Thelohan
Sphaeromyxa incurvata Dollein
Sphaeromyxa sphaerulosa Laveran et Mesnil
Lentospora asymmetrica Parisi
Myxobolus exigus Thelohan
Myxobolus müller Büttschli
Heneguya neapolitana Parisi

II MONACO

Myxosporidia of fish from Ligurian Sea
Leptotheca elongata Thelohan
Ceratomyxa sphaerulosa Thelohan
Ceratomyxa arcuata Thélohan
Ceratomyxa pallida Thélohan
Ceratomyxa herouardi Georgévitch
Ceratomyxa sp. Georgévitch
Chloromyxum leydigi Mingazzini
Myxidium incurvatum Thélohan
Sphaeromyxa sabrazesi Laveran et Mesnil

III FRANCE

A. Myxosporidia of fresh-water fish

1) From Rivers opening into Atlantic Ocean

Aigne: Myxobolus pfeiferi Thélohan
Bretagne: Sphaerospora elegans Thélohan
Lorraine: Myxobolus oviformis Thélohan
Nancy: Myxobolus pfeiferi Thélohan
Marne: Myxobolus pfeiferi Thélohan
Seine: Myxobolus pfeiferi Thélohan
Paris: Chloromyxum fluviatile Thélohan
Wimereux: Myxidium giardi Cépède

2) From Rivers opening into Mediterranean Sea

Dauphiné: Myxobolus mülleri Bütschli
Drac River: Myxobolus mülleri Bütschli
Grenoble: Chloromyxum cristatum Léger
Isère River: Myxidium barbatulae Cépède
Myxobolus oviformis Thélohan
Myxobolus mülleri Bütschli
Myxobolus cycloides Gurley
Henneguya légeri Cépède
Lac d'Annecy: Myxobolus mülleri Bütschli
Lac de Paladru: Myxobolus cycloides Gurley
Lac du Bourget: Myxobolus obesus Gurley
Lyon?: Henneguya peri-intestinalis Cépède
Rhône River: Myxobolus pfeiferi Thélohan
Saône River: Myxobolus pfeiferi Thélohan

B. Myxosporidia of marine fish

1) From Atlantic Ocean

Arcachon: Sphaeromyxa sabrazesi Laveran et Mesnil
Concarneau: Ceratomyxa arcuata Thélohan
Chloromyxum leydigi Mingazzini
Chloromyxum quadratum Thélohan
Sphaerospora divergens Thélohan
Myxidium incurvatum Thélohan
Sphaeromyxa balbianii Thélohan

Le Croisic: Leptotheca elongata Thélohan
Leptotheca parva Thélohan
Leptotheca renicola Thélohan
Ceratomyxa appendiculata Thélohan
Myxoproteus ambiguus (Thél.) Doflein
Sphaerospora restrata Thélohan
Concarneau: Ceratomyxa arcuata Thélohan
Chloromyxum leydigi Mingazzini
Chloromyxum quadratum Thélohan
Sphaerostora divergens Thélohan
Myxidium incurvatum Thélohan
Sphaeromyxa balbianii Thélohan
Roscoff: Ceratomyxa sphaerulosa Thélohan
Ceratomyxa arcuata Thélohan
Ceratomyxa appendiculata Thélohan
Chloromyxum leydigi Mingazzini
Chloromyxum quadratum Thélohan
Sphaerostora rostrata Thélohan
Sphaerostora divergens Thélohan
Myxidium incurvatum Thélohan
Myxidium godi Georgévitch
Sphaeromyxa balbianii Thélohan
Sphaeromyxa saphraesi Laveran et Mesnil
Sphaeromyxa gasterostei Georgévitch
Myxobolus mülleri Bütschli
Le-Vivier-sur-mer: Leptotheca parva Thélohan
Myxidium sphaericum Thélohan
Myxobolus exigus Thélohan
St.-Valery-en-caux: Ceratomyxa sphaerulosa Thélohan

2) From Mediterranean coast
Marseille: Leptotheca elongata Thélohan
Leptotheca parva Thélohan
Leptotheca renicola Thélohan
Leptotheca hepseti Thélohan
Ceratomyxa arcuata Thélohan
Ceratomyxa pallida Thélohan
Ceratomyxa globulifera Thélohan
Ceratomyxa appendiculata Thélohan
Ceratomyxa reticularis Thélohan
Chloromyxum leydigi Mingazzini
Sphaerostora rostrata Thélohan
Myxidium incurvatum Thélohan
Myxidium sphaericum Thélohan
Sphaeromyxa balbianii Thélohan
Myxobolus exigus Thélohan
Banyuls: Leptotheca elongata Thélohan
Leptotheca polymorpha (Thél.) Labbé
Ceratomyxa arcuata Thélohan
Ceratomyxa globulifera Thélohan
Ceratomyxa appendiculata Thélohan
Ceratomyxa reticularis Thélohan
Chloromyxum leydigi Mingazzini
Sphaerostora rostrata Thélohan
Myxidium incurvatum Thélohan
Myxidium sphaericum Thélohan
Sphaeromyxa balbianii Thélohan
Myxobolus exigus Thélohan
ILLINOIS BIOLOGICAL MONOGRAPHS

Villefranche:  
Ceratomyxa pallida Thélohan  
Ceratomyxa truncata Thélohan  
Ceratomyxa coris Georgévitch  
Sphaeromyxa balbianii Thélohan

Locality unknown:  
Leptotheca agilis Thélohan  
Leptotheca perlata (Gurley) Labbé  
Myxidium lieberkühni Bütschli  
Myxidium histophilum Thélohan  
Myxosoma dujardini Thélohan  
Myxobolus pfeiferi Thélohan  
Myxobolus dispar Thélohan  
Myxobolus obesus Thélohan  
Henneguya psorospermica Thélohan  
Henneguya media Thélohan  
Henneguya brenis Thélohan  
Hoferellus cyprini Doflein  
C. Myxosporidian in a reptile 
Myxidium danilewskyi Laveran

IV GERMANY

A. Myxosporidia of fresh-water fish

1) From Rivers opening into North Sea

Throughout country:  
Myxobolus cyprini Doflein

Berlin:  
Henneguya oviperda (Cohn)

Bodensee:  
Chloromyxum dubium Auerbach  
Myxobolus müllerii Bütschli

Gutach:  
Myxobolus neurobius Schuberg et Schröder  
Henneguya nüsslini Schub. et Schröder

Karlsruhe and its vicinity:  
Chloromyxum mucronatum Gurley  
Sphaerospora elegans Thélohan  
Myxidium lieberkühni Bütschli  
Myxidium pfeiferi Auerbach  
Myxidium macrocapsauleare Auerbach  
Henneguya oviperda (Cohn)  
Henneguya lobosa (Cohn)  
Myxobolus gigas Auerbach

Leipzig:  
Myxobolus sp. Gurley

Mosel:  
Myxobolus pfeiferi Thélohan  
Myxobolus squamae Keysselitz  
Myxobolus cordis Keysselitz  
Myxobolus musculi Keysselitz

Neckar:  
Myxobolus exiguis Thélohan (Heidelberg)  
Myxobolus müllerii Bütschli  
Myxobolus pfeiferi Thélohan  
Myxobolus squamae Keysselitz  
Myxobolus cordis Keysselitz  
Myxobolus musculi Keysselitz  
Henneguya psorospermica Thélohan  
Henneguya acerinae Schröder (Heidelberg)

Rhine:  
Myxidium lieberkühni Bütschli  
Myxobolus müllerii Bütschli  
Henneguya psorospermica Thélohan  
Lentospora encephalina Mulsow
2) From Rivers opening into Baltic Sea

Alle: Myxobolus milleri Bütschli
      Myxidium lieberkühni Bütschli
      Myxosoma dujardini Thélohan
      Myxobolus piriformis Thélohan
      Myxobolus dispar Thélohan
      Myxobolus exigus Thélohan
      Myxobolus oviformis Thélohan
      Myxobolus milleri Bütschli
      Myxobolus cycloides Gurley
      Myxobolus anurus Cohn
      Myxobolus sp. Wegener
      Myxobolus permagnus Wegener
      Henneguya psorospermica Thélohan
      Henneguya texta (Cohn)
      Henneguya minuta (Cohn)
      Henneguya lobosa (Cohn)
      Henneguya creplini (Gurley)

Frisches Haff: Myxosoma dujardini Thélohan
             Myxobolus exigus Thélohan
             Myxobolus oviformis Thélohan
             Myxobolus cycloides Gurley
             Henneguya psorospermica Thélohan
             Henneguya texta (Cohn)
             Henneguya creplini (Gurley) Labbé

Kurisches Haff: Myxosoma dujardini Thélohan
                Myxobolus exigus Thélohan
                Myxobolus oviformis Thélohan
                Myxobolus cycloides Gurley
                Henneguya psorospermica Thélohan
                Henneguya texta (Cohn)
                Henneguya creplini (Gurley) Labbé

Masurische Seen: Sphaerospora masovica Cohn
                 Myxobolus dispar Thélohan
                 Myxobolus ellipsoides Thélohan
                 Myxobolus cycloides Gurley
                 Myxobolus anurus Cohn
                 Henneguya psorospermica Thélohan
                 Henneguya texta (Cohn)

Pregel: Myxosoma dujardini Thélohan
       Myxobolus piriformis Thélohan
       Myxobolus dispar Thélohan
       Myxobolus exigus Thélohan
       Myxobolus oviformis Thélohan
       Myxobolus milleri Bütschli
       Myxobolus cycloides Gurley
       Myxobolus anurus Cohn
       Myxobolus permagnus Wegener
       Henneguya psorospermica Thélohan
       Henneguya texta (Cohn)
       Henneguya minuta (Cohn)
       Henneguya lobosa (Cohn)
       Henneguya creplini (Gurley) Labbé

Weichsel: Myxobolus cyprini Doflein

3) Localities unknown: Chloromyxum leydigi Mingazzini
                         Myxidium lieberkühni Bütschli
                         Myxidium sp. Gurley
                         Lentospora cerebralis (Hofer) Plehn
Henneguya schizura (Gurley) Labbé
Hectorius cyprini Dolfin
Gen. et spec. incert. Leydig
Gen. et spec. incert. Leydig
Gen. et spec. incert. Leydig
Gen. et spec. incert. Borne

V NETHERLAND
Myxosporidian of marine fish

Helder:
Chloromyxum quadratum Thélohan

VI ENGLAND
Myxosporidia of marine fish

Firth of Clyde, More-camb, etc.:
Myxobolus aeglefini Auerbach
Liverpool (?):
Sphaerospora platessae Woodcock

VII NORWAY
Myxosporidia of marine fish

Abelvaer:
Myxidium bergense Auerbach
Myxidium oviforme Parisi
Zschokkella hildae Auerbach
Myxobolus aeglefini Auerbach

Bergen:
Leptotheca parva Thélohan
Leptotheca macrospora Auerbach
Leptotheca informis Auerbach
Leptotheca longipes Auerbach
Ceratomyxa sphaerulosa Thélohan
Myxidium incurvatum Thélohan
Myxidium inflatum Auerbach
Myxidium bergense Auerbach
Myxidium procerum Auerbach
Sphaeromyxa heilandii Auerbach
Zschokkella hildae Auerbach
Myxobolus aeglefini Auerbach

Bergsfjord:
Myxidium bergense Auerbach
Zschokkella hildae Auerbach

Boadsfjord:
Zschokkella hildae Auerbach

Bodo:
Myxidium bergense Auerbach
Zschokkella hildae Auerbach

Finkongkjellen:
Myxidium bergense Auerbach
Zschokkella hildae Auerbach

Grönøy:
Myxidium bergense Auerbach
Zschokkella hildae Auerbach

Hammerfest:
Myxidium bergense Auerbach
Myxidium oviforme Parisi
Zschokkella hildae Auerbach

Harstad:
Myxidium bergense Auerbach
Zschokkella hildae Auerbach

Honnigsvaag:
Myxidium bergense Auerbach
Zschokkella hildae Auerbach

Kabelvaag:
Ceratomyxa drepanopsetae Averinzew
STUDIES ON MYXOSPORIDIA—KUDO

Kiberg:
Myxidium bergense Auerbach
Zschokkella hildae Auerbach

Kirkenes:
Myxidium bergense Auerbach

Kristana:
Myxidium bergense Auerbach
Zschokkella hildae Auerbach

Kristiansand:
Leptotheca parva Thélohan
Leptotheca macrosorpa Auerbach
Myxidium oviforme Parisi
Zschokkella hildae Auerbach

Lödingen:
Myxobolus aeglefini Auerbach

Makur:
Myxidium bergense Auerbach
Zschokkella hildae Auerbach

Mosjøen:
Zschokkella hildae Auerbach
Myxidium bergense Auerbach

Nusfjord:
Myxidium bergense Auerbach
Zschokkella hildae Auerbach

Rörvik:
Ceratomyxa drepanopsettae Awerinzew
Myxidium bergense Auerbach

Rossfjord:
Myxidium oviforme Parisi

Skjervøy:
Zschokkella hildae Auerbach

Skjøttingsberg:
Zschokkella hildae Auerbach
Myxidium bergense Auerbach

Smallfjorden:
Sphaerospora divergens Thélohan
Zschokkella hildae Auerbach

Stavanger:
Leptotheca parva Thélohan
Myxidium bergense Auerbach

Svolvaer:
Myxidium bergense Auerbach

Tjømø:
Leptotheca informis Thélohan
Ceratomyxa drepanopsettae Awerinzew
Myxidium bergense Auerbach

Torghatten:
Sphaeromyxa hellandi Auerbach

Trondhjem:
Myxidium bergense Auerbach
Myxidium oviforme Parisi
Zschokkella hildae Auerbach

Vikholmen:
Zschokkella hildae Auerbach

Vardø:
Myxidium bergense Auerbach
Myxidium oviforme Parisi
Zschokkella hildae Auerbach
Myxobolus aeglefini Auerbach

VIII SWITZERLAND

Myxosporidia of fresh-water fish

1) From Lakes connected with North Sea

Neuchatel:
Myxobolus fuhrmanni Auerbach
Myxobolus müllerii Bütschli
Henneguya oviperda (Cohn)
Henneguya zschokkei (Gurley) Doflein

Thun:
Henneguya zschokkei (Gurley) Doflein

Zurich:
Henneguya zschokkei (Gurley) Doflein

Lucerne:
Myxosoma dujardini Thélohan
Myxobolus ellipsoides Thélohan
Myxobolus oviformis Thélohan
Myxobolus mülleri Bütschli
Henneguya psorospermica Thélohan
Henneguya texta (Cohn)
Henneguya zschokkei (Gurley) Doflein
Gen. et spec. incert. Nufer

Wallen:
Henneguya zschokkei (Gurley) Doflein

2) From Lake connected with Mediterranean Sea
Geneva:
Myxobolus sphaeralis Gurley
Henneguya zschokkei (Gurley) Doflein

IX AUSTRIA

A. Myxosporidia of fresh-water fish

1) From Rivers opening into Black Sea

Danube tributaries and Neusiedler:
Chloromyxum thymalli Lebzelter
Myxosoma (?) lobatum Nemeczek
Myxobolus aeglefini Auerbach
Myxobolus cyprini Doflein
Myxobolus rotundus Nemeczek
Myxobolus minutus Nemeczek
Myxobolus sp. Lebzelter
Henneguya acerinae Schröder
Henneguya gigantea Nemeczek

2) From Rivers opening into North Sea

Prag:
Myxosoma dujardini Thélohan
Myxobolus ellipsoides Thélohan
Myxobolus oculi-leucisci Trojan

Krakau:
Myxobolus cyprini Doflein

B. Myxosporidia of marine fish (Adriatic Sea)

Rovigno:
Leptotheca agilis Thélohan
Ceratomyxa pallida Thélohan
Ceratomyxa appendiculata Thélohan
Myxoproetus ambiguus (Thél.) Doflein
Chloromyxum leydigi Mingazzini
Sphaeromyxa sabrazesi Laveran et Mesnil

Locality unknown:
Gen. et spec. incert. Heckel et Kner
C. Myxosporidian of Amphibia

Vienna:
Chloromyxum protei Joseph

X SERBIA

Pergrad (Danube):
Henneguya gigantea Nemeczek

XI RUSSIA

A. Myxosporidia of fresh-water fish

Volga (to Caspian Sea):
Lentospora multiplicata Reuss
Myxobolus volgensis Reuss
Myxobolus scardinii Reuss
Myxobolus physophilus Reuss
Myxobolus macrocapsularis Reuss
Myxobolus sandrae Reuss
Myxobolus broma Reuss
Myxobolus cyprinico Reuss
Myxobolus balleri Reuss
B. Myxosporidia of marine fish from Arctic Ocean

Murman coast:  
*Ceratomyxa ramosa* Awerinzew  
*Ceratomyxa drepanoidea* Awerinzew  
*Myxidium* sp. Awerinzew  
*Leptotheca* sp. Awerinzew  
*Chloromyxum* sp. Awerinzew

B. DISTRIBUTION OF MYXOSPORIDIA IN ANIMALS

The number of host species that harbor Myxosporidia is 237, as will be seen from List III.

The two incompletely studied forms are found in Annelida and Insecta, Myxosporidia are the parasites of Vertebrata, especially of Pisces, only few being found infecting Amphibia and Reptilia. They are distributed among these groups of animals as follows:

Number of host species

<table>
<thead>
<tr>
<th>Host</th>
<th>Number of species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annelida</td>
<td>1</td>
</tr>
<tr>
<td>Insecta</td>
<td>1</td>
</tr>
<tr>
<td>Pisces</td>
<td>223</td>
</tr>
<tr>
<td>Amphibia</td>
<td>8</td>
</tr>
<tr>
<td>Reptilia</td>
<td>4</td>
</tr>
</tbody>
</table>

Gurley (1894:101-105), Wasielewsky (1896:132-148), Labbé (1899: 133-161) and Auerbach (1910: 36-45; 1911: 471-494) gave lists in which they recorded the names of host species. Wasielewsky arranged the names alphabetically while others listed them according to their systematic order. In the following pages, the writer followed Wasielewsky, i.e., the names of the host species are arranged alphabetically as is supposed to be more convenient in referring to the host than any form presented otherwise.

### LIST III. LIST OF HOST SPECIES

<table>
<thead>
<tr>
<th>Host</th>
<th>Organ Infected</th>
<th>Myxosporidian</th>
<th>Locality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annelida</td>
<td>Unknown</td>
<td><em>Myxobolus</em> sp.</td>
<td>Germany</td>
</tr>
<tr>
<td><em>Nais lacustris (N. probo-sicida)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insecta</td>
<td>Abdominal cavity</td>
<td><em>Chloromyxum diploxyz</em></td>
<td>France</td>
</tr>
<tr>
<td><em>Tortrix viridana L. (imago)</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pisces</td>
<td>Branchiae</td>
<td><em>Myxobolus balleri</em></td>
<td>Russia</td>
</tr>
<tr>
<td><em>Abramis ballerus L.</em></td>
<td></td>
<td><em>bramae</em></td>
<td></td>
</tr>
<tr>
<td><em>A. brama L.</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Host</td>
<td>Organ Infected</td>
<td>Myxosporidian</td>
<td>Locality</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------</td>
<td>------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>A. simba L.</td>
<td>Branchiae</td>
<td><em>Myzobolus cycloides</em></td>
<td>&quot; (?)</td>
</tr>
<tr>
<td></td>
<td>&quot;</td>
<td><em>ellipsoides</em></td>
<td>Germany</td>
</tr>
<tr>
<td></td>
<td>&quot;</td>
<td><em>exiguus</em></td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>&quot;</td>
<td><em>oviformis</em></td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>&quot;</td>
<td><em>rotundus</em></td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>Gall-bladder</td>
<td><em>Sphaerostrongylus</em></td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>Kidney</td>
<td><em>masoica</em></td>
<td>Hungary</td>
</tr>
<tr>
<td></td>
<td>Subcut. conn.</td>
<td><em>gigas</em></td>
<td>Germany,</td>
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<td></td>
<td>tissue of oper-</td>
<td></td>
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<tr>
<td></td>
<td>cumulum</td>
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<td><em>cycloides</em></td>
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<tr>
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<tr>
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<td><em>oviformis</em></td>
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<td>A. blainvillei</td>
<td>Gall-bladder</td>
<td><em>Chloromyzum leydi</em></td>
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<td><em>magnum</em></td>
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<td>Acrina cernua L.</td>
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<td><em>Henneguya acerinae</em></td>
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<td>&quot; , Muscle</td>
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<td><em>Myzobolus magnus</em></td>
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<td><em>Zschokkella acheilognath</em></td>
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<td>Temm. et Schl.</td>
<td>Gall-duct</td>
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<td>Alburnus albunus L.</td>
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<td><em>ellipsoides</em></td>
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<td>Eye</td>
<td><em>müller</em></td>
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<td>A. pogen res-mullorum Cuv.</td>
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<td>Locality</td>
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<td><em>Myzidium striatum</em></td>
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<td><em>Myxobolus peifferi</em></td>
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<td><em>Myzidium sphaericum</em></td>
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<td><em>B. belone</em> L.</td>
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<td><em>B. holzi</em> L.</td>
<td>Gall-bladder</td>
<td><em>Myzobolus cycloides</em></td>
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<td><em>Blicca björkna</em> L.</td>
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<td><em>Ceratomyxa pallida</em></td>
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<td><em>Box boops</em> L.</td>
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<td><em>B. salpa</em> L.</td>
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<td><em>Callionymus lyra</em> L.</td>
<td>Muscle</td>
<td><em>Henneugya miyairii</em></td>
<td>France, 1945</td>
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<td><em>dispars</em></td>
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<td><em>Sphaeromyxa carassii</em></td>
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<td><em>Carassius auratus</em> L.</td>
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<td><em>Chloromyxum quadratum</em></td>
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<td><em>Lentospora acula</em></td>
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<td><em>Sphaerospora angulata</em></td>
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<td><em>Mitospora cyprini</em></td>
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<td>Subcutaneous tiss. of head</td>
<td><em>Henneugya miyairii</em></td>
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<td>(C. carassius L.)</td>
<td>Body cavity</td>
<td><em>Myzobolus sp.</em></td>
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<tr>
<td>(C. vulgaris L.)</td>
<td>Body cavity, liver, intestine</td>
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<td>Nippon</td>
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<td>Gall-bladder</td>
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<td><em>Carcharhinus limbatus</em></td>
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<td><em>Ceratomyxa flagellifera</em></td>
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<td><em>C. sp.</em></td>
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<td>Host</td>
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<td>Myxosporian</td>
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<td>Cepola rubescens L.</td>
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<td>Cestracion liburo</td>
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<td>U. S. A.</td>
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<td>C. pilchardus Walb. (Alosa sardina)</td>
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<td>C. fossilis L.</td>
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<td>Conger conger L. (Leptocephalus c.)</td>
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<td>Locality</td>
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<td>Myxobolus sp.</td>
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<td>Eye muscle, etc.</td>
<td>Henneguya schizura</td>
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<td><em>G. callarias</em> L.</td>
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<td><em>Myxobolus aeglefini</em></td>
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<td>Norway</td>
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<td><em>G. merlangus</em> L.</td>
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<td><em>Myxidium oviforme</em></td>
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<td><em>Sphaerospoda elegans</em></td>
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<td><em>Gobio gobi</em> L. (G. fluviatilis)</td>
<td>Fin</td>
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<td><em>Henneguya macrura</em></td>
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<td><em>Idus melanolus</em> Heck</td>
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<td><em>Laboe niloticus</em> Forsk</td>
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<td><em>Laboe niloticus</em> Forsk</td>
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<td><em>Sphaerospora sp.</em></td>
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<td><em>Lepisosteus platyostomus</em></td>
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<td><em>Myxobolus mesentericus</em></td>
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<td>Kidney</td>
<td><em>Mitraspora elongata</em></td>
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<td><em>Wardia ovinae</em></td>
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<td><em>L. megalotis</em> Raf</td>
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<td></td>
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<td>Myxosporidian</td>
<td>Locality</td>
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<td>L. piscatorius L</td>
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<td>Myzoproteus ambiguus</td>
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<td>Myzobolus Mülleri</td>
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<td>Myzobolus cycloides</td>
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<td>Ceratomyxa globulifera</td>
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<td>M. cephalus L</td>
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<td>Myxosporidian</td>
<td>Locality</td>
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<td>Gall-bladder</td>
<td>Ceratomyxa sp.</td>
<td>Monaco</td>
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<td>(M. vulgaris)</td>
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<td>aureatus</td>
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<td>Henneguya brachyura</td>
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<td>Connective tiss.</td>
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<td>Ceratomyxa arcuata</td>
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<td>J. et G.</td>
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<td>Spleen</td>
<td><em>Myzobolus sp.</em></td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot;</td>
<td>Urin. bladder</td>
<td>Henneguya wisconsinis</td>
<td>Italy, Germany</td>
</tr>
<tr>
<td>&quot;</td>
<td>Branchiae</td>
<td>&quot;</td>
<td>Germany</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;permagnus</td>
<td>Germany</td>
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<tr>
<td>&quot;</td>
<td>&quot;</td>
<td><em>Myzosoma dujardini</em></td>
<td>Switzerland</td>
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<td>P. fluviatilis.</td>
<td>Branchiae</td>
<td>Henneguya psorospermica</td>
<td>&quot;</td>
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<tr>
<td>Phoxinus (Clinostomus)</td>
<td>Under scales on</td>
<td><em>Myzobolus transovalis</em></td>
<td>U. S. A.</td>
</tr>
<tr>
<td>funduloides Girard</td>
<td>ext. surf.</td>
<td>mülleri</td>
<td>France</td>
</tr>
<tr>
<td>P. laevis.</td>
<td>Branchiae</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Host</td>
<td>Organ Infected</td>
<td>Myxosporidian</td>
<td>Locality</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------</td>
<td>------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td><em>P. laevis</em></td>
<td>Kidney, ovary</td>
<td><em>Myxidium histophilum</em></td>
<td>France</td>
</tr>
<tr>
<td><em>Physicis biennioides Br.</em></td>
<td>Urin. bladder</td>
<td><em>Sphaerospora elegans</em></td>
<td>Germany</td>
</tr>
<tr>
<td><em>P. mediterraneus (P. physicus L.)</em></td>
<td>Urin. bladder</td>
<td><em>Zschokkella hildae</em></td>
<td>Norway</td>
</tr>
<tr>
<td><em>Pimelodus sebae Cuv. et Val.</em></td>
<td>Gall-bladder</td>
<td><em>Leptotheca polymorpha</em></td>
<td>France</td>
</tr>
<tr>
<td><em>Pimephales notatus Raf.</em></td>
<td>Membrane lining branchial cavity</td>
<td><em>Henneguya linearis</em></td>
<td>S. America</td>
</tr>
<tr>
<td><em>Piramutana blocki C. et V.</em></td>
<td>Gall-bladder</td>
<td><em>Myxobolus notatus inaequalis</em></td>
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<td><em>Platystoma fasciatum L.</em></td>
<td>?</td>
<td><em>Henneguya linearis</em></td>
<td>S. America</td>
</tr>
<tr>
<td><em>Pleuronectes flesus L.</em></td>
<td>Branchiae</td>
<td><em>Ceratomyxa drepanopseta</em></td>
<td>Norway</td>
</tr>
<tr>
<td><em>P. platessa L.</em></td>
<td>Gall-bladder</td>
<td><em>Sphaerospora platesosa</em></td>
<td>England</td>
</tr>
<tr>
<td><em>Pomolobus aestivalis</em></td>
<td>Otic-capsule</td>
<td><em>Chloromyxum clupeidae</em></td>
<td>U. S. A.</td>
</tr>
<tr>
<td><em>P. mediociris Mitch.</em></td>
<td>Muscle</td>
<td><em>clupeidae</em></td>
<td>&quot;</td>
</tr>
<tr>
<td><em>P. pseudoharengus Young.</em></td>
<td>&quot;</td>
<td><em>clupeidae</em></td>
<td>&quot;</td>
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<td><em>Pseudopleuronectes americanus</em></td>
<td>Gall-bladder</td>
<td><em>Ceratomyxa acadiensis</em></td>
<td>Canada</td>
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<tr>
<td></td>
<td>Subcutaneous muscl. tissue</td>
<td><em>Myxidium sp.</em></td>
<td>&quot;</td>
</tr>
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<td><em>Pteroplatea macura</em></td>
<td>Gall-bladder</td>
<td><em>Myxobolus pleuronectidae</em></td>
<td>U. S. A.</td>
</tr>
<tr>
<td>Le Sueur</td>
<td>&quot;</td>
<td><em>Chloromyxum leydigi</em></td>
<td>&quot;</td>
</tr>
<tr>
<td><em>Raja asterias</em></td>
<td>&quot;</td>
<td><em>Leptotheca scissura</em></td>
<td>Italy</td>
</tr>
<tr>
<td><em>R. batis L.</em></td>
<td>&quot;</td>
<td><em>Myxidium giganteum</em></td>
<td>France</td>
</tr>
<tr>
<td><em>R. radiata</em></td>
<td>Gall-duct</td>
<td><em>Chloromyxum leydigi</em></td>
<td>Germany ?</td>
</tr>
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<td>Gall-bladder</td>
<td><em>Chloromyxum sp.</em></td>
<td>Murman</td>
</tr>
<tr>
<td><em>R. undulata Lac.</em></td>
<td>&quot;</td>
<td>&quot;</td>
<td>Coast</td>
</tr>
<tr>
<td></td>
<td>&quot;</td>
<td><em>Chloromyxum leydigi</em></td>
<td>France</td>
</tr>
<tr>
<td><em>Rhina squatina L.</em></td>
<td>&quot;</td>
<td><em>Chloromyxum leydigi</em></td>
<td>&quot;</td>
</tr>
<tr>
<td><em>Rhinobatus sp. (?) Awer.</em></td>
<td>&quot;</td>
<td><em>Ceratomyxa sp. (?)</em></td>
<td>France,</td>
</tr>
<tr>
<td><em>Rhodeus amarus Bl.</em></td>
<td>Branchiae</td>
<td><em>Myxobolus cycloides</em></td>
<td>Germany</td>
</tr>
<tr>
<td><em>Salmo fontinalis Mitch.</em></td>
<td>Cartilage, perichondrium</td>
<td><em>Lentospora cerebralis</em></td>
<td>&quot;</td>
</tr>
<tr>
<td><em>Scardinius erythrophthalmus</em></td>
<td>Branchiae</td>
<td><em>Myxobolus cycloides</em></td>
<td>Russia</td>
</tr>
<tr>
<td></td>
<td>&quot;</td>
<td><em>scardini</em></td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>&quot;</td>
<td><em>Myxosoma duyardini</em></td>
<td>France,</td>
</tr>
<tr>
<td></td>
<td>Gall-bladder</td>
<td><em>Myxidium macrocasculare</em></td>
<td>Germany</td>
</tr>
<tr>
<td></td>
<td>Muscle, spleen</td>
<td><em>Myxobolus dispar</em></td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td>Air-bladder</td>
<td><em>permagnus</em></td>
<td>&quot;</td>
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<tr>
<td></td>
<td>&quot;</td>
<td><em>physophilus</em></td>
<td>&quot;</td>
</tr>
<tr>
<td><em>Scalophagus argus</em></td>
<td>Gall-bladder</td>
<td><em>Ceratomyxa sp. (?)</em></td>
<td>Africa</td>
</tr>
<tr>
<td>Host</td>
<td>Organ Infected</td>
<td>Myxosporidian</td>
<td>Locality</td>
</tr>
<tr>
<td>-------------------------------</td>
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<tr>
<td>Scoliodon terrae-novae</td>
<td>Gall-bladder</td>
<td>Ceratomyza abbreviata attenuata</td>
<td>U. S. A.</td>
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<tr>
<td></td>
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<td>sphaerophora taenia</td>
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<td>Chloromyzum leydigii</td>
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<td>Leptotheca parva</td>
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<td>Scomber scombrus L.</td>
<td>Kidney</td>
<td>Gen. et sp. inc.</td>
<td>&quot;</td>
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<td></td>
<td></td>
<td>Leptotheca renicola</td>
<td>Germany?</td>
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<td>Scorpaena porcus L.</td>
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<td>Ceratomyza arcuata</td>
<td>France</td>
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<tr>
<td></td>
<td></td>
<td>Ceratomyza arcuata</td>
<td>&quot;</td>
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<tr>
<td></td>
<td></td>
<td>Myxidium incurvatum</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leptotheca agilis</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ceratomyza sphaerulosa</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chloromyzum leydigii</td>
<td>&quot;</td>
</tr>
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<td>S. astéria</td>
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<td>Sébastes dactylopterus</td>
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<tr>
<td>S. norvegicus</td>
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<tr>
<td>S. viniparus H. Kr.</td>
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<td>Siphonostoma rondeletii</td>
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<td>Siphonostoma floridæ</td>
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<td>S. louisianæ</td>
<td>Urin. bladder</td>
<td>Sinuolinea arborescens</td>
<td>&quot;</td>
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<tr>
<td>Salea vulgaris</td>
<td>Gall-bladder</td>
<td>Sphaeroxyza sabraesi</td>
<td>Norway</td>
</tr>
<tr>
<td>Sparus berda</td>
<td></td>
<td>Sphaeroxyza balbianii</td>
<td>Eastern</td>
</tr>
<tr>
<td>Sphaeroidea maculatus</td>
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<td></td>
<td>Finmark</td>
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<tr>
<td>Spinax spinax L.</td>
<td>Gall-bladder</td>
<td>Sinuolinea capsularis</td>
<td>Norway</td>
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<td></td>
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<td>Zschokkella globulosa</td>
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<td></td>
<td></td>
<td>Chloromyzum leydigii</td>
<td>Monaco</td>
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<td></td>
<td></td>
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<td>Squalis agassizii Heck</td>
<td>Branchiae</td>
<td>Myxobolus mülleri</td>
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<tr>
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<td></td>
<td></td>
<td>France</td>
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<td>Stenotomus chrysops L.</td>
<td>Muscle</td>
<td>Myxobolus mülleri</td>
<td>&quot;</td>
</tr>
<tr>
<td>Stizostedion vitreum Mitch.</td>
<td>Urin. bladder</td>
<td>Chloromyzum clupeidae</td>
<td>Canada</td>
</tr>
<tr>
<td>Syngnathus acus L.</td>
<td>Gall-bladder</td>
<td>Gen. et sp. incert.</td>
<td>France</td>
</tr>
<tr>
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<td></td>
<td>Myxidium incurvatum</td>
<td>Italy,</td>
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<tr>
<td></td>
<td></td>
<td>Sphaeroxyza sabraesi</td>
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</tr>
<tr>
<td>S. typhle</td>
<td>Muscle</td>
<td></td>
<td>Monaco</td>
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<tr>
<td>Synodontis schall Bl. Schm.</td>
<td>Gall-bladder</td>
<td>Myxidium incurvatum</td>
<td>&quot;</td>
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<tr>
<td></td>
<td>Integum. of</td>
<td>Chloromyzum quadratum</td>
<td>U. S. A.</td>
</tr>
<tr>
<td></td>
<td>cephalic reg.</td>
<td></td>
<td>&quot;</td>
</tr>
<tr>
<td>Synodus faetans</td>
<td>Gall-bladder</td>
<td>Henneguya strenghyura</td>
<td>Egypt</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Myxobolus inaequalis</td>
<td>S. America</td>
</tr>
<tr>
<td>Tautogolabrus adspersus</td>
<td>Gall-bladder</td>
<td>Ceratomyza agglomerata</td>
<td>U. S. A.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>amorphia</td>
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</tr>
<tr>
<td></td>
<td>Muscle</td>
<td>Chloromyzum clupeidae</td>
<td>&quot;</td>
</tr>
<tr>
<td>Host</td>
<td>Organ Infected</td>
<td>Myxosporidian</td>
<td>Locality</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------</td>
<td>--------------------------------------</td>
<td>--------------</td>
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<tr>
<td>Thymallus thyallus L</td>
<td>Gall-bladder</td>
<td>Chloromyxum thyallii</td>
<td>Austria</td>
</tr>
<tr>
<td></td>
<td>&quot;</td>
<td>M. yezobolus sp.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neurilemma (?)</td>
<td>P. pfeifferi</td>
<td>Germany ?</td>
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<tr>
<td>Thysanophris japonicus</td>
<td>Gall-bladder</td>
<td>Sphaeromyxa esseri</td>
<td>Africa</td>
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<tr>
<td>Tinca tinca L. (T. vulgaris)</td>
<td>Branchiae</td>
<td>M. yezobolus piriformis</td>
<td>France,</td>
</tr>
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<td></td>
<td>Air-bladder,</td>
<td>ellipsoides</td>
<td>Germany</td>
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<tr>
<td></td>
<td>kidney, etc.</td>
<td>Chloromyxum cristatum</td>
<td></td>
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<tr>
<td></td>
<td>Gall-bladder</td>
<td>M. yezobolus pfeifferi</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&quot;</td>
<td>M. yezobolus cyprini</td>
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<td>Torpedo narce Risso</td>
<td>Gall-bladder</td>
<td>Chloromyxum leydigi</td>
<td>France</td>
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<tr>
<td>T. ocellata</td>
<td>&quot;</td>
<td>Chloromyxum leydigi</td>
<td>Germany</td>
</tr>
<tr>
<td>T. torped L</td>
<td>&quot;</td>
<td>Chloromyxum leydigi</td>
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<tr>
<td>Trachinus draco L</td>
<td>&quot;</td>
<td>Ceralomyxa reticularis</td>
<td>Hungary</td>
</tr>
<tr>
<td>Trachurus trachurus L</td>
<td>Muscle</td>
<td>M. yezobolus incurvatum</td>
<td>France,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chloromyxum quadratum</td>
<td>Germany</td>
</tr>
<tr>
<td>Trutta tario L</td>
<td>Gall-bladder,</td>
<td>Chloromyxum trutta</td>
<td>France</td>
</tr>
<tr>
<td></td>
<td>Gall-duct</td>
<td>M. yezobolus neurobius</td>
<td>Germany</td>
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<td></td>
<td>Nervous syst.</td>
<td>&quot;</td>
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<tr>
<td></td>
<td>Subcutaneous</td>
<td>Henneguya nussini</td>
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</tr>
<tr>
<td></td>
<td>conn. tiss. at base of</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>fin cartilage</td>
<td>Lentospora cerebrais</td>
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<tr>
<td></td>
<td>peri-chondrium</td>
<td>&quot;</td>
<td></td>
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<tr>
<td>T. iridea Gibb</td>
<td>&quot;</td>
<td>M. yezobolus oviforme</td>
<td>Norway</td>
</tr>
<tr>
<td>T. salar L</td>
<td>&quot;</td>
<td>Chloromyxum leydigi</td>
<td>France</td>
</tr>
<tr>
<td>Trygon pastinaca L</td>
<td>Gall-bladder</td>
<td>Leptotheca agilis</td>
<td>&quot; , Italy</td>
</tr>
<tr>
<td>Tylosurus marianus</td>
<td>&quot;</td>
<td>Chloromyxum granulosum</td>
<td>U. S. A.</td>
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<td>T. schizomastorynchus</td>
<td>Urin. bladder</td>
<td>Ceralomyxa tylosuri</td>
<td>Africa</td>
</tr>
<tr>
<td>Urophycis chuss</td>
<td>Gall-bladder</td>
<td>acadiensis</td>
<td>Canada</td>
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<tr>
<td>Zoarcus angularis</td>
<td>&quot;</td>
<td>acadiensis</td>
<td></td>
</tr>
<tr>
<td><strong>Amphibia</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bufo lentiginosus</td>
<td>Kidney</td>
<td>Wodaria ohimacheri</td>
<td>U. S. A.</td>
</tr>
<tr>
<td>B. marinus L</td>
<td>Gall-bladder</td>
<td>Sphaeromyxa immersa</td>
<td>Brasil</td>
</tr>
<tr>
<td>Hyla aerea</td>
<td>Testis, ovary</td>
<td>M. yezobolus hyale</td>
<td></td>
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<tr>
<td>Leptodactylus ocellatus</td>
<td>Gall-bladder</td>
<td>Sphaeromyxa immersa</td>
<td>Brazil</td>
</tr>
<tr>
<td>Molge cristata Laur. (Trieon c.)</td>
<td>&quot;</td>
<td>Chloromyxum caudatum</td>
<td>France</td>
</tr>
<tr>
<td>Proteus anguineus L</td>
<td>Kidney</td>
<td>Chloromyxum protei</td>
<td>Austria</td>
</tr>
<tr>
<td>Rana esculenta</td>
<td>&quot;</td>
<td>Wodaria ohimacheri</td>
<td>&quot;</td>
</tr>
<tr>
<td>R. temporaria (R. fusca)</td>
<td>&quot;</td>
<td>Wodaria ohimacheri</td>
<td>&quot;</td>
</tr>
<tr>
<td><strong>Reptilia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emys orbicularis L.</td>
<td>Kidney</td>
<td>M. yezobolus danilewskyi</td>
<td>Russia,</td>
</tr>
<tr>
<td>(Cistudo europaea)</td>
<td></td>
<td></td>
<td>France</td>
</tr>
</tbody>
</table>
Host | Organ Infected | Myxosporidian | Locality
---|---|---|---
Lacerta sp. | Ovarian egg | Gen. et spec. incert. | Italy
Trionyx (Amyda) gonzeleticus | Kidney | Myxidium mackiei americanum | India
T. spinifera | | | U. S. A.

C. DISTRIBUTION OF MYXOSPORIDIA IN THE ORGANS OF THE HOST

Altho some species are found in various organs of the host animal, the majority has one or two particular seats of infection. Among the various organs which become infected, the gall-bladder is most frequently infected. The kidney, branchia and urinary bladder have less chances of being parasitized. As to the infection of the reproductive organs of the host, little is known. The male reproductive organ becomes rarely infected, being reported only twice. The female reproductive organ, however, is more frequently infected. The infection of the next generation of the host animal thru the infected ovum which is known to occur in some Microsporidian parasites, has not been reported in Myxosporidia as yet.

LIST IV. ORGANS OF HOST INFECTED BY MYXOSPORIDIA

I. PISCES

1) Integument.— *Sphaerospora* sp. Southwell et Prashad (under the scales)
   *Myxobolus semi* Southwell et Prashad (fin)
   *Myxobolus transovalis* Gurley (under the scales)
   *Myxobolus unica psulatus* Gurley (head)
   *Myxobolus cycloides* Gurley (opercle)
   *Myxobolus inaequalis* Gurley (head)
   *Myxobolus* sp. Gurley (opercle, head, fin)
   *Myxobolus squamae* Keysselitz (inner surface of the scales)
   *Myxobolus volgensis* Reuss (fin)
   *Myxobolus permagnus* Wegener (operculum)
   *Myxobolus aureolus* Ward (fin)
   *Heneguya brackvura* Ward (fin-ray)
   *Heneguya linearis* (Gurley) Labbé (membrane lining branchial cavity)
   *Heneguya gurleyi* Kudo (base of spines of dorsal fin)
   *Heneguya strongylura* (Gurley) Labbé (cephalic region)
   *Lentospora dermatobia* Ishii

2) Connective tissue.— *Myxidium anguilae* Ishii (subcutaneous)
   *Myxobolus fuhrmanni* Auerbach (under the oral mucous membrane)
   *Myxobolus oviformis* Thélohan (subcutaneous)
   *Myxobolus lintoni* Gurley (subcutaneous)
   *Myxobolus oblongus* Gurley (chiefly of the head)
   *Myxobolus gigas* Auerbach (of operculum, sides and fins)
   *Myxobolus capsulatus* Davis (visceral)
   *Heneguya kolesnikovi* (Gurley) Labbé (interstitial)
   *Heneguya nissitini* Schuberg et Schröder (at the base of dorsal fin)
   *Heneguya miyairii* Kudo (of the head)
   Gen. et sp. incert. Linton (subcutaneous)
3) Muscle.—*Leptolheca perlata* (Gurley) Labbé
  Chloromyxum quadratum Thélohan
  Chloromyxum funduli Hahn
  Chloromyxum clupeidae Hahn
  Lentospora multiplicata Reuss
  *Myxobolus notatus* Mavor (connective tissue of voluntary muscle)
  *Myxobolus pfeifferi* Thélohan
  *Myxobolus sondrae* Reuss
  *Myxobolus musculi* Keysselitz
  *Myxobolus funduli* Kudo
  *Myxobolus pleuronectidae* Hahn
  *Myxobolus* sp. Southwell (subcutaneous intermuscular tissue)
  *Myxobolus nodularis* Southwell et Prashad
  *Myxobolus orbiculatus* Kudo
  *Henneguya creplini* (Gurley) Labbé
  *Henneguya monura* (Gurley) Labbé
  *Henneguya szhokkei* (Gurley) Doflein
  *Henneguya salminicola* Ward
  Gen. et spec. incert. Leydig

4) Eye.—*Sphaerospora plateassae* Woodcock (optic capsule)
  *Myxobolus oculi-leucisci* Trojan (vitreous body)
  *Myxobolus ellipsoides* Thélohan
  *Myxobolus müllerii* Bütschli
  *Myxobolus aeglefini* Auerbach
  *Myxobolus volgensis* Reuss
  *Myxobolus magnus* Awerinzew
  *Henneguya schizura* (Gurley) Labbé (intercellular tissue of eye muscle)

5) Branchiae.—*Sphaerospora carassii* Kudo
  *Myxosoma dujardini* Thélohan
  *Myxosoma (?) lobatum* Nemeczek
  *Myxosoma funduli* Kudo
  *Lentospora acuta* (Fujita)
  *Myxobolus piriformis* Thélohan
  *Myxobolus toyamai* Kudo
  *Myxobolus rohitae* Southwell et Prashad
  *Myxobolus dispar* Thélohan
  *Myxobolus ellipsoides* Thélohan
  *Myxobolus esiguus* Thélohan
  *Myxobolus oviformis* Thélohan
  *Myxobolus müllerii* Bütschli
  *Myxobolus globosus* Gurley
  *Myxobolus cycloides* Gurley (also pseudobranchiae)
  *Myxobolus sphaeralis* Gurley
  *Myxobolus anurus* Cohn
  *Myxobolus* sp. Gurley
  *Myxobolus gigas* Auerbach
  *Myxobolus volgensis* Reuss
  *Myxobolus scardinii* Reuss
  *Myxobolus macrocapsularis* Reuss
  *Myxobolus bromae* Reuss
  *Myxobolus cyprinicolae* Reuss
STUDIES ON MYXOSPORIDIA—KUDO

Myxobolus balleri Reuss
Myxobolus sp. Miyairi
Myxobolus sp. Wegener
Myxobolus permagnus Wegener
Myxobolus rotundus Nemeczek
Myxobolus minutus Nemeczek
Myxobolus funduli Kudo
Myxobolus koi Kudo
Myxobolus discrepans Kudo
Henneguya psorospermica Thélohan
Henneguya texia (Cohn)
Henneguya minuta (Cohn)
Henneguya lobosa (Cohn)
Henneguya creplini (Gurley) Labbé
Henneguya linearis (Gurley) Labbé
Henneguya acerinae Schröder
Henneguya gigantea Nemeczek
Gen. et spec. incert. Heckel et Kner

6) Heart.—Myxobolus cordis Keysselitz (muscle of ventricle and bulbus arteriosus)

Gen. et spec. incert. Leydig (auriculo-ventricular valve)

7) Air bladder.—Myxobolus ellipsoides Thélohan (conn. tiss.)

Myxobolus müllerii Bütschli (conn. tiss.)
Myxobolus physophilus Reuss (surface)
Myxobolus permagnus Wegener

8) Body-cavity (cyst).—Myxobolus sp. Gurley

Myxobolus carassii Klokocewá
Gen. et spec. incert. Leydig

9) Nervous tissue.—Myxobolus neurobius Schuberg et Schröder

Lentospora encephalina Mulsow (blood vessel of brain)

10) Bone, cartilage, perichondrium.—Lentospora cerebralis (Hofer) Plehn

Myxobolus aeglegini Auerbach
Henneguya brachyura Ward (of fin)

11) Stomach, pyloric cecum.—Myxobolus exiguis Thélohan

Myxobolus mesentericus Kudo
Henneguya tenuis Vaney et Conte

12) Liver.—Myxobolus ellipsoides Thélohan

Myxobolus oviformis Thélohan
Myxobolus cyprini Doßlein
Myxobolus cordis Keysselitz
Myxobolus musculi Keysselitz
Myxobolus carassii Klokocewá
Myxobolus mesentericus Kudo

13) Gall-bladder.—Leptotheca agilis Thélohan

Leptotheca elongata Thélohan
Leptotheca polymorpha (Thélohan) Labbé
Leptotheca parva Thélohan
Leptotheca hepseti Thélohan
Leptotheca sp. Anerinew
Leptotheca macrospora Auerbach
Leptotheca informis Auerbach
Leptotheca longipes Auerbach
Leptotheca fusiformis Davis
Leptotheca scissura Davis
Ceratomyxa arcuata Thélohan
Ceratomyxa sphaerulosa Thélohan
Ceratomyxa pallida Thélohan
Ceratomyxa globulifera Thélohan
Ceratomyxa appendiculata Thélohan
Ceratomyxa truncata Thélohan
Ceratomyxa reticularis Thélohan
Ceratomyxa inaequalis Doflein
Ceratomyxa lignospora Doflein
Ceratomyxa ramosa Awerinzew
Ceratomyxa drepanotetlae Awerinzew
Ceratomyxa tylosuri Awerinzew
Ceratomyxa (?) spori Awerinzew
Ceratomyxa sp. (?) Awerinzew
Ceratomyxa sp. (?) Awerinzew
Ceratomyxa acadiensis Mavor
Ceratomyxa sp. Georgévitch
Ceratomyxa coris Georgévitch
Ceratomyxa herouardi Georgévitch
Ceratomyxa mesospora Davis
Ceratomyxa sphaerophora Davis
Ceratomyxa laevis Davis
Ceratomyxa attenuata Davis
Ceratomyxa recurvata Davis
Ceratomyxa lunata Davis
Ceratomyxa abbreviata Davis
Ceratomyxa flagellifera Davis
Ceratomyxa agglomerata Davis
Ceratomyxa amorpha Davis
Ceratomyxa monospora Davis
Ceratomyxa streptospora Davis
Ceratomyxa aggregata Davis
Ceratomyxa undulata Davis
Chloromyxum leydigi Mingazzini
Chloromyxum fluviatile Thélohan
Chloromyxum truttae Léger (also gall-duct)
Chloromyxum cristatum Léger
Chloromyxum dubium Auerbach
Chloromyxum sp. Awerinzew
Chloromyxum thyridale Lebzelter
Chloromyxum koi Fujita
Chloromyxum magnun Awerinzew
Chloromyxum misgurni Kudo
Chloromyxum fujilai Kudo
Chloromyxum trijugum Kudo
Chloromyxum catostomi Kudo
Chloromyxum wardi Kudo
Sphaerospora masovica Cohn
Myxidium incurvatum Thélohan
Myxidium sphaericum Thélohan
Myxidium sp. Gurley (only in gall-duct)
Myxidium giganteum Doflein
Myxidium pfeifferi Auerbach
Myxidium inflatum Auerbach
Myxidium bergense Auerbach
Myxidium procerum Auerbach
Myxidium macrocapsulare Auerbach
Myxidium sp. Awerinzew
Myxidium oviforme Parisi
Myxidium sp. Mavor
Myxidium kagayamai Kudo
Myxidium gadi Georgiévitch
Myxidium glutinosum Davis
Myxidium phyllium Davis
Myxidium striatum Cunha et Fonseca
Myxobolus misgurni Kudo (few spores only)
Myxobolus sp. Lebzelter (spores only)
Sphaeromyxa balbianii Thélohan
Sphaeromyxa incurvata Doflein
Sphaeromyxa subrassisi Laveran et Mesnil
Sphaeromyxa hellandi Auerbach
Sphaeromyxa exneri Awerinzew
Sphaeromyxa gasterostei Georgiévitch
Zschokkella nova Klokacewa
Zschokkella acheniognathi Kudo (also in gall-duct)
Gen. incert. congri Perugia
Gen. incert. merlucii Perugia
Gen. et spec. incert. Mavor

14) Spleen.—Myxobolus piriformis Thélohan
Myxobolus sp. Kudo
Myxobolus ellipsoides Thélohan
Myxobolus exigus Thélohan
Myxobolus oviformis Thélohan
Myxobolus pfeifferi Thélohan
Myxobolus cyprini Doflein
Myxobolus cordis Keysselitz
Myxobolus musculi Keysselitz
Myxobolus mesentericus Kudo

15) Intestine.—Myxobolus exigus Thélohan
Myxobolus mülleri Bütschli
Myxobolus pfeifferi Thélohan
Myxobolus miyairii Kudo
Myxobolus carassii Klokacewa
Myxobolus mesentericus Kudo
Henneguya peri-intestinalis Cépède
Henneguya tenuis Vaney et Conte

16) Ovary.—Wardia ovincocus Kudo
Sphaerospora elegans Thélohan
Myxidium histophilum Thélohan
Myxobolus pfeifferi Thélohan
Myxobolus mülleri Bütschli
Myxobolus musculi Keysselitz
Henneguya oviperda (Cohn)
Henneguya media Thélohan
Henneguya brevis Thélohan

17) Kidney.—a) Urinary tubules.—Leptotheca renicola Thélohan
   Mitraspora caudata (Parisi) Kudo
   Mitraspora cyprini Fujita (also in ureter)
   Mitraspora elongata Kudo
   Sphaerospora elegans Thélohan
   Sphaerospora divergens Thélohan
   Henneguya media Thélohan
   Henneguya brevis Thélohan
   Henneguya gasterostei Parisi
   Hoferellus cyprini Doflein

   b) Tissue.—Mitraspora elongata Kudo
      Chloromyxum quadratum Thélohan
      Sphaerospora rostrata Thélohan (Malpighian bodies)
      Myxidium histophilum Thélohan
      Lentospora asymmetrica Parisi
      Myxobolus pfeifferi Thélohan
      Myxobolus cyprini Doflein
      Henneguya neapolitana Parisi (conn. tiss. of ren. tubules)
      Hoferellus cyprini Doflein

   c) Seat, unstated.—Chloromyxum mucronatum Gurley
      Sphaerospora angulata Fujita
      Myxidium barbatulae Cédée
      Myxidium giardi Cédée
      Myxobolus piriformis Thélohan
      Myxobolus ellipsoides Thélohan
      Myxobolus exigus Thélohan
      Myxobolus oviformis Thélohan
      Myxobolus mülleri Bütschli
      Myxobolus obesus Gurley
      Myxobolus cycloides Gurley
      Myxobolus cordis Keysseclitz
      Myxobolus musculi Keysseclitz

18) Urinary bladder.—Leptotheca lobosa Davis
    Leptotheca glomerosa Davis
    Ceratomyxa navicularia Davis
    Ceratomyxa spinosa Davis
    Chloromyxum mucronatum Gurley
    Chloromyxum granulosum Davis
    Sphaerospora elegans Thélohan
    Sphaerospora divergens Thélohan
    Sphaerospora polymorpha Davis
    Sphaerospora sp. Davis
    Sinuolinea dimorpha Davis (also in ureter)
    Sinuolinea capsularis Davis
    Sinuolinea arborescens Davis
    Sinuolinea opacita Davis
    Sinuolinea brachiocephora Davis
    Myxidium lieberkühni Bütschli
    Zschokkella hildae Auerbach
    Zschokkella globulosa Davis
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Myxoproteus ambiguus (Thelohan) Doflein
Myxoproteus cordiformis Davis
Myxoproteus cornutus Davis
Henneguya legeri Cépède
Henneguya wisconsinensis Mavor et Strasser
Henneguya mictospora Kudo
Gen. et spec. incert. Mavor

19) Testis.—Myxobolus pfeifferi Thelohan (only spores)
20) Mesentery.—Myxobolus mesentericus Kudo
21) Seat unknown.—Henneguya sp. Gurley ( integument?)

Gen. et spec. incert. Borne

II AMPHIBIA

1) Gall-bladder.—Chloromyxum caudatum Thelohan
Sphaeromyxa imersa (Lutz) Thelohan
2) Urinary tubules of kidney.—Wardia oldmacheri (Gurley) Kudo
Chloromyxum protei Joseph

<table>
<thead>
<tr>
<th>TABLE I</th>
</tr>
</thead>
<tbody>
<tr>
<td>----------</td>
</tr>
<tr>
<td>Leptotheca</td>
</tr>
<tr>
<td>Ceratomyxa</td>
</tr>
<tr>
<td>Myxoproteus</td>
</tr>
<tr>
<td>Wardia</td>
</tr>
<tr>
<td>Mitraspora</td>
</tr>
<tr>
<td>Chloromyxum</td>
</tr>
<tr>
<td>Sphaerospora</td>
</tr>
<tr>
<td>Sinuolinea</td>
</tr>
<tr>
<td>Myxidium</td>
</tr>
<tr>
<td>Sphaeromyxa</td>
</tr>
<tr>
<td>Zschokkella</td>
</tr>
<tr>
<td>Myxosoma</td>
</tr>
<tr>
<td>Lentospora</td>
</tr>
<tr>
<td>Myxobolus</td>
</tr>
<tr>
<td>Henneguya</td>
</tr>
<tr>
<td>Hoferellus</td>
</tr>
</tbody>
</table>

| Total | ... | 16 | 10 | 18 | 8 | 41 | 1 | 4 | 2 | 3 | 3 | 7 | 8 | 8 | 10 | 8 | 2 | 10 | 39 | 3 | 24 | 1 | 2 |

* For (a), (b) and (c), see page 42.
3) Testis, oviduct.—Myxobolus hylae Johnston et Bancroft

III REPTILIA
1) Kidney (ren. tub.).—Myxidium danilewskyi Laveran
   Myxidium mackiei Bosanquet
   Myxidium americanum Kudo

2) Ovary.—Gen. et spec. incert. Mingazzini

IV INSECTA
1) Abdominal cavity.—Chloromyxum diploxyx Gurley

V ANNELIDA
   Myxobolus sp. Gurley

The data in this section are summarized on the preceding page (Table I).

D. THE EFFECT OF ENVIRONMENT ON THE ORGANEL DISTRIBUTION OF MYXOSPORIDIA IN HOSTS

Myxosporidia are almost equally distributed among marine and freshwater fishes in regard to the number of species. This is shown in the following table.

<table>
<thead>
<tr>
<th>Genus</th>
<th>Number of species found in marine fish</th>
<th>Number of species found in freshwater fish</th>
<th>Other hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rept. Amph. Insect Annelida</td>
</tr>
<tr>
<td>Leptotheca (15)*</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceratomyxza (35)</td>
<td>35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myxoproteus (3)</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wardia (2)</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Mitraspora (3)</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Chloromyxum (22)</td>
<td>7</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Sphaerospora (10)</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Sinulinea (5)</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myxidium (26)</td>
<td>17</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>(2 common)</td>
<td>(2 common)</td>
<td></td>
</tr>
<tr>
<td>Sphaeromyxa (7)</td>
<td>6</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Zschokkella (4)</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Myxosoma (3)</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Lentospora (6)</td>
<td>2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2 common)</td>
<td>(2 common)</td>
<td></td>
</tr>
<tr>
<td>Myxobolus (63)</td>
<td>5</td>
<td>56</td>
<td>1</td>
</tr>
<tr>
<td>Heneguya (32)</td>
<td>1</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Hoferellus (1)</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Gen. et spec. incert (12)</td>
<td>4</td>
<td>7</td>
<td>1</td>
</tr>
</tbody>
</table>

| TOTAL 237+12 | 104+4 | 134+7 | 4   | 5   | 1   | 1   |

* The number in parenthesis denotes the number of species in the corresponding genus.
These genera have certain relations to the organal distribution in the body of the host, which are shown in List IV (page 37) and Table I (on page 43) and which can be put together as follows:

TABLE III

<table>
<thead>
<tr>
<th>Genus</th>
<th>Number of species found in body-cavity</th>
<th>Number of species found in tissue</th>
<th>Number of species found in both</th>
<th>Seat unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leptotheca (15)</td>
<td>14</td>
<td>1</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Ceratomyxa (35)</td>
<td>35</td>
<td>..</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Myxoproteus (3)</td>
<td>3</td>
<td>..</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Wardia (2)</td>
<td>1</td>
<td>1</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Mitraspora (3)</td>
<td>2</td>
<td>..</td>
<td>1</td>
<td>..</td>
</tr>
<tr>
<td>Chloromyxum (22)</td>
<td>18</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sphaerospora (10)</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sinuolinea (5)</td>
<td>5</td>
<td>..</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Myxidium (26)</td>
<td>22</td>
<td>4</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Sphaeromyxa (7)</td>
<td>6</td>
<td>..</td>
<td>1</td>
<td>..</td>
</tr>
<tr>
<td>Zschokkella (4)</td>
<td>4</td>
<td>..</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Myxosoma (3)</td>
<td>..</td>
<td>3</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Lentospora (6)</td>
<td>1</td>
<td>5</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Myxobolus (63)</td>
<td>2</td>
<td>59</td>
<td>..</td>
<td>2</td>
</tr>
<tr>
<td>Henneguya (32)</td>
<td>4</td>
<td>28</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Hoferellus (1)</td>
<td>..</td>
<td>1</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Gen. et spec. inct (12)</td>
<td>4</td>
<td>5</td>
<td>..</td>
<td>3</td>
</tr>
</tbody>
</table>

**Total 237+12... 121+4**

From the facts shown in the above tables, the following conclusions can be drawn.

1) The genera Leptotheca (one species in tissue), Ceratomyxa, Myxoproteus, Sinuolinea and Sphaeromyxa (one species in Amphibia) include parasites from the body cavity of marine fish.

2) The majority of the genera Lentospora, Myxosoma, Myxobolus (one species in Amphibia), Henneguya and Hoferellus include parasites in tissues of fresh-water fish.

3) The genera Chloromyxum, Sphaerospora, Myxidium and Zschokkella include forms that infect the body-cavity as well as the tissue of marine and fresh-water fishes.

4) The genus Mitraspora includes three species that parasitize the fresh-water fish.

5) The genus Myxidium has three species found in the kidney of reptiles.
6) The genera Wardia, Chloromyxum, Sphaeromyxa and Myxobolus include species parasitic in Amphibia.
7) The genus Chloromyxum has one species found in an insect.
8) The genus Myxobolus has one species found in an annelid, which was not normally recorded.
THE SPORE

As will be shown later (page 52-55), the spore stage is still the only constant character by which various forms of Myxosporidia are identified from each other. For this reason it is necessary to have a clear conception of the form and structure of the spore and at the same time to define the terms used in the present paper, even tho they have commonly been used heretofore.

The spore of Myxosporidia is covered by a shell, which is composed of two valves, usually symmetrical in form and size, that come in contact in the sutural plane. The sutural line is straight in most cases, tho sometimes curved like an S. It is more or less thickened, forming the sutural ridge. The sutural ridge is to be made out clearly in fresh as well as in stained preparations and furnishes important data in regard to the classification of the parasite. The thickness of the shell-valve is usually uniform; in some species (Myxobolus), however, it may differ slightly in different parts of the shell. Besides, in many species of Myxobolus, the shell differentiates a small triangular intercapsular appendix on the inside at the anterior end directed posteriad between two polar capsules.

The form of the spore varies greatly owing to the shape of the shell together with its variously developed appendages; 1) lateral appendages as in Ceratomyxa, 2) anterior processes as in Myxoproteus, 3) posterior processes as in Wardia (fringe-like), Mitraspora (filiform), Hoferellus (spinous), Henneguya (tail-form), etc.
The surface of the shell may be smooth or exhibit various markings. More or less conspicuous ridges varying in form and number in different species, may run parallel to the sutural line, may show a network-like structure or may exhibit short tooth-like processes arising from the sutural ridge and radiating toward the center of each valve. When the ridges are fine, they form delicate striations, arranged usually parallel to the sutural line. Tho these markings are usually easily seen in vivo, they are very often more readily studied in stained preparations.

Inside of the shell are present the polar capsules and sporoplasm. Gurley (1894:120) and Davis (1917:210) used the term "capsules" instead of polar capsules because of the facts that "the situation implied by the the latter (polar capsule) is not constant" (Gurley) and that "they are often not in the position indicated by the term polar capsule" (Davis). The present writer, however, does not agree with these authors and retains the commonly used term, polar capsule, thruout the present paper on the basis of the fact that these polar capsules are situated at or near the more or less attenuated anterior end in the great majority of species or at each end (in Myxidiidae) of the spore, except in the few cases as in Wardia in which they are situated in the central portion and have the foramina at the anterior end of the spore.

The polar capsules may be pyriform or spherical. They are located at or near one end (anterior end) of the spore. In Myxidiidae, one polar capsule is situated at each end, in which case no distinction can be made between the anterior and posterior ends. The end or side opposite to the anterior, is the posterior end of the spore. The number of polar capsules in a spore varies according to the different genera. There is only one polar capsule in the spore of unicapsular Myxobolus, four in Chloromyxum, two in all the other genera. They may be equal or unequal in form and size. When two polar capsules are located at the anterior end, they may be convergent or divergent. Each has a foramen to the outside of the spore thru the shell in or near the sutural line, thru which the polar filament is extruded. The foramen is observable in the fresh condition. Staining will very often show clearly the canals thru the shell. Each polar capsule has an independent foramen.

In the polar capsule exists a coiled polar filament, which in most cases can be recognized without difficulty in the fresh condition. The polar filament is as a rule a more or less extended, probably hollow thread connected with the polar capsule, which is extruded from the spore thru the foramen under the action of the stimulants such as the digestive fluid of the host or certain chemicals. In Sphaeromyxa it is rather short and thick, tapering to a point. The polar filament is coiled around the longest axis of the polar capsule, except in Sphaeromyxa in which it is coiled around an axis perpendicular to the longest axis of the polar capsule.
The sporoplasm occupies the extracapsular cavity at the posterior region of the spore. It is of granular structure with almost always two nuclei. Besides, it has an iodinophilous vacuole mostly round or oval in the spores of the family Myxobolidae. It occurs throughout the spore stage and is the important character of the said family. The contents of the vacuole is probably of glycogenous nature and is stained deeply with iodine. Small refringent fat globules have also been observed in the spore.

Davis (1917:212) proposed to use capsular and postcapsular sides in place of anterior and posterior ends which have most frequently been used and are also used in the present paper. The latter terms can be employed as properly as Davis’ terms except in the case of the Myxidiidae, where both terms, strictly speaking, are inapplicable.

Tho various abnormal spores are very often encountered in several species, the majority of the spores are of typical form, structure and size. In Myxosoma and Myxobolus, the spore sometimes develops a short posterior process, which is highly developed in the spore of the genus Henneguya.

Young spores, generally speaking, are more rounded in form than the mature form, while the mature spores, as a rule, are of definite form, structure and size characteristic to the species. It should, however, be kept in mind that there is a certain amount of variation among these characters.

As is generally recognized, one must mention whether the spores were measured in fresh condition or in fixed and stained state. The fresh spore is generally more or less larger than the mounted one.
DEFINITION OF TERMS USED FOR DESCRIPTIONS

*Anterior end.*—The end of the spore where the polar capsules open; in most cases the polar capsules are situated at this end.

*Anterior process.*—The spinoous process of the shell at the anterior end of the spore of the genus Myxoproteus.

*Breadth.*—The larger diameter of the spore measured at right angles to the length or sutural diameter; the shorter diameter thus measured being the thickness.

*Capsulogenous cell.*—A small island of protoplasm with a nucleus, in which polar capsule becomes differentiated.

*Cyst.*—The vegetative form of more or less conspicuous size in tissues of the host, surrounded usually by a membranous structure composed of the host issue.

*Disporous.*—The character of a trophozoite of forming only two spores.

*Foramen.*—Opening of the polar capsule through which the polar filament is extruded.

*Front view.*—The view in which length and breadth of the spore are laid horizontally.

*Gemmules.*—A small mass of trophozoite separated from the mother body by plasmotomy. Used by Davis (1917). (See page 105.)

*Iodinophilous vacuole.*—The vacuole in the sporoplasm of the spore of the family Myxobolidae, the contents of which are stained brownish with iodine.

*Lateral process.*—The lateral prolongation of the shell-valve at right angles to the sutural plane.

*Length.*—Antero-posterior diameter of the spore in the sutural plane; equivalent to sutural diameter.

*Longitudinal striations.*—Fine ridges or thickenings marked longitudinally on the shell of the spore.

*Mesoplasm.*—An intermediate layer between ectoplasm and endoplasm, coined by Cohn in the case of *Myxidium lieberkühni* (see page 107).

*Mictosporous.*—The character of the trophozoite of forming a variable number of spores in an individual.

*Monosporous.*—The character of the trophozoite of forming a single spore.

*Pansporoblast.*—Coined by Gurley (1893:408) used here in the same meaning, an enclosed area in the endoplasm of the vegetative form, in which two sporoblasts become differentiated.
Plasmogamy. Fusion of two trophozoites, coined by Doflein (1898).
Plasmodiomy.—Division of trophozoite into daughter individuals, coined by Doflein (1898).
Polar capsule.—The pyriform or spherical, hollow body in the spore which forms a polar filament.
Polar filament.—The filament which is coiled inside the polar capsule.
Polyzporous.—The character of the trophozoite of forming spores, more than two.
Posterior filament.—Fine posterior appendage of the spore.
Posterior processes.—Posterior differentiations of the shell.
Ridge.—Linear or network-like elevation of the shell of the spore.
Shell.—The envelope of the spore.
Shell-valves.—Two valves which compose the shell of the spore.
Sporoplasm.—The protoplasmic mass found inside of the spore (amebula or sporozoite), usually situated in the posterior portion of the spore.
Sutural diameter.—Same as length.
Sutural edge.—The edge of the shell-valves cut by the sutural plane.
Sutural line.—The line on the shell of the spore marked by the sutural plane.
Sutural plane.—The plane on which two shell-valves meet together.
Sutural ridge.—The ridge marking the sutural line.
Tail.—The posterior prolongation of the valves from the median posterior end; it may be a single process or bifurcated.
Thickness.—See breadth.
Trophozoite.—The vegetative or multiplicative stage of a Myxosporidian.
Vegetative form.—Same as trophozoite.
CLASSIFICATION OF MYXOSPORIDIA

The classification of Myxosporidia, was first carried out by Thélohan as early as 1892, who considered rightly that the spore was the only reliable means for the purpose. In 1899 and 1901, Doflein introduced into the classification two Legions, Disporea and Polysporea, and a new family. This plan has generally been followed by various authors in dealing with these protozoa.*

The classification of the said author, however, no longer agrees with our present knowledge of the animals. In the first place, as was pointed out by some authors, for instance Davis (1917:217), it is far from being correct to divide the Myxosporidia into two Legions, Disporea and Polysporea, on the basis of the number of spores formed in each vegetative form, since this differs even in one and the same species as was observed by Léger, Auerbach, Awerinzew, Parisi, Georgévitch, Davis, Kudo and others (see Table IV on page 53).

Auerbach who had observed numerous interesting facts in this group, had adopted Doflein’s classification in his splendid work (1910) by simply adding two genera, Zschokkella and Lentospora, to the family Myxidiidae. In the following year (1911), he tried a new classification, on the same basis as Doflein did, by introducing two new Legions besides these two already existing, and by discarding all the families. Thus:

I Monosporea
   a) Genus Coccomyxa

II Mictosporea
   a) Genus Zschokkella
   b) Genus Myxoproteus
   c) Genus Myxidium
   d) Genus Sphaeromyxa
   e) Genus Chloromyxum
   f) Genus Sphaerospora

III Disporea
   a) Genus Ceratomyxa
   b) Genus Leptotheca

IV Polysporea
   a) Genus Myxosoma
   b) Genus Lentospora
   c) Genus Myxobolus
   d) Genus Henneguya
   e) Genus Hoferellus

As will be distinctly seen from Table IV, the classification not only fails to improve Doflein’s classification in bringing together the genera, Myxo-

* Doflein still uses the same classification in his recent work (1916).
proteus, Myxidium and Sphaeromyxa into Mictospora, and Lentospora and Henneguya into Polyspora, but increases the confusion concerning relationship among the genera.

<table>
<thead>
<tr>
<th>Genus</th>
<th>Mono-and di-sporous</th>
<th>Mono-and poly-sporous</th>
<th>Di-sporous</th>
<th>Mono-, di-and poly-sporous</th>
<th>Di- and poly-sporous</th>
<th>Polysporous</th>
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</tr>
</tbody>
</table>

* These three genera are unknown to Auerbach, except two species which were formerly placed in Leptotheca and Sphaerospora.
Parisi (1912) followed Auerbach in his paper dealing with Myxosporidia from Italian waters. Poche (1913) put Auerbach's classification in better form as follows:

Order: Myxosporidia
  2 Superfamily Mictosporea
    2 Family Myxidiidae
      2 Genus Zschokkella
      3 Genus Myxoproteus
      4 Genus Myxidium
      5 Genus Sphaeromyxa
      6 Genus Sphaerospora
  3 Family Chloromyxidae
    7 Genus Chloromyxum
  3 Superfamily Disporea
    4 Family Ceratomyxidae
      8 Genus Ceratomyxa
      9 Genus Leptotheca
  4 Superfamily Polyspora
    5 Family Myxosomatidae (Poche)
      10 Genus Myxosoma
      11 Genus Lentospora
    6 Family Myxobolidae
      12 Genus Myxobolus
      13 Genus Henneguya
      14 Genus Hoferellus

For the same reason given in discussing Auerbach, this, however, is not conformable with the present state of knowledge regarding these protozoa.

It was not until 1917 that the classification of the Myxosporidia approached to a more natural state in the valuable work by Davis (1917: 219–221). He pointed out sharply the unsatisfactory features in Doflein's classification and proposed a different system as follows:

Order: Myxosporidia.
  Suborder I Myxospora Davis
    Family 1 Ceratomyxidae
      Genus 1 Leptotheca
      Genus 2 Ceratomyxa
    Family 2 Sphaerosporidae Davis
      Genus 1 Myxoproteus
      Genus 2 Sphaerospora
      Genus 3 Sinuolinea
    Family 3 Myxidiidae
      Genus 1 Myxidium
      Genus 2 Sphaeromyxa
      Genus 3 Zschokkella
    Family 4 Chloromyxidae
      Genus 1 Chloromyxum
Suborder II Cystosporea Davis
Family 1 Myxosomidae* Davis
   Genus 1 Myxosoma
   Genus 2 Lentospora
Family 2 Myxobolidae
   Genus 1 Myxobolus
   Genus 2 Henneguya
   Genus 3 Hoferellus

Thus, Davis selected the form of the spore for the establishment of two suborders and further rearranged the genera into closer positions to show relationship to each other better than any one of the previous authors. He, however, named the suborders according to a secondary character, i.e., the seat of the parasites in the host. According to his definition the trophozoites of the species belonging to Myxosporea are "with few exceptions free living in the body-cavity," while those of Cystosporea "with few exceptions" are tissue parasites.

From TABLE III on page 45, are taken the following data regarding this point:

<table>
<thead>
<tr>
<th></th>
<th>Total number of species known</th>
<th>Number of species found in body cavity</th>
<th>Number of species found in tissue</th>
<th>Number of species found in both places</th>
<th>Seat unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Myxosporea....</td>
<td>132</td>
<td>114</td>
<td>14</td>
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<td>2</td>
</tr>
<tr>
<td>Cystosporea...</td>
<td>105</td>
<td>7</td>
<td>95</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Thus it appears that the terms Myxosporea and Cystosporea do not seem to be properly used. These may be replaced by terms that denote the first and common character of the suborders.

The suggestions as to the adoption of other characters than the spore for the divisions of Myxosporidia, proposed by Awerinzew (1907:831; 1908:64), Auerbach (1910:161) and Davis (1917:217) can only be applied in the future. At the present time, the characters concerning the vegetative form do not appear to afford a better and more natural basis for the classification of Myxosporidia than those of the spore. Thus from the taxonomic point of view the present situation does not seem to be much improved as compared with that at the end of the last century.

The writer proposes in the following pages a new classification based on the characters of the spore.

* Davis did not notice the establishment of the family Myxosomatidae by F. Poche (1913), including exactly the same genera. See page 54.
Order MYXOSPORIDIA Bütschli 1881
Suborder EURYSPOREA nom. nov.

Largest diameter of the spore at right angles to the sutural plane. One polar capsule on each side of the plane. Sporoplasm with no iodinophilous vacuole. Vegetative form found in body cavity (except 2 species). Great majority parasites of marine fish. Monosporous, disporous and polysporous.

Family CERATOMYXIDAE Doflein 1899
With the characters of the suborder.

Genus LEPTOTHECA Thélohan 1895
Shell-valves of spore hemispherical or shortly rounded. 15 species. Disporous (7 unknown). 14 species in body-cavity; 1 in tissue; all in marine fish. Type species: Leptotheca agilis Thélohan.

Genus CERATOMYXA Thélohan 1892
Shell-valves, conical and hollow, attached on the bases; free ends extended, tapering to more or less sharply pointed or rounded ends. Sporoplasm usually does not fill the cavity, but is located asymmetrically in it. 35 species. Disporous (23 species), monosporous and disporous (3 species), disporous and polysporous (4 species) and unknown (5 species). All (except 2 species in urinary bladder) in the gall-bladder of marine fish. Type species: Ceratomyxa arcuata Thélohan.

Genus MYXOPROTEUS Doflein 1898 emend. Davis 1917
Spores roughly pyramidal; with or without distinct processes from the base of the pyramid. 3 species. Disporous (one species unknown). All in urinary bladder of marine fish. Type species: Myxoproteus ambiguus (Thélohan) Doflein.

Genus WARDIA nov. gen.
Spore form of isosceles triangle with two convex sides. Oval in profile. Surface of shell with fine ridges which turn into fringe-like processes at the posterior end. The polar capsules, large and perfectly spherical, situated at the central portion of the spore, opening at the anterior tip. Two species. Polysporous (one species unknown). Tissué parasite (one species) of fresh-water fish and amphibia, both found in Illinois, U. S. A. Type species: Wardia ovinocua nov. spec.

Genus MITRASPORA Fujita 1912 emend. Kudo
Spores spherical or ovoidal. Two polar capsules pyriform, one situated on each side of the sutural plane. Shell longitudinally striated; with or without long and fine filaments projecting posteriorly in a row at right
angles to the sutural plane at the posterior side. 3 species. Disporous and polysporous. All found in kidney of fresh-water fish. Type species: *Mitraspora cyprini* Fujita.

Suborder **SPHAEROSPOREA** nom. nov.

Sporos without or subspherical, with two to four polar capsules. Sporoplasm without iodinophilous vacuole. Vegetative form found in body-cavity and tissue. Monosporous, disporous and polysporous. Parasites of marine and fresh-water fish and amphibia.

**Family CHLOROMYXIDAE** Thélohan 1892*

Sporos with four polar capsules. Monosporous, disporous and polysporous.

**Genus CHLOROMYXUM** Mingazzini 1890

With the characters of the family. 22 species. 18 in body cavity; 4 in tissue. 7 from marine and 12 from fresh-water fish, 2 in amphibia, 1 in insect. Type species: *Chloromyxum leydigi* Mingazzini.

**Family SPHAEROSPORIDAE** Davis 1917

Sporos with two polar capsules. Monosporous, disporous and polysporous.

**Genus SPHAEROSPORA** Thélohan 1892

Sporos with two polar capsules. Monosporous, disporous and polysporous. 10 species. Body-cavity and tissue. 5 from fresh-water and 5 marine fish. Type species: *Sphaerospora divergens* Thélohan.

**Genus SINUOLINEA** Davis 1917

Sporos with or without lateral processes. Two polar capsules spherical. Sutural line sinuous. 5 species. Disporous and polysporous. In the urinary bladder of marine fish. Type species: *Sinuolinea dimorpha* Davis.

Suborder **PLATYSPOREA** nom. nov.

Sutural plane of the spore coincides with or at an acute angle to the longest diameter. One or two polar capsules. Sporoplasm with or without an iodinophilous vacuole.

**Family MYXIDIIDAE** Thélohan 1892

Two polar capsules, one at each end. Sporoplasm without any iodinophilous vacuole. Spores fusiform.

*Thélohan (1892) used the terms: Chloromyxidées, Myxidiidées, Myxobolidées, which Gurley (1893) made over into Chloromyzidae, Myxidiidae, Myxobolidae, so that the credit of recognizing and establishing these families belongs to Thélohan.
Genus **MYXIDIUM** Bütschli 1882

Spores more or less regularly fusiform, with pointed or rounded ends. Polar filaments long and fine. 26 species. Monosporous, disporous and polysporous. 22 in body-cavity; 4 in tissue. 15 in marine and 6 in freshwater fish, 2 in fishes from both waters and 3 in reptilia. Type species: *Myxidium lieberkühni* Bütschli.

Genus **SPHAEROMYXA** Thélohan 1892

Spores fusiform, with truncated ends. Trophozoites large and disc shaped. 7 species. Polysporous (2 unknown). 6 in body-cavity; 1 unknown. 6 in marine fish; 1 in amphibia. Type species: *Sphaeromyxa halhianii* Thélohan.

Genus **ZSCHOKKELLA** Auerbach 1910

Spores, semicircular in front view; pointed at ends. Polar capsules large and spherical, opening on the flat edge near the tips. Sutural line usually curved in S-form. 4 species. Monosporous, disporous and polysporous. Body-cavity. 2 from marine and 2 from fresh-water fish. Type species: *Zschokkella hildae* Auerbach.

**Family MYXOSOMATIDAE** Poche 1913

Two polar capsules at the anterior end. Sporoplasm without iodinophilous vacuole.

Genus **MYXOSOMA** Thélohan 1892

Spores ovoidal, flattened and more or less elongated. 3 species. Polysporous. Tissue parasites. 2 in fresh-water and 1 in marine fish. Type species: *Myxosoma dujardini* Thélohan.

Genus **LENTOSPORA** Plehn 1905

Spores similar to *Myxobolus* in form. Sporoplasm without any iodinophilous vacuole. 6 species. Disporous and polysporous (2 unknown). 1 in marine and 3 in fresh-water fish, 2 from fishes in both waters. Type species: *Lentospora cerebralis* (Hofer) Plehn.

**Family MYXOBOLIDAE** Thélohan 1892

Spores with one or two polar capsules at the anterior end, with or without posterior processes. Sporoplasm with an iodinophilous vacuole. Majority polysporous in fresh-water fishes.

Genus **MYXOBOLUS** Bütschli 1882

Spores ovoidal or ellipsoidal; flattened. One or two polar capsules at the anterior end. Shell without posterior process. 63 species. Polysporous (9 species unknown). 59 species in tissue; 4 unknown. 5 in marine and 56 in fresh-water fish, 1 in annelid and 1 in amphibia. Type species: *Myxobolus müllerii* Bütschli.
Genus HENNEGUYA Thélohan 1892
Spores more or less globular or ovoidal. Two polar capsules at the anterior end. Posterior end of the shell-valves prolonged into more or less extended processes, which unite and form a tail in the median line. 32 species. Polysporous, disporous and monosporous. 28 species in tissue and 4 in body-cavity. In fresh-water fish, except one. Type species: *Henneguya psorospermica* Thélohan.

Genus HOFERELLUS Berg 1898
Spores pyramidal, with two posterior processes from the lateral faces. 1 species. Polysporous. Tissue and body-cavity of fresh-water fish. Type and only species: *Hoferellus cyprini* Doflein.
DESCRIPTIONS OF GENERA AND SPECIES

Suborder EURYSPOREA nom. nov.
The definition of the suborder is recorded on page 56.

Family CERATOMYXIDAE Doflein
1899 *Ceratomyxidea* Doflein 1899 : 378
1901 *Ceratomyxidae* Doflein 1901 : 182

The characters of the family are described on page 56.

Genus LEPTOTHECA Thélohan
1895 *Leptotheca* Thélohan 1895 : 331

The characters of the genus are described on page 56.

Type species: *Leptotheca agilis* Thélohan.

**LEPTOTHECA AGILIS** Thélohan

[Figs. 1 to 5]
1892 *Ceratomyxa agilis* Thélohan 1892 : 962
1895 *Leptotheca agilis* Thélohan 1895 : 332
1898 *Leptotheca agilis* Doflein 1898 : 294, 297

Habitat: Gall-bladder of *Trygon pastinaca* L. and *Scorpaena* sp.; France, Rovigno, Napoli.
Vegetative form: Form generally elongated. Anterior end rounded where a mass of fat globules is found, while the posterior end terminates in a point. Size not exceeding 85μ by 20 to 25μ. The posterior part is sometimes divided into a certain number of lobes. In the protoplasm, the globules are clearly seen. Pseudopodia are localized at the anterior portion of the body. They are long, 40 to 50μ in length, filiform and very active in moving from back toward front, just like the motion of oars. Disporous.

Spore: Slightly elongated. Dimensions: sutural diameter 6 to 7μ, breadth 11 to 12μ.

**LEPTOTHECA ELONGATA** Thélohan

[Fig. 6]
1895 *Leptotheca elongata* Thélohan 1895 : 332
1898 *Leptotheca elongata* Doflein 1898 : 312
1917 *Leptotheca elongata* Georgévitch 1917b : 99–106

Habitat: Gallbladder of *Merluccius merluccius* L. (*M. vulgaris*) and *Motella tricirrata*; Marseille, Banyuls, Le Croisic, Napoli, Monaco.
Vegetative form: Form variable. Many individuals show, however, a very characteristic form. It is elongated and has the length of about 120\(\mu\). The anterior end is enlarged into a disc-shaped depression, on the edge of which, the branched pseudopodia are formed. The body gradually narrows itself toward the posterior end. Also club-shaped, etc. The short lobose pseudopodia show no movement like that of oars.

Georgevitch's form: Young forms, oval or rounded, are attached to the epithelial cells of the bladder with a long filiform pseudopodium at the free end. Such forms often agglomerate in great number.

Spore: Form similar to the spore of Leptotheca agilis. Dimensions on the average: Sutural diameter 12 to 15\(\mu\), breadth 18 to 20\(\mu\).

**Leptotheca Polymorpha** (Thélohan) Labbé

1895 *Leptotheca elongata* Thélohan 1895: 332-333
1899 *Leptotheca polymorpha* Labbé 1899: 88

Habitat: Gall-bladder of *Phycis mediterraneus* (*P. phycis* L.); Banyuls.

Vegetative form: Form extremely polymorphous, with three main types. 1) Somewhat regularly club-shaped, with lobose pseudopodia, sometimes filiform at one end. 2) Irregular as is the case with *Ceratomyxa truncata*, with long (25\(\mu\)) ectoplasmic processes, which are motionless or very slow in motion. Lobose pseudopodia are formed actively. 3) More or less rounded with bristle-like filose pseudopodia. Intermediary forms are also found. Often many individuals unite together. The protoplasm is much different from other forms, i.e., more homogeneous and compact. Granules are hardly visible on account of vacuolar appearance.

Spore: Dimensions: sutural diameter 10 to 12\(\mu\), breadth 18 to 20\(\mu\), length of polar filament 40\(\mu\).

**Leptotheca Parva** Thélohan

[Fig. 7]

1895 *Leptotheca parva* Thélohan 1895: 333
1912 *Leptotheca parva* Auerbach 1912: 42-43

Habitat: Gall-bladder of *Scomber scombrus* L.; Marseille, Le Croisic, Le Vivier-sur-mer, Kristiansund, Stavanger, Bergen.

Vegetative form: Form ordinarily rounded, spherical or subspherical. Often club-shaped. Size not larger than 12 to 15\(\mu\) in diameter. Protoplasm finely granular. Pseudopodia lobose.

Spore: Small, more or less elongated, curved in arch-form. Dimensions: sutural diameter 3 to 4\(\mu\), breadth 8 to 10\(\mu\).

**Leptotheca Renicola** Thélohan

1895 *Leptotheca renicola* Thélohan 1895: 333

Habitat: Urinary tubules of the kidney of *Scomber scombrus* L.; Marseille, Le Croisic.
Vegetative form: Small. No marked character.
Spore: Globular. Form similar to the spore of Sphaerospora. Dimensions: sutural diameter $8\mu$, breadth $10\mu$.

**LEPTOTHECA HEPSETI** Thélohan

1895 *Leptotheca hepseti* Thélohan 1895 : 334

Habitat: Gall-bladder of *Atherina hepsetus* L.; Marseille. Of rare occurrence; Thélohan observed it but once.
Vegetative form: Not described.
Spore: Form triangular with rounded angles. Dimensions: sutural diameter 7 to $8\mu$, breadth 12 to $15\mu$.

**LEPTOTHECA PERLATA** (Gurley) Labbé

1883 *Chloromyxum (Sphaerospora) perlatum* Balbiani 1883 : 201, 204
1894 *Leptotheca perlata* Gurley 1894 : 272
1899 *Leptotheca perlata* Labbé 1899 : 88

Habitat: *Aerina cernua* L.; France (?).
Vegetative form: Not described.
Spore: Elliptic. Two small polar capsules converging. Dimensions not given.

**LEPTOTHECA sp.** Awerinzew

1908 *Leptotheca sp.* Awerinzew 1908 : 51, 52

Habitat: Gall-bladder of *Sebastes norvegicus*; Eastern Finmark?
Vegetative form: Rounded form with clear differentiation of protoplasm into ectoplasm and endoplasm. Plasmotomy occurs.
Spore: Undescribed. No figure.

**LEPTOTHECA MACROSPORA** Auerbach

1909 *Leptotheca macrospora* Auerbach 1909 : 70-71
1910 *Leptotheca macrospora* Auerbach 1910b : 768-769
1910 *Leptotheca macrospora* Auerbach 1910c : 167
1912 *Leptotheca macrospora* Auerbach 1912 : 42-43

Habitat: Gall-bladder of *Sebastes viviparus* H. Kr. and *S. dactylopterus*; Bergen, Kristiansund (May, September).
Vegetative form: Trophozoites spherical with the average diameter of 26 to 30$\mu$. Homogeneous ectoplasm layer exhibits somewhat active ameboid movements. Endoplasm, granular in living specimen, is rather sharply distinguishable from the ectoplasm and contains large nuclei.
Spore: Size large. Form resembles to that of Leptotheca parva. Dimensions: sutural diameter and thickness 13μ, breadth 26μ. Polar capsules short oval, with a length of 5.2μ, length of polar filament about 130μ (KOH). In the second host, a few normal and numerous abnormal spores with three or four polar capsules were observed.

**LEPTOTHECA INFORMIS** Auerbach

*Fig. 10*

1910 *Leptotheca informis* Auerbach 1910b: 770-771
1912 *Leptotheca informis* Auerbach 1912: 42-44

**Habitat:** Gall-bladder of *Molva vulgaris* Flem. and *Gadus merlangus*; Bergen, Tjomo.

**Vegetative form:** Young trophozoites with somewhat long and narrow pseudopodia formed of hyaline ectoplasm; movements active. The protoplasm is differentiated into ectoplasm and endoplasm. When stained, two large (7 to 9μ) and two small (3 to 4μ) nuclei were observed in an individual, 27μ long excluding the pseudopodia. Sporulating trophozoites are generally round and each forms two spores, which are developed independently to each other (i.e., not in ordinary pansporoblast). Auerbach observed centrosomes in the nuclei of larger type in division. Disporous.

**Spore:** Large and heavily built. Greatly curved. Sutural line fairly well marked. Polar capsules round. Dimensions: sutural diameter 10μ, breadth 18 to 20μ, thickness 9μ, diameter of polar capsules 3 to 4μ. Sporoplasm contains two nuclei, 3.5 to 4μ in diameter.

**LEPTOTHECA LONGIPES** Auerbach

*Fig. 11*

1910 *Leptotheca longipes* Auerbach 1910b: 771
1912 *Leptotheca longipes* Auerbach 1912: 42-43

**Habitat:** Gall-bladder of *Brosmius brosme* Asc.; Bergen (May).

**Vegetative form:** Trophozoites elongated or rounded. Only few pseudopodia which are very long. Small forms with a very long process, were observed in large numbers; length of the body being 10μ, while the process was 60μ long. Endoplasm contains nuclei of various sizes. Disporous.

**Spore:** Form similar to that of *Leptotheca informis*, though smaller. Dimensions: sutural diameter 8 to 9μ, breadth 12 to 14μ, thickness 8μ, diameter of polar capsule 2.5μ.

**LEPTOTHECA FUSIFORMIS** Davis

*Fig. 12*

1917 *Leptotheca fusiformis* Davis 1917: 222

**Habitat:** Gall-bladder of *Cestracion zygaena*; Beaufort (July).
Vegetative form: Pyriform, tapering gradually toward the posterior end, which usually terminates in a long, slender process; colorless and transparent. Progressive movements rapid. Endoplasm granular, the granules being more abundant at the anterior end. The average size of full-grown individuals: 50μ by 13μ. Disporous.

Spore: Elliptical in front view; fusiform in side view. Sutural plane slightly oblique to the longest diameter, the line forming a marked ridge. Polar capsules open on opposite sides of the spore. Sporoplasm finely granular, confined to the central part of spore. Dimensions: sutural diameter 9μ, breadth 16μ, polar capsule 4.5μ long, length of polar filament 30μ.

**LEPTOTHECA SCISSURA** Davis

[Fig. 13]

1917 *Leptotheca scissura* Davis 1917: 222

Habitat: Gall-bladder of *Dasybatis hastatus* and *Pteroplatea maclura* Le Sue; Beaufort (July, August).

Vegetative form: Young form elongated, with long attenuated posterior process; usually slightly constricted just posterior to rounded anterior end, which bears numerous long, filiform pseudopodia. Progressive movement rapid. Ectoplasm distinguishable at the anterior end. Endoplasm usually filled with small, clear, colorless spherules, which become larger and yellowish as the body increases in size. Each spherule contains one to several dark-brown granules, which increase in size and number and finally collect in an irregular clump at the centre of spherule. The larger individuals are usually flattened dorso-ventrally. The posterior end is divided into long slender processes, presenting sometimes a network caused by the fusion of two or more adjacent processes. Full-grown forms: length 125 to 150μ, breadth 20 to 25μ. The longest observed, 195μ by 16μ. Disporous.

Spore: Elliptical in front view; somewhat flattened along the posterior side. Sutural line distinct and at right angles to the longest diameter. Polar capsules have foramina at some distance from the capsular margin. Sporoplasm finely granular, nearly filling both valves. Dimensions: sutural diameter 11μ, breadth 22μ, diameter of polar capsule 4μ.

**LEPTOTHECA LOBOSA** Davis

[Fig. 14]

1917 *Leptotheca lobosa* Davis 1917: 223

Habitat: Urinary bladder of *Paralichthys dentatus* L.; Beaufort (July). Vegetative form: Usually spherical which may form a large rounded pseudopodium composed of ectoplasm. Body colorless and transparent to translucent. Ameboid movements very slow. Ectoplasm contains coarse granules, which are of uniform size and very distinct. Endoplasm
less granular and more transparent than ectoplasm, containing numerous large, yellow, fat globules, which are abundant in large forms. Diameter up to 24µ. Disporous.

Spore: Elliptical in front view; valves slightly tapering but rarely alike. Sutural line forming a sinuous ridge. Polar capsules open at some distance from the anterior margin. Sporoplasm nearly filling both valves. Free spores are often seen to remain united at the sutural line. Dimensions: sutural diameter 9 to 10µ, breadth 16 to 18µ; diameter of polar capsule 3µ.

LEPTOTHECA GLOMEROSA Davis

[Fig. 15]

1917 Leptotheca glomerosa Davis 1917: 223

Habitat: Urinary bladder of Paralichthys albiguttus; Beaufort.

Spore: Approximately cylindrical; valves rounded at ends. The coiled polar filament not visible in the polar capsule. Sutural line at right angles to the longest diameter. Sporoplasm finely granular, fills the extracapsular cavity of spore. Dimensions: sutural diameter 4.5µ, breadth 9µ, diameter of polar capsule 2µ.

Genus CERATOMYXA Thélohan

1892 Ceratomyxa Thélohan 1892: 169, 171, 175
1895 Ceratomyxa Thélohan 1895: 334

The characters of the genus described on page 56.
Type species: Ceratomyxa arcuata Thélohan.

CERATOMYXA ARCUATA Thélohan

[Fig. 18 to 22]

1892 Ceratomyxa arcuata Thélohan 1892a: 1091
1895 Ceratomyxa arcuata Thélohan 1895: 335–336
1899 Ceratomyxa arcuata Labbé 1899: 90
1912 Ceratomyxa arcuata Parisi 1912: 290–291
1913 Ceratomyxa arcuata Jameson 1913: 2
1916 Ceratomyxa arcuata Georgévitch 1916a: 3

Habitat: Gall-bladder of Pagellus centrodontus C. et V., Crenilabrus melops L., Motella tricirrata Bl., Ophidium vasalli, Gobius paganellus L., Helias chromis Gthr.; Scorpæca scofa L., S. porcus L.; Francé (Marseille, Banyuls, Concarneau, Roscoff), Italy (Napoli, summer), Monaco (May).
Vegetative form: Polymorphous; generally club-shape, pseudopodia localized at the broad end; the other end cylindrical or terminating in a sharp point. Some other different forms. Pseudopodia, always localized, lobose pointed at the extremities. Ectoplasm hyaline and thin. Endoplasm contains fat globules and particular elements, mostly large refractive globules, which seem to disappear in the sporulating individuals. Dimensions (maximum): length 35 to 40μ, breadth 12 to 15μ, pseudopodia about 10μ long. Disporous.

Spore: Arch form. Shell valves equal. Sporoplasm occupies the extracapsular cavity of the spore. The length varies rather considerably according to the development of the lateral processes, which are occasionally acuminated or very short. Often extremities are rounded. Dimensions (Thélohan); breadth 20 to 30μ, sutural diameter 5 to 8μ. Parisi's measurements: breadth 25 to 31μ, sutural diameter 5.5 to 6μ, length of polar capsules 3.5 to 4μ, length of polar filaments 25μ.

Remarks: The writer agrees with Parisi in eliminating Labbé's two subspecies (1899:90), as they are too arbitrary.

**CERATOMYXA SPHAERULOSA Thélohan**

<table>
<thead>
<tr>
<th>Year</th>
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<td>Thélohan</td>
<td>1892 : 171</td>
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<td>1895</td>
<td>Ceratomyxa sphaerulosa</td>
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<td>1895 : 334-335</td>
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<td>1909</td>
<td>? Ceratomyxa sphaerulosa</td>
<td>Auerbach</td>
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<td>1912</td>
<td>Ceratomyxa sphaerulosa</td>
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<tr>
<td>1916</td>
<td>Ceratomyxa sphaerulosa</td>
<td>Georgévitich</td>
<td>1916a : 3</td>
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</table>

**Habitat:** Gall-bladder of *Mustelus canis* Mitch. (*M. vulgaris*), *Galeus galeus* L. (*G. canis*), *Clupea harengus*, *Scyllium canicula* Cuv.; St-Valery-en-Caux, Roscoff, Bergen, Monaco (May).

Vegetative form: Form more or less definite among the adults. Generally elongated. Both ends slightly attenuated. Wide in the middle part of the body. Lobose pseudopodia at one of the extremities. Others more massive or more or less regularly spherical, in which case the pseudopodia are formed from the whole surface. Spherical form does not exceed 50 to 60μ in diameter. Other forms 90 to 100μ by 30 to 40μ (largest). Young forms colorless and are more variable than the adults. Protoplasm homogeneous and finely granular. Adult form, on the contrary, yellowish or greenish yellow. The endoplasm is filled with small (5μ in diameter) spheres, in the centre of which 5 to 6 small granules, yellowish brown or greenish in color, are present. Disporous.

Spore: Remarkably large. Polar filament can be seen *in vivo* (easily extruded by KOH, ether, etc.) Sporoplasm occupies one of the shell-valves, while a small mass of very pale looking substance is seen in the other. Dimensions: sutural diameter 10 to 12μ, breadth 90 to 100μ, subspherical polar capsule 6 to 7 by 5μ, sporoplasm 12 to 15 by 8 to 9μ.
STUDIES ON MYXOSPORIDIA—KUDO

CERATOMYXA PALLIDA Thélohan

1895 Ceratomyxa pallida Thélohan 1895: 336-337
1898 Ceratomyxa pallida Doslein 1898: 341
1916 Ceratomyxa pallida Georgévitch 1916b: 2, 3

Habitat: Gall-bladder of Box boops L. and B. salpa L.; Marseille, Villefranche, Rovigno, Monaco (May).
Vegetative form: Ordinarily spherical not exceeding 16 to 20µ in diameter. Many individuals often found in massive groups. Pseudopodia lobose and mostly short. Protoplasm extremely pale with fine granules.
Spore: Dimensions: sutural diameter 5µ, breadth 25 to 30µ.

CERATOMYXA GLOBULIFERA Thélohan

[Fig. 25]

1895 Ceratomyxa globulifera Thélohan 1895: 338

Habitat: Gall-bladder of Merluccius merluccius L. (M. vulgaris); Marseille, Banyuls.
Vegetative form: Polymorphous. Elongated into long branches, including endoplasm. Endoplasm contains small refractive globules.
Spore: Elongated. Shell-valves unequal, one being longer and finer than the other. Dimensions: sutural diameter 10µ, breadth 50µ.

CERATOMYXA APPENDICULATA Thélohan

[Fig. 26]

1892 Ceratomyxa appendiculata Thélohan 1892a: 963-964
1895 Ceratomyxa appendiculata Thélohan 1895: 337
1898 Ceratomyxa appendiculata Doslein 1898: 300, 311

Habitat: Gall-bladder of Lophius piscatorius L., L. budegassa Spin.; Roscoff, Le Croisic, Marseille, Banyuls, Napoli, Rovigno.
Vegetative form: Extremely polymorphous. Young form spherical, spatulaform, club-shape, etc. In adult form, the main thick part of the body, in which spore formation takes place, forms 1 to 6 long prolongations, twice or three times longer than the main part of the body. Pseudopodia lobose, filiform or elongated with enlargements. Disporous.
Spore: Lateral prolongations of shell-valves well developed. Dimensions: sutural diameter 5 to 7µ, breadth 50µ.

CERATOMYXA TRUNCATA Thélohan

[Fig. 27]

1895 Ceratomyxa truncata Thélohan 1895: 336
1912 Ceratomyxa truncata Parisi 1912: 289-290

Habitat: Gall-bladder of Clupea pilchardus Walb. (Alosa sarda); Marseille, Villefranche, Napoli (August, September).
Vegetative form: Polymorphous. Ordinarily more or less rounded, with lobose pseudopodia. Pseudopodia long and often shows very active movements. Endoplasm very finely granular, contains small fat globules which are found in irregular mass or in a circular form. Disporous.

Spore: Valves are short and truncate. Sporoplasm occupies the whole cavity. Spores with three valves are frequently encountered. Dimensions: breadth 25μ, 5μ in sutural diameter. According to Parisi, spores with two shell-valves are rather few (10%), while those with three (70%) and four shell-valves (20%) prevail in number! Dimensions: breadth 20 to 30μ, length of the polar filament 45μ.

**CERATOMYXA RETICULARIS** Thélohan
[Fig. 28]

1895 *Ceratomyxa reticularis* Thélohan 1895 : 337-338

Habitat: Gall-bladder of *Trachinus draco* L.; Banyuls.

Vegetative form: Extremely polymorphous. Generally spherical or club-shaped. Well developed trophozoites have the similar form as in *C. appendiculata*. Endoplasm highly reticular, with refringent fluid.

Spore: Shell valves are short and truncate, one of which is curved to the rear. Dimensions: sutural diameter 12 to 15μ, breadth 45 to 50μ.

**CERATOMYXA INAEQUALIS** Doflein
[Fig. 29]

1898 *Ceratomyxa inaequalis* Doflein 1898 : 284-285

Habitat: Gall-bladder of *Crenilabrus mediterraneus* and *C. pavo*; Napoli.

Vegetative form: Form usually club-shaped. Protoplasm in active motion, is differentiated distinctly into ectoplasm and endoplasm. Body yellowish brown by the presence of granules in endoplasm. Inactive formation of pseudopodia. Ameboid movements or progressive movements by means of the posterior process. Size: 20 to 40μ by 5 to 10μ in average. Length of the posterior process up to 30μ. After spore formation, only two nuclei remain in protoplasm, which apparently degenerate later. Disporous.

Spore: Elliptical, somewhat flattened. Massive. Very transparent. Both ends round, but unequally built, i.e., one end is club-shaped. Polar capsules are somewhat round and are bound to the shell by protoplasmic bridges. The polar filament is not seen in fresh spores. Dimensions: sutural diameter 6μ, breadth 31μ, diameter of the polar capsule 2.5 to 3μ, length of polar filament is half breadth of the spore (diluted nitric acid).
CERATOMYXA LINO SPORA Doflein
[Fig. 30 to 31]
1898 Ceralomyxa linospora Doflein 1898: 285

Habitat: Gall-bladder of Labrus turdus; Napoli.
Vegetative form: Club- or spindleshape. Protoplasm highly granulated. Body whitish grey, though very transparent. Pseudopodia very fine and only formed at the anterior end of the body. Size: 30 to 35μ by 16 to 18μ. Disporous.
Spore: Form symmetrical with long thread-like lateral processes. In sporoblast, the processes are wound around the spore. It is twice as long as the breadth of the spore. Polar capsules large and spherical pyriform. Dimensions: total breadth 50μ, breadth of the main part of the spore 10 to 12μ, sutural diameter 5μ, length of lateral process 20μ. “Polar filament was too fine to be measured.”

CERATOMYXA RAMOSA Awerinzew
[Fig. 32 and 33]
1907 Ceralomyxa ramosa Awerinzew 1907: 831-834
1908 Ceralomyxa ramosa Awerinzew 1908: 60-66

Habitat: Gall-bladder of Hippoglossus vulgaris Flemm.; Kjellebjord, Murman coast.
Vegetative form: Form irregular ameboid, owing to the presence of peculiar pseudopodia. The middle part of the body is enlarged into an ellipsoidal form, where nuclei and sporoblasts are present. From this part two, rarely one or three processes are formed, which branch out several pseudopodia of different length. The finer portions of pseudopodia anastomose each other and form a characteristic and remarkable network. Differentiation of protoplasm is not very distinct. Ectoplasm is not well developed, tho covering the entire surface of the body as a thin layer. Endoplasm slightly vacuolated and granular, forms the greater part of the body. Disporous and polysporous.
Spore: Form and size (?) resemble C. arcuata. Slightly curved toward the posterior side. Valves usually unequally built, one being longer than the other. Sporoplasm almost always asymmetrically situated in the shell. Polar capsules on each side of the sutural plane and of the plane perpendicular to the sutural plane, cutting the spore into two equal parts. Young spores in development ellipsoidal to kidney bean shape. Dimensions: sutural diameter 12 to 20μ, breadth 50 to 80μ.

*Professor J. Zeitlin has kindly translated some part of the paper, for which the writer expresses his thanks.
CERATOMYXA DREPanOPSETTAE Awerinizew
[Figs. 34 to 39]

1907 Ceratomyxa sp. Awerinizew 1907: 832-833
1908 Ceratomyxa drepanopsettae Awerinizew 1908: 1-41, 45-47
1909 Ceratomyxa drepanopsettae Awerinizew 1909: 74-112
1912 Ceratomyxa drepanopsettae Auerbach 1912: 44-45
1918 Ceratomyxa drepanopsettae Kudo 1918: 14-15

Habitat: Gall-bladder of Pleuronectes platessa, P. flesus, Drepanopsetta platessoides, Hippoglossus vulgaris, Hippoglossoides limandoides and Paralichthys dentatus; Murmankuste, Kabelvaag, Rorvik, Tjomo, Woods Hole (August, September).

Vegetative form: Polymorphous. Usually very much elongated and slender forms. Protoplasm differentiated. Endoplasm coarsely granular. Pseudopodia lobose and filiform (2 to 3μ), with which the trophozoites attach themselves to the epithelium of the bladder. Disporous.

Spore: Curved toward the posterior side. Shell with rounded ends. Valves almost always unequally built. Dimensions: breadth 50 to 80μ. Auerbach’s form: Form variable. Size: sutural diameter about 12 to 14μ, breadth about 56μ, diameter of polar capsule about 4 to 6μ, length of the cavity in which the sporoplasm is located about 34μ. Kudo’s form: Variable. Sutural diameter 8 to 10μ, average breadth 64μ, diameter of polar capsule 6μ.

CERATOMYXA TYLOSURI Awerinizew
[Figs. 40 and 41]

1913 Ceratomyxa tylosuri Awerinizew 1913a: 153

Habitat: Gall-bladder of Tylosurus schismatorkynchus; Lorenço Marques, Delagoa Bay (Africa).

Vegetative form: Large, irregular, disc-like or large ameboïd, with blunt lobose pseudopodia and highly granular protoplasm.

Spore: Large. The anterior edge arch-shape, while the posterior edge has two small horns which are located symmetrically to the sutural line. Polar capsules elongated and are separated from binuclear sporoplasm by a special membrane. Rarely spore with three polar capsules. Dimensions breadth 124 to 140μ, sutural diameter 40 to 45μ, thickness 25 to 30μ.

CERATOMYXA (?) SPARI Awerinizew
[Figs. 42 and 43]

1913 Ceratomyxa (?) spari Awerinizew 1913a: 153-154

Habitat: Gall-bladder of Sparus berda; Lorenço Marques, Delagoa Bay (Africa).
Vegetative form: Large (100 to 120μ), disc-form ameboid, containing a large number of enclosures and granules of different size. In one case, a number of this form, carrying no spore, underwent budding, which resulted in forming spherical forms of various size, some of which divided again into 2 to 6 parts (Plasmotomy?). Monosporous and disporous.

Spore: More or less curved. Two polar capsules lie closely together on each side of the sutural plane. Ends of shell-valves are rounded.

Dimensions: breadth 50 to 60μ, sutural diameter 12 to 15μ, thickness 12 to 15μ, polar filament very long (length not given).

Remarks: Awerinzew thinks this is the intermediate form between Leptotheca and Ceratomyxa.

CERATOMYXA sp. (?) Awerinzew

1913 Ceratomyxa sp. (?) Awerinzew 1913a : 154

Habitat: Gall-bladder of Scatophagus argus; Delagoa Bay (Africa).

Vegetative form: Small, disc-form ameboid (25 to 35μ), containing two spores of indistinct contour, on account of incomplete formation of the shell. Two spores, apparently, developed in one pansporoblast. Disporous.

Spore: Form could not exactly be made out. Polar capsules were arranged like those of other Ceratomyxa.

CERATOMYXA sp. (?) Awerinzew

1913 Ceratomyxa sp. (?) Awerinzew 1913a : 154-155

Habitat: Gall-bladder of Rhinobathus Awer. (?); Lorenço Marques (Africa).

Vegetative form: Irregular shape. Endoplasm highly granular. In the epithelial layer of the gall-bladder numerous, spherical cysts (30 to 35μ) were found. Two spores are formed in one pansporoblast. Disporous.

Spore: Cylindrical with broad and slightly rounded ends. Dimensions: sutural diameter 16 to 19μ, breadth 70 to 80μ, thickness 16 to 19μ.

CERATOMYXA ACADIENSIS Mavor

[Figs. 44 to 47]

1915 Ceratomyxa acadiensis Mavor 1915 : 27-30
1916 Ceratomyxa acadiensis Mavor 1916 : 551-574

Habitat: Gall-bladder of Urophycis chuss (trophozoites are attached to undetermined Myxosporidia, see p. 176), Zoarces angularis, Pseudopleuronectes americanus; New Brunswick (Canada) (July to September).

Vegetative form: Polymorphous. Typically club-shaped with very long tail, or irregularly stellate. Pseudopodia show rigidity. Sometimes
clumps of protoplasm along their length, which are connected by thin hyaline filaments of ectoplasm. Differentiation of protoplasm is usually observable at the anterior region. Dimensions: length, excluding tail, 12 to 15μ, breadth 10 to 20μ, tail up to 60μ. Disporous.

Spore: Wide, short and slightly compressed dorso-ventrally, with very long fine lateral filaments. Polar capsules spherical. Polar filament invisible in vivo. Dimensions: breadth 40 to 50μ, sutural diameter 7 to 8μ, diameter of polar capsule 3 to 4μ, length of polar filament 70μ, length of lateral filaments 250 to 300μ.

CERATOMYXA sp. Georgévitch
1916 Ceratomyxa sp. Georgévitch 1916a : 3

Habitat: Gall-bladder of Muraena sp.; Monaco (May).
Vegetative form: No description.
Spore: No description. No figure.

CERATOMYXA CORIS Georgévitch
[Fig. 48]
1916 Ceratomyxa coris Georgévitch 1916a : 4-5
1917 Ceratomyxa coris Georgévitch 1917a : 1-20

Habitat: Gall-bladder of Coris julius, C. giofredi; Villefranche (March, June).
Vegetative form: Various forms, club-shape, spherical or elongated, with lobose or filiform pseudopodia. Disporous and rarely Polysporous.
Spore: More or less ellipsoidal. Lateral prolongations of the shell-valves short and truncate. Sutural line straight. Sporoplasm, elongate, rounded, elliptical, fills a part of the extracapsular cavity of the spore. Polar capsules rounded, almost spherical, not converging. Dimensions not given.

Remarks: Georgévitch observed (1917: Fig. 30) that spores of Glugea marionis occurred in disporous trophozoite of Ceratomyxa coris, which he thought to have happened accidentally by plasmogamy of these two Cnidosporidia. The above mentioned figure, however, strongly suggests that G. marionis may be leading parasitic life in the trophozoite of C. coris.

CERATOMYXA HEROUARDI Georgévitch
[Fig. 49]
1913 Leptotheca (?) sp. Jameson 1913 : 2
1916 Ceratomyxa herouardi Georgévitch 1916a : 5-8
1916 Ceratomyxa herouardi Georgévitch 1916b : 717-19, 983-985
1917 Ceratomyxa herouardi Georgévitch 1917 : 375-399

Habitat: Gall-bladder of Box Salpa L.; Monaco (May).
Vegetative form: Polymorphous. Elongated with same breadth or tapering to one end; club-shaped with roundish enlargements. Young trophozoites spherical or pyriform. Pseudopodia long and narrow or broad and bi- or multi-lobate. Body colorless both in the young and the adult. Protoplasm homogeneous and finely granular. Disporous and polysporous. Spores are found inside of the endoplasm and in the roundish buds, ordinarily two spores being formed in each bud. Number of buds on one trophozoite varies. Plasmodiation by budding and division.

Spore: Elongated elliptic. Polar capsules spherical and large. Sutural plane cuts the spore into exactly equal two parts. Two nuclei in sporoplasm are rather small and are always in one of the shell-valves. Dimensions not given.

Remark: The form, mentioned by Jameson in the same seat, host and locality, that "has something of the appearance of a Leptotheca" and that is also "almost certainly neither of the two Myxosporidia—Ceratomyxa pallida and Henneguya neapolitana . . . ;" is probably identical with the present form.

CERATOMYXA MESOSPORA Davis

[Fig. 50]

1917 Ceratomyxa mesospora Davis

Habitat: Gall-bladder of Cestracion zygaena, C. tiburo; Beaufort (July).


Spore: Greatly elongate, each valve forming a slightly tapering cone, rounded at the apex. Valves not compressed. Sutural plane forming an acute angle with the longest diameter. Polar capsules conspicuous. Coiled polar filaments very distinct. Polar capsules are remarkable in that they are asymmetrically situated, one being always located in the widest part of the spore, while the other being a little to one side. Sporoplasm asymmetrically situated, sometimes being entirely confined to the larger valve. Dimensions: breadth 50 to 65 μ, sutural diameter about 8 μ, diameter of polar capsule 4.5 μ, length of polar filament 90 μ.

Remarks: Similar to C. sphaerulosa Thél. and occurs with C. recurvata Davis in the same organ.

CERATOMYXA SPHAIROPHORA Davis

[Fig. 51]

1917 Ceratomyxa sphairophora Davis

Habitat: Gall-bladder of Scoliodon terrae-novae; Beaufort.
Vegetative form: Pyriform, elongate. Numerous fine filiform pseudopodia at anterior end. Progressive movements rapid. Body colorless and transparent. Ectoplasm clear and homogeneous. Structure of endoplasm highly variable, in majority of trophozoites filled with transparent homogeneous spherules. Small fat globules at the anterior end. In some sporulating individuals, the endoplasm shows vacuolated structure without any spherules, usually, however, sporulating trophozoites exhibit well-defined spherules. The spherules or vacuoles, as the case may be, are separated by a thin layer of distinctly granular endoplasm containing numerous rod-shaped or rounded, colorless bodies, which in their appearance are strikingly like small bacteria tho they are not bacteria, as they fail to take Giemsa stain. Size of sporulating trophozoites 100 to 110μ by 25μ. Disporous.

Spore: Shell-valves greatly elongated, tapering gradually toward the ends. Long, attenuated ends of valves hollow and so fragile that it is almost impossible to find an example in which they are not more or less distorted. Sutural plane perpendicular or only slightly oblique to the longest diameter. Polar capsules are spherical and large; slightly convergent, opening some distance apart on the anterior side. Coiled polar filament distinct. Sporoplasm confined to large, central part of spores, but extending farther into one valve than the other. Dimensions: total breadth 115 to 140μ, sutural diameter about 12μ, diameter of polar capsules 6μ, length of polar filament 75μ.

CERATOMYXA TAENIA Davis
[Figgs. 52 and 53]

1917 Ceratomyxa taenia Davis 1917: 224-225

Habitat: Gall-bladder of Scoliodon terra-novae; Beaufort.

Vegetative form: Similar to those of C. sphairophora Davis, and no character has been found by which they may be distinguished. Sporulating trophozoites can be easily distinguished on account of the very different appearance of the spore and their different arrangement within the trophozoites. The spores of this species are situated, as is usually the case in Ceratomyxa, with the greater part of the spore parallel to the long axis of the trophozoite, only a part of one valve being bent back along the rest of the spore. Size: sporulating trophozoites length 80μ, breadth 25μ. Disporous.

Spore: Valves greatly elongated. Shell very thin, the membrane on opposite sides of each valve being in contact for about two-thirds of its length, forming a thin ribbonlike structure; basal third of each valve only slightly compressed; terminal ribbonlike portion of each valve usually twisted so that plane of ribbon is at right angles to the main part of the spore. Polar capsules small, pyriform to spherical and convergent. Coiled polar filament indistinct. Sutural plane perpendicular to the longest
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diameter. Sporoplasm finely granular, filling the basal third of each valve, sometimes extending farther into one valve than the other. Dimensions: breadth 140 to 150μ, breadth of central portion 45μ, sutural diameter 6μ, diameter of the polar capsules 3μ.

CERATOMYXA ATTENUATA Davis
[Fig. 54]

1917 Ceratomyxa attenuata Davis 1917 : 225

Habitat: Gall-bladder of Scoliodon terrae-novae; Beaufort (July).

Vegetative form: Elongate, pyriform, with long, tapering posterior process; at anterior end numerous long filiform pseudopodia. Progressive movements rapid. Ectoplasm distinct only at anterior end. Endoplasm filled with small, refractive, yellowish or brownish granules, which are uniformly distributed throughout the trophozoite. Between the brownish granules, the endoplasm is clear and colorless, except at extreme anterior end where it contains a clump of small fat globules. Size of full-grown trophozoites 100 to 120 by 27μ. Disporous.

Spore: Valves greatly elongated; a symmetrical, one valve being about 15μ shorter than the other and ending abruptly; the longer valve tapering gradually to a point. About midway of each valve, is a thin septum; external to the septum the valves are empty. Polar capsules are large, opening on the anterior margin. Coiled polar filaments distinct. Sutural plane oblique to longitudinal axis, usually forming a ridge. Sporoplasm asymmetrically situated in central part of the spore. Dimensions: breadth 115μ, sutural diameter 9μ, diameter of polar capsules 4.5μ, length of polar filament 60μ.

CERATOMYXA RECURVATA Davis
[Fig. 55 and 56]

1917 Ceratomyxa recurvata Davis 1917 : 225–226

Habitat: Gall-bladder of Cestacion zygaena; Beaufort (July).

Vegetative form: Pyriform with long, slender posterior process. Body colorless. Actively motile, forming filiform pseudopodia of ectoplasm at anterior end. Endoplasm colorless and granular, filled with large, homogeneous spherules. Full-grown trophozoites 130 to 175μ, length of the main body about 100μ. Spores are developed singly from distinct sporoplasts and not necessarily in pairs. Disporous and polysporous (up to 10 spores, 6 and 8 are common numbers).

Spore: Valves greatly curved toward the posterior side, usually symmetrical, but occasionally one may be much more incurved than the other. Valves circular in cross section at the base but toward the ends greatly
flattened. Ends of valves sharply pointed. Polar capsules large, opening at some distance from the anterior margin. Coiled polar filaments distinct. Sporoplasm finely granular usually extending farther into one valve than the other. Dimensions: breadth between points of greatest curvature about 16μ, sutural diameter 8 to 9μ, diameter of polar capsules 4.5μ.

CERATOMYXA LUNATA Davis
[Figs. 57 to 60]
1917 Ceratomyxa lunata Davis 1917 : 226-227

Habitat: Gall-bladder of Galeocerda tigrinus; Beaufort (August).
Vegetative form: Pyriform, rounded after being on the slide for some time. Progressive movements slow. Endoplasm filled with large, homogeneous spherules, which are usually colorless, sometimes light yellow. At extreme anterior end, the endoplasm contains numerous small fat globules. Disporous.

Spore: Considerably variable in size and form. The larger and more typical are more or less crescent-shaped; symmetrical; valves curved toward rear, terminating in more or less rounded ends. Polar capsules large and open on opposite sides of spore. Coiled polar filament distinct. Sporoplasm finely granular, symmetrically situated in spore. Smaller spores differ from large ones chiefly in size; valves are much shortened and have a greater curvature, with more distinctly rounded ends. Dimensions: breadth 30μ (longest 38μ), sutural diameter 9μ, diameter of polar capsules 4μ, length of polar filament 37μ. Small forms: breadth 15μ, sutural diameter 7μ, diameter of polar capsules 3μ.

CERATOMYXA ABBREVIATA Davis
[Fig. 61]
1917 Ceratomyxa abbreviata Davis 1917 : 227

Habitat: Gall-bladder of Scloiodon terrae-novae; Beaufort (August).
Vegetative form: Elongate, pyriform, with usually a very long, slender posterior process. Body colorless. Progressive movements rapid. Distinct differentiation of protoplasm, posterior process usually composed of ectoplasm (rarely endoplasm may extend into it for a short distance). Pseudopodia, short, tapering or filiform at anterior end. Dimensions: length up to 90μ, breadth 10 to 12μ, diameter of rounded sporulating trophozoites about 27μ. Disporous.

Spore: Roughly crescent-shaped; sutural diameter exceptionally great in comparison with the breadth. Ends of valves rounded, slightly asymmetrical. Shell exceptionally tough and resistant to reagents. Polar capsules large, prominent and open on opposite sides of spore. Sporoplasm finely granular, confined entirely to one valve. Dimensions: breadth 17μ, sutural diameter 14μ, diameter of polar capsules 4.5μ.
Habitat: Gall-bladder of Carcharhinus sp.; Beaufort (July).

Vegetative form: Pyriform, short, tapering toward the posterior end, sometimes dividing into a number of long, slender, transparent processes. Extremely long filiform pseudopodia, developed at anterior end, can be seen to sweep slowly back like a whiplash until they come to lie by the side of the body. Progressive movements slow. Ectoplasm clear, transparent, forming a distinct layer at anterior end. Endoplasm in large trophozoites filled with large numbers of rod-shaped, bacteria-like bodies, which are more abundant in the anterior half than in the posterior. Endoplasm in younger trophozoites, with much less or without any bacteria-like bodies, shows a vacuolated structure. Size up to 115 to 120μ in length and 40 to 45μ in breadth. Disporous.

Spore: Valves greatly elongated, conical, with rounded ends. Sutural ridge well marked. Polar capsules large, opening on opposite sides of spore. Coiled polar filament very distinct. Sporoplasm granular, symmetrically situated, but extending only a short distance into each valve. Dimensions: breadth 118μ, sutural diameter 12μ, diameter of polar capsules 6μ.

CERATOMYXA AGGLOMERATA Davis

[Fig. 63]

1917 Ceratomyxa agglomerata Davis 1917:228

Habitat: Gall-bladder of Synodus foetans; Beaufort.

Vegetative form: Pyriform, usually with long, slender, posterior process. Body colorless and transparent. Actively motile, moving by means of characteristic wavelike movements of the ectoplasm, from which are projected numerous short, conical to filiform pseudopodia. Pseudopodia travel back along sides of body for about one-third its length and then disappear, new ones being continually formed at the anterior end. Ectoplasm distinguishable at anterior end. Endoplasm clear, very transparent, usually homogeneous, sometimes finely granular. Large numbers of fat globules usually present. Size of sporulating trophozoites 38μ by 12μ. Disporous.

Spore: Asymmetrical, one valve being smaller and more attenuated than the other; larger valve compressed. Polar capsules spherical. Coiled polar filaments indistinct. Sporoplasm filling nearly entire smaller valve, but only extending a short distance into the larger one. Dimensions: breadth 24 to 28μ, sutural diameter 5μ, diameter of polar capsules 3μ.
CERATOMYXA AMORPHA Davis

[Fig. 64]

1917 Ceratomyxa amorpha Davis 1917 : 228

Habitat: Gall-bladder of Synodus foetans; Beaufort.
Vegetative form: Rounded or irregular in shape, with short lobose pseudopodia; not pyriform; slowly ameboid. Body colorless. Ectoplasm well developed, forming a distinct layer; transparent, finely granular. Endoplasm granular, with large numbers of small fat globules scattered through it or aggregated into one or two large clumps (difference between the present form and C. agglomerata). Disporous.

Spore: Asymmetrical; crescent-shaped; valves short, conical, somewhat compressed. One valve distinctly smaller and more conical than the other. Sutural ridge perpendicular to longitudinal axis. Polar capsules large, opening at some distance from the anterior side. Coiled polar filaments distinct. Sporoplasm granular, asymmetrically situated, being chiefly confined to smaller valve. Dimensions: breadth $27\mu$, sutural diameter $11\mu$, diameter of polar capsules $4\mu$.

CERATOMYXA MONOSPORA Davis

[Figs. 65 to 67]

1917 Ceratomyxa monospora Davis 1917 : 228–229

Habitat: Gall-bladder of Peprilus alepidotus; Beaufort. Abundantly present in June, much less in July, being entirely absent in the bladder at the end of the month.
Vegetative form: Pyriform, with a slender posterior process and one to several filiform pseudopodia at anterior end. Body colorless and transparent. Movements very slow. No clear differentiation between ectoplasm and endoplasm, the entire body being composed of a clear, finely granular protoplasm. Fat globules more abundant in larger individual, which are aggregated into small clumps. Size of vegetative trophozoites up to $24\mu$ in length and $15\mu$ in width. Monosporous form much smaller than disporous. Monosporous and disporous. Nearly entire substance of trophozoite is used up in spore formation.

Spore: Crescent-shaped. Valves cylindrical, tapering toward the end, which is rounded and compressed. Curvature of valves varies. One valve is more attenuated than the other. Sutural ridge perpendicular to the longest diameter. Polar capsules large. Sporoplasm usually asymmetrically situated. Dimensions: breadth 18 to $25\mu$, sutural diameter 5 to $6\mu$, diameter of polar capsules $3\mu$.

Remarks: This species is evidently very close to C. pallida Thél. Similar form was found in Prionotus evolans (gall-bladder), which showed somewhat larger trophozoites and spores than C. monospora.
CERATOMYXA STREPTOSPORA Davis
[Figs. 68 and 69]
1917 Ceratomyxa streptospora Davis  1917 : 229

Habitat: Gall-bladder of Chaetodipterus faber; Beaufort (June, but not in July).

Vegetative form: Pyriform, colorless and transparent. A few conical, filiform, wavelike pseudopodia at anterior end. Ectoplasm recognizable at anterior end. Endoplasm finely granular, with a few, small, fat globules, filled with transparent, homogeneous spherules. Size: 48 by 12μ to 60 by 9μ. Disporous.


CERATOMYXA AGGREGATA Davis
[Fig. 70]
1917 Ceratomyxa aggregata Davis  1917 : 229

Habitat: Gall-bladder of Leostomus xanthurus, Micropogon undulatus; Beaufort (July).

Vegetative form: Form rounded to somewhat irregular in shape, rarely pyriform; slowly ameboid. Body colorless and transparent. No clear differentiation of protoplasm. Endoplasm finely granular, containing numbers of small fat globules. Sporulating trophozoites show a tendency to collect in groups composed of a large number of individuals so closely associated that it is often impossible to make out the individual outlines. Size of full-grown form 18μ by 14μ. Disporous.

Spore: Crescent-shaped; valves much elongated, tapering toward the ends, which are compressed. Polar capsules spherical and opaque. Sporoplasm granular, situated symmetrically in the spore cavity. Dimensions: breadth about 50μ, sutural diameter 6 to 7μ, diameter of polar capsule 3.5μ.

CERATOMYXA UNDULATA Davis
[Fig. 71]
1917 Ceratomyxa undulata Davis  1917 : 230

Habitat: Gall-bladder of Ancylopsetta quadrocellata Gill.; Beaufort (June to August).

Vegetative form: Pyriform, sometimes fusiform, tapering toward posterior end. Movements rapid. Body colorless. Ectoplasm observable at anterior part, constantly undergoes rapid, wavelike undulating movements and extrudes fine conical or filiform pseudopodia. Pseudopodia
are formed very rapidly and vary in length. After reaching a considerable
length the pseudopodia usually travel posteriorly along sides of body
and then disappear. Endoplasm very transparent, often vacuolated,
containing numerous small fat globules. Size of full-grown trophozoite:
25μ by 10 to 12μ in average. Disporous.

Spore: Crescent-shaped. Valves cylindrical, not compressed, ends
rounded, one valve being somewhat longer and more conical than the other.
Polar capsules convergent. Coiled polar filaments distinct. Sporoplasm
granular, asymmetrically situated, sometimes being almost confined to
more conical valve. Dimensions: breadth 22 to 24μ, sutural diameter 6μ,
diameter of polar capsules 3μ.

CERATOMYXA NAVICULARIA Davis

Habitat: Urinary bladder of Paralichthys dentatus, P. albicuttus,
Sphaeroides maculatus; Beaufort (June to August).

Vegetative form: Rounded or slightly irregular in shape, never pyri-
Entire trophozoite finely granular, containing a few small fat globules.
Nearly entire body is used up in the formation of spores. Diameter about
17μ. Disporous.

Spore: Variable in shape and size. Symmetrical or asymmetrical,
often boat-shaped, slightly compressed dorso-ventrally, with rounded
ends. Polar capsules convergent, shows polar filament indistinctly.
Sporoplasm finely granular, extending into both valves, but usually
somewhat farther into one than the other. Dimensions: breadth 14 to 22μ
(average 16μ), sutural diameter 5 to 7.5μ (average 6μ), diameter of polar
capsules 2μ.

CERATOMYXA SPINOSA Davis

Habitat: Urinary bladder of Paralichthys albicuttus; Beaufort.

Vegetative form: Rounded or slightly irregular in shape, with short,
lobose pseudopodia; slowly ameboid. Body colorless and transparent.
Distinct differentiation of protoplasm along the entire surface, ectoplasm
forming outer layer. Endoplasm faintly granular, with numerous small
fat globules. Monosporous and disporous.

Spore: Central portion greatly enlarged; ovoid, with very long tapering
process extending out from each end. Sutural line perpendicular to the
longest diameter. Polar capsules large and spherical. Sporoplasm finely
granular, chiefly located in one valve, extending into the other only a short
distance beyond the capsule. Dimensions: breadth 80μ, breadth of
enlarged central portion 13μ, sutural diameter 7μ, diameter of polar cap-
sules 4μ.

Genus **MYXOPROTEUS** Doflein emend. Davis

1898  *Myxoproteus* Doflein  1898 : 287
1917  *Myxoproteus* Davis  1917 : 219

The characters of the genus are described on page 56.
Type species: *Myxoproteus ambiguus* (Thélohan) Doflein.

**MYXOPROTEUS AMBIGUUS** (Thélohan) Doflein

[Figs. 75 to 80]

1895  *Myxosoma ambiguum* Thélohan  1895 : 344
1898  *Myxoproteus ambiguus* Doflein  1898 : 287-288

Habitat: Urinary bladder of *Lophius piscatorius*; Le Croisic, Rovigno,
Napoli.
Vegetative form: Polymorphous. Color milky white. Protoplasm is
filled with numerous granules and fat globules. Pseudopodia, short,
pointed lobose. Plasmogamy and plasmotomy take place. Many small
individuals formed apparently by plasmotomy, often, make up groups.
Disporous, polysporous?
Spore: Almost pyramidal, with anterior processes. Two very large
polar capsules at the anterior end. The distance between these capsules
is equal to or greater than the diameter of the capsules. Sporoplasm with
two nuclei. Dimensions: length 25μ, breadth 18 to 20μ, diameter of polar
capsules 7μ.

**MYXOPROTEUS CORDIFORMIS** Davis

[Figs. 81 to 83]

1917  *Myxoproteus cordiformis* Davis  1917 : 231

Habitat: Urinary bladder of *Chaetodipterus faber*; Beaufort (June,
July).
Vegetative form: Rounded; very slowly ameboid, usually forming a
single, short, lobose pseudopodium. Body colorless and transparent.
Ectoplasm not distinct. Entire trophozoite finely granular, with a few
fat globules. Rarely vacuolar. Small trophozoites often show a single
large, central vacuole. Rounded sporulating trophozoites 18μ in diameter.
Disporous.
Spore: Heart-shaped in front view, with peculiar wing-like expansions on each side which contain remains of parietal cells. Sutural plane oblique in position. Capsulogenous cells distinct. Sporoplasm finely granular, fills the extracapsular cavity of the spore. Dimensions: length 12\(\mu\), breadth 10 to 11\(\mu\), thickness 6\(\mu\), polar capsules 3 to 4\(\mu\) in diameter.

**MYXOPROTEUS CORNUTUS** Davis

[Fig. 84]

1917 *Myxoproteus cornutus* Davis 1917: 231

Habitat: Urinary bladder of *Bairdiella chrysura*; Beaufort.

Vegetative form: Somewhat elongated or irregular in shape, with short lobose pseudopodia; slowly ameboid. Differentiation of protoplasm clear. Ectoplasm well developed, hyaline; in rounded individuals forming a distinct layer around the body. Endoplasm opaque, contains coarse refringent granules varying in shape, and a few fat globules. In contracted rounded resting condition, endoplasm becomes condensed, while ectoplasm appears more abundant. Rounded trophozoites up to 27\(\mu\) in diameter. Disporous.

Spore: Heart-shaped, with two anterior processes. Shell very thick. Polar capsules large, opening some distance apart. Coiled polar filament distinct. Sporoplasm finely granular, with a few small fat globules, fills the extracapsular cavity of the spore. Dimensions: sutural diameter exclusive of the processes 9\(\mu\), breadth 12\(\mu\), length of processes 5\(\mu\), diameter of polar capsules 3\(\mu\).

Genus **WARDIA** nov. gen.

The characters of the genus are described on page 56.

Type species: *Wardia ovinocua* nov. spec.

**WARDIA OVINOCUA** nov. spec.

[Figs. 85 to 95]

Habitat: Ovum and connective tissue of ovary of *Lepomis humilis* Girard;* Salt Fork, Ill. (November). Only one fish, 6.5 cm. long with normal appearance, was found to be infected.

Vegetative form: Trophozoites form cysts visible to the naked eyes as white spherical spots in the pink-colored ovary. Four cysts present. The cyst (Figs. 85 and 86), in section, shows a circular form surrounded by several layers of hypertrophied nurse cells and connective tissue, in which many large blood vessels are present. Protoplasm is not clearly differ-

*Professor F. Smith of the Department kindly identified all the fish that were collected in the vicinity of Urbana and mentioned in this paper as hosts, for which the writer wishes to express his appreciation.
ented into ectoplasm and endoplasm, the whole protoplasm showing granulated reticular structure. Cysts contained numerous fully developed spores and a small number of spores in developmental stages, which suggested the fact that two spores rise from each pansporoblast. The parasite is also found in the state of diffuse infiltration in the connective tissue around the cyst. Diameter of cysts 316 to 445\(\mu\) in sections. Polysporous.

Spore: In front view, isosceles triangular form, two sides of which usually convex, with more or less attenuated anterior end (Figs. 87, 90, 92); in profile, ellipsoidal (Fig. 88); and oval viewed from the anterior end (Fig. 89). Sutural plane at right angles to the longest diameter (Figs. 87 and 89). Shell comparatively thin except at the anterior end and has many fine network-like ridges on the surface. These ridges are hardly observable on fresh spores on account of their fine form and the conspicuously large polar capsules lying in the spore. When stained, however, they are not only made distinctly visible, but the prolongation of each ridge from the posterior edge which forms about 1\(\mu\) long fringe-like structure is also more clearly recognized (Figs. 90–95). Two large and spherical polar capsules located in the central portion of the spore. Coiled (5 to 6 times) polar filament extremely distinct. The openings of polar capsules at the anterior end. Sporoplasm comparatively small, finely granular, without any vacuole, contains two small nuclei, when stained. Dimensions in vivo: sutural diameter 9 to 10\(\mu\), breadth 10 to 12\(\mu\), thickness 6\(\mu\), diameter of the polar capsule 4\(\mu\), length of polar filament 35 to 45\(\mu\).

WARDIA OHLMACHERI (Gurley) Kudo

[Figs. 96 and 97]

1893 Myxosporidium Ohlmacher 1893: 561–567
1893 Chloromyxum ohlmacheri Whinery 1893: 660–662
1894 Chloromyxum (Sphaerospora) ohlmacheri Gurley 1894: 267–272
1895 ? Leptotheca ranae Thélohan 1895: 383
1899 Leptotheca ohlmacheri Labbé 1899: 87

Habitat: Urinary tubules of kidney of *Bufo lentiginosus* Shaw and kidney of *Rana esculenta* and *R. temporaria* (R. fusca); Sycamore, De Kalb county, Ill.

Vegetative form: Not found.

Spore: Transversely elliptic. Sutural plane perpendicular to the longer axis of the spore. A well defined undulate-parallel longitudinal striation on the shell. Sutural ridge comparatively well marked. Two polar capsules lying side by side, occasionally only one. Dimensions: sutural diameter 6\(\mu\), breadth 8\(\mu\), diameter of polar capsule 3 to 3.5\(\mu\), length of polar filament 6 to 8 times the breadth of spore (48 to 64\(\mu\)).

Remarks: This form is apparently very much different from any species of genus Leptotheca, in the general form, form of polar capsules,
striations on the shell and the habitat. Tho the form of the spore is differ-
ent from the type species of the genus Wardia and nothing is known about
the vegetative form, the presence of large spherical polar capsules in the
central portion of the spore, the striations on the shell and the occurrence
of the same nature, i.e., from fresh waters in the close-by localities, show
its nearer relationship to the genus Wardia than to the genus Leptotheca.
Hence it is placed here provisionally.

Genus MITRASPORA Fujita emend. Kudo

1912 Mitraspora Fujita 1912 : 259-260

The characters of the genus are described on page 56.
Type species: Mitraspora cyprini Fujita.

MITRASPORA CYPRINI Fujita

[Fig. 98 to 104]

1912 Mitraspora cyprini Fujita 1912 : 259-260

Habitat: Renal tubules of kidney and ureters of Cyprinus carpio L.
and Carassius auratus L.; Sapporo (winter), Tokio (March).
Vegetative form: Fujita's only description is as follows: "The sporo-
blast contains generally three or four spores." The present writer observed
a similar form in the ureter and the renal tubule of the kidney of Cyprinus
carpio L., in Tokio. The observations are as follows: Trophozoites small
ameboid (Fig. 98). Body colorless. Movements tardy. Differentiation
of protoplasm imperfect. The hyaline ectoplasm recognizable at one side
of the body, where lobose pseudopodia are formed (Figs. 98-99). Endo-
plasm granular with vacuoles and brownish granules, which become
larger as the body grows. Size 10 to 40μ. Disporous (Kudo) and poly-
sporous (? Fujita).
Spore: Fujita's descriptions are as follows: Form resembles monk's
hood, slightly attenuated at its anterior end. Shell uniformly thin, except
at two points of the truncated posterior end. Each shell valve has eight
distinct striations which run longitudinally and turn into long cilia up to
5.8μ long, planted in a single row at the posterior end of the spore. Two
polar capsules at the anterior end. The nucleus is obscure and no vacuole
is present. Dimensions: length 10 to 13μ, breadth 5μ, polar capsules
3.8μ by 2μ, length of polar filament 15μ (weak glycercine). The writer
observed the following facts: More rounded with rounded anterior end in
front and side views. Shell more or less thick along the entire posterior
margin. Striations on shell, variable in number. Sporoplasm granular,
without any vacuole, exhibits two nuclei when stained. Posterior filaments
5 to 6 in number and 5 to 6μ long, being absent in some spores. Dimen-
sions in vivo: length 10μ, breadth 8 to 9μ, thickness 6 to 8μ, polar capsule
4μ by 1.5 to 2μ, length of polar filament 35 to 40μ.
Remarks: Tho Fujita does not describe the vegetative form and there are some differences in the form and size of the spore between the forms, the writer does not find out any objection against the union of the above mentioned two forms.

**MITRASPORA CAUDATA** (Parisi) Kudo

[Figs. 105 to 107]

<table>
<thead>
<tr>
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Habitat: Renal tubules of kidney of *Alosa fina* Cuv. var. *lacustris* Fatio; Lake Como.

Vegetative form: Rounded or variously elongated owing to the movements. Protoplasm is distinctly differentiated into ectoplasm and endoplasm. Ectoplasm, hyaline and homogeneous, forms slowly moving lobose pseudopodia. Endoplasm granular, contains yellow globules and fat granules. Disporous and polysporous.

Spore: Subspherical in front view; oval in profile; anterior end being more rounded than the posterior end. Shell rather thick, longitudinally striated. In front view, the posterior end enlarged into a quadrangular form, which appears as a small spine in side-view and which projects backward long and fine filaments, usually six in number. Two well developed polar capsules open on each side of the sutural plane. Polar filament coiled 5 to 6 times. Sporoplasm without any iodoniphilous vacuole. Dimensions: external length 10 to 11 μ, internal length 7 to 9 μ, length of polar capsules 4 to 4.5 μ, length of polar filament up to 48 μ, length of posterior filaments up to 28 μ.

**MITRASPORA ELONGATA** nov. spec.

[Figs. 602 to 621]

Habitat: In the urinary tubules and tissue of kidney of *Lepomis cyanellus*; Crystal Lake, Urbana, Ill. From June to July, all the fish examined, 36 in number and 10 cm. in average length, were found to be infected. Other fish such as *Lepomis pallidus* and *Lepomis humilis*, caught at the same time, were free from the infection. Early in June, the number and size of the parasites in a host body were rather small and only a small number of spores could be recognized in the fresh state with the addition of potassium hydrate solution. The growth of the parasite was rather remarkable during the hot weeks in the latter part of June and July so that every fish caught on July 17th showed a heavy infection, exhibiting small whitish pustules over the surface of the organ. During June, vegetative forms and spores were found in the lumen of the urinary tubules,
altho some contained the parasitic masses in the tissue. About the middle of July, the parasite forms conspicuous cysts in the tissue thruout the organ. The cyst may or may not be covered by a thick layer of connective tissue from the host. Aside from this hypertrophy, the host did not show any pathological change which could be recognized.

Vegetative form: Youngest trophozoite found in the urinary tubule is multinucleate, rounded, and of from 20 to 50μ in diameter. The protoplasm is not differentiated, the entire body is finely granular or coarsely reticulated in structure. In the protoplasm are to be seen nuclei and sporoblasts at different stages of development. The union of two propagative cells similar to that of Myxobolus toyamai produces a small body which develops into a single sporoblast and ultimately into a single spore (Figs. 605-613). In later stages, the trophozoite reaches a size of 200μ in diameter showing many stages of spore formation and mature spores, surrounded by thick layers of connective tissue from the host. Poly- sporous.

Spore: Elongated oblong with pointed anterior and truncated posterior extremities. The width is often greatest at the middle of the polar capsules, the posterior portion is much narrower than the anterior. Nearly circular in the cross-section thru the polar capsules. The shell is thin, the sutural line being faintly marked in fresh state. It generally is obliquely located in relation to the capsules. The shell also shows fine longitudinal striations, 14 to 16 in number, on each valve. The sutural line as well as the striations are best seen in spores stained with Heidenhain's iron hematoxylin. Two polar capsules elongated pyriform, mostly equal in size, occupy the anterior half of the spore. Abnormal situations of the polar capsules are sometimes observed (Fig. 619). The coiled polar filament is faintly visible in fresh spores. It is spirally coiled along the wall of the polar capsule without any central axis. This fact was clearly observed in stained section as is shown in Figs. 620 and 621. The filament has seven or eight windings, thus agreeing with the actual length of the extruded polar filament. The polar filament was extruded under the action of potassium hydrate solution. The extrusion takes place even in some spores which were treated with Schaudinn's fixative and kept in 95 per cent alcohol for three months (see the similar observations on Myxobolus discrepans on page 157). The sporoplasm is finely granular and transparent. When stained, it shows two nuclei in the center or near the posterior part of the body. Dimensions of preserved spores: length 15 to 17μ, breadth 5 to 6μ, thickness 4.5 to 5.5μ, polar capsule 7.5μ by 2μ, length of polar filament 40 to 50μ.

Suborder SPHAERO SPOREA nom. nov.

The definition of the suborder is recorded on page 57.
Family CHLOROMYXIDAE Thélohan

1892 Chloromyxidees Thélohan 1892 : 173
1895 Chloromyxidees Thélohan 1895 : 344

The characters of the family are described on page 57.

Genus CHLOROMYXUM Mingazzini

1890 Chloromyxum Mingazzini 1890 : 160
1892 Chloromyxum Thélohan 1892 : 173-176
1895 Chloromyxum Thélohan 1895 : 344

The characters of the genus are described on page 57.

Type species: Chloromyxum leydigi Mingazzini.

CHLOROMYXUM LEYDIGI Mingazzini

[Figs. 108 to 113]

1851 Leydig 1851 : 225-234
1852 Leuckart 1852 : 435
1854 Lieberkuhn 1854 : 352
1890 Chloromyxum leydigi Mingazzini 1890 : 160-164
1892 Chloromyxum leydigi Thélohan 1892 : 166, 169-170
1894 Chloromyxum leydigi

Chloromyxum incisum Gurley 1894 : 259-260
1895 Chloromyxum leydigi Thélohan 1895 : 345-346
1898 Chloromyxum leydigi Doflein 1898 : 292, 310, etc.
1912 Chloromyxum leydigi Erdmann 1912 : 149-162
1916 Chloromyxum leydigi Georgévitch 1916a : 3
1917 Chloromyxum leydigi Davis 1917 : 236-237
1917 Chloromyxum leydigi Erdmann 1917 : 276-321
1918 Chloromyxum leydigi Georgévitch 1918 : 182-189

Habitat: Gall-bladder of Rhina squatina L., Spinax spinax L., Scyllium canicula, S.asterias, Raja batis L., R. clavata L., R. undulata Lac., Torpedo narce Ris., T. marmorata, T. ocellata, T. torpedo L., Acanthias acanthias L., Trygon pastinaca L., Dasybatis hastatus, D. sabina, Pteroplatea macura Le Sueur, Scoliodon terrae-novae, Cestracion zygaena, C. tiburo, Carcharhinus limbatis; Roscoff, Concarneau, Marseille, Banyuls, Rovigno, Heligoland, Beaufort, Monaco (May), Napoli, Genova. Erdmann observed the species at Naples from March to August. She noticed mixed infection with Ceratomyxa reticulata and especially with Leptotheca parva. Georgévitch studied the parasite at Monaco from February to April.

Vegetative form: Polymorphous, being spherical, oval or irregular. The change of the form rather rapid under favourable conditions. Differentiation of protoplasm distinct. Ectoplasm with pseudopodia of various form, i.e., lobose, filiform or intermediary; short, pointed or branched. Endoplasm alveolar, filled with yellowish granules. Doflein observed the plasmodotic multiplication of young trophozoites. Polysporous. Erdmann’s observations (1917) may be summarized as follows: Ameboid.
Color of the body greenish to dark green. The protoplasm is clearly differentiated into ectoplasm and endoplasm. The ectoplasm is hyaline and covers the entire surface of the body. It appears as a fine fibrous structure when fixed with Bouin's solution. The endoplasm contains besides nuclei, two kinds of spherules; one smaller and yellowish "color-carriers" and the other larger and light to dark greenish reserve bodies. The color-carrier is in part composed of myelin, while the reserve body is of glycogenous nature. The infection was studied experimentally *per os*: young trophozoites appeared in 3 to 5 days which continued to 10th day, various trophozoites were seen in 13 to 19 days, and sporulating individuals were first recognized in 39 days after the infection. The trophozoite multiplies in number either by fission or by budding. It usually contains enclosures which seem to be degenerating erythrocytes. Mictosporous.

Spore: Ovoidal. Shell-valves show wide edge at sutural plane, which is attenuated at the anterior end and forms a quadrilateral process at the posterior end, from which a row of cilia grows. Shell-valves have ridges (6 to 7), which run parallel to the posterior margin. The striations may vary considerably. Four polar capsules at the anterior end. Dimensions: length 8μ. Erdmann gave the following dimensions: Spores from *Torpedo marmorata* and *T. ocellata*: length 6 to 9μ, breadth 5μ, polar capsule 3μ by 2μ. Those from *Scyllium asterias*: length 8 to 9μ, breadth 6μ, polar capsule 2μ by 1μ. Those from *Raja batis*: length 7 to 8μ, breadth 5μ, polar capsule 2μ by 1μ. Length of polar filament 20 to 30μ (absolute alcohol warmed up to 40° C.).

**CHLOROMYXUM CAUDATUM** Thélohan

[Fig. 114]

1895 *Chloromyxum caudatum* Thélohan 1895 : 346

Habitat: Gall-bladder of *Molge cristata* Laur.; Vicinity of Rennes.

Spore: Oval or spheroidal. Shell enlarged at the anterior part, having a simple or bifurcated tail-like process, as in Henneguya, at the posterior end. Dimensions: total length 18μ, length 8μ, breadth 6 to 7μ, length of tail 10μ.

**CHLOROMYXUM QUADRATUM** Thélohan

[Figs. 115 to 117]

1891 1891 : 111
1893 1893 : 81
1895 *Chloromyxum quadratum* Thélohan 1895 : 347
1912 *Chloromyxum quadratum* Parisi 1912 : 289
1913 *Chloromyxum quadratum* Awerinzew 1913a : 155
1913 *Chloromyxum quadratum* Fermor 1913 : 199
Habitat: Muscle of Syngnathus acus L., Trachurus trachurus L., Nerophis aequorens L., Callionymus lyra L., Ariodes polystaphyodon, kidney of Blennius gattorugine Brunn; Helder, Roscoff, Concarneau, Marseille, Beira (Africa), Napoli (summer).
Vegetative form: Not described by any of these authors.
Spore: Quadrangular pyramid with curved edges and roundish angles. Four polar capsules at the anterior end. Dimensions: length 6μ, breadth 5μ, length of polar filament 8 to 10μ.

CHLOROMYXUM FLUVIATILE Thélohan

[Fig. 118]

1892 Chloromyxum fluvia
tile Thélohan 1892 : 173–176
1895 Chloromyxum fluvia
tile Thélohan 1895 : 346

Habitat: Gall-bladder of Leuciscus cephalus L.; Paris.
Vegetative form: Young trophozoites colorless; adults yellowish. Form highly variable. Active change of the form of body. Clear differentiation between ectoplasm and endoplasm. Ectoplasm usually recognizable at one end of the body where lobose pseudopodia are formed. Size reaches 25 to 30μ. Polysporous.
Spore: Spherical, generally small. Sutural ridge fairly well marked. Dimensions: 7 to 8μ in diameter.

CHLOROMYXUM MUCRONATUM Gurley

[Fig. 119 to 122]

1854 1854 : 352–353
Leuckart 1879 : 248
1882 Büttschli 1882 : Pl. 38 : 17
1883 Balbiani 1883 : 201, 203
1893 Chloromyxum mucronatum Gurley 1893 : 419
1894 Chloromyxum mucronatum Gurley 1894 : 264, 265
1908 Chloromyxum mucronatum Auerbach 1908 : 456
1909 Chloromyxum mucronatum Auerbach 1909a : 71

Habitat: Urinary-bladder and kidney of Lota lota L.; Bodensee, other localities not mentioned.
Vegetative form: Spherical, elliptical or irregular. Size up to 75μ in diameter. Protoplasm containing irregularly scattered fat-like globules.
CHLOROMYXUM DIPLOXYS (Gurley) Thélohan
[Figs. 123 to 125]

1866 Balbiani 1866 : 600–602
1867 Balbiani 1867 : 275, 276, 335
1882 Bütschli 1882 : 590
1890 Pfeiffer 1890 : 559
1892 Henneguy et Thélohan 1892 : 587
1893 Cystodiscus ? diploxyis Gurley 1893 : 411
1894 Cystodiscus ? diploxyis Gurley 1894 : 281
1895 Chloromyxum diploxyis Thélohan 1895 : 347

Habitat: Abdominal cavity of Tortrix viridana L. (imago);
Spore: Elliptic or slightly flattened. Sutural line straight, forming a ridge. Two polar capsules at each end.

CHLOROMYXUM PROTEI Joseph

1905 Chloromyxum protei Joseph 1905 : 450–451
1907 Chloromyxum protei Joseph 1907 : 398–412

Habitat: Renal tubules of kidney of Proteus anguineus L.; Vienna.
Vegetative form: Generally rounded or sausage form. No clear differentiation between ectoplasm and endoplasm. Movements slow. Probable occurrence of plasmatomy by budding and division. Size: 40 to 45μ by 28 to 40μ.
Spore: Spherical. Shell finely striated parallel to the sutural line. Four polar capsules each with an independent opening. Dimensions: 10 to 13μ in diameter, polar capsules 4 to 6μ long. The polar filament appears to be rather short.

CHLOROMYXUM TRUTTAE Léger
[Fig. 126]

1906 Chloromyxum truttae Léger 1906 : 267–270

Habitat: Gall-bladder and gall-duct of Trutta fario L.; Dauphiné.
Vegetative form: Ameboid form. Elongated. Form resembles an Amoeba limax of about 40μ in length. Roundish or irregularly contoured, with small pseudopodia. Ovoidal or spherical, 25 to 40μ in diameter without any visible pseudopodia (resting state). Body colorless, clear and hyaline. Very active movements which last for several hours after the death of the host. Broad and obtuse pseudopodia well developed at the anterior end of the body. Endoplasm alveolar, contains variable numbers of nuclei, which are seen in vivo, refractive bodies and chromatic granules. Monosporous(?) and polysporous.
Spore: Spherical. Four polar capsules of different size. Shell-valves marked with parallel ridges. Dimensions: 8 to 9μ in diameter.
CHLOROMYXUM CRISTATUM Léger  
[Figs. 127 and 128]  
1906 Chloromyxum cristatum Léger 1906: 270-272

Habitat: Gall-bladder of Tinca vulgaris Cuv.; Grenoble.  
Vegetative form: Ordinarily massive, with oval or round contours, without noticeable pseudopodium. Ectoplasm hyaline. Endoplasm granular and colorless. Average diameter of the adults about 20μ. Monosporous, rarely disporous.

Spore: Spherical or subspherical. Ten marked ridges run antero-posteriorly on each shell-valve, so that it presents a cog-wheel form in cross section. Four polar capsules at the anterior end, one pair being smaller than the other. Sporoplasm with two nuclei. Dimension: 10 to 11μ.

CHLOROMYXUM DUBIUM Auerbach  
[Figs. 129 to 133]  
1908 Chloromyxum dubium Auerbach 1908: 456-459  
1910 Chloromyxum dubium Auerbach 1910c: 177

Habitat: Gall-bladder of Lota vulgaris Cuv.; Bodensee (April to September).

Vegetative form: Spherical or rounded. Rarely irregular forms. Protoplasm is differentiated distinctly into ectoplasm and endoplasm. Ectoplasm very thin, forms pseudopodia which move slowly. Endoplasm granular, contains fat globules. Majority of the trophozoites appear to live floating in the bile, while some are attached to the epithelium of the bladder. Disporous and polysporous.

Spore: Spherical, with four polar capsules. Each shell valve has longitudinal ridges, variable in number (6 ridges are found on the drawing), which run parallel to the sutural line. Four polar capsules of nearly same size and convergent. Sporoplasm finely granular with two nuclei. Dimensions: diameter 10.8μ, length of polar capsule 3.6μ.

CHLOROMYXUM sp. Awerinzew  
[Fig. 134]  
1908 Chloromyxum sp. Awerinzew 1908: 43, 47, 48

Habitat: Gall-bladder of Raja radiata; Murman coast?.

Vegetative form: Form rounded. The protoplasm is distinctly differentiated into ectoplasm and endoplasm. Ectoplasm hyaline and comparatively abundant in quantity compared with endoplasm, forms lobose pseudopodia of active movements. Endoplasm vacuolated, contains enclosures. Between the two layers, a thin layer of protoplasm, reticular in structure and stained deeply with hematoxylin, is present.

Spore: No figure.
CHLOROMYXUM THYMALLI Lebzelter
1912 Chloromyxum thymalli Lebzelter 1912: 295-296
Habitat: Gall-bladder of Thymallus thymallus L.; Vienna?
Vegetative form: Irregular form, 33 to 35μ long in average. Endoplasm contains fat globules which stain brown with carmine. Trophozoites attached to the epithelium. In average, 6 spores formed in each individual. Intracellular stage in the epithelial cell is supposed. Polysporous.
Spore: Spherical. Shell structure similar to C. protei, but ridges are more developed and exhibit somewhat wavy courses. Polar capsules of equal size. Dimensions: 9 to 9.5μ in diameter, polar capsules 3μ.

CHLOROMYXUM KOI Fujita
[Fig. 135] 1913 Chloromyxum koi Fujita 1913: 257-259
Habitat: Gall-bladder of Cyprinus carpio L.; Sapporo (Nippon).
Vegetative form: Spherical, with greatest diameter lip to 50μ, containing 1 to 3 spores. Each spore is situated in a clear space surrounded by a membranous envelope (sporoblast?), around which there is some finely granular matter (endoplasm?).
Spore: Spherical, exhibiting a somewhat angular contour at the anterior end. Shell thick and has marked ridges on the surface, i.e., 4 to 5 circular ridges and on both sides of these ridges, two more ridges each bent in a loop-like manner, so that the outline of spore in cross section, is very much like of a toothed wheel with nearly equidistant teeth, 16 to 18 in number. Four polar capsules, two slightly larger than the other two. Dimensions: length 16μ, breadth 10μ, length of polar capsule 4μ, length of polar filament 64μ.

CHLOROMYXUM MAGNUM Awerinzew
[Figs. 136 to 138] 1913 Chloromyxum magnum Awerinzew 1913: 155-156
Vegetative form: Ameboid. Body yellowish by the presence of large yellowish granules in endoplasm. Often round or rosary form. Pseudopodia sometimes absent, so that the trophozoites move like Amoeba limax with a cluster of small, hairy pseudopodia at the posterior end. In larger form, small round pseudopodia, composed of homogeneous ectoplasm, are formed. Plasmotomy by budding, was often observed. Usually polysporous, rarely monosporous.
Spore: Elongated spherical form. Four polar capsules at the narrow, anterior end. Sporoplasm with two nuclei. Dimensions: length 40 to 48μ, breadth 30 to 38μ, length of polar capsules 12 to 15μ.

* Misprinted in Awerinzew's paper as blainvilei.
CHLOROMYXUM FUNDULI Hahn

[Fig. 139 and 140]

1915 Chloromyxum funduli Hahn 1915 : 205-206

Habitat: Muscle of Fundulus sp.; Woods Hole. In one fish.

Vegetative form: Hahn made observations on few fresh and stained smears. According to him, it is clear that the staining was abnormal. It is hard to quote this here as he used different terms without giving any definition. The reader is advised to consult Hahn's paper.

Spore: Form slightly resembles that of Chloromyxum quadratum. Posterior end rounded, the anterior portion narrow and truncated at the tip; optical cross-section thru the posterior part of the polar capsules, circular. Four polar capsules at the anterior end. Dimensions: height (length) 6μ, breadth and thickness 7.5μ respectively.

Remarks: As to the comparison of the present species with Chloromyxum clupeidae Hahn, see p. 94.

CHLOROMYXUM MISGURNI Kudo

[Fig. 141 to 146]

1916 Chloromyxum misgurni Kudo 1916 : 6-7

Habitat: Gall-bladder of Misgurnus anguillicaudatus Cantor; Tokio (September).

Vegetative form: Round or irregular. Semicircular when viewed from side. From the flat surface, many fine root-like, filiform pseudopodia are extruded. No clear differentiation between ectoplasm and endoplasm. Endoplasm alveolar. Trophozoites always found attached to the lining epithelial cells. Size up to 50μ by 20μ. Polysporous (6 to 8 spores), rarely disporous.

Spore: Spherical, slightly attenuated at the anterior end. Sutural line straight and forms a ridge. Fine longitudinal striations run parallel to the sutural line. Four polar capsules at the anterior end. Sporoplasm finely granular, has two nuclei of equal size. Dimensions: length 8 to 9μ, breadth 6 to 7μ, thickness 5 to 6μ, length of polar capsule 2 to 3μ, of polar filament 28 to 35μ (KOH).

Remarks: The host is often infected at the same time by Chloromyxum fujitai, the trophozoites of which can be distinguished from the present form by the structure and the floating habit in the bile. Spores in the two species are decidedly different in form, structure and size.

CHLOROMYXUM FUJITAI Kudo

[Fig. 147 to 152]

1916 Chloromyxum fujitai Kudo 1916 : 7-9

Habitat: Gall-bladder of Misgurnus anguillicaudatus Cant.; Tokio, (5% of the fish examined in September, found infected).
Vegetative form: Round or irregular. No clear differentiation of protoplasm. Endoplasm highly vacuolated. Ectoplasm being hardly distinguishable. Size up to 40μ in diameter. Trophozoites float in the bile in almost all cases. Disporous and polysporous (up to 8 spores).

Spore: Spherical, often attenuated at the anterior end. Sutural line not straight. Shell very thick, shows thick ridges running longitudinally on the surface. In optical cross section, the spore presents an outline like a cog-wheel with 20 to 22 ridges. The thickness of ridges varies regularly; the thickest ones being located on two lines where a plane perpendicular to sutural plane cuts the shell longitudinally, others decreasing in thickness as they approach the sutural line. Four polar capsules at the anterior end. Sporoplasm with two nuclei. Dimensions: length 10 to 12μ, breadth 8 to 10μ, polar capsules 2 to 3μ, length of polar filament 23 to 30μ (KOH).

**CHLOROMYXUM CLUPEIDAE Hahn**

[Figs. 153 to 156 and 562 to 565]

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<th>Author</th>
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<td>Auerbach</td>
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<td>1901</td>
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<td>Linton</td>
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<td>Chloromyxum sp.</td>
<td>Tyzzer</td>
<td>1910 : 178</td>
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<td>1917</td>
<td>Chloromyxum sp.</td>
<td>Hahn</td>
<td>1917 : 13–19</td>
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**Habitat:** Body musculature of Clupea harengus, Pomolobus pseudoharengus, P. aestivalis, P. mediocris, Brevoortia tyrannus, Stenotomus chrysops, Tautogolabrus adspersus; Woods Hole.

Tyzzer mentioned in his paper and also in a letter to the writer that he collected the material in August of 1900 and that he found the infection occurred only among young fish. Hahn also called attention on the latter fact.

Vegetative form: Hahn's observations are as follows:

Clusters of spores ("pseudocysts") are spindle-shaped, especially when young, usually lying between the bundles of muscle fibres. Color white or creamy. Larger ones usually "in pocket just beneath the integument." Schizogonic multiplication probably exists. Parasites hard to stain, anilin dyes being unable to stain at all. Large form (probably composed of many individuals) 890μ by 30μ.

Tyzzer described as follows: Cysts up to 1 to 2 mm. in length, lying between the muscle fibres of the myotomes, surrounded at times by membraneous connective tissue. The parasites also occur in diffused infiltration.

Linton found two cysts, 1.74mm. by 1.16mm. and 1.16mm. by 0.58mm. and also diffused state between the fibrillae.

The writer's observation on slides prepared by Dr. Tyzzer* is as follows: Two cysts in sections; one almost spherical, 480μ by 430μ, sur-

*The writer had recently the opportunity of examining the slides of the parasites prepared by Dr. Tyzzer, which occasion he appreciated very much. As a result of this, the writer became convinced of the identity of forms observed by Tyzzer, Linton and Hahn, tho he could not examine the latter authors' specimens.
rounded by several layers (about 10µ thick) of connective tissue of the host, the other oval, 120µ by 110µ. The staining sufficed to reveal only indistinct structure of the parasites. The homogeneous ectoplasm surrounds the entire surface of the body as a uniform, but very thin layer. Endoplasm granular, filled with spores of remarkably identical stages of development. Isolated spores, also, occur in the muscle bundle in the state of diffused infiltration. Polyosporous.

Spore: Hahn describes it as follows: Low conical pyramid with round base; square with bulging sides. No indication of valves in the spore shell. Dimensions: height (length) 5µ, breadth and thickness 7µ, polar capsule 2µ by 1µ.

Linton’s form: squarish in outline with rounded corners, 7µ in diameter.

Tyzzer describes his form as follows: Quadrilateral in anterior end view; oval in side view. The four corners are a little protuberant and are directed slightly forward. Shape varies considerably in different species of host. The corners of the spore from Stenolomus chrysops, are greatly drawn out, exhibiting stellate form. Four polar capsules radiating from the anterior extremity toward the four corners. Shell shows four furrows radiating from the anterior extremity outwards to the side. Sporoplasm occupies extracapsular cavity. Polar filaments are extruded under the action of acetic acid. Dimension: breadth 7 to 7.5µ.

The writer's observations are as follows:

Spores in fixed and decolorized smears. In smear, most of the spores are seen lying on the base exposing the anterior end view toward the observer's eyes, a few lying with the sutural diameter parallel to the surface of the slide. Form quadrilateral with corners more or less drawn out in anterior end view; oval, with concave posterior side in front view (Figs. 562 to 564). Shell apparently thin but was not clearly separated from the sporoplasm which is finely granular and fills the extracapsular cavity of the spore. Four polar capsules of nearly same size and pyriform. Coiled polar filament indistinct. When stained, the polar capsules stained deeply. It is remarkable to see almost all of the spores exhibit four deeply stained nuclei of capsulogenous cells, which in ordinary case disappear as the spore matures. Dimensions: height (length) 4 to 4.75µ, breadth and thickness 5.4 to 6.5µ, polar capsule about 1.5µ by 0.75µ.

Remarks: Thus the forms of Tyzzer, Linton and Hahn had better be treated as one and the same species. As to the distinction of Chloromyxum funduli and the present species, the writer is unable to make it clear as he could not examine the preparation of the former species and especially as he observed some intermediate forms between these two forms in Dr. Tyzzer's preparations of the present species.
Habitat: Urinary bladder of Tylosurus marianus; Beaufort (July, August).

Vegetative form: Elongated when first placed on the slide, but soon becomes contracted and motionless; progressing by very slow ameboid movements. Ectoplasm usually undistinguishable, being noticed only in a few individuals which had formed one or two short, lobose pseudopodia of hyaline ectoplasm. Body colorless to light yellow. After being on the slide for some time rounded trophozoites often became surrounded by a distinct ectoplasmic layer. Entire body usually coarsely granular, the granules varying greatly in size and shape; sometimes indistinctly vacuolated. Fat globules also present. Size of rounded trophozoites about 30μ. Disporous and polysporous.

Spore: Spherical, with four distinct ridges on the posterior half of each valve converging toward the anterior end. Sutural ridge distinct. Polar capsules pyriform and convergent. Dimensions: diameter 7μ, polar capsules 2μ.

Remarks: Trophozoites from some fish were all colorless, while the larger trophozoites from others were distinctly yellow.

CHLOROMYXUM TRIJUGUM nov. spec.  
[Figs. 159 to 182]

Habitat: Gall-bladder of Lepomis megalotis Raf.; Stony Creek, and Homer Park, Ill. (November). The parasite was only found in this species, Lepomis humilis and L. cyanellus seined at the same time being free from the infection. Six specimens, three from each of the above mentioned localities, harbourd abundantly both free spores and trophozoites of various stages of development in the bile. The fish, from 6.5 to 10.5cm long, were normal in external appearance and the bladders did not show any particular abnormality, compared with those of other fish, as is usually the case.

Vegetative form: Trophozoites float usually free in the bile, younger forms are most frequently attached to the epithelium of the bladder. Form extremely polymorphous, manifesting various shapes such as, almost circular, rounded, oval, elongated or irregular, which is chiefly due to the active extrusion and retraction of the pseudopodia from the body surface. Body is highly transparent and colorless in both the young and the adult. The differentiation of protoplasm into ectoplasm and endoplasm, is distinctly visible in vivo as well as in stained preparations, especially in larger forms (Figs. 159 to 165). The endoplasm presents an alveolar structure without
any enclosure except the nuclei and various stages of spore formation (Figs. 161, 165, 168 to 171), the alveolar network being smaller at the periphery than in the center. The ectoplasm is a hyaline, transparent and homogeneous layer, free from any course granulation in fresh conditions. It shows, however, a very fine reticular structure in stained preparations. The pseudopodia are of two kinds in form, always, formed of ectoplasm alone: the filose and bristle-like form, sometimes branching and protruding from the entire surface or from a localized part of the body, vary in length from 0.5 to 4µ according to the size of the individual (Figs. 159, 161, 164). This form developed, sometimes, into a thicker form with two to four branched finer processes. The blunt, lobose pseudopodium formed at a localized part of the body is well recognizable in larger individuals. Frequently the filose and the lobose pseudopodia are formed on a trophozoite at the same time. The movements of the blunt pseudopodia were striking in some specimens. At the beginning of the observation, ten minutes after the bile was removed from the host, two club-shaped pseudopodia (Figs. 161 to 163) which were extruded from a trophozoite, the largest diameter of which being 20µ, moved very actively in the semicircular area changing their forms, showing maximum length of 20µ. In about thirty minutes, they were retracted and from the same place, a short, oval-shaped pseudopodium was seen to be extruded, which remained in the same position for some time without great change of form (Fig. 164). In another case, a trophozoite with a very broad and rounded pseudopodium extruded actively two to three rounded smaller processes at its extremity (Figs. 165 to 167). After fifteen minutes the pseudopodium was retracted, the ectoplasm forming a uniformly thick layer around the endoplasm. The observations were done at room temperature in hanging drop preparations, sealed with vaseline and paraffin, by using comp. oc. 12 and apo. imm. ob. 2mm., which caused no mechanical pressure upon the parasites. The change of form and especially that of pseudopodia, was clearly observed for one hour and twenty minutes under the above mentioned conditions after the bile was removed from the host. The trophozoites when kept for sixteen hours at room temperature, underwent degeneration and disintegrated, setting free the spores which were formed in them.

No active multiplication by plasmotomy, was observed in vivo. In fixed preparations, however, forms that suggested the occurrence of the process in the present myxosporidian, were recognized. As was stated before, the pseudopodia are always formed of the ectoplasm and as each portion of these dividing forms has many nuclei, the author is inclined to record the presence of plasmotomy in the present form.

Size varies greatly. The monosporous form 10µ by 14µ, disporous 15µ by 25µ and polysporous 30µ by 50µ, the largest individual, developing and containing more than 200 spores, was 300µ by 50µ.
Spore: Generally circular in front view; oval in side view. Shell comparatively thick, consequently the coiled polar filament is frequently indistinct. Sutural ridge straight and distinct. Each valve has a thick straight, sometimes slightly zigzag-form ridge that runs parallel to the sutural line, so that in side view, three distinct ridges encircling the spore are recognized (Figs. 177 and 180). From each of these two ridges, eight to twelve short ridges are directed toward the center of each valve, which can distinctly be observed on the spores stained with Heidenhain's iron hematoxylin (Figs. 179 and 180). They can be seen as faint markings rising from the margin directed toward the center of the spore, in front view of fresh spores. Four pyriform polar capsules of slightly different size open their foramina independently at the anterior end of the spore (Figs. 178 and 181). The sporoplasm, granular and finely reticular, shows almost always two nuclei when stained. Dimensions in vivo: length and breadth 8 to 10μ, thickness 5 to 7μ, polar capsules 3 to 5μ by 2 to 3μ, length of polar filament 32 to 40μ (H₂O₂, KOH).

Remarks: In carefully made smear of the bile, a number of empty spores which had been seen in fresh hanging drop preparations, and often spores, in which the sporoplasm with two elongated nuclei seemed to leave the shell (Fig. 182), were recognized. As this particular spore was found close to a thicker mass of the wall of the gall-bladder in the smear, it can hardly be thought that the mechanical pressure during the preparation lead to the mission of the sporoplasm from the spore. It is possible, on the other hand, to think that this is one of the cases of the germination of the spore in the host in which they were developed, as was reported by the author in *Nosema bombycis* Nägeli (Kudo, 1916).

**CHLOROMYXUM CATOSTOMI** nov. spec.

[Figs. 560 and 561]

Habitat: Gall-bladder of *Catostomus commersonii* Lac.; Salt Fork, Urbana, Ill. (October). Four fish, from 8 to 14cm.; apparently normal.

Vegetative form: Form usually rounded, with filiform pseudopodia. Majority attached to the epithelium, a few being free in the bile. Body colorless. Protoplasm is not well differentiated. Endoplasm occupying the entire body is of granular structure with vacuoles and refringent spherules. Size: from 15 to 35μ. When kept for 16 hours in a refrigerator, the trophozoites liberated the spores. The number of spores in each trophozoite is usually 2 or 3, rarely 5 to 6. Active plasmatomotic multiplication observed when examined. Spores were comparatively small in number, while the trophozoites were attached abundantly to the epithelium of the gall-bladder. Disporous and polysporous.

Spore: Form approximately spherical in front view; oval in profile. Shell with very fine striations which run parallel to the sutural ridge that is fairly well marked. Rounded polar capsules almost of same size, have
independent openings at the anterior end. Coiled polar filament indistinct. Abnormal spores with five polar capsules are sometimes seen. Dimensions of fixed spores: length 8μ, breadth 7μ, thickness 5 to 6μ, polar capsules 2 to 2.5μ by 1.5μ.

**CHLOROMYXUM WARDI** nov. spec.  
[Fig. 632 to 642]

Habitat: In the gall-bladder of *Oncorhynchus nerka*: Klutina Lake, Alaska (August). A single gall-bladder collected and preserved in formol by Professor Ward, was found to harbor the present species. The study was done on preserved material and on stained smear preparations.

Vegetative form: Young trophozoites (Fig. 632) show ameboid form, and are mostly multinucleated. The protoplasm is not well differentiated either in unstained material or in stained specimens. It is granulated throughout the body, and is vacuolated at places. The smallest form measured was 18μ in largest diameter. The shape of the body suggests its possession of ameboid movements when alive, altho the writer could not examine fresh specimens. Large trophozoites in which the spore formation had partly been completed are generally rounded with reticular protoplasm. Size varies to some extent. The trophozoite shown in figure 633 contains six mature spores and is 23μ in largest diameter. The largest one found was 38 by 30μ, showing ten spores and nuclei. Each spore appears to develop independently from a single sporoblast. Disporous and polyporous.

Spore: Rounded pyramidal in front view (Figs. 640 and 641); circular in transverse section (Fig. 638). The shell is thickened near the posterior margin (Figs. 640 and 641). Sutural line is not straight, the ridge being fairly distinct. The striations on the shell vary to a considerable extent (Figs. 634 to 637 and 639). Four polar capsules at the anterior end, mostly unequal in size and shape. The coiled polar filament is invisible in formol material. Potassium hydrate solution does not cause its extrusion in the preserved spores. The sporoplasm is finely granular with two nuclei. Dimensions of unstained preserved spores: diameter 7.5 to 9μ, polar capsule 3 by 2.5μ.

Remarks: The writer was able to study forty specimens of gall-bladder of Alaskan fishes, chiefly of salmon, which have been collected by Professor Henry B. Ward, during the summer of 1919, for which he wishes to express his deepest appreciation. The examination of these specimens showed that myxosporidia were found only in one of the gall-bladders, and that specimen presented a fairly heavy infection of the present species.

Family **SPHAEROSPORIDAE** Davis 1917  
*Sphaerosporidae* Davis 1917 : 219

The characters of the family are described on page 57.
Genus SPHAEROSPORA Thélohan

1892 *Sphaerospora* Thélohan 1892 : 167

The characters of the genus are described on page 57.

Type species: *Sphaerospora divergens* Thélohan.

SPHAEROSPORA DIVERGENS Thélohan

[Figs. 183 to 186]

1895 *Sphaerospora divergens* Thélohan 1895 : 339-340
1912 *Sphaerospora divergens* Parisi 1912 : 289
1912 *Sphaerospora divergens* Auerbach 1912 : 41-42

Habitat: Urinary tubules of kidney of *Blennius pholis* L., *Crenilabrus melops* L., *C. pavo* Cuv. et V, and urinary bladder of *Hippoglossoides limandois*; Concarneau, Roscoff, Napoli (July), Smallfjorden.

Vegetative form: Rounded discoidal or spherical or more or less elongate. Ectoplasm transparent, without real pseudopodium. Movements extremely slow. Endoplasm, granular, contains fat globules and small yellowish granules. Size of sporulating individuals: 65μ by 55μ, 60μ by 25μ, 60μ by 20μ, etc. Polysporous (Thélohan); monosporous, and disporous (Auerbach).

Spore: Spherical. Shell with fine striations. Two polar capsules divergent; coiled polar filament visible in fresh state. Sporoplasm fills the extracapsular cavity of the spore. Dimensions: 10μ in diameter, often 10μ by 12μ, the larger diameter coinciding with sutural plane, thickness 8μ (Auerbach), polar capsules about 4μ long, length of polar filament 20 to 25μ.

SPHAEROSPORA ELEGANS Thélohan

[Figs. 187 and 188]

1890 *Sphaerospora elegans* Thélohan 1890 : 193-209
1892 *Sphaerospora elegans* Thélohan 1892 : 167-175
1894 *Chloromyxum (Sphaerospora) elegans* Gurley 1894 : 266
1895 *Sphaerospora elegans* Thélohan 1895 : 338-339
1909 *Sphaerospora elegans* Auerbach 1909a : 71
1912 *Sphaerospora elegans* Parisi 1912 : 289


Vegetative form: Rounded or slightly elongated, not exceeding 20 to 25μ in diameter. Protoplasm homogeneous, very finely granular, contains numerous refractive globules, probably of fatty nature. Pseudopodia lobose. Movements slow. Disporous.

*Misprinted as Sphaeromyza elegans.*
Spore: Spherical, somewhat attenuated at the anterior end. Sutural ridge present, terminating in a small projection at each end of the spore. Two polar capsules spherical. Coiled polar filament not visible in fresh state. Dimensions: diameter 10µ in average, sutural diameter about 11µ.

SPHAEROSPORA ROSTRATA Thélohan
[Fig. 189]
1895 Sphaerospora rostrata Thélohan 1895 : 339

Habitat: Malpighian bodies of kidney of Mugil sp.; Roscoff, Le Croisic, Le Vivier-sur-mer, Marseille, Banyuls.

Vegetative form: Not described.

Sphore: Subspherical. Shell shows deep longitudinal striations which end in sharp spinous edges at the posterior end. Sutural ridge well marked. Anterior part shows enlargement of quadrangular lamella, which is spinous in side view. Dimensions: 10 to 12µ in diameter, sutural diameter 1 to 2µ longer, length of polar filament 40µ.

Remarks: The parasites cause the degeneration of the Malpighian bodies.

SPHAEROSPORA MASOVICA Cohn
[Figs. 190 to 192]
1902 Sphaerospora masovica Cohn 1902 : 628–632

Habitat: Gall-bladder of Abramis brama L.; Mauersee.

Vegetative form: Polymorphous, due to active movements. Transparent and colorless, while in motion. Endoplasm highly granular, contains yellowish enclosures. Ectoplasm hyaline, forms a narrow layer around the body, occasionally developing into a blunt lobose pseudopodium. Pseudopodia of two kinds; lobose and filose, also intermediate forms. Filiform pseudopodia are formed and retracted more slowly than the lobose. Plasmotomy is of probable occurrence. Two spores are formed in each pansporoblast. Size variable: 10µ (with no spore), 18µ (with sporoblasts), 29µ (with 4 sporoblasts), 38µ (with 22 sporoblasts). Disporous(?), polysporous.

Spore: Spherical. Sutural ridge well marked. Polar capsules and sporoplasm are comparatively small, the former convergent. By warming the spore, polar filament is extruded and at the same time two filaments ("starren Fäden") are made visible at the anterior part of the sutural plane. Sporoplasm with two nuclei, no vacuole being present. Dimensions: diameter 8µ, length of polar filament 38µ, length of sutural filament 14µ.

Remarks: Cohn did not observe free spores in the gall-bladder. He, however, saw many free spores; separated from each other, in the intestine, concluding that the body and pansporoblast membrane of trophozoites, are destroyed in the intestine, setting the spores free.
SPHAEROSPORA PLATESSAE Woodcock
[Figs. 193 and 194]

1904 *Sphaerospora platessae* Woodcock 1904: 59-60

Habitat: Otic-capsule of *Pleuronectes platessa* L.; England.
Vegetative form: Cysts opaque masses about 1 mm. in diameter. The cartilage was greatly hypertrophied. Polysporous (presumably).
Spore: Spherical. Shell unornamented. Two polar capsules. Sporoplasm with several refractive granules, but without any vacuole. Dimensions: diameter 8 to 9 μ, length of polar filament about 70 μ.
Remarks: Woodcock placed this species provisionally in the genus as he could not examine any fresh material, but had studied smears only.

SPHAEROSPORA ANGULATA Fujita
[Figs. 195 to 197]

1912 *Sphaerospora angulata* Fujita 1912: 261-262

Habitat: Kidney of *Cyprinus carpio* L., *Carassius auratus* L.; Sapporo (Nippon).
Vegetative form: Only description: "The number of the spore in the sporoblast is in this case always less than in the others, rarely exceeding two."
Spore: Somewhat triangular, with convex sides, oval in sideview. Slightly pointed at the mid-posterior margin of the spore. Shell very thin, faintly marked with concentric striations. Two oblong polar capsules are of unequal size. Dimensions: length 7 to 8 μ, breadth 6 to 7 μ, thickness 5 μ, length of largest polar capsule 3.8 μ, length of polar filament twice as long as that of the spore.

SPHAEROSPORA POLYMORPHA Davis
[Figs. 198 and 199]

1917 *Sphaerospora polymorpha* Davis 1917: 231-232

Habitat: Urinary bladder of *Opsanus tau*; Beaufort (June, July).
Vegetative form: Elongate, but never very irregular in shape. Slowly ameboïd. Body colorless. Ectoplasm clearly seen in younger forms, forming one to several large lobate pseudopodia, which in turn extrude several short, conical pseudopodia. In larger forms, ectoplasm is, often, recognizable only at ends of pseudopodia, which in such cases are composed chiefly of endoplasm. Endoplasm granular, vacuolated in some smaller forms, but in larger individuals vacuoles are indistinct or absent; small fat globules abundant in large forms; numbers of rounded sporoblast cells can be distinctly seen. Size of large trophozoites 35 μ by 50 μ. Disporous and polysporous (polysporous forms rarely contain many spores at the same time).
Spore: Spherical, sometimes slightly compressed infero-superiorly. Sutural ridge; on each side are a number of concentric striations extending around each valve parallel to sutural line. Polar capsules pyriform and large. Coiled polar filaments indistinct. Sporoplasm finely granular. Dimensions: diameter 7 to 10μ, (8μ in average), polar capsules 4 to 5μ by 2 to 2.5μ.

SPHAEROSPORA sp. Davis

1917 Sphaerospora sp. Davis 1917 : 213


SPHAEROSPORA sp. Southwell et Prashad

1918 Sphaerospora sp. Southwell and Prashad 1918 : 347-348

Habitat: Under the scales of Barilius barna; from the vicinity of the Ruby Mines, Burma (June). Vegetative form: The cysts occurred in very large numbers, one under each scale. Spore: Authors' description: "The poor condition of the material did not allow of a complete account of its structure, but the bicapsulate, rounded structure of its spores places it undoubtedly in the genus Sphaerospora Thélohan."

SPHAEROSPORA CARASSII nov. spec.

[Figs. 200 to 204]

Habitat: Gill filament of Carassius carassius L.; Tokio (February). Vegetative form: Trophozoites small ameboid in groups or in diffused condition in the connective tissue of the gill filament. No cyst formation. The number of trophozoites in groups is generally small. The largest group found in sections was 96μ by 36μ, the macroscopical examination always failing to trace the parasites. The trophozoites, 10 to 20μ long, with poorly differentiated protoplasm and usually reticular endoplasm without any particular enclosure (Fig. 200). Ameboid movements not observed. Schizogonic multiplication rapid, each of the daughter individuals developing into two spores. Disporous. Other sporous characters could not be determined. Spore: Spherical in front and side views, tho form variable to some extent (Figs. 201-203). Shell smooth. Sutural ridge fairly distinct. Two polar capsules, broadly pyriform, of equal size and convergent, located at
the anterior end, one on each side of the sutural plane. Coiled polar filament highly distinct (5 to 6 times) in vivo. Sporoplasm granular, shows two nuclei when stained; no vacuole of any nature. Dimensions in vivo: diameter 8 to 13\(\mu\), polar capsules 4 to 5\(\mu\) by 2.5 to 3.5\(\mu\), length of polar filament 35 to 40\(\mu\) (KOH or pressure).

Remarks: No species of the genus, has ever been found in the branchiae. The characters of the spore, however, compel the writer to place the form in the present genus.

Genus SINUOLINEA Davis
1917 Sinuolinea Davis 1917 : 219

The characters of the genus are described on page 57.

Type species: Sinuolinea dimorpha Davis.

SINUOLINEA DIMORPHA Davis
[Figs. 205 to 213]

1916 Sphaerospora dimorpha Davis 1916 : 333-377
1917 Sinuolinea dimorpha Davis 1917 : 232-233

Habitat: Urinary bladder and ureter of Cynoscion regalis; Beaufort.
Vegetative form: Disporous and polysporous trophozoites differ distinctly from each other. Disporous trophozoites irregular, colorless, transparent and show slow movements. When attached to the epithelium, rounded with one to several pseudopodia. Differentiation of protoplasm distinct. Occasionally endoplasm contains one or more erythrocytes. Average diameter of full-grown form 25 to 30\(\mu\).

Polysporous form: when attached to the bladder epithelium, the free end is drawn out into a long, cylindrical process, covered with numerous short, hairlike ectoplasmic processes. While not movable, these processes are readily absorbed and reformed. When the trophozoite is detached from the epithelium, the larger end gives rise to numerous conical or arborescent pseudopodia, by means of which the trophozoite moves slowly. Endoplasm extends into the proximal portion of large pseudopodia. It is granular and vacuolated, contains numerous fat globules, refractive granules, yellowish crystals (hematoidin?) and erythrocytes in various stages of disintegration. Endoplasm also contains gemmules, each composed of outer layer and finely granular central portion. Size varies greatly: up to 575\(\mu\) by 90\(\mu\).

Spore: Spherical. Sutural ridge well marked. Polar capsules large and spherical. Sporoplasm forms a rounded granular mass. Dimensions: diameter 15\(\mu\), diameter of polar capsules 4.5\(\mu\), length of polar filament 27 to 35\(\mu\).
SINUOLINEA CAPSULARIS Davis

[Fig. 214 to 216]

1917 Sinuolinea capsularis Davis 1917: 233

Habitat: Urinary bladder of Paralichthys albiguttus, P. dentatus, Spheroides maculatus; Beaufort (July, August).

Vegetative form: Rounded to irregular shape. Body colorless or light yellow. Progressive movements slow. Pseudopodia large branched or arborescent, formed entirely of ectoplasm. Ectoplasm transparent and usually granular, merging gradually with the endoplasm. Endoplasm contains numerous fat globules. In large trophozoites, gemmules are observed. The gemmules are more finely granular and more transparent than the surrounding protoplasm and are practically identical with the small, free trophozoites. Trophozoites containing several gemmules are usually rounded and motionless and appear to be more or less degenerate. Disintegration of such trophozoites were actually observed. Sporulating trophozoites were rare and were never seen to contain gemmules. Size up to 40μ in diameter. Disporous and polysporous(?).

Spore: Spherical, sometimes slightly elongated. Sutural plane much twisted on its axis. Sutural ridge very distinct. Polar capsules and cap-sulogenous cells large occupying more than one-half of the cavity of spore. Coiled polar filament distinct. Sporoplasm granular contains numerous fat globules. Dimensions: diameter 12 to 14μ, diameter of polar capsules 4.5μ, length of polar filament 50μ.

SINUOLINEA ARBORESCENS Davis

[Fig. 217 and 218]

1917 Sinuolinea arborascens Davis 1917: 233

Habitat: Urinary bladder of Siphonostomum florides; Beaufort

Vegetative form: Rounded or irregular. Body colorless or light yellow. Actively ameboid, forming large arborescent pseudopodia of ectoplasm. Ectoplasm well developed, hyaline and homogeneous. Endoplasm coarsely granular, sometimes containing a few fat globules. Larger trophozoites are less active and the ectoplasm less distinct. In sporulating trophozoites the ectoplasm may entirely disappear, the entire trophozoite consisting of a coarsely granular mass. Diameter of rounded sporulating trophozoites 75μ. Polysporous.

Habitat: Urinary bladder of *Paralichthys albiguttus*; Beaufort (August).


Spore: Nearly spherical, with flattened, lateral appendages extending from the posterior side. Sutural plane slightly twisted on its axis. Sutural ridge distinct. Polar capsules large. Coiled polar filament distinct. Sporoplasm finely granular, containing several comparatively large fat globules. Dimensions: diameter 12 to 13μ, diameter of polar capsules 4μ.

**SINUOLINEA BRACHIOPHORA** Davis

Habitat: Urinary bladder of *Paralichthys albiguttus*; Beaufort (August only in one fish).


Spore: Nearly spherical, with a long lateral appendage from each valve. These appendages are empty except at extreme distal end, which contains a granular mass, probably the remains of the parietal cell. Sutural plane slightly oblique to longitudinal axis. Sutural ridge distinct. Polar capsules and capsulogenous cells large, occupying more than half of cavity of spore. Sporoplasm finely granular. Dimensions: length exclusive of appendages 9 to 11μ, length of appendages 18 to 22μ, breadth of spore 9μ, diameter of polar capsules 3.5μ.

Remarks: Davis mentions that in many respects this species is very similar to *S. opacita*, which occurs in the same host.

Suborder **PLATYSPOREA** nom. nov.

The definition of the suborder is recorded on page 57.

Family **MYXIDIIDAE** Thélohan

1892 *Myxididæ* Thélohan 1892 : 173, 175
1893 *Myxidiidae* Gurley 1893 : 412

The characters of the family are described on page 57.
Genus MYXIDIUM Bütschli

1882 Myxidium Bütschli 1882 : Pl. 38

The characters of the genus are described on page 58.
Type species: Myxidium lieberkühni Bütschli.

MYXIDIUM LIEBERKÜHNI Bütschli

[Figs. 221 to 240]

1854 Lieberkühni 1854 : 5–6, 349
1879 Leuckart 1879 : 246
1881 Bütschli 1881 : 638–648
1882 Myxidium lieberkühni Bütschli 1882 : 593–595
1883 Balbiani 1883 : 201–202, 274–275
1891 Myxidium lieberkühni Pfeiffer 1891 : 20, 91, 105, 127
1894 Myxidium lieberkühni Gurley 1894 : 283–289
1895 Myxidium lieberkühni Thélohan 1895 : 340
1895 Myxidium lieberkühni Cohn 1895 : 5–36
1898 Myxidium lieberkühni Dolein 1898 : 229, 341
1902 Myxidium lieberkühni Frenant 1902a : 200–217
1902 Myxidium lieberkühni Laveran and Mesnil 1902 : 469–472
1906 Myxidium lieberkühni Léger and Hesse 1906 : 720
1909 Myxidium lieberkühni Auerbach 1909a : 71
1912 Myxidium lieberkühni Schröder 1912 : 326–327
1912 Myxidium lieberkühni Parisi 1912 : 286
1916 Myxidium lieberkühni Mavor 1916a : 66–68
1916 Myxidium lieberkühni Mavor 1916b : 373–378

Habitat: Urinary bladder of Esox lucius L., Lola lola L. (L. vulgaris); France, Canada (Georgian Bay), U. S. A., (Wisconsin, Lake Mendota), Italy (Lago Maggiore, Lago di Como, Milano, Germany).

Vegetative form: Form variable with lobose or immovable filiform pseudopodia. Clear differentiation of protoplasm. Cohn described third layer of protoplasm (mesoplasm). Endoplasm yellowish in older trophozoites, contains yellow globules, fat globules and hematoidin crystals. Size varying with age up to a maximum length of 300μ by a breadth of 136μ (Bütschli). Plasmotomous multiplication active. Cohn described budding of larger forms, while Laveran et Mesnil observed only the division of smaller forms. Each pansporoblast develops into two spores. Polysporous.

Spore: Elongated fusiform. Shell with longitudinal striations. Polar capsule at each end of the spore. The longer axis of polar capsules coincides with that of spore. Dimensions: length 18 to 20μ, width 5 to 6μ. Mavor's measurement: polar capsules 5μ by 2.5 to 3μ, length of polar filament 40 to 45μ.
MYXIDIUM INCURVATUM Thélohan

[Figs. 241 to 251]

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Habitat: Gall-bladder of Nerophis aequoreus L., N. annulatus, N. lumbriciformis, Blennius pholis L., Callionymus lyra L., Fundulus majalis, Gambusia affinis, Hippocampus brevirostris, Mugil cephalus, Scorpaena scrofa L., Syngnathus acus L., S. typhle; Roscoff, Concarneau, Marseille, Banyuls, Napoli, Bergen, Monaco, Beaufort (July).

Vegetative form: Thélohan describes as follows: Trophozoites usually small, sometimes reaching a considerable size. Pseudopodia lobose. Protoplasm pale and finely granular with refractive globules. Disporous. According to Parisi and Davis rarely monosporous. Georgévitch observed apparently the polysporous form.


Davis's form: lobose pseudopodia, occasionally being drawn out into a long process. Many trophozoites often cling together closely. Diameter of rounded disporous forms about 13 to 15μ, that of monosporous forms about 10 to 11μ.

Spore: Thélohan's description is as follows: Irregular fusiform. Longest axis curved into S-form, both ends sharply pointed and directed toward opposite directions. Polar capsule opening on opposite side of the spore, in some spores the axis of the polar capsules being parallel to each other. Dimensions: length 8 to 9μ, breadth 4 to 5μ, length of polar filament 10 to 15μ.

Parisi gave the following dimensions: length 10 to 12μ, breadth 5 to 6μ, length of polar capsule 3μ, length of polar filament 28μ.

According to Georgévitch, young spores are not curved (Fig. 245).

Davis's form; Polar filaments when extruded in HCl remained tightly coiled. Dimensions: length 8 to 9μ, width 5 to 6μ, diameter of polar capsule about 3μ.

Remarks: As are shown in figures, Davis's form seems to be somewhat different from the European forms.
MYXIDIUM SPHAERICUM Thélohan

1895 *Myxidium sphericum* (corr. *sphaericum*) Thélohan 1895: 341-342

Habitat: Gall-bladder of *Belone acus* (*Belone belone* L.); Banyuls, Le Vivier-sur-Mer.

Vegetative form: Trophozoites spherical or subspherical, not exceeding 20 to 22μ in diameter with lobose pseudopodia formed from the entire surface. Endoplasm granular, contains small refractive granules. Disporous.

Spore: Form similar to *M. incurvatum*, but much greater. Coiled polar filament distinctly visible in fresh spore. Dimensions: length 15 to 20μ, width 7 to 8μ, length of polar filament 60μ (KOH).

MYXIDIUM HISTOPHILUM Thélohan

1895 *Myxidium histophilum* Thélohan 1895: 341

Habitat: Connective tissue of kidney and ovary of *Leuciscus phoxinus* L. (*Phoxinus laevis* Ag.); France.

Vegetative form: Small mass.

Spore: Fusiform, being compressed at the middle part. Shell with longitudinal striations. Length of the spore 15μ.

MYXIDIUM sp. Gurley

1851 Leydig 1851: 226, 234
1852 Leuckart 1852: 436
1894 *Myxidium ? sp. incert.* Gurley 1894: 290
1899 *Myxidium sp.* Labbé 1899: 92

Habitat: Gall-duct of *Raja batis* L.

Vegetative form: No description.

Spore: Not described. One figure.

MYXIDIUM DANILEWSKYI Laveran

1887 Danilewsky 1887: 35
1897 *Myxidium danilewskyi* Laveran 1897: 725-726
1898 *Myxidium danilewskyi* Laveran 1898: 27-30

Habitat: Kidney of *Emys orbicularis* L.; France.

Vegetative form: Form elongated, circular in cross-section, tapering toward the ends. Body of greenish color, occupying the lumen of the renal tubules of the kidney. Body bent along the cavity of the tubule. Endo-
plasm granular, ectoplasm covering the entire surface of the body as a thin layer. Each pansporoblast develops two spores. Polysporous.

Spore: Elongated fusiform, similar to *M. lieberkühni*, but much smaller. Polar capsule at each end, extrudes filament under the action of nitric acid. Sporoplasm granular with one nucleus. Dimensions: length 12μ, breadth 3 to 4μ.

**MYXIDIUM GIGANTEUM** Doflein

[Fig. 258]

1898 *Myxidium giganteum* Doflein 1898 : 285-286

Habitat: Gall-bladder of *Raja asterias*; Napoli.

Vegetative form: Rounded trophozoites. Lobose pseudopodia with slow movement, show remarkable dimensions. Posterior portion forms "Stemm-pseudopodien." Small form club-shaped. Endoplasm is of yellowish color. Diameter of large form 500μ, of medium sized 200μ, small individuals 70–90μ, quite young ones, polymorphous 8 to 40μ. Larger individual up to 700μ by 180μ. Many trophozoites form a cyst-like motionless stage, in which many individuals seem to be covered with a common gelatinous envelope. Each pansporoblast forms two spores. Polysporous.

Spore: Elongated. Fusiform in front view; in side view, one valve arch-form, the other being flat. Transparent. Two polar capsules, one at each end. Coiled polar filament is clearly seen in larger polar capsules. Dimensions: length 28μ, breadth 8μ, polar capsules 8μ by 4μ.

**MYXIDIUM BARBATULAE** Cépède

1906 *Myxidium barbatulae* Cépède 1906 : 67

1906 *Myxidium barbatulae* Cépède 1906a : 15-16

Habitat: Kidney of *Cobitis barbatula* L.; Isère.

Vegetative form: Trophozoites form cysts. Form and size vary greatly. Average size: 400 to 500μ in length and 200μ in breadth.

Spore: Irregular fusiform. Polar capsule at each end of the spore. Shell longitudinaly striated, number being variable. Dimensions: length 12 to 15μ, breadth about 6μ, polar capsules 5μ by 2.5 to 3μ.

**MYXIDIUM GIARDI** Cépède

[Fig. 259 to 261]

1906 *Myxidium giardi* Cépède 1906a : 16; 1906b : 170-173

1908 *Myxidium giardi* Cépède 1908 : 93-95

1908 *Myxidium giardi* Cépède 1908a : 8

Habitat: Kidney of *Anguilla vulgaris* Flem.; Wimereux (August).

Vegetative form: Subspherical white cysts, 800 to 900μ in diameter, surrounded by a thick (up to 30μ) membrane, composed of the connective tissue of the host.
Spore: Irregular fusiform, greatly enlarged at the middle portion. Plane of symmetry of the spore coincides with the sutural plane. Shell thick with 9 to 11 longitudinal striations on each valve, which are more clearly seen on spores stained with iron hematoxylin. Polar capsule at each end. Coiled polar filament distinct. Sporoplasm finely granular with two nuclei and refringent globules. Dimensions in vivo: length 9 to 10μ, width 5 to 5.6μ, thickness 4.75 to 5μ, polar capsules 3.5μ by 2μ.

**MYXIDIUM PFEIFFERI** Auerbach

[Fig. 262 to 265]

1908 *Myxidium pfeifferi* Auerbach 1908 : 459-464
1910 *Myxidium pfeifferi* Auerbach 1910c : 171-172

Habitat: Gall-bladder of *Tinea vulgaris* Cuv.; Karlsruhe.

Vegetative form: Observations in sections. More or less flattened, disc-form, often enrolled. The ectoplasm finely granular, without large pseudopodia. It is not usually distinguishable from the endoplasm which is highly alveolar and contains numerous nuclei, but no enclosures.

Spore: Form varies to some extent. Similar to *Myxidium lieberkühni*; slightly curved. Shell with fine longitudinal striations. Polar capsules two, one at each end. Polar filament is extruded by adding one drop of water to the smear of the spore, which had been dessicated for 24 hours. Sporoplasm with one or two nuclei, in one case with four small nuclei, which is thought to be an abnormal. Dimensions: length 13 to 18μ, breadth 5.2 to 5.8μ, length of polar capsule 5.2 to 6μ, length of polar filament 45 to 54μ.

**MYXIDIUM INFLATUM** Auerbach

[Fig. 266]

1909 *Myxidium inflatum* Auerbach 1909 : 72-74
1909 *Myxidium inflatum* Auerbach 1909a : 31
1910 *Myxidium inflatum* Auerbach 1910c : 172
1912 *Myxidium inflatum* Auerbach 1912 : 39

Habitat: Gall-bladder of *Cyclopterus lumpus* L.; Bergen (September).

Vegetative form: Extremely polymorphous. Rounded, spherical, or much elongated. Ameboid movements very active. Differentiation of protoplasm is sharp and clear, which is best observed in individuals in motion; highly hyaline ectoplasm forms very long lobose pseudopodia, into which granular endoplasm flows in slowly. Size variable. Rounded large form 44 to 45μ in diameter. Fully grown spores are set free from the mother trophozoite in comparatively short time. Spore formation similar to that of *Myxidium bergense*. Disporous and polysporous (5 spores in maximum).
Spore: Very broad compared with the length. The longitudinal axis is curved in S shape. Polar capsule situated in opposite way at each end of the spore. Dimensions: length 20.8 to 23.4μ, breadth 13 to 15.6μ, polar capsules 7.8μ, length of polar filament 90 to 100μ (KOH).

**MYXIDIUM BERGENSE** Auerbach

*Fig. 267*

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Habitat: Gall-bladder of Gadus virens L., G. aeglefinis, G. merlangus, Pleuronectes platessa and Sebastes viviparus, Melanogrammus aeglefinis; Norway (Bergen), Canada (St. Andrew, July to September).

Vegetative form: Rounded or elongated, as the result of formation of various pseudopodia. Trophozoites partly free, partly attached to the epithelium of the bladder. Size up to 54μ in diameter. Pseudopodia of two kinds: lobose and long filose, sometimes slightly branched. Mavor observed a cyst-like stage under certain conditions, which, he thinks, may be due to some exceptional conditions of the parasite. Plasmogamy. Monosporous, disporous and polysporous.

Spore: Fusiform. Main axis curved into S shape. Form, roughly speaking, very much similar to that of *M. sphaericum* Thél. Dimensions: length 16.2 to 19μ, breadth 7 to 9μ, length of polar capsules 5.4μ, length of polar filament about three times as that of spore.

**MYXIDIUM PROCERUM** Auerbach

*Fig. 268*

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Habitat: Gall-bladder of Argentina silus As.; Bergen.

Vegetative form: Not observed.

Spore: Greatly elongated and narrow. Sporoplasm with one or two nuclei. Dimensions: length 21.6 to 25.2μ, breadth 3.6 to 4μ, length of polar capsule 7.2μ.

**MYXIDIUM MACKIEI** Bosanquet

*Figs. 269 to 271*

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Vegetative form: The largest trophozoite 160μ by 27μ. No distinction between ectoplasm and endoplasm could be drawn, except in a few individuals in which there was a cyst-wall. Spores are formed in pairs. Protoplasm with two kinds of nuclei, some vesicular, others smaller and compact. Polysporous.

Spore: Fusiform with rather pointed ends. Shell finely striated. Two comparatively small polar capsules, one at each end. Sporoplasm with one or two nuclei, contains, often, two large vacuoles. Dimensions: length 16μ (a few 17μ), breadth 5μ (many broader than this).

Remarks: The discoverer, J. P. Mackie mentioned that the parasites did not appear to excite any reaction in the tissue of the host, the animal's health being unaffected.

**MYXIDIUM MACROCAPSULARE Auerbach**

[Figs. 272 and 273]

1910 Myxidium macrocapsulare Auerbach 1910 : 440-441

Habitat: Gall-bladder of Scardinius erythrophthalmus L.; Karlsruhe.

Vegetative form: Not observed.

Spore: Elongated elliptical when viewed at right angles to sutural plane. Shell somewhat thick with longitudinal striations parallel to the sutural line. In side-view, both ends pointed in diagonally opposite directions. Polar capsules are comparatively large, one at each end, opening at the sharply pointed end. Dimensions: length 10 to 12μ, breadth 6μ, polar capsules 3 to 4μ.

Remarks: No pathological change. Bile was clear.

**MYXIDIUM sp. Awerinzew**

[Figs. 274 to 276]

1908 Myxidium sp. Awerinzew 1908 : 33, 43, 45, 55
1909 Myxidium sp. Awerinzew 1909 : 76, 78, 80, 81
1911 Myxidium sp. Awerinzew 1911 : 199-204

Habitat: Gall-bladder of Cottus scorpius; Aleksandrowsk, North Sea.

Vegetative form: Trophozoites are small. The protoplasm is differentiated into ectoplasm and endoplasm in some specimens. Very active formation of filiform pseudopodia of various length. Degenerating trophozoites, with one or two empty spaces are often noticed. Each spore is formed independently from each other. Monosporous, disporous and polysporous (with three spores).

Spore: Form similar to Myxidium incurvatum. Young spores not curved. Dimensions: length 20 to 35μ, breadth 10 to 15μ.
MYXIDIUM DEPRESSUM Parisi
[Figs. 277 and 278]
1912 Myxidium depressum Parisi 1912 : 287

Habitat: Gall-bladder of Citharus linguatula Gthr.; Napoli (August).
Vegetative form: Not observed.
Spore: Fusiform with greatly attenuated extremities in front view; flattened and curved in S-form in profile. The axis of polar capsules parallel to each other. Coiled polar filament visible in vivo. Sporoplasm with two nuclei, occupies the extracapsular cavity of the spore. Dimensions: length 12 to 14μ, breadth 5.5 to 6μ, thickness 2.5 to 3μ, polar capsules 5.5 to 6μ by 2.3μ, length of polar filament 30μ.

MYXIDIUM OVIFORME Parisi
[Figs. 279 and 280]
1912 Myxidium oviforme Parisi 1912 : 287-288
1912 Myxidium oviforme Auerbach 1912 : 39

Vegetative form: Unobserved by Parisi. Auerbach’s observation is as follows:
Trophozoites, small ameboid, usually spherical. Size 10 to 12μ in diameter. Monosporous (probably).
Spore: Oval with rounded extremities, slightly pointed at the foramina of polar capsules. Shell with numerous fine striations running longitudinally. Polar capsules being often invisible, opening a little above and below of the hypothetical horizontal plane. Sporoplasm fills the extracapsular cavity of the spore, leaving little space at the extremities of the polar capsules. Dimensions: length 11μ, breadth 8 to 8.5μ, polar capsules 4.5μ by 3μ, length of polar filament 30 to 35μ. Auerbach’s measurements: length 12 to 13μ, breadth 8 to 9μ, polar capsules about 4μ long.

MYXIDIUM ANGUILLAE Ishii
[Figs. 281 to 284]
1915 Myxidium anguillae Ishii 1915 : 372-382

Habitat: Integument of the side of the body of Anguilla japonica Temm. et Sch.; Schizuoka, Nippon (October). Number of the cysts visible to unaided eye, 10 and 9 on the left and the right side respectively.
Vegetative form: Trophozoites form white and sharply contoured cysts. Cysts, spherical or oval, surrounded by a membranous connective tissue (about 2μ thick) of the host. Protoplasm is clearly differentiated into ectoplasm and endoplasm. Diffuse infiltration also occurs. Size measured along the skin, 1.2 to 2mm. in diameter; in sections 1.174mm. by 0.658mm.
Spore: Form similar to *Myxidium pfeifferi* Auerbach, but rather straight fusiform, rarely slightly bent. In many spores the shell tapers to a sharp point at each end. Shell striated longitudinally, 22 in all (2 sutural ridges?). Two polar capsules, one at each end. Sporoplasm usually with two nuclei. Dimensions: length 9.1μ, breadth 2.8μ, length of polar capsule 3.5μ.

**MYXIDIUM sp. Mavor**

**Habitat:** Gall-bladder of *Pseudopleuronectes americanus*; New Brunswick (Canada), of rare occurrence.

Vegetative form: Observations in smears are as follows: Spheroidal, with numerous long pseudopodia on one side, which suggests the attachment of the trophozoite to the bladder. Trophozoites without any spore. Pansporoblasts spherical, 15 to 16μ in diameter.

Spore: Spindle shaped. The long axis being slightly bent in S-form. Two pear shaped polar capsules, one at each end of spore. Coiled polar filament visible in fresh state. Dimensions: length 14 to 15μ, breadth 6 to 7.5μ, polar capsules 4μ by 2.5μ, length of polar filament 90 to 95μ (ammonia water).

**MYXIDIUM GADI** Georgévitch

**Habitat:** Gall-bladder of *Gadus pollachiou, Solea vulgaris* Quens; Roscoff (September).

Vegetative form: Highly polymorphous. Spherical or oval. Large forms fill up the bladder. Ectoplasm hyaline and transparent, forming one long or many short lobose pseudopodia. Endoplasm colorless and finely granular, contains more or less large numbers of nucleus. Monosporous, disporous and polysporous.

Spore: Fusiform with attenuated ends. Young spores more attenuated than the fully grown forms. The main axis of the spore coincides with the longitudinal axis of the polar capsules, with slight deviation. Two nuclei of the sporoplasm, are always smaller than those of the shell-valves or of polar capsules. Dimensions: length 6 (?) to 14μ, breadth 4 to 6μ.

**MYXIDIUM GLUTINOSUM** Davis

**Habitat:** Gall-bladder of *Cynoscion regalis*; Beaufort.
Vegetative form: Elongated or irregular. Slowly ameboid, moving by means of a broad, lobose pseudopodium of hyaline ectoplasm. Body colorless. Ectoplasm only distinct in pseudopodium. Endoplasm finely granular. The mature spores while still within the mother trophozoites, are surrounded by a clear, refractive gelatinous envelope. Diameter of rounded sporulating trophozoites 20μ. Disporous.

Spore: Cylindrical, ends of valves rounded except at one side, where the polar capsules open at the apex of a small, conical elevation. Spore characterized by the presence of a transparent, homogeneous, gelatinous envelope. Polar capsules pyriform, opening on each side nearly at right angles to the longitudinal axis. Dimensions: length 10 to 11μ, breadth 6μ, length of polar capsules 3μ.

**MYXIDIUM PHYLLIUM** Davis

[Fig. 292 and 293]

1917 *Myxidium phyllium* Davis 1917 : 235

Habitat: Gall-bladder of *Gambusia affinis*; Beaufort.

Vegetative form: Exceptionally large; flattened, leaflike, usually folded on itself; motionless. Pseudopodia were not observed. Ectoplasm forming a distinct transparent layer around entire body. After being on slide for some time ectoplasm usually becomes covered with very numerous, short, hairlike processes. Endoplasm finely granular, contains numerous fat globules. Diameter up to 1.35mm. Polysporous.

Spore: Fusiform, slightly truncated at each end where polar capsules open. Shell with numerous longitudinal striations. Sporoplasm finely granular, with several small fat globules. Dimensions: length 11μ, breadth 8μ, diameter of polar capsules 3μ.

**MYXIDIUM STRIATUM** Cunha et Fonseca

1917 *Myxidium striatum* Cunha et Fonseca 1917 : 321

Habitat: Gall-bladder of *Menticirrhhus americanus* L., *Bairdiella ranchus* Cuv. et Val.; Brazil.

Vegetative form: More or less spherical. Body small and colorless. Endoplasm granular. Ectoplasm visible when pseudopodia are formed. Pseudopodia filiform, being projected radially. Size variable, 16μ in diameter in average.

Spore: Elliptical. Shell with fine longitudinal striations which run parallel to sutural line. Sutural plane oblique to the longitudinal axis of the spore which is thickened at the extremities. Two ovoidal polar capsules, one at each end. Dimensions: length 10 to 14μ, breadth 6 to 8μ, length of polar capsules 4μ, length of polar filament 30μ.
MYXIDIIUM KAGAYAMAI nov. spec.
[Figs. 294 and 295]

Habitat: Gall-bladder of Misgurnus anguillicaudatus Cant.; Tokio (September), 2% of the fish examined infected.

Vegetative form: Not observed.

Spore: Fusiform; one valve being more convex than the other. Suture line straight. Shell with fine longitudinal striations. Dimensions in fixed preparations: length 15 to 18µ, breadth 6 to 7µ, length of polar capsules 7 to 8µ, length of polar filament 60 to 70µ.

Remarks: Tho the vegetative form is still unobserved, the author is compelled to consider the present form as a new species by careful reexamination of the material and proposes the name in honor of Dr. T. Kagayama, Tokio, Nippon.

MYXIDIIUM AMERICANUM nov. spec.
[Figs. 622 to 627]

Habitat: In the lumen of urinary tubules of the kidney of Trionyx spinifera; Crystal Lake, Urbana, Ill. (July). A single host specimen showed a light infection in the above mentioned organ. No intracellular stage was detected.

Vegetative form: The young trophozoite in the lumen of the tubule of the kidney is multinucleate, and more or less irregular in shape which suggests the ameboid movements of the animal (Figs. 622, 623). The older form with mature spores is rather spherical in form with a distinct outline. The protoplasm is fairly well differentiated into ectoplasm and endoplasm (Fig. 624). The size of the trophozoites varies from 12 to 25µ in diameter. A pansporoblast produces two spores. Polysporous.

Spore: Spindle-form; with the two pointed extremities stretched in opposite directions. Circular in cross-section. The shell is rather thin; sutural line is straight. Fine longitudinal striations on the shell, eight to ten in number on each valve. The polar capsules are nearly spherical, coiled polar filament being visible in fresh material (three turns). The polar filament is easily extruded from the fresh spores under the influence of potassium hydrate solution. The direction of the extruded polar filament forms an angle of about 45° with the main axis of the spore and the two filaments are parallel to each other. Preserved spores do not show any filament extrusion under the influence of the said chemical. The sporospor is finely granular, and shows, upon staining, two small nuclei of ring-shape, as their peripheral layer takes stain more deeply than the central portion. Average dimensions of fresh spores: length 15 to 16µ, breadth 5.5 to 6µ, polar capsule 4µ by 3.5µ, length of polar filament 25 to 32µ.
Remarks: Two species of the genus Myxidium were reported to occur in chelonian hosts; i.e., *M. danilewskyi* (page 109) and *M. mackiei* (page 112). The former differs from the present form in having an elongated vegetative form which is greenish in color, and in having spores of different shape, dimensions and structure, not to speak of the difference of the host. The latter resembles closely to the species under consideration in dimensions of the spores, but differences in the trophozoite and in the structure of the spore do not allow one to consider two forms as identical. The species is therefore treated as new.

**Genus SPHAEROMYXA Thélohan**

1892 *Sphaeromyxa* Thélohan 1892 : 1091-1093

The characters of the genus are described on page 58.
Type species: *Sphaeromyxa balbianii* Thélohan.

**SPHAEROMYXA BALBIANII Thélohan**

[Figs. 296 to 307]

1892 *Sphaeromyxa balbianii* Thélohan 1892a : 1091-1093
1895 *Sphaeromyxa balbianii* Thélohan 1895 : 342
1912 *Sphaeromyxa balbianii* Parisi 1912 : 288
1916 *Sphaeromyxa balbianii* Georgévitch 1916 : 92-93
1917 *Sphaeromyxa balbianii* Davis 1917 : 235-236

Habitat: Gall-bladder of *Motella tricirrata* Bl., *M. maculata* Risso., *Cepola rubescens* L., *Clupea pilchardus*, *Siphostoma floridæ*, *S. louisianæ*; Roscoff (September), Concarneau, Marseille, Banyuls, Napoli (September), Beaufort (June to August).

Vegetative form: Flattened leaf-like or disc-form, reaching 3 to 4mm. in diameter. Often forms spherical with opaque appearance. The protoplasm is distinctly differentiated into endoplasm and ectoplasm. Ectoplasm forms rounded lobes which exhibit slow movements and show a clear radially striated structure in sections. Endoplasm reticular, contains nuclei, young and mature spores and fat globules. Each pansporoblast develops two spores. Polysporous.

Davis mentions that the largest form he observed was 900μ in diameter.

Georgévitch recognized a large number of small trophozoites which were formed by repeated plasmotomous multiplication.

Spore: Fusiform, with truncate ends. Shell longitudinally striated. One polar capsule at each end. Polar filament is wound around an imaginary axis perpendicular to the longitudinal axis of the spore. When extruded, the polar filament is seen as a short, conical and hollow thread-like structure. Sporoplasm finely granular with two nuclei. Dimensions: length 15μ, width 5μ, length of polar filament 15μ.
Parisi gave the following dimensions: length 15 to 20μ, width 5 to 6μ, polar capsule 7μ by 4.7μ, length of polar filament 25 to 30μ.

Davis’ measurements are as follows: length 17 to 20μ, breadth 5 to 6μ, length of polar filament 20μ.

Georgévitch observed young spores with both ends tapering into a point. Later they assume the typical form with truncated ends. He did not recognize the striations on the shell. He also mentions the occurrence of abnormal spores, such as elliptical, spherical forms, etc.; or with only one polar capsule.

**SPHAEROMYXA IMMERSA** (Lutz) Thélohan

[Figs. 308 to 311]

Habitat: Gall-bladder of *Bufo marinus* L. and *Leptodactylus ocellatus* L.; Brazil.

Vegetative form: Leaf-like or disc form, visible thru the bladder wall. Upper and lower sides slightly convex. Size up to 1.5 or 2mm. in diameter; thickness being 1/20 to 1/10 of the diameter. Protoplasm is well differentiated. Ectoplasm transparent and membranous, often contains a large number of micrococcus-like bodies. No ameboid movements nor change of form. Endoplasm highly vacuolar, contains fat globules. Plasmotomic multiplication probably occurs. Spores always arranged in pairs. Polysporous.

Spore: Oval with rounded extremities. Shell more or less thick, with fine transverse striations. Spherical polar capsule at each end. Sutural plane is oblique to the longitudinal axis of the spore. Sporoplasm transparent. Dimensions: length 12 to 14μ, breadth 9 to 10μ, length of polar filament 50 to 70μ (4 to 5 times that of the spore) (KOH).

**SPHAEROMYXA INCURVATA** Doflein

[Figs. 312 to 314]

Habitat: Gall-bladder of *Blennius ocellatus*; Napoli.

Vegetative form: Trophozoites are found in large masses (Plasmodia ?), in which they form a thin, hollow ball, 5–7mm. in diameter.

As the surface is greater than the inner surface of the bladder, some parts of the body are folded up. Body bluish white and transparent. Protoplasm highly vacuolar, contains numerous fat globules, nuclei and spores. Polysporous.

Spore: Curved to one side along sutural plane and also in a plane at right angles to it. Polar capsule at each end. Sporoplasm with two nuclei.
Polar filament is wound along the longer diameter of the capsule, and relatively thick, but thinner than that of *S. balbianii* Thél. Dimensions: length (along the inner side of the arch) 30 to 35μ, breadth 8μ, distance between two polar capsules 12 to 15μ, polar capsules 12 to 15μ by 4 to 5μ.

**SPHAEROMYXA SABRAZESI** Laveran et Mesnil

[Figs. 315 and 322]

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Habitat: Gall-bladder of *Hippocampus breviostris* Cuv., *H. guttulatus* Cuv.; *Syngnathus acus*, *Motella tricirrata*, *Nerophis annulatus*, *Siphonostoma rondeletii*; Arcachon, Rovigno, Napoli, Roscoff (September), Monaco, Villefrance, (March to June).

Vegetative form: Disc form. Diameter up to 2mm. Thickness variable. Body whitish in color. Ectoplasm thin, transparent and homogeneous. Young trophozoites may probably have lobose pseudopodia. Endoplasm highly vacuolated, contains nuclei of various sizes, pansporoblasts, spores and more or less refringent granules. Polysporous.

Schröder observed larger forms up to 5mm. Ectoplasm also was found to project numerous fine short (1μ) hair-like processes from the surface. Each pansporoblast develops into two spores.

Spore: Cylindrical, bent in arch form; with truncated ends. Large cylindrical polar capsule at each end. Sporoplasm granular, contains one nucleus. Polar filament short and conical, is extruded under the action of nitric acid. Dimensions: length 28μ, width 4.3μ, polar capsule 9 to 10μ by 3μ, distance between the polar capsules 8μ, length of polar filament 8μ.

Schröder noticed the stained sporoplasm contained one or two nuclei. He observed indistinctly marked longitudinal striations on the shell. Dimensions: length 22 to 25μ, breadth 3 to 4μ, polar capsule 8μ by 2 to 3μ, length of polar filament about 12μ.

Georgévitch described the presence of a hyaline substance, containing pale granules, in the spore cavity. Young spores were found to take the form of Myxidium type. In mature spores, he always found two nuclei by staining.

*Misprinted in Schröder's paper.*
STUDIES ON MYXOSPORIDIA—KUDO

SPHAEROMYXA HELLANDI Auerbach

[Figs. 323 and 324]

1909 *Sphaeromyxa hellandi* Auerbach 1909: 78-79
1910 *Sphaeromyxa hellandi* Auerbach 1910b: 772-774
1910 *Sphaeromyxa hellandi* Auerbach 1910c: 174-175
1912 *Sphaeromyxa hellandi* Auerbach 1912: 4, 40

Habitat: Gall-bladder of *Molva vulgaris* Flem., *Centronotus gunellus*, *Brosnius brosme* Asc.; Bergen, Torghatten.

Vegetative form: Large and rounded disc form. Protoplasm is distinctly differentiated into ectoplasm and endoplasm. Thickness up to 160µ, folded in the bladder. Ectoplasm finely granular; in unstained specimens, it is recognizable as 10 to 12µ thick layer, in which about 2µ thick radially striated outer layer and 8 to 10µ thick inner finely granular region can be distinguished. In stained sections, the outer layer remains unstained. Endoplasm highly alveolar, contains refractive granules of different size which are not stained with Sudan III. Each pansporoblast develops into two spores. Polyssporous.

Spore: Arch form in front view. The degree of curvature varies greatly. Sutural line curved in S-shape and well marked. Both ends more or less truncated. Polar capsule at each end. Polar filament being wound along the longest axis of the polar capsule and is extruded with KOH. Sporoplasm rounded with one or two nuclei. Dimensions: length 20.8 to 26µ, breadth and thickness 5.4µ, length of polar capsule 10 to 10.8µ.

SPHAEROMYXA EXNERI Awerinzew

[Figs. 325 and 326]

1913 *Sphaeromyxa exneri* Awerinzew 1913a: 155

Habitat: Gall-bladder of *Thysanophris japonicus*; Lorenço Marques (Africa).

Vegetative form: Not observed.

Spore: Somewhat resembles that of *S. hellandi* Auer. in being bent to one side with sutural line of S-form but differs in dimensions. Both ends slightly tapering. Polar capsules two, one at each blunt end, in which the polar filament is wound parallel to its longer axis. Sporoplasm comparatively small and sharp-contoured, contains only one nucleus. Dimensions: length 75 to 80µ, breadth 18 to 20µ, length of polar capsule 30 to 35µ.

SPHAEROMYXA GASTEROSTEI Georgévitch

[Fig. 327]

1916 *Sphaeromyxa gasterostei* Georgévitch 1916: 88

Habitat: Gall-bladder of *Gasterosteus spinachio*; Roscoff (September).

Vegetative form: Trophozoites form large plasmodia.
Spore: Large, elongated fusiform; ends less truncated than those of the spore of *Sphaeromyxa balbianii*. As the spore becomes mature, the ends assume more pointed shapes. Polar capsules two, one at each end. Sporoplasm with two nuclei, fills the extracapsular cavity. Dimensions: twice or three times larger than those of *Sphaeromyxa balbianii* Thélohan.

Genus ZSCHOKKELLA Auerbach

1910 *Zschokkella* Auerbach 1910 : 62–63
1910a *Zschokkella* Auerbach 1910a : 240–256
1910c *Zschokkella* Auerbach 1910c : 175

The characters of the genus are described on page 58. Type species: *Zschokkella hildae* Auerbach.

ZSCHOKKELLA HILDAE Auerbach

[Figs. 328 to 331]

1910 *Zschokkella hildae* Auerbach 1910 : 62–63
1910 *Zschokkella hildae* Auerbach 1910a : 240–254
1912 *Zschokkella hildae* Auerbach 1912 : 40–41


Vegetative form: Trophozoites float in the bile or attach themselves to the epithelial layer of the bladder. Youngest ameboid form about 4.5 to 6μ. In floating form, pseudopodia more or less long, lobose, are formed; while in the attached form those similar to the pseudopodia of *Myxidium bergense* Auer. are developed. Plasmogamy occurs. Size varies greatly according to the number of spores which are formed in each individual. Monosporous (with or without the remnant of protoplasm), disporous and polysporous (up to 4 spores).

Spore: Semicircular in front view, with slightly and equally attenuated ends. At each end, large spherical polar capsule is situated which opens not at the extremity, but on the flat surface. Shell bivalve and thick. Sutural line S-form. Sporoplasm with two nuclei. Dimensions: length 16 to 28.8μ, breadth 13 to 18μ, polar capsules 5.6 to 7.2μ in diameter, length of polar filament 72μ (KOH).

ZSCHOKKELLA NOVA Klokačewa

[Figs. 332 and 333]

1914 *Zschokkella nova* Klokacewa 1914 : 184–186

Habitat: Gall-bladder of *Carassius vulgaris*; Russia?

Vegetative form: Not observed.

Spore: Outline irregular. Observations on fixed materials alone. Two large round polar capsules open at the side near ends. Sporoplasm with two nuclei. On some spores, striations that run parallel to the sutural line were observed. Dimensions: length 9.5 to 11.5μ, breadth 6.5 to 7μ, diameter of polar capsule 3 to 3.5μ.
ZSCHOKKELLA ACHEILOGNATHI Kudo

[Figs. 334 to 338]

1916 Zschokkella acheilognathi Kudo 1916 : 3-5

Habitat: Gall-bladder and gall-duct of Acheilognathus lanceolatum Temm. et Schl.; Tokio (May). Over 80% of the fish examined were found to be infected.

Vegetative form: Disc-shape. In bile duct, large trophozoites are folded up. Body colorless and transparent. Protoplasm is well defined into two regions. Ectoplasm finely granular in vivo. In stained sections, it shows two layers; thin outer layer (2μ thick) presents very fine striations, while inner layer (6 to 8μ thick) is finely vacuolated without any enclosure. Endoplasm is highly vacuolated. Lobose pseudopodia formed only in younger individuals (15 to 30μ in diameter), in which ameboid movements are not slow. Size: up to 720μ by 550μ, thickness 5 to 30μ. Polysporous.

Spore: Form resembles Zschokkella hildae, but slightly elongated. Form varies to some extent. Some spores are of Myxidium type. Sutural line curved. Longitudinally striated. Spherical polar capsule at each end opening near the extremity. Dimensions: length 10 to 14μ, breadth 6 to 7μ, diameter of polar capsule 3 to 5μ, length of polar filament 65 to 70μ (KOH).

ZSCHOKKELLA GLOBULOSA Davis

[Figs. 339 and 340]

1917 Zschokkella globulosa Davis 1917 : 236


Spore: Semicircular. Sutural line twisted on its axis and oblique to longitudinal axis; sutural ridge distinct. Polar capsules opening on flat surface. Sporoplasm finely granular and very transparent. Dimensions: length 11μ, breadth 7μ, diameter of polar capsules 3μ.

Family MYXOSOMATIDAE Poche

1913 Myxosomatidae Poche 1913 : 230

The characters of the family are described on page 58.

Genus MYXOSOMA Thélohan

1892 Myxosoma Thélohan 1892 : 175

The characters of the genus are described on page 58.

Type species: Myxosoma dujardini Thélohan.
MYXOSOMA DUJARDINI Thélohan  
[Figs. 341 to 343]

1841 Müller 1841 : 486-487
1845 Dujardin 1845 : 644
1892 Myxosoma dujardini Thélohan 1892 : 175
1895 Myxosoma dujardini Thélohan 1895 : 343-344
1905 Myxosoma dujardini Nufer 1905 : 77, 79, 186
1910 Myxosoma dujardini Wegener 1910 : 72-73
1916 ?Myxosoma dujardini Kudo 1916 : 3

Habitat: Branchial lamellae of Scardinius erythrophthalmus L., Perca fluviatilis, Leuciscus rutilus L. and Cyprinus carpio L.; France, Frisches Haff, Kurisches Haff (February, April, May), Tokio (May), Switzerland.

Vegetative form: White cysts being branched, rounded, spherical or irregular; 1 to 1.5mm. in diameter.

Wegener's form 1 to 1.7mm. long.

Spore: Ovoidal, flattened, with attenuated anterior end which is slightly bent laterally. Two pyriform polar capsules at the anterior end. Sporoplasm without any iodicinophilous vacuole. Dimensions: length 12 to 13μ, breadth 7 to 8μ.

Wegener's form: polar capsules 6μ by 3μ.

Kudo's form: polar capsules 6 to 7μ by 2μ, length of polar filament 70μ.

MYXOSOMA (?) LOBATUM Nemeczek

[Fig. 348]

1911 Myxosoma (?) lobatum Nemeczek 1911 : 160-162

Habitat: Branchiae of Leuciscus leuciscus L. and Aspius rapax Ag.; Austria.

Vegetative form: Cysts spherical, oval or elongated; of white color. Size from 0.5 to 3mm. by 0.5 to 1mm. Those in Aspius rapax, oval to spindle-shape, 1 to 3mm. long and 1 to 1.5mm. wide.

Spore: Ovoidal; anterior end narrowly pointed and straight; posterior end rounded, with lobose appendix (about 6μ long). A transverse fold on the shell behind the polar capsules in fresh as well as preserved spores. No iodicinophilous vacuole. Dimensions: length 12.6μ, breadth 8.2μ, length of polar capsule 4.2μ, length of polar filament 80 to 90μ. Spores found in Aspius rapax, had slight difference in dimensions, the structure, however, being similar to the above.

Remarks: Nemeczek doubts if this form is really Myxosoma because of the following: 1) different shape of the cysts compared with that of the type species as described by Thélohan; 2) spores observed might develop later into other forms like Henneguya.
MYXOSOMA FUNDULI Kudo

[Figgs. 344 to 347]

1918 Myxosoma funduli Kudo 1918: 12-14

Habitat: Branchiae of Fundulus majalis Wal. and F. heteroclitus L; Woods Hole (August, September).

Vegetative form: Cysts. Spherical and small; 150μ in average diameter. Largest form observed 360μ by 264μ. Spores, young and mature, were found in the cysts. Polysporous.

Spore: Pyriform. Shell uniformly thick with 7 to 10 folds on sutural edge at the posterior portion. Sutural ridge, fairly well marked. Two polar capsules pyriform and of equal size at the anterior end. Sporoplasm finely granular with two nuclei but without any iodoniphilous vacuole. Dimensions: length 14μ, breadth 8μ, thickness 6μ, polar capsule 8μ by 2μ, length of polar filament 38 to 42μ (perhydrol, KOH).

Remarks: The writer could not find any evidence of an iodoniphilous vacuole by treatment with various iodine mixtures, which is the most important characteristic of the genus. Hahn's form (Myxobolus funduli, p. 151) should be distinguished from the present form.

Genus LENTOSPORA Plehn

1905 Lentospora Plehn 1905: 150

The characters of the genus are described on page 58.
Type species: Lentospora cerebralis (Hofer) Plehn.

LENTOSPORA CEREBRALIS (Hofer) Plehn

[Figgs. 349 to 354]

1903 Myxobolus cerebralis Hofer 1903: 8
1904 Myxobolus chondrophagus Hofer 1904: 53
1905 Lentospora cerebralis Plehn 1905: 145-166
1909 Lentospora cerebralis Plehn 1909: 38
1910 Lentospora cerebralis Auerbach 1910c: 176

Habitat: Cartilage and perichondrium of Trutta iridea Gibb., Salmo fontinalis Mitch., Trutta salar L.; Germany (Karlsruhe and other localities).

Vegetative form: Ameboid form. Size varies greatly. Small ameboid form probably grows up into large individual which has often fifty or more ringform nuclei and breaks up into numerous small forms by division. No sporous character is observed except a figure of a disporous form.

Spore: Circular in front view; lenticular in side view, with more or less extensive variation in length and breadth. Shell smooth. Sutural ridge distinctly thickened. Two polar capsules pyriform and convergent, are usually of same size. Extruded polar filaments cross each other. Sporoplasm with two ring-form nuclei but without any iodoniphilous vacuole.
Dimensions: diameter 6 to 10μ, length of polar capsule 2/5 that of the spore, length of polar filament 40 to 50μ (limewater, 1% KOH).

Remarks: Plehn noticed that the present form causes the chronic form of "Drehkrankheit" among young fish in German waters. She was unable to extrude the polar filament with mineral (?) acids. Auerbach, however, could extrude the filament by means of acids.

LENTOSPORA MULTIPLICATA Reuss
[Fig. 355]
1906 Lentospora multiplicata Reuss 1906 : 203

Habitat: Muscle of Idus melanotus Heck.; Volga?, Russia.
Vegetative form: Not described.
Spore: Oval. Sutural edge broad with many folds. No iodinophilous vacuole. Dimensions: length 12μ, breadth 9.5μ, thickness 6μ, polar capsules 4μ by 2.25μ.

LENTOSPORA ENCEPHALINA Mulsow
1911 Lentospora encephalina Mulsow 1911 : 483-485

Habitat: In the blood vessel of the brain, especially of the mid-brain of Cyprinus carpio L.; Munich (spring). Blood vessels are the only seat of infection. In most cases many individuals lie parallel to one another. The infection occurs frequently and heavily. The effect, however, is undetermined.
Vegetative form: Trophozoite elongated, worm-like and circular in cross section. The body is covered with a pellicula. The protoplasm is distinctly differentiated into homogeneous ectoplasm layer and inner endoplasm. In the latter are found numerous granules, small nuclei and spores.
Spore: Almost circular in front view; profile? No iodinophilous vacuole is found. The polar filament is easily extruded by means of a highly diluted KOH solution. Diameter: 5 to 5.5μ.

LENTOSPORA ASYMMETRICA Parisi
[Figs. 356 to 359]
1912 Lentospora asymetrica Parisi 1912 : 292-293

Habitat: Connective tissue of kidney of Crenilabrus pavo C. et V.; Napoli (September).
Vegetative form: One trophozoite found; a small, rounded form with thin and hyaline ectoplasm which could be distinguished from the endoplasm with coarse yellowish globules, containing two spores. Disporous?
Spore: Oval from the front; flattened and fusiform in profile. Sutural edge with many triangular folds, which are more clearly seen in material.
preserved in formalin than in fresh condition. Two polar capsules of same size, are situated asymmetrically, opening at the side near the anterior end. Sporoplasm granular and with two nuclei, but without any iodinophilous vacuole. The polar filament not being extruded by ordinary reagents, probably because the spores were not full-grown. Dimensions: length 10 to 11μ, breadth 6.5 to 7μ, length of polar capsules 5μ.

**LENTOSPORA ACUTA** (Fujita) Kudo
[Fig. 360 to 362]

1912 *Sphaerospora acuta* Fujita 1912 : 260-261

Habitat: Epithelium of branchial lamellae of *Carassius auratus* L.; Sapporo, Nippon.

Vegetative form: Fujita’s description is simply as follows: Sporoblast contains about two spores.

Spore: Spherical in front view, with slightly pointed anterior end; spindle shaped in side-views. Shell thin and smooth. Two convergent polar capsules are of different sizes, occupying about 5/8 in space of the spore. No vacuole could be made out in sporoplasm. Dimensions: length 8 to 10μ, breadth 7 to 8μ, thickness 5 to 6μ, polar capsules 5μ by 4μ.

Remarks: This species, recorded incompletely by Fujita as *Sphaerospora*, shows characters of the genus *Lentospora* in spore form so that it is provisionally placed here.

**LENTOSPORA DERMATOBIA** Ishii
[Fig. 594 to 596]

1916 *Lentospora dermatobia* Ishii 1916 : 472-474

Habitat: In the integument of *Anguilla japonica* Temm. et Schl.; Shizuoka, Nippon. From the same specimen which harboured *Myxidium anguillae*, see page 114. The number of cysts reaches probably “several hundreds.”

Vegetative form: Cysts, beneath the epidermis, usually subcircular, more or less irregularly triangular or quadrilateral under the magnifier, with the largest diameter of from 142 to 267μ. The epidermis is slightly lifted up by the cyst. No chromatophore on the surface of the cyst. The cysts separated from each other, are found mostly in the central region of the body, head and fins being free from cysts. In cross-section, cysts exhibit oval or lenticular shape with the longest diameter, which is twice as long as the depth, placed parallel to the surface of the skin. No particular pathological change was noticed.

Spore: Circular in front view; broad fusiform or lenticular in side view. Sutural ridge fairly distinct. Sutural edge comparatively broad, especially
at the posterior margin, where a few folds (three are figured) are seen. Two oval polar capsules convergent and of equal size. Sporoplasm is sharply contoured, no iodonophilous vacuole being recognized. Dimensions in preserved material (?): diameter 6.3 to 7μ, thickness 4.2 to 4.9μ, length of polar capsule 2.8 to 3.5μ.

Family MYXOBOLIDAE Thélohan

1892 Myxobolidae Thélohan 1892 : 173, 176
1893 Myxobolidae Gurley 1893 : 412, 413
1895 Myxobolidae Thélohan 1895 : 347

The characters of the family are described on page 58.

Genus MYXOBOLUS Bütschli

1882 Myxobolus Bütschli 1882 : Pl. 38 : 6-10

The characters of the genus are described on page 58.

Type species: Myxobolus mülleri Bütschli.

MYXOBOLUS MÜLLERI Bütschli

[Figs. 397 to 403]

Habitat: Air bladder and branchiae of Leuciscus cephalus L.; kidney and ovary of L. phoxinus L.; eye of Crenilabrus melops L. and Alburnus lucidus; branchiae of Aspro asper L., Barbus vulgaris Flem., Leuciscus rutilus L., Squalius cephalus L., S. agassizi Heckel, Lota vulgaris L., Phoxinus loevis Ag.; pseudobranchiae of Cottus gobio L.; intestine of Mugil auratus Risso.; France, Germany [Karlsruhe, Alle (October), Pregel, Frisches Haff], Switzerland (Neuchatell Lake), Italy (Napoli, September).

Vegetative form: White cysts in the connective tissue. Form elongated oval, 2 to 3mm. in diameter. No clear differentiation of protoplasm is observed even in young forms. In sections, some cysts show radiate striations in the thick granule-free ectoplasm. Endoplasm filled with nuclei.

Cépède writes as follows: Cysts in branchiae, subspherical or elliptical, 1.5mm. by 0.5mm.

Wegener’s form: Cysts small and rounded, 0.2 to 0.3mm. in diameter.

Spore: Ordinarily spherical or subspherical. Two polar capsules
with a small triangular intercapsular appendix. Polar capsules pyriform and of same size. Sutural edge exhibits folds (7 to 9).

Thélohan’s dimensions: length 10 to 12μ, breadth 9 to 11μ, length of polar capsule 5μ.

Cépède gave the following dimensions in vivo: length 10μ, breadth 9μ, thickness 6μ, length of polar capsule 5μ.

Wegener’s form. Usually oval, often almost spherical. Length 10 to 11μ, breadth 8 to 9μ, diameter of spherical form 9μ, polar capsule 4 to 5μ by 2 to 3μ.

MYXOBOLUS PIRIFORMIS Thélohan
[Figs. 363 to 364]

<table>
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<th>Year</th>
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<td>1883</td>
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<td>1891</td>
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<td>1891 : 132</td>
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<td><em>Myxobolus piriformis</em></td>
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<td><em>Myxobolus piriformis</em></td>
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<td>1910 : 22-27</td>
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<td><em>Myxobolus piriformis</em></td>
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Habitat: Branchiae, spleen, kidney of Tinca tinca L., Cobitis fossilis L. and subcutaneous connective tissue, spleen, liver, connective tissue of the intestine of Leuciscus sp.; France, Germany (Pregel), Switzerland.


Wegener’s form: average size, length 1mm., breadth 0.09 to 0.1mm

Spore: Elongated oval; flattened. Anterior end highly attenuated and slightly bent to one side. One pyriform polar capsule at this end. Dimensions: length 16 to 18μ, breadth 7 to 8μ, length of polar filament 30μ.

Wegener gives the following dimensions: length 18μ, breadth 7.5μ, polar capsule 7.5μ by 3.5μ.

MYXOBOLUS UNICAPSULATUS Gurley
[Figs. 365 to 366]

<table>
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<td><em>Myxobolus unicapsulatus</em></td>
<td>1894 : 210-211</td>
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Habitat: In the skin of Labeo niloticus For.; Nile.

Vegetative form: Cysts very small pustules in the skin of the head.
Spore: Form similar to *Myxosoma dujardini*. A single polar capsule at the anterior end, obliquely directed. Dimensions: length 0.0051", breadth 0.0034".

**MYXOBOLUS FUHRMANNI** Auerbach

[Fig. 367]

1909 *Myxobolus fuhrmanni* Auerbach 1909: 65-68
1910 *Myxobolus fuhrmanni* Auerbach 1910c: 178-179

Habitat: Connective tissue under the mucous membrane of the mouth of *Leuciscus rutilus* L.; Neuchatel Lake.

Vegetative form: Cysts, of pea-size, surrounded by several membranous layers of connective tissue with a few nuclei. Finely granular ectoplasm forms outer layer. Endoplasm is dense and contains faintly stained nuclei. Pansporoblasts and spores are found in the central portion of the cyst. Polysporous.

Spore: Elongated pyriform, with attenuated anterior and rounded posterior ends. Majority with a single polar capsule; spores with two polar capsules were also observed. Shell thick, at the posterior end. 4 to 6 notch-like markings on the posterior part of the shell. Sutural ridge thickened and fairly well marked. Coiled polar filament visible in preserved material. The opening of the polar capsule is either at the anterior end or near it. Sporoplasm with two nuclei of unequal size and a comparatively large iodinophilous vacuole, stained brown with iodine alcohol. Dimensions: length 18 to 20μ, breadth about 8μ, thickness 6μ, length of polar capsule 9 to 10μ.

**MYXOBOLUS OCULL-LEUCISCI** Trojan

[Fig. 368]

1909 *Myxobolus oculi-leucisci* Trojan 1909: 679-682

Habitat: Vitreous body of the eye of *Leuciscus rutilus* L.; Prague (May?).

Vegetative form: Two cysts, spherical and subspherical, 100 to 180μ in diameter. Ectoplasm finely granular. Outer portion of endoplasm with small nuclei, then larger nuclei each surrounded by protoplasm, while the central portion contains spores. Polysporous.

Spore: Elongated oval, flattened dorso-ventrally. Posterior margin rounded. At the anterior end, a single polar capsule with distinctly visible coiled polar filament. Shell smooth without any markings. Sporoplasm with one nucleus, usually elongated oval (2.8μ in diameter) and one vacuole, occupies more than half of the space of the spore. Dimensions: length 9 to 10μ, breadth 4.5 to 5.5μ, thickness 3μ, polar capsule 5μ by 2μ.
STUDIES ON MYXOSPORIDIA—KUDO

MYXOBOLUS TOYAMAI Kudo
[Figs. 369 to 370]

1915 Myxobolus toyamai Kudo 1915: 517-523
1917 Myxobolus toyamai Kudo 1917: 163-170

Habitat:—Connective tissue of branchial lamellae of Cyprinus carpio L.; Tokio (July).

Vegetative form: Cysts, ovoidal or in shape of calabash. Small form 67 by 50μ, shows clear differentiation of protoplasm. Ectoplasm radially striated, often, differentiates fine processes (2 to 3μ long). Endoplasm coarsely granular, contains nuclei from 1 to 4μ in diameter. Size up to 190μ in greatest diameter in sections. Two spores are formed in each pansporoblast. Polyssporous.

Spore: Pyriform, with attenuated anterior and rounded posterior ends. No bilateral symmetry. Lateral sides are curved. Calabash shaped spores often occur. Shell without any marking, thickened at the anterior end. Sutural ridge shows sometimes a short (1.5μ long) tail-like process at the posterior tip. A single pyriform polar capsule at the anterior end; in stained preparations, a small, oblong mass of protoplasm is seen between the polar capsule and the shell. Coiled polar filament distinct. Sporoplasm with two nuclei of usually same size and a relatively large iodo-nophilous vacuole, 3μ in diameter. Dimensions: length 15μ, breadth 7 to 8μ, thickness 5 to 6μ, polar capsule 7 to 8μ by 3 to 4μ, length of polar filament 40 to 45μ (pressure, perhydrol, KOH).

MYXOBOLUS NOTATUS Mavor
[Figs. 371 to 372]

1916 Myxobolus notatus Mavor 1916a: 70-71

Habitat: Connective tissue of the voluntary muscles on the sides or tail of Pimephales notatus Raf.; Georgian Bay, Canada (Summer).

Vegetative form: Cysts as large as 3mm. in diameter, are surrounded by a layer of columnar epithelial cells (origin and significance?) and a dense layer of connective tissue. Protoplasm is not clearly differentiated, tho the cyst is surrounded by an area devoid of nuclei. In the outer region of endoplasm, numerous nuclei each with a caryosome, are recognized. In the course of spore formation, two nuclei for polar capsules appear at first, one of which degenerates later. Polyssporous.

Spore: Pyriform, with a posterior extension forming a process, 5μ in length and as broad as the spore. A single polar capsule at the anterior end. An iodo-nophilous vacuole in the sporoplasm. Dimensions: length 17 to 18μ, breadth 7.5 to 8μ, polar capsule 7μ by 4μ, length of polar filament 95μ.
MYXOBOLUS sp. Kudo
1918 Myxobolus sp. Kudo 1918 : 15

Habitat: Spleen of Perca flavescens; West Falmouth, Mass. (August). Isolated spores were noticed in one fish, in smears and section preparations. Vegetative form: Not observed.

Spore: Ovoidal, attenuated at the anterior end. Shell uniformly thick. A single polar capsule opens at the anterior tip. Sporoplasm contains an iodinophilous vacuole and two nuclei of equal size (2μ). Dimensions: length 18 to 20μ, breadth 8μ, polar capsule 7 to 9μ by 3 to 6μ.

MYXOBOLUS ROHITAE Southwell et Prashad [Figs. 373 to 374]
1918 Myxobolus rohitae Southwell et Prashad 1918 : 344-347

Habitat: Branchiae of Labeo rohita; Turag river, Mirpur, Dacca district, Bengal (June). Type specimens of Indian Museum P48/1. Infection was heavy. In one case 53 cysts were found on one surface of a single gill.

Vegetative form: Cysts in the gill-filaments. The cysts preserved in alcohol are of a creamy-yellow color, oval to cylindrical in form, lying with the long axis parallel to the gill-filaments. Cysts attached to the gill-filaments with the flattened surface. Size: length 3.1 to 3.8mm.; breadth 0.8 to 1.2mm. Cyst-wall striated vertically, covered with an epithelium, two to three layers thick. In the central portion and at the periphery, mature spores and pansporoblasts as well as immature spores were found respectively. Polysporous.

Spore: Elongated pyriform, rounded at the posterior end and acutely pointed anteriorly. Sutural ridge slightly raised. One polar capsule present, being of conspicuous size. Coiled polar filament is distinctly observed in the polar capsule. An iodinophilous vacuole, 3.6μ in diameter, in the sporoplasm. "Lying just posterior to it is the nucleus of the spore. A few granules of chromatin were also seen lying scattered in the protoplasm." Dimensions: length 30 to 32μ, breadth 7 to 8μ, length of the polar capsule 22 to 23μ, that of polar filament 92 to 97μ.

MYXOBOLUS SENI Southwell et Prashad [Figs. 375 to 376]
1918 Myxobolus seni Southwell et Prashad 1918 : 347

Habitat: On the median and caudal fins of Labeo rohita; Mirpur, Dacca (January). Type specimens in Indian Museum numbered P 53/1.

Vegetative form: Trophozoites form cysts which are elongated ellipsoidal. Size from 4.7mm. to 5.4mm. in length, 2.9mm. to 3.7mm. in
breadth. Color of the cyst whitish with black scattered granules on the surface.

Spore: Oval, much wider behind than in front and pointed at the anterior end. Sutural ridge is slightly thickened. A single polar capsule, showing much coiled polar filament. Iodinophilous vacuole 2.3μ in diameter. Dimensions: length 13.2 to 13.6μ, breadth 10.1 to 10.3μ, length of polar capsule 4μ, length of polar filament 43μ (in one case).

**MYXOBOLUS MISGURNI** nov. spec.  
[Figs. 377 to 378]  
1916 *Myxobolus fuhrmanni* Kudo 1916 : 5  

Habitat: Gall-bladder of *Misgurnus anguillicaudatus*; Tokio (September). About 50% of the fish examined showed a few isolated spores floating in the bile.

Vegetative form: Unobserved.

Spore: Form elongated pyriform, with attenuated anterior and rounded posterior ends. Shell uniformly thick. Over sutural edge, shell exhibits many (up to 12) triangular markings. Sutural ridge distinct. A single pyriform polar capsule at the anterior end. Sporoplasm contains an iodinophilous vacuole and two nuclei. Coiled polar filament distinct in vivo. Dimensions of fresh spores: length 14 to 15.5μ, breadth 6 to 7.3μ, thickness 5 to 6μ, polar capsule 6.3μ by 2 to 3μ, length of polar filament up to 100μ.

Remarks: The writer reported this species as identical with *Myxobolus fuhrmanni* Auerbach. By repeated reexamination and comparison with Auerbach's description, however, he came to the conclusion that the present form should be treated as a new species, on account of the difference of the host and the characters of the spore.

**MYXOBOLUS PFEIFFERI** Thélohan  
[Figs. 379 to 385]  
1890 *Myxosporidian* Pfeiffer 1890 : 30–37  
1891 *Myxosporidian* Pfeiffer 1891 : 100, 105–110, 130  
1893 *Myxosporidian* Pfeiffer 1893 : 118–130  
1895 *Myxobolus pfeifferi* Thélohan 1895 : 350  
1898 *Myxobolus pfeifferi* Dollein 1898 : 306, 320, etc.  
1906 *Myxobolus pfeifferi* Cépède 1906 : 59  
1906 *Myxobolus pfeifferi* Stazzi 1906 : 14–19  
1908 *Myxobolus pfeifferi* Keyssellitz 1908 : 253–273, 286–306  
1909 *Myxobolus pfeifferi* Mercier 1909 : 5–30
Habitat: Muscle and connective tissue of kidney, spleen, intestine, ovary, etc., of Barbus barbus L., and branchiae of B. fluviatilis Ag. and B. plebejus Val.; Drac (June), Neckar, Prag, Milano. The cause of well known "Boil disease" (Beulenkrankheit) or Myxoboliasis tuberosa (Hofer) of the barbels in European waters. Among many observers Keysselitz made a thoro study of the parasite. His observations are as follows: The disease occurs among the fish at any stage of growth. About 8% of the fish, 7 to 15cm. long, caught in May and June between Conz and Trier were infected with the parasites. The heaviest infection, however, occurs among fish up to 40cm. in length; fish 50cm. long or larger show the tumors caused by the parasites, rather rarely. Most of the fish die as the result of the infection between the early part of April and the end of October. The highest mortality is reached in the hottest months, i.e., July and August. The temperature greatly affects the growth of the parasites. Fish kept in the aquarium at a temperature of 25° C. or higher demonstrate the growth of the boil in size daily. The boils are not noticed during the winter and spring, they are formed from the early part of April to the middle of October.

Vegetative form: The parasites develop tumors of conspicuous size.

Keysselitz's observations are as follows: The tumor varies in size from millet-grains to hen's eggs. Form spherical, oval or elongated. The number of cysts on a single fish, is usually 3 to 4; often one, in some fish, however, 23 were recognized on one fish. Usually tumors separated from each other, rarely many forming one tumor. In one fish, 27cm. in length, a tumor of 7cm. long, 4cm. broad and 3cm. thick, was observed in July. The seat of infection is: the muscle of the body, muscle of pectoral and anal fins, often in peritoneum and rarely in intestine. As the result of breaking up of the cyst membrane, spores are also found in the testis, liver and kidney.

The tumor is composed of many vegetative forms, rounded, oval, elongated, variously branched or flattened. Size reaches to 1.5mm. in diameter. Protoplasm is usually differentiated into ectoplasm and endoplasm. The surface is not often smooth, but shows irregular outline. Ectoplasm is seen often as a very thin, uniformly hyaline, indistinctly granular or radially striated layer, giving the network-like appearance to the surface of the body. Endoplasm, stained more deeply around the peripheral part than other portion, shows a coarsely alveolar structure in the central region. It contains vegetative nuclei, developmental stages of propagative nuclei, granules, fat-like, often leucocytes and red blood corpuscles. The leucocytes, uninuclear or multinuclear, were seen at the periphery, apparently in the course of degeneration. Red blood corpuscles were found, in section, inside of the apparently intact parasite. Each pansporoblast develops into two spores. Polysporous.
Cépède observed one cyst, about 2mm. in diameter, in the connective tissue of the third gill arch.

Spore: Thélohan described as follows: Ovoidal. Sutural edge shows folds. A small triangular intercapsular appendix. Dimensions: length 12μ, breadth 10μ. Cépède’s form showed exactly the same dimensions.

Keysselitz gave the characters of the spore as follows:
- Flattened oval. Shell smooth. A small intercapsular appendix. Sutural edge having a number of small flat enlargement, size and number being variable. Two convergent narrow canals (foramina) penetrate the shell at the anterior end. Two polar capsules, pyriform and of equal or nearly equal size, are located at the anterior half. Coiled polar filament distinct, coiled 7 to 8 times. No distinct connection between polar capsule and the filament. Sporoplasm fills the posterior half of the spore, extending into intercapsular cavity. It is finely reticular, exhibits one or two rounded or oval vesicular nuclei and an iodinophilous vacuole. Fat-like substance is often seen around the polar capsules. Spores kept in water for four months remain intact in large numbers. Dimensions: length 12 to 12.5μ, breadth 10 to 10.5μ, length of polar capsule, 5.5 to 6μ, length of polar filament 28 to 34μ.

**MYXOBOLUS INAEQUALIS** Gurley

*Fig. 411*

1841 Müller 1841: 487-488
1893 Myxobolus inaequalis Gurley 1893: 414
1894 Myxobolus inaequalis Gurley 1894: 212

Habitat: In the skin of the head of *Piramutana blochi* Cuv. et Vil. and *Synodontis schall* Bl. Schn.; Guiana, Surinam.

Vegetative form: Very small pustules in the skin of the head.

Spore: Ovoidal. Two polar capsules of unequal size at the anterior end. Dimensions: length 0.0052″, breadth 0.0033″.

**MYXOBOLUS DISPAR** Thélohan

*Fig. 386*

1895 Myxobolus dispar Thélohan 1895: 348
1904 Myxobolus dispar Hofer 1904: 50
1910 Myxobolus dispar Wegener 1910: 73-74
1911 Myxobolus dispar Nemeczek 1911: 145

Habitat: Branchiae of *Carassius carassius* L., branchiae and epithelium of intestine of *Cyprinus carpio* L., also muscle and spleen of *Scardinius erythrophthalmus* L. and in the skin and the connective tissue of *Alburnus lucidus* Heck.; France, Austria, Königsburg (March, July, September).

Vegetative form: Not described by Thélohan.

Wegener's description is as follows: Cysts: white in color; spindle shape with pointed ends. Cysts in *Carassius carassius* L. smaller and oval.
Size 3.5mm. by 0.8mm. Cysts are surrounded by thick layers (7 to 8μ) of the connective tissue of the host. Ectoplasm seems to be undifferentiated. Endoplasm granular, contains a larger number of spores. Polysporous.

Spore: Thélohan’s diagnosis is as follows:

Ellipsoidal or slightly oval. Shell with 3 to 5 folds along sutural edge. Polar capsules of unequal size, with a small intercapsular body. The vacuole is difficult to stain with iodine. Dimensions: length 10 to 12μ, breadth 8μ, polar capsule 7μ by 5μ.

Wegener’s form is as follows: length 11 to 12μ, breadth 7.5 to 8μ, larger polar capsule 6 to 7μ by 3.5μ, smaller one 4μ by 2.5 to 3μ. The sporoplasm is shifted toward the smaller polar capsule.

**MYXOBOLUS ELLIPSOIDES** Thélohan

[Fig. 387 to 389]

<table>
<thead>
<tr>
<th>Year</th>
<th>Species</th>
<th>Remak</th>
<th>Year</th>
<th>Diagnosis</th>
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<td>1852</td>
<td><em>Myxobolus ellipsoides</em></td>
<td>Thélohan</td>
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<td>1892</td>
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<td>1892</td>
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<td>1895</td>
<td><em>Myxobolus ellipsoides</em></td>
<td>Thélohan</td>
<td>1895</td>
<td>350-351</td>
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<tr>
<td>1898</td>
<td><em>Myxobolus ellipsoides</em></td>
<td>Dolein</td>
<td>1898</td>
<td>324, etc.</td>
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<tr>
<td>1905</td>
<td><em>Myxobolus ellipsoides</em></td>
<td>Nufer</td>
<td>1905</td>
<td>77, 79, 186.</td>
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<tr>
<td>1910</td>
<td><em>Myxobolus ellipsoides</em></td>
<td>Wegener</td>
<td>1910</td>
<td>74-75</td>
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<tr>
<td>1912</td>
<td><em>Myxobolus ellipsoides</em></td>
<td>Lo Giudice</td>
<td>1912</td>
<td>1-79</td>
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</table>


Vegetative form: Thélohan does not describe.

According to Wegener, white cysts, elongated oval; 2mm. by 0.5mm. in size. Polysporous.

Spore: Thélohan described as follows: Flattened elliptical, rather elongated. Sutural edge broad without any folds. Shell with no marking. Form of the spore somewhat variable. Two polar capsules of equal size, capsulogenous nuclei present even when fully grown. Abnormal spores are of frequent occurrence. Dimensions: length 12 to 14μ, breadth 9 to 11μ, length of polar capsule 4μ.

Wegener’s form: length 14 to 15μ, breadth 10 to 11μ, polar capsule 4 to 5μ by 3μ. Shell comparatively thick. One spore had a tail 5μ long.

**MYXOBOLUS EXIGUUS** Thélohan

[Fig. 390 to 395]

<table>
<thead>
<tr>
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<th>City</th>
<th>Year</th>
<th>Diagnosis</th>
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<td>1891</td>
<td><em>Myxosporidium mugilis</em> ?</td>
<td>Perugia</td>
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<td>1895</td>
<td><em>Myxobolus exiguum</em></td>
<td>Thélohan</td>
<td>1895</td>
<td>349-350</td>
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<td>1906</td>
<td><em>Myxobolus exiguum</em></td>
<td>Schröder</td>
<td>1906</td>
<td>195</td>
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<td>1910</td>
<td><em>Myxobolus exiguum</em></td>
<td>Wegener</td>
<td>1910</td>
<td>75</td>
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<tr>
<td>1912</td>
<td><em>Myxobolus exiguum</em></td>
<td>Parisi</td>
<td>1912</td>
<td>294-295</td>
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</table>

Vegetative form: No description by Thélohan.

Wegener writes as follows:

Cysts of variable size. Color white. Usually small and narrow, 0.5 to 0.7mm. long and 0.2mm. wide. Frequently large round cysts of 1.2 to 1.5mm. in diameter, filling the lamella. Cysts are surrounded by 10 to 11μ thick membrane composed of the connective tissue of the host. Ectoplasm, 5μ thick, is faintly stained by hematoxylin. Outer region of endoplasm, alveolar and densely loaded with nuclei, while in the central portion with mature spores in granular ground-mass.

Parisi's observations are as follows:

Cysts in the intestinal wall of Mugil auratus, large; reaching a length of 3mm.

Spore: Thélohan's description is as follows:

Flattened ovoidal, with more or less attenuated anterior end. Sutural edge shows fairly noticeable folds. A small triangular intercapsular appendix. Vacuole in the sporoplasm is usually hard to stain with iodine. Dimensions: length 8 to 9μ, breadth 6 to 7μ, length of polar filament 15μ (KOH).

Wegener observed as follows: Rounded with slightly pointed anterior end. Length 8 to 9.5μ, breadth 6 to 7.5μ, polar capsule 4.5μ by 2 to 3μ. Shell exhibits small folds around the sporoplasm. An intercapsular triangular body indistinctly visible.

Parisi gave the following dimensions: length 8 to 8.5μ, breadth 6 to 7μ, thickness 5.5μ, polar capsule 3 to 4μ by 1.5 to 2μ, length of polar filament 30μ (alkaline). Folds usually 6 in number. Coiled polar filament visible in vivo.

MYXOBOLUS OVIFORMIS Thélohan

[Fig. 396]

<table>
<thead>
<tr>
<th>Year</th>
<th>Species</th>
<th>Authors</th>
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<td>1854</td>
<td>Myxobolus oviformis</td>
<td>Lieberkühn</td>
<td>1854 : 21-22</td>
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<td>1892</td>
<td>Myxobolus oviformis</td>
<td>Thélohan</td>
<td>1892 : 177</td>
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<td>1895</td>
<td>Myxobolus oviformis</td>
<td>Thélohan</td>
<td>1895 : 351</td>
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<td>1905</td>
<td>Myxobolus oviformis</td>
<td>Nüfer</td>
<td>1905 : 77, 186</td>
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<td>1906</td>
<td>Myxobolus oviformis</td>
<td>Cépède</td>
<td>1906 : 60</td>
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<tr>
<td>1910</td>
<td>Myxobolus oviformis</td>
<td>Wegener</td>
<td>1910 : 76-78</td>
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</table>

Habitat: Fin (subcutaneous tissue), spleen, kidney and liver of Gobio gobio L.; branchiae of Alburnus lucidus Heck., Cyprinus carpio L., Blicca björkna L., Abramis brama L. and A. vimba L.; France (Isère), Frisches Haff (especially spring months), Switzerland.
Vegetative form: Thélohan gave no description.
Wegener’s observations are as follows:
Cysts, white, 0.75 to 1.7mm. by 0.4 to 0.7mm. In sections, cysts are shown to be surrounded by a thick (10 to 20μ, average 16μ) layer of connective tissue. Ectoplasm a thin (6 to 8μ thick) layer, exhibits a transverse striation. The striation is often absent at places in ripe cysts. Endoplasm finely granular. In young cysts, it is, however, reticulated, with nuclei of 1.5μ in diameter.

Spore: Thélohan described as follows: Flattened ovoid with pointed anterior end. Shell smooth. No folds. Polar capsule comparatively large. Dimensions: length 10 to 12μ, breadth 9μ, polar capsule 6μ.

Cépède observed numerous spores in the liver and kidney of Gobio gobio. Dimensions in vivo: length 10 to 12μ, breadth 9μ, length of polar capsule 6μ. Polar capsules of equal size. Coiled polar filament distinct.

Wegener’s form: length 10.5 to 11μ, breadth 7.5 to 8μ, polar capsule 5 to 6μ by 3μ.

Remarks: Wegener recognized another form, which seems to be of very rare occurrence and which can not be distinguished distinctly from the above described form. Cysts at the end of the branchial lamellae. Size 1.7 to 2mm. in largest length. Spore resembles more closely the figure given by Thélohan for Myxobolus oviformis than the above mentioned form which he observed. A small intercapsular appendix (rounded) indistinct. Sporoplasm comparatively small. Length 12.5 to 13.5μ, breadth 9μ, polar capsule 7.5μ by 3μ.

**MYXOBOLUS LINTONI** Gurley

[Figs. 404 to 408]

<table>
<thead>
<tr>
<th>Year</th>
<th>Species</th>
<th>Author 1</th>
<th>Author 2</th>
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<tr>
<td>1891</td>
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<td>Linton</td>
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<td>1891: 99-102</td>
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<td>1893</td>
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<td>Gurley</td>
<td>1893: 414</td>
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<tr>
<td>1894</td>
<td><em>Myxobolus lintoni</em></td>
<td>Gurley</td>
<td>1894: 238</td>
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Habitat: Superficial musculature and subcutaneous tissue of *Cyprinodon variegatus*; Woods Hole (August).

Vegetative form: Cysts, not closed, but fungoid masses of an irregular shape, varying in size from 4mm. by 2.5mm. to 10mm. by 4mm., projecting as much as 3mm. above general surface of skin. The skin of the host overlying these tumors, is more or less cracked and broken, the scales being scattered.

MYXOBOLUS GLOBOSUS Gurley
[Fig. 409 and 410]

1893 Myxobolus globosus Gurley 1893: 415
1894 Myxobolus globosus Gurley 1894: 241

Habitat: Branchial lamellae of Erimyzon succetta oblongus Lac. (Catostomus tuberculatus Le Sueur); Kinston (N.C.), Columbia, (S.C., March), tributaries of Fox River.

Vegetative form: Cysts, whitish, elongated elliptical or rod-shaped, surrounded by very thin membrane? Size up to 0.5mm. in max. length. Polysporous.

Spore: Globose, subcircular in outline. Shell thin and very transparent. Sutural ridge very wide, being one third of the thickness of the spore. Polar capsules two, of equal size, divergent. Vacuole present, but not clearly contoured. Dimensions: length 7 to 8μ, breadth 6 to 7μ, thickness 5μ.

MYXOBOLUS OBLONGUS Gurley
[Fig. 412 to 416]

1841 Myxobolus oblongus Müller 1841: 487-490
1893 Myxobolus oblongus Gurley 1893: 414
1894 Myxobolus oblongus Gurley 1894: 234-238

Habitat: Beneath the skin, chiefly of the head of Erimyzon succetta oblongus Lac. (Catostomus tuberculatus Le Sueur); Kinston, tributaries of Fox River.

Vegetative form: Cysts, round or elliptic, not over 1mm. in diameter, covered by resistant membrane. Color whitish. Polysporous.

Spore: Spatular, approaching roundish-oblong. Shell thin and transparent. Sutural ridge wide. Two polar capsules, pyriform, of equal size. Sporoplasm extending forward along the upper surface. Vacuole could not be detected. Dimensions: length 14 to 17μ, breadth 8.5μ, thickness 5 to 6μ.

MYXOBOLUS TRANSOVALIS Gurley
[Fig. 417 and 418]

1893 Myxobolus transovalis Gurley 1893: 415
1894 Myxobolus transovalis Gurley 1894: 242

Habitat: Under scales on external surface of Phoxinus (Clinostomus) funduloides Girard; 4 Mile Run, Carlisle, Va., tributary of Potomac River (June). No fish of the same species caught from the same locality on August 29 of the same year was found infected.

Vegetative form: It is not certain whether cysts exist or not. Spores in mass, appear to be held together by a small gelatinous or mucoid mass
which has no attachment to the subjacent connective tissue. It forms a thin discoidal mass situated in the center of the concave surface of the scale. The color of the mass slightly more yellowish than the surrounding tissue, when coagulated. It is exceedingly difficult to detect its presence in the fresh state.

Spore: Elliptical, with the largest diameter passing thru two polar capsules. Shell thin. Sutural edge narrow. Two polar capsules of equal size convergent. Polar filament is extruded under the action of glycerine and sulphuric acid. The vacuole in the sporoplasm is difficult to detect. Sporoplasm also contains two nuclei, rarely one, 1 to 1.5μ in diameter. Dimensions: length 6 to 7μ, breadth 8μ.

**MYXOBOLUS OBESUS** Gurley  
[Figs. 419 and 420].

<table>
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<th>Year</th>
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<td>Balbiani</td>
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<td><em>Myxobolus obesus</em></td>
<td>Gurley</td>
<td>1893 : 415</td>
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<td><em>Myxobolus ? obesus</em></td>
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<td>1894 : 239</td>
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<td>1899</td>
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<td>Labbé</td>
<td>1899 : 100</td>
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<tr>
<td>1906</td>
<td><em>Myxobolus obesus</em></td>
<td>Cépède</td>
<td>1906 : 60-61</td>
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Vegetative form: Balbiani gave no observation.

Cépède observed as follows: Cysts, ovoidal, more or less elongated or variable in form, not exceeding 800μ in length. In kidney, numerous cysts were of subspherical, ovoidal or rarely irregularly elongated form. Subspherical cysts 500 to 600μ in average diameter. Polysporous.

Spore: Cépède describes as follows: Subcircular or ovoidal in front view; lenticular in side view. Sutural edge exhibits variable numbers (4 to 5) of fold-like markings on the shell. Polar capsules pyriform and of equal size. Coiled polar filament distinct. A small triangular intercapsular appendix. Sporoplasm with a subspherical and clearly outlined vacuole and two nuclei. Dimensions in vivo: length 11.5 to 12μ, breadth 7.5 to 8μ, thickness 5μ. Those of fixed and stained spores: length 11.25 to 11.50μ, breadth 7.25 to 7.50μ, length of polar capsule 5μ.

Remarks: Cépède mentions that *Alburnus alburnus* L. mentioned by Gurley is “without doubt” identical with *A. lucidus* Heckel.

**MYXOBOLUS CYCLOIDES** Gurley  
[Fig. 421]  

<table>
<thead>
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<td>1841</td>
<td><em>Myxobolus cycloides</em></td>
<td>Müller</td>
<td>1841 : 481, 486</td>
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<td>1893</td>
<td><em>Myxobolus cycloides</em></td>
<td>Gurley</td>
<td>1893 : 415</td>
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<td>1906</td>
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<td>Cépède</td>
<td>1906 : 61-63</td>
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<td>1910</td>
<td><em>Myxobolus cycloides</em></td>
<td>Wegener</td>
<td>1910 : 79-80</td>
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</table>

Vegetative form: Wegener observed cysts as follows. A type: 1 to 2mm. by 0.4 to 0.7mm. Form exactly like that of Myxobolus oviformis. B type: small and round, present in groups. C type: small 0.5mm. by 0.2mm.

Spore: Gurley gave the following short diagnosis from the observations of J. Müller: subcircular-ovate or broadly rounded elliptic, length 12μ.

Cépède distinguishes three different types of spores as follows: Lenticular in side view; subcircular (13.5μ by 13μ), oval (14.7μ by 11.4μ) and ovoidal (16μ by 11μ) in front view. Two polar capsules of equal size (6μ by 4μ), closely set or separated (3μ apart) from each other. Coiled polar filament distinct. A small triangular intercapsular appendix. Sporoplasm refractive and finely granular. Sutural edge exhibits folds of variable number at the posterior portion. Dimensions of fixed and mounted spores: length 10.5 to 12μ, breadth 7.5 to 8μ.

Wegener, without noticing Cépède’s paper, also mentions three different types chiefly distinguished by the spore as follows:

A type (common form), in the branchiae of Lota lota, Abramis brama, A. vimba, Blicca björkna, Leuciscus rutilus, Alburnus alburnus and scardinius erythrophthalmus. Cysts mentioned above.

Spore. Rounded or oval; flattened. A tail, 15μ long, was noticed twice. A triangular intercapsular appendix. Sutural edge usually having folds. Polar capsules often differ in form and size in different cysts, tho they are constant in one and the same cyst, causing the variability in size of sporoplasm. Dimensions: length 11 to 12.5μ, breadth 8 to 9μ, polar capsule 4.5 to 6μ by 3 to 3.7μ, in many cysts, 7.5μ by 4μ.

B type. In the fifth gillarch of Gobio gobio L. Cysts mentioned above.

Spore. Elongated oval. A triangular intercapsular appendix. Indistinct folds on sutural edge. Dimensions: length 12.5 to 13.5μ, breadth 8 to 10μ, polar capsule 5 to 6μ by 3 to 4μ.

C type. In the branchiae of Rhodeus amarus Bl. and Alburnus alburnus L. (April and May). Cysts mentioned above.

Spore. Rounded. Distinct intercapsular appendix. Folds distinct on sutural edge. Dimensions: length 12 to 15μ, breadth 9 to 10μ, polar capsule 5 to 7μ by 3 to 4μ.

**MYXOBOLUS SPHAERALIS** Gurley

<table>
<thead>
<tr>
<th>Year</th>
<th>Species</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>1874</td>
<td><em>Myxobolus sphaeralis</em></td>
<td>Claparède</td>
</tr>
<tr>
<td>1893</td>
<td><em>Myxobolus sphaeralis</em></td>
<td>Gurley</td>
</tr>
<tr>
<td>1894</td>
<td><em>Myxobolus sphaeralis</em></td>
<td>Gurley</td>
</tr>
</tbody>
</table>
Habitat: Mucosa of branchiae of *Coregonus lavaretus L.* (*C. fera*); Lake Geneva.

Vegetative form: Cysts, 0.25 to 0.33mm. in diameter. Polysporous.

Spore: Spherical, 9µ in diameter.

**MYXOBOLUS ANURUS** Cohn

[Figs. 422 and 423]

<table>
<thead>
<tr>
<th>Year</th>
<th>Species</th>
<th>Author</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1895</td>
<td><em>Myxobolus anurus</em></td>
<td>Cohn</td>
<td>1895 : 42-43</td>
</tr>
<tr>
<td>1896</td>
<td><em>Myxobolus anurus</em></td>
<td>Cohn</td>
<td>1896 : 266</td>
</tr>
<tr>
<td>1899</td>
<td><em>Henneguya psorospermica anura</em></td>
<td>Labbé</td>
<td>1899 : 102</td>
</tr>
<tr>
<td>1910</td>
<td><em>Myxobolus anurus</em></td>
<td>Wegener</td>
<td>1910 : 76</td>
</tr>
<tr>
<td>1911</td>
<td><em>Henneguya psorospermica anura</em></td>
<td>Nemeczék</td>
<td>1911 : 146</td>
</tr>
</tbody>
</table>

Habitat: Branchiae of *Esox lucius L.*; Königsberg (March, December), Frisches Haff, Pregel, Masurische See, Lotzen, (September, October).

Vegetative form: Cysts small rounded and of white color. Cohn measures length 0.6mm., breadth 0.34mm. Wegener’s form: length 0.3 to 0.5mm., and breadth 0.2 to 0.3mm.

Spore: Cohn’s descriptions are as follows: More or less oval. Dimensions: length 12 to 15µ, breadth 4 to 6.8µ, polar capsule 5.5 to 7µ by 2.1 to 2.5µ, length of polar filament 32 to 38µ.

Wegener’s form: Elongated and narrow, often with a tail. Dimensions: length 15µ (maximum up to 18µ), breadth 6 to 7µ, polar capsule 8µ by 3µ.

Remarks: Tho Labbé classified this as a subspecies of *Henneguya psorospermica* Thélohan, Wegener’s observation gives stronger basis for placing this form in the genus Myxobolus.

**MYXOBOLUS sp.** Gurley

[Fig. 424]

<table>
<thead>
<tr>
<th>Year</th>
<th>Species</th>
<th>Author</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1882</td>
<td><em>Myxobolus sp. incert.</em></td>
<td>Bützchli</td>
<td>1882 : 590</td>
</tr>
<tr>
<td>1894</td>
<td><em>Myxobolus sp. incert.</em></td>
<td>Gurley</td>
<td>1894 : 214</td>
</tr>
<tr>
<td>1899</td>
<td><em>Myxobolus sp.</em></td>
<td>Labbé</td>
<td>1899 : 100</td>
</tr>
</tbody>
</table>

Habitat: *Nais lacustris* L. (*N. proboscidea*); Locality?

Vegetative form: Cysts, 8mm. by 4.25mm. Polysporous.

Spore: Oval or circular; tailed or untailed. These spores of different form occur, often, without order in the same cyst.

**MYXOBOLUS sp.** Gurley

[Fig. 425]

<table>
<thead>
<tr>
<th>Year</th>
<th>Species</th>
<th>Author</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1894</td>
<td><em>Myxobolus sp. incert.</em></td>
<td>Gurley</td>
<td>1894 : 239</td>
</tr>
</tbody>
</table>

Habitat: Body cavity of *Carassius carassius* L.; Leipsic.

Vegetative form: Not observed.
Spore: Broadly elliptic; shell bivalve; valves equally convex. Sutural ridge. Two equal polar capsules. Sporoplasm with a vacuole. Dimensions: length 14\(\mu\), breadth 10\(\mu\), thickness 5\(\mu\).

Remarks: This species seems to be very similar to \textit{M. carassii} Klokováewa (page 150).

\textbf{MYXOBOLUS} \textit{sp.} Gurley

[\textit{Figs. 426 to 429}]

\begin{tabular}{ll}
1841 & Müller 1841 : 480 \\
1894 & \textit{Myxobolus} \textit{sp.} Gurley 1894 : 240-241 \\
1899 & \textit{Myxobolus} \textit{sp.} Labbé 1899 : 100
\end{tabular}

Habitat: Skin of opercle, in the branchiae, on the head or on the fin of \textit{Lucioperca lucioperca} \textit{L.}; Germany, Don.

Vegetative form: Cysts 1.09 to 2.18mm. in diameter. Color whitish. Polysporous.

Spore: Rounded. Thickness equal to half the breadth. Sutural ridge. Two polar capsules, of equal size, converging.

\textbf{MYXOBOLUS CYPRINI} Doflein

[\textit{Figs. 430 to 432}]

\begin{tabular}{ll}
1896 & Hofer 1896 : 2, 38-39 \\
1898 & \textit{Myxobolus} \textit{cyprini} Doflein 1898 : 288, 320, 325 \\
1904 & \textit{Myxobolus} \textit{cyprini} Hofer 1904 : 66-67 \\
1909 & \textit{Myxobolus} \textit{cyprini} Doflein 1909 : 780-783 \\
1916 & \textit{Myxobolus} \textit{cyprini} Doflein 1916 : 1026-1027
\end{tabular}

Habitat: Suppurative connective tissue and epithelium of kidney, liver and spleen of \textit{Cyprinus carpio} \textit{L.}, rarely \textit{Tinca vulgaris} Cuv. and \textit{Abramis brama} \textit{L.}; Germany, Austria. According to Hofer the parasites cause so-called “small pox of carp” among carp in German waters.

Vegetative form: Small ameboid. Form irregular. The youngest form with a single or many nuclei, is found in the epithelium of the kidney. Multiplication by multiple division, the nuclei undergoing amitotic division. Endoplasm contains homogeneous, yellow and refractive bodies. Also found in the state of diffuse infiltration. Spores are found in the parenchym of the kidney.

Spore: Oval. Shell thickened (1.5\(\mu\) wide) along the sutural edge. Two converging polar capsules cross each other, in front view, at the anterior tip. Sporoplasm with an iodinophilous vacuole. Dimensions: length 21\(\mu\), breadth 15\(\mu\), length of polar capsule 6\(\mu\). Doflein (1916:1027) gives the following dimensions: length 10 to 16\(\mu\), breadth 8 to 9\(\mu\).

Hofer gives the following dimensions: length 10 to 12\(\mu\) (up to 16\(\mu\)), breadth 8 to 11\(\mu\), polar capsule 5 to 6\(\mu\) by 3\(\mu\), sutural edge 1.5\(\mu\).
MYXOBOLUS NEUROBIUS Schuberg et Schröder

[Figs. 433 to 436]

1905 Myxobolus neurobius Schuberg and Schröder 1905: 49-56

Habitat: Nervous tissue of Trutta fario L.; Gutach (May?).

Vegetative form: Cysts, usually elongated, often spherical. Elongated form 0.9mm. by 0.02mm. The seat of the cysts is between the medullary sheath and sheath of Schwann. Neither medullary sheath nor axis-cylinder was infected. Cyst-membrane could not be made out. Cysts contained only full-grown spores without any younger stage. Polysporous.

Spore: Broad oval in front view; spindle shaped in side view. Anterior end attenuated, posterior end rounded. Shell somewhat thick. Sutural ridge is not particularly marked. Edge without any fold. No intercapsular appendix. Sporoplasm, with a large and spherical iodinophilous vacuole and a single nucleus, occupies less than one half of the inner space of the spore. Two polar capsules, pyriform, fuse into one at the anterior end. Coiled (8 to 10 times) polar filament distinct. Dimensions: length 10 to 12μ, breadth 8μ, thickness 6μ, polar capsule 6 to 7μ by 2μ.

MYXOBOLUS AEGLEFINI Auerbach

[Figs. 437 to 441]

1906 Myxobolus aeglefini Auerbach 1906: 568-570
1906 Myxobolus aeglefini Auerbach 1906a: 115-119
1907 Myxobolus esmarkii Johnstone and Woodcock 1907: 204-208
1909 Myxobolus aeglefini Auerbach 1909: 76-78
1910 Myxobolus aeglefini Auerbach 1910c: 181-182
1911 Myxobolus aeglefini Nemeczek 1911: 162


Vegetative form: Cysts in cartilage and bone of cranium and in cartilaginous layer of the sclerotic of the eye. Protoplasm is distinctly differentiated. Ectoplasm somewhat vacuolated; endoplasm granular with numerous small nuclei. Polysporous.

Johnstone's observations are as follows: Round the peripheral part of the cornea, and covered loosely by conjunctiva are a number of milk-white rounded or oval bodies, from about 1 to 3mm. in diameter. Several of these fused to form elongated mass which lie along the curvature of the periphery of the eye. These cysts also invade the lateral and posterior parts of the bulbus oculi. In sections, the cysts lie within the thickness of cartilaginous layer of the sclerotic. This latter is enlarged into thick layer (2mm.) by the presence of the cysts.

Nemeczek mentions irregular cysts of 1.5mm. in diameter.
Spore: Elliptical in front view. Two polar capsules convergent. No intercapsular appendix. Sutural edge rather thick with a number of folds on the posterior margin. Sporoplasm with two nuclei and an iodinophilous vacuole. Dimensions: length 10.8 to 11.7μ, breadth 9.9 to 10.4μ, thickness 7.2 to 9μ, length of polar capsule 4.5 to 5μ.

Woodcock's form has a spore with the following characters:
Slightly ovoid. Sporoplasm always contains a large and well defined vacuole and two nuclei. Dimensions: length 10μ, breadth 8μ, length of polar capsule 3.25 to 3.5μ.

MYXOBOLUS GIGAS Auerbach
[Figs. 442 to 445]

1906 Myxobolus gigas Auerbach 1906: 386-391
1910 Myxobolus gigas Auerbach 1910c: 182
1912 Myxobolus gigas Parisi 1912: 293-294

Habitat: Subcutaneous connective tissue of the operculum of Abramis brama L.; Karlsruhe, Pavia. Parisi observed cysts on the side, on the caudal fin (5 cysts on rays), on other fins, branchiae and in the internal organs of the fish.

Vegetative form: Cysts, spherical or ovoidal. No cyst membrane composed of the connective tissue of the host. Protoplasm is indistinctly differentiated. Ectoplasm thin and radially striated, which gradually turns into endoplasm. Endoplasm finely granular, contains numerous nuclei (2.5 to 2.7μ in diameter). Size of greatest form 360μ by 290 to 300μ. According to Parisi size up to 1.5mm.

Spore: Elliptical when viewed from the front. Sutural edge somewhat narrow, having a number of folds at the posterior portion. Sporoplasm with an iodinophilous vacuole and two nuclei. Dimensions: length 16.9 to 21.6μ, breadth 13 to 16.2μ thickness 9μ, length of polar capsules 7.8μ, length of polar filament 90μ (sulphuric acid).

Parisi gives 150μ for the length of polar filament.

MYXOBOLUS VOLGENSIS Reuss
[Figs. 446 to 448]

1906 Myxobolus volgensis Reuss 1906: 200-201

Habitat: Branchiae, cornea and dorsal fin of Lucioperca volgensis Pall; Volga.

Vegetative form: Cysts, spherical, 0.3 to 1mm. in diameter. Poly-sporous.

Spore: Broad elliptic or rounded. Sutural edge has at least 3 folds. Sporoplasm with an iodinophilous vacuole. Dimensions: length 8.25 to 9.5μ, breadth 7.25 to 8.25μ, thickness 4.5 to 5.5μ, polar capsule 3μ by 2μ.
MYXOBOLUS SCARDINII Reuss
[Fig. 449]
1906 Myxobolus scardinii Reuss 1906: 201
Habitat: Branchiae of Scardinius erythrophthalmus L.; Volga.
Vegetative form: Cysts, elongated oval. Smaller cysts rounded oval, 0.8mm. by 0.5mm., the larger forms elongated, 1.2mm. by 0.5mm. Poly- sporous.
Spore: Broad elliptical. Sutural edge narrow, having folds. A larger triangular intercapsular process. An iodinophilous vacuole in sporoplasm. Dimensions: length 11 to 12μ, breadth 9 to 9.5μ, thickness 4.5 to 5μ, polar capsules 5μ by 2.5μ.

MYXOBOLUS PHYSOPHILUS Reuss
[Figs. 450 and 451]
1906 Myxobolus physophilus Reuss 1906: 201-202
Habitat: Surface of air bladder of Scardinius erythrophthalmus L.; Volga.
Vegetative form: Cysts, rounded, 1.5mm. in diameter. Polysporous.
Spore: Oval, with attenuated anterior end. Sutural edge narrow and smooth. Polar capsules rather large. An iodinophilous vacuole in sporoplasm. Dimensions: length 12 to 13μ, breadth 8.25 to 9μ, thickness 6.5 to 7μ, polar capsules 6μ by 2.5μ.

MYXOBOLUS MACROCAPSULARIS Reuss
[Fig. 452]
1906 Myxobolus macrocapsularis Reuss 1906: 202
Habitat: Branchiae of Blicca björkna L.; Volga.
Vegetative form: Cysts, Elongated oval. Size: 1mm. by 0.5mm. Polysporous.
Spore: Oval with greatly attenuated anterior portion. Sutural edge broad and without any fold. Polar capsules rather large. An iodinophilous vacuole in sporoplasm. Dimensions: length 11 to 13μ, breadth 8.25 to 9.25μ, thickness 5.5μ, polar capsules 6μ by 2.5 to 3μ.

MYXOBOLUS SANDRAE Reuss
[Fig. 453]
1906 Myxobolus sandrae Reuss 1906: 202-203
Habitat: Muscle of Lucioperca sandra Cuv.; Volga.
Vegetative form: Cysts. Rounded, 0.5mm. in diameter. Polyspor- ous.
Spore: Oval. Sutural edge broad with many distinct folds. An iodinophilous vacuole in sporoplasm. Dimensions: length 9.25 to 10μ, breadth 7.25 to 8.25μ, thickness 4 to 5μ, polar capsules 3.5μ by 2μ.
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MYXOBOLUS BRAMAE Reuss
[Fig. 454]
1906 *Myxobolus bramae* Reuss 1906 : 203–204
Habitat: Branchiae of *Abramis brama* L.; Volga.
Vegetative form: Cysts. Oval, 0.5mm. long, 0.25mm. broad. Poly-
sporous. Spore: Oval to nearly spherical. Sutural edge narrow and with indis-
tinct folds. Two polar capsules, with a small triangular intercapsular
process. An iodonophilous vacuole. Dimensions: length 11 to 12μ, 
breadth 9.25 to 10μ, thickness 4.5 to 5.5μ, polar capsules 4 to 5μ by 2.25μ.

MYXOBOLUS CYPRINICOLA Reuss
[Fig. 456]
1906 *Myxobolus cyprinicola* Reuss 1906 : 204
Habitat: Branchiae of *Cyprinus carpio* L.; Volga.
Vegetative form: Cysts, oval, 0.5mm. by 0.3mm. Polysporous. Spore: Elongated oval. Sutural edge narrow with many indistinct
folds. An iodonophilous vacuole. Dimensions: length 9.25 to 10μ, breadth 7 to 7.25μ, thickness 5 to 5.5μ, polar capsules 4.5μ by 2.5 to 3μ.

MYXOBOLUS BALLERI Reuss
[Fig. 455]
1906 *Myxobolus balleri* Reuss 1906 : 204–205
Habitat: Branchiae of *Abramis ballerus* L.; Volga.
Vegetative form: Cysts. Elongated, 1.5mm. by 0.5mm. Polysporous. Spore: Oval, slightly pointed at the anterior end. A triangular intercapsular appendix. Sutural edge smooth. An iodonophilous vacuole. Dimensions: length 11 to 12μ, breadth 9.25 to 10μ, thickness 5.5 to 6.5μ, polar capsules 5.5μ by 2.75μ.

MYXOBOLUS SQUAMAE Keysselitz
[Figs. 457 to 459]
1908 *Myxobolus squamae* Keysselitz 1908 : 273–274
Habitat: Inner surface of the scales of *Barbus fluviatilis* Agass.; Mosel
and Neckar.
Vegetative form: Form variable; rounded, oval, elongated or rarely branched. The outline of the body is not smooth but irregular withnumer-
ous small tooth-like projections with which the body comes in contact 
with the surrounding substance. The parasites seem to be able to dissolve 
the substance composing the scale. Length 50 to 800μ. In one scale, one
or many, up to 8, individuals were found. All showed only advanced stages 
of spore formation. The parasites are surrounded by a variously developed 
envelope of connective tissue. Polysporous.
Spore: Elongated oval. Two polar capsules, with 7 to 8 times coiled polar filament. A triangular intercapsular projection. Sporoplasm with an iodinophilous vacuole. Dimensions: length 10 to 10.5μ, breadth 8 to 8.5μ, length of polar capsule 4.5μ.

**MYXOBOLUS CORDIS** Keysselitz  
[Figs. 460 and 461]  
1908 *Myxobolus cordis* Keysselitz 1908: 279-282

**Habitat:** Muscle of ventricle, rarely that of bulbus arteriosus of *Barbus fluviatilis* Ag., spores found in kidney, liver and spleen in the condition of somewhat scattered infiltration; Germany (Mosel and Neckar).

**Vegetative form:** Elongated, oval, sausage or club form. The body whitish, later yellowish. Size from 0.25 up to 4mm., usually 1 to 1.5mm. in length. Propagative stage and cysts observed. One end of the body is held more or less deeply in the muscle and is covered by cellular envelope as in *Myxobolus musculi*, while remaining larger portion of the body is suspended freely inside of the ventricle, covered with a thin layer probably of endocardiac cells. Fish 30 to 45cm. long harboured 40 to 60 parasites. No movements. Ultimately the cysts are formed with differentiated protoplasm. Polysporous.

**Spore:** Oval. Shell very thin at the anterior end. At the posterior end, cell-like appendage, 2 to 3μ wide which is probably formed by both valves, is present. Two pyriform polar capsules at the anterior end, which show the polar filament coiled 7 to 8 times. Sporoplasm with a comparatively large and oval iodinophilous vacuole and two nuclei, rarely one (syncaryon). Dimensions: length 12μ, breadth 10μ, length of polar capsule 4.5μ.

**MYXOBOLUS MUSCULI** Keysselitz  
[Figs. 462 to 464]  
1908 *Myxobolus musculi* Keysselitz 1908: 282-286

**Habitat:** Muscle of the main body, rarely that of fins and operculum, and kidney of *Barbus fluviatilis* Agass. of various size (youngest fish found infected, 2 months old), spores in liver, spleen, kidney and ovary (not the ovum) in diffuse infiltration; Mosel and Neckar.

**Vegetative form:** Elongated. Body whitish opaque, with differentiated protoplasm. Smallest individual observed, 24μ. Large form 2mm. in length. Many trophozoites are found closely situated, forming a large mass of parasites that reached dimensions of 4mm. by 2mm. The surrounding envelope, varying in thickness, composed of cells with elongated nuclei as those of perimysium. Young cysts surrounded by thin layer of ectoplasm. Polysporous.
Spore: Oval. Two polar capsules usually unequal. Shell as in M. cordis with a small peg closer to the anterior end, polar filament coiled 4 to 5 times, visible in the capsule. Sporoplasm with rarely one (syncaryon), but usually two nuclei and an iodinophilous vacuole. A posterior process as is seen in the spores of M. cordis, but much smaller, was occasionally observed. Dimensions: length 11\(\mu\), breadth 8\(\mu\), polar capsules 6\(\mu\) and 4\(\mu\) long.

**MYXOBOLUS sp. Miyairi**

1909  \textit{Myxobolus sp.} Miyairi 1909 : 126

Habitat: Branchiae of loach (\textit{Misgurnus anguillicaudatus} Cant.?); Fukuoka? (Nippon).

Vegetative form: Cysts were not observed.

Spore: No description.

**MYXOBOLUS sp. Wegener**

[Fig. 465]

1910  \textit{Myxobolus sp.} Wegener 1910 : 78

Habitat: Branchiae (gill-arch) of \textit{Perca fluviatilis} L.; Germany (Frisches Haff, March). Only one case.

Vegetative form: Cysts on a gill-arch, white and round, with a diameter of 1.1mm. Polysporous.

Spore: Form and size very variable. Rounded or elliptical, pointed at the anterior end. Sutural edge showing folds at the posterior portion. Dimensions: length 8 to 10\(\mu\) (in round form) and 11\(\mu\) (in elliptical form), breadth 8 to 9\(\mu\), polar capsules 4 to 5\(\mu\) by 2 to 3\(\mu\), length of polar filament 40\(\mu\).

**MYXOBOLUS PERMAGNUS Wegener**

[Fig. 466]

1910  \textit{Myxobolus permagnus} Wegener 1910 : 78-79

Habitat: Branchiae and operculum of \textit{Perca fluviatilis} L., air bladder of \textit{Scardinius erythrophthalmus} L.; Königsberg (May), Pregel (March).

Vegetative form: Cysts rounded in form and white in color, resemble to those of \textit{M. gigas}. No clear ectoplasm layer, nor typical protoplasmic structure. Polysporous.

Spore: Oval, sharply pointed at the anterior end. Sutural edge with 5 to 6 distinct folds at the posterior portion. Polar filament visible in the polar capsules. Dimensions: length 17 to 18\(\mu\), breadth 10 to 13\(\mu\), polar capsules 7 to 8\(\mu\) by 3.5 to 4\(\mu\).

**MYXOBOLUS ROTUNDUS Nemeczek**

[Fig. 467]

1911  \textit{Myxobolus rotundus} Nemeczek 1911 : 156-157

Habitat: Branchiae of \textit{Abramis brama} L.; Austria.
Vegetative form: Cysts, ovoidal or spindle form, 1 to 3mm. long and 1 to 1.5mm. wide. Body white. An extraordinary large number of spores were found in the cysts. Polysporous.

Spore: Round or slightly oval, when viewed from the front. Greatly flattened in side view. Polar capsules convergent, with no intercapsular body. Shell smooth. Sutural edge narrow, without folds. Dimensions: length 10μ, breadth 9.8μ, thickness 3μ, polar capsules 3.8 to 5μ long, length of polar filament 40μ.

**MYXOBOLUS MINUTUS** Nemeczek

[Fig. 468]

1911 *Myxobolus minutus* Nemeczek 1911: 160

Habitat: Branchiae of *Leuciscus* sp.; Austria.

Vegetative form: Cysts spherical, oval or elongated with white color. Size: 0.5 to 3mm. by 0.5 to 1mm. Polysporous.

Spore: Rounded oval, similar to that of *Myxobolus rotundus*. Shell smooth. Sutural edge narrow without folds. Sporoplasm with an iodinophilous vacuole. No intercapsular appendix. Dimensions: length 6μ, breadth 4.2 to 5μ, polar capsule 3μ by 2μ, length of polar filament 50 to 60, often 70μ.

**MYXOBOLUS sp.** Lebzelter

1912 *Myxobolus sp.* Lebzelter 1912: 296-297

Habitat: Gall-bladder of *Thymallus thymallus* L.

Vegetative form: Not observed.

Spore: Sutural ridge distinct. Dimensions, length 5μ, breadth 3μ.

**MYXOBOLUS MAGNUS** Awerinzew

[Figures 469 and 470]

1913 *Myxobolus magnum* Awerinzew 1913: 75-76

Habitat: Eye of *Acerina cernua* L.; Petrograd.

Vegetative form: Trophozoites form white spots in the tissue of iris, with many spores (300 to 400). Each pansporoblast forms in most cases two, sometimes 3 or 5 spores! Polysporous.

Spores: Large, elongated roundish, slightly flattened. Sutural edge somewhat thick, forming a wide ridge, with 4 to 5 folds at the posterior portion. Polar capsules do not cross each other. Sporoplasm with an iodinophilous vacuole and two nuclei. Dimensions: length 38 to 45μ, breadth 32 to 38μ, thickness 28 to 35μ, length of polar capsules 15 to 17μ, diameter of the vacuole 12 to 16μ.

**MYXOBOLUS CARASSII** Klokačewa

[Figures 471 to 473]

1914 *Myxobolus carassii* Klokačewa 1914: 182-184

Habitat: Body cavity, liver and intestine of *Carassius vulgaris* L.; Petrograd?
Vegetative form: Cysts spherical. Those in liver and intestine yellowish, surrounded by an envelope composed of fibrous connective tissue. Secondary cysts are formed. Polysporous.

Spore: Oval, in front view. Two ovoidal polar capsules convergent at the slightly attenuated anterior end. Coiled polar filament visible. Sporoplasm with an iodinophilous vacuole and two nuclei. Sutural edge shows folds in some cases. Dimensions: length 13 to 17μ, breadth 8 to 10μ, thickness 5 to 7μ, polar capsules 6 to 7μ long.

Remarks: Compare with Myxobolus sp. Gurley on page 142.

MYXOBOLUS sp. Southwell

Habitat: Subcutaneous intermuscular tissue of Rasbora (Cyprinus) daniconius Day; from a stream near Katwan, Mirzapore (U.P.), India.

Vegetative form: 6 cysts found on four fish. The seat is immediately below the scales, in the epidermis. Color milky white. Soft, flattened and roughly oval in shape. Greatest length found, 1.1mm. No pigment was present on the cyst.

Spore: Two equal capsules, with a very short tail-like process. Sporoplasm with vacuole; iodine treatment could not be carried out. Dimensions: length 13μ, breadth 15μ, polar capsule 4μ by 4μ(?).

Remarks: Dimensions, especially that of polar capsule seem to be misprinted. Southwell gave one figure of a fish with a cyst near the dorsal fin. He thinks that "it is quite possible that our parasites may belong to Myxobolus cyprini." The incomplete observation without any figure, leads the writer to leave the form also as Myxobolus sp. Southwell.

MYXOBOLUS FUNDULI Kudo

[Figs. 474 to 476]

Habitat: Branchiae and muscle of Fundulus heteroclitus, F. majalis; Woods Hole. Hahn claims that he succeeded in causing experimental infection in F. diaphanus and Cyprinodon variegatus by inoculation.

Vegetative form: Hahn uses quite a number of different terms from those that are ordinarily used in describing Myxosporidia, without giving any definitions. Naturally it is hard to put what he wrote in several pages in the following lines. Granular vegetative forms produce a great many pansporoblasts, each with a single spore. "Trophoplasm" is difficult to stain. Size: 74 by 33μ, 24 by 19μ. Cysts within and between the muscle fibers, containing several hundred spores.

Spore: Hahn's descriptions may be summarized as follows: Dimensions: length 14.3μ, breadth 6.7μ, thickness 6.7μ to 2/3 of width, polar
capsule, 6.5μ by 2μ, polar filament 3 to 4 times the length of the spore (42.9 to 57.2μ). Polar filament coiled 10 to 14 times. Shell thin, almost invisible. The spores found in the gill: length 12 to 13.4μ, breadth 6μ to 10.4μ. A vacule is present in the sporoplasm.

Remarks: Examination of Hahn's first paper suggested that he was dealing with the present form as a new species tho he did not mention at all Keysselitz who gave the name Myxobolus musculi Keysselitz to the parasite of Barbus fluviatilis from German rivers. I was informed by Hahn that he gave the name, Myxobolus musculi, without knowing the fact that it was preoccupied by Keysselitz (1908) (see page 148) and that tho he became aware of it later, he can not determine differences by which the two forms can be distinguished. A comparison of the descriptions of Keysselitz and Hahn, however, shows that these two forms differ in several respects. Hence the latter form is recorded here as a distinct species under the new name.

It is interesting to note that very similar forms, one without an iodinophilous vacuole at any stage of spore-formation (Myxosoma funduli Kudo, see page 125) and the other with a vacuole, occur in the same hosts in the same locality. As mentioned above, the reader is requested to refer to Hahn's original paper for further data.

**MYXOBOLUS PLEURONECTIDAE** Hahn

[Fig. 477]

1917 Myxobolus pleuronectidae Hahn 1917: 160-161

Habitat: Subcutaneous muscular tissue of Pseudopleuronectes americanus; Woods Hole.

Vegetative form: Similar to that of Myxobolus funduli.

Spore: Hahn writes as follows: Shape and appearance resembles Myxobolus pfeifferi. Dimensions: length 14.5μ, breadth 11.9μ, polar capsules 6μ by 3.7μ.

**MYXOBOLUS CAPSULATUS** Davis

[Fig. 478]

1917 Myxobolus capsulatus Davis 1917: 237

Habitat: Visceral connective tissues of Cyprinodon variegatus; Beaufort.


Spore: Pyriform, flattened. Polar capsules large and pyriform, filling almost entire cavity of the spore. Sporoplasm relatively small. Iodinophilous vacuole visible in living spore. Dimensions: length 16μ, breadth 10 to 11μ, polar capsules 11μ by 4μ, length of polar filament 84μ.
MYXOBOLUS NODULARIS Southwell et Prashad
[Figs. 479 and 480]
1918 Myxobolus nodularis Southwell and Prashad 1918 : 347

Habitat: In the muscles of Rasbora daniconius occurring in two fish on the sides, and in another as a globular cyst near the anus; Mirpur, Dacca (June). Type specimens, numbered P 52/1.

Vegetative form: Cysts rounded or slightly elongated, varying in length 3.5 to 3.8mm. and 2.3 to 2.8mm. in width. Creamy yellow in color, in one case appearing blackish owing to the large number of black granules scattered in its surface.

Spore: Ovoidal. Sutural ridge very wide (about 1/5 thickness of the spore). Two polar capsules of equal size, which show coiled polar filaments clearly. Dimensions: length 9µ, breadth 7.2µ, length of polar capsule 3.4µ, that of polar filament 18.3µ.

MYXOBOLUS HYLAE Johnston et Bancroft
[Figs. 591 to 593]
1888 Myxobolus sp. Fletcher 1888 : 337
1890 Myxobolus sp. Haswell 1890 : 661
1909 Myxobolus sp. Johnston 1909 : 29
1910 Myxobolus kylae Johnston and Cleland 1910 : 25
1918 Myxobolus kylae Johnston and Bancroft 1918 : 171-175

Habitat: In the testes, vasa efferentia and oviducts of Hyla aurea; Sidney, Australia (April, other months not mentioned). Fletcher observed the parasites also in the urinary bladder of both sexes, which fact was not confirmed by Johnston and Bancroft on account of the scarcity of the material. The latter authors could not infect Hyla caerulea by feeding infected testes or the cysts, giving the conclusion that the parasite is specific to H. aurea. The male is more often attacked by the parasite than the female. The infected animal appeared sickly and emaciated. As to the infection in kidneys, they write as follows: In one male specimen both testes and both kidneys were affected, and the upper parts of the ureters adjacent to the kidneys were swollen and milky in appearance. In another, in addition to the testes, the adjacent kidney and mesentery were attacked. No spores have yet been detected by them in sections of the kidney tubules.

Vegetative form: Johnston and Bancroft describe as follows:
Cysts: In male, either imbedded in the tissue or may project freely into the coelom of the testes; in female, lying between the layers of the wall, being projected into the lumen of the oviduct. Size from those of microscopic dimensions up to 2 to 3mm. in diameter. In sections, the protoplasm
is differentiated into two regions. The outer layer (ectoplasm) surrounds the body as a thin, light-staining region, while the endoplasm being denser and of more or less granular structure filled with spores especially in the central portion.

Spore: Johnston and Bancroft describe as follows:

Form somewhat variable, caused by the reduction in length. Oval, egg-shaped or nearly circular in front view. Sutural ridge slightly thickened. Two pyriform polar capsules are located at the anterior end. Sporoplasm with an iodinophilous vacuole (2μ in diameter), shows usually two distinct nuclei, rarely but one. Dimensions: length variable, diameter of circular form 7 to 8μ, breadth 8 to 10μ, thickness about 6μ, thickness of shell 1μ, polar capsules 4 to 5μ by 2μ, length of polar filament 90 to 98μ (acids or alkalies).

**MYXOBOLUS AUREATUS** Ward

[Figs. 643 to 649]

1919  *Myxobolus aureatus*  Ward  1919 : 49

Habitat: Between the ectodermal layers of the fin membrane of *Notropis anogenus*; Put-in-Bay, Lake Erie (August). Out of thirty fish, two to three cm. in length, seven were found to be infected. The infected fish were not inferior in size or vigor to others of the same species. The most heavily infected one was the most vigorous of all. The number of cysts in the individual fish, varied from one to forty, being confined in the fin. The cysts are always separated from each other, tho in a few instances they were apparently connected.

Vegetative form: The parasite forms cysts between the ectodermal layers of the fin membrane. The cyst is a smooth margined ellipsoid, measuring from 1 to 1.6 mm. in layer diameter and from 0.8 to 1.2 mm. along its transverse axis. The opaque cyst is of a clear orange yellowish color. This gilt color is contained in the cyst wall, fading away in alcohol and formol. The chromatophores of the skin of the host are distinctly more abundant on the cyst than in other parts of the skin, and the older the cyst the more abundant the chromatophores. The wall of the cyst is noticeably tough and thick. In section, the protoplasm shows a poor differentiation into ectoplasm and endoplasm. The former granular and reticular, covers the entire surface as a thin layer, while the latter is highly vacuolated, containing only mature spores. Polysporous.

Spore: Ovoid; slightly pointed anterior and rounded posterior ends in front view; slightly compressed in lateral view. Sutural ridge distinct. The shell is of moderate thickness, and bears a flange at the posterior half in some spores. Two pyriform polar capsules, frequently of slightly different dimensions, are at the anterior part of the spore. No intercapsular appendix is present. When the spore is allowed to stand for 24 hours
STUDIES ON MYXOSPORIDIA—KUDO

or more in water, the polar filaments are extruded. The binucleated finely granular sporoplasm shows an iodinophilous vacuole. Dimensions: length 12.4 to 13.5μ, breadth 6.5 to 7.5μ, thickness 5μ, length of polar capsule 6 to 7μ (rarely 7.5μ), length of polar filament about 20 to 26μ, diameter of iodinophilous vacuole about 2μ.

MYXOBOLUS MIYAIRII nov. spec.
[Fig. 481]

Habitat: Intestinal wall of Parasilurus asotus L.; Fukuoka ? (Nippon) Vegetative form: Cysts. Size rather small up to 0.5mm. Full-grown spores as well as those in developmental stages fill the central portion of cysts, while numerous nuclei are chiefly found along the periphery of endoplasm.

Spore: Elongated elliptic. Two polar capsules of nearly same size. Sporoplasm with a comparatively large iodinophilous vacuole. Dimensions: length 13 to 14.5μ, breadth 6 to 7μ, length of polar capsules 4.5μ, length of polar filament 30 to 35μ.

Remarks. As the descriptions show the form and structure are distinguishable from other species, the writer establishes the present species.

MYXOBOLUS KOI nov. spec.
[Figs. 482 to 485]

Habitat: In the connective tissue of the gill filament of Cyprinus carpio L.; Tokio (April). One fish was found infected in a slight degree.

Vegetative form: Cysts small and spherical; white in color. Size up to 230μ in largest diameter. The seat similar to Myxobolus toyamai. The structure of the cysts, observed in section preparations, is also similar to the above mentioned unicapsular Myxobolus.

Spore: Oval with attenuated anterior and rounded posterior ends in front view; elongated pyriform in side view. Shell comparatively thin. No marking on shell. Sutural ridge fairly well marked. No intercapsular appendix. Two polar capsules are pyriform, large, and of usually equal form and size. Coiled polar filament distinct in vivo. Sporoplasm rather small, finely granular, shows two nuclei in almost all spores. An iodinophilous vacuole is deeply stained by Lugol’s solution. Dimensions: 14 to 16μ, breadth 8 to 9μ, thickness 5 to 6μ, polar capsule 8 to 9μ by 2.5 to 3μ, length of polar filament 72μ in average (KOH).

MYXOBOLUS ORBICULATUS nov. spec.
[Figs. 566 to 576]

Habitat: Muscle of myotomes of Notropis gilberti J. et M.; Stony Creek, Ill. (November). The fish was kept alive in an aquarium from November
11, 1918, until March 10, 1919, when it was killed, being then nearly dead. The material was examined on March 15. A few isolated spores occurred in the muscle of *Notropis blennius* (Homer Park, Ill., November).

Vegetative form: In and between the muscle bundles of the myotomes. Size variable. Color opaque white under the dissecting microscope. Smallest rounded ameboid forms with a single or numerous nuclei, in the muscle bundle, have the size of from 10μ to 30μ in greatest diameter (Figs. 573 to 575). The largest form observed was 400μ by 120μ. Young forms without any differentiated protoplasm, shows indistinct granular and reticular structure with deeply staining spherical or ring-form chromatinic granules. The number of the nuclei increases with the growth of the body. Larger form (Fig. 576), spindle shape, circular in cross-section, lies with its long axis parallel to the muscle fibres. The protoplasm vacuolated, contained mostly mature spores. Spores were also found in the state of diffuse infiltration. Polysporous.

Spore: Form somewhat variable. Typical form almost circular, slightly pointed at the anterior end (Fig. 566) in front view; spindle shaped in profile (Figs. 569 and 570). Sutural ridge marked. Shell uniformly thick, usually exhibiting four triangular folds on the surface along the posterior margin (Figs. 566, 568 and 571). No intercapsular appendix. Two pyriform polar capsules are, as a rule, of the same size and form. Frequent occurrence of the inequality of the polar capsules together with abnormalities in the form of the spore, were noticed especially among comparatively young spores. The granular sporoplasm, shows two spherical nuclei when stained. The iodiophilous vacuole, spherical and 2μ in average diameter, is deeply stained with Lugol's solution. Dimensions of unstained preserved spores: length and breadth 9 to 10μ, thickness 6.5 to 7μ, polar capsule 6 to 7.5μ by 2.5 to 3μ.

**MYXOBOLUS DISCREPANS** nov. spec.

[Figs. 597 to 601]

Habitat: Branchial lamellae of *Carpiodes difformis*; Salt Fork, Urbana, U.S.A. (May). One fish caught, died (soon after the capture) two hours before being fixed. Length 8.5cm.

Vegetative form: The parasites formed numerous cysts on the branchial lamellae. Cysts slightly yellowish white and mostly rounded or elongated along the lamella, occur in groups, often occupying the entire lamella. Infection was fairly heavy. Every gill arch harbored ten to twenty cysts mostly on the outer surface. Size of the cyst varies, small rounded one 500μ in diameter up to elongated forms 2mm. by 0.5mm., the majority being from 0.5 to 1mm. in diameter. The cyst is surrounded by a thin connective tissue layer of the host. The protoplasm shows little differen-
tiation. The ectoplasm is a rather narrow zone around the entire body and the endoplasm is filled with various nuclei, several stages of developing pansporoblasts, and mature spores. Each pansporoblast produces two spores. Polysporous.

Spore: Approximately circular with broad anterior and more or less narrower posterior end in front view; broadly fusiform in profile. Shell uniformly thin with 5 to 6 markings on the posterior margin. Two polar capsules broadly oval and convergent, fill the anterior half of the spore. A small triangular intercapsular appendix presents. Coiled polar filament is fairly visible in vivo. The spores from the cysts which were fixed with alcohol-acetic and preserved in 95 per cent alcohol, showed the extrusion of the polar filament under the influence of potassium hydrate solution (35 per cent) even after a considerable length of time as is shown in the following:

Material fixed on May 29.
June 2; Extrusion took place in almost all spores.
June 10; Extrusion took place in almost all spores.
June 26; Extrusion took place in almost all spores.
July 28; Extrusion took place in almost all spores.
August 29; Extrusion took place in numerous spores.
September 29; Extrusion took place in about 70 per cent of the spores, some filaments being rather short, and not fully extended.

October 20; Extrusion took place in about 50 per cent of the spores, most filaments being short, and not fully extended.

Sporoplasm coarsely granular shows clearly two ring-form nuclei in fresh preparations. Dimensions of preserved spores: length 11.4 to 13.5µ, breadth 9.5 to 11µ, thickness 8.5 to 9.5µ, polar capsule 5.5 to 6µ by 3.5 to 4µ, length of polar filament 50 to 55µ.

Remarks: The present species differs from the hitherto known species, *Myxobolus lintoni* (page 138) and *Myxobolus orbiculatus* (page 155) which are the nearest to the present form, differ from *Myxobolus discrepans* in the host, organ of infection, vegetative form and form and structure of the spore.

**MYXOBOLUS MESENTERICUS** nov. spec.

[Figs. 628 to 631]

Habitat: In the mesentery, liver, spleen and wall of stomach, pyloric coecum, intestine, and gall-bladder of *Lepomis cyanellus*; Crystal Lake, Urbana, Ill. (June and July). Out of thirty-six host fish, 10 cm. in average length, seven were found to be infected. In every case, except one, the mesentery was the main seat of infection, harboring conspicuous cysts. The number of cysts found in the host body varied from three to seven. The infected fish did not exhibit any recognizable pathological changes. Other species of fish caught at the same time, were free from the infection.
Vegetative form: The cysts are mostly spherical in form, and are covered by a tough resistant envelope composed of the connective tissue of the host. They are uniformly white in color, and have the variable dimensions of from 0.5 to 1.5mm. in diameter. In section, the protoplasm shows a coarsely reticulated structure without distinct differentiation. In all cysts of various sizes fully mature spores were only observed. The spore formation could not be worked out. Polysporous.

Spore: Broadly oval with a slightly truncated anterior end in front view (Fig. 628), lENTICULAR in side or end view (Fig. 629). No intercapsular appendix is seen. The shell is rather thick, and shows about eight folds on the sutural edge, two of which located laterally being more conspicuous than others. The sutural ridge is rather fine. Two convergent polar capsules equal in size occupy the anterior half of the spore. The coiled polar filament becomes more distinctly visible with the addition of Lugol’s solution, altho it is faintly observable in fresh state. Fresh spores extruded their polar filaments under the action of potassium hydrate solution. In some spores, the extruded filaments cross each other near the foramina. The preserved spores showed no extrusion of the filament as in the last species. The sporoplasm is extremely finely granulated. The iodinophilous vacuole is comparatively large. When stained, the spore shows two nuclei in the sporoplasm. Dimensions of fresh material: length 10 to 11.5μ, breadth 8.5 to 9.5μ, thickness 6.5μ, polar capsule 4.75μ by 1.5 to 2μ, length of polar filament 32 to 40μ. Average dimensions of unstained preserved spores: length 9.5μ, breadth 8μ, polar capsule 4.75 μ by 2μ.

Remarks: The habitat and the structure of the spores, lead the writer to record the species as a new species.

Genus HENNEGUYA Thélohan

1892 Henneguya Thélohan 1892 : 167, 176
1895 Henneguya Thélohan 1895 : 352

The characters of the genus are described on page 59.
Type species: Henneguya psorospermica Thélohan.

HENNEGUYA PSOROSPERMICA Thélohan
[Fig. 486, 487 and 496]

1895 Henneguya psorospermica Thélohan 1895 : 353
1896 Myxobolus psorospermica s. str. Cohn 1896 : 261
1899 Henneguya psorospermica typica Labbé 1899 : 101
1905 Henneguya psorospermica Nufer 1905 : 77, 185
1910 Henneguya psorospermica Wegener 1910 : 81-82
1911 Henneguya psorospermica typica Auerbach 1911 : 5, etc.

Habitat: Branchiae of Esox lucius L. and Perca fluviatilis; France,
Frisches and Kurisches Haff, Pregel, Masurische Seen (all the year round, but rarer in Winter) Switzerland.

Vegetative form: Thélohan’s observations on the structure of the cyst, are as follows: The surface of the cyst is covered by a layer, homogeneous, refringent and deeply stained, with which the cyst comes in direct contact with the surrounding epithelial cells of the host. Inside of this layer, there is a “pseudoectoplasmic” zone, in which the protoplasm is dense at places, forming radiate irregular striations, enclosing numerous irregular masses which are composed of apparently the same substance that forms the external layer. Toward the central portion of the cyst, there are masses of spores (Fig. 496).

Cohn’s descriptions are as follows: The purely white cyst is elliptical; length 1.15mm. and breadth 0.85mm. The seat is under the epidermis. It is surrounded by the host tissue with small, elongated and scattered nuclei. The outer layer of the cyst is a thin membranous protoplasm.

Wegener writes as follows: The white cysts are round or elliptical, usually on the upper end of the branchial lamella. Size of larger cysts, 1.5 to 2mm. long and 1.1 to 1.5mm. wide.

Spore: Elongated; anterior part fusiform and anterior end blunt. Polar capsules elongated and parallel to each other. Coiled polar filament visible in fresh conditions. Shell unstriated. Dimensions: total length 40μ in average, largest breadth 7μ, length of polar capsule 7 to 8μ.

Cohn’s form is described by him as follows: Spore narrow with blunt anterior end. Sporoplasm with 6 horns (no figure to explain this expression!). When kept in water, sporoplasm takes round form and becomes highly refractive. Dimensions: length 29 to 38μ, length between the tip and the posterior margin of the cavity (15 to 20μ) 18μ, breadth 9 to 10μ, polar capsule (8 to 11μ) 9μ by 2μ, length of “starren Fäden” 14μ, length of tail 14 to 18μ.

Wegener’s form is as follows: total length 35 to 38μ, breadth 7 to 8μ, length of the spore cavity 15μ, length of tail 15 to 20μ, polar capsule 8μ by 2 to 3μ.

HenneGuya Texta (Cohn) Labbé

1895 Myxobolus textus Cohn 1895 : 38-39
1899 HenneGuya pisorospermica texta Labbé 1899 : 101
1910 HenneGuya texta Wegener 1910 : 82-83

Habitat: Branchiae of Perca fluvialitis L.; Pregel, Frisches and Kurisches Haff (all the year round).

Vegetative form: Cohn observed as follows: Cyst distinctly elliptical. Length 0.75mm., breadth 0.375mm. The cysts surrounded by a thick layer of the host tissue. In the peripheral portion of the cyst, the protoplasm exhibits a network-like structure which forms a fibrous structure further inside, crossing the cyst at right angles to the long axis of the cyst.
Wegener writes as follows: The white cysts are elongated, 1.2 to 1.8 mm. long and 0.5 to 0.7 mm. wide.

Spore: Cohn mentions dimensions exactly the same as those of Henneguya psorospermica and can not distinguish the two species by the spore.

Wegener gives the following dimensions: length 30 to 40 μ, breadth 7 to 8 μ, length of the cavity of spore 15 to 18 μ, length of tail 15 to 25 μ, polar capsule 8 μ by 2 to 3 μ.

HENNEGUYA MINUTA (Cohn) Labbé
[Fig. 488 and 489]

1895 Myxobolus minutus ♂ Cohn 1895: 39-40
1899 Henneguya psorospermica minuta ♂ Labbé 1899: 102

Habitat: Branchiae of Perca fluviatilis L.; Frisches Haff, Lesina.
Vegetative form: Cohn's description is as follows: Cysts oval and small, difficult to distinguish them from those of Henneguya psorospermica. Size, 130 μ by 115 μ. The parasite was met only once. But the number of the cysts was far greater than that of Henneguya psorospermica, often 5 to 6 on one lamella, reaching up to 200 cysts on a single gillarch.

Spore: Cohn gives the following dimensions: total length (28 to 45 μ) about 36 μ, length from the tip to the end of cavity (20 to 28 μ) about 26 μ, breadth 10 to 11 μ, thickness 8 μ, polar capsule 11 to 14 μ by 2 to 3 μ, length of polar filament 42 to 45 μ, length of tail (8 to 17 μ) 12 μ. Cohn gives a figure (Fig. 489) of a spore with two vacuoles (?) .

HENNEGUYA OVIPERDA (Cohn) Labbé
[Fig. 490 and 491]

1892 Myxobolus oviperdus ♂ Weltner 1892: 28-36
1895 Myxobolus oviperdus ♂ Cohn 1895: 40-41
1899 Henneguya psorospermica oviperda ♂ Labbé 1899: 102
1904 Henneguya psorospermica oviperda ♂ Fuhrmann 1904: 469-471
1911 Henneguya psorospermica oviperda ♂ Auerbach 1911: 5-22
1911 Henneguya psorospermica oviperda ♂ Nemeczek 1911: 146

Habitat: Ovary of Esox lucius L.; Switzerland, Berlin, Frisches Haff (all the year round), Upsala (May), Austria (December).
Vegetative form: Cohn writes as follows: No real cyst exists. The parasite occupies the ovum.
Auerbach, however, mentions the presence of cysts in the connective tissue and follicle epithelium of the ovary. Dimensions, 1 mm. up to 5 or 6 mm. in diameter.
Spore: Cohn states the form and dimensions are very much similar to those of *H. psorospermica*.

**HENNEGUYA LOBOSA** (Cohn) Labbé

[Figs. 492 and 493]

1895 *Myxobolus lobosus* Cohn 1895: 42
1899 *Henneguya psorospermica lobosa* Labbé 1899: 102
1910 *Henneguya (?) lobosa* Wegener 1910: 83
1911 *Henneguya (?) lobosa* Auerbach 1911: 22-25

Habitat: Branchiae of *Esox lucius* L.; Frisches Haff, Pregel, Karlsruhe.

Vegetative form: Cysts irregular in shape, size up to 2.5mm.

Wegener noticed that the cyst resembles that of *Myxosoma dujardini* with the dimensions of 2.2 to 2.8mm. by 1 to 1.1mm.

Spore: Cohn gives the dimensions as follows: total length 30 to 40μ, length from the tip to the posterior margin of cavity 11.5 to 15μ, breadth 5 to 6.5μ, polar capsules 6.5 to 8μ by 2 to 2.5μ, length of tail 22 to 28μ.

Wegener’s form: oval; length 35 to 40μ, breadth 5μ, polar capsule 6 to 7μ by 2.5 to 3μ, length of the cavity of spore 13 to 15μ, length of tail 20 to 25μ, the iodinophilous vacuole could not be detected.

Auerbach gave the following dimensions: total length 30μ, breadth 4 to 6μ, length of polar capsule 6μ, length of polar filament 48 to 54μ.

Remarks: Wegener and Auerbach did not observe the iodinophilous vacuole.

**HENNEGUYA PERI-INTESTINALIS** Cépède

1906 *Henneguya psorospermica peri-intestinalis* Cépède 1906: 67
1907 *Henneguya psorospermica peri-intestinalis* Cépède 1907: 137
1912 *Henneguya psorospermica peri-intestinalis* Parisi 1912: 295

Habitat: Intestine of *Esox lucius* L.; Lac du Bourget, Pavia. (June).

Vegetative form: Cysts.

Spore: Cépède mentions that it resembles that of *Henneguya psorospermica*.

**HENNEGUYA MEDIA** Thélohan

[Figs. 494 and 495]

1890 *Henneguya media* Thélohan 1890: 198-200
1892 *Henneguya media* Thélohan 1892: 177
1894 *Myxobolus medius* Gurley 1894: 248
1895 *Henneguya media* Thélohan 1895: 353
1898 *Henneguya media* Doflein 1898: 342

Habitat: Renal tubules of kidney and ovary of *Gasterosteus aculeatus* and *G. pungillus* L.; France. Mixed infection with *Sphaerospora elegans*. 
Vegetative form: Rounded or elongated. In larger individuals, clear differentiation of protoplasm. Monosporous (?) and polysporous.


HENNEGUYA BREVIS Thélohan

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<td>Henneguya brevis</td>
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<td>1895</td>
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<td>Thélohan</td>
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Habitat: Similar to H. media Thélohan.
Vegetative form: Undescribed.

Spore: Fusiform with short tail. Dimensions: length 14 to 15μ, breadth 5 to 6μ, polar capsules 1.4 to 5μ, tail 4 to 5μ long.

HENNEGUYA SCHIZURA (Gurley) Labbé

[Figgs. 497 to 499]

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<td>1899</td>
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<td>Labbé</td>
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Habitat: In cellular tissue of the eye muscles, in that of the sclerotic, and in that between the sclerotic and choroid of Esox lucius L.; Germany, U. S. A.

Vegetative form: Cysts white; membrane delicate; 0.44 to 1.09mm. in diameter.

Spore: Oval. Dimensions: length 12μ, breadth 6μ, thickness one-half the breadth, tail 3 to 4 times length of the body.

HENNEGUYA CREPLINI (Gurley) Labbé

[Figgs. 500 to 503]

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<td>1899</td>
<td>Henneguya creplini</td>
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<td>1910</td>
<td>Henneguya creplini</td>
<td>Wegener</td>
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Habitat: Branchiae of Acerina cernua L.; Pregel (March), Frisches and Kurisches Haff.

Vegetative form: Wegener describes as follows: Cysts, usually elongated oval and are located at the end of branchial lamella. Color white. Size 1 to 1.1mm. by 0.5mm. During winter, the cyst has only pansporoblasts, but no fully grown spores.

Spore: Creplin writes as follows: Elongated elliptical. Length 1/120"", breadth 1/360"", tail about as long as or a little longer than the body.

Wegener's form: elongated spindle shape; length 20μ, breadth 8 to 9μ, polar capsule 8μ by 2 to 3μ (parallel to each other).
Remarks: Wegener thinks that the present species and *Henneguya acerinae* Schröder, are one and the same species, and that the differences between the dimensions are due to the miscalculation of measurement in lines given by Creplin on the part of Gurley and Labbé.

**HENNEGUYA LINEARIS** (Gurley) Labbé

[Fig. 504]

1841 Müller 1841:489
1893 *Myxobolus linearis* (part) Gurley 1893:417
1894 *Myxobolus linearis* Gurley 1894:255
1899 *Henneguya linearis* Labbé 1899:103

Habitat: Membrane lining branchial cavity of *Pimelodus sebae* Cuv. et Val., branchiae of *Platystoma fasciatum* L.; South American rivers.
Vegetative form: Not described.
Spore: Very narrow. Length 3 to 4 times breadth.

**HENNEGUYA GURLEYI** Kudo

[Fig. 505]

1893 *Myxobolus linearis* (part) Gurley 1893:417
1894 *Myxobolus cf. linearis* Gurley 1894:253-254
1899 *Henneguya linearis* var. Labbé 1899:103

Habitat: Base of spines of the second dorsal fin of *Ameiurus melas* Raf.; Iowa (Storm Lake) (August).
Vegetative form: Spherical cysts, 1mm. in diameter.
Spore: Lanceolate. Dimensions: length of the body 19μ, width 5 to 6μ, thickness about 3μ.
Remarks: The species is most probably different from *Henneguya linearis* judging from the difference in the form and structure of spores, the seat of infection, and host species. Hence, it is recorded here as an independent species.

**HENNEGUYA STRONGYLURA** (Gurley) Labbé

[Fig. 506]

1841 Müller 1841:480
1894 *Myxobolus strongylurus* Gurley 1894:249
1899 *Henneguya strongylura* Labbé 1899:103

Habitat: Skin of cephalic region of *Synodontis schall* Bl. Schn.; Nile.
Vegetative form: Cysts over 2.18mm. in diameter.
Spore: Dimensions: length of the body 9μ, breadth 5.4μ. Tail always undivided. Two polar capsules of equal size.
HENNEGUYA MONURA (Gurley) Labbé

[Fig. 507]

1880 Ryder 1880: 211-212
1893 *Myxobolus monurus* Gurley 1893: 416
1894 *Myxobolus monurus* Gurley 1894: 249-250
1899 *Henneguya monura* Labbé 1899: 103

Habitat: Subcutaneous intermuscular tissue of *Aphredoderus sayanus* Gill.; New Jersey (Woodbury).

Vegetative form: Cysts, lenticular, large, white, opaque and numerous (20). Membrane thin.

Spore: Lenticular or slightly obovate. Tail 2 to 3 times longer than the body.

HENNEGUYA KOLESNIKOVI (Gurley) Labbé

[Fig. 508]

1886 Kolesnikov 1886: 242-248
1894 *Myxobolus kolesnikovi* Gurley 1894: 256-257
1898 *Myxobolus bicaudatus* (part) Zschokke 1898: 602-604, 646-655, 699-703
1899 *Henneguya kolesnikovi* Labbé 1899: 103-104

Habitat: Interstitial connective tissue of the thoracic and intercostal muscles of *Coregonus lavaretus* L.; Russia.

Vegetative form: Cysts numerous (80), spherical or oval; length 10 to 30 mm., breadth 7 to 20 mm.

Spore: Oval with a pointed anterior end. Tail three times longer than the body.

Remarks: Zschokke thinks the present species is identical with *Henneguya zschokkei*. But the evidence is not clear enough to bring one to agree with him due to the incomplete description of the present species.

HENNEGUYA MACRURA (Gurley) Thélohan

[Fig. 509 to 512]

1893 Evermann 1893: 76
1894 *Myxobolus macrurus* Gurley 1894: 250-253
1895 *Henneguya macrura* Thélohan 1895: 354

Habitat: Subcutaneous connective tissue of head of *Hybognathus nuchalis* Ag.; Neches River, Texas (November, temperature of water 9°.4C.) Of frequent occurrence.

Vegetative form: Cysts, elongated 6 mm. by 2 mm. or less.

HENNEGUYA ZSCHOKKEI (Gurley) Doflein

[Fig. 513]

1884  
1884  
1894  
1898  
1898  
1901  
1904  
1905  

HENNEGUYA ZSCHOKKEI (Gurley) Doflein  

Habitat: Subcutaneous and superficial intermuscular tissue of Coregonus fera, C. schinzii Fatio, C. hiemalis Jur. and muscular tissue and branchia of C. wartmanni nobilis and C. exigus albellus; Neuchâtel See, Zurich See, Genfer-see, Thuner-see, Vierwaldstätter-see.

Vegetative form: Zschokke writes as follows: Cysts rounded or oval surrounded by a compact membrane with many nuclei. The largest 32mm. by 16mm. Protoplasm granular. Polysporous.

Spore: Rounded oval in front view; broad elliptical in side view. Anterior end rounded; posterior end tapering, forming tail. Sutural ridge distinct. Tail is either bifurcated along the entire length or a single form, no intermediate form being observed. Dimensions: total length 55μ, length of the body 10μ, breadth 7μ, length of tail 4 to 5 times the length of the spore-body, length of polar filament 6 to 10 times that of the body of the spore.

Remarks: Zschokke thinks that Henneguya kolesnikovi, H. zschokkei and H. sp. Gurley are one and the same species, for which he proposed the name Myxobolus bicaudatus.

HENNEGUYA sp. (Gurley) Labbé

[Fig. 514]

1886  
1894  
1899  
1904  

HENNEGUYA sp. (Gurley) Labbé

Habitat: Integument (?) of Leuciscus rutilus L. The parasites formed boil-like enlargement in the skin.

Vegetative form: Not described.

Spore: Not described.

HENNEGUYA sp. (Gurley) Labbé

Habitat: Branchial-arches of Coregonus fera; Genfer-see.
Vegetative form: One cyst, 1mm in diameter.
Spore: Tail short. Zschokke quotes: length 8 to 10μ.
Remarks: According to Zschokke, this species is identical with H. zschokkei.

HENNEGUYA TENUIS Vaney et Conte
[Fig. 515]
1901 Henneguya tenuis Vaney and Conte 1901: 103-106
Habitat: Connective tissue of alimentary tract of Acerina cernua L.; Lyon (February).
Vegetative form: Numerous cysts particularly in the pyloric coecum. Usually spherical. Size: 30 to 150 μ in diameter.
Spore: Oval and small. Tail short. Two polar capsules at the anterior end. Sporoplasm with a nucleus, rod-shaped, with somewhat enlarged ends which is located at right angles to the longitudinal axis. Iodinophilous vacuole could not be traced. Dimensions: length 4μ, breadth 2μ.

HENNEGUYA NÜSSLINI Schuberg et Schröder
[Fig. 516 and 517]
1905 Henneguya nüsslini Schuberg and Schröder 1905: 56-59
Habitat: Subcutaneous connective tissue at the base of dorsal fin of Trutta fario L.; Gutach.
Vegetative form: Trophozoites form cysts (2 cysts found). Cysts lenticular, 1.5 to 2mm., surrounded by many concentric layers of fibrous connective tissue. Cysts containing only mature spores.
Spore: Broad oval form, flattened. Anterior end rounded. Tail at the posterior end. Shell somewhat thick, often shows sutural ridge. Tail filaments two. A "dark part" which in side-view is of triangular form, runs into the tail. Sporoplasm, occupying the posterior half of the spore, projects a narrow portion between the polar capsules beyond the middle of the capsules. Sporoplasm, uniformly granular, contains an iodinophilous vacuole and one, sometimes two nuclei connected by nuclear bridge. Polar capsules, pyriform, opening independently. Coiled polar filament observable, coiled 6 to 7 times. Dimensions: length excluding tail 12μ, length with tail 32μ, breadth 8 to 9μ, polar capsules 5μ by 3μ, length of polar filament 4 to 5 times longer than that of spore excluding tail (48 to 60μ).

HENNEGUYA LÉGERI Cépède
[Fig. 518 to 523]
1905 Henneguya légeri Cépède 1905: 905-913
1906 Henneguya légeri Cépède 1906: 66
1913 Henneguya légeri Cépède 1913: 302-305
Habitat: Urinary bladder of Cobitis barbatula L.; Isère (January).
Vegetative form: Young trophozoites subcircular, irregularly elliptical or elongated with distinct differentiation of protoplasm into ectoplasm and endoplasm. Plasmotomic multiplication takes place during winter months, when no spore is formed.

Spore: Oval with short tail, mostly bifurcated at the free end. The anterior end is more rounded, occasionally acuminated. Two polar capsules of equal size. Coiled polar filament distinct in vivo. Sporoplasm granular, contains two nuclei and a vacuole. The spore often shrinks in fresh conditions, probably owing to the poorly developed thin valves. Dimensions of spores mounted in balsam: length variable. Examples: Total length 22.5μ, tail 8.5μ; total length 19.5μ, tail 8μ; length of main part 8.5μ, breadth (comparatively constant) 6μ.

HENNEGUYA ACERINAE
Schröder

[Figs. 525 and 526]

<table>
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<tr>
<th>Year</th>
<th>Species</th>
<th>Author</th>
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<tr>
<td>1906</td>
<td>Henneguya acerinae</td>
<td>Schröder</td>
</tr>
<tr>
<td>1910</td>
<td>Henneguya crepilini</td>
<td>Wegener</td>
</tr>
<tr>
<td>1911</td>
<td>Henneguya acerinae</td>
<td>Nemeczek</td>
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Vegetative form: Schröder describes as follows: Rounded or spherical cysts in the connective tissue of branchial lamella. Full-grown cysts up to 300μ in diameter. Protoplasm is differentiated into ectoplasm and endoplasm. Ectoplasm shows fine radial striations. Endoplasm granular, contains many nuclei, especially lying in the middle portion. Well developed cyst, containing only spores, is surrounded by a membrane. On the surface of the ectoplasm, numerous edge-like elevations, branched and joining together, were recognized. Polysporous.

Nemeczek observed the largest cyst, spherical and 600μ in diameter.

Spore: Pyriform in front view; flattened. The anterior end is more or less blunt. Shell uniformly thin. Sutural edge slightly enlarged. Sporoplasm finely granular, contains an iodoniphilous vacuole and two nuclei. Polar capsules approximated closely, each having an independent opening. Dimensions: length 20 to 22μ, breadth 8 to 9μ, thickness 6 to 7μ, length of tail 50 to 60μ, polar capsules 10μ by 2 to 3μ, length of polar filament 80 to 90μ (water and nitric acid).

Nemeczek’s form is as follows:

The tail is bifurcated along its entire length. In one case (May, 1909), however, all the spores had no bifurcated tail, while the polar capsules were of unequal size. Dimensions in fresh state: total length 37.6 to 41.8μ, length, excluding tail 12.6 to 16.8μ, breadth 4.5μ, length of polar capsule 6.3 to 8.4μ, length of polar filament 67μ, length of tail 25μ.
Nemeczek observed two more different (?) forms. One form found in Lucioperca sandra, tho the size differs from the dimensions given by Schröder, is thought to be identical with the present species. Another form in the branchiae of Aspro singel, which is also to be one and the same species with the present species has the following dimensions: total length 35μ, length of spore excluding tail 15μ, breadth 5μ, length of polar capsule 6μ, length of tail 20μ.

HENNEGUYA GIGANTEA Nemeczek
[Figs. 527 to 535]

1911 Henneguya gigantea Nemeczek 1911: 146–154
1914 Henneguya gigantea Georgévitch 1914: 387–409

Habitat: Branchiae of Lucioperca sandra Cuv.; Apatin, Komitat Bacs-Bodrog, Hungary, Petrograd. Nemeczek mentions that the infection takes place only among young fish.

Vegetative form: Cysts numerous and of conspicuous size in the free end of branchial lamella. In average, each gill-arch has about 100 cysts which are of creamy color. Young cysts 400 to 450μ in diameter. They gradually begin to increase the size, from autumn until toward the end of spring, during which period, the contents remaining in the stages of pansporoblasts formation. Older cysts rounded spindle shape with the length of 4 to 7mm. and the breadth of 2 to 3mm. The connective tissue and epithelial cell layers form the cyst membrane. The connective tissue either simply surrounds the parasite or branches in the surface of the parasite, increasing in thickness and forming more or less enclosed chambers of the parasite. The membrane of the cyst which contains mature spores is usually very thin. Throughout the growth of the cyst, “chromatoid body” is seen in the endoplasm, which appears first as a filiform structure, stained deeply with nuclear stain. Later they gather together and form a compact body, situated excentrically. Fine branches from it become directed toward the surface of the body, anastomosing each other so that a network is formed on the surface of the cyst. The latter develops small ovoidal or columnal bodies (1.2μ long and about 1μ wide), which are arranged radially and densely. The number and quantity of these bodies increase in proportion to the number of propagative nuclei and they begin to disappear, first in the central portion, then in the periphery, so that in fully grown cysts (in summer months) these chromatoidal bodies are more rudimentary. Differentiated protoplasm is only recognized in young individuals, in which case ectoplasm is homogeneous and endoplasm reticular. Polysporous.

Spore: Nemeczek gives the following accounts.
Spindle shape, with truncate anterior end and very long thread like tail at the posterior end. The tail seems split into two at about the middle part of its length. Gentian violet stains the tail so intensively that its entire length could easily be made out. Dimensions: total length 87.5 to 110.5 μ, length of the body 10.5 μ, breadth 5 μ, length of tail 77 to 100 μ, length of polar capsule 5 μ, length of polar filament 70 μ (pressure or dessication followed by immersion in water).

Georgévitch’s form: length excluding tail 15 μ, breadth 6 μ, length of tail 75 μ, length of polar capsule 6 μ, length of polar filament 75 μ, diameter of the iodonophilous vacuole 4 μ.

Remarks: Nemeczek mentions that from October on, cysts had no spores, only containing propagative cells. The velocity of the development of spores depends upon the temperature of water.

Georgévitch worked out the spore formation of the species and observed that the binucleated sporeplasm emerged from the posterior end of the spore.

HENNEGUYA (?) sp. Nemeczek
[Fig. 536 to 539] 1911

Habitat: Branchiae of Abramis brama; Komorn, Komitat Komorn, Hungary (March).

Vegetative form: Cysts in the branchiae.

Spore: Besides normal spores of Myxobolus rotundus (page 149), spores of Henneguya type in small number were found. The anterior part of these spores resembles that of the species mentioned above, while the breadth is much smaller (8 μ) than the latter. Majority of spores have a thread like tail, 10 to 15 μ long, which was often bifurcated. An iodonophilous vacuole was fairly marked.

Remarks: It is placed here as a species of Henneguya by reason of the bifurcate tail.

HENNEGUYA GASTEROSTEI Parisi
[Fig. 540 to 543] 1912

Habitat: Kidney of Gasterosteus aculeatus L.; Lago di Garda (February).

Vegetative form: Rounded or oval, usually with two, but rarely with four spores. Ectoplasm thin and hyaline. Endoplasm contains numerous granules, most probably of fatty nature and decreasing in number as spores grow. Free full-grown spores were seen abundantly in the connective tissue of renal tubules, glomeruli, etc. Disporous and polysporous.
Spore: Oval with slightly attenuated anterior end; posterior end tapering into tails, which end in one point or bifurcated; asymmetrical in shape, one valve is more curved than the other. This asymmetry of the shell-valves in profile enables the present species to be distinguished from other species. Shell striated longitudinally. Two polar capsules pyriform and well developed, reaching to the middle of the spore. Sporoplasm with a round iodonophilous vacuole. Dimensions: total length 38 to 48μ, length of the cavity of the spore 15μ, breadth 6 to 7.5μ, polar capsules 7.5 to 9μ by 3 to 3.5μ, length of polar filament 50μ.

HENNEGUYA NEAPOLITANA Parisi
[Figs. 544 and 545]
1912 Henneguya neapolitana Parisi 1912 : 297–298

Habitat: Connective tissue of the renal tubule of kidney of Box salpa C. et V.; Napoli (August).
Vegetative form: Small cyst (40 to 50μ in diameter) surrounded by thin membrane, containing a number of spores, numerous pigment granules and coarse yellowish globules.

Spore: Oval, slightly flattened. Anterior end rounded when seen from the front, but attenuated in profile. Shell tapering into a long fine tail posteriorly. The fine distal portion of the tail wraps around the thicker part. Two polar capsules, pyriform, occupying the anterior half of the cavity of the spore, cross each other when seen from the front. Sporoplasm finely granular with two nuclei, the iodonophilous vacuole being hardly visible. Dimensions: total length 50 to 60μ, length of the cavity of spore 8.5 to 9.5μ, breadth 8.5 to 9.5μ, internal breadth 6.3 to 7μ, thickness 8μ, polar capsules 4.7 to 5.5μ by 3μ.

HENNEGUYA WISCONSINENSIS Mavor et Strasser
[Figs. 558 and 559]
1916 Henneguya wisconsinensis Mavor et Strasser 1916 : 676–682

Habitat: Urinary bladder of Perca flavescens; Lake Mendota, Wisconsin (April).
Vegetative form: Trophozoites are usually elongated and have the general form and shape of a limax ameba. It may reach a size of 300μ by 70μ. Clear differentiation of ectoplasm and endoplasm. Pseudopodia lobose. Two spores are formed in each pansporoblast. Polysporous.

Spore: Ovoid, bilaterally symmetrical, and have a bifurcated caudal process. Two polar capsules at anterior end. Coiled polar filament visible in vivo (5 windings). Dimensions: length excluding tail 11.5μ, breadth 7μ, tail 9.6μ, polar capsules 3.5μ by 2.5μ, length of filament 33μ.
HENNEGUYA BRACHYURA Ward

[Figs. 650 to 653]

1919 Henneguya brachyura Ward 1919 : 57

Habitat: In the cartilaginous fin ray of the caudal fin of Notropis anogenus; Put-in-Bay, Lake Erie (August). The species was found encysted in the same fish which was heavily infected by Myxobolus aureatus.

Vegetative form: Cysts rounded with slightly irregular contour imbedded in the fin ray. The size varies from 160μ in diameter up to 360μ by 240μ. No particular cyst membrane could be recognized. The differentiation of the protoplasm into ectoplasm and endoplasm is distinct. The ectoplasm covering the entire surface of the parasite as a layer 4 to 6μ thick, shows structure of a very finely granular nature. The endoplasm coarsely alveolar, is filled with mature spores in the central portion, while numerous nuclei and young spores in various developmental stages are present at the peripheral portion. Polysporous.

Spore: Rounded oval in front view; spindle shape with symmetrically built valves in profile. Shell rather thick. Sutural ridge fairly well marked; sutural edge exhibiting a variable number of folds (8 to 10). Two pyriform polar capsules are usually of the same size and form. The tail is a single process, usually more or less bent or irregularly curved, very rarely being straight. In general, it is sinuous with two or three shallow curves and is rather short, tapering gradually to a point. In young spores which are less deeply stained by any stain, various developmental stages of the tail are readily recognized. Giemsa solution stains the shell proper in clear blue, while the tail takes on a beautiful pink color, a distinct difference in affinity for dyes between the material in the tail and the shell. It seems probable that the tail of this type is entirely different in its development from that of the ordinary bifurcated type. Dimensions in section: length 10 to 11.5μ, breadth 8 to 8.75μ, thickness 4 to 5μ, polar capsules 3 to 4μ by 2μ, length of the tail up to 17μ.

HENNEGUYA SALMINICOLA Ward

[Figs. 654 to 656]

1914 ?Henneguya zschokkei Zschokke and Heitz 1914 : 200-201
1919 Henneguya salminicola Ward 1919 : 59

Habitat: In the sub-dermal tissue of Onchorhynchus keta and O. kisutch (Zschokke and Heitz, Kamtschatka) and in the connective tissue in body muscles of Onchorhynchus keta, Stickeen River, Alaska (Ward, September). The last named author undertook a careful examination of a part of the infected tissue preserved in formol. The species forms conspicuous cysts in the muscle from the sub-peritoneal to the sub-dermal connective tissue, tho all are sub-peritoneal in position.
Vegetative form: Ward describes as follows: The whitish opaque cysts are pyriform, and fairly uniform in size (3 to 6mm. in diameter). The cyst is covered by numerous layers of connective tissue which form a tough membrane around the parasite. The cyst contains young spores in various stages of development, which showed that two spores are formed in one pansporoblast, and mature spores thickly massed together in the central area. Polysporous.

Spore: Oval with rounded anterior and more or less attenuated posterior ends; elliptical in profile with attenuated anterior end. Shell smooth. Sutural edge exhibits folds variable in number (usually 6 to 7). Tail double, composed of two fine and equal halves which are the prolongation of the shell valves. The processes usually run roughly parallel to each other. Two pyriform polar capsules are of slightly different dimensions. Coiled polar filament is indistinct in preserved unstained specimens. Sporoplasm finely granular, shows a large iodinophilous vacuole. Dimensions of stained and mounted spores: total length 47μ (42.75 to 52.44μ), length of the main part 12μ (11.97 to 14.25μ), breadth 8μ (7.12 to 8.43μ), thickness 4.78μ, length of tail 35μ (30.78 to 38.19μ), polar capsule 3.70 to 4.55μ by 1.59 to 2.85μ.

Remarks: Zschokke and Heitz (1914) observed a species from Kampschatka, which they thought to be identical with Henneguya zschokkei (page 165). The writer is inclined to think that the species is identical with the species just described from Alaska.

HENNEGUYA MIYAIRII nov. spec.
[Fig. 524]

1909 Henneguya sp. Miyairi 1909: 127-129

Habitat: Subcutaneous tissue of head of Carassius auratus L.; Fukuoka (Nippon).

Vegetative form: Trophozoites form cysts and are also found in the condition of diffuse infiltration around the cysts. Cyst-membrane fibrous and thin. Ectoplasm and endoplasm fairly well differentiated, though the border line is not sharply marked. At the periphery of endoplasm, pansporoblasts with 7 to 12 nuclei are present (Two spores are formed in each pansporoblast?). Polysporous.

Spore: Oval, with broadly rounded anterior and slightly elongated posterior ends, the latter ending in long and fine tails. Two polar capsules at the anterior portion, are pyriform, small and convergent. Sporoplasm with an iodinophilous vacuole. Dimensions: length 12μ, breadth 8μ, length of the tails 10 to 30μ, length of polar filaments 23 to 40μ.

Remarks: As the description gives the details by which the species can be distinguished from other species, the writer establishes it on an independent basis.
HENNEGUYA MICTOSPORA nov. spec.  
[Figs. 546 to 557]


In one out of three (6.5 to 8 cm. long) of the first, in one out of two (7 and 9.5 cm. long) of the second and in one of the third species, examined in the middle of November, was found the present form. None showed a heavy infection, a number of scattered trophozoites and spores being observed. The host did not show any pathological change.

Vegetative form: Polymorphous. Generally rounded or elongated oval. In small monosporous and disporous forms, the tail of the spores developed inside, is extruded from the body, so that these trophozoites show long processes (Figs. 546, 553, 555). Pseudopodia lobose, and extruded from the entire surface of the body (Fig. 547), tho sometimes they are well formed at one end of the body. Protoplasm is differentiated distinctly into ectoplasm and endoplasm. Ectoplasm is homogeneous and hyaline, forming the outer layer. Endoplasm is of reticular structure. The body is colorless, often yellowish, when the endoplasm is loaded with numerous yellowish coarse granules. The size varies from 6 or 7 μ up to 60 μ. In a rounded form of 38 μ in longest diameter, five pansporoblasts, each developing two spores and many nuclei were observed. In another oval form of 45 μ by 60 μ in size, numerous nuclei were stained, showing that no development of pansporoblast has yet taken place. Disporous, polysporous and monosporous, tho of rare occurrence.

Spore: Broad spindle shape with attenuated anterior end. Shell rather thin. Each valve has 6 to 8 longitudinal striations on the surface. A long tail composed of two halves, is developed at the posterior end. Two pyriform polar capsules with distinctly visible coiled polar filament opens at the anterior tip. Sporoplasm, finely granular, contains an iodinophilous vacuole which is made distinctly visible by treating with Lugol's solution. When stained two typical nuclei are recognized in the sporoplasm. Dimensions of the fresh spores: length excluding tail 13.5 to 15 μ, breadth 8 to 9 μ, thickness 6 to 7.5 μ, length of tail 30 to 35 μ, often up to 40 μ, polar capsule 5 to 6 μ by 3 μ, length of polar filament 40 μ.

Genus HOFERELLUS Berg

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<th>Year</th>
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<tr>
<td>1898</td>
<td>Hoferellus</td>
<td>Berg</td>
<td>1898 : 41</td>
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<td>1898</td>
<td>Hoferia</td>
<td>Doflein</td>
<td>1898 : 288-289</td>
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The characters of the genus are described on page 59.
Type and only species: *Hoferellus cyprini* Doflein.
HOFERELLUS CYPRINI Doflein

[Figs. 577 to 581]

1898  Hoferia cyprini  Doflein  1898 : 289-290
1908  Hoferella cyprini  Mercier  1908 : LIII-LIV
1910  Hoferellus cyprini  Plehn  1910 : 20-22

Habitat: In lumen and epithelial cells of renal tubules of kidney of Cyprinus carpio L.; France and Germany.


Spore: Pyramidal with two short tail-like processes at the posterior end, which are formed from the shell-valves like those of Henneguya. Between these two processes, rarely small protoplasmic pointed processes occur. Each shell-valve has 9 to 10 longitudinal striations on it. Two polar capsules at the anterior part, show clearly the coiled polar filaments. Sporoplasm has two nuclei and an iodinophilous vacuole. Dimensions: total length 10 to 12\mu, breadth 8\mu, tail-process 2\mu long, polar capsule 3\mu long.

MYXOSPORIDIA GENERA ET SPECIES INCERTAE

Gen. et spec. incert. Leydig

1851  Gen. et spec. incert.  Leydig  1851 : 222

Habitat: Cysts in the root of tongue of Chondrostoma nasus L.; Germany.

Gen. et spec. incert. Leydig

1851  Gen. et spec. incert.  Leydig  1851 : 223

Habitat: Heart (auriculo-ventricular valve) of Leuciscus rutilus L.

Gen. et spec. incert. Leydig

1851  Gen. et spec. incert.  Leydig  1851 : 223

Gen. et spec. incert. Heckel et Kner

1851  Gen. et spec. incert.  Heckel and Kner  1851 : 12

Habitat: Branchiae of Lucioperca lucioperca L.; Austria.

Gen. et spec. incert. Borne

1886  Gen. et spec. incert.  Borne  1886 : 211

Habitat: Scomber scombrus L.
Genus incert. MERLUCII Perugia
[Figs. 582 and 583]
1891 Myxosporidium merlucii Perugia 1891 : 22-24
1899 Myxobolus merlucii Labbé 1899 : 100

Habitat: Gall-bladder of Merlucius merlucius L.; Italy.
Disporous (?).
Spore: Oval, with two polar capsules.
Remarks: The species was placed in the genus Myxobolus by previous authors. The figures given by Perugia show that the spores are at least dimorphous. From the habitat and the disporous characters, one should place it rather in one of the genera of the Family Ceratomyxidae.

Genus incert. CONGRI Perugia
[Figs. 584 and 585]
1891 Myxosporidium congri Perugia 1891 : 24-25
1894 Genus incert. congri Gurley 1894 : 182
1912 Myxobolus congri Parisi 1912 : 284

Habitat: Gall-bladder of Conger conger L.; Genova.
Vegetative form: Floating in the bladder. Form variable. Movements incessant, slow and ameboid.
Spore: Not described.

Gen. et spec. incert. Linton
[Fig. 590]
1891 Linton 1891 : 359-361

Habitat: Subcutaneous tissue of Notropis megalops Raf.; Ohio (Black River; September, October).
Vegetative form: Cysts. Globular, discrete or aggregated into clusters, white, with minute patches of black pigment from host; size varying from 2.5mm. (single cyst) to 7mm. by 5mm. (clusters); cyst-membrane composed of connective tissue.
Remarks: The cysts and figures of spores given by Linton suggest that it is most probably a unicapsular Myxobolus. As Linton could not detect (?) the polar capsule, tho his figures faintly show the said structure, it is placed in this group.
Gen. et spec. incert. Mingazzini

1892 Mingazzini 1892 : 398
1899 Labbé 1899 : 113

Habitat: Ovarian egg of *Lacerta* sp.
Vegetative form: Ameboid with hyaline pseudopodia and granular protoplasm.
Spore: Not observed.

Gen. et spec. incert. Nufer

1905 *Myxobolus* sp. Nufer 1905 : 71, 77, 79, 85, 186

Habitat: In the connective tissue of branchia of *Chondrostoma nasus*; Lake of Lucerne. A single cyst in a single host fish.
Vegetative form: Cyst white, and of 1mm. in diameter.
Spore: With two polar capsules at one pole and the sporoplasm.
Dimensions or any other characters are not given.
Remarks: Altho Nufer placed the form in the genus *Myxobolus*, this must be brought into the present group in view of the fact that the iodinophilous vacuole was not detected, and that the observation is too incomplete to place it to any one of the genera.

Gen. et spec. incert. Mavor

[Fig. 586 and 587]

1915 Mavor 1915 : 27-28, 32-33
1916 Mavor 1916 : 553-554

Habitat: Gall-bladder of *Urophycis chuss*; St. Andrews (July to September).
Vegetative form: Mavor writes as follows:
Attached, usually in large numbers, to the epithelium of the bladder, occurs a spherical or ellipsoidal trophozoite which in stained preparations is found to contain numerous nuclei. Very often clusters of *Ceratomyxa acadiensis* are found adhering to the free surface of myxosporidium. In fresh preparations the appearance is that of budding from a parent organism. An examination of sections has shown a sharp division between the myxosporidium and *Ceratomyxa acadiensis*.
Spore: Not found.
Remarks: Mavor supposed that the form under discussion probably was some species of Myxidium or Chloromyxum.

Gen. et spec. incert. Mavor

[Fig. 588 and 589]

1916 Mavor 1916a : 68-69

Habitat: Urinary bladder of *Stizostedion vitreum* Mitch.; Georgian Bay (Canada).
Vegetative form: Free forms vary greatly in shape, being rounded, elongated or branched. The largest individual 200µ. Ectoplasm layer clearly visible, sometimes projecting many bristle-like short processes. Endoplasm contains greenish granules. Trophozoites also attached to the epithelium by means of deeply stainable portion of the body.

Spore: Not observed.

Remarks: Mavor mentions resemblance of the present form to *Myxidium lieberkühni* Bütschli in many respects.
KEYS TO THE GENERA AND SPECIES OF MYXOSPORIDIA

No key to the genera and species of Myxosporidia has been published up to the present time. This is due of course to the difficulties which accompany such an attempt. These difficulties lie chiefly in the incompleteness of the observations and descriptions of the majority of the species of Myxosporidia.

The writer has attempted in the following pages to carry out this task. The key is by no means complete, as is unavoidable in the present state of knowledge concerning this particular group of the Protozoa.

Altho the spore is the fundamental factor used in constructing this key, it was necessary to refer also to some other secondary characters such as vegetative form and habitat.

Some authors are inclined to think that the difference in host species gives an ample basis on which to record the parasite as a new species. In some cases the parasite is specific in a certain host species while in other cases a number of different host species are infected by one and the same parasite. Therefore one can not lay much emphasis upon a difference of hosts in fixing the identification of a Myxosporidian.

KEY TO THE GENERA OF MYXOSPORIDIA

1(6) Spore approximately spherical
   Suborder Sphaerospora Kudo 1919................................. 2
2(3) Spore with four polar capsules
    Family Chloromyxidae Thélohan 1890
    Genus Chloromyxum Mingazzini 1890..............................(183)
3(2) Spore with two polar capsules
    Family Sphaerosporidae Davis 1917.............................. 4
4(5) Sutural line of spore straight
    Genus Sphaerospora Thélohan 1892..............................(185)
5(4) Sutural line of spore sinuous
    Genus Sinuolinea Davis 1917.................................(186)
6(1) Spore not spherical........................................... 7
7(16) Largest diameter of spore at right angles to sutural line; two polar capsules, one on each side of sutural line
   Suborder Eurysporea Kudo 1919
   Family Ceratomyxidae Doflein 1899............................. 8
8(11) Shell-valves prolonged laterally.............................. 9
9(10) Shell-valves hemispherical or rounded
    Genus Leptotheca Thélohan 1895...............................(179)
10(9) Shell-valves conical; free end tapering to a more or less pointed end
    Genus Ceratomyxa Thélohan 1892..............................(180)
11(8) Shell-valves rather elongated; circular in cross-section....... 12
12(13) Spore rounded oblong; shell longitudinally striated; polar capsules pyriform, with or without long and fine posterior filaments
    Genus Mitraspora Fujita 1912 emend. Kudo 1919..............(183)

Numbers enclosed in parentheses refer to the page of the article on which is found the description of the species named.
13(12) Spore angular, not rounded .................................................. 14
14(15) Spore pyramidal in front view; with its base at anterior end; with or without distinct anterior processes; shell smooth
   Genus *Myzoproteus* Dolein 1898 ........................................(183)
15(14) Spore isosceles triangular in front view; anterior end attenuated; polar capsules spherical and large; shell with fine network-like ridges; with posterior fringe-like processes
   Genus *Wardia* Kudo 1919 ........................................(183)
16( 7) Largest diameter of spore coincides with or at an acute angle to sutural plane;
one or two polar capsules which are in sutural plane
   Suborder *Platyspora* Kudo 1919 ...................................... 17
17(22) Spore fusiform; two polar capsules, one at each end of spore
   Family *Myxidiidae* Thélohan 1892 .................................. 18
18(21) Spore more or less regularly fusiform; shell-valves symmetrical ............. 19
19(20) Polar filament fine and long
   Genus *Myzidium* Bütschli 1882 ....................................(166)
20(19) Polar filament thick and short
   Genus *Sphaeromyxa* Thélohan 1892 ..................................(188)
21(18) Spore semi-circular in front view; polar filament fine
   Genus *Zschokkella* Auerbach 1910 ..................................(188)
22(17) Spore not fusiform; with one or two polar capsules at anterior extremity .... 23
23(26) Sporoplasm without iodinophilous vacuole
   Family *Myxosomatidae* Poche 1913 .................................. 24
24(25) Spore elongated ovoid in front view; anterior end mostly pointed
   Genus *Myxosoma* Thélohan 1892 ..................................(189)
25(24) Spore more or less rounded in front view
   Genus *Lentospora* Plehn 1905 ......................................(189)
26(23) Sporoplasm always with iodinophilous vacuole
   Family *Myxobolidae* Thélohan 1892 ................................ 27
27(30) Spore with posterior process; shell sometimes striated ....................... 28
28(29) Process more or less long, projecting posteriad along median line of spore; process either single or double; shell sometimes striated
   Genus *Henneguya* Thélohan 1892 .................................(193)
29(28) Process short projecting posteriad from sides; shell longitudinally striated
   Genus *Hoferellus* Berg 1898 .......................................(173)
30(27) Spore without posterior process; shell unstriated; one or two polar capsules
   Genus *Myxobolus* Bütschli 1882 ..................................(189)

II. KEY TO THE SPECIES

Genus *LEPTOTHECA* Thélohan 1895

1(14) Spore: sutural diameter always more than half of greatest breadth .......... 2
2( 7) Average sutural diameter less than 10μ .................................. 3
3( 4) Posterior margin of spore concave in front view; sutural diameter 8 to 9μ, breadth 12 to 14μ. Trophozoite usually with a long process
   *Leptotheca longipes* Auerbach 1910 .................................(63)
4( 3) Posterior margin of spore not concave .................................. 5
5( 6) Posterior margin of spore flattened; polar capsules pyriform; sutural diameter 6 to 7μ, breadth 11 to 12μ. Trophozoite with actively motile long filiform pseudopodia at rounded end
   *Leptotheca agilis* Thélohan 1892 .................................(60)

Numbers enclosed in parentheses refer to the page of the article on which is found the description of the species named.
6(5) Spore regularly ovoidal; polar capsules short pyriform, opening on opposite sides; sutural diameter 9μ, breadth 16μ. Trophozoite pyriform without any recognizable pseudopodium

Leptotheca fusiformis Davis 1917 ........................................ (63)

7(2) Average sutural diameter of spore equal to or larger than 10μ .......................... 8

8(13) Shell-valves symmetrically built; sutural ridge straight .......................... 9

9(10) Posterior margin of spore concave in front view; sutural diameter 10μ, breadth 18 to 20μ; each spore formed independently

Leptotheca informis Auerbach 1910 ........................................ (63)

10(9) Spore regularly ovoidal ........................................ 11

11(12) Trophozoite extremely polymorphous. Spore: sutural diameter 10 to 12μ, breadth 18 to 20μ

Leptotheca polymorpha Thélohan 1895 ........................................ (61)

12(11) Typical form of trophozoite elongated; anterior end depressed surrounded by short often branched pseudopodia. Spore: sutural diameter 12 to 15μ, breadth 18 to 20μ

Leptotheca elongata Thélohan 1895 ........................................ (60)

13(8) Shell-valves asymmetrically built; sutural ridge sinuous; sutural diameter 9 to 10μ, breadth 16 to 18μ. Trophozoite rounded; movements slow

Leptotheca lobosa Davis 1917 ........................................ (64)

14(1) Sutural diameter equal to or less than half of greatest breadth .......................... 15

15(16) Average sutural diameter smaller than 10μ ........................................ 16

16(17) Spore arch-shaped in front view; polar capsules pyriform; sutural diameter 3 to 4μ, breadth 8 to 10μ

Leptotheca parva Thélohan 1895 ........................................ (61)

17(16) Spore cylindrical; sutural diameter 4.5μ, breadth 9μ

Leptotheca glomerosa Davis 1917 ........................................ (65)

18(15) Average sutural diameter greater than 10μ ........................................ 19

19(20) Posterior margin of spore slightly concave in front view; anterior end attenuated; polar capsules pyriform; sutural diameter 13μ, breadth 26μ. Trophozoite rounded; with active amoeboid movements

Leptotheca macrospora Auerbach 1909 ........................................ (62)

20(19) Posterior margin of spore more or less flattened; anterior end smoothly rounded; polar capsules rounded; sutural diameter 11μ, breadth 22μ. Trophozoite elongated; pseudopodia often anastomose

Leptotheca scissura Davis 1917 ........................................ (64)

Incompletely described species

Leptotheca renicola Thélohan 1895 ........................................ (61)

Leptotheca kepsel Thélohan 1895 ........................................ (62)

Leptotheca perlata Gurley 1894 ........................................ (62)

Leptotheca sp. Awerinzew 1908 ........................................ (62)

Genus CERATOMYXA Thélohan 1892

1(52) Spore constant in form and size ........................................ 2

2(21) Sutural diameter equal to or less than one-eighth of total breadth .................. 3

3(10) Sutural diameter not less than one-tenth of total breadth .......................... 4

4(9) Pseudopodia of vegetative form located at rounded end .......................... 5

5(6) Pseudopodia long filiform; with slow whiplash-like movements toward pointed extremity. Spore: sutural diameter 12μ, breadth 118μ

Ceratomyxa flagellifera Davis 1917 ........................................ (77)

Numbers enclosed in parentheses refer to the page of the article on which is found the description of the species named.
Pseudopodia short lobose ........................................... 7
Extremities of spore attenuated; spore large; sutural diameter 10 to 12μ, breadth 90 to 100μ
Ceratomyxa sphaerulosa Thélohan 1892 ........................... (66)
Extremities of spore rounded; spore small; sutural diameter 4μ, breadth 34 to 39μ
Ceratomyxa streptospora Davis 1917 ............................... (79)
Sutural unlocalized; from main part of sporulating trophozoite are branched out from one to six long prolongations. Spore: sutural diameter 5 to 7μ, breadth 50μ
Ceratomyxa appendiculata Thélohan 1892 ........................ (67)
Sutural diameter equal to or less than one-tenth of total breadth .......................... 11
Shell-valve terminating in a fine thread-like process at distal end .......................... 12
Sutural diameter 7 to 8μ, breadth 40 to 50μ, lateral process 250 to 300μ
Ceratomyxa acadiensis Mavor 1915 ................................ (71)
Sutural diameter 5μ, breadth 10 to 12μ, length of lateral process 20μ
Ceratomyxa linospora Dolein 1898 ................................ (69)
Shell-valves not terminating in thread-like processes .............................................. 15
Shell-valve drawn out into a delicate process ......................................................... 16
Lateral process ribbon-like; sutural diameter 6μ, breadth 140 to 150μ
Ceratomyxa laenia Davis 1917 ........................................ (74)
Lateral process not ribbon-like, but circular in cross-section .................................... 18
Posterior margin of main part of spore flattened; sutural diameter 12μ, breadth
115 to 140μ; trophozoite disporous
Ceratomyxa sphairophora Davis 1917 ................................ (73)
Posterior margin of main part of spore rounded; sutural diameter 7μ, breadth 80μ. Trophozoite monosporous or disporous
Ceratomyxa spinosa Davis 1917 ....................................... (80)
Shell-valve tapering gradually to attenuated point; asymmetrical; sutural diameter
9μ, breadth 115μ
Ceratomyxa attenuata Davis 1917 ................................... (75)
Sutural diameter more than one-eighth of total breadth ........................................... 22
Sutural diameter equal to or more than one-fifth of breadth ................................... 23
Shell-valves symmetrically built ......................................................... 24
Shell-valves attenuated at distal end ................................................................. 25
Pseudopodia peculiar network-like form. Spore: sutural diameter 12 to 20μ, breadth 50 to 80μ
Ceratomyxa ramosa Awerinzew 1907 ................................ (69)
Pseudopodia never unite together .............................................................................. 27
Shell-valves curved greatly posteriorly; polar capsules rounded; sutural diameter
8 to 9μ, breadth 16 (?)μ. Trophozoite elongated pyriform
Ceratomyxa recurvata Davis 1917 ...................................... (75)
Shell-valves not curved; two thickenings on posterior margin equidistant from
sutural line; polar capsules pyriform; sutural diameter 40 to 45μ, thickness 25
to 30μ, breadth 124 to 140μ
Ceratomyxa tylosuri Awerinzew 1913 ................................ (70)
Shell-valve rounded at distal end ............................................................... 30
Spore arch-shaped; sutural diameter and thickness 12 to 15μ, breadth 50 to 60μ.
Trophozoite large amoeboid
Ceratomyxa sparsi Awerinzew 1913 .................................. (70)
Spore straight ......................................................................... 32
Numbers enclosed in parentheses refer to the page of the article on which is found the description of the species named.
32(33) Shell-valves shorter (sutural diameter: breadth = 1:1.6)  
\textit{Ceratomyxa coris} Georgévitch 1916 ........................................ (72)

33(32) Shell-valves longer (sutural diameter: breadth = 1:2.6)  
\textit{Ceratomyxa hewardi} Georgévitch 1916 ........................................ (72)

34(23) Shell-valves asymmetrically built ............................................. 35

35(40) Spore arch-shaped in front view .............................................. 36

36(37) Sutural diameter equal to one-fifth of breadth; sutural diameter 10\(\mu\), breadth 50\(\mu\)  
\textit{Ceratomyxa globulisera} Thelohan 1895 .......................................... (67)

37(36) Sutural diameter more than one-fifth of total breadth ...................... 38

38(39) Spore: breadth shorter; sutural diameter 14\(\mu\), breadth 17\(\mu\)  
\textit{Ceratomyxa abbreviata} Davis 1917 ............................................... (76)

39(38) Spore: breadth longer; sutural diameter 12 to 15\(\mu\), breadth 45 to 50\(\mu\)  
\textit{Ceratomyxa reticularis} Thelohan 1895 .......................................... (68)

40(35) Spore straight ............................................................................... 41

41(42) Sutural diameter 11\(\mu\), breadth 27\(\mu\). Trophozoite always rounded  
\textit{Ceratomyxa amorpha} Davis 1917 ............................................... (78)

42(41) Sutural diameter 6\(\mu\) ................................................................ 43

43(44) Trophozoite with active pseudopodia. Spore: sutural diameter 6\(\mu\), breadth 22 to 24\(\mu\)  
\textit{Ceratomyxa undulata} Davis 1917 ........................................... (79)

44(43) Trophozoite with inactive pseudopodia. Spore: sutural diameter 6\(\mu\), breadth 31\(\mu\)  
\textit{Ceratomyxa inaequalis} Doflein 1898 ............................................... (68)

45(22) Sutural diameter less than one-fifth of total breadth ...................... 46

46(49) Breadth of spore equal to or greater than 50\(\mu\)  
\textit{Ceratomyxa pseudopodia} Davis 1917 ........................................... (73)

47(48) Shell-valve tapering gradually toward distal end; sutural diameter 8\(\mu\), breadth 50 to 55\(\mu\). Trophozoite usually elongated pyriform  
\textit{Ceratomyxa mesospora} Davis 1917 ............................................... (79)

48(47) Shell-valve rounded at distal end; sutural diameter 6 to 7\(\mu\), breadth 50\(\mu\). Trophozoite usually rounded or irregular form; size small  
\textit{Ceratomyxa aggregata} Davis 1917 ............................................... (77)

49(46) Breadth of spore smaller than 30\(\mu\) ......................................... 50

50(51) Trophozoite ordinarily spherical, diameter not exceeding 16 to 20\(\mu\); protoplasm extremely pale looking. Spore: sutural diameter 5\(\mu\), breadth 25 to 30\(\mu\)  
\textit{Ceratomyxa pallida} Thelohan 1895 ............................................... (67)

51(50) Trophozoite pyriform with a long posterior process; movements by wavelike motion of ectoplasm; also active backward movements of pseudopodia. Spore asymmetrically built; sutural diameter 5\(\mu\), breadth 24 to 28\(\mu\)  
\textit{Ceratomyxa agglomerata} Davis 1917 ......................................... (77)

52(1) Spore variable in size and form .................................................... 53

53(54) Variation in number of shell-valves conspicuous; sutural diameter 5\(\mu\), breadth 25\(\mu\)  
\textit{Ceratomyxa truncata} Thelohan 1895 ............................................... (67)

54(33) Variable in size and form of spore, but not in number of shell-valve. 55

55(60) Trophozoite more or less definite in shape ................................... 56

56(59) Trophozoite usually pyriform .................................................... 57

57(58) Trophozoite disporous. Spore: sutural diameter 7 to 9\(\mu\), breadth 15 to 38\(\mu\)  
\textit{Ceratomyxa lunata} Davis 1917 .................................................... (76)

58(57) Trophozoite monosporous or disporous. Spore: sutural diameter 5 to 6\(\mu\), breadth 18 to 25\(\mu\)  
\textit{Ceratomyxa monosporea} Davis 1917 .......................................... (78)

Numbers enclosed in parentheses refer to the page of the article on which is found the description of the species named.
59(56) Trophozoite always rounded, never pyriform. Spore: sutural diameter 6\(\mu\), breadth 16\(\mu\)

*Ceratomyxa navicularia* Davis 1917........................................(80)

60(55) Trophozoite polymorphous.................................................. 61

61(62) Shell-valves symmetrically built; sutural diameter 5 to 8\(\mu\), breadth 20 to 31\(\mu\)

*Ceratomyxa arcuata* Thelohan 1892..........................................(65)

62(61) Shell-valves often asymmetrically built; sutural diameter 8 to 14\(\mu\), breadth 50 to 80\(\mu\)

*Ceratomyxa drepanopsettae* Awerinzew 1907.................................(70)

Incompletely described species

*Ceratomyxa* sp. (?) Awerinzew 1913........................................(71)

*Ceratomyxa* sp. (?) Awerinzew 1913........................................(71)

*Ceratomyxa* sp. Georgévitch 1916............................................(72)

Genus MYXOPROTEUS Doflein 1898

1( 2) Spore with two long (5\(\mu\)) processes extending anteriad from sides; sutural diameter 9\(\mu\), breadth 12\(\mu\)

*Myxoproteus cornutus* Davis 1917..........................................(82)

2( 1) Spore without long process............................................... 3

3( 4) Spore with two small spinous processes at anterior end; sutural diameter 25\(\mu\), breadth 18 to 20\(\mu\)

*Myxoproteus ambiguis* Thelohan 1895....................................(81)

4( 3) Spore without any process; posterior end slightly pointed; sutural diameter 12\(\mu\), breadth 10 to 11\(\mu\)

*Myxoproteus cordiformis* Davis 1917......................................(81)

Genus WARDIA Kudo 1919

1 Spore isosceles triangular form; shell with network-like striations which end in fringe-like processes at posterior margin; sutural diameter 9 to 10\(\mu\), breadth 10 to 12\(\mu\), diameter of polar capsule 4\(\mu\).

*Wardia ovinocua* Kudo 1919..................................................(82)

Doubtfully placed species

*Wardia ohlmacheri* (Gurley 1894)...........................................(83)

Genus MITRASPORA Fujita 1912 emend. Kudo 1919

1( 4) Spore with posterior filaments.......................................... 2

2( 3) Posterior filaments short (5 to 6\(\mu\) long); length 10\(\mu\), breadth 8 to 9\(\mu\), thickness 6 to 8\(\mu\), polar capsule 4\(\mu\) by 1.5 to 2\(\mu\)

*Miraspora cyprini* Fujita 1912..............................................(84)

3( 2) Posterior filaments of spore long (up to 28\(\mu\)); length 10 to 11\(\mu\), polar capsule 4 to 4.5\(\mu\) long

*Miraspora caudata* Parisi 1910...............................................(85)

4( 1) Spore without posterior filament; anterior end slightly attenuated; posterior end truncate; length 15 to 17\(\mu\), breadth 5 to 6\(\mu\), thickness 4.5 to 5.5\(\mu\), polar capsule 7.5\(\mu\) by 2\(\mu\)

*Miraspora elongata* Kudo 1919..............................................(85)

Genus CHLOROMYXUM Mingazzini 1890

1( 4) Spore with posterior appendage......................................... 2

2( 3) Posterior appendage fine and numerous; length 6 to 9\(\mu\), breadth 5 to 6\(\mu\), polar capsule 2 to 3\(\mu\) by 1 to 2\(\mu\)

*Chloromyxum leydigii* Mingazzini 1890....................................(87)

Numbers enclosed in parentheses refer to the page of the article on which is found the description of the species named.
3. (2) Posterior appendage single or bifurcated; length 8 μ, breadth 6 to 7 μ, appendage 10 μ long

Chloromyxum caudatum Thélohan 1895. .....................................(88)

4. (1) Spore without posterior appendage ........................................ 5

5(34) Spore circular or subcircular in front view; parasitic in body cavity of host. ....... 6

6(29) Shell-valves marked with striations or ridges .................................... 7

7(24) Main part of striations or ridges parallel to sutural line ..................... 8

8(11) Shell-valves partially marked .................................................. 9

9(10) Ridges on each shell-valve variable in number (six found in original drawing) running closely to sutural line; diameter 10.8 μ

Chloromyxum dubium Auerbach 1908. .........................................(91)

10. (9) Each shell-valve with one ridge from which eight to twelve short ones are directed towards centre of valve; oval in profile; length and breadth 8 to 10 μ, thickness 5 to 7 μ

Chloromyxum trijugum Kudo 1919. ...........................................(96)

11(8) Entire shell-valve marked ...................................................... 12

12(19) Shell-valve marked with fine striations .................................... 13

13(16) Spore oval in lateral view .................................................... 14

14(15) Trophozoite larger; size up to 50 μ by 20 μ; polysporous (up to eight spores) rarely disporous. Spore: length 8 to 9 μ, breadth 6 to 7 μ, thickness 5 to 6 μ

Chloromyxum misgranti Kudo 1916. ............................................(93)

15(14) Trophozoite smaller; size up to 35 μ in diameter; polysporous (up to six spores) or disporous. Spore: length 8 μ, breadth 7 μ, thickness 5 to 6 μ

Chloromyxum calosomi Kudo 1919. ............................................(98)

16(13) Spore circular in lateral view ................................................ 17

17(18) Trophozoite rounded; 40 to 45 μ by 28 to 40 μ. Spore: diameter 10 to 13 μ, polar capsule 4 to 6 μ long

Chloromyxum prolei Joseph 1905. ..............................................(90)

18(17) Trophozoite irregular form; 33 to 35 μ in average length. Spore: striations thicker and somewhat wavy; diameter 9 to 9.5 μ, polar capsule 3 μ long

Chloromyxum thymalli Lebzelter 1912. ...........................................(92)

19(12) Shell-valves marked with ridges ............................................. 20

20(21) Trophozoite small (average diameter of adults about 20 μ); monosporous, rarely disporous. Spore: shell-valves with ridges marked antero-posteriad; diameter 10 to 11 μ

Chloromyxum cristatum Léger 1906. ...........................................(91)

21(20) Trophozoite large, diameter reaching 40 to 50 μ .................................. 22

22(23) Ridges on shell-valves united into a line at each end and unequal in thickness; spore small; length 10 to 12 μ, breadth 8 to 10 μ

Chloromyxum fujitai Kudo 1916. ...................................................(93)

23(22) Shell-valve with two circular and two small ridges; spore large; length 16 μ, breadth 10 μ

Chloromyxum koi Fujita 1913. ...................................................(92)

24(7) Striations or ridges not parallel to sutural line .................................. 25

25(26) Striations irregular; posterior margin thickened at sides; diameter 7.5 to 9 μ

Chloromyxum wardsi Kudo 1919. ...................................................(99)

26(25) Striations parallel to each other ................................................ 27

27(28) Striations forming acute angles with sutural line; diameter 8 to 9 μ

Chloromyxum truttae Léger 1906. .............................................(90)

28(27) Four ridges on posterior half of shell-valve converging toward anterior end; diameter 7 μ

Chloromyxum granulosum Davis 1917. .......................................(96)

Number enclosed in parentheses refer to the page of the article on which is found the description of the species named.
29(6) Shell-valves without marking, beside sutural ridge
30(31) Anterior end of spore rounded; diameter 7 to 8\(\mu\); one or two short spinous thickenings at posterior margin

Chloromyxum fluitabile Thélohan 1892

31(30) Anterior end of spore mucronate or truncate
32(33) Anterior end of spore mucronate; length 8\(\mu\)

Chloromyxum mucronatum Gurley 1893

33(32) Anterior end of spore truncate; spore large; length 40 to 48\(\mu\), breadth 30 to 38\(\mu\)

Chloromyxum magnum Awerinzew 1913

34(5) Spore rounded quadrangular in end view; conical in front view; parasitic in muscular tissue of fish

35(36) Length of spore larger than breadth; length 6\(\mu\), breadth 5\(\mu\)

Chloromyxum quadratum Thélohan 1895

36(35) Length (sutural diameter) of spore smaller than breadth

37(38) Spore variable in form; anterior end narrower or broader than posterior end;

length 4 to 4.75\(\mu\), breadth 5.4 to 6.5\(\mu\)

Chloromyxum clupeidæ Hahn 1917

38(37) Anterior end of spore drawn out; almost circular in end view; length 6\(\mu\), breadth 7.5\(\mu\)

Chloromyxum funduli Hahn 1915

Incompletely described species

Chloromyxum diplöyi Gurley 1893
Chloromyxum sp. Awerinzew 1908

Genus SPHAEROSPORA Thélohan 1892

1(8) Shell-valve of spore without marking except sutural ridge
2(7) Vegetative form amoeboïd
3(4) Movements of vegetative form active. Spore: sutural ridge fairly well marked;

a pair of short filaments become visible at anterior end on warming; diameter 8\(\mu\)

Sphaerospora masovica Cohn 1902

4(3) Vegetative form without active movements

5(6) Spore: sutural ridge not prominent; polar capsule pyriform; diameter 8 to 13\(\mu\),
polar capsule 4 to 5\(\mu\) by 2.5 to 3.5\(\mu\)

Sphaerospora carassii Kudo 1919

6(5) Spore: sutural ridge prominent; polar capsule spherical; slightly attenuated at anterior end; diameter 10 to 11\(\mu\)

Sphaerospora elegans Thélohan 1892

7(2) Vegetative form produces cyst in tissue. Spore: diameter 8 to 9\(\mu\)

Sphaerospora platessae Woodcock 1904

8(1) Shell-valves striated

9(10) Polar capsules divergent; diameter of spore 10 to 12\(\mu\), thickness 8\(\mu\)

Sphaerospora divergens Thélohan 1895

10(9) Polar capsules not divergent

11(14) Striation marked antero-posteriad

12(13) Spore with a quadrangular lamella at anterior margin; striations ending in small spines at posterior margin; length 12 to 14\(\mu\), breadth 10 to 12\(\mu\)

Sphaerospora rostrata Thélohan 1895

13(12) Spore smooth-contoured; polar capsules parallel to each other; diameter 7 to 10\(\mu\)

Sphaerospora polymorpha Davis 1917

Numbers enclosed in parentheses refer to the page of the article on which is found the description of the species named.
14(11) Faint concentric striations; pointed at sides and middle part of posterior margin; polar capsules unequal in size; length 7 to 8 μ, breadth 6 to 7 μ, thickness 5 μ
*Sphaerospora angulata* Fujiita 1912. (102)

Incompletely described species
*Sphaerospora* sp. Davis 1917. (103)
*Sphaerospora* sp. Southwell et Prashad 1918. (103)

Genus *SINUOLINEA* Davis 1917

1(4) Spore with two processes. 2
2(3) Processes lateral and long (20 μ); spore: 9 to 11 μ long, 9 μ broad, process 18 to 22 μ long
*SINUOLINEA brachiophora* Davis 1917. (106)
3(2) Processes posteriad from sides and short; diameter 12 to 13 μ. Trophozoite opaque
*SINUOLINEA opacita* Davis 1917. (106)
4(1) Spore without process. 5
5(6) Trophozoite with active amoeboid movements. Spore: sutural ridge S-shaped at anterior part; length 15 μ, breadth 12 μ, thickness 8 μ
*SINUOLINEA arborescens* Davis 1917. (105)
6(5) Trophozoite with slow amoeboid movements. 7
7(8) Sutural plane much twisted on its axis; capsulogenous cells large occupying more than half of sporal cavity; polar capsules opening on opposite sides; diameter 12 to 14 μ
*SINUOLINEA capsularis* Davis 1917. (105)
8(7) Sutural plane not much twisted; diameter 15 μ
*SINUOLINEA dimorpha* Davis 1916. (104)

Genus *MYXIDIUM* Bütchli 1882

1(16) Breadth of spore equal to or more than half of length. 2
2(7) Shell-valves unstriated. 3
3(6) Sutural plane curved into an S. 4
4(5) Spore small; length 8 to 12 μ, breadth 4 to 6 μ
*MYXIDIUM incurvatum* Thélohan 1892. (108)
5(4) Spore large; much broader; length 20.8 to 23.4 μ, breadth 13 to 15.6 μ
*MYXIDIUM inflatum* Auerbach 1909. (111)
6(3) Sutural plane straight; spore cylindrical; surrounded by a gelatinous envelope; length 10 to 11 μ, breadth 6 μ
*MYXIDIUM glutinosum* Davis 1917. (115)
7(2) Shell-valves striated. 8
8(9) Sutural line curved into an S; form oval; circular in cross-section; openings of polar capsules pointed; length 11 to 13 μ, breadth 8 to 9 μ
*MYXIDIUM oniforme* Parisi 1912. (114)
9(8) Sutural line straight. 10
10(13) Sutural line coincides with longitudinal axis of spore. 11
11(12) Sutural ridge distinct; extremities mucronate; length 9 to 10 μ, breadth 5 to 5.6 μ, thickness 4.7 to 5 μ. Vegetative form produces cysts, 800 to 900 μ in diameter
*MYXIDIUM giardi* Cépède 1906. (110)
12(11) Sutural ridge faintly marked; extremities gradually drawn out; length 11 μ, breadth 8 μ. Trophozoite large and leaf-like; diameter up to 1.35 mm.
*MYXIDIUM phyllium* Davis 1917. (116)

Numbers enclosed in parentheses refer to the page of the article on which is found the description of the species named.
<table>
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<td>13(10)</td>
<td>Sutural line forming an acute angle with longitudinal axis of spore.</td>
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<td>14(15)</td>
<td>Shell thickened at extremeties; polar capsules ovoidal; length 10 to 14μ, breadth 6 to 8μ, length of polar capsule 4μ. <em>Myxidium striatum</em> Cunha et Fonseca 1917.</td>
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<tr>
<td>15(14)</td>
<td>Shell uniformly thick; polar capsules rounded pyriform; length 10 to 12μ, breadth 6μ, length of polar capsule 3 to 4μ. <em>Myxidium macrocapsulare</em> Auerbach 1910.</td>
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<td>16(1)</td>
<td>Breadth of spore less than half of length.</td>
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<tr>
<td>17(34)</td>
<td>Breadth more than one-third of length.</td>
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<tr>
<td>18(25)</td>
<td>Shell-valves unstriated.</td>
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<td>19(22)</td>
<td>Extremities of spore pointed.</td>
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<tr>
<td>20(21)</td>
<td>Spore: extremities sharply pointed; greatly curved; narrow; length 12 to 14μ, breadth 5.5 to 6μ, thickness 2.5 to 3μ. <em>Myxidium depressum</em> Parisi 1912.</td>
</tr>
<tr>
<td>21(20)</td>
<td>Spore: extremities not so sharply pointed; not greatly curved; broader; length 16.2 to 19μ, breadth 7 to 9μ. <em>Myxidium bergense</em> Auerbach 1909.</td>
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<tr>
<td>22(19)</td>
<td>Extremities of spore not pointed.</td>
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<td>23(24)</td>
<td>Spore larger; length 15 to 20μ, breadth 7 to 8μ. <em>Myxidium sphaericum</em> Thélohan 1895.</td>
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<tr>
<td>25(18)</td>
<td>Shell-valves striated.</td>
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<td>26(33)</td>
<td>Spore definite in shape.</td>
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<td>27(28)</td>
<td>Spore constricted in middle part of length; length 15μ. <em>Myxidium histophilum</em> Thélohan 1895.</td>
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<td>28(27)</td>
<td>Spore regularly fusiform.</td>
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<td>30(29)</td>
<td>Vegetative form does not produce cyst.</td>
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<tr>
<td>31(32)</td>
<td>Sutural line slightly curved in S-form; length 15 to 16μ, breadth and thickness 5.5 to 6μ. <em>Myxidium americanum</em> Kudo 1919.</td>
</tr>
<tr>
<td>32(31)</td>
<td>Sutural line not curved in S-shape, but bent to one side; length 15 to 18μ, breadth and thickness 6 to 7μ. <em>Myxidium kagayamai</em> Kudo 1919.</td>
</tr>
<tr>
<td>33(26)</td>
<td>Spore variable in form; straight and constricted; one side concave, the other convex; arch-shaped, etc.; length 13 to 18μ, breadth 5.2 to 5.8μ. <em>Myxidium pfeifferi</em> Auerbach 1908.</td>
</tr>
<tr>
<td>34(17)</td>
<td>Breadth of spore equal to or less than one-third of length.</td>
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<tr>
<td>35(40)</td>
<td>Shell-valves unstriated.</td>
</tr>
<tr>
<td>36(37)</td>
<td>Spore greatly elongated (breadth: length = 1.6:2); length 21.6 to 25.2μ, breadth 3.6 to 4μ. <em>Myxidium procurum</em> Auerbach 1910.</td>
</tr>
<tr>
<td>37(36)</td>
<td>Spore less elongated (breadth: length = 1.3 or 1.3.4).</td>
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<td>38(39)</td>
<td>Spore large; valves asymmetrical; length 28μ, breadth 8μ. <em>Myxidium giganteum</em> Dollein 1898.</td>
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<tr>
<td>39(38)</td>
<td>Spore small; valves symmetrical; length 12μ, breadth 3 to 4μ. <em>Myxidium danilewskyi</em> Laveran 1897.</td>
</tr>
<tr>
<td>40(35)</td>
<td>Shell-valves striated.</td>
</tr>
<tr>
<td>41(44)</td>
<td>Spore definite in shape.</td>
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</tbody>
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42(43) Length of polar capsule more than one-fourth of that of spore; spore 18 to 20μ long, 5 to 6μ broad
   *Myxidium lieberkühni* Bütschli 1882.............................................................................(107)
43(42) Length of polar capsule less than one-seventh of that of spore; length 16 to 17μ, breadth 5μ
   *Myxidium mackiei* Bosanquet 1910...................................................................................(112)
44(41) Spore variable in shape; S-form, straight fusiform, etc.; length 9.1μ, breadth 2.8μ. Vegetative form produces cyst
   *Myxidium anguillae* Ishii 1915.......................................................................................(114)
Incompletely described species
   *Myxidium* sp. Gurley 1894.................................................................................................(109)
   *Myxidium* sp. Awerinzew 1908.........................................................................................(112)
   *Myxidium* sp. Mavor 1915....................................................................................................(115)

Genus **SPHAEROMYXA** Thélohan 1892

1(6) Spore straight, not arch-shaped..................................................................................2
2(5) Shell-valves symmetrical...............................................................................................3
3(4) Ends of spore truncate; striations longitudinal; length 15 to 20μ, breadth 5 to 6μ.
   *Sphaeromyxa balbianii* Thélohan 1892.............................................................................(118)
4(3) Ends of spore rounded; sutural plane forming some angles with longitudinal axis
   of spore; striations transverse; length 12 to 14μ, breadth 9 to 10μ
   *Sphaeromyxa immera* Lute 1889......................................................................................(119)
5(2) Shell-valves asymmetrical; unstriated; ends less truncate; dimensions about
   twice or three times larger than those of *Sphaeromyxa balbianii*
   *Sphaeromyxa gasteroseta* Georgévitch...............................................................................(121)
6(1) Spore arch-shaped, not straight..................................................................................7
7(8) Shell-valves indistinctly striated; ends truncate; length 22 to 28μ, breadth 3 to
   4.3μ
   *Sphaeromyxa sabrazesi* Laveran et Mesnil 1900.................................................................(120)
8(7) Shell-valves unstriated.....................................................................................................9
9(10) Spore extremely large; length 75 to 80μ, breadth 18 to 20μ; ends slightly tapering
   *Sphaeromyxa exneri* Awerinzew 1913.............................................................................(121)
10(9) Spore less than 35μ in length.....................................................................................11
11(12) Extremities rounded; length 30 to 35μ, breadth 8μ
   *Sphaeromyxa incurvata* Doflein 1898.............................................................................(119)
12(11) Extremities truncate; sutural ridge often twisted in S-form; length 20.8 to 26μ,
   breadth and thickness 5.4μ
   *Sphaeromyxa hellandii* Auerbach 1909............................................................................(121)

Genus **ZSCHOKKELLA** Auerbach 1910

1(4) Shell-valves unstriated.................................................................................................2
2(3) Openings of polar capsules on flattened side; spore large; length 16 to 28.8μ,
   breadth 13 to 18μ
   *Zschokkella hildæ* Auerbach 1910..................................................................................(122)
3(2) Openings of polar capsules at pointed ends; spore small; length 11μ, breadth 7μ
   *Zschokkella globulosa* Davis 1917..................................................................................(123)
4(1) Shell-valves striated.......................................................................................................5
5(6) Openings of polar capsules at pointed ends; polar capsules spherical; spore larger;
   length 10 to 14μ, breadth 6 to 7μ
   *Zschokkella aechilognathi* Kudo 1916............................................................................(123)

Numbers enclosed in parentheses refer to the page of the article on which is found the description of the species named.
6(5) Openings of polar capsules on side; polar capsules rounded pyriform; spore smaller; length 9.5 to 11.5μ, breadth 6.5 to 7μ

Zschokkella nova Klokacewaw 1914 .............................................(122)

Genus MYXOSOMA Théllohan 1892
1(2) Spore: shell thickened at anterior end; length 12 to 13μ, breadth 7 to 8μ, polar capsule 6 to 7μ by 2 to 3μ. Cysts polymorphous

Myxosoma dujardini Théllohan 1892 .............................................(124)

2(1) Spore: shell of uniform thickness and with seven to ten folds on sutural edge; length 14μ, breadth 8μ, thickness 6μ, polar capsule 8μ by 2μ. Cysts spherical up to 360μ in largest diameter

Myxosoma fimduli Kudo 1918 .....................................................(125)

Ambiguous form

Myxosoma lobatum Nemeczek 1911 .............................................(124)

Genus LENTOSPOR A Plehn 1905
1(8) Spore circular in front view ............................................. 2

2(3) Vegetative form produces cysts. Spore: length and breadth 6.3 to 7μ, thickness 4.2 to 4.9μ

Lentospora dermaiobia Ishii 1916 .............................................(127)

3(2) Vegetative form does not produce cysts or cysts unobserved .......................... 4

4(5) Spore small; trophozoites found in the blood vessel of the brain. Spore 5 to 5.5μ in diameter.

Lentospora encephalina Mulsw 1911 .............................................(126)

5(4) Spore large, greater than 7.5μ in average diameter .................................................. 6

6(7) Spore slightly pointed at anterior end; length 8 to 10μ, breadth 7 to 8μ, thickness 5 to 6μ

Lentospora acau Fujita 1912 .....................................................(127)

7(6) Anterior end of spore rounded; diameter 6 to 10μ

Lentospora cerebrais Plehn 1905 .............................................(125)

8(1) Spore oval in front view ..................................................... 9

9(10) Spore symmetrically built; length 12μ, breadth 9.5μ, thickness 6μ

Lentospora multiplicata Reuss 1906 .............................................(126)

10(9) Spore asymmetrically built; length 10 to 11μ, breadth 6.5 to 7μ

Lentospora asymetrica Parisi 1912 .............................................(126)

Genus MYXOBOLUS Bütitschli 1882
1(18) Spore with one polar capsule ............................................. 2

2(9) Breadth of spore equal to or more than half of length ............................................. 3

3(6) Breadth of spore equal to half of length ............................................. 4

4(5) Spore larger; often calabash-shaped; anterior end drawn out into a rounded tip; shell thickened at tip; length 15μ, breadth 7 to 8μ, thickness 5 to 6μ

Myxobolus toyamae Kudo 1915 .............................................(131)

5(4) Spore smaller; anterior end pointed; shell of uniform thickness; length 9 to 10μ, breadth 4.5 to 5.5μ, thickness 3μ

Myxobolus ochli-leucisci Trojan 1909 .............................................(130)

6(3) Breadth of spore more than two-thirds of length ............................................. 7

7(8) Polar capsule small and oblique in position

Myxobolus unicapsulatus Gurley 1893 .............................................(129)

8(7) Polar capsule long and median in position; spore broader; length 13.2 to 13.6μ, breadth 10.1 to 10.3μ

Myxobolus sent Southwell et Prashad 1918 .............................................(132)

Numbers enclosed in parentheses refer to the page of the article on which is found the description of the species named.
9(2) Breadth of spore less than half of length ........................................... 10
10(17) Breadth of spore more than two-fifths of length ............................. 11
11(16) Spore without any process ........................................................... 12
12(15) Shell of uniform thickness ............................................................ 13
13(14) Spore bent to one side; shell thickened at slightly rounded anterior tip; sutural edge without marking; length 16 to 18μ, breadth 7 to 8μ, polar capsule 5 to 7μ long  
Mycobolus piriformis Thélohan 1892 ....................................................... (129)
14(13) Spore straight; shell thickened at posterior part; sutural edge with four to six markings; length 18 to 20μ, breadth 8μ, thickness 6μ, polar capsule 9 to 10μ long  
Mycobolus furcatusn Mavor 1909 ............................................................. (130)
15(12) Shell of uniform thickness; valves symmetrical; sutural edge with markings up to 12 in number; spore 14 to 15.5μ long, 6 to 7.3μ broad, 5 to 6μ thick, polar capsule 6.3μ by 2 to 3μ  
Mycobolus mizurani Kudo 1919 ................................................................. (133)
16(11) Spore with a posterior process, 5μ in length and as broad as spore; length 17 to 18μ, breadth 7.5 to 8μ, polar capsule 7μ by 4μ  
Mycobolus notatus Vivar 1916 ................................................................. (131)
17(10) Breadth of spore about one-fourth of length; spore large; polar capsule extremely large; length 30 to 32μ, breadth 7 to 8μ, length of polar capsule 22 to 23μ  
Mycobolus rokitae Southwell et Prashad 1918 ......................................... (132)
18(1) Spore with two polar capsules ......................................................... 19
19(24) Form of spore variable ..................................................................... 20
20(23) Spore with an intercapsular appendix at anterior end ......................... 21
21(22) Spore oval; length 10 to 12μ, breadth 8 to 9μ, thickness 6μ, polar capsule 5μ by 2 to 3μ  
Mycobolus müleri Bütschli 1882 ............................................................... (128)
22(21) Spore pyriform or elongated oval; length 11 to 16μ, breadth 8 to 13μ, polar capsule 6μ by 4μ  
Mycobolus cycloides Gurley 1893 ............................................................... (140)
23(20) Spore without intercapsular appendix; circular form 7 to 8μ, breadth 8 to 10μ, thickness 6μ, polar capsule 4 to 5μ by 2μ  
Mycobolus kylae Johnston et Bancroft 1918 ............................................. (153)
24(19) Form of spore definite ..................................................................... 25
25(28) Polar capsules in each spore regularly of considerably different size  26
26(27) Spore with an intercapsular appendix; anterior end rounded; sutural edge with folds (3 to 5); length 10 to 12μ, breadth 8μ  
Mycobolus dispar Thélohan 1895 ............................................................... (135)
27(26) Spore without intercapsular appendix; anterior end pointed; no fold on sutural edge  
Mycobolus inaequalis Gurley 1893 ............................................................... (135)
28(25) Polar capsules approximately of equal form and size ....................... 29
29(30) Sutural diameter smaller than breadth; length 6 to 7μ, breadth 8μ  
Mycobolus transversalis Gurley 1893 ......................................................... (139)
30(29) Length equal to or more than breadth of spore ................................ 31
31(102) Length longer than breadth ........................................................ 32
32(37) Breadth of spore less than half of length ........................................ 33
33(34) Extremities of spore equally pointed; length 13 to 14.5μ, breadth 6 to 7μ, polar capsule 4.5μ long  
Mycobolus miliarii Kudo 1919 ................................................................. (155)
34(33) Anterior end of spore attenuated; posterior end rounded. ................. 35

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<th>Spore Markings</th>
<th>Sutural Markings</th>
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<th>Intercapsular</th>
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<th>Spore Markings</th>
<th>Sutural</th>
<th>Breadth</th>
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<td>10(36)</td>
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63(64) Marking variable in number along posterior margin of spore; spore more elongated; length 12 to 12.5μ, breadth 10 to 10.5μ, polar capsule 5.5 to 6μ long
Myxobolus fsteiferi Thélohan 1895. (133)

64(63) Sutural edge with four markings around posterior margin; spore rather short; length 11 to 12μ, breadth 9 to 9.5μ, thickness 4.5 to 5μ, polar capsule 5μ by 2.5μ
Myxobolus scardinii Reuss 1906. (146)

65(62) Markings indistinct.............................................. 66

66(67) Markings about five at posterior margin; spore larger and shorter; length 11 to 12μ, breadth 9.25 to 10μ, thickness 4.5 to 5.5μ, polar capsule 4 to 5μ by 2.25μ
Myxobolus brasae Reuss 1906. (147)

67(66) Markings many along entire sutural edge except anterior tip; spore smaller, longer and thicker; length 9.25 to 10μ, breadth 7 to 7.25μ, thickness 5 to 5.5μ, polar capsule 4.5μ by 2.5 to 3μ
Myxobolus cyprinicola Reuss 1906. (147)

68(51) Intercapsular appendix rounded; sutural edge smooth; length 11μ, breadth 8μ, polar capsule 4 to 6μ long
Myxobolus musculi Keysselitz 1908. (148)

69(50) Spore without intercapsular appendix.............................................. 70

70(75) Length of spore less than 10μ.............................................. 71

71(72) Spore very much flattened and small; length 6μ, breadth 4.2 to 5μ, polar capsule 3μ by 2μ
Myxobolus minutus Nemeczek 1911. (150)

72(71) Thickness of spore about half of length.............................................. 73

73(74) Shell thick; length 9.25 to 10μ, breadth 7.25 to 8.25μ, thickness 4 to 5μ
Myxobolus sandrae Reuss 1906. (146)

74(73) Shell thin; spore 8.25 to 9.5μ long, 7.25 to 8.25μ broad, 4.5 to 5.5μ thick
Myxobolus volgensis Reuss 1906. (145)

75(70) Length of spore greater than 10μ.............................................. 76

76(85) Extremities of spore approximately equal.............................................. 77

77(80) Spore elongated (breadth: length = 1:1.8 or 1:1.4).............................................. 78

78(79) Spore larger; length 14 to 17μ, breadth 8.5μ, thickness 5 to 6μ
Myxobolus oblongus Gurley 1893. (139)

79(78) Spore smaller; length 12 to 15μ, breadth 9 to 11μ
Myxobolus elliptoides Thélohan 1892. (136)

80(77) Spore shorter (breadth: length = 1:1.3, 1:1.2 or 1:1.1).............................................. 81

81(82) Sutural edge with markings; slightly truncate at anterior end in front view; spore 9.5 to 11.5μ long, 8.5 to 9.5μ broad, 6.5μ thick, polar capsule 4.75μ by 1.5 to 2μ
Myxobolus mesenericus Kudo 1919. (157)

82(81) Sutural edge without markings.............................................. 83

83(84) Polar capsule larger; spore 13.9μ long, 11μ broad, 8μ thick
Myxobolus liniouni Gurley 1893. (138)

84(83) Polar capsules smaller; spore 14.5μ long, 11.9μ broad, polar capsule 6μ by 3.7μ
Myxobolus pleuronectidæ Hahn 1917. (152)

85(76) Anterior end of spore more attenuated than posterior.............................................. 86

86(89) Sutural edge with markings.............................................. 87

87(88) Markings five or six in number; spore 17 to 18μ long, 10 to 13μ broad, polar capsule 7 to 8μ
Myxobolus permagrus Wegener 1910. (149)

88(87) Markings sometimes present; spore 13 to 17μ long, 8 to 10μ broad, 5 to 7μ thick, polar capsule 6 to 7μ long
Myxobolus carassii Klokackewa 1914. (150)

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90 Anterior end of spore highly attenuated. .................................................. 91
91 Length of polar capsule equal to or less than half of that of spore ............ 92
92 Spore: anterior end pointed; length 12.4 to 13.5 μ, breadth 6.5 to 7.5 μ, thickness 5 μ, polar capsule 6 to 7 μ long. Cysts of bright golden color
  Myxobolus aureatus Ward 1919. ............................................................... (154)
93 Anterior tip of spore not pointed ............................................................ 94
95 Spore greater in thickness (6.5 to 7 μ), length 12 to 13 μ, breadth 8.25 to 9 μ, polar capsule 6 μ by 2.5 μ; anterior end more rounded
  Myxobolus physophilus Reuss 1906 .......................................................... (146)
96 Length of polar capsule greater than half of that of spore ......................... 97
97 Length of polar capsule greater than two-thirds of that of spore; spore 16 μ long, 10 to 11 μ broad, polar capsule 11 μ by 4 μ.
  Myxobolus capsulatus Davis 1917 ................................................................ (152)
98 Length of polar capsule less than two-thirds of that of spore; spore 14 to 16 μ long, 8 to 9 μ broad, 5 to 6 μ thick, polar capsule 8 to 9 μ by 2.5 to 3 μ.
  Myxobolus koi Kudo 1919 ........................................................................... (155)
99 Anterior end of spore rounded .................................................................... 100
100 Cysts: size up to 1.7 mm. by 0.7 mm.; parasitic in various tissues of host.
  Spore 10 to 12 μ long, 9 μ broad.
  Myxobolus oviformis Thélohan 1892 ............................................................ (137)
101 Cysts: 0.9 mm. by 0.02 mm.; parasitic in nervous system. Spore 10 to 12 μ long, 8 μ broad, 6 μ thick, polar capsule 6 to 7 μ by 2 μ.
  Myxobolus neurobius Schuberg et Schröder 1905 ....................................... (144)
102 Spore almost circular in front view ............................................................ 103
103 Anterior end somewhat attenuated; sutural edge with four markings; spore 9 to 10 μ long and broad, 6.5 to 7 μ thick, polar capsule 6 to 7.5 μ by 2.5 to 3 μ.
  Myxobolus orbicularus Kudo 1919 .............................................................. (155)
104 Spore regularly circular in front view ......................................................... 105
105 Cysts large, up to 3 mm. by 1.5 mm. Spore 10 μ long, 9.8 μ broad, 3 μ thick, polar capsule 3.8 to 5 μ long.
  Myxobolus rotundus Nemeczek 1911 ........................................................... (149)
106 Cysts small, up to 0.33 mm. in diameter. Spore 9 μ in diameter.
  Myxobolus sphaeralis Gurley 1893 ............................................................... (141)
Incompletely described species
  Myxobolus sp. Gurley 1894 ........................................................................... (142)
  Myxobolus sp. Gurley 1894 ........................................................................... (142)
  Myxobolus sp. Gurley 1894 ........................................................................... (143)
  Myxobolus sp. Miyairi 1909 ......................................................................... (146)
  Myxobolus sp. Wegener 1910 ....................................................................... (149)
  Myxobolus sp. Lebzelter 1912 ...................................................................... (150)
  Myxobolus sp. Southwell 1915 ..................................................................... (151)
  Myxobolus sp. Kudo 1918 ............................................................................ (132)

Genus HENNEGUYA Thélohan 1892

1(10) Parasitic in urinary bladder or urinary tube of kidney of host .................. 2
2(7) Shell-valves striated .................................................................................. 3

Numbers enclosed in parentheses refer to the page of the article on which is found the description of the species named.
3(6) Length of tail equal to two-thirds of length of main part of spore*...........4
4(5) Shell-valves asymmetrical; spore smaller; total length 38 to 48μ, length of main part 15μ, breadth 6 to 7.5μ, polar capsule 7.5 to 9μ by 3 to 3.5μ. Trophozoite disporous and polysporous
Henneguya gasterostei Parisi 1912.......................(169)
5(4) Shell-valves symmetrical; spore broader; length of main part 13.5 to 15μ, breadth 8 to 9μ, thickness 6 to 7.5μ, polar capsule 5 to 6μ by 3μ, length of tail 30 to 40μ. Trophozoite mictosporous
Henneguya mixtospora Kudo 1919..............................(173)
6(3) Length of tail equal to half of length of main part of spore and single(?); length 20 to 24μ, breadth 5 to 6μ, length of polar capsule 4 to 5μ
Henneguya media Thélohan 1892.........................(161)
7(2) Shell-valves unstriated........................................8
8(9) Spore elongated; polar capsule longer; posterior portion of main part broad; tail wider and bifurcated to same direction; total length 19.5 to 22.5μ, length of main part 8.5μ, breadth 6μ, length of tail 8 to 8.5μ
Henneguya légeri Cépéde 1905..............................(160)
9(8) Spore oval; polar capsule shorter; posterior part of main portion narrow; tail narrower and bifurcated to opposite directions; length of main part 11.5μ, breadth 7μ, length of tail 9.6μ, polar capsule 3.5μ by 2.5μ
Henneguya wisconsinensis Mavor et Strasser 1916...........(170)
10(1) Parasitic in tissue of host.............................11
11(28) Tail always appears as a single process...............12
12(13) Spore small; length 4μ, breadth 2μ
Henneguya tenuis Vaney et Conte 1901..............(166)
13(12) Spore longer and larger, at least 27μ long...........14
14(15) Sutural edge with eight to ten markings; tail rather long; length of main part 10 to 11.5μ, breadth 8 to 8.75μ, thickness 4 to 5μ, polar capsule 3 to 4μ by 2μ, tail up to 17μ long
Henneguya brachysura Ward 1919.............................(171)
15(14) Sutural edge without markings..........................16
16(19) Total length of spore greater than 40μ...........17
17(18) Anterior end rounded; polar capsule large; shell-valves asymmetrical; tail long; main part 10 to 11μ long, 6 to 8μ broad, 4μ thick, tail 30 to 40μ long. Cysts elongated and large up to 6 mm. by 2 mm.
Henneguya macrura Gurley 1894......................(164)
18(17) Anterior end attenuated; polar capsule smaller; shell-valves symmetrical; tail shorter; length 20μ, breadth 8 to 9μ, polar capsule 8μ by 2 to 3μ. Cysts elongated oval and smaller, 1.1 mm. by 0.5 mm.
Henneguya creplini Gurley 1894..............................(162)
19(16) Total length of spore less than 40μ..................20
20(21) Tail about one-third of main part; total length 38μ, main part 26μ long, 10 to 11μ broad, 8μ thick, polar capsule 11 to 14μ by 2 to 3μ. Cysts oval, numerous and small (130μ by 115μ)
Henneguya minuta Cohn 1895.................................(160)
21(20) Tail about three-sevenths of main part; total length 29 to 40μ, main part 15 to 20μ long, 7 to 8μ broad, polar capsule 8μ by 2μ..................22
22(25) Cysts large..................................................23

*Length of main part of spore denotes in all possible cases the distance between the outer anterior tip and the posterior margin of sporal cavity; and consequently that between the latter and the distal end of the tail is the length of the tail.

Numbers enclosed in parentheses refer to the page of the article on which is found the description of the species named.
23(24) Cysts spherical up to 6 mm. in diameter; parasitic in ovary
   *Henneguya oviparida* (Cohn 1895) ............................................. (160)
24(23) Cysts elongated up to 2 mm. by 1.5 mm.; parasitic in branchia
   *Henneguya psorospermica* Thélohan 1895 ................................... (158)
25(22) Cysts rather small or size not observed .................................. 26
26(27) Elongated cysts 0.75 mm. by 0.375 mm.; parasitic in branchia
   *Henneguya texta* (Cohn 1895) ................................................ (159)
27(26) Parasitic in intestinal wall
   *Henneguya peri-intestinalis* Cépède 1906 ................................. (161)
28(11) Tail composed of two processes ............................................ 29
29(30) Total length reaches 87.5 to 110.5μ; length of main part 10.5 to 15μ, breadth
   5μ, length of polar capsule 5μ, length of tail 75 to 100μ
   *Henneguya gigantea* Nemeczek 1911 ......................................... (168)
30(29) Total length of spore less than 82μ ........................................ 31
31(34) Sutural edge with markings .................................................. 32
32(33) Tail longer and spore larger; anterior end more rounded; total length 47μ. Cysts
   spherical and large, up to 6 mm.
   *Henneguya salminicola* Ward 1919 ............................................. (171)
33(32) Tail shorter and spore smaller; anterior end slightly more attenuated; total
   length 32μ. Cysts lenticular, up to 2 mm. in length
   *Henneguya nüsslini* Schuberg et Schröder 1905 .......................... (166)
34(31) Sutural edge without markings ............................................... 35
35(38) Distal end of tail thread-like ............................................... 36
36(37) Tail 40 to 50μ in length; total length 50 to 60μ, main part 8.5 to 9.5μ long, 8.5 to
   9.5μ broad, polar capsule 4.7 to 5.5μ by 3μ. Cysts small, up to 50μ in
   diameter
   *Henneguya neapolitana* Parisi 1912 ........................................... (170)
37(36) Tail 10 to 30μ in length; main part 12μ long, 8μ broad
   *Henneguya miyairii* Kudo 1919 ................................................. (172)
38(35) Distal end of tail tapers to a point and not thread-like .................. 39
39(40) Cysts irregular in shape; size up to 2.5 mm. Spore: total length 30 to 40μ,
   main part 11.5 to 15μ long, 5 to 6.5μ broad, polar capsule 6.5 to 8μ by 2 to
   2.5μ, tail 22 to 28μ
   *Henneguya lobosa* (Cohn 1895) ................................................. (161)
40(39) Cysts spherical or oval ......................................................... 41
41(42) Anterior end of spore rounded; tail either single or double processes; total length
   55μ, length of main part 10μ, breadth 7μ, length of tail 40 to 50μ. Cysts
   spherical or oval up to 32 mm. by 16 mm.
   *Henneguya zschokkei* (Gurley 1893) ......................................... (165)
42(41) Anterior end attenuated; spore large; main part 20 to 22μ long, breadth 8 to
   9μ, 6 to 7μ thick, polar capsule 10μ by 2 to 3μ, tail 50 to 60μ long
   *Henneguya acerinae* Schröder 1906 .......................................... (167)

Incompletely described species

   *Henneguya schizura* (Gurley 1893) ............................................. (162)
   *Henneguya linearis* (Gurley 1893) ............................................. (163)
   *Henneguya gurleyi* Kudo 1893 ................................................. (163)
   *Henneguya monura* (Gurley 1893) ............................................. (164)
   *Henneguya strongylura* (Gurley 1894) ....................................... (163)
   *Henneguya kolesnikovi* (Gurley 1894) ....................................... (164)
   *Henneguya brevis* Thélohan 1895 ............................................. (162)
   *Henneguya sp.* (Gurley 1894) ................................................. (165)
   *Henneguya sp.* (Gurley 1894) ................................................. (165)
   *Henneguya sp.* Nemeczek 1911 .............................................. (169)

Numbers enclosed in parentheses refer to the page of the article on which is found the description of the species named.
SUMMARY

1) All species of Myxosporidia which have been observed in various parts of the world, reaching 237 in number, are recorded with figures.

2) A new classification of Myxosporidia is proposed after discussion of those of previous authors.

3) A complete list of the specific names of the hosts that harbor Myxosporidia, is given together with the names of the organ of infection and the localities from which recorded.

4) By study of the geographical distribution of Myxosporidia, it is shown that few species are common both to American and European waters or Asiatic and European waters, while the majority of Myxosporidia are localized in definite and limited regions.

5) The study of the organal distribution of Myxosporidia in the host, shows that the gall-bladder is the organ most frequently invaded by the parasite. The kidney, branchia and urinary bladder have less chances of being attacked.

6) One new genus, Wardia, is established.

7) Nine new species; Wardia ovinocua, Mitraspora elongata, Chloromyxum trijugum, Chloromyxum catostomi, Myxidium americanum, Myxobolus orbiculatus, Myxobolus discrepans, Myxobolus mesentericus and Henneguya mictospora, are described from fresh-water fish collected in the vicinity of Urbana, Ill.

8) Six new species; Sphaerospora carassii, Myxidium kagayamai, Myxobolus misgurni, Myxobolus miyairii, Myxobolus koi and Henneguya miyairii, are recorded from fresh-water fish of Nippon.

9) One new species; Chloromyxum wardi, is described from Alaska. This is the second species of Myxosporidia from that part of North America.

10) Keys to the genera and species of known Myxosporidia are included.
APPENDIX: NEW MYXOSPORIDIA FROM AUSTRALIA

The following six species described by Johnston and Bancroft did not reach the writer until the page proof was read. For this reason they could not be put in the text and are recorded here separately.

**MYXIDIUM THERAPON** Johnston et Bancroft

1919 *Myxidium therapon* Johnston and Bancroft 1919 : 520-521

Habitat: In the gall bladder of *Therapon carbo* and *Th. hillii*; Thomson River at Longreach, Australia.

The parasite occurred in one specimen of the former host fish and in nine out of thirteen specimens of the latter. No visible effect of the infection on the part of the host fish was recognized.

Vegetative form: Body pale yellowish to green in color. Form(?). Size varies from 3 to 12mm. in diameter. The protoplasm is differentiated into a clear narrow ectoplasm, about 10μ in width, and a coarsely grained endoplasm. No movements could be seen on slides; but undulations were observed to travel round the margin of the trophozoite. Polysporous.

**Spore**: Spindle-shaped with slightly pointed extremities. Polar capsules are more or less rounded. Shell with faintly marked longitudinal striaion. The sporoplasm is binucleated. Average dimensions: length 9 to 10μ, breadth 4μ, polar capsules 2 to 3μ by 1 to 2μ.

**MYXOSOMA OGILBYI** Johnston et Bancroft

1919 *Myxosoma ogilbyi* Johnston and Bancroft 1919 : 521-522

Habitat: In the fibrous tissue of the gill arch of *Plectroplites ambiguus*; Thomson River at Longreach, Australia. Three out of nine host specimens examined showed the infection.

Vegetative form: The parasite forms white cysts usually close to the bases of the gill filaments. Cysts are small and rounded, being less than 1mm. in diameter. The authors simply mention that sections revealed the structure usually present in a Myxosporidian cyst.

**Spore**: Oval with pointed anterior end. The inner margin of the shell is indented posteriad. The sporoplasm contains a single nucleus, but not any iodonophilous vacuole. Average dimensions: length 11 to 13μ, breadth 6 to 8μ, thickness 5μ, polar capsules 5 to 6μ by 2μ.

**MYXOBOLUS PLECTROPLITES** Johnston et Bancroft

1919 *Myxobolus plectroplites* Johnston and Bancroft 1919 : 522-523

Habitat: In the kidney and gall-bladder of *Plectroplites ambiguus*; Thomson River at Longreach, Australia. The parasite was observed in
four out of nine host fish examined; in two cases in the kidney only, in one case only in the gall-bladder, and in one instance in both gall-bladder and kidney. Cysts were found in the kidney, while only spores were recognized in the gall-bladder.

Vegetative form: The cysts which could only be detected in sections, lie in the connective tissues of kidney. They are of minute size, ranging somewhat widely from 36μ in diameter to 144 by 100μ. According to the authors no definite structure could be found.

Spore: Rounded oval. It bears quite a close resemblance to that of Myxobolus hylae (page 153), which is slightly longer, and which has a longer polar filament than the present form. The vacuole, however, is apparently not iodinophilous(?). Average dimensions: length 10 to 12μ, breadth 7 to 8μ, polar capsules 5 by 2μ, length of polar filament 30 to 40μ.

HENNEGUYA AUSTRALIS Johnston et Bancroft
1919 Henneguya australis Johnston and Bancroft 1919 : 523-524

Habitat: In the branchiae of Plectroplites ambiguus; Thomson River at Longreach, Australia. The parasite was detected in four out of nine host fish examined. The infection was extremely light in all cases. Vegetative form: The parasites form cysts. They lie embedded in the spongy mass of the gill filament, and in many cases occupy a relatively large area of the section. Cysts showed two layers in section; the outermost clear ectoplasm and inner endoplasm with developing spores, the central portion of which being filled with mature spores. The spores appear to lie in a definite manner, the long axis of the spore commonly being at right angles to the boundary of the cyst, the anterior end of the spore pointing outwards.

Spore: Elongated ovoidal. Anterior end pointed, posterior end drawn out into a tail. The tail appears single when the spore is removed from the cyst but separates soon afterward into two halves which usually diverge widely. Two polar capsules parallel to each other are quite frequently of different length. The sporoplasm contains two nuclei and a small vacuole (iodinophilous?). Average dimensions: length 11 to 15μ, breadth 3 to 5μ, thickness 3 to 4μ, polar capsules 5 to 6μ by 1 to 2μ, length of tail about 20μ.

HENNEGUYA GRACILIS Johnston et Bancroft
1919 Henneguya gracilis Johnston and Bancroft 1919 : 524-526

Habitat: In the gill filament of Therapon hillii; Thomson River at Longreach, Australia. Out of thirteen specimens examined, eight were infected. Heavy infection was recognized only in one case. Vegetative form: The cyst is of definite, narrow, pear-shaped form, and lie transversely, i.e., at right angles to the long axis of the gill filament.
Spore: The spore resembles Henneeguya australis, but is slightly smaller, while the tail is longer in proportion. The spores are arranged with long axis parallel to that of the cyst. Average dimensions: length 10 to 14μ, breadth 2.5 to 3μ, thickness 3μ, polar capsules 5 to 6μ by 1 to 2μ, length of tail about 20 to 26μ.

HENNEGUYA sp. Johnston et Bancroft
1919 Henneeguya sp. Johnston and Bancroft 1919 : 526

Habitat: In the branchiae of Nematalosa elongata; Thomson River at Longreach, Australia.

The authors state that they observed a number of spores of a Henneeguya in the scrapings of the gill of one of four host fish.
Vegetative form: Undescribed.
Spore: Undescribed.
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GENERAL EXPLANATION OF FIGURES

For the type species of each genus, both the vegetative form and the spore are illustrated. For the other species, except those which are new, figures of the spore are given, unless the vegetative forms are different from those of the type species or the species were reported in papers which seem to be of less universal distribution.

The original drawings were made with the Abbe drawing apparatus. The combinations used were Zeiss apochromatic objectives 16, 8, 3, and homogeneous oil immersion 2 mm. with compensation oculars 2, 4, 6, 8, 12 and 18. All the other drawings were copied from the original figures of the respective observers, an exact citation of which is given in each case, and were also made with the same drawing apparatus on the same scale except that a few figures were enlarged among those that were taken from other authors.

Magnifications were also calculated and given for those quoted figures, for which the respective authors failed to mention the scale at which the drawings were made.
PLATE I
EXPLANATION OF PLATE

Figs. 1 to 5. *Leptotkeca agilis.*
Fig. 1. A typical trophozoite *in vivo.* After Thélohan (1895, Fig. 29); ×750.
Fig. 2. A young form. After Thélohan (1895, Fig. 31). ×750.
Fig. 3. A trophozoite in motion. After Doflein (1898, Fig. 5).
Fig. 4. A trophozoite in contracted condition. After Doflein (1898, Fig. 7).
Fig. 5. A fresh spore. After Thélohan (1895, Fig. 30). ×1500.

Fig. 6. A fresh mature spore of *Leptotkeca elongata.* After Thélohan (1895, Fig. 38). ×1500.

Fig. 7. A fresh mature spore of *Leptotkeca parva.* After Thélohan (1895, Fig. 25). ×1500.
Fig. 8. A fresh spore of *Leptotkeca perlata.* After Balbiani (1884, Fig. 40).
Fig. 9. A spore of *Leptotkeca macropora.* After Auerbach (1909, Fig. 2a). ×1350.
Fig. 10. A spore of *Leptotkeca informis,* preserved in formol. After Auerbach (1910b, Fig. 1a). × about 2000.

Fig. 11. A spore of *Leptotkeca longipes,* preserved in formol. After Auerbach (1910b, Fig. 1d). × about 2200.

Fig. 12. A fresh spore of *Leptotkeca fusiformis.* After Davis (1917, Fig. 1). ×1500.
Fig. 13. A fresh spore of *Leptotkeca scissura.* After Davis (1917, Fig. 8). ×1500.
Fig. 14. A fresh spore of *Leptotkeca lobosa.* After Davis (1917, Fig. 11). ×1500.
Fig. 15. A fresh spore of *Leptotkeca glomerosa.* After Davis (1917, Fig. 13). ×1500.
Fig. 16. A trophozoite of *Leptotkeca* sp. After Awerinzew (1908, Pl. 2, Fig. 14). 1/12 and comp. oc. 12.

Fig. 17. Another trophozoite of the same. After Awerinzew (1908, Pl. 2, Fig. 17). 1/12 and comp. oc. 12.

Figs. 18 to 20. *Ceratomyxa arcuata.* After Thélohan (1895).
Figs. 18 and 19. Typical young form. After Thélohan (1895, Figs. 16 and 17).
Fig. 20. A trophozoite with two spores. After Thélohan (1895, Fig. 18).
PLATE II
EXPLANATION OF PLATE

Fig. 21. A sporulating trophozoite of Ceratomyxa arcuata. After Parisi (1912, Fig. 6a).
Fig. 22. A spore of Ceratomyxa arcuata treated with KOH. After Thélohan (1895, Fig. 19). ×1500.

Figs. 23 and 24. Ceratomyxa sphaerulosa. After Thélohan.
Fig. 23. A part of the trophozoite (1895, Fig. 2). ×750.
Fig. 24. A fresh spore (1895, Fig. 3). ×750.

Fig. 25. A fresh spore of Ceratomyxa globulisera. After Thélohan (1895, Fig. 43). ×1500.
Fig. 26. An adult trophozoite of Ceratomyxa appendiculata. After Thélohan (1895, Fig. 4). × about 400.

Fig. 27. A spore of Ceratomyxa truncata. After Thélohan (1895, Fig. 51). ×1500.

Fig. 28. A spore of Ceratomyxa reticularis. After Thélohan (1895, Fig. 27). ×1500.
Fig. 29. A spore of Ceratomyxa inaequalis. After Doflein (1898, Fig. 10). ×1250.

Fig. 30. A spore (1898, Fig. 39).
Fig. 31. A trophozoite with spores (1898, Fig. 43).

Figs. 32 and 33. Ceratomyxa ramosa. After Awerinzew (1908).
Fig. 32. A trophozoite (1908, Pl. 2, Fig. 20). Zeiss obj. D and comp. oc. 4.
Fig. 33. A spore (1908, Pl. 2, Fig. 19). Zeiss obj. E and comp. oc. 4.
PLATE III
EXPLANATION OF PLATE

Figs. 34 to 39. *Ceratomyxa drepanopsella*. Awerinzew (1908).
Fig. 34 and 35. Trophozoites (1908, Pl. 2, Figs. 7 and 9). Obj. D and oc. 4.
Fig. 36. The part of a trophozoite attached to the epithelium of the gall-bladder of the host 1908, Pl. 2, Fig. 10). Obj. E and oc. 4.
Figs. 37 to 39. Spores (1908, Pl. 1, Figs. 2, 3 and 1). Obj. D and oc. 4.
Figs. 40 and 41. Two different views of the spore of *Ceratomyxa tylosuri*. After Awerinzew (1913a, Fig. 1). × about 350.
Figs. 42 and 43. *Ceratomyxa (?) spari*. After Awerinzew (1913a, Fig. 2).
Fig. 42. A trophozoite.
Fig. 43. A spore. × about 345.
Figs. 44 to 47. Spores of *Ceratomyxa acadiensis*. After Mavor (1916). Figs. 44 and 45 (1916, Fig. B). ×270. Fig. 46 (1916, Fig. A) ×1800. Fig. 47 (1916, Fig. 40)×2950.
Fig. 48. A spore of *Ceratomyxa coris*. After Georgévitch (1916a, Fig. 1).
Fig. 49. A spore of *Ceratomyxa herouardi*. After Georgévitch (1917, Fig. 1).
Fig. 50. A spore of *Ceratomyxa mesospora*. After Davis (1917, Fig. 15). ×1500.
Fig. 51. A spore of *Ceratomyxa sphairophora*. After Davis (1917, Fig. 23). ×950.
Figs. 52 and 53. Spores of *Ceratomyxa taenia*. After Davis (1917, Figs. 26 and 25). ×700.
PLATE IV
EXPLANATION OF PLATE

Fig. 54. A spore of Ceratomyxa attenuata. After Davis (1917, Fig. 28). ×950.
Figs. 55 and 56. Spores of Ceratomyxa recurvata. After Davis (1917, Figs. 32 and 33). ×1500.

Figs. 57 to 60. Spores of Ceratomyxa lunata. After Davis (1917, Figs. 34 to 37). ×1500.
Fig. 61. A spore of Ceratomyxa abbreviata. After Davis (1917, Fig. 41). ×1500.
Fig. 62. A spore of Ceratomyxa flagellifera. After Davis (1917, Fig. 42). ×1500.
Fig. 63. A spore of Ceratomyxa agglomerata. After Davis (1917, Fig. 45). ×1500.
Fig. 64. A spore of Ceratomyxa amorpha. After Davis (1917, Fig. 47). ×1500.
Figs. 65 to 67. Spores of Ceratomyxa monospora. After Davis (1917, Figs. 57, 56 and 55). ×1500.
Figs. 68 and 69. Spores of Ceratomyxa streptospora. After Davis (1917, Figs. 59 and 60). ×1500.

Fig. 70. A spore of Ceratomyxa aggregata. After Davis (1917, Fig. 63). ×1400.
Fig. 71. A spore of Ceratomyxa undulata. After Davis (1917, Fig. 66). ×1500.
Figs. 72 and 73. Spores of Ceratomyxa navicularia. After Davis (1917, Figs. 69 and 68). ×1500.

Fig. 74. A spore of Ceratomyxa spinosa. After Davis (1917, Fig. 72). ×1500.
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Figs. 75 to 80. *Myxoproteus ambiguis*. After Doflein (1898).
Figs. 75 and 76. Trophozoites of typical forms (1898, Figs. 12 and 52).
Figs. 77 and 78. Young trophozoites produced by budding (1898, Figs. 55 and 56).
Figs. 79 and 80. Spores (1898, Figs. 54 and 64). × about 800 and 1080.
Figs. 81 to 83. Spores of *Myxoproteus cordiformis*. After Davis (1917, Figs. 79, 80 and 78). ×1500.

Fig. 84. A spore of *Myxoproteus cornutus*. After Davis (1917, Fig. 85). ×1400.
Figs. 85 to 95. *Wardia ovocucu*. Original.
Fig. 85. A portion of the cross-section thru an infected ovary of *Lepomis humilis*, showing the parasite in one ovum and the hypertrophied nurse cells and several connective tissue layers. × 160.

Fig. 86. A portion of the cross-section of a cyst. ×640.
Figs. 87 to 89. Three different views of fresh spore. ×2000.
Figs. 90 and 91. Stained spores. ×1700.
Fig. 92. A spore mechanically pressed and stained with Giemsa's mixture, showing the escaping polar capsules without extruding polar filament, and the sporoplasm. ×1700.
Figs. 93 to 95. Front and lateral views of the shell valves, exhibiting the network-like fine ridges on the surface and the posterior processes. ×1700.
Figs. 96 and 97. Spores of *Wardia ohlmaceri*. After Ohlmacher (1893, Figs. 4a and 2). 2mm. and oc. 4.
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Figs. 98 to 104. *M. cyprini.*
Figs. 98 and 99. Trophozoites from the ureter of *Cyprinus carpio in vivo.* Original. × about 1500.
Figs. 102 to 104. Spores. After Fujita (1912, Figs. 1a to 1c).
Fig. 105. A trophozoite (1910, Fig. 1).
Figs. 106 and 107. Front and lateral views of the spore (1913, Fig. 20 and 1910, Fig. 2). × about 1600.
Figs. 108 to 113. *Chloromyxum leydigi.*
Figs. 108 and 109. Trophozoites. After Thélohan (1895, Figs. 7 and 6). ×750.
Figs. 110 and 111. Trophozoites in division. After Doflein (1898, Figs. 57 and 58).
Figs. 112 and 113. Different views of spores. After Thélohan (1895, Figs. 10 and 9). ×1500.
Fig. 114. A spore of *C. caudatum.* After Thélohan (1895, Fig. 36). ×1500.
Figs. 115 and 116. Different views of the spore of *C. quadratum.* After Thélohan (1895, Figs. 100a and 100b). ×1500.
Fig. 117. A spore of *C. quadratum* treated with nitric acid. After Thélohan (1895, Fig. 100c). ×1500.
Fig. 118. A spore of *C. fluviatile.* After Thélohan (1892, Fig. 2). ×1500.
Figs. 119 and 120. Different views of the spore of *C. mucronatum.* After Lieberkühn from Gurley (1894, Pl. 39, Fig. 5). × about 1750.
Figs. 121 and 122. The same after Balbiani (1884, Fig. 41). × about 1200.
Figs. 123 and 125. Spores of *C. diploxy.* After Balbiani from Gurley (1894 Pl. 42, Figs. 13a, 13b and 13c).
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Fig. 126. Trophozoite of *Chloromyxum truttae*. After Léger (1906, Fig. 4). X1000.

Figs. 127 and 128. Trophozoites of *Chloromyxum cristaum*. After Léger (1906, Fig. 7). X1000.

Figs. 129 to 133. *Chloromyxum dubium*. After Auerbach (1908).

Figs. 129 and 130. Trophozoites (1908, Figs. 2 and 1).

Figs. 131 and 132. Spores (1908, Figs. 3 and 4). X about 2250.

Fig. 133. A stained young spore (1908, Fig. 5).

Fig. 134. Trophozoite of *Chloromyxum sp.* After Awerinzew (1908, Figs. 2 and 1).


Figs. 136 to 138. *Chloromyxum magnum*. After Awerinzew (1913a, Fig. 4).

Figs. 136 and 137. Trophozoites.

Fig. 138. A spore. X about 320.

Figs. 139 and 140. Spores of *Chloromyxum funduli*. After Hahn (1915, Figs. 34 and 33). X2000.


Figs. 141 and 142. Trophozoites (1916, Figs. 3f and 3g).

Figs. 143 to 145. Different views of fresh spore (1916, Figs. 3a, 3c and 3b).

Fig. 146. A spore treated with potassium hydrate (1916, Fig. 3e).


Fig. 147. A trophozoite (1916, Fig. 4a).

Fig. 148. A fresh spore (1916, Fig. 4e).

Fig. 149. A spore stained with Giemsa’s mixture (1916, Fig. 4g).

Figs. 150 to 152. Two surface views and an optical cross-section of a stained spore, showing the ridges on the shell valves (1916, Figs. 4b, 4d and 4c).

Figs. 153 to 156. Spores of *Chloromyxum clupeidae*.

Figs. 153 to 155. Fresh spores. After Linton (1901, Fig. 3). "Variously magnified."

Fig. 156. A spore. After Hahn (1917b, Fig. 10). X1650.

Figs. 157 and 158. Two views of *Chloromyxum granulosum*. After Davis (1917, Figs. 137 and 138). X1500.
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Figs. 159 to 182. *Chloromyxum trijugum*. Original.
Figs. 159 to 174. Trophozoites of various form and age.
Figs. 159 and 160. Trophozoites of medium size. ×640.
Fig. 161. A trophozoite, ten minutes after it was removed from the host. ×1700.
Figs. 162 and 163. The movements of pseudopodia of the same specimen in ten minutes. ×1700.
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Figs. 165 to 167. A trophozoite, showing the change of pseudopodia in five and ten minutes. ×1700.
Figs. 168 to 172. Small trophozoite with different numbers of the nuclei. Fig. 172 is probably a disporous form. ×2350.
Fig. 173. A monosporous trophozoite with a young spore. ×2350.
Fig. 174. A young spore. ×2350.
Figs. 175 to 177. Different views of fresh spores. ×1700.
Fig. 178. A Giemsa stained spore. ×1700.
Figs 179 and 180. Side views of the valves showing the ridges by Giemsa staining. ×1700.
Fig. 181. A spore treated with potassium hydrate solution, and stained with Giemsa solution. ×1700.
Fig. 182. A spore from which the sporoplasm is leaving the shell. From the Giemsa smear of the infected bile. ×1700.
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Fig. 183 to 186. *Sphaerospora divergens.*

Fig. 183. Trophozoite. After Thélohan (1895, Fig. 12). ×750.

Figs. 184 and 185. Two views of spore. After Auerbach (1912, Pl. 5, Fig. 4). × about 1500.

Fig. 186. A spore treated with nitric acid. After Thélohan (1895, Fig. 13). ×1500.

Figs. 187 and 188. Spores of *Sphaerospora elegans.* After Thélohan (1890b, Fig. 1). × about 1000.

Fig. 189. A spore of *Sphaerospora rostrata.* After Thélohan (1895, Fig. 93). × about 1635.

Figs. 190 to 192. Spores of *Sphaerospora masovica.* After Cohn (1902, Fig. 3). ×1000.

Fig. 192. Spore with extruded polar filaments and “starren Fäden” by warming.

Figs. 193 and 194. Spores of *Sphaerospora platesae.* After Woodcock (1904, Fig. 7d). ×900.

Figs. 195 to 197. Spores of *Sphaerospora angulata.* After Fujita (1912, Fig. 3). × about 2800.

Figs. 198 and 199. Spores of *Sphaerospora polymorpha.* After Davis (1917, Figs. 91 and 92). × about 1500.

Figs. 200 to 204. *Sphaerospora carassii.* Original.

Fig. 200. A trophozoite. ×2250.

Figs. 201 to 203. Different views of spores. ×1800.

Fig. 204. A young spore. ×2250.

Figs. 205 to 209. *Sinuolinea dimorpha.* After Davis (1916).

Fig. 205. A fresh trophozoite (1916, Fig. 1). ×1400.

Figs. 206 and 207. Trophozoites with erythrocytes in different stages of disintegration (1916, Figs. 2 and 57). ×640.

Fig. 208. A stained disporous trophozoite (1916, Fig. 41).

Fig. 209. A stained gemmule (1916, Fig. 72).
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Figs. 210 to 213. *Sinuolinea dimorpha*. After Davis (1916 and 1917).

Fig. 210. A living trophozoite (1916, Fig. 56).  ×640.

Fig. 211. A living trophozoite from which a gemmule is just escaping (1916, Fig. 60).  ×640.

Figs. 212 and 213. Spores (1917, Figs. 99 and 100).  ×1400.

Figs. 214 to 216. Spores of *Sinuolinea capsularis*. After Davis (1917, Figs. 105 to 107).  ×1500.

Figs. 217 and 218. Spores of *Sinuolinea arborescens*. After Davis (1917, Figs. 109 to 110).  ×1500.

Fig. 219. Spore of *Sinuolinea opacita*. After Davis (1917, Fig. 112).  ×1500.

Fig. 220. Spore of *Sinuolinea brachiophora*. After Davis (1917, Fig. 113).  ×1500.

Figs. 221 to 224. *Myxidium lieberkühni*. After Bütschli (1881 and 1882).

Fig. 221. A trophozoite (1882, Pl. 38, Fig. 12).  × about 60.

Fig. 222. A trophozoite (1882, Pl. 38, Fig. 13).  ×160.

Figs. 223 and 224. Trophozoites (1881, Figs. 27 and 26).
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Figs. 225 to 240. *Myxidium lieberkühni.*

Fig. 225. A trophozoite. After Lieberkühn from Gurley (1894, Pl. 43, Fig. 1a). \( \times 330. \)

Figs. 226 and 227. Trophozoites. After Bütschli (1881, Figs. 25 and 31).

Figs. 228 to 230. Stained trophozoites. After Thélohan (1895, Figs. 44, 46 and 45). \( \times 750. \)

Fig. 231. A trophozoite forming daughter individuals by budding. After Cohn (1895 Fig. 5).

Fig. 232. Four figures showing the separation of a bud. After Cohn (1895, Figs. 6a, 6b, 6d and 6e).

Fig. 233. A cross-section of a trophozoite, showing the ectoplasm, mesoplasm and endoplasm. After Cohn (1895, Fig. 2).

Fig. 234. A trophozoite. After Laveran and Mesnil (1902, Fig. 3). \( \times 500. \)

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Figs. 239 and 240. Fresh and stained spores. After Thélohan (1895, Figs. 47 and 48). \( \times 1500. \)

Figs. 241 to 251. *Myxidium incurvatum.*

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Fig. 242. A spore. After Thélohan (1895, Fig. 54). \( \times 1500. \)

Figs. 243 and 244. Different views of spore. After Parisi (1912, Fig. 1).

Fig. 245. A young spore. After Georgévitch (1916, Fig. 11).

Figs. 246 to 248. Spores. After Georgévitch (1916, Figs. 10, 9 and 8).

Figs. 249 to 251. Spores. After Davis (1917, Figs. 119 to 121). \( \times 1500. \)

Fig. 252. Trophozoite of *Myxidium sphaericum.* After Thélohan (1895, Fig. 28). \( \times 1500. \)

Fig. 253. A spore of *Myxidium histophilum.* After Thélohan (1895, Fig. 49). \( \times 1500. \)

Fig. 254. A spore of *Myxidium* sp. After Leydig from Gurley (1894, Pl. 47, Fig. 6).
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Figs. 255 to 257. *Myxidium danilewskyi*. After Laveran (1898).
Figs. 255 and 256. Longitudinal and transverse sections thru renal tubules, showing the trophozoites (1898, Figs. 1 and 2). Fig. 255. ×350.
Fig. 257. Spores (1898, Figs. 4, 5 and 6). ×800.
Fig. 258. Spores of *Myxidium giganteum*. After Doflein (1898, Fig. 48). × about 500.
Figs. 259 to 261. Spores of *Myxidium giardi*. After Cépède (1906a, Figs. 1, 3 and 2). ×2000.
Figs. 262 to 265. Spores of *Myxidium pfeifferi*. After Auerbach (1908, Figs. 6 and 7). × about 2000, except Fig. 265.
Fig. 266. A spore of *Myxidium inflatum*. After Auerbach (1909, Fig. 3a). × about 1500.
Fig. 267. A spore of *Myxidium bergense*. After Auerbach (1910a, Fig. 57). × about 1820.
Fig. 268. A spore of *Myxidium procercum*. After Auerbach (1910a, Fig. 58). × about 2000.
Figs. 269 to 271. Spores of *Myxidium mackiei*. After Bosanquet (1910, Fig. 12). × about 1250.
Figs. 274 to 276. *Myxidium* sp. After Awerinzew (1908 and 1911).
Fig. 274. A monosporous trophozoite (1911, Fig. C).
Fig. 275. A disporous trophozoite (1908, Pl. 2, Fig. 6). Obj. E and oc. 4.
Fig. 276. A spore (1908, Pl. 1a, Fig. 17). × about 1000.
Figs. 277 and 278. Spores of *Myxidium depressum*. After Parisi (1912, Figs. 2a and 2b). × about 1600.
Figs. 279 and 280. Spores of *Myxidium oviforme*. After Parisi (1912, Fig. 3). × about 1600.
Figs. 281 to 284. Spores of *Myxidium anguillae*. After Ishii (1915, Fig. 3a). ×1450.
Fig. 285. A spore treated with ammonia water (1915, Fig. 3a). ×660.
Fig. 286. A spore (1915, Fig. 3b). ×1320.
Figs. 287 to 290. Spores of *Myxidium gadi*. After Georgévitch (1916, Figs. 1, 4, 3 and 2).
Fig. 288. A spore from *Solea vulgaris*.
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Fig. 291. A spore of Myxidium glutinosum. After Davis (1917, Fig. 124). ∙1400.
Figs. 292 and 293. Spores of Myxidium phylgium. After Davis (1917, Figs. 126 and 127).
∙2000.
Figs. 294 and 295. Spores of Myxidium kagayamai. After Kudo (1916, Fig. 2). ∙1750
and ∙1000 respectively.
Figs. 296 to 307. Sphaeromyxa balbianii.
Fig. 296. A trophozoite. After Thélohan (1895, Fig. 57). ∙3.
Fig. 297. A trophozoite. After Davis (1917, Fig. 128). ∙640.
Fig. 298. A trophozoite in plasmatomy. After Georgévitch (1916, Fig. 15).
Figs. 299 and 300. Spores. After Thélohan (1895, Figs. 58 and 59). ∙1500.
Fig. 301. An end of a spore. After Thélohan (1895, Fig. 60).
Fig. 302. A spore treated with nitric acid. After Thélohan (1895, Fig. 61).
Fig. 303. A spore. After Parisi (1912, Fig. 4). ∙ about 1750.
Fig. 304. A spore. After Davis (1917, Fig. 130). ∙2100.
Figs. 305 to 307. Mature and young spores (Figs. 306 and 307). After Georgévitch (1916,
Figs. 17, 20 and 19).
Figs. 308 to 311. Sphaeromyxa immersa. After Lutz (1889: 301).
Fig. 308. An infected gall-bladder of Bufo aqua (1889, Fig. 1). ∙1.
Fig. 309. Spores (1889, Figs. 4, 5 and 6).
Fig. 310. A spore (1889, Fig. 10). ∙600.
Fig. 311. A spore with extruded polar filaments (1889, Fig. 7).
Figs. 312 to 314. Spores of Sphaeromyxa incurvata. After Doflein (1898, Fig. 49). ∙
about 1000.
Figs. 315 and 316. Sphaeromyxa sabrazesi. After Schröder (1907).
Fig. 315. A trophozoite (1907, Fig. 1). ∙15.
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Figs. 317 to 322. Spores of *Sphaeromyxa sabrazesi*. ×1500.
Figs. 317 to 319. After Laveran and Mesnil (1900, Figs. 1, 3 and 4).
Fig. 318. A spore treated with nitric acid (1900, Fig. 3).
Figs. 320 and 321. Spores. After Schröder (1907, Figs. 39 and 41). ×1500.
Fig. 322. A polar capsule. After Schröder (1907, Fig. 45).
Figs. 323 and 324. Spores of *Sphaeromyxa hellandi*. After Auerbach (1909, Fig. 5).
Figs. 317 to 319. After Laveran and Mesnil (1900, Figs. 1, 3 and 4).
Fig. 318. A spore treated with nitric acid (1900, Fig. 3).
Figs. 320 and 321. Spores. After Schröder (1907, Figs. 39 and 41). ×1500.
Fig. 322. A polar capsule. After Schröder (1907, Fig. 45).
Figs. 323 and 324. Spores of *Sphaeromyxa hellandi*. After Auerbach (1909, Fig. 5). × about 1500.
Figs. 325 and 326. Spores of *Sphaeromyxa exneri*. After Awerinzew (1913a, Fig. 3). × about 365.
Fig. 327. A spore of *Sphaeromyxa gasterostei*. After Georgévitch (1916, Fig. 22).
Figs. 328 to 331. *Zschokkella hildae*. After Auerbach (1910a and 1912).
Fig. 328. A monosporous trophozoite (1912, Pl. 5, Fig. 2).
Figs. 329 to 331. Spores (1910a, Fig. 62).
Figs. 332 and 333. Spores of *Zschokkella nova*. After Klokacewa (1914, Fig. 2). × about 2500.
Figs. 334 to 338. Spores of *Zschokkella acheilognathi*. After Kudo (1916).
Figs. 341 to 344. Spores of *Myxosoma funduli*. After Kudo (1918a, Fig. A). ×1500.
Figs. 341 to 344. Spores of *Myxosoma dujardini*. After Thélohan (1895, Figs. 90, 91, and 89). ×1500.
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Fig. 348. A spore of *Myxosoma (?) lobatum*. After Nemeczek (1911, Fig. 18). ×1000.
Fig. 349 to 354. *Lentospora cerebralis*. After Plehn (1905). ×1200.
Fig. 349. Various young ameboid forms; stained (1905, Textfig. 5).
Fig. 350. A stained larger form (1905, Textfig. 5).
Fig. 351. A trophozoite with two spores (1905, Textfig. 4).
Fig. 352. Various spores (1905, Textfig. 2).
Fig. 353. A stained spore (1905, Textfig. 3).
Fig. 354. A spore with extruded polar filaments (1905, Textfig. 2).
Fig. 355. A spore of *Lentospora multiplicata*. After Reuss (1906, Fig. 8). ×1500.
Fig. 356 to 359. Spores of *Lentospora asymmetrica*. After Parisi (1912, Fig. 7). × about 1500.
Figs. 360 to 362. Spores of *Lentospora acuta*. After Fujita (1912, Fig. 2). ×2000.
Figs. 365 and 366. Spores of *Myxobolus unicapsulatus*. After Müller (1841, Fig. 5).
Fig. 367. A spore of *Myxobolus furhmanni*. After Auerbach (1909, Fig. 1b). ×1840.
Fig. 368. A spore of *Myxobolus oculi-leucisci*. After Trojan (1909, Fig. 3). ×2000.
Figs. 369 and 370. Spores of *Myxobolus toyamai*. After Kudo (Original and 1917, Fig. 40). ×2500.
Figs. 373 and 374. Spores of *Myxobolus rohitae*. After Southwell and Prashad (1918, Figs. 26 and 27). × about 1720 and 700 respectively.
Figs. 375 and 376. Spores of *Myxobolus senti*. After Southwell and Prashad (1918, Figs. 29 and 30). × about 1700.
Figs. 377 and 378. Spores of *Myxobolus misgurni*. Original. ×1500.
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Figs. 379 to 385. *Myxobolus pfeifferi.*

Figs. 379 and 380. Parts of section thru cyst. After Keysselitz (1908a, Pl. 15, Figs. 1 and 2).

Fig. 381. A spore. After Thélohan (1895, Fig. 77). ×1500.

Fig. 382. An optical section of spore. After Keysselitz (1908a, Fig. A).

Fig. 383. A spore treated with Lugol's solution. After Keysselitz (1908a, Pl. 14: Fig. 92).

Fig. 384. A spore with extruded filaments. After Keysselitz (1908a, Fig. C).

Fig. 385. A stained young spore. After Keysselitz (1908a, Pl. 14, Fig. 81).

Figs. 387 to 389. Spores of *Myxobolus ellipsipoides.* Fig. 389. An abnormal spore with six polar capsules. After Thélohan (1895, Figs. 112, 113 and 115).

Fig. 390. A part of the infected intestine of *Mugil auratus,* showing cysts of *Myxobolus exigus.* After Parisi (1912, Fig. 9e). × about 3.

Fig. 391. A spore of *Myxobolus exigus.* After Thélohan (1895, Fig. 98). × 1500.

Figs. 392 to 395. Spores of *Myxobolus exigus.* After Parisi (1912, Fig. 9). ×2500.

Fig. 396. A spore of *Myxobolus oviformis.* After Thélohan (1895, Fig. 81). ×1500.

Figs. 397 to 398. Spores of *Myxobolus mülleri.* After Thélohan (1895, Figs. 96 and 97). ×1500.

Figs. 399 and 400. Spores of *Myxobolus mülleri.* After Bützchli (1881, Figs. 1 and 2).

Fig. 401. A spore of *Myxobolus mülleri* in conc. sulphuric acid. After Bützchli (1881, Fig. 6).

Figs. 402 and 403. Abnormal spores of *Myxobolus mülleri.* After Bützchli (1881, Figs. 9 and 8).

Figs. 404 and 405. Spores of *Myxobolus lintoni.* After Linton (1891, Figs. 3 and 5).

Fig. 406. Diagram of the cross section of a spore of *Myxobolus lintoni.* After Linton (1891, Fig. 8).

Fig. 407. A spore of *Myxobolus lintoni* with extruded polar filaments. After Linton (1891, Fig. 10).

Fig. 408. A stained spore of *Myxobolus lintoni.* After Gurley (1894, Pl. 26, Fig. 7). × about 2000.

Figs. 409 and 410. Spores of *Myxobolus globosus.* After Gurley (1894, Pl. 26, Fig. 7). × about 2900.

Fig. 411. Spores of *Myxobolus inaequalis.* After Muller (1841, Fig. 6).
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Figs. 412 to 416. Spores of *Myxobolus oblongus*. Figs. 412 to 414. After Gurley (1894, Pl. 26, Fig. 6). X2300. Figs. 415 and 416. After Müller (1841, Fig. 9).

Figs. 417 and 418. Spores of *Myxobolus transvalius*. After Gurley (1894, Pl. 29, Fig. 1).

Figs. 419 and 420. Spores of *Myxobolus obesus*. After Balbiani (1884, Fig. 39).

Fig. 421. Spores of *Myxobolus cycloides*. After Müller (1841, Fig. 3).

Figs. 422 and 423. Spores of *Myxobolus anurus*. After Cohn (1895, Fig. 25). X1500.

Fig. 424. Spores of *Myxobolus* sp. X700. After Bütschli (1872, Pl. 36, Fig. 23).

Fig. 425. *Myxobolus* sp. After Gurley (1894, Pl. 28: Fig. 4a). X about 1500.

Figs. 426 to 429. Spores of *Myxobolus* sp. After Müller (1841, Fig. 4).

Fig. 430. A vegetative form of *Myxobolus cyprini*. After Döeflein (1898, Fig. 112).

Figs. 431 and 432. Spores of *Myxobolus cyprini*. After Döeflein (1898, Figs. 113 to 115).


Figs. 433 and 434. Longitudinal and transverse sections thru infected nerve fibres (1905, Figs. 2 and 4a). X520.

Figs. 435 and 436. Spores (1905, Figs. 5 and 6). Comp. oc. 12 and imm. obj. 2mm.

Figs. 437 to 441. *Myxobolus aeglefini*. After Auerbach (1906a).

Fig. 437. A cyst in the sclerotic cartilage of the eye of *Gadus aeglefini* (1906a, Fig. 2).

Figs. 438 and 439. Spores (1906a, Figs. 5a and 3d). Xabout 1320.

Figs. 440 and 441. Abnormal spores (1906a, Figs. 5b and 5c). Xabout 1320.


Fig. 442. A part of the section of a cyst (1906b, Fig. 1).

Figs. 443 to 445. Spores (1906b, Figs. 3a, 3c, 5 and 3b). X about 850.

Figs. 446 and 447. Spores of *Myxobolus volgensis*. After Reuss (1906, Fig. 1). X2000.
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Fig. 448. The branchia of *Lucioperca volgensis* with cysts of *Myxobolus volgensis*. After Reuss (1906, Fig. 2). \( \times 2.25 \).

Fig. 449. A spore of *Myxobolus scardinii*. After Reuss (1906, Fig. 3). \( \times 1500 \).

Fig. 450. Air bladder of *Scardinius erythrophtkalmus* with the cysts of *Myxobolus physophilus*. After Reuss (1906, Fig. 5). \( \times 2 \).

Fig. 451. A spore of *Myxobolus physophilus*. After Reuss (1906, Fig. 4). \( \times 1500 \).

Fig. 452. A spore of *Myxobolus macrocapsularis*. After Reuss (1906, Fig. 6). \( \times 1500 \).

Fig. 453. A spore of *Myxobolus sandrae*. After Reuss (1906, Fig. 7). \( \times 2000 \).

Fig. 454. A spore of *Myxobolus bramae*. After Reuss (1906, Fig. 9). \( \times 1500 \).

Fig. 455. A spore of *Myxobolus balleri*. After Reuss (1906, Fig. 10). \( \times 1500 \).

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Fig. 457. A part of the infected scale (1908a, Fig. G).

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STUDIES ON MYXOSPORIDIA

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Fig. 587. A trophozoite (1915, Fig. 6).

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