HOST-PARASITE RELATIONSHIPS AND GEOGRAPHICAL DISTRIBUTION OF THE PHYSALOPTERINAE (NEMATODA)

BANNER BILL MORGAN

Department of Veterinary Science, University of Wisconsin

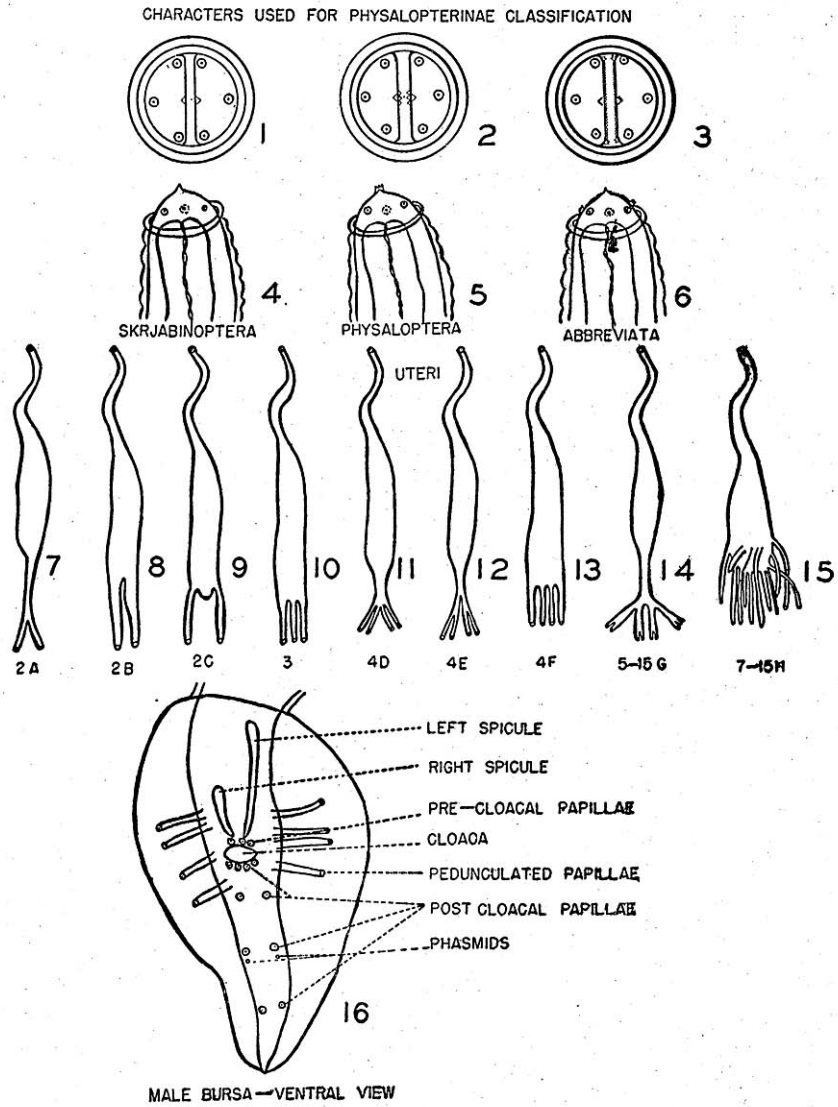
INTRODUCTION

The host-parasite relationships of the subfamily Physalopterinae, a group of nematode worms varying in size from ¼ to 4 inches in length which lives in the stomach of many animals, are not very well known. This is due in part because the Physalopteridae present more taxonomic difficulty than other spirurids since they tend toward polydelphy.

Positive identification of species can be made only on characters possessed by both male and female specimens. The characters of value for species determination in the Physalopterinae are as follows, in the order of their importance: (1) dentition (generic value), (2) number of uteri, (3) mode of origin of uteri, (4) number of male ventral papillae, (5) arrangement of male ventral papillae, (6) shape of spicules , (7) length of spicules, and (8) position of vulva. (figs. 1–16)

Certain characters cannot be used for specific determination because of the wide variation within species: (1) posterior sheath, (2) size and height of teeth, (3) length of esophagus, (4) position of excretory pore and cervical papillae, (5) size of eggs, (6) shape of bursa, (7) bursal markings, and (8) shape of seminal receptacle.

Ortlepp (1922, 1937) divided the genus *Physaloptera* into four groups on the basis of uterine numbers: Didelphys (2), Tridelphys (3), Tetradelphys (4) and Polydelphys (more than 4). Also the mode of origin of the uteri were taken into consideration. At the present time the origin of the uteri has been divided into various groups: 2A (2 uteri with common


CHARACTERS USED FOR PHYSALOPTERINAE CLASSIFICATION
1
2
3
4
SKRJABINOPTERA
5
PHYSALOPTERA
6
ABBREVIATA
UTERI
7
8
9
10
11
12
13
14
15
2A
2B
2C
3
4D
4E
4F
5-15G
7-15H
LEFT SPICULE
RIGHT SPICULE
PRE-CLOACAL PAPILLAE
CLOACA
PEDUNCULATED PAPILLAE
POST CLOACAL PAPILLAE
PHASMIDS
16
MALE BURSA-VENTRAL VIEW

EXPLANATION OF PLATE

All figures diagrammatic

Fig. 1. Anterior end, *enface* view of *Skrjabinoptera.*
Fig. 2. Anterior end, *enface* view of *Physaloptera.*
Fig. 3. Anterior end, *enface* view of *Abbreviata.*
Fig. 4. Anterior end, lateral view of *Skrjabinoptera.*
Fig. 5. Anterior end, lateral view of *Physaloptera.*
Fig. 6. Anterior end, lateral view of *Abbreviata.*
Fig. 7. 2A type uteri.
Fig. 8. 2B type uteri.
Fig. 9. 2C type uteri.
Fig. 10. 3 type uteri.
Fig. 11. 4D type uteri.
Fig. 12. 4E type uteri.
Fig. 13. 4F type uteri.
Fig. 14. 5–15G type uteri.
Fig. 15. 7–15H type uteri.
Fig. 16. Male bursa, ventral view of typical Physalopterinae.

trunk), 2B (2 uteri without common trunk), 2C (2 uteri without common trunk, branches from the lateral sides), 3 (3 uteri without common trunk), 4D (4 uteri with common trunk), 4E (4 uteri with bifurcation of common trunk), 4F (4 uteri without common trunk), 5–15G (5–15 uteri with common trunk), and 7–15H (7–15 uteri without common trunk). (Figs. 7–15)

When Schulz (1927) divided the genus *Physaloptera* into several genera according to pseudolabial dentition the family Physalopteridae was broken into two subfamilies, namely, Physalopterinae and Proleptinae. The latter contains five genera: *Proleptus, Thubunaea, Heliconema, Ortleppina,* and *Physalopteroides.* Morgan (1943) placed the genus *Physalopteriodes* Wu and Liu (1940) in the subfamily Physalopterinae, but further evidence showed closer relationship of *Physalopteroides* to *Thubunaea,* and consequently has been placed in the subfamily Proleptinae. The subfamily Physalopterinae has since been grouped into four genera by Schulz (1927) and Baylis (1934). The genera include *Physaloptera* Rudolphi, 1819; *Abbreviata* (Travassos, 1920) Schulz, 1927; *Skrjabinoptera* Schulz, 1927; and *Pseudophysaloptera* Baylis, 1934.

LIFE CYCLE

The life cycles of the Physalopterinae are still unknown. On the basis of findings in allied genera of the spirurids, this group of nematodes will probably require certain arthropods as intermediate hosts. Alicata (1937) found that the embryonated eggs of *Physaloptera turgida* after ingestion by the cockroach (*Blatella germanica*) developed to the 3rd stage larvae. Hobmaier (1941) reported similar findings for *P. maxillaris.* Cram (1931) and Boughton (1937) reported the finding of immature *Physaloptera* encysted in the breast muscles of bobwhite quail (*Colinus v. virginiania*) and the ruffed grouse (*Bonasa umbellus*). As soon as some of the life cycles of the more common species of *Physaloptera* have been determined the host-parasite relationships of the group will become more easily understood. This would enable one to conduct animal experiments on host-specificity.

The knowledge of host specificity and speciation is yet too meager for final analysis and no doubt many synonyms exist. Considerable more experimental evidence is needed to justify the naming of new species created entirely on host occurrence.

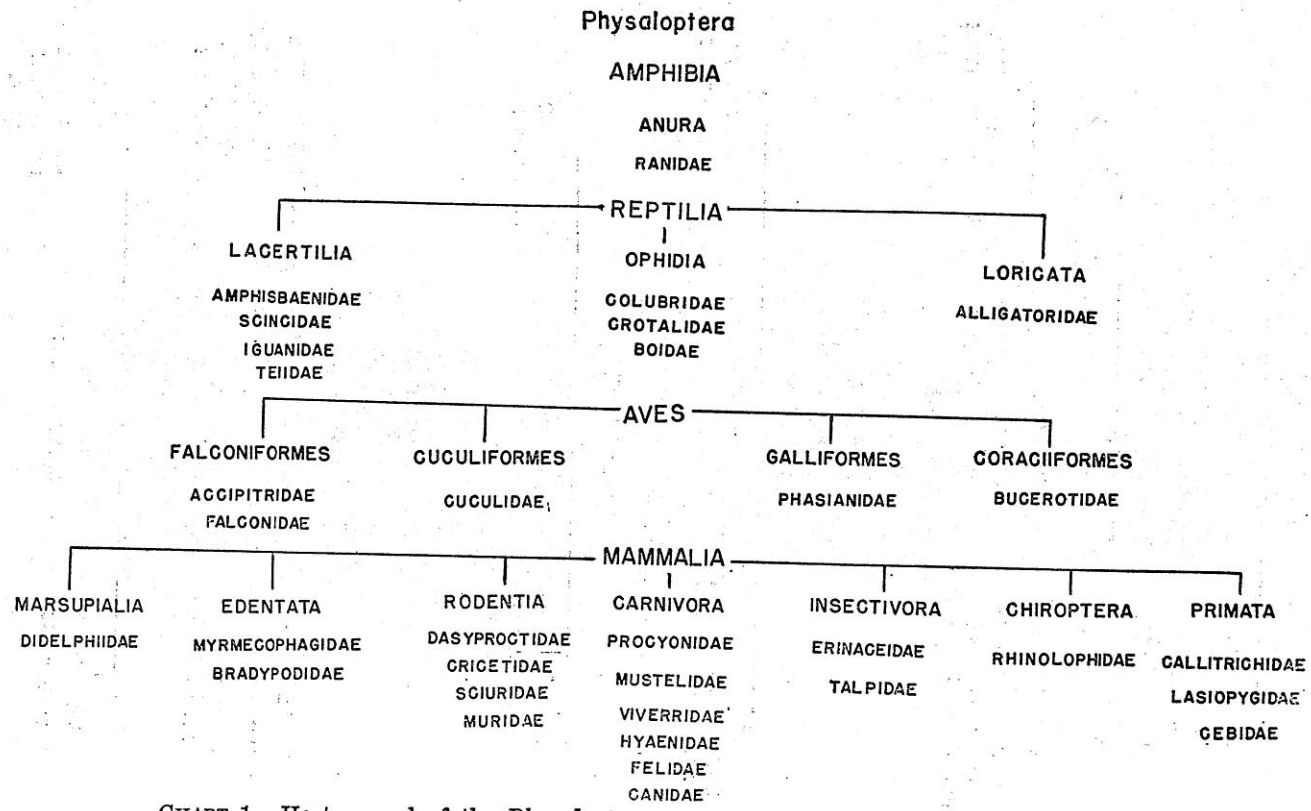


CHART 1.—Host spread of the *Physaloptera* arranged by Classes, Orders, and Families.

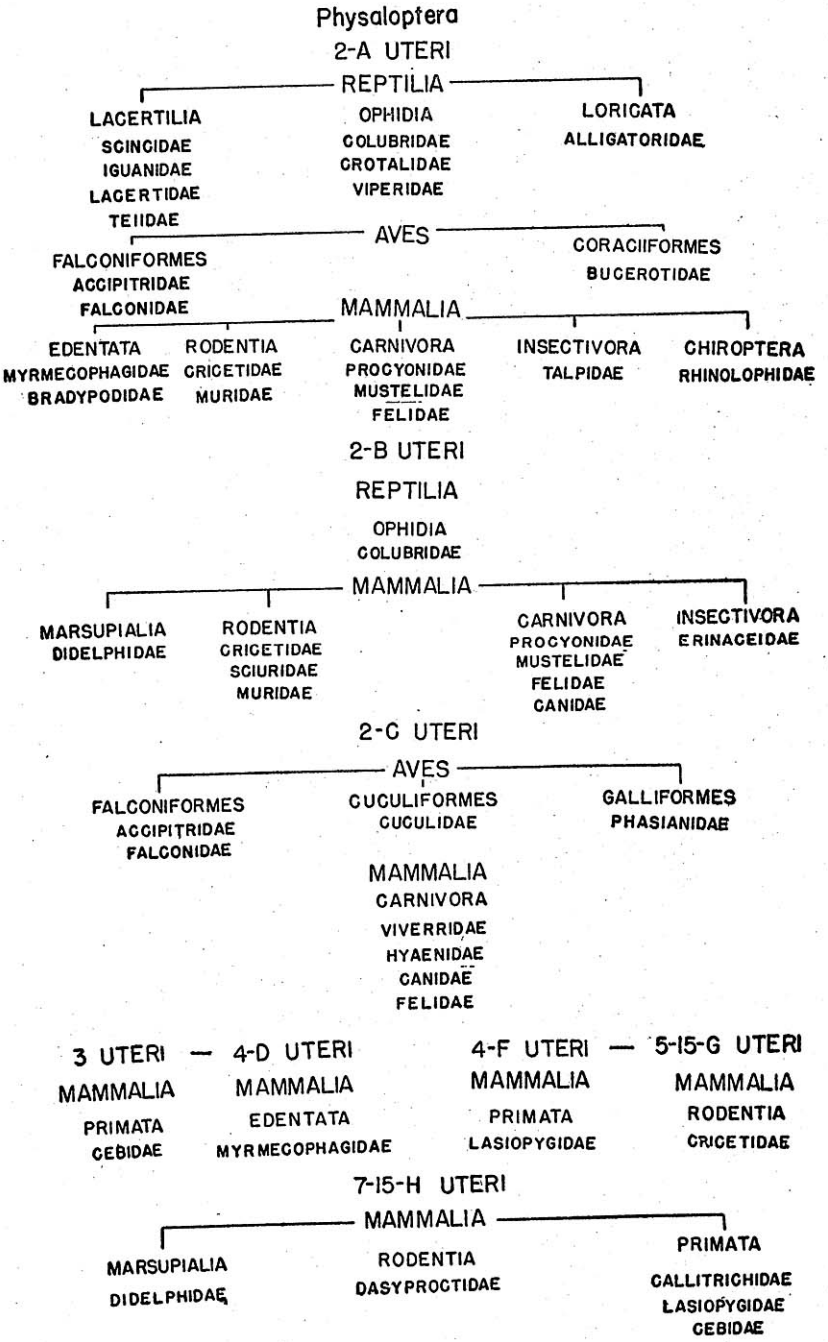


CHART 2.—Different types of uterine origin in the *Physaloptera* arranged by Classes, Orders, and Families of the hosts.

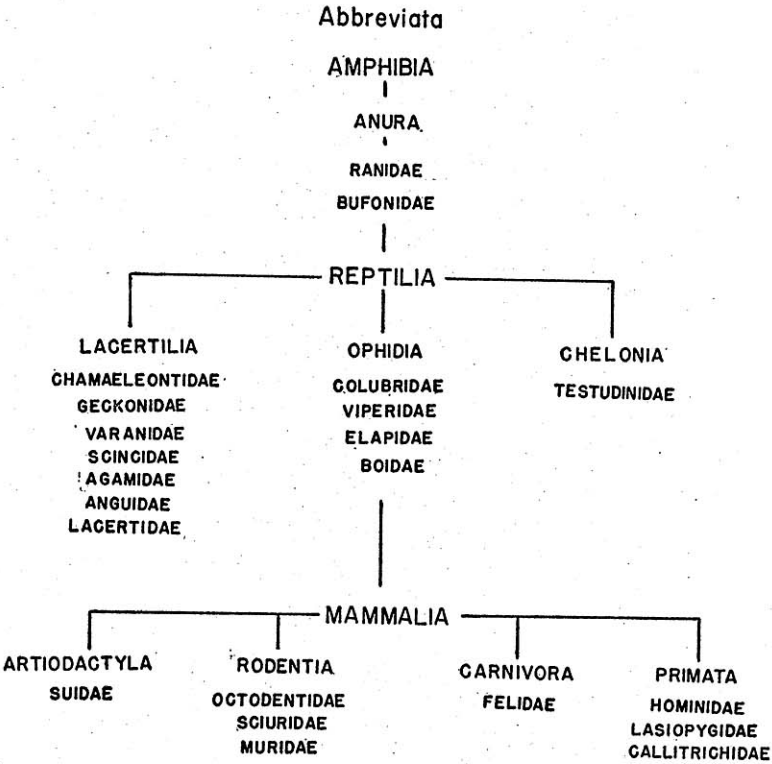


CHART 3.—Host spread of the *Abbreviata* arranged by Classes, Orders, and Families.

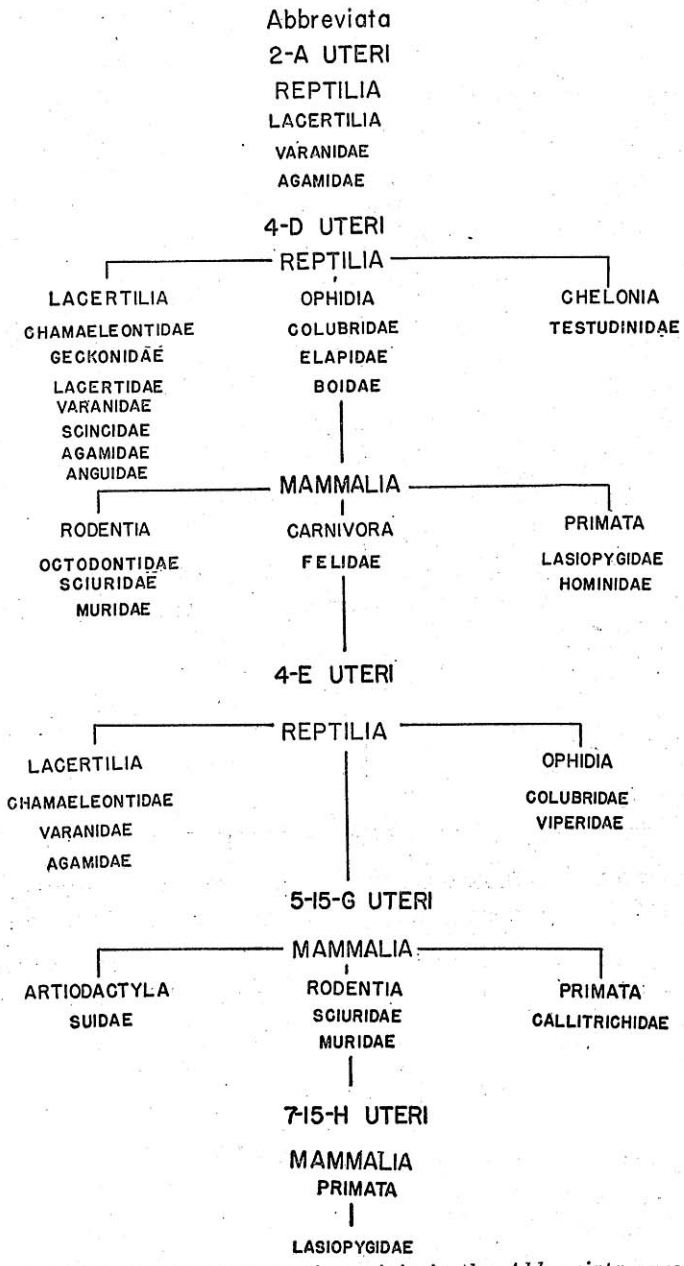


CHART 4.—Different types of uterine origin in the *Abbreviata* arranged by Classes, Orders, and Families of the hosts.

RELATIONSHIPS OF THE *PHYSALOPTERA*

Physaloptera is now characterized by 1 externolateral tooth and 1 internal group of 3 teeth, and usually no denticles on the margins of the pseudolabia. The genus contains approximately 42 species. They are represented in the following hosts: *Amphibia;* ANURA (Ranidae) [1 species]; Reptilia; LACERTILIA (Scincidae, Teiidae, Amphisbaenidae, Iguanidae), OPHIDIA (Colubridae, Crotalidae, Boidae), LORICATA (Alligatoridae) [4 species]; *Aves*: FALCONIFORMES (Accipitridae, Falconidae), CUCULIFORMES (Cuculidae), GALLIFORMES (Phasianidae, Tetraonidae), STRIGIFORMES (Strigidae), CORACIIFORMES (Bucerotidae), CICONIIFORMES (Threskiornithoidae), SPHENISCIFORMES (Spheniscidae) [12 species]; *Mammalia*: CARNIVORA (Canidae, Felidae, Mustelidae, Procyonidae, Hyaenidae, Viverridae) [9 species]; RODENTIA (Muridae, Sciuridae, Cricetidae, Dasyproctidae) [5 species]; CHIROPTERA (Rhinolophidae) [1 species]; EDENTATA (Myrmecophagidae, Bradypodidae) [2 species]; INSECTIVORA (Erinaceidae, Talpidae) [4 species]; MARSUPIALIA (Didelphiidae) [2 species]; PRIMATA (Cebidae, Lasiopygidae, Callitrichidae) [3 species].

The genus *Physaloptera* is widely distributed throughout the animal kingdom embracing 42 species among 4 classes, 15 orders representing 33 families. The number of hosts totals well over 250 different animals. Chart 1 shows in tabular form the spread of hosts as arranged by orders. The Amphibia is represented by 1 family, Reptilia by 8, Aves by 5, and the Mammalia by 19. The order Carnivora has the largest number of families, six being represented.

Of the 42 known valid species several are somewhat restricted in geographical distribution. This may be due to the range of the various susceptible hosts; *P. abjecta, P. torquata,* and *P. limbata* has been reported only from the United States; *P. amphibia* only from the Philippine Islands (Luzon); *P. brachycera* from Angola; *P. crosi, P. galinieri, P. losseni, P. rapacis, P. aduensis, P. canis, P. immerpani, P. bedfordi* from Africa; *P. hieracideae* from Australia; *P. mexicana* from Mexico; *P. reevisi* from China; *P. mirandai, P. magnipapilla, P. papillotruncata, P. torresi, P. anomala* and *P. bonnei,* from South America; *P. masoodi* and *P. tumefaciens* from India. The most cosmopolitan species would include *P. praeputialis, P.*

maxillaris, P. turgida, P. getula, P. rara, P. alata and *P. acuticauda.*

From the examination of host-parasite lists, several species of *Physaloptera* may occur in a similar host. For example, *P. praeputialis* may occur in the cat, mountain lion, bobcat, dog, or gray fox. Two different species of *Physaloptera* have never been reported occurring in the same animal at the same time; for example, *P. praeputialis* and *P. rara* from the same dog. Super parasitism is not known to occur in the Physalopterinae.

The genus *Physaloptera* is the only member of the subfamily *Physalopterinae* reported from birds. So far as is known, species occurring in birds have not been found in any other class of vertebrates. It is probably safe to say that species of *Physaloptera* found in birds are host specific for Aves. This is, of course, discounting aberrant or pseudoparasites.

This group of nematode worms are found mainly in the pharynx, crop, esophagus, proventriculus, ventriculus and occasionally in the intestine of various bird hosts. Rarely, immature forms are found encysted in breast muscles of birds. There are two cases on record of *Physaloptera* found in the orbital cavity of birds; *P. acuticauda* from a South American black hawk and *Physaloptera* sp. from a sacred ibis.

All of the species of *Physaloptera* found in birds have been recorded from the order Falconiformes; *P. acuticauda* has the widest host range, having been found in Falconiformes, Galliformes, and Cuculiformes; *P. galinieri* next with a host range of two orders, Falconiformes and Coraciiformes. The remaining species from birds are restricted entirely to Falconiformes. Many immature *Physaloptera* have been reported from birds not in the order Falconiformes, thus suggesting accidental hosts.

The *Physaloptera* from the Reptilia have a spear-shaped left spicule, a characteristic not found in the *Physaloptera* from the Amphibia, Aves, or Mammalia.

The following parasite-host list of the *Physaloptera* has been arranged by classes, orders, and families to facilitate a comprehensive view of host parasite relationships. The geographical distribution is also given. Morgan reported in detail the *Physaloptera* from certain host groups (1941, 1942, 1943, 1944).

Physaloptera papuensis Johnson and Mawson, 1940, probably from a bandicoot from Papua; *P. peramelis* Johnson and Mawson, 1939, *P. parvicollaris* Johnson and Mawson, 1940, from

Parameles nasuta (long-nosed bandicoot); *P. peragale* Johnson and Mawson, 1940, *P. thalacomys* Johnson and Mawson, 1940, from *Peragale minor* (rabbit bandicoot or bilby) and *P. sarcophili* Johnson and Mawson, 1940, from *Sarcophilus harrisi* (Tasmanian devil), all from various Australian marsupials, cannot be evaluated because of inadequate descriptions. The species position of these *Physaloptera* must remain doubtful until the types are re-examined and the number and mode of origin of the uteri determined. Also, the male spicules and papillae should be accurately pictured. *Physaloptera troughtoni* Johnson and Mawson, 1941, from *Rattus assimilis* may be a synonym of *P. getula* while the position of *P. banfieldi* Johnson and Mawson, 1941, from *Melomys banfieldi* (Muridae) is not clear. The description of *P. hieracideae* Johnson and Mawson, 1941, from *Hieracidea orientalis* (brown hawk) is not complete for species identification.

LIST OF SPECIES OF *PHYSALOPTERA* AND HOSTS ACCORDING TO CLASSES, ORDERS, FAMILIES AND GEOGRAPHICAL DISTRIBUTION

Amphibia

1. *P. amphibia* Linstow, 1899. Anura (Ranidae) Philippine Islands, Luzon.

Reptilia

2. *P. abjecta* Leidy, 1856. Syn. *P. variegata* Reiber, Byrd, and Parker, 1940. Ophidia (Colubridae) U. S. A. (Pennsylvania, Georgia, Florida, Mississippi, Wisconsin)
3. *P. obtusissima* Molin, 1860. Syn. *P. monodens* Molin, 1860; *P. squamatae* Harwood, 1932. Ophidia (Colubridae, Crotalidae, Boidae). Lacertilia (Scincidae). Brazil, New Britain, U. S. A. (California, Pennsylvania, Ohio, Wisconsin, Mississippi, Texas).
4. *P. retusa* Rudolphi, 1819. Syn. *Spiroptera retusa* Dujardin, 1845, *P. largarda* Sprehn, 1932; *P. mucronata* of Leidy, 1856. Lacertilia (Teiidae, Amphisbaenidae, Iguanidae) Loricata (Alligatoridae). Brazil, U. S. A. (New York, Utah).

AVES

5. *P. acuticauda* Molin, 1860. Syn. *P. truncata* Schneider, 1866; *P. quadridentata* Walton, 1927. FALCONIFORMES (Accipitridae). CUCULIFORMES (Cuculidae). GALLIFORMES (Phasianidae) Brazil, Africa, Mexico, French Guiana, U. S. A. (Florida, Wisconsin, Arizona).
6. *P. alata* Rudolphi, 1819. Syn. *Spiroptera physalura* Dujardin, 1845; *P. megalostoma* Creplin, 1839; *P. alata chevreuxi* Seurat, 1914; *P. alata nouveli* Seurat, 1915. FALCONIFORMES (Accipitridae). Italy, Austria, Africa, China, Germany, Brazil, Japan, France, Australia, Canada, U. S. A. (Colorado, Wisconsin).
7. *P. brachycerca* Kreis, 1938. FALCONIFORMES (Accipitridae). Angola.
8. *P. crosi* Seurat, 1914. FALCONIFORMES (Accipitridae). Africa.
9. *P. galinieri* Seurat, 1914. FALCONIFORMES (Accipitridae). CORACIIFORMES (Bucerotidae). Africa.
10. *P. hieracideae* Johnson and Mawson, 1941. FALCONIFORMES (Accipitridae). Australia.
11. *P. losseni* Ortlepp, 1937. FALCONIFORMES (Accipitridae). Africa.
12. *P. mexicana* Caballero, 1937. FALCONIFORMES (Accipitridae). Mexico.
13. *P. rapacis* Monnig, 1926. FALCONIFORMES (Accipitridae). Africa.
14. *P. reevisi* Chu, 1931. FALCONIFORMES (Accipitridae). China.
15. *P. subalata* Schneider, 1866. FALCONIFORMES (Falconidae, Accipitridae). Brazil, Europe.

MAMMALIA

16. *P. mirandai* Lent and Freitas, 1937. MARSUPIALIA (Didelphiidae). Brazil.
17. *P. turgida* Rudolphi, 1819. Syn. *P. ackerti* Hill, 1939. MARSUPIALIA (Didelphiidae). Brazil, U. S. A., Panama.
18. *P. magnipapilla* Molin, 1860. EDENTATA (Myrmecophagidae). Brazil.

19. *P. papillotruncata* Molin, 1860. Syn. *P. pyramidalis* Linstow, 1879. EDENTATA (Myrmecophagidae, Bradypodidae). Brazil.
20. *P. aduensis* Baylis, 1928. RODENTIA (Muridae). Africa (Nigeria).
21. *P. getula* Seurat, 1917. Syn. *P. bispiculata* Vaz and Pereira, 1935. RODENTIA (Muridae, Cricetidae, Sciuridae). Africa, Brazil. U. S. A. (Florida, Georgia, Texas, Louisiana, Colorado, Montana).
22. *P. massino* Schulz, 1926. Syn. *P. spinicauda* McLeod, 1933. RODENTIA (Muridae, Sciuridae). Russia, Canada, U. S. A. (Minnesota, Wisconsin).
23. *P. muris-brasiliensis* Diesing, 1861. Syn. *Spiroptera bilabiata* Molin, 1860; *P. circularis* Linstow, 1897; *P. sciuri* Parona, 1898; *P. ruwenzorii* Parona, 1907; *P. inermis*? Linstow, 1906. RODENTIA (Muridae, Cricetidae). Brazil, Hawaiian Islands, U. S. A. (Iowa, Georgia).
24. *P. torresi* (Travassos, 1920). RODENTIA (Dasyproctidae). Brazil.
25. *P. maxillaris* Molin, 1860. Syn. *P. semilanceolata* Molin, 1860; *P. mephites* Solanet, 1909; *P. mydai* Baylis, 1926. CARNIVORA (Mustelidae, Procyonidae). Brazil, Europe, Argentina, Trinidad, British West Indies, Canada, Mexico, Borneo. U. S. A. (New York, Iowa, Illinois, Wisconsin, Louisiana, California, Nebraska, Montana).
26. *P. rara* Hall and Wigdor, 1918. Syn. *P. cerdocyona* Sprehn, 1932; *P. felidis* Ackert, 1936; *P. clausa* of Caballero and Peregrina 1938; *P. turgida* of Leigh, 1940. CARNIVORA (Canidae, Felidae). Mexico, Germany, U. S. A. (Wisconsin, Michigan, Tennessee, Minnesota, Iowa, Mississippi, Nebraska, Kansas, North Dakota, South Dakota, California, Virginia, Arizona, Illinois, Kansas).
27. *P. praeputialis* Linstow 1889. Syn. *Chlamydonema felineum Hegt*, 1910; *C. praeputialis* Travassos, 1917; *C. praeputiale* Yorke and Maplestone, 1926. CARNIVORA (Felidae, Canidae, Viverridae). Brazil, Batavia, Belgium, British Guiana, Federated Malay States, China, Ceylon, Dutch Guiana, India, Eastern Russia, Southwest Russia, Puerto Rico, Panama, Africa (Nigeria, Tanganyika, Zanzibar) Union of South Africa, Mexico. U. S. A.

(Wisconsin, Iowa, Indiana, West Virginia, California, Oregon, Arizona, Virginia, New Hampshire, Nevada).

28. *P. torquata* Leidy, 1886. Syn. *P. papillotruncata* of Canavan, 1931. CARNIVORA (Mustelidae, Procyonidae). U. S. A. (Pennsylvania, Wisconsin, Illinois, Montana, Arizona, Iowa).
29. *P. anomala* Molin, 1860. CARNIVORA (Felidae). Brazil, Dutch Guiana.
30. *P. brevispiculum* Linstow, 1906. Syn. *P. malayensis* Ortlepp, 1922; *Chlamydonema fuelleborni* Mirza and Narain, 1934. CARNIVORA (Felidae Hyaenidae). Ceylon, Federated Malay States, Nigeria, India.
31. *P. canis Monnig,* 1929. CARNIVORA (Canidae, Felidae). South Africa.
32. *P. masoodi* (Mirza, 1934). Syn. *Chlamydonema masoodi* Mirza, 1934. CARNIVORA (Felidae). India.
33. *P. terdentata* Molin, 1860. Syn. *P. digitata* Schneider 1866. CARNIVORA (Felidae). Brazil, Sudan.
34. *P. clausa* Rudolphi, 1819. Syn. *Spiroptera clausa* Dujardin, 1845; *P. dispar* Linstow, 1904. INSECTIVORA (Erinaceidae). Russia, China, Europe, Africa (Nigeria, Tunis, Tanganyika).
35. *P. immerpani* Ortlepp, 1937. INSECTIVORA (Erinaceidae). South Africa.
36. *P. seurati* Issaistchikoff 1926. INSECTIVORA (Erinaceidae). Russia, Europe.
37. *P. limbata* Leidy, 1856. INSECTIVORA (Talpidae). U. S. A. (Wisconsin, Iowa, Illinois, Maryland, Kansas, Vermont).
38. *P. bedfordi* Ortlepp, 1932. CHIROPTERA (Rhinolophidae). South Africa.
39. *P. cebi* Ortlepp, 1923. PRIMATA (Cebidae). South America.
40. *P. dilatata* Rudolphi, 1819. Syn. *P. multiuteri* Canavan, 1929. PRIMATA. (Lasiopygidae, Cebidae, Callitrichidae). Brazil, Panama, Peru.
41. *P. tumefaciens* Henry and Blanc, 1912. PRIMATA (Lasiopygidae). India.
42. *P. bonnei* Ortlepp, 1922. Host unknown. Probably Reptilia. Dutch Guiana.

UTERINE TYPE RELATIONSHIPS

The genus *Physaloptera* has the widest uterine range in the subfamily Physalopterinae. Eight different uterine origins and numbers are represented. The 2-A type has the largest host spread in the group including the Reptilia (8 families), Aves (3 families), and Mammalia (5 orders and 9 families). The 2B type includes the Reptilia (1 family) and Mammalia (4 orders and 9 families). The 2C group is represented by Aves (3 orders, 4 families) Mammalia (1 order, 4 families). The remaining uterine types of 3, 4–D, 4–F, 5–15G and 7–15H are found only in mammals as shown by Chart 2.

RELATIONSHIPS OF THE *ABBREVIATA*

Abbreviata is characterized by 1 externolateral tooth, 1 internolateral tooth and 2 double submedian teeth on each pseudolabium; usually the entire margin of the pseudolabia is dentated (Fig. 1-16). This genus has been recorded from many hosts, namely, Amphibia, chiefly Reptilia, and Mammalia. Schulz (1927) placed 23 species in this genus although approximately 27 species are now listed. Of the 27 species, 17 are parasites of the Reptilia: LACERTILIA (Varanidae, Agamidae, Lacertidae, Anguidae, Scincidae, Geckonidae, Chamaeleontidae), OPHIDIA (Colubridae, Elapidae, Boidae, Viperidae), CHELONIA (Testudinidae). One species is from the Amphibia: ANURA (Ranidae, Bufonidae). The remaining 9 species are recorded from the *Mammalia:* CARNIVORA (Felidae) [1 species]; ARTIODACTYLA (Suidae) [1 species]; PRIMATA (Hominidae, Lasiopygidae, Callitrichidae) [3 species]; RODENTIA (Muridae, Sciuridae, Octodontidae) [4 species]. Many of the *Abbreviata* are found in Africa, the remainder in Europe, Asia, Australia, and North America.

The genus *Abbreviata* is not as widely distributed among hosts as the *Physaloptera.* However, the majority of species are found in Reptiles. Three classes, 5 orders and 22 families are represented among the hosts. Chart 3 shows the distribution of the genus arranged by host family relationships. The Amphibia is represented by 2 families, Reptilia by 12 and the Mammalia by 8. The lizards are by far the most prominent host.

Geographically, 15 species are found in Africa, 3 in the United States, and 2 in Australia. The locality of the hosts of three species is not known. No species is very widely distributed; *A. abbreviata, A. varani,* and *A. caucasica* have the widest geographical range.

The parasite host list of the *Abbreviata* has been arranged similar to that of the *Physaloptera* for convenience in study.

This genus does not occur in birds, although there have been two cases on record of accidental or pseudoparasites of *Abbreviata* from Aves. *Abbreviata* originally described from Reptilia was reported by Linstow (1883) from *Aconia alba* (white stork) and *A. gemina* (Linstow, 1899) originally described from a cat was reported by Railliet (1915) from a domestic chicken. Morgan (1945) reported in some detail on the genus *Abbreviata.*

UTERINE TYPE RELATIONSHIPS

Only 5 uterine types are found in the *Abbreviata* in comparison with 8 for the *Physaloptera.* The 2-A type uteri is restricted to the Reptilia (2 families), type 4-D to Reptilia (12 families) and Mammalia (3 orders, 6 families), 4-E to Reptilia (5 families); type 5–15–G and 7–15–H are found only in the Mammalia as shown in Chart 4.

LIST OF SPECIES OF *ABBREVIATA* AND HOSTS ACCORDING TO CLASSES, ORDERS, FAMILIES, AND GEOGRAPHICAL DISTRIBUTION

AMPHIBIA

1. *A. ranae* (Wallon, 1931). ANURA (Ranidae Bufonidae). U. S. A. (Indiana, Louisiana, Wisconsin, Illinois, Oklahoma). [Larval form.]

REPTILIA

2. *A. gracilis* (Ortlepp, 1922). LACERTILIA. Uganda.
3. *A. leptosoma* (Gervais, 1848). LACERTILIA (Varanidae, Agamidae). Algeria.
4. *A. abbreviata* (Rudolphi, 1819). LACERTILIA (Lacertidae, Agamidae, Anguidae). OPHIDIA (Colubridae). Spain, Algeria, Turkestan, British East Africa.

5. *A. amaniensis* (Sandground, 1928). LACERTILIA (Agamidae). Africa.
6. *A. antarctica* (Linstow, 1899). Syn. *Physaloptera alba* Stossich, 1902. OPHIDIA (Elapidae, Boidae). LACERTILIA (Scincidae, Varanidae). Australia.
7. *A. bancrofti* (Irwin-Smith, 1922). Syn. *Physaloptera natricus* Kreis, 1940; *P. physignathi* Baylis, 1924. LACERTILIA (Geckonidae, Agamidae). OPHIDIA (Colubridae). Australia, New Zealand.
8. *A. heterocephala* (Kreis, 1940). LACERTILIA (Agamidae). Location not given.
9. *A. leidyi* (Walton, 1927). LACERTILIA (Varanidae). Location not given.
10. *A. oligopapillata* (Kreis, 1940). LACERTILIA (Scincidae). Location not given.
11. *A. ortleppi* (Sandground, 1928). LACERTILIA (Chamaeleontidae). Africa.
12. *A. pallaryi* (Seurat, 1917). LACERTILIA (Agamidae). Morocco.
13. *A. polydentata* (Walton, 1932). LACERTILIA (Geckonidae). British East Africa.
14. *A. varani* (Parona, 1889). Syn. *Physaloptera quadrovaria* Leiper, 1908. LACERTILIA (Varanidae Iguaindae). OPHIDIA (Colubridae). Ceylon, India, China, U. S. A. (Maryland, Wisconsin, Illinois).
15. *A. achari* (Mirza, 1935). LACERTILIA (Agamidae). India.
16. *A. paradoxa* (Linstow, 1908). Syn. *Physaloptera affinis* Gedoelst, 1916. LACERTILIA (Varanidae). OPHIDIA (Viperidae, Colubridae). South Africa, Algeria, Belgian Congo, Sudan, Nigeria.
17. *A. tasmania* (Ortlepp, 1937). LACERTILIA (Chamaeleontidae). Rhodesia.
18. *A. terrapenis* (Hill, 1941). CHELONIA (Testudinidae). U. S. A. (Oklahoma).

MAMMALIA

19. *A. joyeuxia* (Gendre, 1928). ARTIODACTYLA (Suidae). Africa.
20. *A. africana* (Monnig, 1923). RODENTIA (Muridae, Octodontidae, Sciuridae). South Africa.

21. *A. leiperi* (Skrjabin, 1924). RODENTIA (Sciuridae). Russia.
22. *A. capensis* (Ortlepp, 1922). RODENTIA (Sciuridae). South Africa.
23. *A. musculi* (Thwaite, 1927). RODENTIA (Muridae). Ceylon.
24. *A. vandenbrandeni* (Gedoelst, 1924). CARNIVORA (Felidae). Belgian Congo.
25. *A. caucasica* (Linstow, 1902). Syn. *Physaloptera mordens* Leiper, 1908. PRIMATA (Hominidae, Lasiopygidae). Caucasus, Uganda, Africa, Arabia, North East Africa.
26. *A. poicilometra* Sandground, 1936. PRIMATA (Callitrichidae). East Africa.
27. *A. multipapillata* (Kreis, 1940). PRIMATA (Lasiopygidae). Location not given.

RELATIONSHIPS OF THE *SKRJABINOPTERA* AND *PSEUDOPHYSALOPTERA*

Skrjabinoptera is characterized by a single internolateral tooth on each pseudolabium and is restricted entirely to the Reptilia. At the present time 4 species are included in this genus and are found in the OPHIDIA (Colubridae), LACERTILIA (Chamaeleontidae, Iguanidae).

Skrjabinoptera colubri and *S. simplicidens* have been reported only from Australia; *S. chamaeleontis* only from Africa (Belgian Congo; *S. phrynosoma* is the only well-known representative of the genus. The geographical distribution is limited to Southern United States and Mexico, the range of the horned toad, American chamaeleon, and tree lizards. This species is restricted entirely to the family Iguanidae. The 2A and 4D types of uteri are represented in this genus, 2 species in each group. Morgan (1943) reported on the occurrence of this genus in North America.

LIST OF SPECIES OF *SKRJABINOPTERA* AND HOSTS ACCORDING TO CLASSES, ORDERS, FAMILIES, AND GEOGRAPHICAL DISTRIBUTION

REPTILIA

1. *S. colubri* (Rudolphi, 1819) OPHIDIA (Colubridae) Australia.
2. *S. chamaeleontis* (Gedoelst, 1916) LACERTILIA (Chamaeleondidae) Belgian Congo, Africa.
3. *S. simplicidens* (Ortlepp, 1922) LACERTILIA Australia.

4. *S. phrynosoma* (Ortlepp, 1922) LACERTILIA (Iguanidae) Mexico, U. S. A. (Texas, New Mexico, Oklahoma, California, Arizona, Utah, Idaho, South Carolina, Louisiana, and Florida).

The genus *Pseudophysaloptera* has pseudolabia similar to *Physaloptera,* however, the male is without caudal pedunculated papillae and spicules. Only one species is known at the present time; *P. soricina* from *Crocidura* sp. (shrew) from Tanganyika. Chen (1927) reported this parasite from *Suncus coerulus* (shrew) from China. Morgan (1941) also recovered this species from *Sorex p. personatus* (masked shrew). The genus so far as known is restricted to the Insectivora (Soricidae). The female possesses the 2-A type uteri. The species, reported by Yokagawa (1922) from *Sorex* sp. (*P. formosana*) cannot be grouped conveniently because of inadequate descriptions.

BIBLIOGRAPHY

ALICATA, J. 1937. Larval development of the spirurid nematode, *Physaloptera turgida,* in the cockroach, *Blatella germanica.* Papers on Helm. 30 yr. Jubileum, K. I. Skrjabin. 11–14.

BAYLIS, H. A. 1934. On a collection of cestodes and nematodes from small animals in Tanganyika. Ann. Mag. Nat. Hist. 13:338–353.

BOUGHTON, R. 1937. Endoparasitic infestations in grouse, their pathogenicity and correlation with meteroro-topographical conditions. Minn. Tech. Bul. 121:1–50.

CHEN, H. T. 1937. Some parasitic nematodes from mammals of South China. Parasitology. 29:419–434.

CRAM, E. B. 1931. Recent findings in connection with parasites of game birds. Trans. Amer. Game Confer. 18:243–247.

HOBMAIER, M. 1941. Extramammalian phase of *Physaloptera maxillaris.* Molin, 1860 (Nematoda) Jour. Parasitol. 27:233–235.

JOHNSON, T. H. and MAWSON, P. M. 1939. Sundry nematodes from Eastern Australian marsupials. Trans. Roy. Soc. South Australia. 63:204–209.

——— 1940 a. Nematodes from South Australian marsupials. *Ibid.* 64:95–100.

——— 1940 b. New and known nematodes from Australian marsupials. Proc. Linn. Soc. New South Wales. 65:468–476.

——— 1941 a. Some parasitic nematodes in the collection of the Australian museum. Rec. Australian Mus. 21:11–12.

——— 1941 b. Some nematodes from Australian birds of prey. Trans. Roy. Soc. South Australia. 65:30–35.

LINSTOW, O. 1883. Nematoden, Trematoden, and Acanthocephalen gesammelt von Prof. Fedtschenko in Turkestan. Arch. f. Nat. 49:274–314.

——— 1899. Nematoden Aus der Berliner Zoologischen Sammlung. Mitt. Zool. Mus. 1:5–28.

MORGAN, B. B. 1941 a. A summary of the Physalopterinae (Nematoda) of North America. Proc. Helm. Sec. Wash. 8:28–30.

——— 1941 b. Additional notes on North American Physalopterinae (Nematoda). *Ibid.* 63–64.

——— 1942 a. The Physalopterinae (Nematoda) of North American Vertebrates. Sum. Doctoral Diss. Univ. Wis. 6:88–91.

——— 1942 b. The nematode genus *Skrjabinoptera* Schulz 1927. Lloydia. 5:314–319.

——— 1943 a. The Physalopterinae (Nematoda) of Aves. Trans. Amer. Micro. Soc. 62:72–80.

——— 1943 b. The *Physaloptera* (Nematoda) of Rodents. Wassmann Collector. 5:99–107.

——— 1943 c. The *Physaloptera* (Nematoda) of reptiles. Le Naturaliste Canadien 70:179–185.

——— 1945 a. The *Physaloptera* (Nematoda) of carnivores. Trans. Wisconsin Acad. Sci. 36:375–388.

——— 1945 b. The nematode genus *Abbreviata* (Tavassos, 1920) Schulz, 1927. Amer. Midl. Nat. 34:485–490.

——— 1943 d. New host records of nematodes from Mustelidae (Carnivora). Jour. Parasitol. 29:158–159.

ORTLEPP, R. J. 1922. The nematode genus *Physaloptera* Rud. Proc. Zool. Soc. London. 999–1107.

——— 1937. Some undescribed species of the nematode genus *Physaloptera* together with a key to the sufficiently known forms. Onder. Jour. Vet. Sci. 9:71–84.

RUDOLPHI, C. 1819. Entozoorum synopsis, cui accedunt mantissa duplexet indices locupletissimi. Berolini.

SCHULZ, R. 1927. Die. Familie Physalopteridae Leiper, 1908. Nematodes und die principen ihre Klassifikation. Samml. Helm. arb. Prof. K. I. Skrjabin. 287–312.

TRAVASSOS, L. 1920. Contribuicoes para canhecimento da fauna helmintolojica Brazileira. Mem. Inst. Oswaldo Cruz. 73–77.

WU, H. and LIU, C. 1940. Helminthological notes. II. Senensia. 11:397–406.

YOKAGAWA, S. 1922. On a new species of *Physaloptera* (*Physaloptera formosana*) and the tumour caused by this parasite. Trans. Jap. Path. Soc. 12:201–202.