I. PATHOGENS OF PSYCHODIDAE (PHLEBOTOMINE SAND FLIES)

D. G. Young [a]

Department of Entomology and Nematology
University of Florida
Gainesville, FL 32611, USA

and

D. J. Lewis [b]

c/o Department of Entomology
British Museum (Natural History)
Cromwell Road, London SW7 5BD, England

a Research sponsored by US Army Medical Research and Development Command under contract No. DADA 17-72-C-2139.

b Supported by a grant from the Medical Research Council, London.

PATHOGENS OF PSYCHODIDAE (PHLEBOTOMINE SAND FLIES)[a]

Host	Host stage infected	Pathogen	% Incidence	Locality	Lab. or field study	Reference
Lutzomyia camposi (Rodriquez)	Adults	Acephaline gregarines	<1%	Panama	Field	McConnell & Correa (1964)
Lutzomyia cayennensis braci Lewis	"	Nematode	Unknown	Cayman Brac Island	"	Lewis (1967b)
Lutzomyia cruciata (Coq.)	"	Acephaline gregarines	<1%	Panama	"	McConnell & Correa (1964)
"	"	Nematode	<1%	Belize, formerly British Honduras	"	Lewis (1965a)
"	"	Unidentified small bodies	1.6%	"	"	"
"	"	Unidentified parasites	<1%	"	"	"
Lutzomyia flaviscutellata (Mang.)	"	Monocystis chagasi; Adler & Mayrink[b]	11-26%	Brazil (Pará)	"	Lewis et al. (1970)
Lutzomyia gomezi (Nitz.)	"	Fungus	3.7% in resting collections; 0% in biting collections	Panama	"	McConnell & Correa (1964)
Lutzomyia hartmanni (Fchld. & Hertig)	"	Acephaline gregarines	<1%	Panama	"	"

[a] The classification of Phlebotominae follows that of Theodor (1965).

[b] The generic status of this gregarine and Monocystis mackiei Shortt & Swaminath is unsettled. Tuzet and Rioux (1966) place them in the genus Ascocystis. Other workers, eg. Vávra (1969), put them in Lankesteria. The life cycle of M. mackiei is summarized by Vávra.

PATHOGENS OF PSYCHODIDAE (PHLEBOTOMINE SAND FLIES) (continued)

Host	Host stage infected	Pathogen	% Incidence	Locality	Lab. or field study	Reference
Lutzomyia lainsoni (Fraiha & Ward)	Adults	Microsporida	< 1%	Brazil (Pará)	Field	Ward & Killick-Kendrick (1974)
"	Larvae	Fungus	Not stated	"	Lab.	"
Lutzomyia lichyi (Floch & Abonnenc), as P. vexillarius Fchld. & Hertig	Adults	"	10% in resting collections, 0% in biting collections	Panama	Field	McConnell & Correa (1964)
Lutzomyia longipalpis (Lutz & Neiva)	Larvae	"	Not given	Brazil (Bahia)	Lab.	Sherlock & Sherlock (1959)
"	Adults	Monocystis chagasi	10% field, 20-80% lab.	Brazil (Minas Gerais)	Lab. & field	Adler & Mayrink (1961)
"	Larvae Pupae Adults	"	Not given	"	Field & lab.	Coelho & Falcão (1964)
"	Adults	Fungus	Not given	"	Field?	Adler & Mayrink (1961)
Lutzomyia ovallesi (Ortiz)		Minute, unidentified parasites	3.1%	Belize	Field	Lewis (1965a)
"	"	Fungus	43.7% in resting collections; 0% in biting collections	Panama	"	McConnell & Correa (1964)
Lutzomyia panamensis (Shannon)	"	Acephaline gregarines	< 1%	Panama	"	"
Lutzomyia panamensis (Shannon)	"	Fungus	0.5% in biting collections; 0% in resting collections	Panama	"	"
"	"	Nematode	< 1%	"	"	"

PATHOGENS OF PSYCHODIDAE (PHLEBOTOMINE SAND FLIES) (continued)

Host	Host stage infected	Pathogen	% Incidence	Locality	Lab. or field study	Reference
Lutzomyia sallesi (Galvão & Coutinho)	Adults	Monocystis chagasi	Not given	Brazil (Minas Gerais)	Field	Coelho & Falcão (1964)
Lutzomyia sanguinaria (Fchld. & Hertig)	"	Acephaline gregarine	< 1%	Panama	"	McConnell & Correa (1964)
"	"	Fungus	0% in resting collections; 0.2% in biting collections	"	"	"
"	"	Nematode	< 1%	"	"	"
Lutzomyia shannoni (Dyar)	"	Gregarine	Unknown	Belize	"	Garnham & Lewis (1959)
"	"	Gregarine	< 1%	Panama	"	McConnell & Correa (1964)
"	"	Fungus	10% in resting collections	"	"	"
"	"	Fungus	"	"	"	Lewis (1965a)
"	"	Ciliates	"	"	"	"
"	"	Nematode	11%	Costa Rica	Field	Rosabal & Miller (1970)
Lutzomyia steatopyga (Fchld. & Hertig), as Brumptomyia beltrani	"	Nematode	Unknown	Belize	"	Lewis (1965a)
Lutzomyia trapidoi (Fchld. & Hertig)	"	Acephaline gregarine	< 1%	Panama	"	McConnell & Correa (1964)
Lutzomyia trinidadensis (Newst.)	"	Acephaline gregarine	< 1%	"	"	"
"	"	Fungus	3.7%	"	"	"
Lutzomyia vespertilionis (Fchld. & Hertig)	"	Fungus	20%	"	"	"
"	"	Nematode	< 1%	"	"	"

PATHOGENS OF PSYCHODIDAE (PHLEBOTOMINE SAND FLIES) (continued)

Host	Host stage infected	Pathogen	% Incidence	Locality	Lab. or field study	Reference
Lutzomyia vespertilionis (Fchld. & Hertig)	Adults	Nematode, apparently close to genus Tylenchinema	<1%	Panama	Field	McConnell & Correa (1964)
Phlebotomus argentipes	"	Plerocercoids	Unknown	India (Deccan, Hyderabad)	Field?	Subramaniam & Naidu (1944)
Phlebotomus ariasi Tonn.	"	Nematode, Mastophorus muris (Gmelin)	8 positive, 370 examined	France	"	Golvan et al. (1963)
"	"	"	Unknown	France (Herault)	"	Rioux & Golvan (1969)
"	"	Entomophthora sp.	"	"	"	Rioux & Golvan (1969)
"	"	Nematode, Rictularia proni Seurat	"	"	"	Rioux & Golvan (1969)
"	"	"	"	"	"	Rioux et al. (1969)
"	"	Entomophthora sp.	1 positive, 317 examined	"	"	Rioux et al. (1966)
Phlebotomus caucasicus Marzinowsky	"	Gregarine, Diplocystis sp.	0.6%	USSR	"	Lisova (1962)
Phlebotomus chinensis Newst.	"	"	1.3%	"	"	"
Phlebotomus longipes Parrot & Martin	"	Gregarine, Lankesteria sp.	4.5%	Ethiopia	"	Ashford (1974)
Phlebotomus mascittii Grassi	"	Cestode, hymenolepid cysticercoid	<1%	Corsica	"	Quentin et al. (1971)

PATHOGENS OF PSYCHODIDAE (PHLEBOTOMINE SAND FLIES) (continued)

Host	Host stage infected	Pathogen	% Incidence	Locality	Lab. or field study	Reference
Lutzomyia vexator vexator (Coq.)	Probably adults	Rickettsia	Unknown	USA (probably) Washington, DC	Not stated	Hertig (1936)
Lutzomyia vexator occidentis (Fchld. & Hertig)	Adults	Lankesteria sp.	Common	USA (California)	Field	Ayala (1971,1973)
"	"	Fungus	Not stated	"	Lab. & field	Chaniotis & Anderson (1968)
"	Larvae, pupae	Pseudomonas sp.	"	"	Lab.	"
Lutzomyia ylephiletor (Fchld. & Hertig)	Adults	Acephaline gregarine	< 1%	Panama	"	McConnell & Correa (1964)
"	"	Fungus	4.2% in resting collections; 0% in biting collections	"	"	"
Lutzomyia sp. or spp.	Eggs	Coelomomyces citerrii Leão & Pedroso	Not stated	Brazil (Minas Gerais)	Probably field	Leão & Pedroso (1965)
Lutzomyia spp.	Larvae	Fungus, Aspergillus sp.	Not stated	Panama	Lab.	Hertig & Johnson (1961) Hertig (1964)
Phlebotomus argentipes Ann. & Brun.	Adults	Monocystis mackiei	High	India (Assam)	Field	Shortt & Swaminath (1927)
"	"	Unidentified abdominal parasite	Unknown	Malaysia	"	Lewis & Killick-Kendrick (1973)
Phlebotomus orientalis Parrot	"	Nematode	0.8%	Ethiopia	"	Ashford (1974)
"	"	Cestode, hymenolepid cysticercoid	0.1%	"	"	"

PATHOGENS OF PSYCHODIDAE (PHLEBOTOMINE SAND FLIES) (continued)

Host	Host stage infected	Pathogen	% Incidence	Locality	Lab. or field study	Reference
Phlebotomus papatasii (Scopoli)	Adults	Fungus	Unknown	Palestine	?	Adler & Theodor (1927)
"	"	"	"	Palestine & Syria	Field	Adler & Theodor (1929)
"	"	Entomophthora papatasi (= Empusa papatasi)	"	Malta	Lab.	Marett (1915); Larrousse (1921)
"	"	Gregarine, Diplocystis sp.	<1%	USSR	Field	Lisova (1962)
"	"	Monocystis mackiei	1 positive, 450 examined	Italy	"	Missiroli (1929,1932)
"	"	Nematode	"	Iraq (Baghdad)	Field, lab.?	Adler & Theodor (1929)
"	"	"	Unknown	India	Field	Mitra (1956)
"	"	"	"	Pakistan	"	Lewis (1967a)
"	"	Hepatozoon	50% 1 positive, 2 examined	Palestine (Jericho)	"	Adler & Theodor (1929)
Phlebotomus papatasii	Larvae	Fungus, Penicillium glaucum	Not given	USSR (Sebastopol)	Lab.	Zotov (1930)
Phlebotomus perniciosus Newst.	Adults	Micro-sporida, Adelina sp.	"	Corsica	Field	Rioux et al. (1972)
"	"	Mastophorus muris (Gmelin)	"	France	Field	Golvan et al. (1963)
"	"	"	8 positive, 370 examined	France (Herault)	"	Rioux & Golvan (1969)

PATHOGENS OF PSYCHODIDAE (PHLEBOTOMINE SAND FLIES) (continued)

Host	Host stage infected	Pathogen	% Incidence	Locality	Lab. or field study	Reference
Phlebotomus perniciosus Newst.	Adults	Spirochaeta phlebotomi (=Treponema phlebotomi)	8 positive, 370 examined	France (Marseilles)	Field?	Pringault (1921)
Phlebotomus perniciosus	"	Cestode, hymenolepid cysticercoid	<1%	Corsica	Field	Quentin et al. (1971)
Phlebotomus rodhaini Parrot	"	Gregarine, monocystis?	5 positive, 5 examined	Uganda	"	Barnley (1968)
Phlebotomus sergenti Parrot	"	Fungus	Unknown	Palestine & Syria	"	Adler & Theodor (1929)
"	"	Nematode	"	Pakistan	"	Lewis (1967a)
"	"	Nematode	"	Iraq (Baghdad)	Field, lab.?	Adler & Theodor (1929)
"	"	Gregarine, Diplocystis sp.	5%	USSR (Taškent)	Field	Lisova (1962)
Phlebotomus sp.	"	Fungus	Unknown	Sudan	"	Kirk & Lewis (1947)
Sergentomyia adleri (Theodor)	"	Unidentified parasite	"	"	"	"
"	"	Helminth	"	Uganda	"	Barnley (1968)
"	"	"	16 positive, about 2000 examined	"	"	"
Sergentomyia affinis (Theodor)	"	Tylenchid nematode	Not given	Ethiopia	"	Ashford (1974)
Sergentomyia africana (Newst.)	"	Fungus	"	Sudan	"	Kirk & Lewis (1940)
Sergentomyia bedfordi (Newst.)	"	Helminth	No positive, about 2000 examined	Uganda	"	Barnley (1968)

PATHOGENS OF PSYCHODIDAE (PHLEBOTOMINE SAND FLIES) (continued)

Host	Host stage infected	Pathogen	% Incidence	Locality	Lab. or field study	Reference
Sergentomyia clydei (Sinton)	Adults	Nematode	Unknown	Pakistan	Field	Lewis (1967a)
"	"	"	"	Sudan (Sennar)	"	Lewis (1975b)
"	"	"	"	Kenya	"	Lewis & Minter (1960)
Sergentomyia garnhami (Heisch, Guggisberg & Teesdale)	"	Acephaline, gregarine	"	Kenya	"	"
Sergentomyia graingeri Heisch, (Guggisberg & Teesdale)	"	Nematode	"	"	"	"
Sergentomyia hirta (Parrot & Jolinière)	"	Undetermined[a]	"	Algeria (Ahaggar)	"	Theodor (1948); Kirk & Lewis (1951)
Sergentomyia ingrami (Newst.)	"	Fungus	"	Sudan	"	Kirk & Lewis (1947)
Sergentomyia minuta minuta (Rond.)	"	Adelina sp.	"	Corsica	"	Rioux et al. (1972)
"	"	Mastophorus muris	8 positive, 370 examined	France (Herault)	"	Rioux & Golvan (1969)
Sergentomyia schwetzi (Adler, Theodor & Parrot)	"	Nematode	1 positive, 33 examined	Kenya	"	Lewis (1974c)
"	"	Helminth[b]	Unknown	Uganda	"	Barnley (1968)
Sergentomyia sp., probably S. schwetzi	"	Tylenchid nematode	"	Kenya	"	Lewis & Minter (1960)

[a] Abnormality possibly due to parasitism.

[b] Parasite apparently caused abnormality of male external genitalia.

ABSTRACTS

Mary Ann Strand

Adler, S. & Mayrink, W. (1961). A gregarine, Monocystis chagasi n. sp., of Phlebotomus longipalpis. Remarks on the accessory glands of P. longipalpis. Rev. Inst. Med. Trop., São Paulo, 3: 230-238.

A new species of gregarine is described from sandflies collected in Brazil. About 10% of the wild specimens and 20-80% of the laboratory specimens were infected. Oocysts were observed in the accessory glands in 20% of infected females. During oviposition, the surface of the eggs becomes contaminated with oocysts from the infected glands.

Adler, S. & Theodor, O. (1927). The transmission of Leishmania tropica from artificially infected sandflies to man. Ann. Trop. Med. Parasitol., 21: 89-110.

An unidentified fungus was observed infecting Phlebotomus papatasi in Israel.

Adler, S. & Theodor, O. (1929). The distribution of sandflies and leishmaniasis in Palestine, Syria and Mesopotamia. Ann. Trop. Med. Parasitol., 23: 269-306.

During the survey, several parasites of sandflies were observed: a fungus on eggs, nematodes in the haemocoel and ovaries, an oocyst (probably Hepatozoon sp.), and Crithidia in the midgut, cardia and stomach.

Ashford, R. W. (1974). Sandflies (Diptera:Phlebotomidae) from Ethiopia: taxonomic and biological notes. J. Med. Entomol., 11: 605-616.

Gregarines similar to those described by Ayala (1971) were found in the haemocoel of Phlebotomus longipes. Of 669 males examined 30 were infected. Nematodes were found infecting 0.8% of the female P. orientalis dissected. One nematode type nearly destroyed the reproductive organs of its host. Parasites were rarely observed in other species.

Ayala, S. C. (1971). Gregarine infections in the California sandfly, Lutzomyia vexatrix occidentis. J. Invert. Pathol., 17: 440-441.

Lankesteria gammonts were found in the haemocoel of adult sandflies. In male and nulliparous female flies, this stage persists; however, the onset of the females' ovarian cycle apparently stimulates the gregarines' sexual cycle. The Californian gregarines are larger than those from Brazil.

Ayala, S. C. (1973). The phlebotomine sandfly-protozoan parasite community of central California grasslands. Amer. Midland Nat., 89: 266-280.

The role of sandflies in transmission of protozoan parasites to vertebrates is examined. Female sandflies were occasionally killed by feeding on malaria-infected lizards with excessively high gametocyte levels. Lizard trypanosomes caused an upset of the normal blood meal digestion, although most parasites cause no apparent effect on the sandflies.

Barnley, G. R. (1968). Unpublished data. Attributed malformation of male genitalia of S. schwetzi to be caused by a helminth parasite.

Chaniotis, B. N. & Anderson, J. R. (1968). Age structure, population dynamics and vector potential of Phlebotomus in northern California. Part II. Field population dynamics and natural flagellate infections in parous females. J. Med. Entomol., 5: 273-292.

Flagellates (appeared to be leptomonads) were observed in 20% of the female Lutzomyia vexator occidentis which had taken a blood meal. Nulliparous females and males were not infected. The infections were located in the intestines of the females, the leptomonad forms in the hindgut and the crithidial forms in the midgut. The flagellates are endosymbiotic. A few wild-caught flies and some laboratory reared ones were also infected with fungus mycelia which either grew over the entire body or only in the thoracic muscles. In other cases, Pseudomonas sp. was isolated from apparently diseased larvae and pupae.

Coelho, M. de V. & Falcão, A. L. (1964). Aspects of the life cycle of Monocystis chagasi, Adler & Mayrink, 1961, in Phlebotomus longipalpis. Rev. Brasil. Biol., 24: 417-421.

Sandflies collected in Minas Gerais, Brazil, were found to harbour the gregarine M. chagasi. Larvae become infected by ingesting oocytes. All developmental stages of the parasite are found in the 4th instar and in adult males. Oocytes are eliminated in the faeces. Adult gregarines migrate to the body cavity, when the host pupates, and they eventually degenerate and are eliminated. M. chagasi was also found in Lutzomyia sallesi.

Feng, L. C. (1951). The role of the peritrophic membrane in Leishmania and trypanosome infections of sandflies. Peking Nat. Hist. Bull., 19: 327-334.

The peritrophic membrane found in some phlebotomines may influence the distribution of ingested parasites.

Forattini, O. P. (1973). Entomologia Médicia, vol. 4. Psychodidae. Phlebotominae. Leishmanioses. Bartonelose. Edgard Blucher, Ltda-, São Paulo, 658 p. (in Portuguese).

General review.

Golvan, Y. J. et al. (1963). Infestation spontanée de Phlébotomes par le Spiruridie Mastophorus muris (Gmelin). Ann. Parasitol. Hum. Comp., 38: 934.

The collection of the nematode M. muris infesting larvae of P. ariasi and P. perniciosus near Roquebrun, France, is reported.

Hertig, M. (1936). The rickettsia, Wolbachia pipientis (gen. et sp. n.) and associated inclusions of the mosquito, Culex pipiens. Parasitology, 28: 453-486.

Hertig mentions observing a rickettsia in the gonads of Lutzomyia vexator.

Hertig, M. (1964). Laboratory colonization of Central American Phlebotomus sandflies. Bull. W.H.O., 31: 569-570.

Although the whole genus Phlebotomus appears to be relatively free of parasites, bacteria and fungi, particularly Aspergillus, can be serious mortality factors in laboratory colonies.

Hertig, M. & Johnson, P. T. (1961). The rearing of Phlebotomus sandflies (Diptera: Psychodidae) I. Technique. Ann. Entomol. Soc. Am., 54: 753-764.

Aspergillus is pathogenic to larvae in culture. The larvae ingest the spores from mouldy food. The spores germinate in the intestine and the resulting mycelia invade the muscles of the thoracic region, killing the larvae.

Jenkins, D. W. (1964). Pathogens, parasites and predators of medically important arthropods. Bull. W.H.O., 30(Suppl.), 150 p.

A review of the literature through 1963 is given.

Kirk, R. & Lewis, D. J. (1940). Studies in leishmaniasis in the Anglo-Egyptian Sudan. III. The sandflies (*Phlebotomus*) of the Sudan. Trans. R. Soc. Trop. Med. Hyg., 33: 623-634.

An unknown fungus was observed infecting adult *Sergentomyia africana*.

Kirk, R. & Lewis, D. J. (1947). Studies in leishmaniasis in the Anglo-Egyptian Sudan. IX. Further observations on the sandflies (*Phlebotomus*) of the Sudan. Trans. R. Soc. Trop. Med. Hyg., 40: 869-888.

During the survey, a fungus was observed occasionally infecting sandflies.

Kirk, R. & Lewis, D. J. (1951). The Phlebotominae of the Ethiopian Region. Trans. R. Entomol. Soc. Lond., 102: 383-510. Abnormality in *S. hirta* may be due to parasitism.

Larrousse, F. (1921). Etude systématique et médicale des phlébotomes. Vigot, Paris, 106 p.

Leão, A. E. A. & Pedroso, M. C. (1965). Nova espécie do genero *Coelomomyces* parasito de ovos de *Phlebotomus*. Mycopathol. Mycol. Appl., 26: 305-307.

A new species, *C. ciferrii*, is described. The fungus was found in *Phlebotomus* eggs collected in Minas Gerais, Brazil.

Lewis, D. J. (1965a). Internal structural features of some Central American phlebotomine sandflies. Ann. Trop. Med. Parasitol., 59: 375-385.

Parasites were observed in a few sandflies taken on human bait. Fungal, nematode, ciliate, and flagellate endoparasites were found usually in the abdomen or midgut. None was identified.

Lewis, D. J. (1965b). Sand-flies and black-flies (Dipt. Phlebotominae and Simuliidae). Proc. South Lond. Entomol. Nat. Hist. Soc., 1964: 14-17.

The biology and taxonomy of phlebotomines are discussed in this general article. Sandfly larvae, not being aquatic, are not exposed to aquatic parasites and phlebotomines, perhaps for this reason, appear to have relatively few parasites.

Lewis, D. J. (1967a). The phlebotomine sand-flies of West Pakistan (Diptera:Psychodidae). Bull. Br. Museum (Nat. Hist.) Entomol., 19: 1-57.

Nematodes were found in 3 sandflies during an extensive survey. They were large, about 3.7 mm long, and were packed with oval brown eggs. This may be the same worm seen in the same species by Adler & Theodor (1929).

Lewis, D. J. (1967b). Phlebotomine sand-flies from Cayman Brac Island (Diptera:Psychodidae). J. Nat. Hist., 2: 73-83.

A nematode was found in the abdomen of a male Lutzomyia cayennensis braci. This specimen did not resemble nematodes previously reported from sandflies. It does not appear to be a filarial worm or mermithid.

Lewis, D. J. (1971). Phlebotomid sandflies. Bull. W.H.O., 44: 535-551. The relationship between sandflies and leishmaniasis is reviewed. Ninety references are given.

Lewis, D. J. (1973). Phlebotomidae and Psychodidae, p. 155-179. In Smith, K. G. V., Insects and other arthropods of medical importance, British Museum (Nat. Hist.) Pub. No. 720, London.

General review.

Lewis, D. J. (1974a). The biology of Phlebotomidae in relation to leishmaniasis. Ann. Rev. Entomol., 19: 363-384.

Taxonomy and ecology of the flies are reviewed.

Lewis, D. J. (1974b). The phlebotomid sandflies of the Yemen Arab Republic. Z. Tropenmed. Parasitol., 25: 187-197.

Notes on distribution, habits, and taxonomy of Phlebotomus and Sergentomyia species found in Yemen are given. Cibarial filtration in S. antennata, and its possible relation to parasitism, are discussed.

Lewis, D. J. (1974c). Unpublished data.

Lewis, D. J. (1975a). Functional morphology of the mouth parts in New World phlebotomine sandflies (Diptera:Psychodidae). Trans. R. Entomol. Soc. Lond., 126: 497-532.

Lewis discusses the differences in the stylets of the biting fascicle in relation to probable function, blood-sucking habits, and taxonomic grouping. The cibarial teeth may act as a comb.

Lewis, D. J. (1975b). Unpublished data.

Lewis, D. J. & Killick-Kendrick, R. (1973). Some phlebotomid sandflies and other Diptera of Malaysia and Sri Lanka. Trans. R. Soc. Trop. Med. Hyg., 67: 1-5.

A female Phlebotomus argentipes with a large abdominal parasite was found in Ulu Gombak, Malaya.

Lewis, D. J. et al. (1970). Determination of parous rates in phlebotomine sandflies with special reference to amazonian species. Bull. Entomol. Res., 60: 209-219.

Of 524 Lutzomyia flaviscutellata dissected, 24% were infected by Monocystis. The parous rate of infected and uninfected flies is nearly the same. This suggested that either the parasites are non-pathogenic or that they have little effect on longevity.

Lewis, D. J. & Minter, D. M. (1960). Internal structural changes in some African phlebotominae. Ann. Trop. Med. Parasitol., 54: 351-365.

Lisova, A. I. (1962). [Gregarina (Genus Diplocystis) in the body cavity of sandflies.] Zool. Zh., 41: 1095-1099. (R)

A survey of sandflies in Tashkent revealed a gregarine parasite, Diplocystis sp. Four species of sandflies were infected: Phlebotomus papatasi, P. caucasicus, P. chinensis, and P. sergenti. Gregarines were found in the body cavity glands and ovaries. They caused marked changes in the organs affected. Frequency of infection is greatest in P. sergenti, about 5%.

Marett, P. J. (1915). The bionomics of the Maltese Phlebotomi. Br. Med. J., 2: 172-173.

Phlebotomus papatasi was found infected by Entomophthora (Empusa) papatasi. Ingested blood appeared to remain in thorax of infected flies. Motile spores were found in the salivary glands and mycelium was seen in the intestines.

McConnell, E. & Correa, M. (1964). Trypanosomes and other microorganisms from Panamanian Phlebotomus sandflies. J. Parasitol., 50: 523-528.

Acephaline gregarines of one or more species were found in the hemocoel of 10 species of sandflies. Only 18 of more than 6000 female flies dissected contained this parasite. No pathogenic conditions were noticed in the flies. Also, mycelia of fungi occurred in individuals of 10 sandfly species. The fungus was almost always associated with the gonads. The infection may disturb the normal physiology so as to prevent the female from seeking a blood meal. Nematodes were observed in hemocoels of three species of sandfly.

Missiroli, A. (1929). I protozoi parassiti del Phlebotomus papatasii. Ann. Ig., 39: 481-487.

In Italy no parasites were found in sandflies collected in areas where human leishmaniasis occurs. In other areas, parasites resembling a developmental stage of Trypanosoma lewisi and Monocystis mackiei were observed.

Missiroli, A. (1932). Sullo sviluppo di una gregarina del Phlebotomus. Ann. Ig., 42: 373-377.

The developmental stages of Monocystis mackiei in a sandfly (probably P. papatasi) are described.

Mitra, R. D. (1956). Notes on sandflies. Sandflies of the Poona District. Z. Tropenmed. Parasitol., 7: 229-240.

Pringault, E. (1921). Présence de spirochètes chez Phlebotomus perniciosus Newstead. C. R. Séances Soc. Biol. Ses Fil., 84: 209-210.

Spirochaeta phlebotomi was found in P. perniciosus collected in the Marseilles region.

Quentin, J. C. et al. (1971). Présence du cysticercoïde d'Hymenolepsis brusatae Vaucher, 1971, chez Phlebotomus perniciosus Newstead, 1911 et Phlebotomus mascittii Grassi, 1908. Ann. Parasitol. Hum. Comp., 46: 589-594.

Of 15 436 sandflies collected in Corsica, 2 adult females were infected with H. brusatae. This parasite in its adult stage infects the shrew mouse. The cystercercoids were found in the abdomen of the sandflies.

Rioux, J. A. et al. (1969). Infestation spontanée de Phlebotomus ariasi par Rictularia proni, Spiruride parasite du mulot. Les terriers de mulots sont-ils des gîtes larvaires à phlébotomes? Ann. Parasitol. Hum. Comp., 44: 757-760.

A description is given of the nematode R. proni which was found infecting P. ariasi larvae from France. This nematode also infects the field mouse, Apodemus sylvaticus.

Rioux, J. A. & Golvan, Y. J. (1969). Epidemiologie des leishmanioses dans le sud de la France. Mon. Inst. National Santé Rech. Méd., No. 37, 220 p.

Parasitism of P. ariasi and S. minuta by Mastophorus muris is reported. Study of parasites can help to determine the breeding places of sandfly hosts.

Rioux, J. A. et al. (1972). Adelina sp. parasite de phlébotomes. Ann. Parasitol. Hum. Comp., 47: 347-350.

The development of Adelina sp. in Phlebotomus perniciosus is described.

Rioux, J. A. et al. (1966). Infestation à Entomophthora sp. chez Phlebotomus ariasi tonnoir, 1921. Ann. Parasit. Hum. Comp., 41: 251-253.

Of 317 female sandflies dissected, one was found to be infected with Entomophthora. The body cavity of the fly was filled with resting spores.

Rosabel, R. & Miller, A. (1970). Phlebotomine sandflies in Louisiana (Diptera:Psychodidae). Mosq. News, 30: 180-187.

A key to the species of Lutzomyia found in the US is given. No parasites were found in any of 29 female L. shannoni collected in Louisiana. However, nematodes were found in the hemocoels of 2 females of 18 examined in Costa Rica.

Sherlock, I. A. & Sherlock, V. A. (1959). Criação e biologia, em laboratorio do Phlebotomus longipalpis Lutz and Neiva, 1912 (Diptera:Psychodidae). Rev. Brasil. Biol., 19: 229-250.

Fungal growths fatal to larvae occurred in cultures of Lutzomyia longipalpis.

Shortt, H. E. & Swaminath, C. S. (1927). Monocystis mackiei n. sp., parasitic in Phlebotomus argentipes Ann and Brun. Indian J. Med. Res., 15: 539-552.

The parasite was found in about 25% of the adult sandflies caught in Assam. Oocysts are deposited with eggs and are ingested by the newly emerged larvae. The infection does not apparently affect feeding or longevity.

Subramaniam, M. K. & Naidu, M. B. (1944). On a new plerocercoid from a sand-fly. Curr. Sci., 13: 260-261.

Plerocercoids were found in the adipose tissue of a sandfly collected near Hyderabad, India. It resembles Sparaganum proliferum; however this specimen possesses distinct segmentation.

Theodor, O. (1948). Classification of the Old World species of the subfamily Phlebotominae (Diptera, Psychodidae). Bull. Entomol. Res., 39: 85-115.

In his discussion of the genus Sergentomyia, Theodor mentions a species, S. hirta, which is probably an abnormality.

Theodor, O. (1965). On the classification of American Phlebotominae. J. Med. Entomol., 2: 171-197.

A general classification of the subfamily is given.

Tuzet, O. & Rioux, J. A. (1966). Les gregarines des Culicidae, Ceratopogonidae, Simuliidae, et Psychodidae. Unpublished document WHO/EBL/66.50, 18 pp.

A taxonomic review of the gregarines is given.

Vávra, J. (1969). Lankesteria barretti, n. sp. (Eugregarinida, Diplocystidae), a parasite of the mosquito Aedes triseriatus (Say) and a review of the genus Lankesteria Mingazzini. J. Protozool., 16: 546-570.

Ward, R. D. & Killick-Kendrick, R. (1974). Field and laboratory observations on Psychodopygus lainsoni Fraiha and Ward and other sandflies (Diptera, Phlebotomidae) from the Transamazonica highway, Pará state, Brazil. Bull. Entomol. Res., 64: 213-221.

A microsporidian parasite was found rarely infecting Lutzomyia lainsoni adults.

Zotov, M. P. (1930). /Experiments in breeding sandflies in the laboratory./ Vestn. Mikrobiol., 9: 236-243. (R)

Penicillium glaucum was found to be pathogenic to larvae in culture.