A SURVEY OF THE PARASITES FOUND IN AND ON THE
FOX SQUIRREL (SCIURUS NIGER RUFIVENTER GEOFFROY) AND THE
SOUTHERN GRAY SQUIRREL (SCIURUS CAROLINENSIS CAROLINENSIS
GAMELIN) IN OHIO

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By
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Approved by:

[Signature]
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A survey of eighty-eight squirrels taken from five areas in Ohio was undertaken to learn some facts about the incidence of external and internal parasites in the Southern Gray Squirrel (Sciurus c. carolinensis Gmelin) and Fox Squirrel (Sciurus niger rufiventer Geoffroy). There were seventy-two Gray Squirrels and sixteen Fox Squirrels examined. Fifteen species of parasites were recovered from these squirrels:

Six Arthropoda - Hoplopleura sciuricola Ferris 1921, Cuterebra sp., Ceratophyllus fasciatus Bosc., Sarcoptes scabiei var. Latreille, Ticks (immature), Mites (Trombidiidae); Two cestoda - Catenotaenia sp. Janicki 1904 and Hymenolepis sp. Weinland 1858; Five Nematoda - Ascaris lumbricoides Linnaeus 1758, Capillaria sp. Zeder 1800, Citellinema bifurcatum Hall 1916, Heligmodendrium hassalli (Price 1928) Travassos 1937. Rictularia sp. Frolich 1802; One Pentastomida - Linguatula serrata Frolich 1789; One Sporozoa - Eimeria sp. (sciurorum?)

The squirrels taken from forested areas were not significantly more frequently parasitized than those taken from small woodlots, although there were larger numbers of parasites in the former. There appears to be a correlation between: the number of parasitic species, the number of individual parasites, and the physical condition of the host, the Southern Gray Squirrel. Squirrels taken from small woodlots were
significantly more frequently infected with coccidia than those from the forest. There were no apparent gross changes in tissues caused by any of the internal parasites. The Sarcoptes mite was the only ectoparasite recognized as harmful to squirrels. Four animals killed by this mite were examined and the parasite recovered from them. The occurrence of *Linguatula serrata*, *Ascaris lumbricoides* and the *Hymenolepis* sp. in squirrels are considered of interest in that the former two are known to parasitize domestic animals and the latter may possibly be similar to the one found in humans. Twenty-two annotated references to the parasites found in Fox and Gray Squirrels and seventy-four annotated references to parasites found in members of the family Sciuridae over the world are appended to the survey.

Approved by
II. INTRODUCTION

Disease has been suggested as a possible agent in the cause of epizootic diminishes of wild animals. The one phase of medical investigation which has lent itself most advantageously to the study of disease, as it occurs in wild animals, is Parasitology. This is due to the gross evidence of the parasites and to the mistreatment which the parasites may tolerate in collection and handling, yet be able to be identified.

Exo- and endo-parasites of wildlife have been studied by many investigators. These men have postulated and, in some cases, proved that parasites are one of the main factors in recurrent epizootics among many animal species. LeDune (1933) examined 186 rabbits and found that all carried parasites. "The highest percentage of infestation was found to be in rabbits one year of age and in poor condition, the lowest percentage of infection being found in young fat rabbits." Gross (1930), after the examination of 144 grouse stated: "In Southern New England and New York State a large percentage of the ruffed grouse found dead and examined were found to have died from the effects of this worm (Dispharynx spiralis)." Clarke (1936) reported after an examination of 162 ruffed grouse, "the only organism found to be significantly associated with the cyclic diminution and compatible with its characteristics was a blood protozoon, Leucocytozoon bonasae." Connell and Dorems (1937) examined the parasite fauna of seventy grouse during a population diminution and summarized their findings:
findings: "the diminution cannot be attributed to parasitism, Leucocytozoon excepted" - (the blood of only six birds was examined). Venard (1933) reported, "lesions due to nematodes were found in birds infected with Dispharynx spiralis and Seurocyrnea colini" among sixty-seven adult bobwhite quail examined for helminths and coccidia. Other similar surveys (O'Keke 1928a, 1928b; Boughton 1932, 1937; Harkema 1936; Bills 1935; Woodhouse and Bennett 1936; McLeod 1933) have revealed several parasite species which occurred in several species of wildlife.

Results of the above cited studies indicate that several species of parasites are extremely detrimental to the welfare of the host, causing death in many individuals (Gross 1930). On the other hand, the incidence of infestation by other species of parasites may be extreme, yet produce no apparent ill effects in the host (LeDune, 1933 and Harkema, 1936).

The people of Ohio are interested in an abundance of squirrels from an aesthetic, recreational and economic viewpoint. The enforcement of regulatory measures, thus far initiated in this State, has not produced the desired results (viz., a size squirrel crop to fit the demand every year). Some biotic factors may cause an increase or a decrease in squirrel populations. To attempt to find the causes of these limiting factors, all the factual information should be considered and, by elimination, the true etiological agents ascertained.
The wildlife investigators have been searching for the possible causes of these unaccountable fluctuations in the number of squirrels in some sections of Ohio. A critical study is being made of the presence or lack of suitable food, habitat, of the climatic conditions, and of other biotic factors. Parasites may also be considered one of the factors incorporated in such a population phenomenon, as investigations recorded above indicate.

This survey was conducted to ascertain some facts concerning the parasites found in and on the Ohio Gray and Fox Squirrels:

1. To determine the species of parasites, their frequency of occurrence, and number of individuals.

2. To note if any correlation existed between the locality from which the host was taken and the occurrence of the various parasites.

3. To note the physical condition, sex, and age of the host as compared with numbers of parasites in the host.

4. To note any difference which may occur in the parasite fauna of the Gray and Fox Squirrels taken from the same areas.

5. To learn whether any of the parasite species found is of importance in domestic livestock and humans.
III. REVIEW OF LITERATURE

A review of all available literature revealed twenty records of parasites from individual Fox Squirrels and Gray Squirrels in the United States. These records have been compiled alphabetically by author in Appendix A at the end of this paper.

Two investigators have examined several specimens of Gray and Fox Squirrels for parasites. Martin (1936), in Ohio, reported parasite findings in six Fox Squirrels (*Sciurus niger rufiventris*) as follows:

<table>
<thead>
<tr>
<th>County origin</th>
<th>Date received</th>
<th>Wt. in grams</th>
<th>Sex</th>
<th>Condition</th>
<th>Parasites</th>
<th>Cause of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>1-31-36</td>
<td>702</td>
<td>M.</td>
<td>Good</td>
<td>2 Strongylids coccidia in cecum</td>
<td>Frozen</td>
</tr>
<tr>
<td>Wood</td>
<td>2-15-36</td>
<td>665</td>
<td>M.</td>
<td>Emmaciated Poor</td>
<td>Many coccidia in cecum and large intestine</td>
<td>Frozen Hemorrhagic enteritis</td>
</tr>
<tr>
<td>Wood</td>
<td>2-15-36</td>
<td>792</td>
<td>M.</td>
<td>Fair</td>
<td>Few coccidia in cecum and large intestine</td>
<td>Frozen</td>
</tr>
<tr>
<td>Erie</td>
<td>2-14-36 died 2-18-36</td>
<td>533</td>
<td>M.</td>
<td>Poor</td>
<td>Capillaria in intestines Coccidia in cecum</td>
<td>Frozen</td>
</tr>
<tr>
<td>Erie</td>
<td>2-21-36</td>
<td>755</td>
<td>F.</td>
<td>Fair-estimal 1 Capillaria half mature Few coccidia in each uterine horn</td>
<td>Frozen</td>
<td></td>
</tr>
<tr>
<td>Erie</td>
<td>2-26-36</td>
<td>655</td>
<td>M.</td>
<td>Fair</td>
<td>Coccidia in cecum and large intestine</td>
<td>Injured in trap Found dead</td>
</tr>
</tbody>
</table>
Harkema (1936) examined fifty-three Southern Gray Squirrels

(*Sciurus carolinensis carolinensis*). These animals were collected
in Durham County, North Carolina. He reported the following:

(The upper figure indicates average number of parasites per host)
(The lower figure indicates the percentage of hosts infested)

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Number of hosts</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td><strong>examined</strong></td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td><em>Taenia</em></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.16</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>taeniaformis</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Longistriata</em></td>
<td>110.33</td>
<td>102.6</td>
<td>101</td>
<td>13</td>
<td>106.9</td>
<td>62.33</td>
<td>19.33</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td><strong>hassalli</strong></td>
<td>95.71</td>
<td>100</td>
<td>87.77</td>
<td>60</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td><strong>Trombicula</strong></td>
<td>7.0</td>
<td>14.1</td>
<td>22.75</td>
<td>13.75</td>
<td>13.3</td>
<td>3.3</td>
<td>2.0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>sp.</strong></td>
<td>102.75</td>
<td>60</td>
<td>87.5</td>
<td>60</td>
<td>50</td>
<td>66.75</td>
<td>66.75</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Atrichoechus</em></td>
<td>0.57</td>
<td>0.1</td>
<td>0</td>
<td>0</td>
<td>0.2</td>
<td>0</td>
<td>1</td>
<td>0</td>
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<tr>
<td><strong>laelaps</strong></td>
<td></td>
<td>10</td>
<td></td>
<td></td>
<td>30</td>
<td></td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>glasgowi</em></td>
<td>0.14</td>
<td>11.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td><em>Ixodes hexagonus</em></td>
<td>0.2</td>
<td>0</td>
<td>0.2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Neoaematomonus</td>
<td>2.7</td>
<td>5.1</td>
<td>6.5</td>
<td>30.2</td>
<td>101.3</td>
<td>2.16</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>sciurinus</td>
<td>14.44</td>
<td>50.0</td>
<td>87.5</td>
<td>100</td>
<td>90</td>
<td>16.75</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hoplopleura</td>
<td>0.7</td>
<td>0</td>
<td>0.25</td>
<td>2.2</td>
<td>17.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>sciuricola</td>
<td>14.44</td>
<td>0</td>
<td>12.5</td>
<td>60.0</td>
<td>70.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Orthopras Wickhami</td>
<td>0.72</td>
<td>0.3</td>
<td>1.0</td>
<td>13.5</td>
<td>3.1</td>
<td>9.5</td>
<td>7.0</td>
<td>1.33</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>28.57</td>
<td>20.0</td>
<td>62.5</td>
<td>60.0</td>
<td>60.0</td>
<td>60.0</td>
<td>33.3</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
IV. METHODS OF STUDY

A. Source of Study Material

1. Controlled hunting areas

During the squirrel hunting seasons of 1936 and 1937, regulated squirrel hunting procedures on the Roosevelt Hunting Preserve and Shawnee State Forest (Scioto County) permitted the collection of viscera and a rapid check of a number of the carcasses of squirrels taken by hunters from those areas. The controlled hunting areas were organized and maintained by Floyd B. Chapman of the Ohio Division of Conservation and the Ohio Wildlife Research Station.

Each hunter checked out of the area at designated C. C. C. Camp Stations. His day's kill was observed and a record made of the sex, age, weight, physical condition, external parasites, and gross pathology of each specimen. Physical condition of each squirrel was designated by the extent that adipose tissue occurred over the organs and body:

(a) Poor, as noted by the lack of visible fat; (b) Fair, with fat around the kidneys and in the mesentery; and (c) Good, having fat subcutaneously as well as in the body cavities. The viscera of many of these individuals were removed, numbered, tied into a cheesecloth sack and placed in a container filled with 10% formalin.
- **FOX SQUIRREL** (*Sciurus niger rufiventris*)
- **SOUTHERN GRAY SQUIRREL** (*Sciurus carolinensis carolinensis*)
2. Research Station staff in Ohio

Several specimens of Fox Squirrels were collected in some of the northern counties of Ohio by Luther L. Baumgartner of the Ohio Wildlife Research Station staff. Some of these squirrels, taken alive, were sent to the writer for examination. Others were destroyed and their viscera preserved in 10% formalin.

B. Handling live squirrel specimens

Each animal was anesthetized and a sample of blood drawn from the heart. Smears were prepared from this blood and fixed in 70% alcohol. The squirrel was then placed in a white muslin sack and over-anesthetized. The fast-moving ectoparasites, such as fleas and flies, escape as soon as the host dies, if the muslin sack is not used. The pelage was combed and examined for ectoparasites, many of which were found free in the muslin sack. All of these parasites were placed in 70% alcohol containing 5% glycerin. The animal was skinned and the skeletal muscles examined for parasites or gross lesions. The abdominal cavity was opened and examined. In removing the viscera, blood smears were made from kidney, liver, and spleen and fixed in 70% alcohol.

The thoracic cavity was opened and examined. Smears were made from the bronchial exudate to locate larvae or parasite eggs. Gross lesions were looked for on and in the heart. The oral, nasal, auditory, and cranial cavities were examined for gross lesions. The various portions of the digestive tract were cared for in the same manner as the preserved specimens mentioned below.
C. Collection of parasites from the host

1. Examination of viscera for parasites

Each specimen of viscera was placed in cold running water until the tissues softened. The four portions of the alimentary tract (stomach, small intestine, caecum, and large intestine) were placed in separate beakers of warm water. The mesentery was closely examined for gross lesions. The lungs, heart, liver, spleen and kidneys were each examined for the presence of parasites or gross lesions.

Each portion of the digestive tract was opened and the contents gently scraped into a beaker containing water. Scrapings from the mucosa at various levels of the small intestines and caecum were examined for the presence of coccidia, using the saturated salt flotation method. Each beaker of ingesta was decanted and refilled with water repeatedly. A special decanting device was employed for this procedure. The sediment which remained after the repeated decantation was placed in a flat tray (12" x 7" x 1"), one-half of which was painted black for the detection of light-colored parasites, the opposite half painted white for the detection of dark-colored parasites. The parasites were collected from the sediment and counted. All of the parasites were rinsed, passed through a series of 35%, 50%, 60%, and 70% alcohol, in which they were stored until identified.

2. Care and identification of parasites

The parasites from each squirrel were collectively numbered and the organ from which they were taken recorded. All parasites were previously fixed in 10% formalin due to the need of bulk preservation, and due to the field facilities for collecting.
FIGURE I.

Equipment for finding and recovery of Parasites in the host.

A. Decanting device
B. Collecting sack
C. Pan in which sediment was examined for parasites
D. Vials for salt *flotation*
E. Refiller for decanting device
F. Salt (super-saturated) solution
G. Parasite clearing and mounting solution
FIGURE II.

Decanting device - Right side
Beakers tilted, as in pouring

FIGURE III.

Decanting Device and Refiller
Left Side and Back
The small nematodes were cleared and mounted in: 10 cc. distilled water; 8 Gm. gum arabic; 53 Gm. chloral hydrate; 5 cc. glycerin, and enough iodine to tint to a slightly dark amber color. Cestodes were stained in a watery solution of alum carmine, cleared in Xylene, and mounted in Canada balsam. Coccidia were successfully sporulated in 2.5% and 5% potassium dichromate and also in 1% formalin.

Several specimens of nematodes and coccidia were measured to assist in the identification of species. Yorke and Maplestone (1926), Hall (1916), Meggitt (1924), and Ewing (1929) were the principal sources of assistance in the identification of parasites. The species of parasites found and the numbers of each in every animal were recorded. The mites were centrifuged, cleared and mounted in Canada balsam. Flies were studied after clearing in 10% sodium hydroxide; some were mounted in Canada balsam. Specimens of all species found were placed in the Veterinary Parasitology Museum at the Ohio State University in Columbus.
V. RESULTS OF SURVEY (Chart I)

A. Summary of Parasitic Findings:

Fifteen species of parasites were found in this survey. Five were found on the skin and in the pelage of the hosts:

1. Arthropoda:
   Anoplura
   (a) Hoplopleura sciuricola Ferris 1921
   Acarina
   (b) Sarcoptes scabei var. Latreille
   Ixodidae
   (c) Ticks (immature)
   Cestridae
   (d) Ctenocephalides sp.
   Siphonaptera
   (e) Ceratophyllus fasciatus Bosc.
   Trombidiidae
   (f) Mite

Eight species of parasites occurred in the small intestines:

2. Cestoda:
   (g) Catenotaenia sp. Janicki 1904
   (h) Hymenolepis sp. Weinland 1858

3. Nematoda:
   (i) Ascaris lumbricoides Linnaeus 1758
   (j) Citellininae bifurcatum Hall 1916
   (k) Heligmosoides hassali (Price 1928) Travassos 1937
   (l) Rictularia sp. Frolich 1802
   (m) Capillaria sp. Zeder 1800

4. Pentastomida:
   (n) Linguatula serrata Frolich 1789

Only one species occurred in the Cecum:

5. Sporozoa:

   (o) Eimeria sp. (sciurorum?)
(a) *Hoplopleura sciuricola* Ferris 1921

**Classification:** Class Insects, Order Anoplura, Suborder Siphunculata, family Haematopinidae, subfamily Lino-

**gnathinae, genus Hopopleura**

**Description:** Anoplura without eyes; with five segmented antennae which are not sexually dimorphic; anterior legs small, with slender claw; middle legs somewhat larger with stouter claw; posterior legs still larger, somewhat flattened with stout blunt claw and usually with a tooth-like "clecanon process" at the outer proximal angle of the tibia; pleural plates well developed, present on at least first to seventh segments, first pair small and lying upon the dorsum; Female usually with third to seventh abdominal tergites and sternites bearing three transverse rows of setae usually with a like number of chitinized plates; occasionally with three rows of setae on third tergite and sternite only, the other segments with not more than two; male always with two rows of setae on third to seventh sternites, and third tergite, and usually with but one row of setae on the remaining tergites, but occasionally with two on the fourth to seventh; first plate of the third sternite in both sexes usually extending from pleurite to pleurite, and usually with two pairs (or occasionally two groups of three) of conspicuously enlarged setae; head usually with slight post-antennae angles, and without a constricted occipital region; genitalia of the males of a quite uniform type, the basal plate undivided, the parameres large, and usually enclosing the pseudopenis.
Occurrence: Occurs, as far as known, only on rodents of the families Muridae, Sciuridae, Petauristidae, and Octodontidae. The genus appears to be especially characteristic of the first two families named.

This blood sucking louse was found on four of the Fox Squirrels, with thirteen as the maximum number counted on any one host.

(b) Sarcoptes scabiei var. Latreille (Fig. VII)

Classification: Class Arachnida, order Acarina, family Sarcoptidae, genus Sarcoptes.

Description: Sarcoptidae. Almost circular in shape, and are almost nude except for sharp-pointed scales, and short sharp, stubby spines. The tarsal suckers have unsegmented pedicels and are present on the first and second pairs of legs in the female and on the first, second, and fourth pairs in the male. Males are without anal suckers and the anus is terminal.

Occurrence: Martin (1938) has examined Fox and Gray Squirrels which were severely infested with mites from various counties in Ohio: 1934, a Fox Squirrel from Wood County, Liberty Township in winter; 1935, a Gray Squirrel from Knox County and another from Preble County; also a Fox Squirrel from Licking County; 1936, one Gray Squirrel; 1937 one Fox Squirrel, Henry Township, Wood County and another experimentally infested in Erie County. One Fox Squirrel from Medina County.

The writer collected specimens of Sarcoptes mites and observed the animals recorded for 1937. No records of mange in squirrels were found in the literature excepting one case of Demodex sciu-rinus on Sciurus vulgaris in Scotland. The sarcoptes mite was not found on any of the animals examined in this survey.
(c) *Ixodidae (sp.)*

**Classification:** Class Arachnida, order Acarina, superfamly *Ixodoidea*, family *Ixodidae* (subfamily *Ixodinae*).

**Description:** A hard, chitinous shield, or scutum which extends over the whole dorsal surface of the male and covers only a small portion behind the head in the larva, nymph, and female. Mouth parts anterior and visible from dorsal aspect. Eyes present or lacking, when present paired, situated on lateral margins of the scutum. The capitulum shows two dorsal porose areas in the female. The scutum has bilateral, cervical and lateral grooves, varying in depth, and length in different species. The body of female may have a pair of lateral "marginal grooves" behind the scutum, while postero-lateral and median grooves are usually present on the dorsum in both sexes. The posterior border of the body is frequently notched, forming festoons, generally eleven in number. The genital opening is a transverse slit situated in the anterior half of the ventral surface. The anus opens in the posterior half. Ventral plates may be present in the male.

**Occurrence:** All of the ticks found on two of the Fox Squirrels were immature. They were sent to Dr. F. C. Bishop of the Bureau of Entomology, Washington, D. C. These are being identified at the present time.

The writer has collected *Haemaphysalis leporispalustris* and *Dermacentor variabilis* in Ohio from vegetation.
(d) Cuterebra sp.  

**Classification:** Class Insecta, order Diptera, suborder Cyclorrhapha, family Oestridae, genus Cuterebra.  

**Synonyms:**  
C. fontinalla Clarke 1815  
Cutiterebra Austen 1895  
Bogaria Austen 1895  

**Occurrence:** Larval cuterebra, varying in size from 11 x 4.5 mm. to 25 x 11 mm. were found subcutaneously along the ventral portion of the neck, and anterior abdomen in four of the seventy-two Gray Squirrel carcasses examined. They lodged in a capsule which opened on the surface of the skin. No gross changes were evident in tissues surrounding the indurated capsule.  

So far as available literature revealed this Cuterebra has not been reported from the Gray Squirrel. The *Cuterebra emasculator* Fitch (*Bogaria emasculator*) is commonly called the squirrel warble. None of the larvae in this survey occurred in the scrotum, or in the surrounding tissue. Two Ohio records of Ad it Cuterebra are available: *Bogaria emasculator*, July 27, 1899 and *Cuterebra horripilum* Clarke Jul. 9, 1903 both taken at Cedar Point, Sandusky County.
(e) Ceratophyllum fasciatus Bosc.

Classification: Class Insecta, order Siphonaptera, family Döckopsyllidae, genus Ceratophyllum

Description: Dolichopsyllidae - Eyes well developed, about 18 spines on the pronotal comb; there are three evenly spaced setae in the lower genal row.

Occurrence: This flea was found on six of the eighty-eight squirrels examined, three Grey and three Fox Squirrels. Ten fleas were the largest number to be counted from any one host. The incidence was probably higher, but many of the insects were lost because the carcasses were carried around uncovered after the hunters had killed the squirrels. This gave the fast-moving flea a chance to abandon their dead host. When a carcass was placed immediately into a sack, the fleas occurred more frequently.

(f) Trombidiidae (mite)?

Classification: Class Arachnida, order Acarina, superfamily Trombidiidae, family Trombidiidae.

Occurrence: Two mites belonging to the family Trombidiidae were found on one Fox Squirrel.

(g) Catenotaenia sp. Janicki 1904

Classification: Class Gastoda, order Cyclophyllidea, family Taeniidae, genus Catenotaenia.

Synonym: Cattotaenia Shipley 1908.

Diagnosis: Taeniidae: Scolex unarmed without rostellum. Genital canals pass dorsally to excretory vessels and nerve. Testes numerous, posterior to female glands. Inner egg membrane thick, but not radially striated. Type species - Catenotaenia pusilla Janicki 1904.
Occurrence: This parasite was recovered from four of the seventy-two Gray Squirrels. The species could not be determined due to loss of the scoleces in the disintegrated mucosa of the small intestine.

One species of this genus was described from Sciurus vulgaris: Catenotaenia dendritica (Goeze 1782). The genus is reported to occur in mammals.

(h) Humenolepis sp. Weinland 1858

Classification: Class Cestoda, order Cyclophyllidea, family Humenolepididae, subfamily Humenolepidinae, genus Humenolepis.

Synonyms: Cercocestis Villot 1882; Dicranotaenia Railliet 1892; Diplacanthus Weinland 1858; Drepanidotaenia Railliet 1892; Globus Scopoli 1772; Lepidotrias Weinland 1858; Triorchis Clerc. 1903.

Diagnosis: Humenolepidinae - rostellum armed with a single crown of hooks rarely rudimentary and unarmed. Suckers sometimes armed. Three testes in each segment. Vas deferens with internal (i.e. inside the cirrus pouch) as well as external vesicula seminialis (outside the cirrus pouch). Type species: Humenolepis diminuta Rudolphi 1819.

Sub-genus - Humenolepis Weinland 1858 s. str. Diagnosis: Rostellum armed with a single crown of hooks, rarely rudimentary and unarmed. Suckers in adults generally unarmed. Sacculus accessorius generally absent. Type species: Humenolepis diminuta (Rudolphi 1819)

Larval form: Larval stages assume different forms. There is always a cyst containing more or less fluid, and a single invaginated scolex; tail of cyst present or absent.
Occurrence: Adult forms are reported from mammals and birds; larval stages are reported from fresh water Crustacea, beetles, Diptera, Lepidoptera and intestinal villi of mammals.

This cestode occurred in four Gray Squirrels and one Fox Squirrel. Generally the proglottids were in the small intestine and also in the large intestine of the one Fox Squirrel.

Certain species of the genus Hymenolepis do not require an alternation of hosts, although it is almost certain that the eggs must first reach the exterior and then be taken in by way of the mouth for reinfection to occur.

(i) *Ascaris lumbricoides* Linnaeus 1758

Classification: Class Nematoda, order Bunematoda, superfamily Ascaroidea, family Ascaridae, subfamily Ascarinacea, genus Ascaris.

Synonyms: *Fusaria* Zeder 1800

*Stomachida* Peraboorn 1780

*Lombricoides* Merat 1821

Description: Ascarinacea: lips with dentigerous ridges; interlabia absent, cervical alae absent. Female: vulva anterior to middle of body; vagina directed backwards, two uterine tubes. Oviparous, eggs with a thick smooth shell surrounded by an albuminous coat, with a coarsely granular surface, and containing an unsegmented ovum when deposited. Type species: *Ascaris lumbricoides* Linnaeus 1758.

Occurrence: This nematode has been reported from man, monkey, one squirrel in India and the pig. It occurred as an immature female (72 mm.) in one Gray Squirrel.
(j) *Citellinema bifurcatum* Hall 1916

**Classification:** Class Nematoda, order Bunematoda, superfamily Strongyloidea, family Trichostrongylidae, sub-family Trichostrongylinae, genus *Citellinema*.

**Description:** Trichostrongylinae: Cuticle with pronounced longitudinal striations; mouth apparently six lips surrounded by a collar. Male: 6.8 mm. long and 170 microns thick at base of bursa. Head diameter 26 microns without collar and 36 microns with it. Esophagus 535 microns long x 70 microns thick. Nerve ring 170 microns back of head. Longitudinal striaion of the body cuticle is continued along the bursal rays, while the bursal membrane is transversely striated. The bursa is apparently not deeply incised dorsally. The rays are arranged as given in the generic diagnosis. The medio-lateral and extero-lateral rays are the largest. The spicules are 360 microns long and are bifurcated 70 microns from the proximal end. The proximal end is cup-shaped and is 35 microns in diameter. Female undescribed. Type material - 16176 - U.S. N. H. (Wur. Anim. Indus. Helminth Coll.) one male.

**Occurrence:** This nematode was found in the small intestine of four Fox Squirrels and twenty-five Gray Squirrels. Both the males and females were spirally coiled. No fresh specimens were handled to check whether the coiling was due to the formalin which was used in fixing or not. The writer was not able to identify the collar about the mouth which Hall (1916) described on the male. Three other species of this genus have been recorded (Schulz 1933) and are thought to be identical. Bayliss and Daubney (1926) stated that the validity of the genus *Citellinema* was yet unproven, and that possibly Vianella and *Citellinema* are synonymous.

The measurements of this species: Female (average): 18.69 x 0.14 mm. Male (average): 9.53 x 0.14 mm. The width was measured at the widest point just anterior to the anus.
(k) *Heligmodendrium hassalli* (Price 1928) Travassos 1937

**Classification:** Class Nematoda, order Eunematoda, super family Strongyloidea, family Trichostrongylidae, sub-family Heligmosominae, genus Heligmodendrum

**Synonyms:** Heligmostrongylus hassalli Price 1928.

Longistriata hassalli (Price 1928) Dekmans 1935

**Descriptions:** Heligmosominae: body filiform, not spirally rolled; cuticle with fine transverse striations, and marked longitudinal striations of which the dorsal is in the form of a flange extending from the cephalic cuticular dilatation almost to the posterior extremity. Male: bursa well developed; with the following formula - ventro-ventral and ventro-lateral rays united in their proximal third, the distal portions being widely separate and directed forwards, medio-lateral, and postero-lateral united in their proximal third, and widely separated distally, the dorsal is completely doubled and very long, each branch giving off near its base the externo-dorsal and further down a short lateral branch; spicules long and delicate; gubernaculum consists of a central piece with a number of branches; Female: vulva near anus, and almost always with a ventral process, which may extend even as far as the end of the tail.

**Occurrence:** The parasite has been reported from rodents. It was found in two Fox Squirrels and fifty Gray Squirrels; the most frequently occurring and numerous of nematodes in the animals examined. A maximum of 443 parasites was found in one host. The nematode was taken from the small intestine.
(k) continued

**Measurements:**
Female: Average length 10.83 mm.
Extremes - 7.36 - 12.96 mm. Eggs - 40μ-76.5 microns av.
Extremes - 40 x 72 - 40 x 32 mm.
Male: Average 7.65 mm. Extremes - 6.24 - 9.12
spicules - Average 512 microns. Extremes 370-704 micron

(1) **Rictularia sp.** Frolich 1802

**Classification:**
Class Nematoda, order Eunematoda, superfamily
Spiruroidea, family Rictularidae, subfamily
Rictulariinae, genus Rictularia

**Synonyms:**
Ophiostoma Reid 1801, Ophiostomum Creplin 1839
Laphycetes Dujardin 1845 (Rictularia renamed)' Pherygodermatetes Wedl 1861

**Description:** Rictulariinae: buccal capsule well developed and
narrow with its aperture more or less distinctly dorsal, surrounded by
a circlet of denticules and with its base armed with teeth and spines.
Along practically the entire ventral surface of each side there are two
rows of cuticular combs, or spines. Male: tail with or without small
alae; with pre- and postanal pedunculated papillae, spicules small, equal
or unequal. Female: vulva anterior, near the posterior end of the
oesophagus. Oviparous, eggs contain embryos at deposition.

**Occurrence:** Parasites of small intestine of carnivora, rodents
and lizards? The classification of this parasite is not fully accepted.
It apparently has spirurid relationships, and approached the group
Thelexunae most closely. Seven Gray Squirrels and one Fox Squirrel were
infested with this nematode. It occurred in the small intestines.

**Measurements:**
Female (average) 27.34 x 0.65 mm.
Male (average) 21.60 x 0.35 mm.
(m) *Capillaria sp.*, Zeder 1800

**Classification:** Class Nematoda, order Bunematoda, superfamily Trichuroidea (syn. Trichinelloidea Hall 1916)  
family Trichuridae (syn. Trichocephalidae Baird 1857); Trichosomidae Leiper 1912), Subfamily Capillariinae, genus *Capillaria*

**Synonyms:** Trichosona Reid 1819  
Trichosomum Creplin 1829  
Liniscus Dujardin 1845  
Thominx Duj. 1845  
Caoldium Duj. 1845

**Description:** Capillariinae - Body caudate; mouth simple, cuticle with bacillary bands; dorsal, ventral or lateral in position. Oesophagus long and gradually increasing in size posteriorly. Male: anus terminal or subterminal, small membranous caudal alae, or bursa-like structure present or absent; spicule long and slender, surrounded by a sheath with or without spines on its surface. Female: vulva near termination of oesophagus. Oviparous, eggs lemon-shaped, with the usual apericlar plugs at the poles.

**Occurrence:** Parasites of the intestine or urinary bladder of mammals and birds. This parasite was recorded from one Fox Squirrel which harbored five adult worms in the small intestines.
(n) *Linguatula serrata* Frolich 1789

**Classification:** (Samson 1922) Class Arachnida, order Acarina, family *Linguatulidae*, Section *Linguatulini*, genus *Linguatula*

**Synonyms:** *Taenia Pilger 1803; Helysis Zeder 1803; Colonius Rudolphi 1805; Prionoderma Rudolphi 1808; Polystoma Rudolphi 1809; Echinorhynchus Braun 1809; Tetrangulus Boeck 1810; Linguatula Lamarck 1815; Pentastoma Rudolphi 1819; Linguatula rhinaria Rafflet 1900*


**Occurrence:** Adult linguatulids, although they occur occasionally in the gut or body cavity, are parasitic principally in the lungs of reptiles and in the frontal sinus, and maxillary antra (connected with the nasal chambers) of the dog, wolf, and occasionally in man. They occur less rarely in birds and amphibians.

The larvae occur in animals which are preyed upon by the host in which the adult parasite lives.

The literature reviewed did not uncover any records of this parasite in squirrels. It was found in the small intestine of one Gray Squirrel.
(c) *Eimeria sp.* Schneider 1875

**Classification:** Class Sporozoa, sub-class Coccidiomorpha, order Coccidiida, suborder Eimeriidea, family Eimeriidae, subfamily Eimeriinae, genus *Eimeria*.

**Description:** Eimeriinae: produce more or less spherical, elliptical or ovoid oocysts, which when mature, contain four sporocysts, each of which contains two sporozoites.

**Occurrence:** This protozoa was found in thirty-four Grey Squirrels and twelve Fox Squirrels. The site of infection was the cecum. Knipling and Becker (1935) reported *Eimeria sciurorum* Galli Valerio 1922 from the cecum and intestines of a Fox Squirrel in Iowa.

**Measurements:** Average measurements of oocyst: 24.19 micron long x 14.2 microns wide
- Extremes of length - 20 micron - 29 micron
- Extremes of width - 12 micron - 18 micron
VI. THE SPECIES OF PARASITES, THEIR FREQUENCY OF OCCURRENCE AND NUMBER (CHART I)

The most frequently occurring parasite recovered in this survey was the Heligmodendrium hassalli. The life-history of this parasite is unknown. Since it is a member of the family Heligmosomidae, and closely related to the hookworms, one might expect a similar life cycle (i.e., a direct life cycle with portal of entry by either ingestion or skin penetration).

Ectoparasites were not as common as expected. Fleas of many different genera have been reported from squirrels, and apparently occur quite frequently. When the host was collected and immediately placed into a sack, more of these parasites were recovered. Two adult Fox Squirrels collected during late August in the above manner did not harbor a single external parasite.

The Cuterebra larvae, which attacked about 6% of the Gray Squirrels examined, need to be reared to the adult fly for identification.
CHART I
SUMMARY OF PARASITE SURVEY FINDINGS

<table>
<thead>
<tr>
<th>Location in Host and Species of Parasite</th>
<th>GRAY SQUIRREL 72 examined</th>
<th>FOX SQUIRREL 16 examined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hosts Infested</td>
<td>%</td>
</tr>
<tr>
<td>SKIN Anoplura-Hoplópleura sciuricola</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ixodidae-Ticks (Immature)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cestridae-Cuterebra spp.</td>
<td>4</td>
<td>5.6</td>
</tr>
<tr>
<td>Siphonaptera- Ceratophyllus fasciatus</td>
<td>3</td>
<td>4.2</td>
</tr>
<tr>
<td>Trómbidiidae-Mites</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SMALL INTESTINE Cestoda-Catenotaenia</td>
<td>4</td>
<td>5.6</td>
</tr>
<tr>
<td>Hymenolepis</td>
<td>4</td>
<td>5.6</td>
</tr>
<tr>
<td>Nematoda-Ascaris Lumbricoides</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>Citellinema bursatellum</td>
<td>25</td>
<td>34.7</td>
</tr>
<tr>
<td>Heligmosomum bassetti</td>
<td>50</td>
<td>69.4</td>
</tr>
<tr>
<td>Hectularia sp.</td>
<td>7</td>
<td>9.7</td>
</tr>
<tr>
<td>Capillaria sp.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pentastomida</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linguatula serrata</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>CECUM Sporozoa-Ziemia</td>
<td>84</td>
<td>47.2</td>
</tr>
</tbody>
</table>
Cecal coccidia, *Eimeria sp.*, occurred in 75% of the Fox Squirrels and about 47% of the Gray Squirrels examined.

The presence of an *Ascaris lumbricoides*, immature female, in one adult Gray Squirrel in the vicinity of Columbus is an interesting record. This parasite was reported only once in a *Sciurus vulgaris*, during the eighteen-hundreds. The occurrence of *Lingulatula serrata* as an adult in the small intestine of the Gray Squirrel raises the question, is this accidental or normal? The squirrel, being herbivorous, might be considered a possible host of the immature form of this pentastomid, but the mature parasite has not been recorded from the digestive tract of any herbivorous animal. It generally occurs in the respiratory tract of carnivores, according to present records.

A spirally coiled nematode, *Citellinema bifurcatum*, which occurred in about 35% of Gray Squirrels and 25% of Fox Squirrels was originally described from a *Citellus elegans* by Hall (1916). Harkema (1936) did not report any of these *Citellinema* parasites from 53 Gray Squirrels which he examined. Nothing is known concerning the life cycle of this worm.

The spirurid which belongs to the genus, *Rictularia*, occurred as both male and female with the female predominating. The *Rictularia* which Harkema (1936) found in 16.65% of 54 white-footed mice caused him to suggest that "the males of *Rictularia* apparently do not remain long on the host, as none was found." The *Rictularia sp.* found in this survey occurred in about 10% of the Gray Squirrels and 6% of the Fox Squirrels. The life-history of this spirurid is not known. One striking point about the mature females of this species is the large number of eggs and yet the low incidence of the adult worms in the Squirrels.
The two genera of Cestodes which include those species found in the Gray and Fox Squirrels are: Catenotaenia and Hymenolepis. Some species of both genera have been described as occurring in rodent hosts. The Catenotaenia sp. occurred in about 6% of the Gray Squirrels. Hymenolepis sp. occurred in about 6% of both the Gray and Fox Squirrels. An examination of the scolices of these tapeworms will assist in the identification of the species involved. The scolices were not found in the specimens which were preserved in formalin, thus making identification, other than genus, impossible. None of the squirrels examined by either Martin (1936) or Kerkema (1936) harbored any of these adult cestodes.

The description of the Sarcoptes scabiei condition found in both the Gray and Fox Squirrel is taken from data gathered by Martin (1938) and the writer. The animals infested with these mites were not included in the survey data, since the viscera were not examined for other parasites.

Parasitism in animals taken from heavy forest, as compared with those taken from small woodlots (Chart II, Maps I, III)

These animals taken from the forested area did not demonstrate a significantly greater susceptibility to parasitism than those taken from the small woodlots. The parasites did, however, occur in larger numbers in the former group of hosts.

Squirrels taken from the small woodlots were significantly more susceptible to coccidial infection. The two nematodes, Citellimena and Heligmosodendrium occurred more frequently and in larger numbers in the forest-inhabiting squirrels.
### CHART II

**PARASITISM IN HEAVY FOREST AND SMALL WOODLOT**

(number of individuals affected over the % individuals affected)

<table>
<thead>
<tr>
<th>Location in Host</th>
<th>Species of Parasite</th>
<th>Heavy Forest (72)</th>
<th>Small Woodlots and Adjacent cultivated Fields (16)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Parasitized</td>
<td>Not Parasitized</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Number %</td>
<td>No. Parasites</td>
</tr>
<tr>
<td>SKIN</td>
<td>Hoplopleura scurricula</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Ticks (Immature)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Cuterebra sp.</td>
<td>$rac{4}{5.6}$</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>Ceratophyllus fasc.</td>
<td>3</td>
<td>4.2</td>
</tr>
<tr>
<td></td>
<td>Mites</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SMALL INTESTINE</td>
<td>Catenotaenia sp.</td>
<td>$rac{4}{5.5}$</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Hymenolepis sp.</td>
<td>1</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>Ascaris lumbricoides</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Citellusia oifurcatum</td>
<td>25</td>
<td>13.7</td>
</tr>
<tr>
<td></td>
<td>Heligmodendrium hassal.</td>
<td>50</td>
<td>69.4</td>
</tr>
<tr>
<td></td>
<td>Rictularia sp.</td>
<td>8</td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td>Capillaria sp.</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Location in Host</th>
<th>Species of Parasite</th>
<th>PARASITIZED</th>
<th></th>
<th>NOT PARASITIZED</th>
<th>PARASITIZED</th>
<th></th>
<th>NOT PARASITIZED</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number %</td>
<td>No. Parasites Av. - Maximum</td>
<td>Number %</td>
<td>No. Parasites Av. - Maximum</td>
<td>Number %</td>
<td>No. Parasites Av. - Maximum</td>
<td>Number %</td>
</tr>
<tr>
<td></td>
<td>Linguatula serrata</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>71</td>
<td>98.6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Cecum</td>
<td>34</td>
<td>47.2</td>
<td></td>
<td>38</td>
<td>72.3</td>
<td>12</td>
<td>75.0</td>
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<tr>
<td></td>
<td>Eimeria sp.</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>
MAP I. DISTRIBUTION OF GRAY AND FOX SQUIRRELS OVER OHIO

MAJOR LAND USES

GLACIAL BOUNDARY

Lake Plains
Flat, Limestone
Grain Crops

Northern Till Plains
Gentle to heavy rolling
(Limestone) (Sandstone, Shale)
(Pasture & Grain Crops)

Gentle rolling to hilly
2:197

Central Till Plains
Heavy rolling
(Limestone) (Sandstone, Shale)
Grain Crops & Pasture

Hilly to very steep and broken
2:197

Woods and Pasture

Unglaciated Plateau
(except western part)

Unglaciated Appalachian Plateau

Scale of Miles

1:991 1:397 etc. - Estimated Ratio in percent of Gray Squirrel to Fox Squirrel in each land use division

Convenient Land use Divisions of the State

Unglaciated Appalachian Plateau
ARThropoda:
(1) Hoplopleura sciuæcola
(2) Ticks (immature)
(3) Gutsæbra sp.
(4) Lingutæla serræta
(5) Ceratophyllus fasciatus
(6) Mites

Cestoda:
(7) Catenotaenia sp.
(8) Hymenolepis sp.
(9) Ascaris lumbricoides
(10) Otelinæma bifurcatæum
(11) Heligmosomædium hassælli
(12) Ricinæla sp.
(13) Capillæria sp.
(14) Eimeria
(15) Immature Nematodes

Sporozoa:

Nematoda:

Scale of Miles
The spirurid, Rictularia sp.; dipteran larvae, Cuterebra sp.; cestode, Catenotaenia sp. and pentastomid, Linguatula serrata were not found in any of the animals taken from the small woodlots. The occurrence of the Cuterebra sp. larvae is limited to the occurrence of the adult fly which is apparently in the southern portion of Ohio. No warbles have been reported from the Fox Squirrel in Ohio. It is the writer's belief that where the adult fly occurs in Fox Squirrel habitat, infestation may be found in those animals.

The Ascaris lumbricoides, the Hoplopleura sciuricola, the Trombididae sp. and the Capillaria sp. occurred only in and on animals taken from small woodlots.

Parasitism as found in different age, sex and physical condition groups of Gray Squirrels. (Chart III)

The physical condition of these animals was designated. Poor, with no fat visible anywhere on the carcass; Fair, with fat around the kidneys and in the mesentery; and Good, with fat subcutaneously as well as in the body cavities.

In these groups the adult males in poor condition composed about 27% and the adult females in fair condition about 24.5% of the total number of parasitized Gray Squirrels. The remainder of the parasitized animals were classed about 15% as adult males in fair condition and 18% adult females in poor condition.

Approximately 7% of the parasitized adult individuals were in good condition. One-half of them were adult males, the other half adult females. About 4% of the parasitized animals were immature males in fair condition, while 4% of the parasitized group were immature females in poor condition. None of the parasitized immature squirrels were in good condition.
CHART III. PARASITISM AS FOUND IN DIFFERENT AGE, SEX, AND PHYSICAL CONDITION GROUPS - GRAY SQUIRRELS

Poor - No visible fat.  Fair - Fat around the kidneys and in the mesenteries
Good - Fat subcutaneously as well as in the body cavities

<table>
<thead>
<tr>
<th>AGE</th>
<th>SEX</th>
<th>PHYSICAL CONDITION</th>
<th>PARASITIZED (not including coccidia)</th>
<th>NOT PARASITIZED</th>
<th>COCCIDIA INFECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number %</td>
<td>Average Number Parasites</td>
<td>Maximum Number Parasites</td>
<td>Average No. Parasite species</td>
</tr>
<tr>
<td></td>
<td>MALE</td>
<td>Poor</td>
<td>72.5</td>
<td>379</td>
<td>1.67</td>
</tr>
<tr>
<td></td>
<td>Fair</td>
<td>14.5</td>
<td>142.6</td>
<td>413</td>
<td>1.13</td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td>3.6</td>
<td>35.0</td>
<td>70</td>
<td>0.5</td>
</tr>
<tr>
<td>ADULT</td>
<td>FEMALE</td>
<td>Poor</td>
<td>18.3</td>
<td>94.8</td>
<td>325</td>
</tr>
<tr>
<td></td>
<td>Fair</td>
<td>23.5</td>
<td>19.1</td>
<td>47</td>
<td>2.31</td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td>3.6</td>
<td>29.5</td>
<td>45</td>
<td>2</td>
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<tr>
<td>IMMATURE</td>
<td>MALE</td>
<td>Poor</td>
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<td>0</td>
</tr>
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<td>Fair</td>
<td>3.6</td>
<td>9.5</td>
<td>19</td>
<td>0.5</td>
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<tr>
<td></td>
<td>Good</td>
<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td></td>
<td>FEMALE</td>
<td>Poor</td>
<td>3.6</td>
<td>46</td>
<td>83</td>
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<td></td>
<td>Fair</td>
<td>1.8</td>
<td>operculate eggs</td>
<td>---</td>
<td>1</td>
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<tr>
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<td>Good</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Eight animals or about 13.5% of the 63 Gray Squirrels examined were not parasitized. Of these approximately 38% were immature males in poor condition. The remaining, one each, were: an adult female in poor condition; an adult female in fair condition; an immature male and female in good condition; and an immature female in fair condition.

A maximum of three species of parasites (not counting coccidia) was found in animals grouped with the adult males, and also adult females in poor condition.

The greatest incidence of coccidia occurred in the poor condition adult males, 16%; and in the fair condition adult females, 15%. The next two groups affected were the poor condition female adults, 9%; and the fair condition adult males, 7%. Thirty-one or 56% of the 55 parasitized Gray Squirrels were affected with coccidia.

Parasitism as found in different age, and sex groups of Fox Squirrels (Chart IV)

Sixteen squirrels are represented in this comparison. Ninety-two percent of the total thirteen animals parasitized were infested with Eimeria. The larger number of parasite species (three and four) occurred in individuals listed with the male and female immatures. The maximum number of individual parasites also occurred in the immature group. Animals which were not parasitized fit into the adult female and male groups.

None of the immature Fox Squirrels was free of parasites.
CHART IV.  PARASITISM AS FOUND IN DIFFERENT AGE
AND SEX GROUPS. = FOX SQUIRRELS

FOX SQUIRRELS

<table>
<thead>
<tr>
<th></th>
<th>MALE (4)</th>
<th>FEMALE (3)</th>
<th></th>
<th>MALE (4)</th>
<th>FEMALE (3)</th>
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<tbody>
<tr>
<td>PARASITIZED</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>2</td>
<td>4</td>
<td></td>
<td>4</td>
<td>3</td>
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<tr>
<td>%</td>
<td>50.0</td>
<td>80.0</td>
<td></td>
<td>100.0</td>
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<tr>
<td>Coccidia</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>2</td>
<td>4</td>
<td></td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>%</td>
<td>50.0</td>
<td>80.0</td>
<td></td>
<td>100.0</td>
<td>66.7</td>
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<tr>
<td>Av. No. of Parasites</td>
<td>2.5</td>
<td>2.0</td>
<td></td>
<td>6.75</td>
<td>5.0</td>
</tr>
<tr>
<td>Maximum No. Parasites</td>
<td>4</td>
<td>5</td>
<td></td>
<td>21</td>
<td>9</td>
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<tr>
<td>Av. Number Parasite Species</td>
<td>2</td>
<td>1</td>
<td></td>
<td>1.75</td>
<td>1.67</td>
</tr>
<tr>
<td>Maximum No. Parasite Species</td>
<td>3</td>
<td>1</td>
<td></td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>NOT PARASITIZED</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>0</td>
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</table>
Note of difference between the parasitic fauna of the Gray Squirrels and Fox Squirrels taken from the same area.

Only two Fox Squirrels were taken in the same area where Gray Squirrels had been taken (Scioto County, May III). Both of those animals fit into the "good" condition group as designated above. One of these, an adult male, was entirely free of parasites; the other, an adult female, was only slightly infested with one Heligmosoides plesalli; and four Dictyocaulus sp. as well as coccidia.

Evidence of gross pathology in either species of squirrel due to infestation with parasites.

None of the internal parasites caused any apparent gross changes in tissues. The lice and ticks were not found in large numbers, and only caused slight infiltration and induration at the point of attachment.

Infestation with large numbers of mange mites was the cause of death in four animals found suffering with these skin-burrowing parasites. One of these dead squirrels had been experimentally infested and placed into a 4' x 4' x 6' pen until found dead twenty-nine days after infestation. The parasite was recovered from this animal (Fig. VIII). The lesions which developed are typical of Sarcoptic acarisis: a progressive loss of hair over the head, back and tail; scaling, thickening and wrinkling of the skin, loss of body weight to the point of emaciation (Figs V, VI, VII).

It is interesting to note that the Eimeria oocysts (Fig. IV) which occurred in such large numbers and so frequently had not caused any apparent gross changes in the cecal mucosa of those animals which carried the infection. This apparently perfect adaptation of host to parasite occurs in the
Coccidial oocyst as found in the material scraped from the cecum of squirrels. Magnified 500 X

FIGURE VIII.

Sarcoptes Scabiei Var. Female Adult
Magnified 150 X
Sarcoptes infestation. Note thinning of hair over back and face.

Death due to Sarcoptes mite. Note thick wrinkled skin and loss of fur from almost the entire body. Left view.

Sarcoptes infestation - right view.
domestic fowl. Only some of the total species found in birds are pathogenic and the remaining apparently not injurious under normal conditions. This may point to a parasitic relationship of long standing.

The consideration of parasites found in the Fox and Gray Squirrels in Ohio which may be parasitic to Domestic Animals and Humans.

The genera of parasites reported in this survey bear relationship for the most part, to rodents.

The incidence of Linguatula serrata in the one Gray Squirrel from Scioto County, points to a possible source of a rather rare parasite found in the respiratory tract of dogs in Ohio. There are large numbers of fox and many feral dogs in the area from which this squirrel was taken.

Until the scolex of the Hymenolepis sp. found in the Squirrel is identified, it is impossible to state whether this cestode bears any similarity to the Hymenolepis naevata, fraterna which is considered to be the rodent variety of the human occurring Hymenolepis nana.

The Ascaris lumbricoides found in one Gray Squirrel raises the question as to what the source of infection may be. A field overrun by infected hogs may be the answer.
VII. SUMMARY

1. Eighty-eight squirrels (72 Southern Gray and 16 Fox Squirrels) were examined for the presence of internal and external parasites.

2. Fifteen species of parasites were recovered from these squirrels.

(a) Arthropoda

_Hoplopleura scuicola_ Ferris 1921
_Cuterebra_ sp.
_Ceratophyllum fasciatus_ Boas.
_Sarcoptes scabiei_ var. _Latreille_
_Ticks (Immature)_
_Mites (Trombidiidae)_

(b) Cestoda

_Catenotaenia_ sp. _Janicki_ 1904
_Hymenolepis_ sp. _Weinland_ 1858

(c) Nematoda

_Ascceris lumbricoides_ Linnaeus 1758
_Capillaria_ sp. _Zeder_ 1800
_Citellinena bifurcatum_ Hall 1916
_Heligmodendrum hassalli_ (Price 1928) _Travassos_ 1937
_Rictularia_ sp. _Frolich_ 1802

(d) Pentastomida

_Linguatula serrata_ _Frolich_ 1789

(e) Sporozoa

_Eimeria_ sp. (sciurorum?)
3. Squirrels taken from forested areas were not significantly more frequently parasitized than those taken from small woodlots, although there were larger numbers of parasites in the former.

4. Squirrels taken from small woodlots were significantly more frequently infected with coccidia than those from the forest.

5. There appears to be a correlation between the number of parasitic species, the number of individual parasites and the physical condition of the Southern Gray Squirrel.

6. There were no apparent gross changes in tissues caused by any of the internal parasites.

7. The Sarcoptes scabiei var. was the only ectoparasite in this survey found and recognized as harmful to squirrels. Four animals killed by this mite were examined and the parasite recovered from them.

8. The occurrence of Linguatula serrata, Ascaris lumbricoides and Hymenolepis sp. in squirrels are considered of interest in that the former two are known to parasitize domestic animals and the latter may possibly be similar to the one found in humans.

9. Annotated bibliographies are appended to this survey:
   (a) Fox and Gray Squirrel Parasites
   (b) Parasites found in and on the members of the Family, Sciuridae, recorded over the world.
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Yorke, W; and P. A. Maplestone
Acknowledgment

This survey was sponsored by the Cooperative Wildlife Research Station, Ohio State University, Columbus, under the supervision of Dr. Lawrence E. Hicks, In Charge. Able assistance in the collection of the squirrels was rendered by the other members of the Station staff.

Thanks are due Dr. Russell E. Rebrassier, Professor of Parasitology, for his patient criticism and guidance during the survey and its write-up. The writer appreciates, also, the aid given by many other members of the Veterinary College Faculty. Laboratory facilities were kindly provided by the Ohio State University at the State Laboratory at Reynoldsburg and by the Ohio Division of Conservation at the State Raccoon Farm, Milan and the Roosevelt Hunting Preserve in Scioto County.

The Division of Zoology of the Bureau of Animal Industry in Washington, D.C. through Dr. E. W. Price, Assistant Chief, cooperated very generously in the verification and identification of several of the parasitic specimens.
VIII. APPENDICES

A. Annotated Bibliography of Fox and Grey Squirrel Parasites

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Cuterebra emasculator

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Sciurus niger - multiceps serialis

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Amer. Micr. Soc. Trans. 53:67  
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Sciurus niger rufiventer (or carolinensis) - E. longiceps
Lincoln, Neb.
Sciurus niger neglectus - Linognathoides montanus
Sc. carolinensis - E. longiceps - Nebraska

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Sc. niger rufiventer - Enderleinellus longiceps - Indiana
Sc. carolinensis - E. longiceps - Mississippi

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Sc. carolinensis - Neohaematopinus sciurinus sciurinus
(Mjoberg), Miss.
Sc. niger rufiventer (Sc. cinerus ludoviciennus) Neohaematopinus
sciurinus sciurinus (Mjoberg). Iowa, Indiana, Nebraska
Sc. niger neglectus - Neohaematopinus sciurinus sciurinus
California

10. Hall, M. O.
Sc. niger neglectus and Sc. carolinensis - Coenurus (multiceps serialis)

Sc. niger neglectus - Cysticercus tenuicollis (Taenia hydatigena)
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Zool. Monogr. 6(2): 153-232
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Longistriata hassalli - small intestine; Trombicula sp.-skin;
Atricholaelaps glasgowi - skin; Ixodes hexagonus - skin;
Neohaematopinus sciurinus - skin; Hoplopleura sciuricola-skin;
Orchopeas wickhami - skin
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Sciurus vulgaris and Sciurus sp.

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Heligmonella streptocerca n sp. from Funisciurus anerythrus, intestine, Okoya, Olorishako, Ife, Onitiri
Heligmonella trifurcata n. sp. from Funisciurus anerythrus, intestine, Adu, Okoya
Trichuris muris (Schrank 1779) in Funisciurus anerythrus. Usually in intestine or cecum, occasionally stomach. Adu, Okoya
Capillaria pearsei n. sp. from Funisciurus auriculatus oliviae.
Intestine - Adu.

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Description of the following:
(a) Chilomastix magna
(b) Trichomonas muris - var. citelli
(c) Trichomonas sp. Y
(d) Tettrachromastix citelli
(e) Hexamitus pulcher
45.

Mention of following:
(a) *Hexamita* or *Urophagus* (?) found in small numbers in a few individuals.
(b) *Giardia beckeri* Hagem - Occasionally in small intestine
(c) *Endamoeba citelli*, Becker is commonly found in coecum


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From *Citellus tridecemlineatus* - Blood
(a) Babesia citelli n. sp.
(b) Trypanosoma iowensis n. sp.

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   (b) Ceratophyllus tuberculatus (91)
   (c) Neopsylla inopina (15)
   (d) Ceratophyllus eumolpi (9)
   (e) Ceratophyllus poeantis (4)
   (f) Spilopsyllus inequalis (3)
   (g) Ceratophyllus lucidus (1)

II. Pine Squirrel - Sciurus hudsonicus richardsoni (81 indiv.)
   (a) Ceratophyllus wickhami (247)
   (b) Ceratophyllus lucidus (59)
   (c) Ceratophyllus eumolpi (9)
   (d) Ceratophyllus divisus (4)
   (e) Ceratophyllus acillis (2)
   (f) Neopsylla wemmannii (2)
Pine Squirrel (continued)

(1) Ceratophyllum ciliatus (1)
(h) " idahoensis (1)
(1) " tuberculatus (1)
(j) " wagneri (1)
(k) Hystrichopsylla dippiei (1)
(l) Spilosyllus inequalis (1)

III. Flying Squirrels - Sciuropterus alpinus (7 indiv.)
(a) Ceratophyllum acasti (51)

IV. Side-striped ground squirrel - Callospermophilus lateralis (3 indiv.)
(a) Ceratophyllum poeantis (10)

All found in Ravalli and Missoula Counties, Montana

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Carteretta (related to Ctenophthalmus and Phalecropsylla)
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Coenurus (multiceps serialis) in Sciurus vulpinus (?) and Sciurus niger neglectus, Sciurus vulgaris

Coenurus in Sciurus carolinensis

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b. Oxyuris obvelata (Rudolphi 1802) Dumardin 1845 in Citellus p. Citellus (Spermophilus citellus, Arctomys citellus)
c. Trichostrongylus delicatus - Hall 1916 n. sp. found in Sciurus aberti minus.
d. Citellinema bifurcatum - Hall 1916 n. sp. found in Citellus elegans.
e. Warrenius quadrivittati - Hall 1916. n. sp. found in Eutamias quadrivittatus.
f. Trichuris leporis (Proelich 1789) - Hall 1916 found in Citellus citellus (Arctomys citellus) Spermophilus citellus

a. Cysticercus tenulicollis (of Taenia hydatigena) from Sciurus niger neglectus (S. cinereus) and Sciurus vulgaris
b. Coenurus (multiceps serialis) from Sciurus vulpinus(?), S. niger neglectus, Sciurus vulgaris and S. carolinensis
c. Hydatid (Echinococcus granulosus) found in Sciurus vulgaris
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Eimeria beechevi n. sp. in Citellus beechevi, intestine
Eimeria in Sciurus griseus griseus

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Stivalius rhoebus on Sciurus brocki, Borneo

Ceratophyllus vesicularis on Sciuropus albimovis from Arizona
C. caedens durus on Sciurus putorius Arizonensis and S. Richardsoni - Arizona
C. arizonensis on Citellus turricaudatus, California
C. Ciliatus protinus on Eutamias townsendi and S. hudsonicus from Arizona
C. ciliatus mononis on Eutamias frater California
Jordan, Karl (continued)

1929. On a small collection of Siphonaptera from the Adirondacks with a list of species known from the State of New York. Novitates Zool. 35(2):168-177
Cerophyllus caedens durus or Sciurus hudsonius
C. vison on Sciurus hudsonius and Tamias striatus
C. acerbus on Tamias striatus
C. gallinae on Tamias striatus
Neopsylla grandis on Tamias brevicauda

31. Kartchner, J. A.; Becker, M. R.
Eimeria citelli (Kartchner & Becker) in Citellus tridecemlineatus

32. Krygeman, B. J.
Tabulation with synonymy, organ attacked and references of the trematodes, cestodes and nematodes parasitic on several animals, including Sciurus prevosti from East Indies. Biol. Abst. 9(1):1045

33. Leveran, A.
Trypanosoma spermophile n. sp. from Spermophilus musivus, guttatus and eversmanni.

34. le Roux, P. L.

35. Leske, N. G.
(See J. F. Meggitt)
Multiceps serialis in Sciurus rufiventer

36. Li, H. C.
Citellina levini n. sp. from Sciurus vulgaris
37. Linton, Edwin
1934. A new genus of Trematodes belonging to the subfamily
Cymophallus fimbriatus (p.82) from Sciurus ocellatus
Beaufort, N. Carolina

38. McCoy, G. W.
1911. A microfilaria (microfilaria rosenaii) n. sp. from the
California ground squirrel (Citellus beecheyi). Parasitol.
Microfilaria rosenaii McCoy 1911 from Citellus beecheyi

39. McCoy, G. W.; Mitzman, M. C.
1909. The regional distribution of fleas on Rodents.
Parasitol. 2(3):297-304, Sept.
Citeillus beecheyi, and Hoplopsyllus anomalus on Citellus
beecheyi

40. McIntosh, A.
1934. Two new species of Trematodes, Scaphiostomum pancreaticicum n.
species and Posthanostomum larvei n. sp. from the chipmunk.
Reported and described the above two Trematodes in Tamias
striatus.

1937. A new trematode; Posthanostomum noverbecensis, n. sp.
(Brachylaemidae) from a chipmunk. Proc. Helminth. Soc. of
Posthanostomum noverbecensis n. sp. is described from a
single specimen found in the intestine of Tamias striatus lysteri.

41. McLeod, J. A.
1933. A parasitological survey of the genus citellus in Manitoba.
Canada Jour. Research. Ottawa, 9(1933) 108-127
Based on exam. of 236 individuals from an area about 80,000
sq. miles.

The investigation was carried out in connection with the
apparent occurrence of cyclic periods of population density
amongst the gophers with a view to ascertain whether their
parasitic fauna is responsible for their destruction and
whether these parasites are of medical or veterinary importance.

Five species of ectoparasites were found which have
previously been recorded and 8 helminthes of which six species
viz. Prochoanotaenia spermophilii, Spirura enfundibuliformis,
Physaloptera spinicana and Moniliformis spiradentatis are
described as new. No trematode nor larval cestode were found.

The pathogenicity of four of the helminthes is described. As
potential transmitters of human disease, Dermacentor veausnte and
Ceratophyllum brunesi are discussed in relation to their
common occurrence in gophers. (Abstr. from Helminth Abst. II(3)
75076
42. Megditt, F. J.
1924. The Cestodes of Mammals - London 1924 pp. 1-282
(a) Multiceps serialis (Gervais 1847) from Sciurus carolinensis - Intestine
(b) Andrya primordialis, Doughitt 1915 in Sciurus hudsonicus.
     Intestine
(c) Multiceps serialis (Gervais 1847) Intestine and Taenia hydatigena (Pallas 1766) liver, mesentery in
     Sciurus niger
(d) Multiceps serialis (Leske) 1780 Sciurus rufiventris. Intest.
(e) Caterotaenia dendritica (Goeze 1782) Echinococcus granulosus (Batsch 1786) liver, thorax
     Hymenocephalus sciurinus Cholodkovsky 1912. Intest.
     Taenia hydatigena (Pallas 1766) liver, mesentery
(f) All in Sciurus vulgaris
     Echinococcus granulosus (Batsch 1786), Multiceps serialis (Gervais 1847) and multiceps sp. (Cobbold 1864)
     all in Sciurus species

43. Middleton, A. D.
1930. The ecology of the American Gray Squirrel (Sci. carolinensis Gaelin) in the British Isles.

     Parasites are discussed. Biol. Abs. 8(9):21459

44. Mirza, M. B.
1934. Sciurus palmarum als ein interessanter Wirt von Physaloptera.
     Sp. z. Parasitenkunde, Berlin 6(1934) pp. 638-641
     Physaloptera sp. slightly differing from published
     description of P. varani and P. paeradicra. This was
     found in the stomach. Encapsulated larvae present in
     mesentery, liver, (various other organs) and subcutaneous
     connective tissue.

     It can be differentiated from other species of the genus
     by the presence of 11 pair of papillae in male. Spicules
     equal, 0.91 mm. long 0.321 mm. broad. In female, vulva
     slightly in front of middle of body.

45. Mirza, M. B.; S. N. Singh
46. Molin, R.
pk. l-2

Filaria pistillaris (filaria sciuri) Molin 1858 in sciurus igniventris

47. Nicoll, William

Fasciola hepatica. Abildg. in Sciurus leucurus Kerr (S. vulgaris Linn.) Nicoll 1923

48. Parona, C.
(a) Oxyurus sciuri (Oxyurus sp. Parona 1889) Hall 1916 new name in Sciurus atrodorsalis (See Hall, M.C. 1916)
(b) Dictylaria elvirae Parona 1889 from Dremomys mufigenis (Sciurus rufigenus) (see Hall, M. C. 1916)


Physaeloptera sciura Parona 1893 in Sciurus melanogaster (See Hall, M. C. 1916)


Strongyulus cavalli Parona 1907 in Funisciurus carruthersi. (See Hall, M. C. - 1915)

49. Patton, W. S.
1906. On a parasite found in the white blood corpuscles of the blood of Palm Squirrels. Scientific memoirs by the Medical Officers of the Army of India, Calcutta - No. 21.

Leucocytozoan funambuli n. sp. in the white blood corpuscles of pine squirrels, Sciurus palmarum (Funambulus pennantii)

50. Patwardhan, S. S.

51. Price, E. W.

(a) Syphacia thompscri n. sp. - from the ceum and colon of flying squirrel Glaucomys volans volans (Falk Church, Va.)
(b) Heliogaststrongyulus hassalli n. sp. from gray squirrel (Sciurus carolinensis) Bowe, Md. - from small intestine
52. Ray, Harendra Nath; Das, Gupta Matiranjan
   Wenyonella hoarie 1935 Ray Harendra and Das Gupta from Indian squirrel (Sciurus sp.)

53. Redikorzev, V.
   Enderleinellus replicatus Redikorzev 1929 from Sciuropterus volans L. and flying squirrel?

54. Rodhain, J.; G. Pons; J. Vandenbranden; J. Bequaert
   T. denysi n. sp. in a flying squirrel (Pteromyys volans) 
   Correction: Rodhain, J.
   1913. A propos de Leptomonas pangonia et Trypanosoma denysi 
   (Bul. Soc. Path. Exot. 6:181-182)

55. Boudabush, Robert L.
   1937. Two Eimeria from the flying squirrel, Glaucomys volans 
   J. Parasitol. 23(1):107-108 
   Eimeria sciurorum Galli-Valerio and Eimeria glaucomydis 
   n. sp. from Glaucomys volans - Ames, Iowa

56. Rudolphi, C. A.
   1819. Entozoon synopsis cui accedunt mantissa duplex et indices locupletissimi XI 811 pp. Octavo Berolini 
   Physaloptera citelli (Rudolphi 1819, spiroptera citelli) 
   Hall 1916 from Citellus citellus (arctomys citellus)

57. Sandground, J. H.
   1935. Spirura michiganensis n. sp. and Rictularia halli n. sp. 
   two new parasitic nematodes from Eutamias striatus lysteri 

57. Sussuchin, D.
   1931. Material zum Studium der Blutparasiten der nager im Sud-Osten 
   Jena (1798 N. Sc.) 
   (a) Babesia kolzovi sp.n. (ApoxoHaemospor) 
   (b) Grahamia hegneri sp. n. (Prot. incert sed.) in the blood 
   of Citellus pygmaeus of Russia
Sassuchin, D. (continued)

1931. Zum Studium der Darmprotozoenfauna der Nager im Sud-Osten
From Citellus pygmaeus - Russia
(a) Entamoeba citelli
(b) Chilomastix magna
(c) Trichomonas muris - v. citelli
(d) Tetrahromastiz citelli
(e) Octomitus pulcher
(f) Giardia becqueri

All from the intestine

58. Sassuchin, D.; W. Tiflow

1932. Endo- und Ektoparasiten des Steppenzieles (Citellus pygmaeus
Parasitenkunde
List of parasites of Citellus pygmaeus a plague carrier
and pest in S.E. of Russia. (A translation of same Russian
paper into German from Rev. Microbiol Epidemicol. Parasitol
XII(2):129-132 (1932)
(a) Citellus pygmaeus in blood and organs
(b) Toxoplasma nikanorovi sp. n. (sporozoa)
Both reported from Russia

1932. (Sassuchin, D.; T. Rauschenbach)
Zum Studium der Darmprotozoen-Fauna der Nager im Sud-Osten
R.S.F.S.R.II Darmcoccidien des Citellus pygmaeus Pallas;
From intestine of Citellus pygmaeus in Russia
(a) Eimeria volgensis n. sp.
(b) Eimeria citelli

1933. Endo und Ektoparasiten des Steppenzieles (Citellus pygmaeus
Pallas) im Sud-Osten R.S.F.S.R.-Z. Parasitenkunde, Berlin
5(1933) pp. 437-442.
List of recorded parasitic protozoa

59. Schulz, R. E.

1933. Citellinema orientale n. sp. (Trichostrongylidae, nematodes)
aus einem Erdhornchen (Eutamias asiaticus orientalis Bonh.)
Zoologischer anzeiger, zugleich Organ der deutschen Zoologischen
Gesellschaft Leipzig 102(1933) pp. 74-78
Describes: Citellinema orientale n. sp from small intestine
of Eutamias asiaticus orientalis in far East Russia. It is
differentiated from the four pre-existing species in a
Table of measurements. Citellinema bifurcatum, C. slegesi,
C. monacis, are very closely related and may prove to be
Identical.
60. Schulz, R. E. S.
1933. Citellinema orientale n. sp. (Trichostrongylidae nematodes) aus einem Erdhörchen (Eutamias asiaticus orientalis Bonh.) Zool. Anz. 102:74-78

61. Schwetz, J.
(a) Anomalurus jacksoni (flying squirrel-blood-congo-
Trypanosoma anomaluri n. sp. (Mastigoph-Frotomon)
(b) Funisciurus congicus-blood-
Trypanosoma sciuri; n. sp.

62. Seurat, L. G.
(a) Oxyuris pallaryi n. sp. in Atlantoxerus getulus
(Xerus getulus)
(b) Dermatoxyx getula, n. sp. Atlantoxerus getulus
(Xerus getulus)

63. Skidmore, L. V.
1929. Note of a new species of coccidea from the pocket gopher
Eimeria geomysis - from Geomys bursarius

64. Skrjabin
1924. Dermatophallaryya gen n. Oxyuridae - bfoilisi n. sp. in
Spermophilus leptodactylus - Turkestan
Moscow-Trudy-Gosudarstvennyi institut eksperimental 'noi
veterinarii - 2 i (1924) pp. 6-9.

65. Sleggs, G. F.
1925. A strongylloid nematode, Warrenius bifurcatus n. sp. from
the Richardson ground squirrel. Parasitology 17:410-416

66. Stewart, M. A.
1926. Two new Siphonaptera from New York. Insecutor Insectiae
Neopsylla striata from nest of Chipmunk, Tamias striatus

Conorhopopsylla, type C. stanfordi in Sciurus hudsonicus,
New York

67. Thwaites, J. Willis
and Parasitol 21(2):225-244.
Subulura andersoni from squirrel in India
68. Vassal, J. J.

Haemamoeba in squirrel

New Haemamoeba in the red blood corpuscles of Sciurus griseimanus (annam Squirrel)

69. Von Linstow, O. F. B.

Pilaria linstow - Hall 1916 in Sciurus caniceps.
(new name)

Oxyurus unguula - n. sp. from Sciurus vulgaris

Oxyurus polyoon, n. sp. from Geosciurus capensis
(Xerus setosus)

70. Watson, E. A.; S. Hadwen

1912-1913. Trypanosomes found in Canadian Mammals. Parasito., v. 5(1); 21-26, Feb.
(a) Trypanosoma Citelli - Watson 1908 from Citellus richardsoni Sabine.
(b) Trypanosoma sp.? Bowhill 1909 from squirrel sp.?

71. Wellman, C.; W. B. Wherry

1909. Ticks on the California ground squirrel. Ent. News. 29:1376

(a) Leucocytozoon citellicola Wellman & Wherry 1909 from Otospermophilus beecheyi.
(b) Trypanozoon otospermophilus Wellman & Sherry 1909 from Otospermophilus beecheyi.
(c) Cystocercus horstiae Wellman & Wherry 1909 from O. beechei
(d) Cytoleichus bankei Wellman and Wherry 1909 from O. beechei
(e) Dermacentor accidentalis Wellman & Wherry 1909 from O. beechei
(f) Ixodes aequalis Wellman & Wherry 1909 from O. beechei
72. Welsh, D. A.; J. E. Berling
Hg. petausi n. sp. in a marsupial flying squirrel red blood cells (Petaurus sciuros)

73. Yakinoff, W. L.; Skoloff, I. I.
1931. (with Sokoloff, I. I.; and E. F. Rastegaiieff)
Zur Frage der Coccidien beim Eichhornchen Arch. Protistenk 73 (3):487-490
Eimeria sciuroman E. Galli-Valerio from Sciurus vulgaris in Russia

1935a. Eimeria beckeri n. sp. a new coccidium from the ground squirrel, Citellus pygmaeus. Iowa State Coll. Jour. Sci. 9(4):
531-585
Found in intestines - Crimea.

Sciurus vulgaris reported in intestine - Eimeria andrewsi sp.n.

74. Zeder, J.G.H.
1800. Erster Buchtrag Zur Naturges und anmerkungen herausgegeben XX 320 pp., 6 pls, Quarto, Leipzig
Oxyuris actuissima (Zeder 1800) Hall 1916. from Sciurus vulgaris