FURTHER STUDIES OF *EIMERIA* (PROTOZOA: EIMERIIDAE) FROM MEXICAN RODENTS

VIRGINIA IVENS, FRANCIS J. KRUIDENIER, AND NORMAN D. LEVINE
University of Illinois, Urbana

MATERIALS AND METHODS

During the summer of 1957 a collecting expedition to Mexico was made by David L. Langebartel, Department of Zoology, University of Illinois, and Joseph C. Schaffner and Richard Widdows of the Department of Zoology and Entomology, Iowa State College, Ames, Iowa. Among the specimens they collected were 7 bats and 28 rodents. Mr. Langebartel obtained fecal samples from these specimens, placed them in 2.5% potassium bichromate solution, and brought them back to Urbana for examination.

Each sample was mixed thoroughly, placed in a thin layer in a Petri dish at room temperature for a week to sporulate, and stored in a refrigerator. The samples were examined microscopically after sugar flotation, using a Leitz Ortholux microscope with apochromatic objectives.

No coccidia were found in the bats, but three new species of *Eimeria* and two previously described ones were found in the rodents.

Numbers given with host designations below are those of host animals preserved in the University of Illinois Natural History Museum.

We should like to express our appreciation to Messrs. Langebartel, Schaffner and Widdows for specimens and to Dr. Donald F. Hoffmeister, Director of the Museum, for final identifications of the hosts.

RESULTS

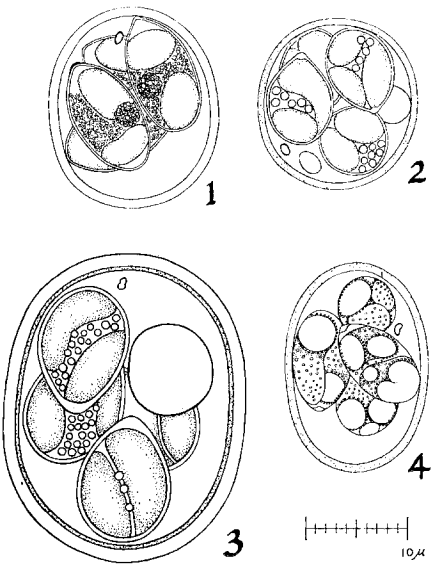
Eimeria hoffmeisteri, Levine, Ivens and Kruidenier, 1958

This species was originally described from *Citellus s. spilosoma* (Bennett, 1833) Allen, 1904, from Rincon de Romos, Aguascalientes, Mexico. In the present survey it was found in the intestinal contents of a single *C. spilosoma* (U. Ill. Mus. No. 16,447) trapped 28 miles south of Barenda, Chihuahua, Mexico. Twenty-nine sporulated oocysts measured 17 to 23 by 16 to 19 microns, with a mean of 19.9 by 17.2 microns. Their length-width ratios ranged from 1.0 to 1.3, with a mean of 1.14.

Very slight differences in the appearance of the sporocyst residual material and Stieda body were noted between the oocysts found in the present (Fig. 1) and previous studies (Levine, Ivens and Kruidenier, 1958). However, these were not great enough to justify the establishment of a new species.

Eimeria liomysis Levine, Ivens and Kruidenier, 1958

This species was originally described from the painted spiny pocket mouse, *Liomys pictus* (Thomas, 1893) Goldman, 1911, from Copala, Sinaloa, Mexico, and from *L. irroratus* (Gray, 1868) Goldman, 1911, from Guadalajara, Jalisco, Mexico. In the present survey it was found



Living, unstained oocysts. x1350. Fig. 1.— *Eimeria hoffmeisteri* from *Citellus spilosoma;* Fig. 2.—*Eimeria penicillati* n. sp. from *Perognathus penicillatus;* Fig. 3.—*Eimeria davisi* n. sp. from *Neotoma albigula;* Fig 4.—*Eimeria langebarteli* n. sp. from *Peromyscus boylii.*

in the intestinal contents of a *Liomys pictus* trapped 14 miles south of Acaponeta, Nayarit, Mexico (U. Ill. Mus. No. 16,454) and of another *L. pictus* trapped 34 miles north of Mazatlan, Sinaloa, Mexico (U. Ill. Mus. No. 16,451). Eight sporulated oocysts from the two animals measured 18 to 23 by 17 to 21 microns, with a mean of 20.8 by 19.1 microns; length-width ratios ranged from 1.0 to 1.1, with a mean of 1.07.

Eimeria penicillati n. sp.

Description: Oocysts (Fig. 2) subspherical, ellipsoidal or slightly ovoid. Oocyst wall pale brownish yellow or tan, smooth, composed of single layer (confirmed by breaking oocyst) about 0.6 microns thick. Micropyle absent. Six sporulated oocysts from type host measured 16 to 20 by 14 to 16 microns, with mean of 17.8 by 14.7 microns; length-width ratios ranged from 1.1 to 1.3, with mean of 1.18. Sporulated oocysts contain four broadly lemon-shaped sporocysts measuring 9 by 7 microns with length-width ratio of 1.33. Stieda body small, rounded. Oocyst residuum composed of one to several large, clear globules. Polar granule present. Sporocyst residuum composed of number of large granules. Sporozoites oriented more or less lengthwise in sporocysts.

Three oocysts from *Perognathus flavus* measured 17 to 20 by 15 to 19 microns. They differed from those from *P. penicillatus* only in having either one or two polar granules instead of a single one. This difference does not appear sufficient to warrant establishing a separate new species.

Type host: Perognathus penicillatus Woodhouse, 1852 (U. Ill. Mus. No. 16,456) (pocket mouse), trapped 8.5 miles northwest of Colonia Oaxaca, Sonora, Mexico.

Additional host: Perognathus flavus Baird, 1855 (U. Ill. Mus. No. 16,458) (pocket mouse), trapped 45 miles north of Casas Grandes, Chihuahua, Mexico.

Location: Intestinal contents.

Locality: Mexico (*vide supra*).

Remarks: The only other species of *Eimeria* which has been described from *Perognathus* is *E. perognathi* Levine, Ivens and Kruidenier, 1957, from *P. intermedius* Merriam, 1889, in Arizona. *E. penicillati* differs

from *E. perognathi* in having a smooth, thinner oocyst wall and oocyst polar granules. Its oocysts are somewhat broader; its sporocysts are distinctly larger; its Stieda body is rounded and protuberant rather than flattened. *E. penicillati* also differs significantly from the species of *Eimeria* which have been described from the rodent genera *Dipodomys* and *Liomys,* both of which belong to the same family, Heteromyidae, to which *Perognathus* belongs.

Eimeria davisi n. sp.

Description: Oocysts (Fig. 3) subspherical to ellipsoidal. Oocyst wall composed of two layers—outer one colorless to pale brownish yellow, smooth to slightly roughened, about 1.2 to 1.3 microns thick, and inner one pale brownish to brownish, about 0.4 to 0.5 microns thick; layers can be separated by crushing oocyst. Micropyle absent. Fifty-eight sporulated oocysts measured 22 to 32 by 21 to 24 microns, with mean of 27.6 by 22.8 microns; length-width ratios ranged from 1.1 to 1.4, with mean of 1.21. Sporulated oocysts contain 4 ovoid sporocysts; 23 sporocysts measured 10 to 12 by 7 to 9 microns, with mean of 11.1 by 8.3 microns; length-width ratios ranged from 1.1 to 1.6, with mean of 1.36. Oocyst polar granule present. Oocyst residuum composed of one to many clear globules up to 9 microns or more in diameter; among 38 oocysts in which this feature was recorded, there was one globule in 30, 2 to 3 in 7, and many small ones in one oocyst. Sporocyst Stieda body medium-sized. Scattered residual granules usually present in sporocyst. Sporozoites lie lengthwise in sporocysts.

Host: Neotoma albigula Hartley, 1894 (U. Ill. Mus. No. 16,472) (white-throated wood rat).

Location: Intestinal contents.

Locality: Found in one of 5 *N. albigula* trapped 23 miles southeast of Agua Prieta, Sonora, Mexico.

Remarks: Four species of *Eimeria* have been described from *Neotoma. E. neotomae* Henry, 1932, and *E. residua* Henry, 1932, were described from *N. fuscipes* Baird, 1858, in California. *E. albigulae* Levine, Ivens and Kruidenier, 1957, was described from *N. albigula* in Arizona, and *E. operculata* Levine, Ivens and Kruidenier, 1957, was described from *N. s. stephensi* Goldman, 1905, in Arizona. *E. davisi* differs from *E. neotomae* in having two-layered wall, oocyst residuum and Stieda body, and in lacking micropyle; it has larger oocysts and sporocysts. It differs from *E. residua* in having smoother, paler outer oocyst wall and darker inner oocyst wall. It differs from *E. operculata* in lacking operculum, in having two-layered rather than single-layered oocyst wall, and in having polar granule, oocyst residuum, sporocyst residuum, and Stieda body. It differs from *E. albigulae* in having smoother oocyst walls and in that its sporozoites lie lengthwise in the sporocysts instead of at the ends. This difference in sporozoite location was constant in 41 *E. albigulae* and 58 *E. davisi* oocysts studied. *E. davisi* also resembles *E. eremici* Levine, Ivens and Kruidenier, 1957, but differs in the shape of the sporocyst and Stieda body.

This species is named in honor of Dr. Wayne H. Davis, University of Minnesota, St. Paul, Minnesota.

Eimeria langebarteli n. sp.

Description: Oocysts (Fig. 4) elongate ellipsoidal. Oocyst wall smooth, pale yellowish, composed of single layer about 0.8 microns thick. Micropyle absent. Fifteen sporulated oocysts from two host animals measured 20 to 23 by 13 to 14 microns, with mean of 21.0 by 13.6 microns; length-width ratios ranged from 1.4 to 1.7, with mean of 1.55. Sporulated oocysts contain 4 thin-walled, elongate ellipsoidal sporocysts; 10 sporocysts measured 8 to 10 by 5 to 6 microns, with mean of 9.4 by 5.3 microns; length-width ratios ranged from 1.6 to 2.0 with mean of 1.78. Stieda body small. Oocyst polar granule present. Oocyst residuum absent. Sporozoites elongate, curled inside sporocysts, with many small granules so closely adherent to sporozoites that it was not possible to be sure whether they were inside or outside the sporozoite membrane. Hence presence of true sporocyst residual material was not definitely established.

Host: Peromyscus boylii (Baird, 1855) Mearns, 1896 (U. Ill. Mus. Nos. 16,467 and 16,469) (deer mouse).

Location: Intestinal contents.

Locality: This species was found in 2 of 4 *P. boylii* trapped 15 miles west of Cuauhtémoc, Chihuahua, Mexico.

Remarks: Three species of *Eimeria* have been described from *Peromyscus*. *E. peromysci* Levine, Ivens and Kruidenier, 1957, and *E. arizonensis* Levine, Ivens and Kruidenier, 1957, were described from *P. t. truei* (Shulfeldt, 1885) Thomas, 1894 in Arizona, and *E. eremici* Levine, Ivens and Kruidenier, 1957, was described from *P. e. eremicus* (Baird, 1858) Allen, 1895, from Arizona. *E. langebarteli* differs from *E. peromysci* in having smooth oocyst wall composed of single layer rather than rough, two-layered one, in lacking oocyst residuum, in character of sporocyst residual granules, and in having smaller oocysts and sporocysts. It differs from *E. arizonensis* in having more elongate oocysts, in lacking oocyst residuum, in character of sporocyst residual granules, and in size and shape of sporocysts. It differs from *E. eremici* in having oocyst wall composed of single rather than double layer, in lacking oocyst residuum, in character of sporocyst residual granules, and in shape and size of oocyst and sporocyst.

Summary

In a survey of 28 rodents of 9 species and 7 bats of 2 species from Mexico, the following new species of *Eimeria* were found and described: *E. penicillati* from the pocket mice, *Perognathus penicillatus* and *P. flavus; E. davisi* from the white-throated wood rat, *Neotoma albigula*; and *E. langebarteli* from the deer mouse, *Peromyscus boylii*. In addition, *E. hoffmeisteri* was found in the spotted ground squirrel, *Citellus spilosoma*, and *E. liomysis* in the painted spiny pocket mouse, *Liomys pictus*. This raises to nine the number of species of *Eimeria* which have been described

from Mexican rodents. It raises to 37 the number of species of North American rodents from which *Eimeria* has been described, and to 59 the number of *Eimeria* species occurring in them.

Literature Cited

Henry, D. P. 1932. Observations on coccidia of small mammals in California, with descriptions of seven new species. Univ. Calif. Publ. Zool., 37: 279-290.

Levine, N. D., V. Ivens, and F. J. Kruidenier. 1957. New species of *Eimeria* from Arizona rodents. Jour. Protozool., 4:80-88.

Levine, N. D., V. Ivens, and F. J. Kruidenier. 1958. New species of *Eimeria* (Protozoa; Eimeriidae) from Mexican rodents. Trans. Ill. St. Acad. Sci., 50: 291-298.