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Kansas Mammals in their Relations to Agriculture.

INTRODUCTION.

THE legislature of Kansas during the session of 1903 authorized the Board of Regents of the State Agricultural College to employ a suitable person to make a study of the food habits of the mammals and birds of the state and to make reports thereon. These reports were to be published as bulletins of the State Agricultural Experiment Station of the College.

Having been selected by the Regents of the College to have charge of the work, I at once began to make the investigations authorized. I had already, during a quarter of a century of residence in the state, made many observations on the fauna of the state, and accumulated many notes on the habits of our animals. By using these notes, together with new information, I am able at this time to present a partial report on the native mammals of Kansas, with special reference to their economic importance to the farmers and fruit-growers of the state.

It has seemed proper to me that such a report should be accompanied by a complete systematic list of the mammals that have been found in the state within recent times. I have prepared such a list, and present it with this report. It is necessary to confess that I pre-

sent it with a perfect understanding of the liability to error in listing forms that are either rare or recently extinct, when properly identified and authenticated specimens are not now available to confirm the record. My own opportunities for collecting have been very limited as to the number of localities, so that I am obliged to depend much upon the materials and records of other collectors. The records have been meager in quantity, and are further confused by later changes in nomenclature. The early explorers of the state, with a few exceptions, were content to mention wild animals found by them under such general names as "deer" or "wolf," without distinguishing the exact species. Such records are, of course, of little value in preparing a list of the mammals of Kansas.

Very little of a systematic nature concerning our mammals has been published. Prof. M. V. B. Knox, formerly connected with Baker University, Baldwin, Kan., prepared a systematic list of the mammals of Kansas, which was published in the Transactions of the Kansas Academy of Science, vol. IV. A few additions to the list were noted in the succeeding volume of the transactions. This list was only partially based on personal captures, and undoubtedly contains a few untenable records and some names that have been changed by the discovery of earlier synonyms and of varietal forms. Considering its time of publication and the limited opportunities for securing information then at the disposal of the author, it was a most valuable piece of work and deserves much credit.

Another local worker, Mr. A. B. Baker, formerly of Trego county, presented before the academy in 1888 a list of the mammals taken or observed by him in the vicinity of Wa Keeney, Kan. This was published in volume XI of the transactions of the academy, and is of much value as a local list. A few changes in nomenclature since its publication are to be noted.

Professor Cragin, formerly of Washburn College, in the natural history bulletins of that institution, presented a few scattered notes on the mammals of the state. Prof. L. L. Dyche, of the State University, has published some valuable notes on the food of some of our smaller mammals. And Mr. J. R. Mead, of Wichita, has published some of his recollections of the larger mammals as he found them during hunting and trapping expeditions on the plains in the '50's.

Professor Dyche has in preparation a list of the mammals of the state, but tells me that he is not yet ready to publish it, because of incompleteness of data about distribution of the species. His list, when published, will be a notable contribution to our knowledge of the Kansas mammalia, and will undoubtedly become the standard for correctness. In the meantime, my own list is presented as a tenta-

tive one, while the data I have prepared concerning the habits of the animals under discussion and the methods of combating the noxious species are of such importance that they should not be withheld because of errors in the systematic list. I believe, however, that the list itself is as nearly correct as it is possible to make it from data now available. Further study may eliminate a few forms now included, and may add nearly all that I have mentioned as "probably occurring."

In the descriptive part of the paper I have endeavored to give sufficient data to enable any one to distinguish the species of the same genera that are likely to be met with in the state. Usually the descriptions include only external characters, and are not sufficient for the careful scientific determination of specimens.

I am indebted to Dr. C. Hart Merriam, of the United States Biological Survey, and to Professor Dyche for information furnished to me and used in this paper.

List of Kansas Mammals.

ORDER I. MARSUPIALIA. Marsupials.

Family DIDELPHYIDÆ. Opossums.

1. *Didelphis virginiana* Kerr. Virginia Opossum.

Common in the wooded parts of the state and westward along the streams. *D. californica* Bennett has been taken in Oklahoma, and may possibly be found in the southern part of Kansas.

ORDER II. UNGULATA. Hoofed Mammals.

Family CERVIDÆ. Deer.

2. *Cervus canadensis* (Erxl.) Elk.

Formerly common, but now extinct. Reported by Say, 1823.

3. *Odocoileus americanus macrourus* Rafin. White-tailed Deer.

The type was from the plains of the Kansas river. Probably extinct in the state.

4. *O. hemionus* (Rafin.) Mule Deer. Black-tailed Deer.

Once common but now extinct. Reported by Say in 1823. Mr. A. B. Baker reported them in western Kansas as late as 1887.

Family ANTILOCAPRIDE. Pronghorn Antelopes.

5. *Antilocapra americana* (Ord). Prong-horn Antelope.

A recent act of the legislature protects this rapidly diminishing species. The enforcement of the law depends entirely upon the people in the few western counties where the antelope is still found.

Family BOVIDÆ. Cattle, Sheep, etc.

6. *Bison bison* (Linn.) American Bison.

Abundant within the recollection of many residents of the state. Now entirely extinct except in private preserves.

ORDER III. RODENTIA. Rodents.

Family SCIURIDÆ. Squirrels, Marmots, etc.

7. *Sciurus rufiventer* E. Geoffroy. Western Fox-squirrel.
 Abundant in the wooded parts of the state. Not protected by law.
8. *S. carolinensis* Gmel. Gray Squirrel.
 Found in eastern and southeastern Kansas. Not common.
9. *Sciuropterus volans* (Linn.) Flying Squirrel.
 Common in the wooded parts of eastern Kansas. Being nocturnal
 in its habits, it is not often seen.
10. *Tamias striatus* (Linn.) Chipmunk.
 Reported on Professor Knox's list of mammals. This is probably
 subspecies griseus or venustus, but not having specimens to
 examine, I am unable to determine. The chipmunk is rare in
 the state.
11. *Citellus spilosoma major* Merr. Spotted Spermophile.
 Common in sand-hills in southwestern Kansas.
12. *C. tridecemlineatus* (Mitch.) Striped Spermophile.
 Common over the eastern two-thirds of the state. In the extreme
 western part of the state it is replaced by the next form.
13. *C. tridecemlineatus pallidus* Allen. Pale Striped Spermophile.
 Replaces the typical form in western Kansas. Abundant.
14. *C. franklini* (Sab.) Franklin's Spermophile.
 Found in most parts of the state, except the southern counties.
 Not very common.
15. *Cynomys ludovicianus* (Ord). Prairie Marmot. Prairie-dog.
 Abundant in the western half of the state.
16. *Marmota monax* (Linn.) Woodchuck. Ground-hog.
 Found in eastern Kansas. Not common.

Family CASTORIDÆ. Beavers.

17. *Castor canadensis* Kuhl. American Beaver.
 Common along most Kansas streams as late as 1880; now rare.

Family MURIDÆ. Rats, Mice, Voles, etc.

18. *Mus norvegicus* Erxl. Brown Rat, Norway Rat.
 Abundant throughout the state.
19. *M. musculus* Linn. Common House Mouse.
 Abundant.
20. *Onychomys leucogaster* (Wied). Missouri Grasshopper Mouse.
 Rather common over a large part of eastern Kansas.
21. *O. torridus* (Coues). Arizona Scorpion Mouse.
 In western part of the state; less common than the last.
22. *Peromyscus texanus nebrascensis* (Mearns). Fulvous White-
 footed Mouse.
 Rather common in northern and western Kansas.
23. *P. michiganensis* (Aud. and Bach.) Michigan White-footed Mouse.
 Abundant in eastern part of the state. Four other species of
 white-footed mice are possibilities of our fauna. They are *P.*
texensis, *P. bellus*, *P. attwateri*, and *P. canus*.

Family MURIDÆ. Rats, Mice, Voles, etc.

24. *Sigmodon hispidus texianus* (Aud. and Bach,) Cotton Rat.
Taken at Cairo, Kan., by Vernon Bailey.
25. *Oryzomys palustris* (Harlan). Rice-field Mouse.
Taken at Neosho Falls by Capt. B. F. Goss, and at Topeka by Charles Popenoe.
26. *Reithrodontomys dychei* Allen. Dyche Harvest Mouse.
Type from Lawrence, Kan. Found in eastern part of the state.
27. *R. dychei nebrascensis* Allen. Nebraska Harvest Mouse.
Taken in Lane county by Mr. Granger. *R. chrysotis* Elliot is to be looked for in Kansas.
28. *Neotoma campestris* Allen. Prairie Wood-rat.
Type from Pendennis, Lane county, Kan. Taken by Mr. Granger.
29. *N. baileyi* Merr. Bailey's Wood-rat.
Common in eastern Kansas.
30. *Microtus pennsylvanicus* (Ord). Meadow Vole.
Common in the moister parts of eastern Kansas.
31. *M. austerus* (LeConte). Prairie Vole.
Abundant in eastern and central Kansas.
32. *M. nemoralis* (Bailey). Woodland Vole.
Found in the wooded parts of eastern Kansas; not common.
33. *M. haydenii* (Baird). Hayden Vole.
Abundant in the western part of the state.
34. *Synaptomys helaletes gossii* Merr. Goss's Lemming.
Type taken at Neosho Falls by Captain Goss. Range not known.
35. *Fiber zibethicus* (Linn.) Muskrat.
Abundant.

Family GEOMYIDÆ. Pocket-gophers.

36. *Geomys bursarius* (Shaw). Prairie Pocket-gopher.
Abundant; increasing in numbers. The most injurious pest to the farmer found in the state.
37. *G. lutescens* (Merr.) Plains Pocket-gopher.
Common in the sandy parts of western Kansas. *G. braviconus* Baird is to be expected in the southern part of the state, and *Cratogeomys castanops* (Baird) in the southwest.

Family HETEROMYIDÆ. Kangaroo Rats and Pocket Mice.

38. *Perodipus richardsoni* (Allen). Richardson's Kangaroo Rat.
Taken at Pendennis, Lane county, by Mr. Granger.
39. *P. ordi* (Woodh.) Ord's Kangaroo Rat.
On Knox's and on Baker's lists of Kansas mammals. *P. longipes* Merr. is probably found in northwestern Kansas.
40. *Perognathus flavescens* Merr. Plains Pocket Mouse.
Common in the north-central part of the state.
41. *P. flavus* Baird. Baird Pocket Mouse.
Found in the western part of the state; not common.
42. *P. hispidus paradoxus* (Merr.) Kansas Pocket Mouse,
Rather common over the greater part of the state. Type from Wa Keeney, Kan. *P. fasciatus* Wied. is on Professor Knox's list, but probably does not occur.

Family ZAPODIDÆ, Jumping Mice.

43. *Zapus hudsonius campestris* Preble. Prairie Jumping Mouse.
Common in suitable places in eastern Kansas.

Family ERETHIZONTIDÆ. Porcupines.

44. *Erethizon epixanthus* Brandt. Yellow-haired Porcupine.
Found in western Kansas. Rare.

Family LEPORIDÆ. Hares and Rabbits.

45. *Lepus campestris* Bachm. White-tailed Jack-rabbit.
Found in the northern part of the state. Not very common.
46. *L. floridanus mearnsi* (Allen). Cottontail Rabbit.
Formerly called *L. sylvaticus* Bach. Abundant in northeastern part of the state.
47. *L. floridanus alacer* (Bangs).
Common in southeastern Kansas. Its range in the state is not well determined.
48. *L. arizonæ minor* Mearns. Prairie dog Hare.
Found in the western third of the state. Smaller and much paler in color than the other Cottontail rabbits of the state.
49. *L. melanotis* Mearns. Black-eared Jack-rabbit.
The type of this species was from Independence, Kan. It is abundant throughout the state. *L. texianus* Waterhouse, the Texas jack-rabbit, probably occurs in the southwestern part of the state.

Order IV. CARNIVORA. Carnivores, or flesh eaters.

Family FELIDÆ. Cats.

50. *Felis oregonensis hipolestes* (Merr.) Mountain Lion.
Occasional in the state. The latest capture was on August 15, 1904, near Hays City.
51. *Lynx ruffus* (Guld.) Bay Lynx. Wildcat.
Not rare in the rougher parts of the state.

Family CANIDÆ. Wolves, Foxes, etc.

52. *Canis occidentalis* (Rich.) Gray Wolf.
Formerly abundant; now possibly extinct.
53. *C. nubilus* Say. Dusky Wolf. Lobo (?).
Some uncertainty exists as to the proper name to apply to the wolves now known as lobo and still found in the western part of the state.
54. *C. latrans* Say. Coyote.
In northeastern Kansas; probably rare.
55. *C. nebrascensis* Merr, Prairie Coyote.
Common over the entire state.
56. *Vulpes fulvus* (Desmarest). Red Fox.
Rather common in the eastern part of the state.
57. *V. macrourus* Baird. Prairie Fox.
Col. N. S. Goss reported two specimens taken in Cowley county in 1886. (*Forest and Stream*, January 6, 1887.)
58. *V. velox* (Say). Swift Fox.
Formerly common in western Kansas; now-rare.

Family CANIDÆ. Wolves, Foxes, etc.

59. *Urocyon cinereoargenteus* (Schreb.) Gray Fox.
Found in the eastern part of the state; rare.

Family URSIDÆ. Bears.

60. *Ursus americanus* Pallas. Black Bear.
Reported by all the early explorers of the territory now embraced in Kansas. Found in Comanche county as late as 1859, according to the statements of Mr. J. R. Mead, of Wichita.

Family PROCYONIDÆ. Raccoons.

61. *Procyon lotor* (Linn.) Raccoon.
Common in the wooded parts of the state and westward along streams where there is scattered timber.
- Bassariscus astutus* (Licht.) Northern Civet Cat.
Is found on Professor Knox's list of Kansas mammals, but I am unable to verify his statement that it occurs in the state.

Family MUSTELIDÆ. Weasels, Otters, etc.

62. *Taxidea taxus* (Schreb.) Badger.
Found throughout the state, but rarely in the eastern part. Common on the plains.
Taxidea taxus berlandieri (Baird) is to be looked for in southwest Kansas. It has a median dorsal stripe of white from the nose to the base of the tail. A specimen seen at Kinsley has the stripe four-fifths of the length of the body.
63. *Mephitis mesomelas varians* (Gray). Long-tailed Texas Skunk.
Common throughout the state, The northern Plains skunk, *Mephitis hudsonica* Rich., is to be looked for in the northern part of the state.
64. *Spilogale interrupta* (Rafin.) Little Striped Skunk.
Common in most parte of the state.
65. *Putorius vison lutrecephalus* (Harlan). Southern Mink.
Rather common in the eastern part and along streams westward.
66. *P. nigripes* Aud, and Bach. Black-footed Ferret.
Found on the plains in the western part of the state. Decreasing in numbers.
67. *P. longicauda* Bon. Long-tailed Weasel.
Not very common in eastern Kansas.
68. ? *P. frenatus neomexicanus* Bart. and Cockerell. New Mexican Bridled Weasel.
A very pale specimen of the Bridled weasel is in the collection of skins at the State University. It came from Liberal, Kan., a point outside of the range of the typical bridled form, and very near to the known range of this variety.
69. *Lutra canadensis sonora* (Rhoads). North American Otter.
Formerly common, but now rare. One taken at Manhattan September, 1904.

Order V. INSECTIVORA Insectivores. Shrews and Moles.

Family SORICIDÆ. Shrews.

70. *Blarina brevicauda* (Say). Large Blarina.

Rather common throughout northern Kansas, and perhaps in the whole state.

71. *Blarina parva* (Say). Small Blarina.

Found in the eastern part of the state.

Family TALPIDÆ. Moles.

72. *Scalops aquaticus machrinus* (Rafin.) Common Garden Mole.

Common in wooded and cultivated parts of Kansas.

Order VI. CHIROPTERA. Bats.

Family VESPERTILIONIDE. Common Bat.

73. *Myotis lucifugus* (LeConte). Little Brown Bat.

Found throughout the state.

74. *M. californicus ciliolabrum* (Merr.) Little Pale Bat.

Type from Trego county, Kansas. Range in the state not known.

75. *M. subulatus* (Say). Say's Bat.

Occurs in western Kansas; probably rare. *M. velifer* Allen probably occurs in southern Kansas, but it has not come under my observation.

76. *Lasionycteris noctivagans* (LeConte). Silver-haired Bat.

Rather common over eastern Kansas and westward in suitable localities.

77. *Pipistrellus subflavus* (F. Cuvier). Georgian Bat.

This species undoubtedly occurs. No specimens have been seen by me. Southeastern Kansas.

78. *Vespertilio fuscus* (Beauvois). Brown Bat.

Common in the eastern half of the state.

79. *Lasiurus borealis* (Mull.)

Eastern Kansas; rather common.

80. *L. cinereus* (Beauvois). Hoary Bat.

Eastern Kansas; common. *Nycticeius humeralis* Rafin. is probably found in Kansas.

Kansas Mammals Economically Considered.

The indigenous wild animals of Kansas belong to six different orders. Each of the orders presents peculiar habits for consideration, and will be taken up separately. Most of them are of economic importance, and a study of their habits is essential to a correct understanding of their relations to the agricultural and horticultural interests of the state. Many of the species are directly injurious to crops; while others may be injurious at times, and yet, because of their influence in checking the undue increase of species that are still more injurious, may be worthy of the farmer's careful protection. This protection should, however, be regulated in accordance with conclu-

sions reached after a careful study of the interdependence of the various species upon each other and upon the other forms of natural life. Relative numbers of the different forms must be considered, and man's needs in the matter of food and opportunities for recreation is a factor of some importance.

Order I. MARSUPIALIA. Marsupials.

This, the lowest order of the Mammalia represented in North America, includes most of the mammals of Australia and the adjacent islands and the opossums of America. The name Marsupialia is derived from the fact that in most of the families of the order the female is provided with an external pouch, or marsupium, into which the young are born while very immature.

The North American representatives of the order belong to the family Didelphyidæ, the only genus being *Didelphis*, with two species and a rather doubtful variety. The genus is of southern origin and habitat, and is seldom found north of the fortieth parallel of latitude. It is characterized by having five distinct toes, all but the first toe of the hind foot being provided with nails. First toe of the hind foot large, opposable to the others in grasping, and without a nail. Tail long, nearly naked, and prehensile. Ventral pouch of female complete. Long bristle-like hairs mingle with the fur, which is of economic value. The incisors are small and have sharp points, the canines are large; whole number of teeth, fifty.

The Virginia opossum (*Didelphis virginiana* Kerr) is the chief representative of the genus. It is found from central Pennsylvania southward to the Gulf coast, and westward to the great plains and Texas. As it is arboreal in its habits, it is not found outside the wooded parts of its range. A variety has been described from Florida and southern Georgia, characterized by a longer tail. In the Southwest, (Oklahoma, Texas, New Mexico, California, and southward,) the California opossum (*Didelphis californica* Bennett) is found. It differs from the Virginia opossum in general color chiefly; the latter has the longer coarse hairs of its upper parts and sides white, giving it a hoary or whitish appearance; the California species has all these long hairs, except a few in the dorsal region, black, and has a decidedly black appearance. As the California opossum has been found in Oklahoma, it is not improbable that it may be found in southern Kansas, but it has not yet been taken, to my knowledge.

The Virginia opossum is common over all the wooded parts of the state and along the streams westward, even where the trees are confined to a slight fringe bordering the banks. Thus, at Kinsley, on the Arkansas river, specimens are not uncommon. At Manhattan it

is a common species, and it increases in numbers toward the southeastern part of the state. It is much esteemed as food, especially by the negro population, and hence its numbers are kept very much reduced.

In accordance with its low and generalized organization, the opossum is nearly omnivorous in its food habits. It eats insects, fishes, fruits, vegetables, frogs, birds eggs, young and old birds, mice, leaves, roots of plants, etc. Its is especially fond of carrion or fresh meat, but will not eat hard nuts or the bark of trees. With all this variety of food, it cannot be said that the animal is injurious to the interests of the farmer. On the other hand, it is not of much direct benefit in destroying noxious species. With wants that are so easily provided for, it is not energetic enough to capture live mice in sufficient numbers to make its work of importance. It much prefers to eat individuals, whether of insects, birds, reptiles, or mammals, that it finds already dead in its way.

The opossum is of much interest to the naturalist. It is the only animal of the order available for study in our laboratories. Kept in confinement, it is also an object of interest, and much has been published concerning its habits. The female produces from eight to fourteen young at a time. They are born into the pouch when but little larger than new-born mice, which they then much resemble. They are carried in the pouch for several weeks, or until they apparently outgrow its capacity. They then emerge, but are still carried about by the mother for some time before they are allowed to shift for themselves. The young are not timid and can easily be captured in traps. In one instance a half grown young opossum escaped from the box where its mother and seven other young ones were confined. It wandered into a cellar where a trap had been set for rats and promptly succeeded in getting itself caught. In the morning it was released and replaced in the cage. The next night it went through the same experience, and for several succeeding nights it regularly allowed itself to be caught in the same trap, set at the same place. Finally, two of the young escaped and were both caught in the trap, after which the cage was so repaired that the animals could not get out.

The value of the opossum as an article of food depends largely on the skill with which it is prepared for the table. If prepared by any but an experienced cook, it is likely to be unpalatable and disappointing to the eater. But there is no doubt about the excellence of it to the taste of persons accustomed to its flavor and skilled in the negro method of cooking it. The fur is not fine, but is considerably esteemed in the manufacture of wearing apparel. It is likely to be-

come more valuable as fur-bearing animals of greater consequence become rarer; and whenever the fur shall command a higher price than now, the animal itself will become very scarce and may soon become extinct.

Order II. UNGULATA. Hoofed Mammals.

The mammals of this order belonging to Kansas are practically extinct, although one species, the antelope, is still met with in western Kansas, but rarely. Three families of hoofed mammals were represented in Kansas—the Cervidæ the Antilocapridæ, and the Bovidæ. They included most of the larger game animals which furnished food for the Indian, and the chase of which was the important business of his life. Had the Indian remained in possession of the land the game might have remained until now, but in ever diminishing numbers. The Indian himself was one of the factors in the process of extinction, He killed for food and for clothing, and cared little for the future of his people. When game became scarce in any section of the country he moved farther away in pursuit of it. If he spared to kill any, other tribes, his hereditary foes, would profit from his forbearance. And when the white man came the slaughter of the game was doubly hastened. The Indian saw that the land was passing from his control, and all incentive for him to spare the game was gone. The white hunter came to hunt for profit or to make a record for wanton slaughter. The smooth contour of the country and the absence of large bodies of timber for shelter was also a hastening agency. In a hilly and closely wooded country the game would have had a chance for existence and would not have disappeared so soon.

I admit that the often-expressed feeling of regret one hears concerning the disappearance of large game from the state is almost entirely a sentimental one. Economically there has been no loss. Much as we would like to have the large game to-day, the ranges of Kansas are of much greater benefit for cattle-grazing than they could ever be as grazing ground for the Ungulata that once occupied them.

The Cervidæ of Kansas comprised three species—the American elk, the White-tailed deer, and the Black-tailed deer.

The American elk (*Cervus canadensis* Erxl.) was once common in much of the territory now embraced in the state. Nearly all the earlier American explorers of the territory reported it. Most of these reports relate to the eastern, wooded part of the state, but Say, in 1823, found them in the Arkansas valley in the southwest, and Gregg, in his "Commerce of the Prairies," published in 1844, makes a similar report of their presence there.

The Oelk had originally the widest distribution of all American deer.

It ranged over nearly the whole of the United States, and both north and south of these limits. It is now practically extinct east of the Rocky Mountains, except in the northern fastnesses, where it is quite rare. In the mountains near the great continental divide considerable herds are still found, but they have been steadily decreasing in numbers. Recently the states in which they still remain have passed stringent laws for their protection, which may, for a time, check the decrease.

The White-tailed deer (*Odocoileus americanus macrourus* Rafin.) was the most abundant deer found in the eastern part of Kansas. The type of this form was obtained from the plains of the Kansas river. Smaller and paler in color than the typical Virginia deer (*O. americanus* Erxl.), it yet resembles it so closely in habits that all that has been written and published about the type form will also apply to this.

The Black-tailed or Mule deer (*O. hemionus* Rafin.) was rather common over the greater part of the state. It was not mentioned as occurring here by explorers earlier than Thomas Say, in 1823. He was the first naturalist of reputation who visited the territory. Earlier explorers mentioned deer as occurring, but did not distinguish the species. It is, of course, impossible for the reader of their accounts to determine which species was meant. The Black-tailed deer was more a creature of the plains than the other Kansas species. Earlier settlers of Wallace county tell me that this deer was found in considerable herds in the hills south of Fort Wallace during the seventies and early eighties. Mr. A. B. Baker, in his list of mammals of western Kansas, states that it was found in the western part of the state as late as 1887. I know of no more recent record.

The family Antilocapridæ has but one representative genus, with a single species. The Prong-horn antelope (*Antilocapra americana* Ord) was unknown to scientific men until the expedition of Lewis and Clark brought back a specimen from the "plains east (?) of the Missouri river." The genus is peculiar in that it stands as a sort of link between the true antelopes and the deer. It is a type that shows long isolation and is sharply distinguished from every other form of ruminant. It was once quite abundant on the open plains of central and western Kansas, but at the present time there are few of them within our borders. In eastern Colorado they are still found in considerable herds, but they are constantly diminishing in numbers.

The Prong-horn antelope is intermediate in size between a sheep and the common deer. Its long legs give it the appearance of greater size than it possesses, and its feet are remarkable in not having accessory hoofs. Unlike the true antelopes, its horns are branched,

recurred, and deciduous. The horns of the female are either rudimentary or absent.

The Prong-horn is an inhabitant of the open plains. Its range extended formerly from the Mississippi almost to the Pacific coast, and from Mexico on the south to the plains of the Saskatchewan, in about latitude 53° north, except the wooded and mountainous parts. Its present range is very much reduced, and embraces the high plains west of the Missouri river to the Rocky Mountains, and a few outlying districts farther west. It feeds only upon grasses and seems to prefer the short buffalo-grass. It is gregarious in habits, and during the winter the bucks, does and kids are together in bands. In the spring the does separate themselves from the herd and, after dropping the young, they gather together for mutual protection against coyotes and wolves. While the Prong-horn is perhaps the fleetest of all our mammals, it does not seem to be as long-winded as the deer, and thus wolves, when banded together, can readily run them down. Herds of antelope are local in their habits and do not stray many miles from the place where they grow up. This is the chief reason that, when any particular range has had these animals all destroyed, it is not restocked in a natural way.

There are several causes for the rapid disappearance of the antelope from western Kansas. The fencing of the ranges by cattlemen is one of the most important of them. The animals do not seem to be able to leap over fences or any barrier if the vertical height is considerable. They have the power of making long, horizontal leaps only. The presence of fences has thus rendered the destruction of those inside the enclosure an easy process, whether the chasing is done by men or by wolves; and, as the fences have multiplied, the animals outside have been pushed farther and farther westward, until few are left in the state. A few small herds were reported last winter on the high divide between the Arkansas and Smoky Hill rivers east of the Colorado line, and there are probably a few in the extreme southwestern part of the state. The killing of antelope is now entirely prohibited in Kansas under severe penalties in fines, but the settlers of the western part of the state have little sympathy with the enforcement of the law. Some of them take every opportunity to kill an antelope, knowing that there is no one in the county charged specifically with the enforcement of the game law, and that it may be disregarded with impunity. There seems to be little hope that the antelope will not become completely extinct inside of our borders within a decade.

Of the family Bovidae our only indigenous representative in Kansas was the American bison (*Bison bison* Linn.) As the animal in

a wild condition is entirely extinct in the state, it is unnecessary to give any lengthy account of it. Historically it has been one of the most interesting of North American animals. Coronado described it in the account of his great expedition into our territory in 1541. The chase of the "buffalo" was the great sport among the Indians as well as among the early white settlers. One of the most interesting and vivid descriptions of the buffalo hunt is to be found in Parkman's "California and Oregon Trail."

The popular regret for the passing of the buffalo is not often heard among farmers and ranchmen. As an article of food their flesh was far inferior to that of domestic cattle, and there could have been no profit in preserving them on our prairies. The regret is that such a noble animal should have been killed wantonly for the profit in the hides alone. A little care might have preserved a remnant of the vast herds that once roamed over the state.

Order III. RODENTIA. The Gnawers.

The rodents comprise the largest and by far the most important order of native mammals. The number of genera, the number of species and the number of individuals are all enormous. They are widely distributed, and, although the species are mostly small and apparently unimportant, their economic relations to man are of more moment than those of any other order. Some, like the beaver and muskrat, furnish important articles of commerce; some, like the hares, furnish food and sport; others, in great multitudes, attack the farmer's growing crops or destroy the supplies of food and grain which he has stored. To this order belong nearly all the mammalian pests of the farm and orchard, and it does not seem possible to make too prominent the importance of a careful study into the habits and characteristics of the various members of the group. It is only such study that will lead to an intelligent application of measures to protect the useful and to destroy the obnoxious species.

All rodents are plantigrade, placing the entire sole of the foot to the ground in walking, and feed principally on products of the vegetable kingdom. The toes are movable and in most of the genera clawed. Canine teeth are entirely lacking, even in the milk dentition. The incisors have no roots and grow as long as the animal is alive. They have the outline of arcs of circles, and only the outer surface is provided with enamel, so that they are constantly sharpened by grinding upon each other. A peculiar arrangement of the line of union of the jaws permits their motion laterally as well as vertically. The effect is to give the animal both a cutting and a prying power with the teeth.

The destructiveness of some of the Rodentia is in many cases due to their extraordinary fecundity. This is especially true in the families Muridæ and Leporidae. So rapidly do some of them increase in numbers that migration becomes necessary to find food for the vast hordes of them. The migrations of the lemming of northern Europe are the most striking examples of this phenomenon. Pressed by the necessity of seeking food, they advance in solid phalanx southward, swimming rivers, nor pausing by day or night, although preyed upon by hawks, owls, wolves, and other enemies.

Rodents are found in all the continents, including Australia; and the great island of Madagascar has its peculiar species of them. South America has the greatest number of genera, many of which are restricted to that grand division. North America north of the Isthmus of Panama has about sixty genera. The Murids are found in all the faunal regions of the world, while squirrels and hares are found indigenous in all but Australia.

The Rodentia of Kansas represent eight families: Sciuridæ, Castoridæ, Muridæ, Geomyidæ, Heteromydidæ, Zapodidæ, Erethizontidæ, and Leporidae.

FAMILY SCIURIDÆ. Squirrels, Marmots, etc.

While the different genera of this family vary much in structure and habits, they all show evidences of their close relation to each other. The gradation from *Sciurus* proper to the larger *Marmota* presents differences at each step, but hardly any sufficient to form subfamilies. Some authorities set off the two genera of Flying squirrels into a separate subfamily, Pteromyinæ, the other genera constituting the subfamily Sciuridæ. There are eleven genera found in North America. *Pteromys* is found in India, and *Xerus* in Africa. Six genera of our continent have representatives in Kansas.

Genus SCIURUS Linn.

The true squirrels may be easily distinguished from the chipmunks and spermophiles by their more strictly arboreal habits; by the broader head and curved dorsal outline of the skull; by the broad, long and bushy tail, which has the hairs directed laterally; by the absence of cheek pouches. The animal is so familiar to all that anatomical characteristics need not be mentioned.

Professor Baird, in his "Mammals of North America," published in 1857, calls attention to the great difficulty in determining the species of squirrels, because of the tendency to local variation in color, and to variation of average size in the different latitudes. Professor Baird reduced the number of North American species to twelve, and Dr. J. A. Allen, in his "Monograph on the Sciuridæ," published

in 1877, further reduced them to five species, with seven well-marked varieties. Since that date, further exploration has added several species and a rather large number of varieties, so that ten species and about twenty-five varieties are now recognized as occurring north of Mexico. Mexico and Central America are rich in the number of species of squirrels, and South America has but few. Europe has but a single species, while Asia and Africa have each several.

Kansas has but two species of the genus *Sciurus*.

The Western Fox-squirrel (*Sciurus rufiventer* E. Geoffroy) is abundant in the wooded parts of the state, extending along the streams well into western Kansas. It is quite variable in color, the upper parts ranging from wholly black to a rich rufous. The under parts are nearly always a bright ferruginous, but melanism sometimes changes even this to black. On the whole, black specimens are comparatively scarce.

The Gray squirrel (*Sciurus carolinensis* Gmel.) is found only along the eastern border of the state. Its total length does not differ much from that of the preceding species, but it has a shorter tail. The upper parts are dark yellowish rusty; under parts white. Melanism is not common with this species, and black forms have not been reported from Kansas.

Both the above species are arboreal in habit, and feed upon nuts and acorns in preference to other foods. When these are not plentiful, seeds of plants and various grains are substituted, and if the number of squirrels were great in a given locality they might become objectionable to the farmer because of depredations on corn. The constant hunting of squirrels and their use as an article of food will undoubtedly prevent their undue increase in numbers. Indeed, the tendency is to diminish them to a marked degree. In some parts of the United States, in spite of protective laws, they have almost entirely disappeared. In our state, as other forms of game become scarcer, the squirrel will more and more become an object of pursuit by hunters, and, with the limited area of woodland, will be in danger of extermination. The Kansas game law of 1905 protects it.

But one litter of young is produced in a year. They are born in March or April and attain their full size by August. In August and September the young specimens are at their best for food. There should be a closed season for squirrels in Kansas, extending at least from February 1 to August 1. Such a law would probably prevent their extermination, and it would at least prevent the cruel practice of killing the old squirrels while the young are still unable to care for themselves.

Both the Fox-squirrel and the Gray squirrel are easily tamed and

make desirable pets. Their presence in parks and among shade-trees in our towns should be encouraged, as they are harmless and most interesting objects. They readily become tame enough to take food even from the hands of strangers.

Genus *TAMIAS* Illiger.

Small; tail shorter than the body, flattened; cheek pouches rather large; dorsal surface with two to four longitudinal whitish stripes. This genus is closely allied to *Citellus*, but forms a connecting link between that genus and the true tree squirrels. Only one species is found in Kansas, and it is rare. Professor Knox reported it as the common chipmunk (*Tamias striatus* Linn.), but if his specimens were still in existence they would probably prove referable to either one of the varieties *griseus* or *venustus*. Not having access to specimens taken in the state, I am unable to definitely place them.

Twenty-five species and a large number of races of chipmunk have been recognized in North America. They are usually quite harmless and, being too small to be available as food, they are not often interfered with by man. Cats are their chief natural enemies, and in the thickly settled parts of the country they have become quite scarce because of the presence of cats in large numbers. This is probably the reason that they are now seen so rarely in Kansas.

Chipmunks take readily to confinement, and make most interesting pets. A pair of adults and four young were kept for months in the same cage, with good facilities for exercise. They spent the greater part of the day in constant motion. A peculiarity was that each individual took a different form of activity for its special exercise, and no two of them performed the same tricks. So marked was this that the animals, all of which looked alike, came to be distinguished from each other entirely by their peculiarities of action. Two were fond of revolving a wooden disk placed almost horizontally; but while one of them always turned it to the right, the other invariably turned it to the left. The other four jumped upon the wheel only by accident, and never attempted to revolve it, but took their exercise mostly on the dead branch of a tree placed in the window that served as a cage. Two of them contented themselves with running up and down, each a different limb. The others turned somersaults from another limb, but one of them turned them forward and the other backward.

Genus *CITELLUS* Oken.

The spermophiles, or ground-squirrels, are often miscalled "gophers," a name which belongs properly to an entirely different family of rodents, the pocket-gophers. Spermophiles are usually larger and have more slender bodies than the chipmunks, and they are never

arboreal in their habits. They have large cheek-pouches, and their food is mostly seeds and grain. The genus is widely distributed over the north temperate parts of both hemispheres, except western Europe and the eastern United States. More than fifty species and varieties are found in North America, and the greater part are restricted to the arid and semiarid regions west of the Rocky Mountains. There they are regarded as the most destructive of rodents. Some of the states have tried many remedial measures against them, and have spent large sums of money for their repression. Fortunately, there are but three species found in Kansas. One of these, while common and generally distributed, is small, and confines its depredations to grain. Of the others, one is large, and feeds on fruits, vegetables, and grain, but is not numerous enough to become a great pest. The other is found chiefly in the sand-hills of the Southwest.

The Spotted spermophile (*Citellus spilosoma major* Merr.) is found in the sand-hills of southwestern Kansas. It may easily be distinguished from the other ground-squirrels of our state. It is not so large as Franklin's spermophile and has a less bushy tail. Also, it is somewhat heavier in body than the Striped ground-squirrel and has the entire upper parts mottled with indistinct white spots. There are no distinct stripes. The animal is found to be rather common in the sand-hills south of Kinsley, and no doubt occurs in similar places in all the region south of the Arkansas river. In habits it resembles the Striped ground-squirrel.

The Striped spermophile (*Citellus tridecemlineatus* Mitch.) is found in all parts of the state that are not timbered, but it is more numerous westward. In the western third of the state the type form is replaced by a paler variety, called pallidus. The Striped spermophile should not be confused with the Striped chipmunk (*Tamias*), which is also often called Striped ground-squirrel. The spermophile is longer, more slender, of a dark brown color, and has seven yellowish white lines alternating with six rows of yellowish spots along the back, whence its specific name, which means thirteen-lined. Kansas comprises but a small part of its range, which extends from central Texas to the plains of the Saskatchewan, and from Michigan to the foot-hills of the Rocky Mountains.

In central Kansas the Striped spermophile retires to its burrows early in October and is not seen again until about April 1. As far as my personal observation has extended, I have found that their hibernation is complete and that it lasts at least five and a half months. The young are produced in the spring, and number from six to ten, or even more, at a litter. During the early spring the animals do not appear to be as active as later in the season. This is probably be-

cause they have stores of grain laid up from the preceding fall, upon which they depend for subsistence during the breeding season, when food is comparatively scarce.

I have often dug open the burrows of this species. Many of them are comparatively short, and seem to be used merely as shelter holes. Others are longer, extending to even twenty feet in length, and are used as permanent homes. All of them go down rather abruptly at first and then go off horizontally. They are rarely over two feet from the surface at any point. They are about two inches in diameter, and the entrance is often hidden by a weed or tuft of grass. The animals are not particularly shy and one may be approached quite closely if it is near enough to its burrow to assure its escape. They often stand upon their hind feet, stretched to the full length, and, as they stand thus motionless, might easily be mistaken for stakes set upon the prairie.

As has been said, their chief food is grain and seeds of grass and weeds, but they also consume a considerable number of insects of various kinds, and will eat dead birds and even small rodents. It is not probable that they are able to capture and kill small birds, but that they eat only such as they find dead in their way. Grasshoppers form a considerable percentage of their food, especially during the months of July and August, and this circumstance alone is almost sufficient to atone for much of the mischief of which they are accused.

I have received from some parts of the state many complaints of the depredations of this species on fields of newly planted corn. They seem to have a way of determining exactly the location of uncovered grain and seem to dig only at that particular spot. It is probable that they can smell the grain. Entire rows of the corn are thus harvested before it has time to sprout. This damage usually occurs on the edge of a pasture in which the spermophiles have their home. The animals are also troublesome to growers of melons and other vegetables that are grown from seeds.

The Pale Striped spermophile (*Citellus tridecemlineatus pallidus* Allen) does not differ in habits from the type form. It is more abundant within its range, and, as cultivated fields are not so numerous as farther east, its depredations are more noticeable and more keenly felt.

Franklin's spermophile (*Spermophilus franklini* Sab.), often called the Gray gopher, is much larger than the preceding species and has a longer and more bushy tail. It is well distributed in the northern half of the state, but is nowhere so abundant that its depredations are serious. Outside of the state it is widely distributed, its

range extending from Indiana westward to the Dakotas, and from central Kansas north to the valley of the Saskatchewan. Its food habits are somewhat similar to those of the Striped spermophile, although there seems to be a greater range in the food chosen. About thirty per cent of its food is animal matter.

The spermophiles breed but once a year, but the number of young seems to be larger than is the case with any other genus of North America Sciuridæ. If it were not for the repressing influence of their natural enemies they would increase so rapidly that they would soon have a serious effect on the crops of the state. These natural enemies include hawks, coyotes, skunks, weasels, the Short-eared owl, and domestic cats and dogs. Nearly all the hawks capture spermophiles, but the Marsh harrier is probably the most important agent in reducing their numbers.

In places where the spermophiles have increased so as to become pests to the farmer, the most effective and easiest remedy is to administer grain which has previously been soaked in a solution of strychnine and sweetened. Wheat is the best bait. The poisoned grain should be scattered near the burrows occupied by the animal or along the edge of the field to be protected. Care must be taken that domestic fowls do not get the poisoned wheat. After the middle of April there is not much danger that insectivorous birds will eat the grain and be killed. Carbon bisulphide can also be used effectively in destroying spermophiles. A special section of this bulletin will give full directions for preparing and using the poison and for using the carbon bisulphide.

Genus CYNOMYS Rafin.

The genus *Cynomys* has shallow cheek pouches, rudimentary ears, and a short, flat tail. The toes are all clawed, the pollex large, with a well developed nail. The pelage is short, full, and soft, and the dentition is heavy. The anatomical characters show that the genus is highly specialized. It is restricted to the plains bordering and the parks within the Rocky Mountain plateau. There are six species, only one of which is found in Kansas.

The Prairie-dog (*Cynomys ludovicianus* Ord) is a remarkable and a characteristic mammal of the plains. It was mentioned by all the early explorers of the West. Pike found it in Kansas, and called it by the Indian name, Wish-ton-wish. Lewis and Clark called it the "Barking squirrel" and "Petit chien." Say gave it the first scientific description, and called it "Louisiana marmot," adding that "the absurd and inappropriate name of "Prairie-dog" was given to the animal from a fancied resemblance of its warning cry to the hurried barking of a small dog." Much has been written about its habits, and indeed

its social life is most interesting. Many mistakes about its habits have been repeated so often that they have taken a firm hold upon the public credulity, and it seems to be almost folly to try to correct them.

The prairie-dog burrows to a depth of from twelve to sixteen feet, for its permanent winter home. The hole goes down at an angle of about forty degrees for a distance of about eighteen inches, and then goes down nearly vertically. At the bottom, it turns off sharply and ascends slightly for a distance of several feet to a hollow cavity in which the nest is placed. This is composed of fine grasses, mostly buffalo-grass. Sometimes the animals have another entrance to the den. A passage leads off from near the nest and gradually ascends to the surface, reaching it at the distance of a rod or more from the main entrance. The passage connecting the "back-door" entrance with the main burrow is closed at certain seasons by closely packed soil taken from the surface of the prairie. It is difficult to find out the reason for this arrangement; but I have observed that the young animals seem always to be first brought to the surface through these secondary openings, and use them until they are nearly full grown. I have found that it is easy to drown out the young from the burrows in which they take shelter, it taking only a few gallons of water to fill the holes to the top. I conclude that the young are born in shallow burrows; but whether new burrows are especially dug to accommodate them, or whether the connecting passage is closed just before the young are produced, I am unable to determine.

The number of young produced at a birth is normally four. I have never found more than that number of embryos in a female, but have also never found less than two. They are born in late March or in April. They come to the surface in May and June, and soon become large enough to shift for themselves. In July and August they are busily engaged in digging new burrows or fitting up and cleaning out old ones. This work is usually done by pairs of the animals working together, and I have no reason to believe that this pairing is not a permanent one. In cold weather the animals collect into groups of from four to a dozen to a single burrow. This arrangement seems to be for mutual warmth and lasts only until the coming of warm weather. In the latitude of Kansas the animals do not hibernate completely, but come to the surface to feed throughout the winter, except in cold and stormy weather. My observations lead me to conclude that there is a partial state of hibernation in the prairie-dog in winter, whenever it is asleep. The respirations and pulse become slow and it is very difficult to arouse it.

The prairie-dog feeds almost entirely upon grass and grass seeds

and seems to get along without water to drink. It is very fond of the wild onions found on the prairie in the vicinity of its burrows, and it goes far afield to find them. In addition to eating the grass, it cuts down grass and all sorts of weeds that obstruct its vision or that would afford concealment to such enemies as wolves or foxes. Its damage in western Kansas is mainly on pasture lands, and amounts to at least half the value of the pasture on the lands occupied by the pests. They do not damage irrigated lands. On wheat lands or where attempts are made to grow crops they stick tenaciously to their homes, unless there are pasture lands adjoining; and it is always a contest between the animals and the growing crop as to which shall prevail over the other. In nearly all cases the prairie-dogs come out victors. The exception is a thickly sown and fast-growing crop of cane or Kafir-corn. With good rains this will grow faster than the animals can cut it down.

Statistics collected in the fall of 1901 showed a total area of lands in Kansas occupied by prairie-dogs amounting to 2,500,000 acres. These involved a loss to the cattlemen of the state of over \$100,000 annually because of impaired pasturage. The loss to crop-growers was probably as great. Three years of warfare against the animals, aided by small legislative appropriations, have followed. The result has been that more than half of the land has been entirely reclaimed, and another year of effort will destroy the animals over more than half of the remaining area. There is no doubt that the prairie-dog of Kansas will soon become so reduced in numbers as to be no longer a pest. The work of destruction was wisely placed under the direction of the State Agricultural College Experiment Station. The strychnine poison by which most of the killing has been accomplished was prepared in the College laboratories, and has been sold to the townships and individual users at the cost of the materials used in its manufacture. The legislative appropriations for the three fiscal years amounted to \$7000, of which about \$6200 was expended; but to offset this the Station has, as capital for the next year's work, about \$3000 in cash, poison and material now on hand. The net cost to the state for carrying on the work has thus been less than \$1100 per year.

Genus MARMOTA Zimmerman.

The genus *Marmota* is the largest of the North American Sciuridæ. The form is stout and heavy, the legs short; tail short, stout and hairy; cheek pouches small; fore feet with a rudimentary pollex having a flat nail; skull heavy. Six species and three varieties are known from North America, and two or more from Europe. Only one species is known from Kansas.

The woodchuck (*Marmota monax* Linn.) is widely distributed

in the middle United States east of the plains. Its range is from middle Georgia north to New York, and westward to eastern Kansas, Nebraska, and the Dakotas. North of central New York and Massachusetts it grades into the form *M. m. canadensis* Erxl. In Kansas, the woodchuck, or ground-hog, is confined to the rolling parts of the northeastern and eastern counties. It has not been reported west of the Blue river. In its food and general habits it resembles the spermophiles, but its larger size makes it a greater factor for harm to crops wherever it is sufficiently numerous. In this state it has been rare, and no complaints of damage from it have been reported. In recent years it seems to be more numerous than formerly, and it may yet become a pest in the state. It is, however, easily trapped and easily poisoned.

Genus SCIUROPTERUS F. CUV.

The Flying squirrels belong to two genera, *Pteromys* and *Sciuropterus*. The former is restricted to southern Asia and the Indian archipelago. The species are the largest of the Sciuridae except those of the genus *Arctomys*. The smaller Flying squirrels comprise the genus *Sciuropterus*.

The anatomical characters of this genus differ but little from those of the true tree squirrels, except that in this "the limbs are united by a furred membrane, formed by the expansion of the skin of the sides of the body, and supported anteriorly by a slender bone articulating with the carpus and directed backward." The tail is about two-thirds as long as the head and body, broad, flat, and depressed, and with the longer hairs directed sidewise, forming a sort of helm to direct the animal's so-called flight. This is merely a leap into space, generally from a high branch of one tree to a low branch of another. The distance covered by some of the leaps is remarkable for so small an animal.

Five species and eleven varieties of this genus are recognized in North America. Europe has a single species, and there are also several in Asia. One species is found in the wooded parts of eastern Kansas.

The Southern Flying squirrel (*Sciuropterus volans* Linn.) is found from the latitude of northern New York south to Florida and west to the plains, and while not really rare in eastern Kansas, is but little known even to people living near to its haunts. This is because of its nocturnal habits. In the daytime it keeps closely to its nest in hollow trees, but at dusk it comes out in search of food. It feeds upon nuts, hackberries, and the seeds of various fruits.

The Flying squirrel is surely the most beautiful of all the Sciuridæ. Its fur is fine and soft, and the animal itself graceful in form and

sprightly in movement. In color, the upper parts are drab, shaded with russet, and the under parts are light buffy gray. It is in no sense a pest to the farmer, although it may sometimes take a few cherries or other fruit from his orchard. Its small size forbids the utilization of its flesh as an article of food or of its fur in the manufacture of apparel. Owls seem to be the most formidable natural enemies of this species; but cats, weasels and skunks undoubtedly capture some of them on the ground. In spite of natural enemies they would increase in numbers, but the steady destruction of the older growth of timber in our forests and the conversion of the forests into fields are restricting its range and threaten soon to drive it from the state.

FAMILY CASTORIDÆ. Beavers.

The differences between this family and the Sciuridae are anatomical and would not appeal to the general reader. The massive lower jaw, the round mandible and the large incisors make the family preeminently the gnawers among the Mammalia. There are several fossil genera, but the genus *Castor* is the only living representative of the family.

Genus CASTOR Linn.

The genus *Castor* is characterized by having the feet four-toed, hind feet large and webbed; the three upper molars are subequal, with one inner and two outer enamel folds; the tail is broad, flat, and scaly,

The beaver is found in North America, Europe, and western Asia. There is a difference of opinion as to whether the old world beaver differs specifically from the American form. Recent authorities lean toward their separation, the former retaining its Linnæan name, *Castor fiber*, and the latter the specific name, *canadensis*.

The American beaver (*Castor canadensis* Kuhl) was once generally distributed over the wooded parts of North America, south almost to the Gulf of Mexico, and, further inland, into Mexican territory. Besides the type form, three local races have been recognized. The Kansas animal is of the typical variety.

The beaver is the largest of North American rodents, and its skill as a builder has been among the wonders of natural history. However, this wonderful skill has been observed only in regions which have been undisturbed by the encroachments of civilization. With the coming of the settler, its huts, canals and dams have fallen into decay, and the animals have taken to living entirely in underground burrows. Even here they do not long resist the rapacity of man, and soon become only a memory to the oldest of the settlers. But in the mountain valleys all over the country they have written the story of their lives in changes of the landscape caused by their operations. By

building dams they have submerged hundreds of acres in a single valley, and the timber has then been cleared from the inundated land. The ponds have slowly filled up with silt, gradually changing to marshes, and finally to beautiful meadows.

The fur of the beaver is of great value, both because of its quality and the size of the skins. The demand for it has increased much more rapidly than has the supply. Indeed, the supply has for years been constantly diminishing. It is this fact that has been the cause of the constantly shrinking range of the animal. As late as 1880, the beaver was still common along the Kansas river and its tributaries. There is no doubt of its rarity at present. For several years I have seen no evidence of its felling trees along our streams, nor has its presence been reported.

FAMILY MURIDÆ. Rats, Mice, and Voles.

“The North American Muridæ are characterized as follows: Dental formula: $i. \frac{1-1}{1-1} m. \frac{3-3}{3-3} = 16$, Anteorbital foramen, a large pyriform slit bounded anteriorly by a broad plate of the maxillary. Coronoid, condylar and descending processes of the mandible well developed and distinct. Tibia and fibula united above.”—*Dr. E. Coues.*

This family of rodents comprises a large number of genera and species, nearly all of which are harmful to the farmer. So rapidly do they multiply, that the aggregate of damage done by them, even when they occur in normal numbers, is immense; but when this damage is increased in any locality by the irruption of vast hordes of a migrating species, it becomes appallingly great. The United States has, fortunately, been comparatively free from such migrations. The different genera have been divided into from two to four subfamilies, based on characters chiefly anatomical, but these subfamilies will be here disregarded, because the purpose of this bulletin is economic rather than scientific. There are nine genera represented in our state.

Genus MUS Linn.

This genus includes the well-known and generally cosmopolitan species that infest the houses, barns and warehouses of this country. The ears and eyes are both large; the snout pointed; the tail long and covered with circlets of scales; the molars have a transverse series of tubercles, three in a series, longitudinal. Two common species inhabit the state.

The Brown rat (*Mus norvegicus* Erxl.), often called the Norway rat, is not indigenous to North America, and were this a scientific paper it would not be considered, but the animal is of such great importance economically, and its repression such a difficult task, that to

neglect it would be a serious omission. Having been introduced into America long after the Black rat (*M. rattus* Linn.) reached our shores, it has nearly always displaced and driven out that species. Its greater vitality and aggressiveness make it also a much more formidable pest than the longer-known species.

The Brown rat may easily be distinguished from the Black rat by its color and the relative length of its tail. The latter is sooty-black above, plumbeous beneath, and has brown feet; tail longer than the head and body. The former is rusty, grayish brown above, ashy white beneath, with sides grayer than the back; tail shorter than the head and body. I do not know that the Black rat has ever been reported from Kansas. The Brown rat is abundant throughout the state, and always a pest when present in large numbers. It is especially annoying in its depredations around granaries, corn-cribs, elevators, and warehouses. The habit of migration is often observed. It appears suddenly in large numbers in places where it had hardly been noticed previously. In June, 1903, the valley of the Kansas river was inundated for miles to a depth of from four to ten feet. Apparently all the rodent pests that had occupied the flooded district had been destroyed; but within six months the entire district was experiencing the worst plague of brown rats that it had ever known.

The problem of effectually dealing with rats is more serious than any other concerning mammalian pests that has confronted the world. Besides the material losses from their depredations, it is quite certain that they are active factors in carrying contagious diseases from place to place. The highest skill of the bacteriologist has been utilized without success in trying to devise an effectual remedy for the plague of rats. From time to time the public press has announced that in London or Paris or Berlin the problem has been solved, and that the rats are dead; but a letter to the authorities of the city named brings the reply that the announcement is false and that the rats still flourish and prey upon the possessions of the people.

My experiments in destroying rats have not been as successful as I desired them to be. Trapping with any known device has proved to be ineffectual. They are the most difficult of rodents to poison to the point of extermination. One can kill large numbers of them with a certain bait and find that the survivors will not eat any of it. A change of bait may be successful for a time, but there always seems to be a remnant that no poison will reach. Strychnine poison is the most successful. Potassium cyanide loses its strength too soon through decomposition. Phosphorus is too dangerous, as the rats are likely to carry it to places where it might ignite and burn buildings. Arsenic is not sufficiently active in its effects.

Until further and more successful investigations have been made, the advice that I can give to farmers plagued with rats, further than recommending the use of strychnine, is of a rather general nature. First, in building granaries or corn-cribs be sure to leave the space under the floor open for the easy ingress of cats, dogs, or other enemies of rats and mice. Also make the floors as tight as possible so as to prevent the ingress of the pests to the stores of grain. With buildings so constructed, and a properly trained rat dog about the premises, there will be little need to resort to poison, unless a migrating body of the rats should appear. Cats are also useful about the farm buildings, unless they are of the kind that prefer birds to rats and mice as a diet. Skunks are by far the best ratters known to me, and a single specimen will, in a few days, either kill or drive away all the rats and mice that may be about the farm buildings. If they can be kept away from the poultry they are in no way objectionable on the premises. Of course, one could not have both dogs and skunks present at the same time without disagreeable complications.

The House mouse (*Mus musculus* Linn.) is abundant in all parts of Kansas. It is so well known that it needs no description. If specimens are taken in the fields, they may be easily distinguished from other species of its size by the facts that the scaly tail is longer than the body, and that the soles of the feet are naked.

The house mouse is a pest everywhere, but its ravages are less extensive than those of the rat. Like the rat, it has a large range of things upon which it habitually feeds, but it is smaller and not so difficult to deal with. Traps, cats, and poisons all succeed better against mice than against rats. Most of the proprietary preparations sold for killing rodents also succeed better with mice. Wheat soaked in a solution of strychnine may be used with absolute success in destroying them, but is open to the objection that all the mice die upon the premises. This would make its use disagreeable in houses occupied as dwellings.

Genus ONYCHOMYS Baird.

The species belonging to this genus are but little known even to scientists. They have very secluded habits, living in burrows somewhat like moles, and feeding mostly at night. Prince Maximilian of Wied first met with the genus during his travels in the West in 1833, and described the species *leucogaster*. As late as in 1877 Doctor Coues knew of but two species, one of them known then by a single specimen. Through the researches of Doctor Merriam and others the number of known forms has increased to about a dozen.

From their food habits the mice of this genus have been known as Grasshopper mice or Scorpion mice. They have also been called Mole

mice because of their fossorial manner of life. They are distinguished from the other genera of the family by their compact form, short tail, and short hind legs; the front legs are well developed, with claws well fitted for burrowing; the pelage is soft and mole-like in character. Two species belong to the fauna of Kansas.

The Missouri Grasshopper mouse (*Onychomys leucogaster* Wied) is probably well distributed in the state. It has been taken at Neosho Falls, Fort Riley, Kinsley, and other places, but its underground life prevents its being well known. This species is distinguished by having strong front legs and a short tail, thick at the base, tapering to a point, and covered with short hairs. In color it is grayish brown above, changing to yellowish red at the sides, and then to a distinct line of fulvous, which borders the white under parts. The outer side of the fore legs, the feet and the tip and under side of the tail are white. It is found in Dakota, Nebraska, Missouri, Kansas, Oklahoma, and Texas.

The Arizona Scorpion mouse (*Onychomys torridus* Coues) has a somewhat wider range than the preceding species. The type is from Arizona, and the species ranges eastward to the Mississippi river, and northward to the Missouri and Red River of the North. It differs from *leucogaster* in having the general color more yellowish, the white of the under parts more tawny, the tail longer and without the whitetip. It is probably not as common in the state as *leucogaster*.

The Grasshopper mice are mainly creatures of the prairie and of the arid regions westward. Their food as far as known is largely composed of insects; but they are known to eat spiders, scorpions, and small mammals. Mr. W. W. Price says of the Arizona species: "It lives in holes under bushes and brush heaps, and is partly carnivorous, for we frequently found the stomachs filled with scorpions, insects, and the hair and flesh of mice. They would often drag off our traps containing small mammals. We sometimes found a trap containing a half-eaten mouse lodged in the mouth of this animal's burrow."

From the evidence obtainable concerning the habits of the genus they are decidedly useful in destroying grasshoppers and other noxious insects, and no evidence of their depredations on crops has thus far appeared.

Genus PEROMYSCUS Gloger.

The White-footed mice, called also Deer mice, are included in this genus. They are characterized by having long hind legs and short front ones; front feet small, digits slender, palms naked; hind feet long, soles with six tubercles, and in some species furred posteriorly; tail terete, tapering, slender, and hairy, sometimes longer than head and body. Size of animal moderate; eyes prominent; nose pointed;

ears thin, mostly rounded, sometimes quite large; colors bright, and the contrast between the upper and lower surfaces of the body and tail is marked. There is much confusion as to the distinguishing characters of the species and as to the real number of species. Mr. Wilfred H. Osgood, of the United States Biological Survey, has a revision of the genus in preparation, and when it is published, the confusion will probably disappear.

There are at least two and possibly five or six varieties of White-footed mice found in Kansas. Professor Knox gave two species in his list of Kansas mammals, but one of them, *Peromyscus nuttalli* Harl., was evidently based on a wrong determination, since Kansas is far removed from the range of that species,

The Fulvous White-footed mouse (*P. texanus nebrascensis* Mearns) is found in the north-central and western part of the state. Probably common. It may be recognized by the white patch in front of the ear. Above gray fulvous, under parts white; tail black above, white below. The Texan White-footed mouse (*P. americanus texanus* Woodh.), taken by Granger at Long Island and at Pendennis, may be the type form of which *nebrascensis* is a variety.

The Michigan White-footed mouse (*P. michiganensis* Aud. & Bach.) is found abundant in the eastern half of the state. It is stoutly built; has the tail more than half as long as the head and body; the ears naked; coloration above mixed brown and black, darker along the median line; cheeks and sides of the neck yellowish fawn; tail, feet and ears light brown. There have been several species of White-footed mouse taken quite near to the borders of Kansas which further investigation may prove to be found within the state also. They are *P. canus*, *P. bellus*, and *P. attwateri*.

The White-footed mice feed on grain, weed and grass seeds, insects, fruits, and tuberous roots of plants. They make their homes in all sorts of places—in the orchard, in sheds, under fences and brush heaps, and anywhere in which they can find shelter and food. They do not hibernate, but endure the severest winter weather without perishing. Their presence in winter and their abundance are shown by the tracks made in the snow near every thicket and clump of grass. The animals undoubtedly do some damage to crops in the field and shock, but the damage is not very serious in extent, and is counter-balanced by some good done by them in the destruction of insects and weed seeds.

Some complaints of serious damage to the contents of hotbeds and cold-frames done by White-footed mice have been received, and there is no doubt of the truth of the charge. In the spring of the year, when their stores of food have been exhausted and they can find an

entrance to such a place, they attack seeds, bulbs, roots, and even tender growing plants, and, if their numbers are great, will ruin the place in a single night, for they carry away stores of the food for future use. The trouble often grows out of the practice of neglecting such places during the latter part of summer and fall, and allowing grass and weeds to mature and remain all winter on the ground as a harbor for the mice. Often the cold-frame is chosen by them as the site of their nests and the depot for their stores. By cleaning up the place before winter and removing the trash that may have accumulated, all trouble of this kind from the White-footed mice can generally be avoided. If they are noticed as present in the cold-frame, a little wheat poisoned with strychnine will soon clear them out.

In Kansas these mice do not often enter houses and barns after stored food, as does the more familiar House mouse, but in the Southwest they are often known to do this, and thus make themselves decided pests. Here there are enough of their natural enemies to keep them somewhat in check. The enemies that hunt at night are the most effective against them. These comprise all the owls, cats, weasels, skunks, and minks. But some of the mice are also captured on daytime by hawks and snakes.

Genus SIGMODON Say and Ord.

The Cotton rat (*Sigmodon hispidus texianus* Aud. & Bach.) is known only from one locality in the state, Cairo, where it was taken by Vernon Bailey, of the United States Biological Survey. He found the animals abundant at this place, and they no doubt occur at other points in southern Kansas.

The Cotton rat is about the size of a half-grown Brown rat and has the color and shape of a vole. The tail is rather long, round, and tapering, and the rings or annuli show plainly through the sparse hairs. The soles and palms are bare and have peculiar wrinkles on them. The pelage is very coarse.

The animal is usually found about shocks of grain, especially of corn, where it does much damage by cutting the leaves and stalks and eating the grain. The young are from six to ten in number at a birth. They mature very soon, and reproduction of the species is so rapid that they are likely to become a great pest wherever they appear. Fortunately their haunts are usually accessible and poison is very effective in destroying them.

Genus ORYZOMYS Baird.

The Rice-field mice of this genus have much the appearance of undersized rats. The tail is longer than the head and body, and is nearly naked above, and tufted at the end. The legs are short, but

the hind feet are very long. The soles are naked, with six tubercles, all small except the posterior, which is long and narrow. The ears, low, orbicular, and covered thickly with hair, have a well-developed antitragus, and are almost concealed in the fur. Other peculiarities of structure show that the animals are well adapted to an aquatic life.

The Texan Rice-field mouse (*Oryzomys palustris texensis* Allen) is the only species of the genus that has been found in Kansas. It was taken at Neosho Falls by Capt. B. F. Goss, and was regarded as a large form of typical *palustris* until the Texan race was described by Doctor Allen.

The Rice-field mouse lives in swamps, but has its name from the fact that the rice-fields are its favorite habitat. Its food is rice and other grains, and when abundant it undoubtedly harms the crops on which it feeds. It is not sufficiently common in Kansas to become a pest.

Genus REITHRODONTOMYS Giglioli.

North American mice with the upper incisors grooved longitudinally are included in this genus. The groove is nearly as broad as the tooth itself. The species are of very small size, much less than the common House mouse, which they resemble in general appearance. They are strictly field mice, and have been called popularly Harvest mice. Some fifty or more species and varieties have been recognized. One species and a variety of it are found in this state.

The Dyche Harvest mouse (*Reithrodontomys dychei* Allen), named by Doctor Allen in honor of Professor Dyche, of the Kansas State University, was first collected by Capt. B. F. Goss, near Neosho Falls, and was referred by Doctor Coues to the species *humilus*. Later Doctor Allen received specimens from Professor Dyche which had been taken near Lawrence. He described them, and named them *dychei*. An examination of the Neosho Falls specimens proved them to be identical with the type from Lawrence. The species is not rare in the state.

The Nebraska Harvest mouse (*R. dychei nebrascensis* Allen) has been taken at Pendennis, Lane county, Kansas. This is the only record of its occurrence in the state with which I am acquainted, but it is probably not uncommon in the western part in suitable localities.

Little is really known about the breeding habits of the Harvest mice. I have found Dyche's mouse under corn-shocks, in October and November. It builds a nest on the ground, and composed of fine grasses lined with soft materials, usually the pappus of the milkweed (*Asclepias*). The young, six in number, are found in the nest about the middle of October. It is probable that there are earlier broods,

but I know nothing of the situation of earlier nests or of the localities chosen by the animals during the summer months. The animals probably feed almost entirely on grains.

Genus NEOTOMA Say and Ord.

This genus is peculiar to north and middle America. It includes the large-sized Sigmodont rats, so familiar to every one who has spent any considerable time in the woods of eastern Kansas, and also a large number of similar forms. They have long, pointed, mobile snouts; long whiskers, often reaching to the shoulder; large eyes and ears, the latter orbicular and nearly naked; long tails, either bushy or almost naked. The feet are small, broad in proportion to their length, and with short toes. The fore foot has four toes, with perfect claws, and a rudimentary thumb with an abortive nail; the hind foot has five perfectly clawed digits. The palms are naked, with five tubercles; the soles nearly or entirely naked, with seven tubercles. The pelage is soft and lustrous, nearly always white below.

About thirty-six distinct species and nearly as many subspecies of this genus have been recognized in North America. The tendency to multiply species and varieties has been characteristic of the last decade and grows out of the better understanding of osteological characters. Doctor Coues, in 1877, recognized only four species in the same range. Two of the newer forms belong to the Kansas fauna, but they had both been previously reported under older names.

The Prairie wood-rat (*N. campestris* Allen) was first taken at Penderdennis, Lane county, by Mr. Granger, and described by Dr. J. A. Allen. It is found in favorable localities in the western part of the state. The tail is long, nearly bare, and terete. The color above is yellowish gray, varying to buffy brown; under parts and feet white. The tail is pale grayish brown above and white below.

Bailey's wood-rat (*N. campestris baileyi* Merr.) is rather common in eastern Kansas. It differs from the Prairie wood-rat in having the color above a grizzled gray instead of yellowish or brownish in any part. The face is clear gray; tail dusky above, white below.

The wood-rats are noted for the large piles of brush and other material which they bring together as a covering for their burrows. These piles are composed of sticks of various lengths but not over two-thirds of an inch in diameter, together with weeds, grass, corn-husks, and miscellaneous trash, the whole rising to the height of from two to five feet above the ground. If the piles are left undisturbed, they will be added to from year to year, and built up as the lower parts rot away. In this way the piles slowly increase in size. They cover the burrows which are the real nests of the animals. These burrows are at the foot of a scrubby tree, in a hedge, under a fallen

log, or in a ledge of rocks, and of course the piles of brush are in these situations.

The food of wood-rats is composed of green vegetable matter or grains and seeds of various kinds. They are noted for the habit of making stores of seeds and of moving them from place to place in a very capricious manner. In the winter they feed on these stores and on the green bark of small trees. They do not hibernate, but are active during the entire year. They often damage growing hedges in which their home is made, by eating the bark far up on the shoots. No complaints of their having damaged orchards by girdling the young trees have been received; but they sometimes enter houses, and are then about as troublesome as the common rat.

I can easily believe that, if their numbers were great enough, these animals would become serious pests on the farm. However, they usually make their homes in deep woods and thickets, where their work of destruction is not seriously felt. It is chiefly in the matter of the Osage-orange hedge that damage has been noticed. The breeding habits of wood-rats are not well known.

Genus MICROTUS Schrank.

This genus includes the voles or Meadow mice, which may be distinguished by the following external characters:

Size moderate or rather large; form stout and clumsy; feet and tail short, the latter longer than the hind foot, terete, and thickly covered with hair; muzzle blunt and covered with fur, except the small nasal pads; eyes small and situated about half-way between the muzzle and the hidden ears, which have a large antitragus; incisors broad and not grooved.

Voles are found throughout the greater part of the northern hemisphere north of the tropics. In North America they are most numerous in the central parts, and decrease in numbers both toward the arctic and the tropical zones. The number of American species and subspecies, as determined by Mr. Vernon Bailey, who recently revised the group, using the vast number of specimens now available, is about seventy. Four species are found in Kansas, and are of great economic importance.

The Meadow vole (*Microtus pennsylvanicus* Ord) is rather common in the eastern part of the state. It is found in meadows on the border of marshes and along the borders of corn-fields. In winter it burrows under stacks and under corn-shocks in the field.

The Prairie vole (*M. austerus* LeConte) is abundant over the greater part of the eastern half of the state and farther west in central Kansas. It also is fond of flat and rather moist prairies, and is a pest in corn- and wheat-fields, and especially in orchards.

The Woodland vole (*M. nemoralis* Bailey) is found in the wooded parts of eastern Kansas, and is not very common.

The Hayden vole (*M. haydeni* Baird) is common in the western half of the state. The open condition of the country and the abundance of the natural enemies of the genus prevent its rapid increase in the dryer portions of the state, so that while it is comparatively common, it does not become so injurious as the species found in the eastern part of the state.

Most of the complaints of destructiveness on the part of voles in the United States are concerning *M. pennsylvanicus*, but in Kansas the great abundance of the Prairie vole make it the most destructive species with which we must contend.

The voles are popularly known in Kansas as Meadow mice, Bear mice, Field mice, Ground mice, and Mole mice. They burrow in the ground to some extent, but their presence is always made known by the smooth trails or runways along the surface of the ground, which extend from burrow to burrow, and are often apparently covered over. This covering of the trail is, however, usually only the trash found along the way and never wholly of soil, as in the case of the common mole. The trail may pass under sods and clods of earth in a plowed field and again emerge without passing into a burrow. The nests of the voles are often built underground in the burrows, but are frequently also placed under corn-shocks and piles of straw, hay, drift-wood, or other litter. A favorite place is under a pile of hay that has been left in the meadow over winter.

The nests are not always built to accommodate the young, but are sometimes used only for sleeping-places for the mature animals. They are made of grass and fine fibers and are rather bulky affairs, very warm and dry. In them the young are also produced. These number from four to eight, and seem to be born at no regular period of the year, but at all seasons. The period of gestation is not known, nor is the number of broods produced in a year. It is known that they increase with great rapidity, so that they have been compelled to choose either to migrate in vast numbers or to starve in their native homes.

The food of the voles consists mainly of green grass, roots, and bark. Of the grasses, they seem to prefer the succulent ends of the stems, but they also eat the blades and heads, including the seeds. In the winter they feed largely on the bark from the roots, trunks and twigs of trees and shrubs. They do not hibernate, but are active during the entire winter, and so become the most dreaded enemies of the orchard and nursery. The attacks of rabbits always leave visible effects, but the voles work under the snow or under the soil at the

base of the trees, and may do much harm before their presence is suspected. They are most liable to attack an orchard in which weeds and other litter have been allowed to accumulate.

The damage of these mice is not confined to the orchard and nursery, but extends to the fields of growing grain and to that stored in stacks and shocks. They cut off much more of the standing wheat than they ever consume, beginning their attacks on it when the stems are still juicy, at which period they do not consume any of the grain itself. If the animals were few in number their work would be of little importance, but they are often so numerous that the aggregate of grain taken on a single farm is enormous.

The voles have many natural enemies. Hawks, owls, skunks, coyotes, weasels, minks, and bull-snakes are among the more important animals that feed upon voles. The Short-eared owl and the Marsh hawk are the most effective destroyers of voles that we have. More than half of the food of these two species consists of field mice, most of which are voles. And yet farmers shoot these birds themselves or allow hunters to shoot them on their premises as though the birds were pests, instead of the most valuable protectors of crops.

In December, 1903, I was called to Lost Springs, Kan., to investigate an invasion of voles and other mice in a large orchard. The orchard covered 320 acres, and the trees were mostly apple, eight to ten years planted. The preceding summer had been very wet. The orchard had been planted in corn, listed between the rows of trees. On account of the wet season the crop had been abandoned, and the field allowed to grow up into grass and weeds, which had not been removed. The conditions were of the best for both mice and voles, and they were present in immense numbers. By December 18, the date of my visit, they had girdled about 6000 of the apple trees, wholly or partially, just at the surface of the ground, and had eaten the bark from many of the lower branches. Rabbits had also begun to attack the branches and trunks of the trees. The general condition was remarkable, because the weather had been warm and the winter entirely open up to this time. The entire orchard was scored thickly with the trails of voles. A force of men and boys was at work with brushes, painting the trunks of the trees with a decoction of soap and carbolic acid. It was subsequently shown that this did not protect the trees for more than forty-eight hours.

Upon my arrival in the evening, I placed a small quantity of poisoned wheat at the foot of each of about fifty of the trees. The next morning I found a considerable number of dead voles and White-footed mice under the trees. Some of the voles were dragged into the mouth of burrows, which I think belonged to the voles themselves, and were

partially devoured. Whether this was the work of shrews or of the voles I was unable to determine. We then prepared a large quantity of the wheat, and the force of men was set at the work of poisoning the mice and rabbits. Large numbers of the voles were found dead on the surface of the ground every morning, and many Michigan White-footed mice were also killed, and some rabbits. One morning twenty-two dead rabbits were counted, two of which were Black-tailed jack-rabbits. In about ten days the manager reported that the work of destruction of the voles had been completed. The voles were all of the species *M. austerus*.

In connection with this work, it is interesting to report that so far as could be learned no birds were poisoned during the time the work was in progress. There were several flocks of quail, many tree-sparrows, some juncos and over a dozen Short-eared owls in the orchard regularly, but none of them received any harm, so far as was reported to me. The owls ate freely of the dead mice without injury, and crows and hawks speedily devoured all the poisoned rabbits. The experience with sparrows and other small birds is quite different from that in western Kansas during the winter work in poisoning prairie-dogs, when many longspurs and shore-larks are killed by eating poisoned wheat. Eagles and hawks eat the dead prairie-dogs without injury.

I am satisfied that voles can readily be destroyed by the timely use of strychnine poison administered in grain as a bait. Perhaps a still better plan is to cut twigs from the apple trees and dip them into a syrup that has been poisoned. The twigs are then left near the base of the trees. They will be eaten readily by both voles and rabbits, and there is no danger of poisoning birds with them.

To save trees that have been injured by voles, cover the base of the tree with sand or soil to a point above the injury. If the bark has not been eaten down to the hard wood, new bark will soon grow over the injury.

Genus SYNAPTOMYS Baird.

A genus which is but little known, on account of the irregularity and rarity of its occurrence. Of the eighteen specimens listed by Doctor Coues in 1874, eleven were from Neosho Falls, Kan. Coues regarded all the specimens examined by him as belonging to one species. Nine species and two varieties are now recognized.

The animals belonging to this group differ from the voles (*Microtus*) in being smaller and in having the upper incisors grooved longitudinally along the outer edge. The ears are equal to or overtop the fur; pelage very soft and full.

For many years the only known Kansas specimens were those taken by Captain Goss at Neosho Falls. They were identified by Doctor

Coues as *Synaptomys cooperi* Baird. Doctor Merriam, in revising the genus in 1896, called it, in honor of the collector, *S. helaletes gossii* Merr. It has recently been found near Topeka.

The False lemming seems to live in the woods, and its food is mostly vegetable in source. It is known that it eats blue-grass stems, clover, and the tuberous roots of the wild artichoke. Its nest is usually in a hollow stump or log, and it produces about four young at a birth, in the winter.

Genus FIBER G. Cuvier.

The external characters of the genus are: Size large; hind feet oblique to the leg; tail flattened and fringed with stiff hairs; ears small, deeply buried in fur; palms and soles naked. The animal is aquatic in habit and so well known that description is useless. Five species and three varieties are found in North America, and it is distributed over the entire continent north of the Gulf and the Rio Grande.

The Common Muskrat (*Fiber zibethicus* Linn.) is found in all parts of Kansas where there is suitable water for its home. On account of the low price for its fur that has prevailed for some years, it has not been profitable to trap and hunt it, and it has increased in numbers, until it may now be said to be abundant. The animal feeds almost entirely on vegetable food, which is usually found sufficiently plentiful along the banks of our streams to satisfy its wants and obviate its attacks upon growing crops. In some sections of the country it has been known to have regular pathways worn from the water to the standing grain in the adjoining fields; but nothing of this kind has come under my observation in this state. In addition to a vegetable diet, it is probable that the muskrat eats crustaceans and freshwater mollusks to a considerable extent. In this state I have never seen any evidences of the dome-like houses, such as the animals build further north for their winter residences. Its home is a long burrow, starting at a point below the surface of the water, slanting upward, and terminating in a small chamber and a warm nest under the shelter of the roots of a tree.

The matter of the undue increase of the number of these animals is self-regulating and may well be left to the operation of the natural law. If they become numerous in any locality some persons will begin trapping them for the pelts, an occupation that is remunerative only when the skins can be readily obtained, but which will cease when they become scarce.

FAMILY GEOMYIDÆ. Pocket-gophers.

In the preceding families of rodents cheek-pouches, when present, had the opening inside the mouth. In the Geomyidae the pouches are present, are fur-lined, and open outside the mouth. The family and the type genus derive their name from their mode of life, which is entirely in the earth. Nine genera of pocket-gophers are known, all of them confined to North America, and distributed from Costa Rica on the south to the Saskatchewan on the north. Only three of the genera enter the United States, five are restricted to Mexico, and one to Costa Rica. Of the United States genera, *Thomomys* is found in the great plateau region from central Mexico and Lower California northward into British America; *Cratogeomys* from east-central Mexico northward through New Mexico, western Texas, western Oklahoma, into Colorado; while *Geomys* is restricted to two large and widely separated districts in the United States. One of these districts includes portions of Alabama, Georgia, and Florida, while the other includes much of the great low plain of the Mississippi valley, and extends from the Rio Grande northward to southern Minnesota and Wisconsin, and from eastern Illinois westward into Colorado and eastern Wyoming.

The pocket-gophers all have the external cheek-pouches, strong lower jaws, fore feet strongly developed for digging, very small eyes and ears. The genera found in the United States may easily be distinguished from each other by the condition of the superior incisors with respect to the number of grooves present. In *Thomomys* there are no median grooves, but sometimes a fine marginal groove is present; in *Cratogeomys* there is a single median groove; and in *Geomys* there are two grooves—a fine sharp one along the inner margin and a larger one bisecting the remaining plane surface.

Kansas has two or three representatives of the genus *Geomys* and perhaps one of the genus *Cratogeomys*.

The Prairie pocket-gopher (*Geomys bursarius* Shaw) is abundant in the eastern part of the state, and is the most formidable mammalian pest with which Kansas farmers have to deal. Its damage to the alfalfa growers of the state alone amounts to more than \$800,000 yearly. This damage is not directly in the destruction of the alfalfa plant so much as it is in the interference with the work of cutting the crop and the loss by reason of having to cut the plant far above the ground, to avoid running into the mounds thrown up by the gophers. This loss amounts to about one-tenth of the entire crop. Besides the damage to alfalfa, there is a similar one to clover, timothy, and native meadows, and the direct destruction of vegetable gardens and other crops. The total loss to the farmers of Kansas is immense, and war-



Pocket-gopher.

rants a careful consideration of the desirability of concerted township or county action to rid the farms of the animals. This species does similar damage to crops in Illinois, Wisconsin, Iowa, Minnesota, the Dakotas, Nebraska, and Missouri, a section of the most fertile land in the entire country.

The Prairie gopher may readily be distinguished from other species of *Geomys* by the color. It is of a dark liver color, lighter on the under parts, and has pure white fore feet, with longer claws than any other species.

The Plains pocket-gopher (*Geomys lutescens* Merr.) is found in the western part of the state, mostly in sandy situations. Its habits are similar to those of the preceding species, but it does not damage crops to near the extent that the Prairie gopher does. This is because the crops are absent and the animals are far less numerous.

The Plains gopher is a pale form, similar in type to *G. bursarius*, but smaller and less robust. It throws up smaller mounds and is distributed over the more arid portions of the plains, from eastern Wyoming and western Nebraska south into Texas.

Geomys breviceps Baird and *Cratogeomys castanops* Baird are two species of pocket-gopher which have been captured very nearly on the borders of Kansas, but no actual records of their existence in the state have been made. An intermediate form of *Geomys*, with some of the characters of the three species, *breviceps*, *bursarius*, and *lutescens*, united in the same specimens, has been captured in southern Kansas.

DESTROYING POCKET-GOPHERS. I have made many experiments in destroying pocket-gophers, principally with carbon bisulphide, gases, traps, and poison. It did not require much experience to convince me that the most effective and economical method of dealing with this pest is by means of poison introduced into food and placed in their runways. The method recommended in Press Bulletins Nos. 109 and 130 of this Station has been used quite generally in the state, and with great success.

BOUNTIES. Many of my correspondents have expressed the opinion that a system of bounties paid by the state would be effective in dealing with gophers, prairie-dogs, and similar pests. Such bounties have been often tried in other sections, always with a great expense to either county or state, and no appreciable results in diminishing the evils aimed at. In 1866 Benton county, Iowa, offered a bounty of ten cents per scalp for pocket-gophers. No diminution of the pest was noticed, and the following year the bounty was increased to twenty cents per scalp. The bounties for that year amounted to \$10,000. The county borrowed \$3000 and had left \$3000 in unpaid gopher warrants. The bounty was then reduced to twelve and one-half cents for

six months, then to ten cents, and was abolished on January 1, 1869. The entire amount paid out in three years was \$18,000; and the gophers were far from being exterminated. Other counties in Iowa, and in Minnesota, North Dakota, and South Dakota, have had somewhat similar experiences in using bounties in dealing with the pocket-gopher.

Under the present laws of Kansas, the county commissioners of any county may, at their discretion, pay a bounty of not exceeding twenty cents for the destruction of pocket-gophers. Under the law, only four counties have made the experiment of paying bounties—Atchison, Chase, Leavenworth, and Wabaunsee, the latter discontinuing the bounty at the end of six months. Previously, however, for over two years Cloud county had been paying a bounty of ten cents per scalp for gophers, with the experience that the claims for bounty were increasing from quarter to quarter without any apparent diminution of the number of animals in the county.

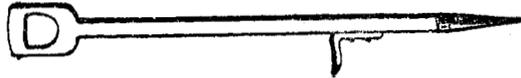
POISONOUS GASES. The use of carbon bisulphide and other poisonous gases has frequently been recommended for the destruction of the pocket-gopher. While these methods have been in part successful, the great length of the burrows and their irregularities in depth prevent the gases from flowing into every part, and thus the animals often escape. It is for this reason that the various machines that have been devised for forcing gases into the burrows of pocket-gophers have been practically useless. It is also true that these animals burrow so rapidly that they can and do instantly close the runways behind them to the ingress of the gases and so escape suffocation.

TRAPPING. Trapping, if properly done, is a sure method of killing the gopher, but it is attended with considerable labor and is very slow. A correspondent in Doniphan county reports that 350 of the animals were caught in four months on a forty-acre field of clover. He used the "Out-o'-sight" gopher trap. An excellent trap for general use is the No. 0 ordinary steel trap. In using it, enlarge the hole sufficiently to admit the trap, and remove all the loose soil which may have fallen in to obstruct the runway. Sink the trap in loose soil to the level of the runway, and nearly conceal it by sprinkling fine earth over it. Leave the hole open or cover it with a board, so as only partly to exclude the light.

POISONING. Pocket-gophers are easily poisoned. They are very fond of common potatoes, sweet potatoes, apples, raisins, and prunes. The presence of strychnine, arsenic or other poisons does not seem to deter them from eating the food; but if the poison is sweetened they seem to eat it more readily. In summer it may be desirable to

take the trouble to sweeten the poison, but in the fall and early spring it does not seem worth while to do this. The poisoned food being introduced to the burrows below the surface, there is no danger of poisoning stock. It might be well, however, not to let swine run in the alfalfa-fields for a time after the poison has been put out.

The following method of introducing the poison is recommended: Cut the potatoes, or other food, into pieces not more than three-fourths of an inch in diameter. Cut a slit in each piece, and with the point of the knife blade insert a little sulphate of strychnine; as much as half the bulk of a grain of wheat will answer the purpose. The moisture from the potato will cause the poison to adhere to the blade. Having prepared the bait in sufficient quantity, go to the field armed with a round, sharp-pointed implement an inch or an inch and a half in diameter and of sufficient length. The tool here illustrated was made for the writer by a blacksmith.



It is a spade handle shod with an iron point. A bar is attached about fifteen inches from the point, to enable the operator to use his foot in pressing it into the soil. This tool has proved to be quite serviceable. With it, it is only necessary to find the runway of the gopher. The handle is sufficiently thick to make a hole large enough to permit one to drop the poisoned potato directly into the burrow. The operator then passes to another place, leaving the hole open. No digging with a spade or other hard labor is necessary. An experienced person can distribute poison to many acres of alfalfa in a day; and if proper care is taken to rightly distribute the bait, it will not be necessary to go over the ground a second time.

Some experience is required to enable one to find the burrows quickly. It is best to insert the food in the main runway as near as possible to the freshest mounds of earth thrown up by the animals. Two or three pieces of potato at that place are worth many scattered in other parts of the runway. The operator should avoid the larger mounds and those that are not freshly made.

Some of the persons who have tried this method of poisoning pocket-gophers have reported that the animals throw out the bait to the surface and do not eat it. The difficulty seems to grow out of the practice of putting the bait in the mound that the animal is throwing up, instead of into the runway. The animal pushes a large quantity of soil before it, and if the bait is in the way will often push it out with the soil, without finding it. Further instructions for poisoning gophers will be found under the special section on poisons.

FAMILY HETEROMYIDÆ. Kangaroo Rats and Pocket Mice.

This family of rodents includes two subfamilies which differ widely in character. The Kangaroo rats (*Dipodomynæ*) have rootless molars and the superior incisors grooved and narrow. The mastoids are enormously developed, so that the temporal region appears much inflated. The pelage is soft. The Pocket Mice (*Heteromyinæ*) have rooted molars and the upper incisors narrow and grooved (except in one genus). The temporal region is moderately inflated or flat. The pelage is hispid or even spinous.

The Kangaroo rats have been divided into three genera—*Dipodomys*, *Perodipus*, *Microdipodops*. *Dipodomys* has the upper incisors grooved and pointing backwards; tail longer than the head and body, pencillate; hind leg long, hind foot with four toes only, soles hairy; cheek-pouches large; fur very soft.

Perodipus differs from the preceding genus in having the hind foot with five claws, the first digit being rudimentary, and having a claw which reaches to the end of the metatarsal bone of the next digit.

Microdipodops is very small in comparison with the other two genera. The tympano-mastoid is much more inflated; tail not pencillate; hind foot long.

The Kansas Kangaroo rats all belong to the genus *Perodipus*. Two species have been found.

Ord's Kangaroo rat (*P. ordi* Woodh.) is said to be found in scattered localities in the state. The size is medium; tail shorter than the head and body. In color the upper parts are ochraceous buff, darkest on the back, and mixed with black on the rump; sides paler; a spot behind the ear, sides of the nose, a stripe across the thighs and the under parts are white. The dorsal and ventral tail stripes are dusky, base of hairs white.

Richardson's Kangaroo rat (*P. richardsoni* Allen) is larger than the preceding form. The general color is similar, but the legs on the outside down to the heels have the same color as the sides of the body. The dorsal and ventral tail stripes are plumbeous black to the tips. This species was taken at Pendennis by Mr. Granger, and is the common form in most parts of the state.

A careful exploration of the state would probably result in the capture of one or more additional species. Kangaroo rats are abundant in all the sand-hills of the state, and, as these are in many widely separated sections, the presence of other forms is not impossible. The species live in burrows in the sand, or in the soft clay along washed banks on the face of the hills or along streams. They feed on seeds of grass or weeds or on grains. Insects form a part of their diet, but the proportion is not known. Farmers who have tried to grow crops of corn and

wheat in the sand-hills have complained to me of the destructiveness of these animals, which they call "sand rats." Like the spermophiles, they also take newly planted seeds of corn and vegetables. In such localities the Kangaroo rats are undoubtedly great pests and should be destroyed.

Genus PEROGNATHUS Wied. Pocket Mice.

This genus is the most important North American representative of the subfamily Heteromyinæ. The molars are rooted, the incisors are narrow and grooved, the mastoids are moderately developed; the tail is of moderate length; the soles are naked or sparsely haired. The genus is restricted to the region west of the Mississippi river, extending from British Columbia southward into the valley of Mexico. The species live almost entirely in the arid and semiarid plains and not often in the mountains. Three species are found in Kansas,

The Plains pocket mouse (*Perognathus flavescens* Merr.) is found in the north-central part of the state. The species is small and has the tail nearly as long as the head and body; ears small; posterior half of the soles haired; color above pale yellowish brown mixed with dusky; beneath white; lateral line, eye ring, and spot below the ear clear buff; tail above pale grayish, below white; feet and legs white.

The Baird pocket mouse (*P. flavus* Baird) is probably found in the extreme western part of the state; not common. This species is still smaller than the last mentioned. The ears are medium; tail moderately haired and shorter than the head and body; pelage very soft for this genus. Color above pinkish buff mixed with black-tipped hairs, which are densest on the dorsal part; postauricular spot clear buff; subauricular spot present but not prominent; tail pale buffy, with no decided contrast between colors above and below.

The Kansas pocket mouse (*P. hispidus paradoxus* Merr.) is the most abundant species in the state, and has been taken in a number of places. The type is from Trego county, Kansas, and the species is widely distributed on the plains from the Dakotas to Texas, and from eastern Kansas to the foot-hills of the Rocky Mountains. The size is large; ears prominent, with an antitragal lobe; soles naked; tail about or nearly equal to the head and body, not crested or penicillate; color above yellowish brown mixed with black; lateral line clear ochraceous, extending on fore and hind legs for half their length and continuing across the lower cheeks; ears dusky inside, buffy white on margins and on the outer side, except an elliptical black spot on the indexed portion; feet and under parts white; tail whitish below, black above, and buffy on sides.

Little is positively known of the habits of pocket-mice. They live in burrows in the sand or loose soil, and throw out little mounds of

soil at the entrance. They stay in the burrows during the day, and come out at night to feed and gather their stores of grass seeds and small grains. Although they lay up considerable in the way of stores, they are active in the winter and feed on the outside, except in severe weather. Their breeding habits are not well known, and the species are too shy for scientists to study them to advantage even in confinement. They probably do not seriously affect any of the crops grown in the state. I have found them under corn and Kafir-corn shocks.

FAMILY ZAPODIDÆ. Jumping Mice.

This family has only one representative in Kansas, a species of the genus *Zapus*. The members of the group are northern, and, with the exception of one species, are confined to North America. They are rodents of small size, and are noted for the shortness of the fore legs and the great elongation of the hind ones. The tail, too, is greatly developed in length, and, although slender, is of much assistance to the animals in balancing while taking the long, quick jumps for which they are noted. No description of the genus further than this will be attempted.

The Prairie jumping mouse (*Z. hudsonius campestris* Preble) is found in certain favorable localities in eastern Kansas. I have found it in pastures and grass meadows near the border of a stream, where there is some scattered growth of bushes or trees. It builds a compact globular nest, several inches in diameter, with an entrance at the side. This is placed in a burrow, under a log, or in a hollow stump or fallen tree. The young are born in these nests in early summer, and are five to six in number. After the young leave the nests, they are usually occupied by two adult animals for the remainder of the summer. In winter the jumping mice hibernate, usually in nests placed underground. They feed chiefly on grass seeds and small grains, but, like nearly all the rodents, they eat animal food when it comes in their way. They capture some insects, but are not sufficiently numerous in this state to affect the farmer either beneficially or injuriously.

FAMILY ERETHIZONTIDÆ. Porcupines.

This family will be sufficiently described by stating that it is characterized by the peculiar change which takes place in some of the long hairs on the body. These become altered to form sharp quills, so armed with retrorse bristles as to make them powerful weapons of defense. The members of the family are usually rather large and clumsy, terrestrial on the eastern continent, but mostly arboreal in America. But one genus is found in North America.

Genus ERETHIZON F. Cuvier.

Form stout; limbs short and strong; four toes on fore feet, five on hind feet; tail short, thick, covered above with thick hair and spines, below with stiff bristles.

The Yellow-haired porcupine (*Erethizon epixanthuus* Brandt) is found along streams and canyons in western Kansas; not common. It may be distinguished from the eastern porcupine by its having the tips of the long hairs greenish yellow instead of yellowish white. The nasals extend backward to the orbits, or two-thirds of the length of the skull. In the eastern form they are one-third of the length of the skull. The spines on the back are yellowish instead of being white, with the terminal third black.

The food of porcupines consists of roots, fruits, leaves, bark, and succulent stalks of trees and other plants. They feed at night, but often move about and take exercise during the day. In places where they are plentiful they destroy a great deal of young timber and have considerable influence in affecting its growth. They are fond of any kind of salted food that may fall in their way, and are noted for their raids upon the supplies of bacon which may be found in the camps of hunting and similar outing parties. In Kansas the porcupine is by no means a common animal, and the records of its occurrence are confined to points on the upper Smoky Hill and Saline rivers, except a single record at Kinsley, on the Arkansas.

FAMILY LEPORIDÆ. Hares and Rabbits.

This family is small and well-defined. The hind legs are elongated; the ears are very long; tail rudimentary and bushy. The skull is flat; postorbital processes well developed; lachrymal bone entirely within the orbit; palate between the molars reduced to a very narrow bridge; clavicles imperfect; metatarsals elongated; hallux wanting, North American hares belong to the genus *Lepus*.

Genus LEPUS Linn.

Dental formula: $i. \frac{2-2}{1-1}$ pm. $\frac{3-3}{2-2}$ m. $\frac{3-3}{3-3}$ = 28. Hares are too well known to require anatomical description, but their structure is interesting in that it presents characters not shared by any other mammals. There are five or six species and subspecies of hares found in the state, and all of them are rather common or even abundant within their particular range. They are of great importance economically, and affect the interests of the farmer and horticulturist harmfully, because of their abundance. Various means have been resorted to for their suppression, among them the paying of bounties for their destruction. This plan was of doubtful results, because most of the counties had

exhausted their appropriation for the payment of bounties before any marked effect on the supply of rabbit scalps was noticed.

The White-tailed jack-rabbit (*Lepus campestris* Bachm.) is found only in the northern part of the state, and is less common than the other species. It is our largest hare, and has the hind leg longer than the ear; the under parts (except the pectoral band), the tail, and the fringe and border of the ears are pure white. In the winter there is a tendency for the entire pelage to turn white, but the change is never complete in this latitude, as it is with this species further north. This hare is rarely found in companies, like the Black-tailed jack-rabbit, but one or two only are seen at a time.

The common Cottontail rabbits (*L. floridanus mearnsi* Allen, and *L. floridanus alacer* Bangs) are abundant throughout eastern Kansas, and are to some extent replaced west of the middle of the state by the next species. The species, of which several geographic races are recognized, is of wide distribution. It extends along the Atlantic coast from Maine to Florida, and westward to eastern Nebraska, Kansas, and Indian Territory. The color is yellowish brown, lined with black above; rump ash, gray, and black; throat yellowish gray; under parts white; tail yellowish brown above, white below; ears ashy brown, edged with white behind, black toward the tip; all the fur lead color at the base. *Mearnsi* is darker than *alacer*, but only cranial characters will suffice to distinguish the two forms.

The Prairie-dog hare (*L. arizonæ minor* Mearns) takes the place of the eastern Cottontail in the western part of the state. It is abundant on the plains, and often utilizes the burrows of the prairie-dog as a place of retreat and as a permanent residence. It may be distinguished from the Cottontail of eastern Kansas by the smaller size and paler colors. The general appearance is much more buffy or yellowish; the fore legs are buffy white above, the hind legs are white; no black on the ears.

The Black-eared jack-rabbit (*L. melanotis* Mearns) is the common jack-rabbit of the state. It is found throughout the state, but is more abundant on the open plains. It is frequently seen in companies of a dozen or more together, especially in the rutting season.

The Texan or Black-tailed jack-rabbit (*L. texensis* Waterh.) has been reported from the southwestern part of the state, but I am in doubt as to the validity of the evidence of its actual occurrence. Kansas is within the range generally ascribed to this species.

The two last-named species have the same average measurements and the same general appearance; but they may often be distinguished by the difference in the color of the ears, which are black-tipped in

melanotis and not in *texensis*. The black of the tail in *melanotis* extends farther up on the rump than that of the other species.

The habits of the hares are well known. Their food consists entirely of vegetable matter—grass, grains, corn, vegetables, fruits, make up the bulk of it in the warmer part of the year. In the winter, when green vegetable matter is scarce, they often eat the bark and twigs of various kinds of trees. Orchards of young apple trees are peculiarly liable to their attacks, and I have known them to eat the bark of trees that had been ten years planted and that were six to eight inches in diameter. In the western part of the state, where the variety of tree and plant life is not so great, young orchards are especially liable to the attacks of the large species of jack-rabbits, and the difficulty of growing orchards is not only one of climate, but is doubly great because of the abundance of these pests.

Rabbits are also fond of the various garden vegetables, such as peas, cabbage, turnips, sweet corn, etc., and they do much damage in certain sections to the crops of the market-gardener. The smaller species are very prolific, having two or three litters of young in a season in our latitude, and producing an average of six at a litter. In spite of the depredations of cats, hawks, owls, coyotes, and other enemies of the rabbits, as well as of the work of hunters during the winter season, there is no perceptible decrease in their numbers from year to year except in the vicinity of larger towns. The destruction of so many of their natural enemies is one of the principal reasons for their increase in numbers. We pay a bounty on coyotes, and have destroyed most of the larger hawks and owls in the state. The Great Horned owl and the Red-tailed hawk were once plentiful along our wooded streams, and did more than other agencies to keep down the increase of rabbits; but these two species have almost disappeared, through the ignorant warfare made upon them by farmers and hunters, who have supposed that they were injurious species.

Trapping and poisoning are the two methods usually resorted to to check the depredations of these animals. The success of ordinary trapping depends largely on the abundance of food in the vicinity of the traps; but if the traps are so constructed as to take advantage of the natural habits of the rabbit to enter a hollow log or other dark passage a much larger measure of success will be attained. A trap made of four narrow strips of board nailed together, so as to make a box about four feet long, closed at one end, and with a swinging door at the other end, has been very successful in this part of the country. The swinging door opens inward but not outward, and is secured with a catch which is released by the animal as it enters the trap. The diameter of the box should be just enough to allow the animal to enter

easily, but not enough to permit it to turn around. Rabbits are not difficult to trap, but that method of destroying them is not sufficiently rapid when they are attacking the orchard in winter, and poisoning should be resorted to. Strychnine placed in pieces of apple, and these placed along the paths worn by the rabbits or near the trees they have injured, is sure to be reasonably successful in destroying the greater number of them. Twigs of the apple tree may also be dipped in a solution of strychnine and sugar, and these placed at the base of the trees to be protected.

Preventive washes have been applied to apple trees with some measure of success, but the most of them are of little use. Soap and carbolic acid have been especially recommended, but my experience with them shows that they will deter the rabbits from attacking the bark for about forty-eight hours only. Wrapping the trunks of small trees with corn-stalks is one of the best ways of keeping rabbits from them. Any wrapping that is used should be put on the trees before the winter sets in. If wrapping is deferred until after the rabbits have begun their work, they are apt to tear off the wrappings to get at the trees again. I have known rabbits to tear off building-paper wrappings nearly as fast as they could be put on; those that were put on one day were nearly all taken off the first night. Had these wrappings been placed on the trees in the fall, the rabbits would probably not have interfered with them at all.

Fortunately for the Kansas fruit-grower, rabbits are subject to periodical plagues that carry off large numbers of them. These diseases usually attack them in the latter part of the winter or in the spring of the year. An attack in an individual rabbit is usually followed by emaciation and a lingering death. The nature of some of the diseases is not fully understood, but it is certain that the rabbits are not fit for human food when thus diseased, and their flesh should be avoided. In the early part of the winter and when they are in good flesh and fat they are good for food, and are much hunted. This is especially true of the smaller species. The larger jack-rabbits are not so good, but there is more sport in hunting them, especially with grayhounds. Jack-rabbit drives are a peculiar feature of life in the Southwest, and have afforded sport to entire communities, and much profit in the destruction of large numbers of the pests. As many as 20,000 jack-rabbits have been captured in a single drive in California.

Order CARNIVORA. Carnivores.

The Carnivores, or flesh-eaters, are much less common in this state than they were when the territory was first settled by whites. In their relations to man they are far less harmful than are the order

Rodentia. This is partly because of the comparatively small number of individuals of the various species found, and also because the rodents, a harmful group, furnish the most convenient food for the Carnivora, and so they prey less upon the domestic animals. Several families of the Carnivora are represented in our state.

FAMILY FELIDÆ. Cats.

This group comprises graceful and well-formed animals, the highest members of the order Carnivora. This family have retractile claws, long, sharp, curved; their feet are digitigrade, with five toes on the fore feet, four on the hind ones; soles hairy, pads naked; number of teeth usually thirty, as follows: $i \frac{3-3}{3-3}$ c. $\frac{1-1}{1-1}$ pm. $\frac{3-3}{2-2}$ ml $\frac{1-1}{1-1} = 30$. There are two North American genera of the family, *Felis* and *Lynx*, the former including the long-tailed and the latter the short-tailed species of cats.

Genus FELIS Linn.

The genus has the tail more than half the length of the body; the first premolar is quite small. There are more than forty distinct species, well distributed throughout the world. They include such well known animals as the lion, the tiger, and the leopard. South America has several representatives, among which the jaguar, the eyra and the ocelot have been taken within the southern United States, and the puma has a wide North American distribution.

The Puma, or Mountain lion (*Felis oregonensis hippolestes* Merr.), in some of its forms is found in both North and South America, and is widely distributed north of Mexico. It is found in Canada to latitude fifty degrees, and from the Atlantic ocean almost or quite to the Pacific. It is one of the largest cats found in America, and most feared of all the wild animals found in the colonies when they were first settled. The stories of its ferocity and of its attacks on man were mostly exaggerations growing out of his fears. The names "American lion" and "panther" were given it from resemblances to old-world species, and the latter has clung to the species for nearly 300 years. The animal has really few of the characteristics so popularly attributed to it. It is generally cowardly, and it is doubtful whether it would attack man, unless under the influence of famine or to protect its young. It feeds on flesh, and, like all the cats, prefers that which it kills for itself; but under the pressure of hunger it will eat any dead flesh that may come in its way, not even rejecting carrion.

In Kansas the puma was once rather common in the rougher parts of the country, but it has almost entirely disappeared. It was reported from Barber and Comanche counties about twenty years ago, and a specimen was killed near Valley Falls at about that period. A

specimen in the museum of the Kansas State Agricultural College is labeled as being taken at Wa Keeney, but no particulars of its capture are just now available.* On August 15, 1904, Mr. W. M. Applebaugh and Mr. Spratt, of Hays City were hunting prairie chickens, and came across a puma in a ravine about nine miles north of that place. The animal was partly hidden by underbrush, and they supposed it to be a coyote until after two shots from repeating guns had been fired into it. It then tried to attack Mr. Applebaugh, but retreated before two more shots. They followed it a short distance and found it dead from the effects of the four charges of No. 6 chilled shot, all of which had struck it at the same place; just behind the shoulder. The specimen was not large, measuring six feet two inches from tip to tip. It was sent to Professor Dyche for mounting.

Genus LYNX Rafin.

This genus is regarded by some writers as merely a subgenus of *Felis*. It is characterized by having a very short tail, less than half the length of the body, and by its having the anterior premolar lacking.

The Bay lynx (*L. ruffus* Guldenst) is found rather well distributed in Kansas, but it is nowhere plentiful. It is popularly called the wildcat, or Bobtailed cat, a name that applies equally well to the Canada lynx. The two species are probably distinct, but they seem to intergrade in the forest regions of the states that border on the great lakes. Kansas specimens have no evidences of the tufts on the tip of the ear, which is a character distinguishing the Canada species. The Bay lynx has soft fur, much shorter and less dense than the other species, and the color is in general reddish brown instead of gray. There are also stripes and spots of dark brown and black that give it a different appearance from the Canada lynx.

The wildcat feeds principally on rabbits and other rodents, lying in wait for them and pouncing upon them as they come along their well-worn paths. It sometimes captures poultry and young pigs or lambs, but this is not habitual with the species. It will also capture frogs, lizards, and snakes, but rabbits seem to be its staple diet. It undoubtedly does much good in the destruction of these pests and little harm to the interests of the farmer. Probably the usefulness of the wildcat is not so positive that it should be protected by legislative enactment, but there is no use, on the other hand, of offering bounties for its destruction, as several Kansas counties have done. The fact that but a very few scalps are offered for the collection of the bounties in those counties is a proff that the bounty is not needed

*Since writing this I have learned that the specimen came from Colorado.

for the repression of the species. With more good to its credit than harm, it seems to me rather desirable that it should not be entirely exterminated from our state.

The Spotted lynx (*L. ruffus maculata* Vig. & Horsf.) has been reported to me as found in western Kansas, but it has not come under my notice, and the authority upon which it has been reported is hardly sufficient to warrant including in a list of our fauna. It is a large southern variety of *L. ruffus*, characterized by coarse fur and large black spots on the under parts.

In this connection it may be well to say something concerning the relation of the common domestic cat (*Felis domestica* Linn.) to the fauna of the state, and of its value as an asset to the farms, gardens and orchards of Kansas. There is much sentiment connected with the relation of the cat to the family, some of it very much misplaced. The cat seldom shows any of the attachment to members of the household exhibited by the domestic dog. Its attachment seems to be more to the locality than to the individual. There is also as much difference in the individual traits of cats as there is among dogs; some of them are just as worthless. Those that prefer a diet of insectivorous birds to rodents should be promptly executed, and the best mousers only be allowed to live and multiply. A few cats learn to catch the pocket-gopher and spermophiles and become the most valuable aids in the destruction of those pests. The descendants of such cats are likely to have the same habits. I would therefore urge upon farmers as careful discrimination in the selection of cats for use about the farm buildings as in the selection of other domestic animals,

FAMILY CANIDÆ. Wolves, Foxes, etc.

The dog family are characterized by having digitigrade feet, the claws not retractile; four toes on hind feet, four or five on the front feet; when five, one is rudimentary and placed high above the others. There are several genera, the largest being *Canis*, which includes dogs and wolves.

Genus CANIS Linn.

The genus contains the larger species, with long legs and round pupils. The nose is long and tapering; the postorbital process of the frontal bone is short and convex, curving downward. The fox-like wolves of South America seem to be a connecting link between the dogs and the foxes. The domestic dogs were all probably originally derived from different species of wild dogs, and the principal varieties caused by interbreeding.

Gray wolves were formerly abundant in Kansas, and are still occasionally met with. Last winter they were reported from Chautau-

qua, Hamilton, Republic, Sherman and Wallace counties; all but the last named paid bounties for destroying them.

It is proper for me to confess that I am uncertain as to the names which should be given to our Kansas gray wolves. Hunters and old plainsmen insist that two distinct forms were formerly common on the plains. The larger form was commonly called "lobo," in distinction from the other. Black specimens of the smaller wolf were not uncommon. This would make it agree with the *Canis occidentalis*, or *C. ater* of Richardson. The animal described by Say as *C. nubilus*, or Dusky wolf, was not the same as the black form of *C. occidentalis*. It had dark muzzle bands and leg stripes, and a dusky, plumbeous color.

One of the two forms is now probably extinct in the state, and I am unable to determine which name should be applied to the surviving animal. It is unfortunate that specimens of Gray wolf representing our Kansas prairie fauna are not to be found in the large collections in this country.

The coyote (*C. latrans* Say) is in color dingy white, suffused above with tawny, black, and gray. The black is in obscure streaks on the back and hips, and in adult specimens forms a distinct collar about the neck and shoulders. It is medium in size between a gray wolf and a fox, and has a wide distribution on the plains of the upper Mississippi and Missouri rivers. Northeastern Kansas is near the southern limit of this form.

The Prairie coyote (*C. nebrascensis* Merr.) is quite common in most parts of the state. It is smaller than *latrans*, paler in color, and the adult has no distinct collar. The teeth are much smaller than in *latrans*, and differences in the molars serve to distinguish the two species.

The abundance of coyotes in Kansas is well shown by the fact that most of the counties still pay bounties for their destruction. During the past year these bounties have ranged from \$48 to \$679 in the various counties, except that about ten of them pay no bounties at all. The total paid for the year ending June 30, 1904, was \$19,514, showing that over 19,000 coyotes were killed during that year. The report from one county was lacking in this total.

The coyote is a familiar pest to the farmers and ranchmen of the plains region. Its persistence in this state when the Gray wolf, once so numerous, has almost entirely disappeared, is a striking illustration of the difference in their characters. The Gray wolf hunted in packs, was fearless, and easily destroyed by poison administered in the carcasses of dead cattle or buffaloes. Thousands were killed for their skins or merely to get them out of the way of the settlers. But the

coyote hunts singly, is cowardly and distrustful, and avoids the traps and baits placed in its way. It prefers live game, and while it will often pursue it with some endurance if the game shows some weakness, its usual plan is to hide in the grass or behind a weed or sage bush until the game comes near enough for it to catch it at a single leap. It will wait for hours in a favorable place for the approach of hens, turkeys, or hares, rather than hunt in other localities where the results might be less certain.

When pressed by hunger the coyote will eat vegetable food or pick up offal about the camp or the ranch-house. It hunts either by day or by night, and great care is necessary to keep the poultry and very young domestic animals out of its way. Some ranchmen have told me that lambs and poultry in an enclosure made by a fence five feet in height are absolutely safe from its attacks. Others have said that while the animals will not jump over such a fence they will dig under it readily, and that the only safety is in a tight and floored enclosure. The depredations of wolves are serious in extent, and the payment of bounties for their destruction may be the wisest way of dealing with the evil. It is certain, however, that the scarcity of wolves is one of the chief causes for the abundance of the hares on the plains. Man cannot in any way interfere with the adjustment of nature in such matters without finding a lack of balance that may work injury to some of his plans. However, the bounty on wolves is more nearly justifiable than that paid for the destruction of other animals in the state.

Genus VULPES Briss

This genus has the same dental formula as the wolves, namely, $i. \frac{3-3}{3-3} c. \frac{1-1}{1-1} pm. \frac{4-4}{4-4} m. \frac{2-2}{3-3} = 42$, but the pupils of the eyes are elliptical, the tail is long and bushy, the form is more slender, and the upper incisors are unlobed. Foxes were rather plentiful in the territory now embraced in this state when it was first visited by whites.

The Red fox (*Vulpes fulvus* Desmarest) was indigenous in eastern Kansas. After the settlement of the country they soon became very rare or entirely disappeared. Sportsmen who were fond of fox-chasing restocked the country with animals brought from the East. These introduced animals have thrived well, and have increased in numbers until the species threatens to become a pest in some of the eastern counties.

The Silver fox (*V. fulvus argentata* Shaw) was probably very rare in Kansas. Lieutenant Abert's party captured a specimen within our territory in the Southwest.

The Prairie fox (*V. macrourus* Baird) was taken in 1886, in Cow-

ley county, and reported in volume 27 of *Forest and Stream*, January 6, 1887, by Col. N. S. Goss.

The Swift fox (*V. velox* Say) was formerly common in western Kansas, but has been rare of late years. I saw a dead specimen of this fox lying on the prairie near Cheyenne Wells, Colo., in April, 1904. It is smaller in size and lacks the sharp muzzle, rich colors and long, bushy tail of the Red foxes. Also, its feet and ears lack the black color found in the Red fox. Only the sides of the muzzle have patches of black.

Genus UROCYON Baird.

This genus is separated from *Vulpes* because of anatomical differences, chiefly in the skull. It has the same number and arrangement of the teeth, but there are differences in their structure and in the form of the jaw. The tail has a concealed mane of stiff hairs and the muzzle is short.

The Gray fox (*Urocyon cinereoargenteus* Mall.) was formerly rather common in the wooded parts of Kansas, especially in the southeastern part, but I do not know whether any of them now survive. No recent specimens have come under my personal observation. This species does not dig extensive burrows, and, when chased by hounds, frequently makes its escape, when closely pressed, by climbing leaning or even upright trees. Lacking deep dens, it was the first to be driven from the country by the advance of civilization. The general aspect of the species is silver gray, but the base of the ears, the sides of the neck, the throat collar, the inside surface of the fore legs and a broad band on the under side are of a cinnamon rufous color. It is about the size of the common Red fox.

Foxes of all kinds, except the introduced Eastern Red fox, are rare in Kansas—too rare to make them formidable as farm pests. Even with the Red fox there is no danger that it will become sufficiently plentiful to become a menace to poultry-growers in the eastern counties of the state. The value of its fur in winter is a sufficient incentive for its destruction, without a bounty; and the offering of an additional reward by the county is merely throwing away that much of the public funds, and does not bring in any more of the dead foxes than if the bounty were wanting.

Besides the above considerations, it is doubtful whether the foxes are to be regarded as pests at all. Their usual food seems to be field-mice, wood-mice, wood-rats, and rabbits, and they destroy large numbers of each. Their good work in this direction will compensate for all their forays on the poultry-yard. The destruction of coyotes, wolves, foxes, weasels and skunks is probably the cause of the great increase of a large number of injurious species of rodents. Foxes do

not increase very rapidly; they have from four to six young at the time, and breed once a year. The young are very interesting and playful, and make fine pets until they become old enough to become too mischievous to keep about the premises.

FAMILY URSIDÆ. Bears.

The bears need no description here. Nine species and three varieties of bears have been recognized in the western continent north of Mexico.

Genus URSUS Waterh.

The Black bear (*Ursus americanus* Pallas) was once common throughout the territory now embraced in Kansas. It was reported by most of the early explorers, and found in the rougher parts of the state until the early sixties. Mr. J. R. Mead, of Wichita, states that they were found in the hills of Comanche and Barber counties in 1859, when he followed the occupation of a hunter and trader on the plains. No recent authentic record of the occurrence of bears in Kansas is known to me.

FAMILY PROCYONIDÆ. Raccoons.

This family seems to be a connecting link between the bears and the cats. Like the bears they are plantigrade, have five toes on each foot, the soles are naked (except in the genus *Ailurius*), and the toes are usually non-retractile. Unlike the bears, they are small in size, have a less number of teeth, and are provided with a long, hairy, and sometimes prehensile tail. *Bassariscus astutus*, the so-called Civet cat of Mexico, is the nearest approach to the cat family in the group. There are two North America genera whose range extends into the United States: *Bassariscus* and *Procyon*.

The genus *Bassariscus* is represented in North America by three species and two subspecies. *B. astutus* Licht. was reported by Professor Knox as not uncommon in southwestern Kansas, but upon what authority I am unable to discover.

Genus PROCYON Storr.

The genus has a stout body, a broad and depressed head, and a pointed muzzle; the ears are short and hairy; the feet are five-toed, toes distinct; tail moderately long, bushy, and ringed in color. Six species are known, one found only in South America, the others north of the Isthmus of Panama. The North American species has several varieties.

The Common raccoon (*Procyon lotor* Linn.) is found in eastern North America, from Canada to Georgia, and west to the Rocky Mountains north of Texas. The characters are those of the genus; tail cylindrical, not tapering. It is found in all the wooded parts of the state

and along the streams wherever scattered trees are to be found. The female has six mammæ, and I conclude that the normal number of young produced at a birth is three, but I know little of this from personal observation. I have seen litters of two, three, and four.

The raccoon is omnivorous, eating almost anything that comes in his way. Of animal food he eats fish, insects, crustaceans, and birds, but seldom eats rats or mice. He is fond of birds' eggs, and will take fruit and green corn. When they are plentiful in a neighborhood, the amount of corn taken from a field by them is considerable. They rarely make raids on poultry-houses. They make their homes in hollow trees, and prefer locations near swamps or streams.

Raccoons are hunted chiefly for the sport; the skins are sometimes utilized for clothing and the flesh for food, but both are poor in quality. The flesh is especially undesirable, because it is likely to be infested by internal parasites. This is probably because of the miscellaneous character of the animal's food and its sluggish habits. Aside from these causes, the raccoon is naturally cleanly in its habits. Before eating a morsel of food, if water is present, it will dip the food under the water; in the absence of water it will rub the food with its paws, as if washing it. It is this habit which has earned it the German name of "washing bear" and its specific name *lotor*, which means "the washer."

Raccoons become objectionable when their number is too great in any locality, and their destruction should then be encouraged; in limited numbers they are not harmful.

FAMILY MUSTELIDÆ. Weasels, Otters, etc.

This family of the Carnivora comprises a number of genera that are of special interest because of the dense pelt, which is often an article of much value commercially. Aside from the economic value of their skins, the group have not been properly understood as to their food habits, and have been condemned as harmful, when, as a matter of fact, they are often the most useful of animals in destroying the real enemies of the farmer. In this family are included the sable, ermine, marten, otter, mink, and other important fur-bearing animals. The subfamilies and genera are very unlike in form and habits. Some are aquatic, some arboreal, and others wholly terrestrial in habits. All, however, agree in some important anatomical characters, and in having all the feet five-toed, digits clawed; palate extending beyond the last molars; no cæcum on the intestine; anal glands secreting a strong odor always present. Omitting the characters of the subfamilies, I take up briefly the five genera found in Kansas.

Genus TAXIDEA Waterh.

This genus is the American representative of the subfamily *Melincaë*, characterized by the large quadrate posterior upper molar. The genus *Melis* includes the typical European badger, and other old world genera show the close connection between the badgers and the skunks. Our genus has a stout, depressed body, short tail, and very large and strong fore claws. One species and three sub-species are recognized.

The American badger (*Taxidea taxus* Bodd.) is found throughout the state; rare in the eastern part but abundant on the plains. The head is usually a hoary brown, sometimes grayish, in color; snout and patch behind the ears black; a white line from the snout to the nape of the neck divides the brown of the head lengthwise; cheeks white, legs black. The general color of the body is a grizzled gray, which varies greatly with the age of the specimen and the season of the year.

The Mexican badger (*Taxidea taxus berlandieri* Baird) is to be expected in the fauna of southwest Kansas. It is distinguished by having the white median stripe of the head continued, as a dorsal stripe, to the tail. A badger seen at Kinsley in August of the present year had the dorsal stripe more than three-fourths of the length of the body. It was a half-grown specimen kept in confinement, and was too young for me to make sure of other characteristics of the sub-species. I should regard it as an intermediate form.*

The badger lives in burrows which it excavates in the prairies. It usually utilizes the side of a bank or a slope for the beginning of its permanent home burrow, but it will often burrow on the level prairie, especially in pursuit of prairie-dogs or spermophiles. The badger remains in its burrow, and is rarely seen between sunrise and sunset, but in the twilight of both evening and morning it is usually abroad. It is very shy, and will make off to its burrow with great rapidity when disturbed. Being nocturnal, and living underground, little is known of its breeding habits. It is said that the number of young is three or four.

The food of the badger is largely animal, and it eats rabbits, prairie-dogs, kangaroo rats, mice, tortoises, birds, and other animals. Some insects are eaten, and succulent roots. I have often noticed in western Kansas that some animal was fond of the roots of a legume, the slender parosela (*Parosela enneandra*), for I could see the excavations at the roots and the torn-up plants everywhere. This summer I discovered the badger digging up the plant in the early morning. I had sus-

* A more recent examination of this specimen has convinced me that should be assigned to the variety *berlandieri*.

pected that this animal did the digging, but it was the first positive proof I had that it ate vegetable food.

As long as the rabbits, spermophiles and prairie-dogs are plentiful in the western part of the state, the badger will continue to do useful work in killing them. In a prairie-dog village it is especially helpful. It will dig into an occupied burrow and remain in it until all the occupants are eaten. It then emerges and enters another burrow. In this way it will go from burrow to burrow and soon materially reduce the number of inhabitants of a "dog town." As a digger no animal can compete with the badger. It has been said that one can easily burrow faster than a man can dig after it with a pick and spade. Some complaint is made by ranchmen that the badger holes on the prairie are dangerous to horses and riders. They are not as numerous or as dangerous as are the prairie-dog burrows, and Western horses readily learn to avoid both, unless the riders are unusually careless. The badger is, on the whole, a decidedly useful animal.

Genus MEPHITIS Cuvier.

This genus is confined to North America and needs no full description. The head is small, the nose pointed, tail long and bushy; color black, with dorsal stripes of white; anal glands highly developed. The last peculiarity, which gives the animal a means of self-protection, is shared by other members of the family of Mustelidæ, but in none is the feature more marked than in the American skunks of this genus. It is to be noted that the skunks learn to use the fetid discharge from these glands more and more as they grow older. Young animals kept in confinement without having their glands removed never use the discharge, and are said to make most useful pets. It is the old animals, that have frequently fought with dogs, that use the discharge when disturbed.

The northern Plains skunk (*Mephitis hudsonica* Rich.) is probably found in the northern part of the state, but no records of its occurrence are known to me. The earlier observers classed all our skunks under the one species, *mephitica*, which does not occur west of Indiana.

The Long-tailed Texas skunk (*M. mesomelas varians* Gray) is the most abundant of our skunks and it is distributed over the greater part of the state. This is a large-sized skunk with a very long tail, ending in a black brush without a pencil. White hairs are found in the tail and show most on the upper surface near the middle, where they form an indistinct band.

The skunks of this genus have a varied diet, consisting largely of small mammals, frogs, toads, lizards, snakes, insects, and birds' eggs. They occasionally destroy poultry, and when pressed for food pick up

offal and even carrion. Fish and crustaceans also form part of their diet. The insect food consists largely of grasshoppers.

These animals have usually been regarded as destructive to poultry and have been destroyed at every opportunity. Their evil reputation has been intensified by the bad odor which they emit when attacked. The bad reputation is in no way deserved. The few cases of loss to poultry-growers is more than compensated by the destruction of rodents and injurious insects about the farm. If the animal is undisturbed the offensive odor will never be observed, and the skunk will be much more efficient in keeping the premises free from rats and mice than any cat would be. If a skunk begins to attack the poultry, a trap properly set for it will soon result in its capture; but there is no reason why the farmer should make war on the species when only an individual offends.

Skunks make their homes in various situations — in caves, in the deserted burrows of wolves, under stone walls and buildings, and in piles of wood or lumber. They are for the most part nocturnal in their habits, but often come out and move about in daytime, especially in the evening and morning. The young are from four to ten in number.

Genus *SPILOGALE* Gray.

This genus is distinguished from the last by the conical head, small size, short tail, and the naked, flat sole, with four oblong pads on the front portion. There are ten or more species, only one of which is found in Kansas.

The Little Striped skunk (*Spilogale interrupta* Rafin.) is common in most parts of the state. The color is black, with variable stripings of white on the upper parts. The tail is long for the genus, black, with a tuft or pencil of white hairs at the tip; claws brown.

The Little Striped skunk has similar habits to the larger skunks. It does not come out in the daytime so often, and there are fewer complaints about its destroying poultry. It is probably as common as the large skunk in the eastern part of the state, but is seen less frequently because of its nocturnal habits. It is just as valuable as a destroyer of rats and mice, and its anal glands are less strongly developed than in the larger species.

At one time my family occupied for two years a house with large cellars opening on the outside, and in which corn and corn-cobs had long been stored, the latter for fuel. The cellars, and in fact the entire house, were overrun with rats and mice. A couple of months after we had first occupied the house, I noticed that a Little Striped skunk was present in the cellar. We could often hear the fights between it and rats, and I was careful not to disturb it when I went to

the cellar for coal. I often saw it in the cellar and it did not seem to fear my presence there. In a very few weeks we could hear no more of the fights with the rats, and all the rats and mice were either killed or driven from the place. The skunk soon left the cellar and was not again noticed in the neighborhood. During the weeks that it was present on the premises I did not once notice its odor as offensive; but on the mornings after an unusually fierce battle with rats, I could detect a faint smell of its presence in the cellar. From this experience, I am inclined to regard this species as one of the most valuable of our wild animals, and would recommend its destruction only in cases where it attacks the poultry roost.

Genua PUTORIUS Cuvier.

This genus includes weasels, ferrets, and minks. They are usually animals of slender, lithe bodies, short legs, round tails, and orbicular ears. The weasels and ermines belonging to the subgenus *Ictis*, and include the most slender and attenuate forms and the smallest known carnivorous mammal, *Putorius rixosus*. The true ferrets are rather stout-bodied animals of the old world, with one American representative, and belong to the subgenus *Putorius*. The minks belong to the subgenus *Lutreola*.

The common Southern mink (*Putorius vison lutrecephalus* Harlan) is rather common throughout eastern Kansas and along the borders of the streams farther west. It is a well-known animal, a little larger than the Striped skunk, with the body above a uniform dark chestnut brown in color; the tail nearly black; a white spot on the chin and sometimes on the chest and abdomen. The toes of this species are webbed at the base, indicating an aquatic habit. The mink is well distributed over the whole of North America north of the Gulf states. It differs but little from the European mink.

The food of the mink is mainly obtained along the streams, which furnish it a home in their steep banks. It consists largely of fish, mollusks, frogs, and crustaceans. It also preys upon the native rats and mice, and will, it is said, not hesitate to attack and kill the muskrat, an animal larger than itself. It is known to capture our smaller hares and eats some birds. Its attacks on poultry are keenly felt by the owner; for, once begun, the visit is repeated from night to night until the coop shows a greatly diminished supply of the birds that formerly roosted there. The trap must be resorted to to stay the marauder. Fortunately minks do not all learn the chicken habit, but the majority go through life content with what the stream and forest afford in the way of food.

Minks live in burrows in the banks of streams, often under the roots of an overhanging tree; but occasionally a hollow log is used

instead. The young are born in April, and are five or six in number. They have been tamed and taught to capture rats, like the European ferrets. They make desirable pets, and, on the whole, are not objectionable animals to have about the farm. The only bad feature is in relation to the poultry-house, and here again it is the individual, and not the species, on which warfare is to be made.

The Black-footed ferret (*P. nigripes* Aud. & Bach.) is found in the plains region, from western Kansas to the foot-hills of the Rocky Mountains, and northward to Montana and North Dakota. In Kansas it is found only in the western third of the state, and is becoming quite rare. It is much larger than an ordinary weasel, has a very long body, and is of a soiled, yellowish-brown color, with a broad black patch on the forehead, including the eyes, and extending downward almost to the tip of the nose. It is closely furred, and has feet covered with hair above and below. The feet and legs are black, as is also about two inches of the tip of its tail.

The food of this species, as far as it is known to me, consists of rabbits and prairie-dogs. So marked is its liking for the last named, that it is popularly known in western Kansas as the Prairie-dog ferret. It often takes up its abode in a prairie-dog burrow, and from this retreat it makes war on the inhabitants of the surrounding "dog town," until all the dogs are killed or driven away. It can follow into every part of the burrow, and kills its victim underground. It does not kill only as many of the animals as it can eat, but, like others of the weasel family, it merely sucks the blood of its victims, and then kills others until satisfied, when it lies down to sleep.

I have an interesting letter from Mr. Henry M. Thiel, county clerk of Thomas county, Kansas, concerning the work of this ferret in destroying prairie-dogs.

COLBY, KAN., August 30, 1904.—There were a great many prairie-dogs in this county until about two years ago. We had large towns, covering from a half section to two or more sections, at intervals of four or five miles. Only a few ferrets came in here. They were of the Black-footed variety, and one would scarcely ever see any of them. Only a few of them, two or three, would go into a town covering a section, and in a month or two would exterminate the dogs. Occasionally we could find a dead dog outside of the hole with his throat cut, but most of them must have been killed in their holes. Personally I do not know whether there are any dogs left in the county or not. I have driven out considerably, and in parts where they were formerly numerous I have not seen any. I talked with a man this morning, and he said that he had seen a few a month ago, six miles north of Colby, where they used to cover a large territory. The ferrets also seem to be gone. I have not heard of any one's having seen one of them for some time.—HENRY M. THIEL.

The work of the Black-footed ferret in destroying prairie-dogs has led some persons in Kansas to suppose that the imported ferrets from

Europe could do equally good work; but experiments made with them have been disastrous to the ferrets instead of to the prairie-dogs. There is no animal known that is so effective in this work as the species under consideration. The species should increase in numbers, for the Western farmers recognize their value. Unfortunately, the great mass of people who hunt for sport do not care for the interests of any one, and they persistently kill the ferret whenever they see one. The animal is not timid, and has a great deal of curiosity. When it takes refuge in a prairie-dog burrow, at the approach of a hunter, it immediately turns and puts out its head to watch the movements of the "man behind the gun." This habit leads to a fatal result, and an animal worth almost its weight in gold to the landowners of the West falls an easy victim to the thoughtlessness of man. It is this same desire to kill something that is destroying many of the most useful birds in the country, particularly the hawks of the open prairie regions.

The Long-tailed weasel (*P. longicauda* Bon.) is found in eastern Kansas, but it is a rare species. This animal feeds on small mammals and birds and has all the characteristics of other members of the family, except that it will kill far more hens in a poultry-yard at one time than will the mink. It merely sucks the blood of its victims without devouring them. It is larger than the familiar weasel of the Eastern states, and has a paler, more yellowish color and a longer tail. While it is an enemy to the poultry-yard, it does much good in the destruction of noxious mammals; but it is not present in our state in sufficient numbers to have much effect on the interests of the people.

The Bridled weasel (*P. frenatus neomexicanus* Bart. & Cockerell) has a place in our fauna on account of a specimen in possession of Professor Dyche, of Kansas State University. It was mailed to him by some one from Liberal, Kan., but no notes concerning its capture accompanied it. The animal was in bad condition and the skin was placed in a tanning liquid to preserve it. This process would have the effect of bleaching out the original color and leave it lighter than before. The fur is now probably somewhat lighter than the usual fur of this pale species. However, the locality is outside (too far north) of the range of typical *P. frenatus*, and is just outside of the known range of the subspecies. This fact, together with the pale color of the specimen, warrant its assignment to the variety *neomexicanus*.

Genus LUTRA Erxl.

This genus has a long body supported on very short legs. The neck is shorter in proportion than the weasel's; tail tapering and flattened. The skull is depressed and flattened on top, making the

entire dorsal outline nearly straight. The dental formula is: $i. \frac{3-3}{3-3}$
 $c. \frac{1-1}{1-1}$ pm. $\frac{4-4}{3-3}$ m. $\frac{1-1}{2-2} = 36$. This partial description does not include the Sea otter, which belongs to the genus *Latax*. Of inland otters (*Lutra*) there are but three North American species, one of which is found only in Newfoundland.

The Canada otter (*L. canadensis sonora* Rhoads) was common in Kansas at one time, but has now become rather rare. While the animals are rarely met with, their "slides" are still found in favorable places along our rivers and creeks to show that the species is not extinct.

There are several local races of the otter in North America, and the Kansas animal is probably of the Sonoran form. It lives in burrows in the banks of streams and feeds almost entirely on fish, which it captures with great skill. Its pelt is of great beauty and much value commercially, and this fact is sufficient explanation of the growing scarcity of the species. It does not multiply as rapidly as most of the Mustelidæ, since the number of young ranges from one to three only at a birth.

Order V. INSECTIVOR A. Insectivores.

This group includes a great variety of forms of placental mammals. They differ in dentition from all other groups, and yet the genera are not alike in the dental formula. The canines are absent, except in one genus, and are replaced by teeth which have no resemblance to the canines of any other animals. Our Kansas representatives of the Insectivora are small, mouse-like animals, which, from their outward appearance, are easily mistaken for mice, and which are likely for this reason to fall under the farmer's condemnation. In structure and food habits they are much more like the bats. Two families are represented in the state.

FAMILY SORICIDÆ Shrews.

Animals of this family are intermediate in structure between the European hedgehogs and the moles. They have sharp, movable snouts, are plantigrade in movement, and have hairless soles. The eyes are very small, but the animals of the group can all see, and have acute other senses.

Genus BLARINA Gray.

The shrews of this genus are of dark color and mole-like appearance. The ear conch is truncated above, and the tail is short and hairy. The two Kansas species were first collected by Long's expedition to the Rocky Mountains, at Blair, Neb. These type specimens,

described by Thomas Say, represent both the largest and smallest species of this genus.

The Large blarina (*Blarina brevicauda* Say) is well distributed in eastern Kansas, and is probably found throughout the state. It is found in the woods and in the fields, and lives in shallow tunnels, which it makes by pressing the soil aside, after the manner of a mole. These tunnels may often be seen on the surface of the ground. The color is uniform dark plumbeous above, a little more ashy beneath, the feet brownish. When full grown it is about four and a half to five inches long.

The Small blarina (*Blarina parva* Say) is found only in the eastern part of the state. I have taken specimens at Manhattan. It is the smallest species of the genus, being a little less than two-thirds of the length of *brevicauda*. It is found principally in fields and meadows, and may easily be distinguished from the Large blarina by its small size and lighter color. The tail, like the body, is sepia colored above and ashy below.

Our knowledge of the shrews is meager. They are mostly nocturnal in habits and, therefore, seldom seen. We know that they feed almost entirely on insects and, from observation of specimens kept in confinement, we suspect that they destroy other small mammals, and even that they sometimes kill and devour other shrews. At least, they are cannibals when in confinement, and only the strongest survive in a cage. In trapping and poisoning small mice I have often come upon partly devoured specimens, and have suspected that shrews were responsible for the work.

There can be no doubt of the usefulness of this genus in destroying noxious insects. Shrews should not be destroyed. Unfortunately, cats and owls do not discriminate between shrews and mice, even if the farmer does; and so the shrews are likely to become less plentiful as settlement becomes more dense. I have frequently found dead shrews in hollow trees occupied by the screech-owl.

FAMILY TALPIDÆ. Moles.

The moles resemble the shrews in some respects, but there is a great difference in their habits. While the shrews spend part of their time in the ground, and probably find a part of their food there, the moles are entirely fossorial and come to the top of the ground only by accident. The shrews are exceedingly active and social, while the moles are hermit like and clumsy. The eyes of the mole are rudimentary, and probably enable it to distinguish the light of the outside world from the darkness of its tunnel. The moles are easily recognized by the stout body, short neck, short limbs, broad manus,

and strong fore claws. Their structure is especially adapted for burrowing in the ground.

Seven genera of moles have been recognized: *Neurotrichus*, *Scalops*, *Scapanus*, *Parascalops*, *Condylura*, *Talpa* and *Chrysochloris*. The last two are not found in North America. *Talpa* is a Eurasian genus whose type is the common mole of Europe. *Chrysochloris* is an African genus, embracing several species of "Golden" moles, tailless, and with but four toes on the fore feet. Of the North American genera, *Neurotrichus* embraces an Asiatic species and a Pacific coast species in America. *Scalops* is restricted to this country and has perhaps three species. *Scapanus* is North American and has six species, confined to the Pacific coast region. *Parascalops* has but one species and is restricted to the eastern United States. *Condylura* has only one species, the familiar Star-nosed mole of eastern North America. South America is supposed to be without moles. Kansas has but one mole, belonging to the genus *Scalops*.

Genus SCALOPS Cuvier.

Besides some important generic internal and dental characters, this genus has the toes of all the feet webbed. Two or three species and four varieties are known.

The common Garden mole (*Scalops aquaticus machrinus* Rafinesque) is larger than the type form of the eastern United States and differs somewhat in color. It is abundant over all the cultivated portions of eastern and middle Kansas. In spite of a continual warfare upon them by the owners of the lawns and gardens, they are undoubtedly rapidly increasing in numbers, especially in the vicinity of towns and farm buildings. In these places they find the cool, moist soil under sidewalks and in the shade of buildings and trees, where their food is most abundant. Here, too, they find places of safe retreat from their chief enemy, man.

Moles have few natural enemies. As they seldom come to the surface of the ground, they do not readily become the prey of cats or predacious birds. Their eyes are rudimentary, but enable them to distinguish the presence of light, so that when they accidentally come to the surface of the ground they immediately make an effort to burrow into the soil again. Their food consists chiefly of earthworms and insects that live in the ground. The presence of moles in large numbers at any place is an evidence of the abundance of their food, and there is no doubt but that they do much good by destroying many noxious insects, especially the larvæ of *Lachnosternidæ* (May and June beetles). If it were not for the injury done to lawns, by their throwing up ridges of earth along which the grass dies, or to gardens, by their loosening the roots of young plants, moles would be

more beneficial than harmful. Aside from the destruction of insect pests, they stir the soil in corn- and alfalfa-fields in a beneficial way. They seldom eat grains of newly planted corn. Much of the damage in this direction, so often attributed to moles, is really done by species of mice that follow in their runways. It is also true that moles sometimes kill young plants and trees by cutting off their roots just below the surface of the ground, but this is not by way of getting food, but solely because the roots are in the way of the animal's progress.

Prof. L. L. Dyche, of the University of Kansas, has published the results of a careful study of the food of the mole. Sixty-seven specimens, taken in the various months of the year, except December and February, were examined, and food was found present in the stomachs of fifty specimens. Of the total food present, earthworms comprised 43.20 per cent.; ground beetles, 22.7 per cent.; grubs and larvae, 22.8 per cent.; vegetable matter, 3.7 per cent.; other materials, largely insect eggs and ants, 7.6 per cent.

Experiments in destroying moles have been made by the writer during the past three seasons with varying success. The poisoning experiments were made with much doubt as to the character of the results that would be attained, owing to the great difficulty in finding suitable baits. Strychnine, the poison which proved most successful in destroying rodents, was assumed as the best adapted to the work. With shelled corn soaked in a solution of strychnine and syrup some of the moles were killed, but no data as to the relative number could be obtained. With sweet corn in the milk or roasting-ear stage, out from the cob and similarly treated, a large measure of success was attained and nearly all the moles destroyed. The kernels of unroasted peanuts, in which strychnine crystals were placed, were found to be reasonably successful bait, and are recommended when green corn is not available. Bits of meat or dead insects properly poisoned will prove successful, but with the meat there is great danger of poisoning dogs, since the mole burrows lie close to the surface of the ground.

The sense of smell seems to be strongly developed in moles. My experiments have verified the statement that if ordinary moth-balls are dropped into their runways and these covered, the moles will not again use them until the moth-balls have entirely disappeared. This does not, however, prevent their working in near-by places.

Traps for catching moles are sold in most of the hardware stores. Nearly all of them work by the use of a spring coil which, when released, drives a number of sharp tines into the ground and through the mole. Some experience in setting these traps will lead to the best results; but trapping is a much slower process than poisoning.

Moles are usually actively at work in the early morning or late in

the afternoon. At times there is also a short period of activity about noon. It is not difficult to kill them with a pitchfork when they are working, the animals being located by observing the movement of the ground above them.

If water is allowed to run into the burrow and fill it, the animal when present can be forced to come to the surface to avoid drowning, and may be easily killed. The writer at one time killed a female and six young at one such operation.

The best remedy for the damage done to lawns and grass plats by moles is prompt rolling with a heavy roller. By continued repetition of this the moles will be driven away, at least temporarily.

Order VI. CHIROPTERA. Bats

Bats are distinguished from all other mammals by the possession of true wings. Flying-squirrels and other mammals outside the Chiroptera are merely supported by membranes attached to limbs that are not modified for real flight. Anatomically considered, the wing of a bat is a much more perfect instrument for its purpose than the wing of a bird. It has five more or less perfect digits for the support of the delicate web which is the chief instrument for sustaining the animal in the atmosphere. Birds have the fingers reduced to two or three. The volar membrane of the bats is exceedingly sensitive, and is richly supplied with nerves and blood-vessels. The senses of bats, except that of sight, are strongly developed, and it is probable that the sense of hearing rather than that of sight enables the animal to capture insects in the dark. There are over 400 known species of bats, belonging to many genera. They are most abundant in the tropical regions, but the United States and British America have about twenty-five species, representing fourteen genera. Kansas has several species and subspecies, all belonging to the same family.

FAMILY VESPERTILIONIDÆ Common Bats.

This family have the tail wholly or partly included in the large interfemoral membrane, and the nostrils not provided with a distinct nose-leaf. The following genera and species belong to this state :

The Little Brown bat (*Myotis lucifungus* LeConte) is found throughout the state.

The Little Pale bat (*M. californicus ciliolabrum* Merr.) is found in western Kansas. The type was taken at Wa Keeney, but its range in the state is not known.

Say's bat (*N. subulatus*) is found in southwest Kansas; probably rare.

The Silver-haired bat (*Lasionycteris noctivagans* LeConte) is

rather common over the eastern part of the state and westward in suitable localities.

The Georgian bat (*Pipistrellus subflavus* F. Cuvier) is found in southeastern Kansas, but no specimens have come under my personal observation.

The Brown bat (*Vespertilio fuscus* Beauvois) is common in the eastern half of the state.

The Red bat (*Lasiurus borealis* Mull) is found in eastern Kansas, and is rather common.

The Hoary bat (*Lasiurus cinareus* Beauvois) is common throughout the eastern part of the state.

In addition to the eight forms mentioned as surely occurring in Kansas, the following are probably to be found: *Myotis velifer* Allen, in southern Kansas; *Nycticeius humeralis* Rafin., in southern Kansas.

The bats are strictly insectivorous and, as they fly only at twilight and after nightfall, they capture only the forms of insects that are abroad at these times. The night-flying insects include several or nearly all the orders and a large proportion of noxious species. There can be no doubt of the beneficial relations of our bats to the farmers and horticulturists, and they should be carefully protected and preserved.

Destroying Noxious Animals by Poisons and Other Devices.

During the past three years the writer has made many experiments with the devices that have been particularly recommended for the destruction of noxious animals. The results of the experiments and the conclusions reached concerning the value of the various plans tried have been partly reported in Press Bulletins Nos. 108, 109, 119, 130, 132, and in regular Bulletin No. 116, of the Experiment Station. A few special directions and suggestions will be here given.

After trying a great many poisons and devices for destroying prairie-dogs especially, the conclusion has been reached that strychnine is the cheapest and most efficient agent that can be employed. The relative cost of the three most practical methods that have been suggested is about as follows: Counting that the average number of occupied burrows in a prairie-dog village is twenty-five to the acre, the cost, including labor, of using a machine to drive sulphur or other suffocating fumes into the burrows is from twenty-five to forty cents per acre. This does not include the cost of the machine itself nor wear and tear on it. The cost of using carbon bisulfide will range from ten to twenty-five cents per acre, dependent on the amount

of moisture in the ground. The dryer the ground the more material will be required to each burrow. The cost of using strychnine poison will range from three to six cents per acre, unless weather and other conditions are unfavorable. These estimates are for complete destruction of the animals.

The experience with other rodents is similar to that with prairie-dogs, except that with some of them there are conditions which render the use of the first two devices entirely impracticable, and leave poison as the only means available. Poisons other than strychnine are available, and in the hands of an expert would give just as good results; but there are reasons why they ought not to be recommended for general use. Safety is the principal consideration. Phosphorus is a sure poison and the taste of it does not deter animals from eating it, but the handling of it is exceedingly dangerous and should not be attempted by the inexperienced. Disastrous fires would undoubtedly result from an extensive use of it for poisoning rodents in the fields or about buildings. The use of hydrocyanic gas is recommended for clearing buildings and granaries of vermin; but the person using the gas must fully understand its deadly nature and handle it with the greatest of care. Potassium cyanide used alone is a most active poison, but when exposed to the air it rapidly decomposes and soon loses its efficiency. It has the further objection to it that it is almost tasteless and there is therefore greater danger of mistaking it for some harmless drug than in the case of strychnine. The deadly nature and taste of strychnine are everywhere quite well understood, and it is, on the whole, a safer poison to recommend for general use than any other with which I am acquainted.

This Station furnishes a prepared poison for destroying noxious animals to citizens of Kansas only. The poison was patented by Mr. David W. Staples, of Craft, Okla., and in purchasing the state right to its use from him we expressly contracted not to send the poison or the formula for its manufacture outside of Kansas. The poison is sold to any citizen of the state at the cost of the materials used in preparing it and the container. As the Station buys the materials at wholesale and manufacturer's prices, we can furnish the poison for considerably less than any one else could prepare it; but we furnish the formula to citizens of the state upon their application for it.

A substitute for the Staples poison has been tried with great success, and the formula for it is here given:

STRYCHNINE POISON. *Formula No. 1.*—Dissolve one and one-half ounces of strichnia sulphate in a quart of hot water. Add a quart of syrup—molasses, sorghum, or thick sugar and water—and a teaspoonful of oil of anise. Thoroughly heat and mix the liquid. While

hot pour it over a bushel of clean wheat and mix completely. Then stir in two or more pounds of fine corn-meal. The quantity of corn-meal will depend upon the amount of extra moisture present. There should be enough to wet every grain of the wheat and no more. Care should be taken that there is no leakage from the vessel in which the wheat is mixed. Let the poisoned grain stand over night, and distribute it in the early morning of a bright day. Use a tablespoonful of the wheat to each hole occupied by prairie-dogs, putting it near the mouth of the burrow, in two or three little bunches. Do not put out the poison in very cold or stormy weather. It will keep for a considerable time, and is much more effective after a cold period, as the animals are then hungry and eat the grain readily. A bushel of wheat should poison 1000 to 1200 holes. An excellent substitute for the oil of anise in the above formula can be made by soaking two ounces of green coffee berries in the whites of three eggs. Let this stand for about twelve hours and use the liquid instead of anise oil,

This poisoned wheat will answer for destroying spermophiles, mice, rats, and English sparrows. For pocket-gophers substitute corn, if the wheat is not successful, or the poison may be poured over pieces of potato and these used instead.

Carbon bisulfide may be used effectively in destroying spermophiles, prairie-dogs, and any animals whose burrows are not of varying depth or too extensive for the gases to reach the occupants. About a tablespoonful of the liquid is used for prairie-dogs, and should be placed upon some absorbent material, as cotton, dry horse manure, or a piece of corn-cob, and rolled down the prairie-dog burrows. It is best immediately to cover the hole with a sod and stamp down firmly. I found by experiment that four parts of gasoline mixed with one part of carbon bisulfide is about as effective as the carbon bisulfide alone, and not nearly as expensive. The mixture is used in the same manner as carbon bisulfide, but a somewhat larger dose is needed. For spermophiles, or Prairie squirrels, a smaller dose is needed than for prairie-dogs, but much depends on the amount of moisture in the ground. A dry soil absorbs the gas very rapidly, and more of the liquid must then be used.

GENERAL DIRECTIONS FOR ORDERING AND USING THE STAPLES
 POISON.

FOR PRAIRIE-DOGS. The poison is put up in half-gallon cans. They have labels which describe the contents, name the ingredients, the quantity of each, the manner of preparing, and also give careful directions for using.

The strychnine in this poison is not in solution, but is held in suspension in the syrup. It settles to the bottom of the can, after the

manner of lead in ordinary mixed paint. A common error in using it is to pour out a portion of the liquid without first having thoroughly shaken or stirred it. When thus used, this top part of the liquid is not sufficiently poisonous to kill all the animals that eat of it. If it is first stirred or thoroughly shaken a part of the can may be used as successfully as the whole of it.

We recommend that the area of "dog town" to be poisoned be gone over very carefully, placing the bait at the outside of all occupied burrows, as directed on the cans or in the directions for using formula No. 1. If some of the animals escape the first application, a change of bait to Kafir-corn, broken corn or corn-meal is recommended for those that remain. If after a second application any animals still remain, carbon bisulfide will probably be the most effective means of destroying the remnant.

The price of the prairie-dog poison is one dollar and seventy-five cents per can, delivered at the freight or express office in Manhattan. Three or less cans may be sent by express, wrapped in paper, but a larger number must be boxed. Any number of cans may be sent by freight, but they must be boxed. No charge is made for packing. A can of the poison weighs five and a half pounds. It will poison a bushel of wheat, and be enough for about 1200 burrows (from 120 to 160 acres).

FOR POCKET-GOPHERS. We have found that this poison is excellent for destroying pocket-gophers, and that it is even more convenient to use than the dry strychnine and potatoes or raisins recommended in Press Bulletin No. 109. The poisoned bait is to be inserted into the runways of the gophers in the same manner as described in that bulletin.

The poison for gophers is put up in quart cans, and by leaving out one ingredient (potassium cyanide) the strychnine is kept in solution. The liquid is therefore equally poisonous throughout, and any part of the contents of the can may be successfully used. A quart will poison a half-bushel of grain, and the price of it is ninety cents per can.

Pour boiling water over a half-bushel of shelled corn and let it stand over night to swell and soften the grain. Then drain off all the water possible, and pour the quart of poison and a cup of syrup over the corn. Add a few pounds of corn-meal and mix all thoroughly. The mass of corn should be somewhat sticky, and there should be no dry corn-meal present.

Make openings into the runways of the gophers with a pointed stick, and with a spoon drop a few kernels of the corn down each opening. A spade or shovel handle, shod with an iron point and

having a bar for the foot about sixteen inches from the point, is recommended for making the holes into the burrows. No digging or covering of holes is required.

The best time to poison gophers is in October and November, when they are most active; but they may also be successfully poisoned in the spring or at any time when they are working. It is not usually necessary to go over the ground with poison more than once; but unless neighboring farmers cooperate the work will have to be attended to about once in two years.

FOR MICE AND PRAIRIE SQUIRRELS. We have recently had considerable complaint of the destruction of young orchards by field-mice. Experiments in the use of this poison to kill the mice have been very successful. We use the gopher poison with wheat as a bait. The poisoned wheat is eaten readily, and two or three applications will easily destroy all of the pests in an orchard. For Prairie squirrels the poison is used in the same manner, the wheat being placed near the openings of their burrows.

FOR RABBITS. Corn poisoned as directed for pocket-gophers has been used successfully for these orchard pests. Kafir-corn is also a good bait, but perhaps the most successful method of all is to use prunes, pieces of apple, or sweet-potato as a bait. Dry, powdered strychnine may be rubbed on the cut surface of the bait or our liquid poison poured over the pieces.

An excellent substitute for the baits here recommended for mice and rabbits in the orchard is found in small twigs cut from the branches of apple trees. Sprouts and suckers are convenient for the purpose. Dip them in the liquid poison or apply it to the twigs with a brush and place a couple of them near the base of the apple tree to be protected. With this method there is no danger of poisoning small birds.

FOR RATS. Rats about barns or corn-cribs are hard to poison, because they have such an abundance of food at hand; yet they will often leave unpoisoned grain to eat that which has been poisoned with our poison. While we do not claim that it will entirely exterminate rats about farm premises, we are sure that the pest can be greatly reduced in numbers by its use. As in the operations with this poison, or any other form of strychnine, against all rodents living in burrows, the great majority of the victims die in the burrows and are never seen. For this reason it is not a desirable means of destroying mice in occupied dwellings. In all cases of its use great care is necessary to avoid placing the poison or baited food where it might be found by domestic animals or persons ignorant of its deadly character.

Orders for poison should be accompanied by payment, and should state for what purpose the poison is desired. Make money orders or drafts payable to Miss Lorena E. Clemons, who is Secretary of the College. Method of shipment preferred should also be stated. The poison cannot be sent by mail.

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